How can incumbents survive in dynamic environments: The case of the automotive industry

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ABSTRACT

Amidst the volatility, uncertainty, complexity, and ambiguity of today's business landscape, firms face multifaceted challenges adapting to dynamic environments. Two overarching research gaps stand out within the scholarly discourse on firms navigating such terrain. First, ambiguity persists regarding the appropriate analytical level for studying firms in dynamic contexts. Second, there is a limited consideration of non-technological resources' role in shaping firms' adaptive capabilities.

To address these gaps, this thesis delves into how firms adapt to disruptive environments, particularly in the context of the COVID-19 pandemic, with a focus on the global automotive industry. The study extends the concept of organisational capabilities and contributes to strategic management literature by scrutinising dynamic capabilities pre- and post-pandemic (2020 - 2023).

The research comprises four semi-independent chapters based on data collected from 77 interviewees across 68 companies. It assesses dynamic capabilities, explores agile market navigation methods, develops a strategic flexibility model, and examines differentiation strategies. Together, these chapters underscore the importance of agility, adaptability, strategic resource allocation, and digitalisation in response to disruptive events in the automotive industry.

The first chapter evaluates dynamic capabilities in the automotive industry, emphasising agility and adaptability post-COVID-19. The second chapter explores agile methods for navigating market opportunities, advocating for their adoption beyond software project management. The third chapter develops a model of strategic flexibility, highlighting operational simplification and collaborative partnerships. Lastly, the fourth chapter delves into differentiation strategies, stressing the integration of digital capabilities and sustainability.

This thesis offers insights into strategic automotive decision-making in dynamic environments during the COVID-19 pandemic, emphasising the critical role of internal and external knowledge, managerial self-awareness, and digitalisation. Despite disruptions caused by the pandemic, opportunities for adaptation and growth have emerged, underscoring the adaptive nature of strategic management.

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ABBREVIATIONS

AI	Artificial intelligence
AV	Autonomous vehicle
BEV	Battery electric vehicle
CASE	Connected, autonomous, shared, and electric
CEO	Chief executive officer
DC	Dynamic capability
ICE	Internal combustion engine
KPI	Key performance indicator
MVP	Minimum viable product
OEM	Original equipment manufacturer
OKR	Objectives and key results
RBV	Resource-based view
R&D	Research and development
SME	Small and medium sized enterprise
TMT	Top management teams
VUCA	Volatility, uncertainty, complexity, and ambiguity

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DECLARATION

I declare that this thesis is a presentation of original work, and I am the sole author. This work has not previously been presented for a degree or other qualification at this University or elsewhere. All sources are acknowledged as references.

PUBLICATIONS

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故曰:	*Hence the saying:*
知彼知己,	*If you know the enemy and know yourself,*
百戰不殆.	*you need not fear the result of a hundred battles.*
不知彼而知己,	*If you know yourself but not the enemy,*
一勝一負 不知彼.	*for every victory gained, you will also suffer a defeat.*
不知己,	*If you know neither the enemy nor yourself,*
每戰必敗.	*you will succumb in every battle.*
孫子, 孙子兵法	Sun Tzu, The Art of War

1. Introduction

1.1. Research background

In the dynamic landscape of modern business, understanding firms amidst disruptive environments has become imperative (Christensen, 2006). This entails examining how organisations navigate uncertainty and shifting market paradigms. Recent years have seen an intensified focus on strategies tailored to operate within the volatile, uncertain, complex, and ambiguous (VUCA) world (Buckley, 2019), with the global COVID-19 pandemic serving as a poignant catalyst for re-evaluation (Bag et al., 2023). Originating in the military, the VUCA concept describes the challenging and rapidly changing conditions organisations face, and it has been widely adopted in business strategy to navigate today's unpredictable environments (Bennett and Lemoine, 2014). As firms grapple with unprecedented challenges, ranging from supply chain disruptions to changing consumer behaviours, the necessity for adaptive and resilient strategies has never been clearer. This thesis background delves into the intricate interplay between disruptive environments and strategic responses, structured into fundamentals of studying firms in dynamic environments and the more recent business strategy implications of the VUCA COVID-19 pandemic.

1.1.1. Firms in dynamic environments

Research on dealing with external change, e.g., innovation and dynamic capabilities literature, often suggests that firms can respond to and survive amid any external change. Schumpeter (1942) observed the dismantling of established practices in firms like Ford to create innovations and described what he called creative destruction as a way to improve business operations and a key driver of capitalism. Christensen (1997) argues that the disruptive process is not a momentary or binary decision but a gradual slow process that leads to the failure of firms investing predominantly in the most immediate and tangible sense of achievement, e.g., shovel manufacturers that invested in better shovels and were wiped out by the disruptive technology of hydraulics. It is implicitly or explicitly stated that the firm has the resources and capabilities to invest sufficiently in disruptive innovations, and it is just a matter of making the right decisions to outperform competitors. This poses the question of why there are many examples of new companies that manage to disrupt an industry successfully while incumbents - established companies with significant market presence and resources (Schumpeter, 1942; Porter, 1980; Christensen, 1997) - lose their once-strong market position (e.g., Bohnsack and Pinkse, 2017; Chang and Sokol, 2020; Pinkse, Bohnsack and Kolk, 2014).

Some describe these new entrants as speedboats with advantages, such as talent with more relevant skills, less hierarchical and more outcome-focused cultures, and more supportive and driven leaders, all of which seem important in dynamic environments (e.g., Amaral et al., 2023; Hockerts and Wüstenhagen, 2010). At the same time, established organisations which lack such skills have been described as bureaucratic, slow, ambition-lacking, and with an outdated talent pool (e.g., Hill and Rothaermel, 2003; van Mossel et al., 2018). These are often seen as reasons why some types of firms outperform others.

While there are some examples of firms that managed to survive over long periods of time (Christensen, Suárez and Utterback, 1998; Gao et al., 2017), business performance outcomes also depend on external changes. For one, customers make product purchase decisions by comparing the attractiveness of different available options (Nora, 2019). Externalities are also in constant flux which has to inform internal product decisions (Adner and Levinthal, 2001; Hayward et al., 2017).

It is important to consider businesses' environmental context when studying how firms adapt to external dynamics. Thereby, the context should cover but is not limited to competitors, customers, regulators, and technological developments (Desarbo et al., 2005; Haarhaus and Liening, 2020). It also is not sufficient to consider these and other relevant factors locally, but given our interconnected and fast-pacing developments, they need to be analysed and assessed globally. Illustrating our interconnected and fast-pacing environments is the shortened time of leading products to achieve 100 million users: 75 years by the telephone, 16 years by the mobile phone, ten years by Netflix, six years by Twitter, five years by Gmail, four years by Facebook, 30 months by Instagram, nine months by Tiktok, and two months by ChatGPT (Hu, 2023; Marques Brownlee, 2023). The faster pace of these and other technological developments challenge businesses as they have to adapt, i.e., update products, develop capabilities, and establish partnerships to stay competitive.

Scholars have highlighted the need to consider external developments when studying firms' responses to external dynamics. Schumpeter, who was an admirer of Marx's work, praised him for attempting to include dynamic elements, such as the temporal sequence and change over time, in his economic theory and goes on in one of his seminal works to describe that "dynamic analysis is the analysis of sequence in time. In explaining why a certain economic quantity, for instance a price, is what we find to be at a given moment, it takes into consideration not only the state of other economic quantities at the same moment, as static theory does, but also their state at preceding points of time, and expectations about their future value" (Schumpeter, 1942, p.103). Later, Christensen (1997, p. 177) acknowledged that "only by recognizing the dynamics of how disruptive technologies develop can managers respond effectively to the opportunities that they present".

However, some scholars argue that incumbents can lose their leading positions despite analysing external dynamics and seemingly making the right decisions. Christensen (1997) refers to a logical decision process by managers that is critical to business success in which they have to allocate appropriate resource to short term survival and disruptive technologies.

The downfall of incumbents is often associated with descriptions of heroic success stories that characterise their leaders as somewhat all-knowing and invincible, e.g., "Tesla's hard charging nature, led by CEO Elon Musk and its unique branding approach enabled it to distinguish itself from other car-makers and attract loyal customers, despite many missed deadlines in the early days of the Roadster and Model S[1] development" (Perkins and Murmann, 2018, p.476). Some of these companies and their

[1] Tesla's first and second automotive vehicle product launches, respectively.

leaders seem to have unique abilities to sense and satisfy customer needs even in the most complex and dynamic environments.

However, not all seem to agree with the black-and-white descriptions of agile new entrants and inert incumbents. For instance, MacDuffie and Fujimoto (2010) explain "why dinosaurs [automotive incumbents] will keep ruling the auto industry" and suggest that there are some insurmountable challenges, such as high capital requirements and economies of scale, for entrants in complex industries like automotive. Early 2023, examples of new entrants' vehicle issues, e.g., Tesla's recall of 362,000 US vehicles over self-driving capability issues (Reuters, 2023), close to 40 per cent of their global 2021 vehicle deliveries (Statista, 2023b), seem to testament complexity management issues and relativises the descriptions of unimpeachable disruptors.

The complexity and ambiguity involved make explanations and causal links of, in Schumpeter's (1942) terminology, creative destruction and disruption difficult. Schumpeter's concept of creative destruction entails the continuous process of innovation disrupting existing economic structures. However, due to the inherent complexity and ambiguity surrounding this phenomenon, establishing clear causal links and explanations regarding creative destruction and disruption becomes challenging. Descriptions of succeeding firms are thus generally limited to characterisations of some beneficial traits (e.g., superior intuition).

While some scholars and practitioners appreciate clear-cut stories of inert incumbents and innovative entrants, the picture of how some incumbents manage to survive remains incomplete. This is particularly true in VUCA environments such as the COVID-19 pandemic.

1.1.2. Strategy in a VUCA COVID-19 world

In the contemporary business landscape, the convergence of technological disruption, geopolitical tensions, and socio-economic shifts has continually challenged firms to evolve their strategic paradigms. Disruptions can take many forms, each with distinct implications for strategic management.

For instance, exogenous shocks like the COVID-19 pandemic represent sudden, external disturbances that require firms to rapidly adapt their operations and strategies (Ciravegna et al., 2023). Similarly, technological paradigm shifts, as described by Christensen's (1997) theory of innovation disruption, challenge firms to rethink their value propositions and business models to remain competitive. Furthermore, in today's VUCA environments, businesses must also contend with "wicked problems"; complex, multifaceted challenges that lack clear solutions and often involve high uncertainty (Lonngren and van Poeck, 2021). These varied forms of disruption underscore the need for strategic agility and resilience across industries. This section seeks to elucidate the multifaceted impacts of COVID-19 on strategic management, highlighting its implications for firms worldwide and the strategies employed to navigate this turbulent environment.

The COVID-19 pandemic exemplified one of the most profound exogenous shocks in recent history, amplifying the VUCA already inherent in global markets and precipitating a cascading series of disruptions across industries. Supply chain networks, long considered the lifelines of modern commerce, were severely strained as lockdowns and travel restrictions disrupted production and distribution channels (Ali et al., 2022; Liu et al., 2020). For some companies – especially in regions already grappling with pre-pandemic trade tensions, such as Asia – the confluence of COVID-19 and geopolitical uncertainties posed acute challenges, particularly in maintaining competitiveness and securing supply chain resilience (Hohenstein, 2022; Park, Hong and Shin, 2023).

The strategic landscape shifted dramatically as businesses grappled with the unprecedented challenges brought about by the pandemic. From multinational corporations to small and medium enterprises (SMEs), organisations were forced to reassess their strategic priorities and recalibrate their operations in response to the evolving crisis. Remote work became the new norm, accelerating the adoption of digital technologies and transforming traditional business models (Sahut and Lissillour, 2023). In the face of uncertainty, strategic agility - defined as the ability of firms to swiftly and effectively respond to changes in the business environment (Denning, 2017a) - emerged as a critical determinant of survival, with firms leveraging data-driven insights and scenario planning to navigate the complex and rapidly changing business environment (Lee and Weder, 2021; Stanca, Dabija and Câmpian, 2023).

Amidst the upheaval wrought by COVID-19, firms mobilised a spectrum of strategic responses to mitigate risks and seize emerging opportunities. Proactive measures such as scenario planning, stress testing, and supply chain diversification were employed to enhance resilience and adaptability (Jun Kang, Diao and Zanini, 2020). Digital transformation initiatives, encompassing e-commerce platforms, remote collaboration tools, and AI-powered analytics, gained traction as organisations sought to enhance operational efficiency and customer engagement in a contactless world (Zia et al., 2023).

Furthermore, strategic partnerships and alliances, which had already been a cornerstone of resilience in automotive and other industries, were intensified and accelerated by the COVID-19 pandemic, with firms collaborating across industries to pool resources, share best practices, and mitigate risks (Sanasi and Ghezzi, 2022; Zahoor et al., 2022). The pandemic introduced new complexities such as supply chain disruptions and sudden shifts in consumer demand, necessitating even greater levels of cooperation and innovation among companies. Government interventions, including fiscal stimulus packages and regulatory reforms, played a pivotal role in shaping strategic responses, providing lifelines for struggling businesses and catalysing economic recovery efforts (Lidskog, Elander and Standring, 2020).

As the world grapples with the enduring impacts of the COVID-19 pandemic, firms face an uncertain and challenging road ahead. The imperative for strategic agility and innovation has never been more pronounced, with organisations needing to embrace change and adapt rapidly to emerging trends and disruptions (Ha, 2023). Strategic agility, defined as the ability of a company to swiftly and effectively respond to changes in the environment while maintaining a competitive advantage (Doz and Kosonen, 2010), is essential in navigating today's fast-paced and unpredictable market conditions. From supply chain resilience to digital transformation and stakeholder engagement, the strategic imperatives of the post-pandemic era will be defined by resilience, adaptability, and sustainability (Ivanov and Dolgui, 2020; Sawyerr and Harrison, 2023; Sreenivasan, Suresh and Tuesta Panduro, 2023).

1.2. Overarching research problems

> *As some firms, albeit not the majority, do survive in the face of change, the question is how they manage to adapt - and why are some firms able to accomplish this while others cannot?*
>
> (O'Reilly and Tushman, 2008, p.189)

Firms' ability to adapt to dynamic environments is critical for their long-term success. However, in the VUCA world, firms encounter multifaceted challenges in effectively navigating change. These challenges cover four key areas.

1) Uncertainty of future developments: One of the primary challenges facing both managers and academics is the uncertainty surrounding future developments. Frequently cited phrases such as Heraclitus's adage, "nothing is as constant as change," underscore the acknowledgment of volatility but fail to provide actionable insights or empirical evidence to guide decision-making. While these phrases may convey a sense of wisdom or superiority, they often lack specificity and fail to capture the nuanced realities of dynamic environments. Consequently, managers and academics alike struggle to anticipate and prepare for future contingencies, hindering effective adaptation strategies (Haarhaus and Liening, 2020; Moon and Nelson, 2020; Sommer, Loch and Dong, 2009).

2) Predicting firm success: Another significant challenge lies in predicting the success of individual firms within dynamic environments. Existing literature often relies on retrospective case studies, cherry-picking successful firms and oversimplifying complex realities to construct narratives of success (Chang and Sokol, 2020; Christensen, 1997; Teece, 2018c). However, such narratives fail to capture the full extent of external uncertainties or the validity of generalisations derived from singular instances. This challenge extends beyond firms to individuals, particularly entrepreneurs, who are often portrayed as heroic figures ex-post without due acknowledgement of the multifaceted factors contributing to their success or failure (Perkins and Murmann, 2018; Walls, Salaiz and Chiu, 2020).

3) Limited implementation-oriented guidance: Despite the abundance of academic strategy and innovation literature, there is a conspicuous gap in offering actionable guidance for management to adeptly adapt to dynamic environments (Hermawati, 2020; Kor and Mesko, 2013; Woiceshyn, 2009). This scarcity of implementation-oriented advice poses a hurdle for managers seeking practical insights to manoeuvre through dynamic landscapes effectively. The prevalent emphasis on contributing to the knowledge base of the academic community might inadvertently rationalise the limited depth and specificity found in existing literature (Baum and Haveman, 2020; Thatcher and Fisher, 2022). However, this scholarly focus overlooks the pressing practical needs of managers grappling with the complexities of dynamic environments.

4) Utilisation of knowledge: Despite the acknowledged importance of knowledge in decision-making, there remains a surprising lack of clarity regarding the utilisation of internal and external knowledge for successful adaptation (El-Kassar et al., 2022; Tsai, 2016; Zheng, Zhang and Du, 2011). While firms draw on a wide range of knowledge sources to inform their decisions (Cepeda and Vera, 2007; Lee, Choi and Lee, 2020), the specific types and utilisation of knowledge in dynamic environments are not well understood. Moreover, the relative importance of knowledge compared to other decision-making factors, such as intuition, remains unclear (Baldacchino, Ucbasaran and Cabantous, 2022; Calabretta, Gemser and Wijnberg, 2017; Woiceshyn, 2009). This lack of clarity impedes firms' ability to leverage knowledge effectively to adapt to changing environments and underscores the need for a more nuanced understanding of knowledge utilisation in dynamic contexts.

In addressing these challenges, the relevance of conducting pre-, during, and post-crisis analyses in the realm of strategy literature becomes apparent. Crises, such as the COVID-19 pandemic, serve as extreme events that profoundly impact business landscapes, exacerbating VUCA. Analysing firm behaviour and strategic responses both before and after such crises provides valuable insights into the efficacy of different adaptation strategies. By integrating pre and post-crisis analyses into the research, this study can capture the dynamic nature of organisational adaptation, offering nuanced perspectives on how firms navigate and evolve in response to disruptive events. This approach, detailed in section 1.6.2, enhances the relevance and applicability of the research findings, providing practical insights for managers and policymakers grappling with the challenges of navigating dynamic environments.

1.3. Overarching research gaps

In the literature on firms operating within dynamic environments (Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000), two overarching research gaps exist (see Chapters 2 to 5 for detailed literature reviews).

1) Ambiguity in analytical levels: One research gap lies in the ambiguity surrounding the appropriate analytical level for studying firms in dynamic contexts. Extant literature often lacks clarity in defining the unit of analysis, leading to ambiguity between firm-specific decisions and broader industry trends, including conclusions at the firm level from data at the industry level (Perkins and Murmann, 2018; Teece, 2007). This ambiguity impedes the derivation of generalisable principles crucial for managerial decision-making. By establishing clear boundaries and identifying relevant dimensions for analysis, researchers can bridge this gap and provide nuanced insights into the interaction between internal firm factors and external environmental influences (Lovallo et al., 2020). Employing a systems thinking approach, which involves analysing and understanding complex systems as interconnected wholes, grounded in systems engineering principles, facilitates a structured examination of firm-industry dynamics, enhancing comprehension of complex relationships within dynamic ecosystems (Sterman, 2000).

2) Limited consideration of non-technological resources: Another research gap pertains to the comprehensive consideration of resources influencing firms' adaptive capabilities in response to external changes. While existing studies predominantly focus on technology-based resources, such as advanced manufacturing technologies (Culot et al., 2020) and digital infrastructure (Chen et al., 2023), there is a paucity of research exploring the role of non-technological resources - such as human capital, organisational culture, and brand reputation - in shaping firms' adaptive strategies (Amaral et al., 2023; Teece, 2018c). This gap is problematic as some advocate that non-technological factors might be more important for firms' survival in the face of disruption (Hodgkinson, Ravishankar and Fischer, 2017). It underscores the need to broaden the scope of resources under examination, encompassing both tangible and intangible assets. Moreover, adopting a dynamic view of the resource-based view (RBV) - a management framework that focuses on the internal resources and capabilities of a firm as the key to its competitive advantage (Barney, 1991) - highlights the importance of product activities informed by industry-wide developments (Lovallo et al., 2020; Teece, 2018b). Researchers can enrich our understanding of firms' adaptive responses in dynamic environments by integrating a holistic perspective that considers the interplay between internal resources (technological and non-technological), external market dynamics (such as shifts in consumer preferences, regulatory changes, and competitive pressures), and product offerings (including product features, pricing strategies, and market positioning).

These research gaps intersect with criticisms directed at DCs studies, particularly regarding their abstract, conceptual nature, and perceived lack in providing practical managerial utility (Ambrosini and Bowman, 2009; Arend and Bromiley, 2009; Easterby-Smith, Lyles and Peteraf, 2009). The level of analysis in DCs studies and conceptualisations typically remains at the firm-business strategy level, neglecting the level of managerial implementation crucial for addressing specific business challenges within dynamic environments. Managerial implementation is problem-driven, where businesses face particular challenges, such as supply shortages or sales channel disruptions, requiring tailored solutions to avoid issues related to value creation and capture. Addressing these gaps calls for issue-specific exploration, reflected in dedicated chapters throughout this thesis, aiming to enhance the practical relevance of research findings and contribute to advancing strategic management practices in dynamic contexts.

1.4. Overarching research question and goal

The overarching research goal of this PhD thesis is to address the four pervasive challenges introduced in section 1.2 surrounding managers' successful adaptation to change within dynamic VUCA environments, considering the unprecedented disruption caused by the COVID-19 pandemic. Thereby, the thesis attempts to answer the following overarching research question: "How do unprecedented disruptions (COVID-19 pandemic) change firms' dynamic capabilities approach?". Motivated by the two overarching research gaps presented in section 1.3, the thesis aims to:

1) Bridging the ambiguity in analytical levels: The first gap addressed pertains to the ambiguity surrounding the appropriate analytical level for studying firms in dynamic contexts. Specifically, this refers to the challenge of defining the unit of analysis, which often leads to confusion between firm-specific decisions and broader industry trends. To address this, the thesis will focus on establishing clear boundaries and identifying relevant dimensions for analysis. For instance, it differentiates between micro-level factors (e.g., internal firm dynamics) and macro-level factors (e.g., industry-wide trends), aiming to provide a nuanced understanding of how these interact within dynamic VUCA ecosystems. This approach is novel in its explicit delineation between firm-level actions and industry-level dynamics, contributing to a clearer alignment of analytical focus with the complexities of VUCA environments, where both levels are critically interconnected.

2) Broadening the scope of resource considerations: The second gap relates to the insufficient consideration of non-technological resources in shaping firms' adaptive strategies, especially within VUCA environments, such as those experienced during the COVID-19 pandemic. Non-technological resources include various intangible assets, such as human capital, organisational culture, and brand reputation, which play pivotal roles in fostering DCs. In this thesis, non-technological resources will be conceptualised as enablers of strategic flexibility and agility across multiple divisions of a firm, allowing rapid adaption to changing circumstances. These resources facilitate processes such as agile working, innovation-driven problem-solving, and the ability to pivot between strategies, thereby enhancing firms’ capacity to capture value through differentiation. Addressing this gap, the thesis will explore how these resources influence adaptive strategies uniquely in VUCA contexts. For instance, it may investigate how a robust organisational culture fosters innovation and resilience amidst the heightened uncertainty of a pandemic. Additionally, the thesis will examine adaptive strategies that leverage non-technological resources, such as investing in employee training programs to enhance adaptability or cultivating a brand reputation for reliability and trustworthiness, which are crucial in maintaining stakeholder confidence during crises. By adopting a dynamic view of the RBV, the thesis aims to enrich our understanding of firms' adaptive responses in dynamic VUCA environments. This approach will highlight how the challenges and opportunities in VUCA environments differ from more stable contexts. For example, in non-VUCA environments, adaptive strategies may focus more on incremental improvements and efficiency, while in VUCA environments, the emphasis shifts to rapid innovation, resilience, and maintaining trust amid uncertainty.

These overarching research aims will be further specified and broken down in the subsequent chapters of the thesis, providing a structured framework for comprehensive exploration and analysis.

1.5. Rationale for industry choice

This research mainly uses data from the global automotive industry for two reasons: first, the industry’s global relevance, and second, the recent and current industry disruption and transformation.

First, the automotive industry holds a crucial position globally. It has historically been referred to as the “industry of industries” (Drucker, 1946, p.149), producing “the machine that changed the world” (Womack, Jones and Roos, 1990, p.1). Today, automotive is the fifth largest industry by revenue globally (IBISWorld, 2024). With approximately 14 million people directly employed in 2021

(International Labour Organization, 2021) and over 67 million vehicles sold annually (Statista, 2021), the industry's reach is vast, influencing social, economic, and environmental landscapes worldwide. Beyond being a major economic force, automobiles play a pivotal role in daily life, often representing significant emotional and conscious purchase decisions for consumers (Chang and Hsiao, 2011; Kato, 2020). Moreover, as “heavy and fast-moving objects in public spaces” (MacDuffie and Fujimoto, 2010, p.23), vehicles are subject to various global safety, privacy, and environmental regulations (Hemphill, Longstreet and Banerjee, 2022; Taeihagh and Lim, 2019). Global developments in regulation, technology, and market needs, including sustainability and connectivity, continue to reshape the industry (Xia, Govindan and Zhu, 2015; Yadav et al., 2020). This global relevance and constant evolution make understanding the automotive industry's response to change a topic of keen interest for scholars worldwide (Macduffie, 2018; Perkins and Murmann, 2018; Teece, 2018c).

Second, recent and current changes in the automotive industry are manifold and vast. The industry is experiencing disruption on the supply side (e.g., new entrants and change of incumbents) and on the demand side (e.g., changing customer needs; Accenture, 2019; Simoudis and Zoepf, 2019). The transformation is driven by factors including technological advancements, such as cloud computing and machine learning, and regulatory changes, such as battery electric vehicle (BEV) purchasing incentives and tightened standards for autonomous driving (Bauer et al., 2020; Fard and Brugeman, 2019). Incumbents are being challenged by new entrants achieving share price highs and competitive sales figures in the emerging electric vehicle, mobility services and autonomous driving markets (Bohnsack et al., 2020; Geels, 2014b; Macduffie, 2018). Simultaneously, incumbents’ internal combustion engine businesses are declining, forcing them to demonstrate DCs to survive long-term (Song and Aaldering, 2019). Hereafter, four specific examples illustrating the industry’s disruption and transformation in the areas of customer, value chain, sustainability, and competition are presented.

Customer dynamics exhibit a rapid evolution, characterised by the emergence of new market segments prioritising mobility services and connectivity features in vehicles. Noteworthy incumbents like

Volkswagen and BMW have strategically ventured into emerging mobility services and electrification markets (Biresselioglu et al., 2018; Novakazi et al., 2020), each adapting their approaches to suit the changing landscape. For instance, mass-market manufacturers like Volkswagen and Toyota prioritise the scalability of their electric vehicle platforms, whereas premium brands like Mercedes and BMW focus on enhancing digital customer experiences through advanced subscription services (Jungwirth, 2018; Volkswagen AG, 2020; Zipse, 2019).

Meanwhile, disruptions in the value chain, which refers to the series of activities that add value to a product or service from conception to delivery (Gereffi, 2018), are palpable as incumbent manufacturers transition from vertically integrated players to supply chain orchestrators (Kaviani et al., 2020; Yadav et al., 2020). The phase-out of internal combustion engine technology in favour of electric drivetrains necessitates a reassessment of value propositions, prompting incumbents to seek new partnerships to remain competitive in evolving market segments (Hill, 2019; Modi, Spulber and Jin, 2018).

Sustainability concerns, including environmental impact and resource efficiency, significantly influence industry practices, driven by regulatory mandates and stakeholder demands (Alvarez-Meaza et al., 2020; Amui et al., 2017). Global regulators are imposing sustainability targets on vehicle emissions and production processes, while incentives for electric vehicles are driving positive sales trends (Barkenbus, 2020; Beier et al., 2017; Burs et al., 2020). Initiatives like the Science Based Targets (SBTi), which set goals for reducing greenhouse gas emissions based on climate science, are gaining momentum (SBTi, 2023). These targets originate from a collaboration between the Carbon Disclosure Project, the United Nations Global Compact, the World Resources Institute, and the World Wide Fund for Nature, guiding organisations in implementing comprehensive sustainability measures across their operations.

Lastly, the competitive landscape undergoes profound transformations, with new entrants like Tesla and Nio disrupting traditional market dynamics (Cramer and Krueger, 2016; Korosec, 2018;

MashableUK, 2019; Statista, 2020; Välikangas, 2018). Concurrently, mergers and alliances among incumbents, such as Fiat Chrysler Automobiles and Peugeot Société Anonyme Group forming Stellantis (2023), reflect efforts to navigate the evolving industry terrain. New entrants, enabled by technological advancements and shifting consumer preferences, capitalise on innovative approaches to address emerging market needs (Hockerts and Wüstenhagen, 2010; Woodward, 2019).

1.6. Thesis structure and approach

1.6.1. Thesis overview

This thesis is structured to address the overarching research goals outlined in section 1.4. It comprises five semi-independent chapters (Chapter 2 through Chapter 5), accompanied by an introduction (Chapter 1) and conclusion (Chapter 6). Each chapter includes an independent literature review, contributing to the exploration of the challenges introduced in section 1.2. The qualitative methodology, detailed in section 1.6.2, is applied consistently across all chapters to investigate managers' successful adaptation to change within dynamic VUCA environments, considering the unprecedented disruption caused by the COVID-19 pandemic. Motivated by the identified research gaps, the thesis aims to bridge the ambiguity in analytical levels in VUCA environments by establishing clear boundaries and identifying relevant dimensions for analysis while also broadening the scope of resource considerations to encompass non-technological resources in shaping firms' adaptive strategies. This ambiguity arises due to the fluidity and unpredictability inherent in VUCA environments, which make it difficult to delineate clear analytical boundaries. By adopting a dynamic view of the RBV based on Barney (1991) and Teece, Pisano and Shuen (1997), the thesis seeks to extend literature on the topic and enrich the understanding of firms' adaptive responses in dynamic VUCA environments, providing insights relevant to both managerial practice and academic discourse on corporate strategy.

Chapter 2 presents results from a review of publicly available secondary sources and semi-structured interviews with automotive managers to ground the research in a specific industry setting and better understand DCs' nature in the automotive industry. Chapter 3 contains results from an in-depth case study of an Asian-based car manufacturer to understand how they demonstrated DCs by implementing agile ways of working as a strategy tool. Chapter 4 conceptualises a model of strategic flexibility based on semi-structured interviews and value stream mapping. Chapter 5 seeks to extend our understanding of how and why through particular ways firms differentiate their product offerings in the face of change by presenting in-depth interview data with automotive managers and further automotive stakeholders. Table 1.1 summarises the research questions and main deliverables per main chapter, which will be detailed in the individual chapters. The overall conclusions are brought together in Chapter 6.

	Chapter 2	Chapter 3	Chapter 4	Chapter 5
Research questions	RQ 1.1: What are the strategic implications of CASE for incumbent car manufacturers? RQ 1.2: How can their DCs be assessed holistically?	RQ 2: How can agile ways of working be used as a strategy tool to respond to unprecedented industry transformation?	RQ 3.1: What are key factors determining strategic flexibility? RQ 3.2: How could a conceptual model of strategic flexibility look like?	RQ 4.1: How do differentiation efforts disseminate from individual firms to industry-wide engagements? RQ 4.2: What is first movers' rationale for their type of differentiation?
Key theme of the literature	Assessing car manufacturers‘ DCs (Teece, 2018c; Teece, Pisano and Shuen, 1997)	Agile ways of working as a strategy tool (Denning, 2017b, 2018a; Rengarajan, Moser and Narayanamurthy, 2021)	Dimensions of strategic flexibility (Herhausen et al., 2020; Sanchez, 1995)	Dynamics of car manufacturers' differentiation strategies (Bohnsack et al., 2020; Firnkorn and Müller, 2012; Sashi and Stern, 1995)
Methodology and data	Two-phase study: review of secondary sources and semi-structured interviews with automotive managers	In-depth case study: interviews with managers at a premium car manufacturer based in Asia	Semi-structured interviews and value stream mapping	In-depth interviews with automotive managers and further automotive stakeholders
Main deliver-able(s)	Analysis of main innovative areas of the automotive industry Framework for assessing DCs	Six principles for implementing agile ways of working as a strategy tool	Conceptual model of strategic flexibility	Analysis of differentiators in the automotive industry Explanatory approaches to varying differentiation strategies

Table 1.1 Overview of research questions and main deliverables

This thesis starts with Chapters 2 (assessing of DCs) and 3 (agile ways of working) on the granular level of strategy implementation. Managers and strategy research have highlighted the assessment of DCs and agile ways of working to explore and exploit market opportunities as being vital in responding to dynamic environments successfully (Arend and Bromiley, 2009; Denning, 2017a; Kaviani et al., 2020; Pearson et al., 2020). Thereby, the aim is to understand the nuances on the manager, team, and firm level of two critical aspects of DCs.

Building on the nuanced insights, the subsequent Chapters 4 (strategic flexibility) and 5 (product differentiation) explore two critical firm- and industry-level issues, especially in dynamic environments, that were emphasised in the findings of Chapters 1 and 2 (Herhausen et al., 2020; Makadok and Ross, 2013; Nachum and Wymbs, 2005; Nadkarni and Narayanan, 2007).

1.6.2. Methodological approach

This section provides an overview of the thesis's methodological approach. Detailed explanations of the methodologies employed in each chapter, including pre-COVID study details and specific analytical methods, are provided within the respective chapters. Overall, the thesis utilises a main study involving 77 interviewees from 68 companies, comprising two rounds of interviews and analysis (April 2020 - February 2021 and April 2023 - June 2023), along with a single-firm case study based on 18 conversations. The two interview rounds, conducted before/early during COVID-19 and after, aimed to enrich and compare findings as the pandemic unfolded. The interviewees were selected from diverse backgrounds within the automotive industry, including executives, managers, and specialists. They were asked questions regarding their perceptions, strategies, and experiences related to adapting to dynamic environments, particularly in response to the COVID-19 pandemic. Employing two rounds of interviews allowed for longitudinal insights into how strategies and perceptions evolved over time, providing a comprehensive understanding of adaptation processes and differences in strategies in VUCA environments. The participant information sheet and consent forms are provided in Appendix 1 and 2, respectively.

The study's philosophical underpinning aligns with a constructivist approach, recognising the co-construction of knowledge between researchers and participants and the importance of context in understanding phenomena (Creswell, 2014). Constructivism, with its focus on subjective sense-making, considers knowledge as being constructed through the engagement of individuals and their social contexts. This approach facilitated in-depth exploration and interpretation of participants' experiences and perspectives within their organisational and the COVID-19 pandemic contexts.

This research followed an inductive approach, generating insights from the interview data collected. The inductive process helped to understand the evolution of organisational strategies in the complex COVID-19 environment. Themes and patterns emerged from the data by observing experiences and views shared by the interviewees. This enabled the development of theories grounded in the industry leaders' lived experiences as opposed to preconceived models.

The inductive approach also aligns with the explorative nature of this research, facilitating an in-depth analysis of how the COVID-19 pandemic changed organisational thinking and decision-making. The pre- and post-COVID-19 comparison further helped capture emerging strategic and behavioural trends. Following an iterative process of data collection and analysis, the philosophical and epistemological approach prioritised contextual knowledge over generalisation while maintaining flexibility in response to new insights. The study structure is illustrated in Figure 1.1, with further explanation to follow.

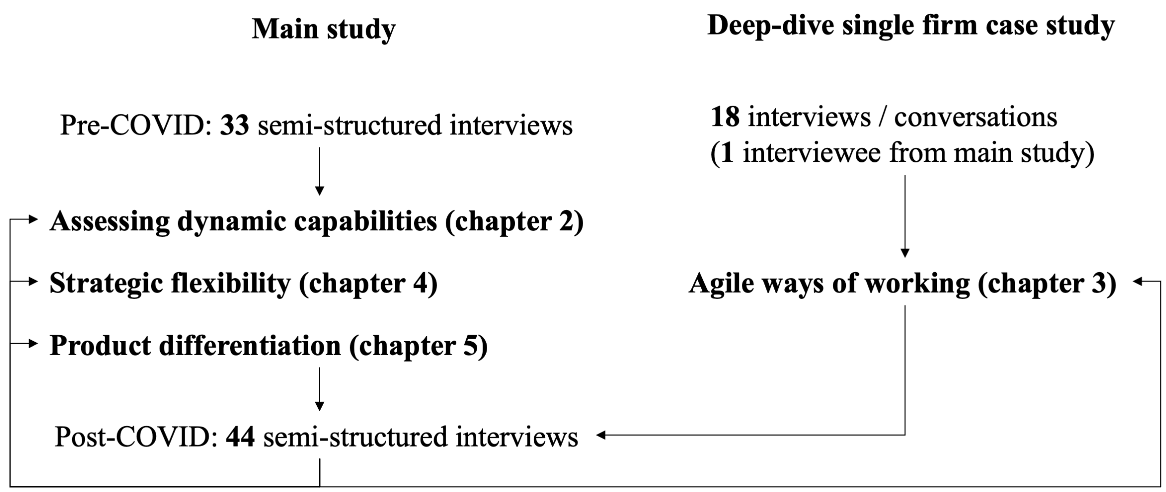

Figure 1.1 Interviews breakdown

The interviewees represent globally operating organisations but are based in 20 countries, as visualised in Figure 1.2.

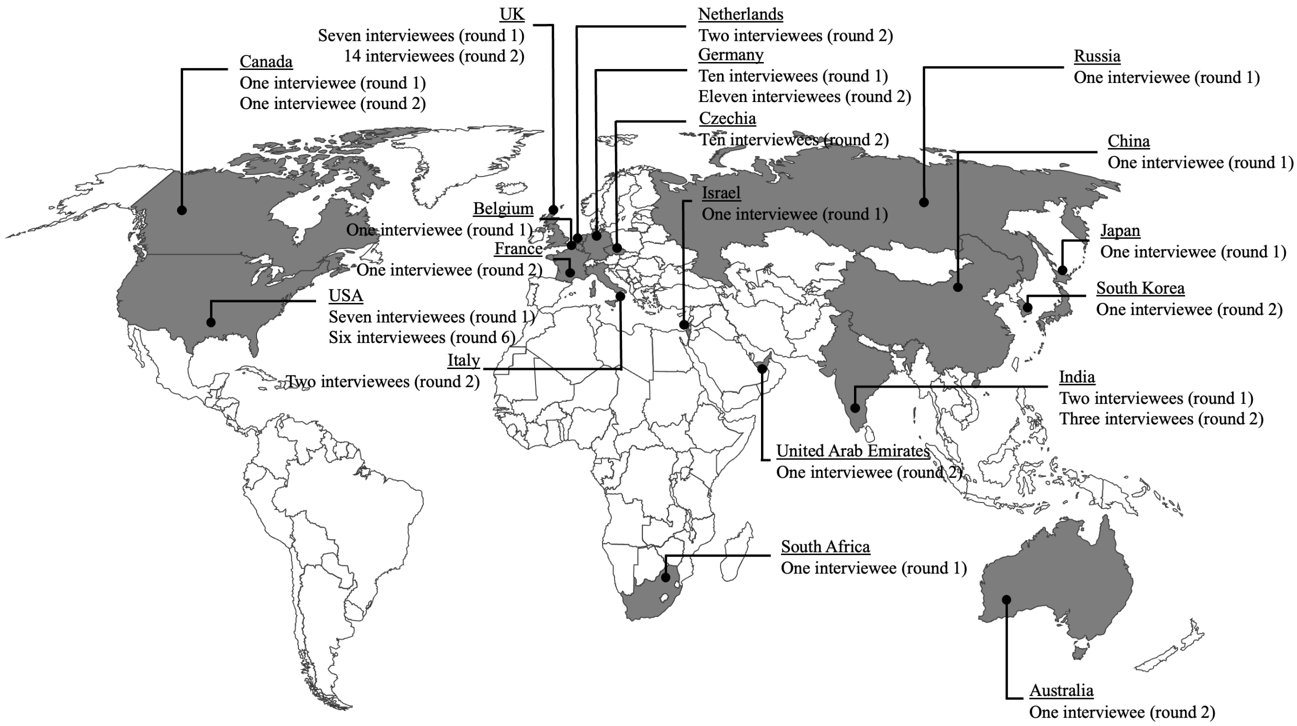

Figure 1.2 Global spread of main study interviewees

The pre- and during COVID part of the main study covers 33 interviewees from 33 organisations based in 11 countries globally. The interviews for this study round were conducted between April 2020 and February 2021. Appendix 5 provides an interviewee overview.

The pre-COVID interview guide and focal points developed as the interviews progressed, which allowed addressing the three issues of assessing dynamic capabilities (Chapter 2), strategic flexibility (Chapter 4), and product differentiation (Chapter 5), as detailed in the individual chapters. Appendices include the consent form (Appendix 2), initial interview guide used for the first round of interviews (Appendix 3), and ethical clearance (Appendix 4).

As per Appendix 6, the April to June 2023 post-COVID round of interviews for the main study covered 44 interviewees from 41 organisations (6 from pre-COVID round and 35 new) located in 7 additional countries for a more diversified firm and geographical sample. Thereby, this thesis has a similar sample size to methodologically comparable doctoral theses in UK universities (e.g., Karsoo, 2022;

McLoughlin, 2023) while enriching insights through other forms of analysis. The interviewee numbering style is used consistently across all main chapters.

The interview protocol evolved over time. As with any qualitative study, earlier data collection experience was leveraged to refine and update later interviews. The theme of the post-COVID interview round leading to the post-COVID findings across all main chapters is “dynamic capabilities in a post-COVID world”. The overarching research question, “How do unprecedented disruptions (COVID-19 pandemic) change firms' dynamic capabilities approach?” guides this interview round. The purpose of this interview round is to compare insights from before and during the pandemic to after the pandemic, following the themes covered across the four main chapters. Thereby, this study addresses the challenges that the DCs literature has received, aiming to enhance the robustness and broaden the scope of arguments through comparisons before, during, and after crises. The revised interview guide is presented in Table 1.2 hereafter, covering main- and sub-questions, and linking the questions to previous chapters (in brackets where the question was addressed but not a focus area of the chapter) and findings made in previous chapters this question engages with. The data analysis approach and structure (e.g., 1st and 2nd order codes), as well as reliability and validity tests (e.g., playing results back to participants for verification) throughout the thesis, followed established practices (e.g., Glaser and Strauss, 1967; Miles and Huberman, 1994; Miles, Huberman and Saldana, 2014).

Data analysis involved an iterative process of data collection and sensemaking (Miles and Huberman, 1994). The first interviews considered general research aims and provided the foundation for a systematically evolved interview guide for the subsequent interviews, leading to increased focus (Glaser and Strauss, 1967). Interviewees were encouraged to set focal points. Given the deeply and broadly grounded empirical evidence, the results are more generalisable and valid than those of single case studies (Eisenhardt, 1989; Yin, 2014). This study adopted a four-step data analysis process introduced by Glaser and Strauss (1967) and refined by Miles and Huberman (1994). The steps cover

(1) identification of key themes, and (2) investigation of issues per interview, (3) cross-interview analysis, and (4) the development of a theoretical framework. Interview transcripts were analysed by applying thematic analysis, using NVivo.

Main question	**Sub-question**	**Addressed in chapter previously**[2]	**Findings I engage with**
Sensing: How does market sensing post-COVID differ from market sensing during and before the pandemic?	Changes in planning processes?	Chapter 2	- Environmental sensing is a key input for scenario building and sensemaking (DCs theory) - Managers sense through a combination of market research (e.g., industry reports, interviews, observations) and non-market research (e.g., intuition, gut feeling)
Seizing: How did the strategy-making approach change during and after the pandemic?	Changes in strategic programmes?	(Chapter 4)	- Strategic flexibility structure into customer (expectations; demand variability), product (product lifecycle; differentiation; alternatives), and process (time-to-market; complexity management; innovation approach) - Strategic programmes more shorter term (1-2 years instead of 3-5)
	Changes in success metrics and/or measurement?	Chapter 3	- Firm-wide use of objective and key results for goal setting and reporting - More focus on sustainability and customer experience metrics
	More / Different strategic experiments (e.g., testing of new markets or products)?	Chapter 3	- More and faster iterations to explore new market opportunities - Higher risk-taking with experiments
	Changes in differentiation approaches?	Chapter 5	- Innovation is a key enabler to successful differentiation - Firms differentiate technologically (e.g., connectivity features, technical product specifications, technical integration) and non-technologically (e.g., brand, price, customer experience)
	Cultural changes?	(Chapter 3)	- More openness to collaborate internally and with partners to solve problems - Increased focus on diversity and inclusion - More open communication (e.g., feedback)
Transforming: How did the organisation's operating model change as a result?	Changes in organisational structure?	(Chapter 3)	- Wider use of cross-functional capability teams - Flatter and more decentralised organisational structures
	Changes in firm-internal collaboration? Changes in external collaborations? (e.g., with competitors, universities, government, and other stakeholders (e.g., suppliers))	Chapter 3	- More cross-functional squads than functional silos to solve problems - More digital collaboration, enabled by modern digital tools

[2] The chapter reference is in brackets where the question was addressed but not a focus area of the chapter.

Main question	Sub-question	Addressed in chapter previously[2]	Findings I engage with
	Changes in how firm internal capabilities are assessed?	Chapter 2	- Focus on technology capabilities - Mapping role descriptions to capability needs to identify gaps
	Changes in the use of agile ways of working across the organisation?	Chapter 3	- Agile methods more widely used outside software development, e.g., to validate market opportunities - Successful implementation of agile is less about rigid frameworks and more about underlying principles (e.g., clear direction, key performance indicators, empowerment)

Table 1.2 Revised post-COVID interview guide and link to previous chapters

The second round of interviews follows the dynamic capabilities structure (sensing, seizing, transforming; Teece, 2007) while engaging with the previous chapters' issues and allowing for a meaningful comparison to the post-COVID world. The literature reviews as well as pre- and during COVID findings that led to the questions and sub-questions have been detailed in the respective main chapters.

Chapter 1 has established the groundwork for delving into the intricate dynamics of firms operating within the automotive industry. It has provided an overview of the rationale behind the research focus, setting the stage for a deeper exploration of firms' adaptive strategies and defining the concepts used throughout the thesis. The subsequent chapter will delve into the assessment of DCs within the automotive sector, offering insights into how firms navigate and thrive amidst uncertainty.

2. Assessing dynamic capabilities of incumbents in the face of unprecedented industry transformation: The case of the automotive industry

2.1. Introduction

As stated in Table 1.1, the key theme of this chapter is DCs. In the realm of strategic management, the theoretical perspective of DCs has become increasingly important (Eisenhardt and Martin, 2000; Schilke, Hu and Helfat, 2018). DCs are organisational capabilities that reflect a "firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" and are a source of competitive advantage (Teece, Pisano and Shuen, 1997, p.516). Although stemming from strategy research, the DC concept found widespread adoption in the business and management domain, including studies on technology (Teece, 2014), operations (Holweg and Pil, 2008), marketing (Morgan, Vorhies and Mason, 2009), and human resource management (Adner and Helfat, 2003). Recently, scholars argued that DCs lack empirical underpinning and operationalizability (Easterby-Smith, Lyles and Peteraf, 2009; Peteraf, Di Stefano and Verona, 2013).

Pivotal in sharpening the DCs perspective is to detach from focusing on conceptual development and improving empirical evidence. This idea led to several approaches aiming at improving the assessment of (dynamic) capabilities (Achtenhagen, Melin and Naldi, 2013; Ulrich and Smallwood, 2004) and further determinants underlying value creation (Argyres, Mahoney and Nickerson, 2019; Lieberman and Dhawan, 2005). Previous studies looked at individual DCs or deployment contexts (Helfat and Raubitschek, 2018; Trejo et al., 2002; Wheeler, 2002).

However, literature still lacks a holistic approach to the assessment of DCs. Holistic refers to incorporating all DCs of an organisation relevant for determining and executing the firm's strategy. Teece (2018c) proposed a framework covering technical capabilities and focusing on firm internal dimensions. This chapter argues that considering non-technological capabilities and external environments are critical in the DCs assessment. It proposes a framework for the holistic assessment of DCs using the case of automotive incumbents.

The case of automotive incumbents is particularly well-suited to study DCs and their assessment now, given the current and unprecedented pace of change in the automotive industry. This chapter refers to incumbent car manufacturers as those coming from the internal combustion engine (ICE) technology regime and still mainly selling ICE vehicles today, such as Volkswagen and Toyota (Bohnsack et al., 2020; McKinsey, 2020; Smink, Hekkert and Negro, 2013; Wang and Wells, 2020; Wesseling et al., 2015). After a century of hardly any change in car manufacturers' (also known as Original Equipment Manufacturers, hereafter OEMs) business model, today's automotive value chains are being challenged. Experts refer to the automotive industry at a crossroads, the second automobile revolution or mobility's second great inflexion point (Hauptmeier, 2010; Simoudis and Zoepf, 2019), reflecting the high degree of dynamism and change ahead. This dynamism stems largely from the four automotive core themes of connectivity (C), autonomy (A), sharing (S) and electrification (E), referred to as CASE (Eisele et al., 2019). Connectivity covers cars connected to the internet and their environments, such as other cars and transport infrastructure, to improve user experience. Autonomy describes drivers' support to ultimately replacing them by fully autonomous operating systems in cars without steering wheels. Sharing is the joint use of cars, offering end-users flexibility in networks of available vehicles, aiming at increasing vehicle utilisation. Electrification is the shift to an electrified drive, complementing and eventually replacing ICEs, promising zero emissions at the location of use.

This study addresses three connected and complementary research gaps: First, the literature on the assessment of CASE and its implications for incumbent car manufacturers is fragmented and unstructured. Previous studies addressed CASE on a high level or focused on certain CASE aspects (Ajanovic and Haas, 2016; Faria and Andersen, 2017; Jiang and Lu, 2018; MacDuffie, 2013; Schulze, MacDuffie and Täube, 2015; Wesseling et al., 2015). This chapter attempts to close the empirical gap.

Second, a holistic approach to firm-level DC assessment has yet to be developed. Existing research considers certain capability deployment contexts (de Bakker and Nijhof, 2002; Lieberman and Dhawan, 2005), specific capability types (Helfat and Raubitschek, 2018; Trejo et al., 2002; Wheeler, 2002), or is narrow in terms of the metrics considered to assess capabilities (Achtenhagen, Melin and Naldi, 2013; Ulrich and Smallwood, 2004). This study argues that developing a holistic approach to assessing DCs has become increasingly pressing for academics and practitioners as environments become more Volatile, Uncertain, Complex and Ambiguous (VUCA). VUCA refers respectively to the dynamics of change, lack of predictability, multiplicity of forces at play and haziness of reality (Petricevic and Teece, 2019; Schoemaker, Heaton and Teece, 2018; van Tulder, Jankowska and Verbeke, 2019), characterising today's risky automotive industry environment. This study attempts to close the theoretical gap by drawing on empirical insights from addressing the first gap.

Third, the CASE capabilities matrix developed by Teece (2018c) in a debate on Tesla and the evolution of the automotive industry has potential for extension, thereby providing a holistic view of car manufacturers capabilities. Combing the empirical and theoretical contributions from addressing the first two research gaps, this chapter develops an extended approach to assessing DCs of incumbent car manufacturers. The approach introduced in this chapter enables identifying inter-firm differences in DCs, creates assessment process transparency and considers a range of contextual scenarios.

To plug these gaps, two research questions guide this chapter:

RQ 1.1: What are the strategic implications of CASE for incumbent car manufacturers?

RQ 1.2: How can their DCs be assessed holistically?

The contribution of this study is twofold. Empirically, it contributes a structured analysis of CASE in the automotive industry and implications for incumbent car manufacturers. Theoretically, it contributes a holistic and empirically grounded approach to the assessment of DCs, promising improved effectiveness and efficiency of strategy development and implementation. The approach extends Teece (2018c) work by proposing the consideration of non-technological capabilities and external environments in the DCs assessment, thereby contributing to the operationalisation of the DC lens.

The approach was applied to incumbent car manufacturers but has potential to be used in other dynamic industries, such as finance or retail.

Following the pre-COVID study, a post-COVID analysis was conducted to revisit and reassess the implications of DCs within the automotive industry in light of the pandemic-induced disruptions. Recognising the unprecedented challenges and shifts in market dynamics brought about by the COVID-19 crisis, this study aimed to capture the evolving landscape and its impact on incumbent car manufacturers' strategies and capabilities. Building upon the foundational insights gleaned from the pre-COVID study, the post-COVID analysis sought to elucidate how the pandemic has reshaped the strategic imperatives and competitive dynamics within the automotive sector. By revisiting key themes such as CASE implications, holistic DCs assessment, and strategic implications for incumbent car manufacturers, the post-COVID study aimed to provide a nuanced understanding of the industry's response to the crisis and identify emergent trends and strategic imperatives for firms navigating the post-pandemic landscape.

This chapter is organised into four sections. Section 2.2 introduces links to previous debates on the transition of the automotive industry. An analytical framework for managing car manufacturers in a risky VUCA environment is introduced, guiding this chapter’s pre-COVID study. CASE and implications for car manufacturers are reviewed. Section 2.3 details the research methodology. Subsequently, the findings from both the pre- and post-COVID studies are presented, allowing for a comprehensive examination of the evolving landscape within the automotive sector. Following the presentation of findings, the discussion section 2.5 critically assesses the changes observed post-COVID and links them to relevant literature, providing insights into the dynamic nature of DCs in response to disruptions. Finally, the conclusion 2.6 highlights the contributions of the study and outlines avenues for future research, thereby closing the chapter on a forward-looking note.

2.2. Literature review

2.2.1. Preceding debate

This chapter ties in with the CASE capabilities matrix developed by Teece (2018c) in the course of an ongoing debate on recent developments in the automotive industry (Macduffie, 2018; Perkins and Murmann, 2018; Teece, 2018c, 2019). The matrix draws conclusions about DCs of car manufacturers, focusing on CASE. This chapter complements by taking a holistic approach, adding internal and external perspectives, to improve strategy and implementation.

2.2.1.1. Recap of the preceding debate

Based on Tesla and the Model S, Perkins and Murmann (2018) argued that any company investing one to two billion USD could design, develop and manufacture a BEV in three to four years. MacDuffie (2018) responded, arguing that incumbent OEMs' competitive strength is stronger than described, clarifying what is (not) unique about Tesla. He points out that new car manufacturers would have to master system integration capabilities, arguing that Tesla has not yet demonstrated it. MacDuffie supports his argument by emphasising that several new mobility service providers, such as Waymo, Uber and Lyft, are opposed to producing vehicles in the future. In line with Christensen's (1997) theory of disruptive innovation, MacDuffie argues that influential new OEMs will work up their way from the low-price segment.

Jiang and Lu (2018) discuss barriers to entry to the automotive industry, focusing on China. They suggests that it is unlikely that today's successful OEMs or internet companies, but rather a "new species" is successful in the future automotive industry. Jiang and Lu argue that the future automobile will be produced and delivered in a new form of ecosystem, requiring capabilities largely not congruent with OEMs capabilities today.

Teece (2018c) links the debate to the wider context of managing in uncertain environments since the automotive industry is characterised by a high VUCA environment today. Therefore, he first outlines a framework that describes a high-level process of managing firms under uncertainty conditions, illustrated in Figure 2.1. The cloud-shaped objects represent environmental factors and the fields in grey are firm activities. The arrows indicate relationships.

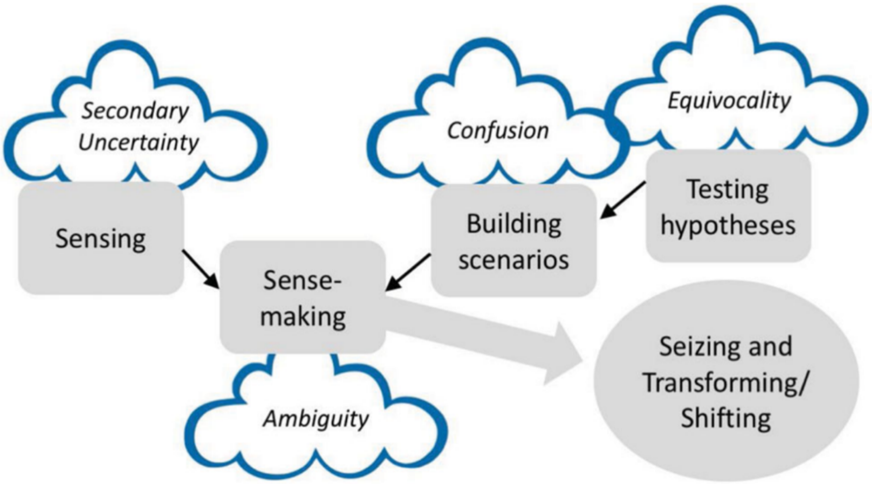

Figure 2.1 Management under uncertainty: Sensing and sensemaking (Teece, 2018c)

The illustration highlights a process that might guide firms to formulate a strategy under conditions of uncertainty. The process covers gathering information about a firm's environment (sensing), analysing the data to identify implications for the organisation (sensemaking), and formulating and testing hypotheses. Teece (2018c) emphasises in his narrative the importance of iterating between sensemaking and strategy formulation to adapt based on new insights. The framework builds on his earlier DCs work, covering sensing, sensemaking and transforming as three vital components to adaptability (Teece, 2007). Transforming refers to the continuous adaption of the organisation based on new knowledge. Teece (2018c) applied the DC lens, using the introduced framework, to CASE and incumbent OEMs. He introduced a matrix for assessing OEMs capabilities and capability gaps, illustrated in Figure 2.2 below. His approach is based on three dimensions: technology, business model and market. The three dimensions refer to the current technological abilities, revenue and profit generation logic, and customer orientation, respectively. Zero, near, medium and far are the classifications used to indicate the capability gaps' extent.

	Three Dimensions of Capability Distance		
	Technology	Business Model	Market
Electric Vehicles	Medium	Near	Medium
Autonomous Vehicles	Far	Zero	Near
Connected Cars	Medium	Medium	Zero
Personal Mobility	Medium	Far	Far

Figure 2.2 Distances to new capabilities from traditional car manufacturer capabilities (Teece, 2018c)

Teece (2018c) infers that incumbent OEMs' capability shortfalls are not particularly large, emphasising technological skill gaps and organisational inertia as main constraints. He argues that if OEMs demonstrate strong DCs and system integration capabilities, they may also dominate the upcoming automotive transformation. System integration capabilities are highlighted as success critical in the automotive industry and area where incumbents still have the edge over new entrants, like Tesla.

2.2.1.2. Areas for extension

Teece's (2018c) CASE capabilities matrix can be expanded, considering assessment process transparency, "traditional car manufacturer" (unit of analysis), "distance" (classification), "dimensions of capability distance" (horizontal axis), "CASE capabilities" (vertical axis), scope of analysis, and the time dimension.

It is not clarified what a "traditional car manufacturer" is. In the business realm, "traditional" may refer to a variety of dimensions, including founding year, strategic focus, business operation, customer structure, sales or profit pools, number of employees or number of cars sold (Amey, 1995; Kley, Lerch and Dallinger, 2011; Millet, Yvars and Tonnelier, 2012). Regardless of the dimension(s) considered, no homogeneous "traditional car manufacturer" exist. BMW and Volkswagen are both incumbents but have different views on their capabilities. BWM considers its core capabilities to be most suitable to become a intelligent hardware provider (Zipse, 2019). Volkswagen views itself as mobility facilitator and service provider (Jungwirth, 2018). These two established, and perhaps “traditional” car manufacturers perceive very different core capabilities.

“Distance” and the gradations of near, medium and far are not specified or quantified. In theoretical models, vague classifications are being accepted (Ansoff, 1980; Schaltegger and Wagner, 2011). However, this practical application requires specification of what is considered or even quantification of gradations for unambiguity (Nissen, 2019; Töytäri et al., 2011).

Categorising the dimensions of capability distance as technology, business model, and market without specification can be made more granular. “Technology” may refer to all capabilities enabled by technology or certain capabilities to be described as technologies (Bharadwaj, 2000), e.g. a machine learning capability. “Business model” of OEMs may describe building cars and selling them to end-users (Chesbrough, 2010). According to an analysis by the Boston Consulting Group, 30 per cent of OEM profits in 2017 came from the traditional components business, 35 per cent from the sales of new cars, 11 per cent from financial services, such as financing and leasing, and 24 per cent from the aftermarket business, such as sales of parts and accessories (Andersen et al., 2018), indicating the complexity of speaking about automakers business model. The “market” dimension may include current customers’ willingness to purchase (Day, 1994), a metric requiring further concretisation.

It is ambiguous what examining a CASE factor includes. All incumbent car manufacturers offer electric, to some extent autonomous and connected cars, and partly mobility as a services today (Athanasopoulou et al., 2019; Miao et al., 2019). For example, in terms of the electric car capability dimension, battery technology make or buy decisions of OEMs differ greatly (Chae, Yan and Yang, 2019; Olivetti et al., 2017). Regarding autonomous and connected cars, the degree or level of autonomy or connectedness requires specification. For example, the Society of Automotive Engineers (SAE, 2024) offers autonomy levels, and McKinsey suggested concretisations of connectivity levels (Bertoncello, Husain and Möller, 2018). Mobility services need specification analogously. Moreover, CASE do not occur isolated in practice but are rather interconnected. For example, mobility as a service can only be used efficiently with a car connected to the internet (Mahmassani, 2016). Large-scale adoption and financial viability of mobility as a service might emerge when fully autonomous electric robo-taxis are widely used (Bansal and Kockelman, 2017; Taiebat et al., 2018; Talebian and Mishra, 2018). These kinds of synergies and their importance for analysing DCs cannot be captured considering CASE in isolation.

The analysis scope can be questioned. A focus purely on internal factors ignores external influences, like regulation and customer needs. External factors have to be considered as they pose VUCA in the DC context (Gu, Liu and Qing, 2017; Harrison and Thiel, 2017).

The analysis does not consider a time dimension. Particularly in a rapidly changing automotive industry (Nicholds and Mo, 2018; Xia, Govindan and Zhu, 2015), it is relevant to consider in what time context capabilities are being assessed and capability gaps identified.

Although classifications and distances could benefit from further development, two statements are explicitly made: AVs do not constitute a change for the business model dimension, and connected cars do not lead to a change in traditional OEMs' market dimension. It can be challenged that AVs do not pose a change for the business model dimension. It is unlikely that fully autonomous vehicles will be used in the same or a similar way and with a comparable utilisation like current passenger cars (SAE, 2024). Increased car productivity, i.e. capacity utilisation, likely leads to a reduction in the total number of passenger cars required and sold (Heineke et al., 2020). Questionable is also that connected cars do not lead to a change in market structures. Indeed, all new cars today are equipped with some form of connectivity. An advanced level of connectivity, e.g. level 5 “Virtual chauffeur: All occupants’ explicit and unstated needs fulfilled by cognitive AI that predicts and performs complex, unprogrammed tasks” (Bertoncello, Husain and Möller, 2018, p.2) is likely to affect the automotive market or potential customer base due to additional customer benefit. Although the CASE capabilities matrix has been challenged, it provides a valuable foundation for further developments - a quest embraced by this chapter.

2.2.2. Managing automakers in a risky VUCA environment

Characterising our world as volatile, uncertain, complex, and ambiguous (VUCA) was coined by the U.S. military in the late 1990s (Whiteman, 1998). In recent years, the acronym has been recognised academically to characterise global environments, associating risks for businesses. This chapter considers VUCA as stemming from managers' perceptions of external influences.

VUCA has severe implications for OEMs. Incumbents competitors are increasingly becoming asymmetrical in terms of origins, organisational forms, and operating speeds (Millar, Groth and Mahon, 2018), increasing uncertainty. Leaders in such environments may thrive by testing different hypotheses about market changes and technologies surpassing detailed and rigid plans (Conger, 2004). Automakers are balancing flexibility and efficiency, e.g., regarding BEV energy storage systems. Fords global head of product development and purchasing, Hau Thai-Tang, describes incumbents innovation dilemma as "But we have a hundred-year-old home that we're trying to update while we live in it" (Thai-tang and Schwartz, 2019, p.4), emphasising technological pace of change and future uncertainty.

The current VUCA environment challenges incumbent car manufacturers to rethink their capabilities. Linked to the DCs concept and building on previous approaches (Teece, 2018c, 2007), the analytical framework below guides this chapter. Dashed ovals are environmental factors influencing all other elements. Dark ovals are addressed in this chapter (in-scope) and connected by solid arrows. In the DCs literature, they are all elements of the sensing capability (Teece, 2018c). Light ovals with dark writing are subsequent elements not specifically addressed in this chapter (out of scope). Dotted arrows indicate their relationships.

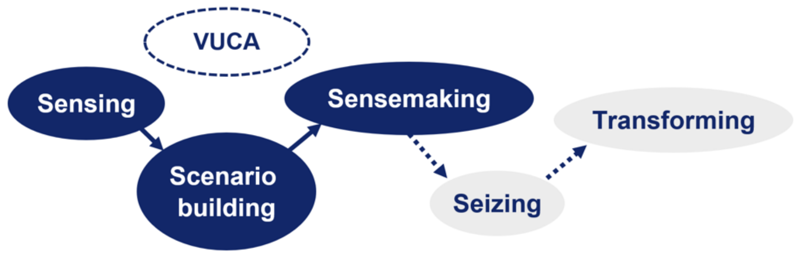

Figure 2.3 Analytical framework: DCs in a VUCA environment

Based on environmental sensing, (hypothesis-driven) scenarios are developed, constituting input for interpretation (sensemaking). Compared to previous approaches (Teece, 2007, 2018c), which Figure 2.3 is based on, this chapter links sensing and scenario building. Environmental sensing is a prerequisite for developing robust and insightful scenarios. Moreover, this chapter considers the influence of all VUCA dimensions on DCs. Sensing, scenario building and sensemaking are being applied to incumbent car manufacturers.

2.2.3. Sensing: CASE analysis

Since its emergence in the early 20th century, the automotive industry has had profound, largely beneficial, influences on peoples live. The next ten years may encompass more change than the past 50 years (Baltic, Hensley and Salazar, 2019). CASE is at the core of this transformation. Academia lacks a holistic understanding of CASE and implications for OEMs (Miao et al., 2019; Taiebat et al., 2018; Teece, 2018c). This chapter discusses CASE and implications for incumbents. CASE dimensions are analysed individually and aggregated, promising a holistic and rich picture by considering CASE interdependencies and synergies.

2.2.3.1. Connectivity

Vehicle connectivity refers to communication, sending and receiving information, between systems in- and outside the vehicle’s local area network (Zohdy and Rakha, 2016). The term Connected Car is frequently used for vehicles accessing the internet (Woo, Jo and Lee, 2015). Connectivity is considered a core element of the automotive customer experience and an enhancer or enabler of further CASE dimensions.

No one widely adopted approach to classifying and specifying vehicle connectivity exists. McKinsey defined five levels of vehicle connectivity based on the degree of customer benefit (Bertoncello, Husain and Möller, 2018), inspired by the five levels of autonomy (SAE, 2024). These span from general hardware connectivity (Level 1), including transfer of basic vehicle usage data, to virtual chauffeur (Level 5), utilising AI to assess and meet customer needs proactively.

Vehicle connectivity opens opportunities for creating and capturing economic, social and ecologic value. Automotive manufacturers and suppliers access large amounts of data to improve the customer experience and vehicle as a product (Möller and Haas, 2019; Woo, Jo and Lee, 2015). Advanced connectivity features store data about car users and create individual usage profiles, used by e.g. Apple CarPlay and Android Auto (Modi, Spulber and Jin, 2018; Möller and Haas, 2019). Machine learning and other forms of AI engage with users proactively, providing customer-centric recommendations and enhancing available services. Future vehicle connectivity may integrate the automobile, today largely transportation-focused, closer socially in customers' lives. Insurance companies may use improved individual risk profiles for usage-based insurance, tightening the link between individual risk and insurance premium (Pütz et al., 2019). Connectivity may improve accident prevention by detecting fatigue symptoms, indicated through conspicuous driving behaviour. Such efforts promise reduced social costs, e.g. arising from infrastructure repairs and hospital treatments (Abra et al., 2019). Technology-enabled reductions in safety distances and traffic flow optimisations could increase road capacity (Möller and Haas, 2019), thereby improving the overall transportation system.

Vehicle connectivity also poses challenges. Data security and user acceptance remain uncertain (Heineke et al., 2020). Automotive incumbents likely have to adapt their ecosystems and partnerships to meet new DC requirements. Regular software updates may enable continuous improvements of car usability but challenge incumbents technical capabilities, like in-vehicle IT architecture capabilities (Apostu et al., 2019).

2.2.3.2. Autonomy

AVs are cars operating with little or no human interference. Terminologies comprise connected and autonomous vehicles, self-driving or driverless vehicles, robo/robotic cars and robo-taxis (Cohen and Hopkins, 2019; Miao et al., 2019). Core capabilities of AVs include environmental sensing, interpreting and steering. Core components include sensors, such lidar and global positioning system, advanced software for interpreting data inputs, technical infrastructure, e.g. computing capacity, and adequate vehicle steering systems (Ding et al., 2015; Gerdes, Thornton and Millar, 2019).

The Society of Automotive Engineers (2019) published the widely accepted classification of autonomous driving levels. It is based on the required driver attention and degree of intervention to operate the car. The six autonomous driving levels range from a fully manual (level 0) to fully autonomous without a steering wheel and no human intervention required (level 5).

Today, autonomous driving is a competitive space. Resource intensive research is conducted by well-financed start-ups, spin-offs and subsidiaries of incumbents. Promising opportunities for new entrants are rare and led to consolidation (Miao et al., 2019; Talebian and Mishra, 2018). Kilometres covered autonomously are considered an indicator of progress. Alphabet Inc. subsidiary Waymo LLC is leading the field. In fall of 2018, the company reported over ten million autonomous miles covered on public roads and over ten billion in a virtual simulator (Oh et al., 2020). Waymo announced its AV taxi service offering in Phoenix, Arizona, in late 2018 (Hwang and Song, 2020). Other technology companies and incumbent OEMs recognised AVs' potential and invested accordingly (Deng, 2018).

The future of AVs suggests challenges for businesses. Insurance companies may change due to reduced accidents and decreases in insurance premiums (Pütz et al., 2019). Cities may experience drops in revenues from vehicle taxes and other fees like fines for driving violations. Besides, set-up and operation of charging infrastructure in conjunction with increased energy consumption may challenge parties involved. The increased capacity utilisation of AV may lead to fewer vehicles, posing challenges for OEMs and suppliers (Heineke et al., 2020). Incumbents developing AVs are facing hardware and software capability gaps (Apostu et al., 2019).

Promising opportunities offset challenges. McKinsey estimates AV associated revenues could amount to $1.6 trillion in 2030 (Baltic, Hensley and Salazar, 2019). This would be more than double the combined 2017 sales of Toyota, Volkswagen, General Motors and Ford (International Organization of Motor Vehicle Manufacturers, 2018). Social benefits, such as alternative use of parking spaces, productive travel time and safer roads may improve.

2.2.3.3. Sharing

In the mobility context, sharing refers to shared and/or joint use of a means of transport (Esztergár-Kiss and Kerényi, 2020). The following focuses on carsharing. Sharing changes personal car purchase and ownership to on-demand consumption of mobility. Main motivators include shared costs, environmental advantages and social benefits (Pütz et al., 2019).

Carsharing adoption is limited, accounting for about one per cent of total vehicle miles travelled in the US (Meyer and Shaheen, 2017). Today, prominent providers include ShareNow, a merger of BMW's DriveNow and Daimler's car2go, Lyft and Uber. All are struggling with profitability, especially due to driver costs involved and yet lower rates compared to traditional taxi companies (Gilibert and Ribas, 2019; Lu, Chen and Shen, 2018). Increasing the geographic coverage, number and distance of rides as well as business expansion, like delivery of goods, are levers to changing cost and revenue structures (Bösch et al., 2018).

Future potential attracted high investments from venture capitalists and incumbents. AVs promise increased ridesharing adoption due to added customer benefit and lower operating costs (Miao et al., 2019). Around $55 billion have been invested in ridesharing over the past seven years. In the US alone, the market potential is estimated to be $30 billion annually. Today, ridesharing costs per mile in the US are $2.5 (Möller et al., 2019).

Increasing carsharing adoption impacts OEMs' core business. Car manufacturers are at risk of being further separated from end-users and their data, losing bargaining power over the customer interface provider. Changing vehicle requirements, like more robust, interchangeable interiors and stricter focus on vehicle costs, are uncertain (Gerdes, Thornton and Millar, 2019).

2.2.3.4. Electrification

Electrification refers to the shift from ICEs to electric drives (Song and Aaldering, 2019). Lower operating and maintenance costs, quieter operation and environmental benefits are among the motivators for electrification (Borén et al., 2017; Noel et al., 2019). Environmental impact of BEVs depends on production and use, emphasising the relevance of electricity generation. Energy storage, today largely lithium-based, accounts for considerable costs associated with BEVs (Baur and Gan, 2018; Olivetti et al., 2017).

Some governments subsidised a lump sum per BEV in recent years, promoting lower price BEVs proportionally higher (Gu, Liu and Qing, 2017). Differences in subsidies are a main reason for great differences in BEV adoption across geopolitical regions (Wesseling et al., 2015). To further increase BEV adoption, some cities, like Oslo and Madrid (Ajanovic and Haas, 2019), are imposing restrictions on ICE vehicles. Norway is leading in BEV sales, driven by government subsidies. In 2019, 42 per cent of all new vehicles sold in the country were electric (Holter, 2020). In 2017, 1.3 million BEVs were sold worldwide. Forecasts suggest a rise to 3 million by late 2020 (Baltic, Hensley and Salazar, 2019).

Incumbent automakers invest heavily in BEVs. Since 2010, investments of $19 billion in BEVs and charging infrastructure, as well as $14.3 billion in battery technologies, have been disclosed (Möller et al., 2019). Incumbents announced around 300 new BEV models until 2025. Manufacturers of BEVs invest in optimising production and models fully geared to electric propulsion. However, a production cost gap between ICE cars and BEVs of around $8000 for comparable models remains (Baltic, Hensley and Salazar, 2019). Volkswagen introduced the modular electric drive matrix platform to improve its cost structure. The platform serves as a basis for several models – an established ICE car approach (Volkswagen AG, 2019). Looking ahead, developments like decreasing production cost gaps and learning curves in research and development (R&D) and manufacturing may benefit BEV sales, posing challenges for incumbents to adapt business models, organisations and operations.

2.2.3.5. CASE combination

Combining CASE may change the way we think about cars. Future mobility seems to be more interconnected, smarter, and better integrated into users' everyday lives (Grazia Speranza, 2018; Pütz et al., 2019). Developments suggest that the automobile has to regain the status of being "a car for every pursue and purpose" as former General Motors president Alfred Sloan once coined (Dale, 1956, p.46).

CASE combination has implications for car manufacturers. Competitive structures and operating models are breaking up, shifting from hierarchical waterfall-oriented manufacturer-supplier relationships to agile forms of collaborating and competing in ecosystems (Chen, Chowdhury and Donada, 2019; Perkins and Murmann, 2018). Changes impact revenue sources, cost structures, operational efficiency, user experience, innovation, security and sustainability. Future automotive revenue pools may rise to $5.5 trillion in 2025 and $7.7 trillion in 2030. $4.3 trillion (56 per cent) of the latter may stem from CASE (Dhawan et al., 2019).

2.2.4. Scenario Building

Car manufacturers support the CASE sensing exercise by considering scenarios. Scenario building, the concretisation of potential future developments, is a success critical tool for strategic management of companies in risky VUCA environments (Heinonen et al., 2017; Sharif and Irani, 2017).

Considering time and degree of VUCA, three cases for assessing DCs may provide managerial insights relevant to business strategy and operation. Table 2.1 provides a framework for classifying alternative scenarios of future developments. Deciding for a case provides the basis for developing scenarios.

Case no.	Time dimension for assessing DCs	Degree of VUCA
#1	Present DCs in the present context	Lowest
#2	Present DCs in an assumed future context	Medium
#3	Assumed future DCs in an assumed future context	Highest

Table 2.1 Cases for assessing capabilities – time and VUCA dimensions

Present or future DCs may be considered in present or future contexts, involving varying degrees of VUCA. Future scenarios may be extrapolations of developments adjusted for assumed future influences. They provide the management of a firm with potentially valuable insights about future value of present DCs. Future scenarios involve incomplete and imperfect information, containing latitude for interpretation concerning bounded rationality (Amit and Schoemaker, 1993; Kahneman, 2003; Simon, 1962) and subjectivity (Amit and Schoemaker, 1993; Ma, 2016; Schubert, Baier and Rammer, 2018).

Modelling the future involves two steps (Bañuls, Turoff and Hiltz, 2013; Goerlandt, Ståhlberg and Kujala, 2012). First, influences are identified to model future DCs and external development scenarios. Second, the degree of influence or development is estimated over time. Definitions of different scenarios, like best, worst and most likely, may help to illustrate the range and uncertainty of possible developments. Digital tools, like Microsoft Excel or more dedicated modelling software such as Carta, may support this exercise (Ulrich and Smallwood, 2004).

Impact and uncertainty are two axes of a scenario to be considered. In this chapter, impact refers to the effect on firm performance (Flynn, Huo and Zhao, 2010). Environmental uncertainty stems from environmental complexity and variability, reflected in extent, frequency, variety, and change (Damanpour, 1996). Scenarios having high impact and uncertainty require further attention.

The proposed extended framework for assessing DCs of car manufacturers is applied, considering present capabilities in a future context. The reason is that current capabilities are a tangible starting point for analysing DCs and identifying potential future DC gaps. The consideration of future development scenarios is essential, as the future automotive industry will be different from the present in terms of actors, roles and CASE involved (Cohen and Hopkins, 2019; Pütz et al., 2019).

2.3. Methodology

Incumbent car manufacturers are a suitable case to examine the holistic assessment of DCs due to the reasons outlined in section 1.5. To address all three research gaps, a two-phase study was conducted. First, secondary sources, such as media, industry, and annual reports, are being used to initially assess CASE and implications for incumbent car manufacturers in a structured way. Second, semi-structured interviews with automotive managers, and further automotive stakeholders offer in-depth insights into CASE, as well as incumbents' strategies and the underlying rationale. Specifically, interviews allowed to explore CASE strategies and investigate associated DCs assessments. The interviews reflected the recent unprecedented magnitude and pace of change in the automotive industry as well as historical perspectives.

Eighteen semi-structured interviews with industry-wide recognised managers directly involved in incumbent car manufacturers' strategic issues have been conducted. The number of interviews resulted from data saturation. Interviews were conducted between 21 April and 3 June 2020. The interview period, including the impact of the Coronavirus pandemic, was taken into account in the analysis and discussion. As detailed in Table 2.2 below, eight interviewees were senior executives at car manufacturers, five were consultancy partners, three represented research institutions, one was a regulatory authority, and one was a CEO of a tier-1 supplier. Purposive sampling has been used to ensure that the sample includes the most knowledgeable participants, complemented by snowball sampling, where applicable. Interviews lasted between 50 and 90 minutes (65 minutes on average), were conducted by the author, audio or video-recorded and transcribed verbatim to provide reliability (Eisenhardt and Bourgeois, 1988).

No.	Affiliation	Position	Country	Justification
1	University	Professor	England	Automotive research group leader
2	Supplier	CEO	England	Heading one of the largest automotive suppliers
3	Consultancy	Partner	Germany	Automotive expert at leading consultancy
4	Supplier	Project Director	England	Transport decarbonisation lead
5	Consultancy	Partner	Germany	Automotive expert at leading consultancy
6	OEM	Outside Director	Japan	Outside director to the management board
7	Consultancy	Senior Partner	Germany	Automotive expert at leading consultancy
8	Consultancy	Partner and CEO	Germany	Automotive practice head at leading consultancy
9	OEM	Vice President	USA	Information systems lead at leading OEM
10	Research institution	President and CEO	USA	Heading one of the most influential automotive research institutions
11	OEM	President and CEO	Russia	Manager responsible for national operations
12	OEM	CMO	England	Marketing lead at leading OEM
13	OEM	Senior Director	Germany	Digital strategy and analytics leader
14	OEM	Senior Manager	Germany	Head of the group-wide strategic initiatives
15	OEM	Vice President	USA	Corporate planning and strategy leader
16	Consultancy	Director	Germany	Automotive expert at leading consultancy
17	University	Senior Researcher	England	Sustainability researcher at leading universities
18	OEM	CEO	South Africa	Manager responsible for the national operation at one of the largest car manufacturers

Table 2.2 Participants sampling table

Data collection and analysis followed the process detailed in section 1.6.2. Data analysis enabled sensemaking by identifying CASE strategies, the underlying managerial rationale and links to DCs assessments. The findings section 2.4 includes some of the interviewees' statements to explain their CASE strategies and tactics, including links to DCs assessments. Cross-interview comparisons helped to identify patterns in CASE and DCs assessment approaches. The analysis is used to expand on Teece's (2018c) CASE capabilities matrix and to develop a conceptual framework for the holistic assessment of DCs.

Following the completion of the pre-COVID study, as detailed in section 1.6.2, a post-COVID analysis was undertaken to re-evaluate the role of DCs within the automotive industry, considering the disruptions caused by the pandemic. Acknowledging the unprecedented challenges and significant shifts in market dynamics precipitated by the COVID-19 crisis, this study aimed to capture the evolving landscape and its ramifications on the strategies and capabilities of incumbent car manufacturers. Based on the pre-COVID study's foundational insights, the post-COVID analysis was designed to elucidate how the pandemic has redefined the strategic imperatives and competitive dynamics within the automotive sector. Through a systematic review of key themes such as the implications of CASE technologies, a comprehensive assessment of DCs, and an exploration of strategic implications for incumbent car manufacturers, the post-COVID study sought to provide a nuanced understanding of the industry's response to the crisis. Furthermore, it aimed to identify emergent trends and strategic imperatives crucial for firms navigating the post-pandemic landscape and formulate actionable insights for industry stakeholders. The post-COVID interviewee overview is attached in Appendix 6.

2.4. Findings

The following sections sequentially summarises the findings of the pre and post-COVID study.

2.4.1. Pre-COVID findings on dynamic capabilities

The reporting of the pre-COVID findings is structured into four sections. First, OEMs constraints are consolidated and provide context to their CASE strategies and tactics. Second, this chapter extends on Teece's (2018c) framework to assess DCs holistically. Third, the framework is applied to the car manufacturer case. Finally, the DC assessment approach is linked to firm strategy.

2.4.1.1. Sensemaking: incumbent automakers' constraints

Sensemaking is employed to perceive and interpret car manufacturers constraints (Schilke, Hu and Helfat, 2018; Teece, 2018c). Car manufacturers constraints are the organisational context to their strategies and tactics, emphasising why a holistic assessment of DCs is useful. Three themes emerged in the qualitative research: talent pool, corporate culture and investment capital constraints.

A change in talent pool – the sum of all skills within a company (Collings and Mellahi, 2009) – is necessary due to various developments. For example, the drive train shift from ICEs to electric is associated with new skill requirements and lower value-added by OEMs (Hayes et al., 2011). Besides, all interviewees agreed that cars are becoming more digital, requiring car manufacturers to accelerate especially in software development capabilities (Apostu et al., 2019). Interviewee 13 highlighted that "*OEMs are working hard on developing capabilities related to digital services. They cannot give it up and let technology companies take the lead*".

The corporate culture – reflected in beliefs and behaviours (Schmid and Grosche, 2008) – poses challenges. Although interviewee 7 pointed out that "*car manufacturers differ in terms of culture*", all interviewees mentioned elements associated with cultural constraints. Today, the pace and magnitude of changes in automotive business models and operations are more radical than ever before (Cohen and Hopkins, 2019; Rao, 2009). For example, agile approaches are required to deliver digital solutions effectively and efficiently, contrasting established hierarchical waterfall approaches. Interviewee 5 stated that "*Agile has been a game-changer for us. The days of building a massive plan and hoping* *that you made all the right decisions before any customer sees it are gone. You're never going to keep up with the speed of change if you're operating like that.*". Besides, interviewees highlighted that cultural constraints are associated with elements such as "*the ability to partner*", "*mental opening towards mobility*", and "*young talent and management structures*". Interviewees 4 and 11 referred to culture as OEMs most severe constraint.

A third challenge is the capital intensity of operating and competing in advanced CASE markets (Möller et al., 2019). The conventional and long-established car business is characterised by long cycles and high capital intensity (Lejarraga et al., 2016). Developing digital solutions is also resource-intensive (Bösch et al., 2018; Cohen and Hopkins, 2019), challenging automotive incumbents while maintaining their core business. Interviewee 15 identified that currently "*the installed over-capacity and need to invest in areas such as autonomous and electrification is creating a major cash crunch for OEMs*" and "*many new BEV entrants, like StreetScooter, failed because they could not meet the cash requirements*". Other interviewees had similar experiences, pointing out that most new BEV entrants are risk-capital backed and might be able to bet more aggressively on new BEV technologies than incumbents.

2.4.1.2. Extended conceptual framework for assessing automakers' DCs

The constraints outlined above highlight challenges car manufacturers face in terms of DCs and their context. This section introduces a conceptual framework that extends Teece's (2018c) CASE capabilities matrix and enables identifying DC gaps in a holistic way. It supports determining suitable strategies and implementation on the quest for sustained value creation (Achtenhagen, Melin and Naldi, 2013).

The framework for identifying DC gaps is based on two dimensions. First, companies present internal and external conditions are assessed. The external dimension is relevant as it directly affects internal requirements, such as external emission regulations affecting car engine choices and required R&D

and production capabilities (Gu, Liu and Qing, 2017; Harrison and Thiel, 2017). Interviewee 2 suggested that "*car manufacturers appear to be always externally driven, always reactive to something evil that supposedly comes, and try to fend off everything*", although this strong opinion has not been reflected in the other interviews. Second, DCs required in the future to respond to internal and external factors are considered based on a specific future scenario, as detailed earlier in the analytical framework for managing DCs in a VUCA environment. Comparing the two assessed dimensions identifies capability gaps requiring further attention, illustrated in Table 2.3.

		Present	
		Internal	External
	Assessment		
Scenario	Internal	*Gaps*	
	External		

Table 2.3 Conceptual framework for assessing DCs (outline)

The framework can be detailed. A breakdown of analysis units concretises the internal analysis dimension. Technological and non-technological capabilities are being considered (Wheeler, 2002), involving different challenges for firms. Technological capabilities may reflect CASE or specific forms of capabilities, such as innovation, integrative and managerial cognitive capabilities (Helfat and Peteraf, 2015; Helfat and Raubitschek, 2018). Strategic factors, such as business model and market (Teece, 2018a; Wheeler, 2002), are considered and tailored to the specific scenario. Interviewees emphasised the importance of considering both capability types. However, interviewee 11 pointed out that "how important (non-)technological capabilities are depends on the regional market preferences". Besides, external influences require investigation as they directly affect the usefulness of internal capabilities in the respective context. The degree of VUCA may be a helpful indication of the magnitude of external influences. Capability gaps result from relative levels of current and future factors, indicated by arrows in Figure 2.4 below.

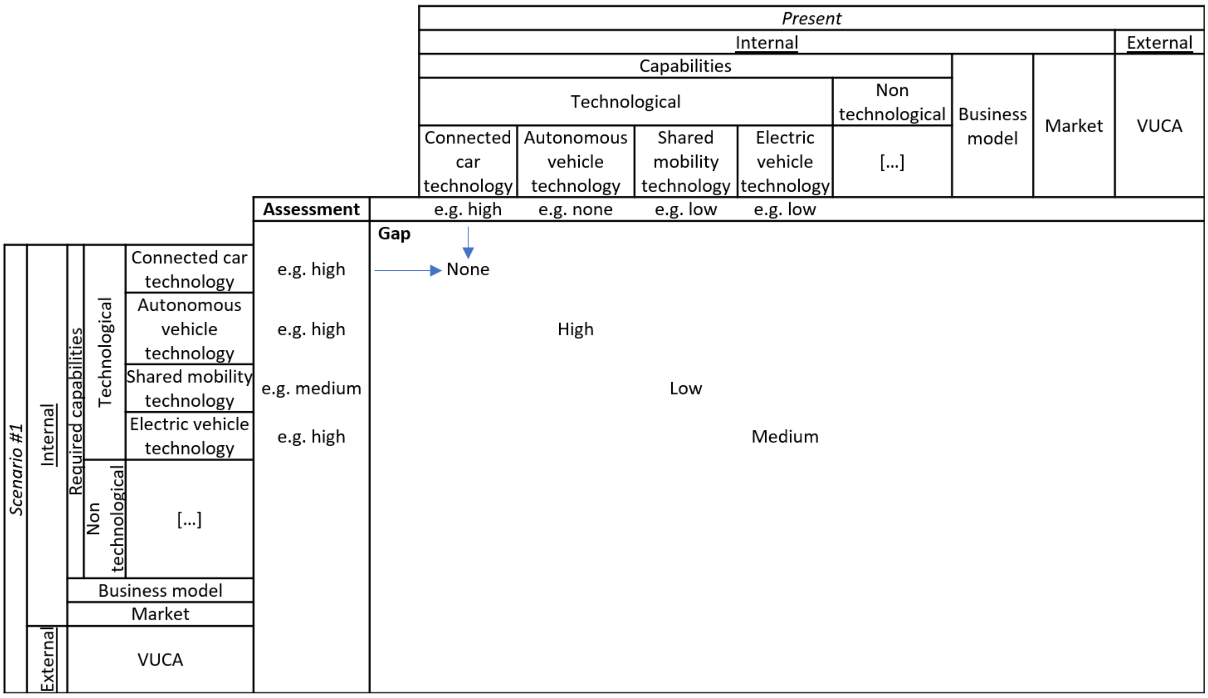

Figure 2.4 Conceptual framework for assessing DCs (detailed)

Three further aspects require consideration to apply the framework. First, transparency and clarity of the assessment process and data need to be provided to ensure retractability and reproducibility (Aguinis and Solarino, 2019). Interviewee 3 emphasised that "*automotive managers have to decide more transparent*", beneficial for the acceptance of strategic decisions within a firm (Wolff et al., 2020). One way to achieving this is introduced later in this chapter. Second, transparency about the "distance" and concretisation or even quantification of the assessments needs to be ensured (Töytäri et al., 2011). Third, the unit of analysis "traditional car manufacturer" requires specification. This chapter considers the 20 largest OEMs in terms of sales, enabling an unambiguous classification based on publicly available data. In 2018, the 20 largest OEMs employed 75 per cent of all employees working at OEMs and produced 88 per cent of cars globally (International Organization of Motor Vehicle Manufacturers, 2018, 2019).

Some companies employ strategic consultants for analysing capabilities. Consultants provide frameworks to resurface information available in organisations. They might help organisations to uncover, what is no longer visible to them. However, interviewee 9 experienced that "*this can conceal information that is only visible from within the organisation and can be revealed through internal communication*". Involvement of employees across hierarchical levels within an organisation may be a success factor for analysing capabilities.

The proposed framework for assessing DCs offers a holistic approach and provides new angles of analysis. First, the time dimension is considered using scenarios, as timing is vital in strategy and implementation. Second, capabilities are broken down into technological and non-technological, sharpening strategic decision making of automakers. Third, the analysis considers external VUCA as they interplay with internal DCs.

2.4.1.3. Application of the framework to incumbent car manufacturers

The framework can be applied to assessing car manufacturers DCs. First, companies define their future scenario, including customer segments to be served and the offer's value proposition. Second, they detail and compare the required with internally available DCs. Finally, companies can close the identified capability gaps either internally or together with partners.

In the first and second step, OEMs need to pay close attention to market developments and competitors. Interviewee 7 pointed out that "*time to market is important, but decisions have to be considered based on previous own and competitors experience*", while interviewee 14 stated that "*Chinese manufacturers are potentially strong future competitors for European and US manufacturers*". Hence, current and potential future competitors require attention. Interviewee 16 emphasised that "*the consideration of competitors is particularly complex due to the wide variety of product ranges and models*" in the automotive industry. Analysing competitors close to OEMs target business and operating model is promising as they require similar DCs.

To close capability gaps, OEMs might benefit from being process-driven. Interviewee 7 highlighted that “*they have job descriptions and competence profiles of their employees*”, enabling them to compare existing and required competencies. If gaps emerge, they can create training opportunities or buy skills externally. While some interviewees focused on in-house capability development, others paid closer attention to external capability gaps closure via, for example, alliances. Interviewee 5 emphasised that “*up and re-skilling works to a certain extent to close capability gaps but is motivated by powerful labour laws in some countries*”, such as Germany.

The conceptual framework for assessing DCs is exemplary applied and tested in the following. One OEM is the unit of analysis. Assessments were made based on realistic assumptions derived from a review of the 20 largest incumbents' annual reports. The future scenario “*In ten years, the car manufacturer analysed will become a leading mobility service provider owning and offering fleets of connected autonomous vehicles.*” is considered.

				Present										
				Internal										External
				Capabilities							Business model	Market	Strategic fit	VUCA
				Technological				Non technological						
				Connected car technology	Autonomous vehicle technology	Shared mobility technology	Electric vehicle technology	System integration	Agility	Leadership				
			Assessment	Medium	None	Low	Medium	High	Low	High	Manufacturing	Dealership	“Carmaker”	Low
			Gap											
Scenario In 10 years the car manufacturer analysed will become a leading mobility service provider owning and offering fleets of connected autonomous vehicles (CAVs).	Internal – Required capabilities – Technological	Connected car technology	Medium	None										
	Internal – Required capabilities – Technological	Autonomous vehicle technology	High		High									
	Internal – Required capabilities – Technological	Shared mobility technology	High			Medium								
	Internal – Required capabilities – Technological	Electric vehicle technology	High				Low							
	Internal – Required capabilities – Non technological	System integration	Medium					(Low)						
	Internal – Required capabilities – Non technological	Agility	High						Medium					
	Internal – Required capabilities – Non technological	Leadership	Medium							(Low)				
	Internal	Business model	Service								High			
	Internal	Market	End customer									Medium		
	Internal	Strategic fit	Mobility service										High	
	External	VUCA	High											Medium

Figure 2.5 Conceptual framework for assessing DCs (applied)

The exemplary application of the framework highlights various capability gaps. In the example, indicated by “(…)”, a surplus of capabilities in system integration and leadership arises (Schulze, MacDuffie and Täube, 2015; Xia, Govindan and Zhu, 2015). The application partly reflects the three constraints of talent pool, corporate culture and investment capital.

Geographic context, including economic and political factors that influence policymaking, has implications for DCs deployed by car manufacturers in different regions. Prior studies discussed what emission regulations imply for car manufacturers BEV strategies and large-scale BEV adoption, finding that the latter still depends on government support in regions across the globe (Pinkse, Bohnsack and Kolk, 2014; Wesseling et al., 2015). However, the governmental framework has broader implications for firms' abilities to adapt to changing environments in certain regions. Although China developed into a technology ecosystem for the automotive industry over recent years, regulation in the country is still more rigid than in the US and Europe. Foreign firms still have to enter collaborations with local Chinese firms to participate in many areas of the local ecosystem, like developments of advanced autonomous driving and vehicle connectivity (Li et al., 2016; Wang, Wijen and Heugens, 2018). In Europe, however, the firm's ability to adapt is more constrained by strong labour laws and rigid permission processes. The Tesla Gigafactory close to Berlin in Germany is one example of a recent and controversial project (Financial Times, 2019a). Geographical context is directly affecting firms DCs and already plays a central role in car manufacturers location decisions today.

2.4.1.4. DCs assessment, firm strategy and organisation design

Capability assessment may provide the foundation for a clear view of a firm's strategy, supporting a target picture's development. Based on cross-interview analysis, the target picture OEMs need to develop may be geared to three layers. The top layer is the strategy layer. It concretises business model elements, such as customer segments, geographical focus, and regulation. The bottom layer is the evolutionary efficiency levers, such as cost reductions, pocket expenses in times of crisis, and workforce capacity management. The middle layer is the "*particularly uncertain layer of the target picture in times of crisis*", according to interviewee 7. It connects the top and bottom layers and addresses organisational issues, including management of R&D and purchasing organisations, production footprint and capacity management. Although change occurs in all layers, it is most dominant in the middle.

Change in the middle layer stems predominantly from mismatching product and organisational architectures. Conway (1968) introduced the idea that a firm designs a system that reflects its communication structure. This observation, later called Conway's law, can be found in today's automotive industry. Interviewee 5 described that "*the 80 to 100 decentralised electronic control units in a car, still widely used today, reflect the organisational structure into 80 to 100 teams*". OEMs are currently moving towards a few centralised in-vehicle electronic control units. Hence, the new product architecture cannot be developed efficiently if it does not fit the organisational structure. The proposed DCs assessment framework may help to uncover inefficiencies by disaggregating today's resources and future requirements.

2.4.2. Post-COVID findings on dynamic capabilities

The post-COVID-19 study revisits the pre-COVID findings and explores what has changed. The transition from ICE to BEV remains a main industry trend that almost all vehicle manufacturers follow. Additionally, three main trends manifested during the COVID pandemic and now challenge manufacturers from a capabilities assessment and gaps closing standpoint. First, China has risen to a leading position in BEV manufacturing and digital experience while growing as a market. Foreign OEMs now have to compete with Chinese OEMs locally and globally. Second, the COVID-19 pandemic highlighted OEMs' supply chain challenges, leading to large-scale supply chain transformation programmes. Finally, as digital experience has become a leading product differentiator, OEMs are being challenged by gaps in hardware-software integration capabilities. The following details change across the areas.

2.4.2.1. Macroeconomic and industry context

The macroeconomic context of the COVID-19 pandemic had implications for the global automotive industry. On the demand side, the slowed economic growth, job losses and increased inflation meant that people cut spending and pushed back vehicle purchases and leases. With the shift to flexible work options, like working from home, people used their vehicles less, and some reduced the number of vehicles per household.

On the supply side, the Russia-Ukraine conflict had global supply chain implications for automotive companies that amplified the microchip supply shortage challenges. For example, wiring looms running around the car are manufactured in Ukraine. The rise in interest rates and lacking dealership stock also present challenges for manufacturers and retailers. Longer-term, interviewees 42 and 51 emphasised that incumbent OEMs somewhat ignored the importance of new BEV entrants, especially from China, before the pandemic and now realise how they are capturing market share. Interviewee 70 summarised: "*I think tier ones are pushing the technology to OEMs, and at the same time, they are trying to deliver these technologies. […] They are trying to understand where the OEMs will go and where they want to go. Because if you take the legislation that is appearing in a few years, that is decided today, it needs to be developed already years before.*" Given the complexity of products and supply chains, manufacturers are still trying to improve resiliency and flexibility in their global responses to recent external disruptions.

2.4.2.2. Managing the electric vehicle transition

2.4.2.2.1. Drivers of battery electric vehicles and market trends

Regulation tasked the automotive industry to bring compelling BEV offerings to market to solve private passengers' transportation needs. Currently, the BEV market grows by about 8 per cent annually, and BEVs are predicted to account for between 40 to 55 per cent of global sales by 2030 (BCG, 2022; Statista, 2022a; The Irish Times, 2023). Major cities introduced bans for ICE vehicles; most governments defined plans to phase out and ban the sales of ICEs (e.g., EU-wide from 2035) while providing purchasing incentives for BEVs (Deloitte, 2020; McKinsey, 2023b). Interviewee 73 confirmed that "*the propulsion systems need to change very fast, coming faster than one would expect. And most of the countries have regulations already in place by a couple of years. The majority of their fleet needs to be, and by fleet, I mean the carparks need to be new car vehicles need to be electric or hydrogen, whatever, hybrid, whatever it could be. But they're moving away from petrol and diesel very fast*". Contrary to previous belief, the industry is not so much at a fork in the road but is presented with various challenges incumbents must address and provide opportunities for new entrants.

2.4.2.2.2. Challenges with current automotive regulation and improvement areas

Given the technological uncertainty involved, some challenged the approach of not incentivising objectives and letting businesses find the right technological solution but determining technological choice from a regulatory standpoint. Interviewees 59 and 75 emphasised that regulation must be long-term and objective-oriented to encourage technological innovation amongst industry players to develop suitable solutions. For example, this would mean not determining drive train solutions while focusing on tailpipe emissions (e.g., US Corporate Average Fuel Economy regulation) but opening the technology solution space and considering product lifecycle sustainability implications. Historically, given legislation periods, regulations have been shorter-term oriented, and businesses had to adapt to changes. Another challenge with BEV purchase incentives was that they disproportionately benefitted wealthy people who could afford BEVs while the poorer part of the population had to buy ICEs.

2.4.2.3. Confusion amongst BEV customers

Potential customers still seem confused about BEVs: when to buy one, which one to get, and what price to pay. Uncertainty is associated with the novelty of the technology, its future stability, and residual value. Customers also need help understanding and comparing product lifecycle costs, including initial purchase and operating costs. They also seem to have confidence and perception issues with charging networks today, while about 80 to 90 per cent of charges happen at home for passenger cars and at depots for trucks (BCG, 2023b; McKinsey, 2022). However, while there might be enough chargers for the 1.5 per cent of BEVs today (IEA, 2023), future charging infrastructure investments are arguably needed to enable increased BEV market penetration[3].

2.4.2.3.1. Organisational and talent gaps

The transition from ICE to BEV also has talent and broader organisational implications for OEMs. OEMs are required to transition ICE engineering and manufacturing to BEV equivalents. Interviewee 50 argued that "*if the companies are not ready for that [electric vehicles], one is that they need to have the technology, they know how to make it right, but the entire value chain in the manufacturers needs to be ready. What do I mean by that? If an engine is not being made anymore, the foundries would be out of business. If the engine is not made anymore, the machine shops that make the engine within the factory and their workers would be redundant. Their skills are not valued anymore if the ICE engines are not being made anymore. […] The parts makers, whether it's independent aftermarket or even the authorised ones, they have way fewer parts to put in the inventory in their warehouses as well. So, the entire supply chain has been impacted, from the manufacturer to the retailers, aftermarket, everyone would be impacted. Are we ready for that? Are we ready to retrain our manpower? Are we already retraining our manpower towards battery electric vehicles?*". The interviewee goes on to explain the talent implications of different servicing models for BEVs and the new talent requirement for advanced connectivity and seamless digital customer experience. Interviewees 56 and 64 point to the reduced parts complexity of BEV compared to ICE vehicles, which has considerable supply chain, manufacturing and talent implications.

[3] Data-driven decision making is needed to determine where charging points exist today and are needed in the future, what types of chargers are needed (e.g., rapid, on-street, etc.), as well as how chargers are being used and how customers would like to use them.

2.4.2.4. China: an automotive window of opportunity

2.4.2.4.1. Competition from and growth of Chinese BEV manufacturers

The Chinese BEV market, heavily supported by the Chinese government, is developing faster than most other BEV markets. The market share of BEVs in China increased from 1 per cent in 2016 to about 26 per cent today, April 2023, with continued strong growth (Statista, 2023a). Chinese OEMs currently have a still growing BEV market share in China of 42 per cent, which is even higher in the lower price segment (ibid.). Scale is the most critical factor in automotive to produce and sell vehicles economically viable.

While some industry incumbents have been conservative (some might say arrogant and sluggish) in investing in BEVs, Chinese companies – vehicle manufacturers, technology companies, and investment firms – have recognised the opportunity and jumped on the BEV bandwagon. Companies like Nio, BYD, and Geely have seemingly come from nowhere, disrupting an industry ruled by a similar set of players over the past century. Three factors have been particularly influential in the rise of these companies. First, they benefit from strong technological and production capability (or proximity) in critical components, such as battery technology and semiconductors. Technical knowledge spillovers are partly a result of mandates posed by the Chinese government to foreign automotive companies to partner with local businesses if they would like to operate in China. Second, there is a strong financial advantage as BEVs are 40 per cent cheaper to produce in China compared to Europe (Lutsey, 2021; White, 2023), where many Western manufacturers produce, and the Chinese government subsidises Chinese car manufacturers, making them more cost competitive. Third, the Chinese firms managed to reduce the time to market significantly, partly by relying more heavily on strategic partners compared to Western manufacturers that tend to try to keep control and more development internally.

Additional, alternative explanations for the success of new entrants in the BEV market, particularly in VUCA environments, include several home country advantages. First, government subsidies played a key role in lowering manufacturing costs and allowing manufacturers to reduce BEV prices. The subsidies incentivised manufacturers to innovate in BEV-related technologies and develop the domestic BEV market. Second, China's large and growing domestic BEV market allows manufacturers to achieve scale economies more quickly compared to smaller markets. The sales volume generates cash that manufacturers can invest into new innovations to further improve their products. Third, local brand advantages play an important role as some Chinese consumers prefer domestic brands. Reasons for this include perceived alignment with local needs, national pride, and competitive prices. Some companies, like Nio, BYD, and Geely, have benefitted from these factors and developed the growing domestic BEV market.

2.4.2.4.2. Main reasons for the strong growth of Chinese BEV brands

Based on statements across the interviews, there are three main reasons for the strong growth of Chinese BEV brands: (1) the brand perception, awareness, and reputation of Chinese brands is positive amongst Chinese customers, (2) the products are compelling in terms of standard features (e.g., advanced driver assistant systems, connectivity and audio), specifications, and efficiency, and (3) customer experience (e.g., in discovery and purchasing). The Chinese OEM's go-to-market approach is different in that they want to own the entire chain and online experience while partnering with some finance partners and dealers across markets. However, their strategy depends on their customer experience approach and financing structure. For example, some offer various models but heavily rely on multiple partnerships in the delivery. The new entrants manage the online-offline integration and understand the customer journey while having creative approaches to testing and learning, which is what these new companies grew up with. The new Chinese BEV entrants are also more technologically open to new solutions compared to traditional OEMs.

2.4.2.4.3. Willingness to switch brands

New Chinese OEMs started introducing compelling products in a historically brand-loyal automotive market. However, with the switch from ICE to EV, customers are no longer as brand loyal. According to recent studies, about 70 per cent of customers are willing to switch brands when transitioning from ICE vehicle to BEV, with potential loyalty increases with the new BEV brand (Latham, 2022; McKinsey, 2023a; McLain, 2022). While some of the Chinese brands might not have the same quality associations compared to some of the traditional automotive brands today, they are improving rapidly. They also started buying (shares in) some of the traditional brands, such as Geely Holding in Volvo and Aston Martin to create synergies with their Geely Automobile offering.

2.4.2.4.4. Foreign OEMs in China: production in China for China

Most incumbent OEMs established a local presence in China to access talent and partners as well as sell vehicles in China. The Chinese government introduced import taxes for foreign companies, forcing OEMs to partner with Chinese firms and establish local businesses. Nissan acknowledged that the competition from China required them to change and that they had to establish a local brand in China for the Chinese market. This new business operates with increased agility and shortened time to market to stay competitive with local firms. Production in China seems challenging for some incumbent OEMs due to the reliance on external partners. Similarly, in a recent interview, Volkswagen's Susanne Lehmann, Executive Director of Logistics, based in Shanghai through the partnership with Shanghai Automotive Industry Corporation Volkswagen, said that their products are directly competing with Chinese brands that are strong in their pace and technological advancement (Financial Times, 2023). She also argued that range anxiety is not an issue in China due to charging infrastructure availability in China but that Chinese cars are designed for a maximum speed of 120 km/h, which could be challenging for European customers.

The window of the ICE to BEV transition opportunity with customers' willingness to move brands seems to be closing fast. It might be critical for automotive incumbents to move quickly, especially in growing BEV markets like China.

2.4.2.5. Supply chain transformation capabilities

2.4.2.5.1. End-to-end sustainability and supply chain transparency

Firms are increasingly held accountable for caring not just about profits but also their people and the planet while acting as a catalyst for sustainability change. Consumers seek alignment with their values in what they purchase, thus requiring OEMs to meet sustainability metrics in circularity from sourcing to recycling. They are being asked to improve their supply chains evidence-based, transparent and holistic. While OEMs have experience understanding ICE supply chains, BEV supply chains are not yet widely understood. Granular, real-time supply chain traceability is critical to understanding social, economic, and environmental sustainability implications while being increasingly demanded by customers and enforced by regulators. Firms like Apple have been providing transparent supply chain information for years. At the same time, the automotive industry seems to lack urgency, i.e., it is technically possible but not being done. Achieving carbon neutrality requires firms to look at their processes end to end and reduce emissions along the value chain, including sourcing, production, distribution, and use. For example, OEMs started paying closer attention to zero-emission materials (e.g., aluminium, which currently accounts for approximately 27 percent of vehicle material emissions) needed for a zero-emission car. Traceability across the value chain (i.e., from mines to the end product) is required to achieve zero emissions (Billy and Müller, 2023; Hydro, 2022). Many automotive companies have set emission targets, and regulations can support the development (e.g., the EU's Carbon Border Adjustment Mechanism). Some suppliers started offering social and environmental impact certifications for their products (e.g., carbon emissions of green aluminium). Certifications seem to be appreciated by investors who look for certainty for secure returns in long-term investments.

2.4.2.5.2. Localisation

Automotive supply chains are moving towards increased localisation, i.e., local suppliers and value creation closer to firms' production. Céline Domecq, Head of Volvo Car EU, said in a recent interview that they "*produce where they sell and source where they produce*", similarly Volkswagen spoke publicly about "*developing in China for China*", referring to hardware but especially software functionality that they adapt to local market needs (Financial Times, 2023). Thereby, firms might prioritise supply chain robustness over labour cost arbitrage. Batteries are critical for the competitiveness of BEVs, while sourcing and managing supply chains is vital to making the 300 currently planned giga factories a success. Governmental subsidies seem to play a critical role in the location of battery production sites. Localisation is supported by recent legislation (e.g., the US Inflation Reduction Act and similar protectionism). In the US and Canada, the Inflation Reduction Act has led to a considerable increase in local battery production investments to mitigate the reliance on other countries. Localisation is challenging for some markets as key technologies are heavily scale-dependent (e.g., UK battery production). The slow five to seven years legislation process in the EU reduces the EU's competitiveness, while it is essential to create a level playing with foreign competitors, e.g., China. McLaren analysed the UK local value content and found that it would decrease from 75 per cent to 35 per cent if they transitioned from hybrid to BEV (Financial Times, 2023).

2.4.2.5.3. Supply chain shocks and robustness

Supply chain visibility is required to improve supply chain robustness, which is arguably needed in severe supply chain disruptions (e.g., due to the COVID-19 pandemic). Based on the interviews, the supply chains are stress-tested with three types of shocks: (1) supply shocks (e.g., greater demand for BEVs), (2) demand shocks (e.g., responsible mining requirements), and (3) strategic shocks (e.g., China and the US competing for access to materials). De-risking supply chains by introducing redundancies for all parts is important to avoid relying on a single source for materials and components, which also helps with being more resilient regarding geopolitical challenges. OEMs try to reduce product offering complexity, which leads to complexity in their supply chains today.

2.4.2.5.4. Supply chain partnerships

While automotive OEMs cannot vertically integrate into all aspects of their supply chains, they can enter longer-term, strategic partnerships, e.g., with mines, to secure necessary materials long-term. These partnerships must be built on a shared understanding of and commitment to sustainability standards. Automotive OEMs can also help partners make their operations safer, e.g., the automotive industry is a leader in safe operations that could help make mining safer. OEMs source materials at the lowest price and look at other characteristics partners can provide, such as availability, features, and sustainability. For example, Volkswagen announced that they aim to recycle 97 per cent of their batteries in a closed-loop approach for battery cells and modules with their partners (Volkswagen UK, 2023). However, cost reductions for BEVs are still a strong focus. For example, Nissan announced that they aim to reduce BEV powertrain costs with their partner Bosch by 30 per cent by 2026 while minimising size, weight, noise, and vibration (Nissan, 2023a).

Interviewee 36 explained that "*it gets down to where they [OEMs] want to play. I will say there's a core capability gap in the supply chain that's been exposed in the last few years. OEMs have really very little transparency in what goes into their vehicle past the tier-one stage. As you get down to tier two, tier three, they just don't have good transparency and that lack of transparency created real issues […] that's an area, and I think in an environment where we're seeing new technologies entering into the vehicle with the emphasis on tech, with the emphasis on battery and battery materials, understanding where the chips are coming from, understanding who not just the foundry is, but the assembler, understanding the materials, which mines are sourced […] all that needs to be known and it's knowable.*" Interviewees 52 and 67 added that OEMs need to improve their supply chain management to understand potential areas of single-source risk and take practice steps to mitigate them. The risks interviewees covered include new technology, new materials, and increasingly geopolitical risk, e.g., Russia-Ukraine as a source of nickel and China-Taiwan as suppliers of semiconductors. As major dependencies exist for OEMs, improving supply chain capability is critical.

2.4.2.6. Hardware-software integration capabilities

As manufacturers move to more tech-centric and data-driven vehicles, incumbents assess how far they integrate technology internally. For example, Tesla is designing their own microchips. Other OEMs do not have this internal capability and are more limited in responding to external chip shortages. Similarly, on the customer experience side, most manufacturers offer Apple CarPlay, while General Motors announced to develop a bespoke solution in-house. Across these and similar technological areas, OEMs are defining their focus that drives the capabilities they are investing in.

Incumbent OEMs come from a cultural context where they define specifications towards suppliers and lead overall product development. While this approach was established over decades for vehicle hardware, OEMs have to be more agile in a software-defined vehicle while integrating into the existing hardware governance structures. The synchronisation of traditional hardware and more agile software development is one of the main challenges for OEMs today. Interviewee 61 summarised that "*my experience with many of the Silicon Valley software folks is that there is a neglect of the robustness of hardware because you cannot drive software, but there still needs to be a very robust hardware platform upon which an BEV or connected vehicle or an autonomous vehicle can perform to customer expectations. I kind of scratched my head a little bit, and talking with some Silicon Valley software folks working in automotive that the feeling is, well, we can just reflash this flash over there, and everything is going to be okay. You might be able to solve some software problems, but you are not going to be able to solve every problem.*"

OEMs are trying to close capability gaps by establishing a culture and hiring talent more aligned with modern mobility services and connectivity offerings. Additionally, they are establishing technology partnerships to leverage external solutions. Interviewee 39 argued that "*my view has always been, regardless of the company I work for, that if you are not the best at it, or maybe the second best, you better find someone else and have them do it for you. [...] there is some tremendous knowledge, background and capability outside that if you forged the right confidentiality agreements, mutual* *agreements, that you can move a lot faster and a lot further forward than doing it on your own*". Overall, interviewees emphasised that the talent management within OEMs also changed in that they no longer hire employees for life without major further development, but continuous learning and updating of skills has become core to their survival.

Main technology skill gaps that have been highlighted across the interviews include digital product management (e.g., infotainment system development and integration), electric vehicle integration to bring BEVs to the market quicker, and digital marketing capabilities (e.g., IT customer relationship management systems, customer data platforms, and advanced analytic engines).

Traditional OEMs are still facing the challenge of becoming more like software companies with the change in business models, moving from being a manufacturer of vehicles and selling them through dealers to becoming more like a service provider. This transition includes the widespread use of agile methodologies and a separate division focused on developing software products. Interviewees emphasised that advanced software development, e.g., transformative customer experiences, generally works best when it is culturally separated from the traditional automotive organisation.

Interviewees also compared incumbent OEMs to new entrants like Tesla, arguing that incumbents must rethink their approach to hardware and software integration and releases. Interviewee 57 summarised that "*Tesla does that very well […] Tesla focuses on the software and consistently develops the software further. And the established OEMs prefer to bring a new generation of vehicles. I think the truth probably lies somewhere in the middle.*" Interviewee 76 added that many of the senior leaders at incumbents grew up with vehicle hardware-centric development processes and found it challenging to change. There was agreement that long-running vehicle programmes remain while a hybrid model that integrates software reliably needs to be developed.

Interviewees 44 and 65 emphasised that the decoupling of hardware and software is important for incumbents that, compared to new entrants, work with legacy IT, e.g., outdated software architecture and electronic control units. The legacy IT is often reflective of long product lead times. Thus, decoupling hardware and software development could allow OEMs to develop talent and design processes internally while outsourcing to or co-developing with suppliers. With this new model, OEMs will have to give some power to suppliers to build and iterate faster while internally setting hardware and software standards. A co-development model is also important to meet customer experience expectations, e.g., Google and Apple integration and increasingly higher levels of personalisation.

Overall, the post-COVID-19 analysis confirmed the importance of timing, (non-)technical capabilities, and external VUCA in the capability assessment. The interviews provided more detailed insights into how important the assessment of capabilities is in responding successfully to external change, especially competitors' actions in the automotive industry. The timing of strategic responses seems to be the main success-determining factor highlighted across interviews. Specifically, the data highlighted four current core challenges that require a nuanced assessment of capabilities and demonstration of dynamic capabilities, i.e., sensing, seizing, and transforming. These challenges are (1) the organisational transformation from ICE to BEV, where the education of the customer about new offer attributes is critical, (2) tapping into China as a rapidly developing market for electric vehicles and competing with Chinese BEV OEMs that are beginning to enter markets globally, (3) developing supply chain transformation capabilities to improve responsiveness to global supply constraints, and (4) improve the integration of hardware and software as vehicle differentiation relies more on digital customer experience while competition enforces shorter development cycles.

2.5. Discussion

Within the intricate tapestry of the post-COVID-19 automotive industry, capability assessment emerges as a pivotal lens through which organisations navigate an evolving landscape (Kaviani et al., 2020). This lens enables companies to strategically evaluate and enhance their competencies, ensuring adaptability and resilience in the face of unprecedented challenges and opportunities within the transformed automotive sector. This discussion explores key themes within this dynamic context, unveiling insights into how capabilities are strategically recalibrated across the key themes, illustrated per row in Table 2.4.

New post pandemic trend	Underlying reasons	General learning
Chinese BEV OEMs internationalising and gaining market share	Shift towards BEV Improvements of Chinese BEV (policy, time-to-market, local partners)	Increased global competition that allows businesses providing sources of differentiation to have a competitive advantage
Global supply chain crisis response programmes	Crisis supply chain disruptions (e.g., COVID-19, Russia-Ukraine war, Taiwan conflict)	Transparency and robustness (e.g., redundancies) in global supply chains can be a competitive advantage
Hardware – Software integration capabilities become key differentiator	Digital customer experience becomes a key product differentiator OEMs must reduce time-to-market due to increased competition (e.g., from China)	Technology timing and delivery speed relative to competition can be a competitive advantage

Table 2.4 Post-COVID-19 capability assessment discussion themes

The key themes shed light on the nuanced dimensions of capability assessment within the changing dynamics of the automotive industry, from heightened global competition and crisis response in supply chains to the critical role of hardware-software integration (Choi et al., 2023; Fredriksson et al., 2018; Wenzel, Stanske and Lieberman, 2021). Each key theme will be discussed hereafter.

2.5.1. Providing sources of competitive advantages as growth accelerator

As the automotive industry grapples with the transformative aftermath of the COVID-19 pandemic, this research endeavours to unravel the complex interplay of capabilities, global competition, and crisis-induced constraints. Within this multifaceted exploration, a focus lies on the heightened competition emanating from Asia, especially China (Lin and Wu, 2021; White, 2023). This study extends and deepens our understanding of the intricate relationships between capabilities (Eisenhardt and Martin, 2000; Teece, 2007; Teece, Pisano and Shuen, 1997), global dynamics (Cowling et al., 2015; Perkins and Murmann, 2018), and crisis-induced shifts (Amaral et al., 2023; Wenzel, Stanske and Lieberman, 2021; Zia et al., 2023).

The evolving landscape of competition in the automotive sector has been a subject of scholarly scrutiny, with studies such as those by Fredriksson et al. (2018) and Macduffie (2018) delving into the changing contours of competition, particularly emphasising technological dimensions. Tasheva and Nielsen (2022) find that the (re)configuration of global assets positively influences subsequent firm performance, which might apply to automotive as one of the largest and most globally interconnected industries. Bonaglia et al. (2007, p. 369) argue that "the success of these firms seems to lie in their ability to treat global competition as an opportunity to build capabilities, move into more profitable industry segments, and adopt strategies that turn latecomer status into a source of competitive advantage. At the same time, their experiences show many strategies and trajectories for going global, consistent with a pluralistic conceptualization of globalization". The following discussion builds upon this foundation, synthesising insights from diverse strands of literature, such as strategic management (Teece, 2007; Teece, Pisano and Shuen, 1997), international business (Schubert, Baier and Rammer, 2018; van Tulder, Jankowska and Verbeke, 2019), and innovation studies (Bohnsack et al., 2020; Smink, Hekkert and Negro, 2013), to provide a framework for understanding the post-COVID-19 industrial milieu.

The first key theme unravels the heightened global competition, with a focus on Asia, where China emerges as a central player. The propulsion factor behind this shift is the pervasive adoption of BEVs, representing a transformative force shaping the industry's future (Bohnsack and Pinkse, 2017; Wesseling et al., 2015).

The analysis scrutinises the trajectory of Chinese BEV advancements, acknowledging the confluence of factors such as strategic policy formulations (e.g., purchasing incentives and market entry requirements), time-to-market efficiencies (i.e., shortened development and go-to-market), and collaborative alliances with local partners (e.g., joint ventures between foreign and local manufacturers; Elshkaki, 2020; Teece, 2019). Porter (1998, p. 77) argues that "competitive advantage lies increasingly in local things--knowledge, relationships, and motivation--that distant rivals cannot replicate". These elements collectively contribute to the competitive edge Chinese automotive companies enjoy, fostering an environment where they outpace global counterparts in the race towards innovation and market penetration. The observation aligns with Woodruff (1997), who argues that customer value learning is a key skill managers need to leverage to implement superior customer value strategies.

The COVID-19 crisis functioned as a catalyst for increased global competition. It propeled companies endowed with sources of competitive advantage, notably key BEV technologies, into a trajectory of accelerated growth. This finding aligns with resource-based views Barney (1991) and dynamic capabilities theories Teece (2007), underlining the pivotal role of unique internal resources and adaptive capacities in navigating post-crisis scenarios.

This study explicates how heightened global competition catalyses companies wielding distinctive competitive advantages. The observation underpins the critical role of crisis-induced limitations on global sourcing. It underscores how these limitations amplify the significance of internal capabilities, particularly in key technologies. By synthesising diverse theoretical perspectives, including resource-based views, dynamic capabilities theories, and crisis management frameworks, the analysis adds to a nuanced understanding of how capabilities, when strategically harnessed, act as linchpins for accelerated recovery and growth in a post-pandemic landscape.

2.5.2. Supply chain transparency and robustness as a competitive advantage

In the post-COVID-19 landscape, the automotive industry confronts a paradigm shift shaped by global supply chain disruptions (Choi et al., 2023; Ivanov and Dolgui, 2020). The following delves into the crisis response programs, dissecting the factors driving their initiation. With a focal point on the imperative nature of response strategies amid crisis-induced supply chain upheavals, this study offers insights illuminating the necessity for transparency and robustness in global supply chains.

The global supply chain crisis response programs examined in this study resonate with ongoing discourse surrounding supply chain resilience, disruptions, and crisis management (e.g., Ivanov, 2020; Poberschnigg, Pimenta and Hilletofth, 2020; Sawyerr and Harrison, 2023). These programs address constraints on OEMs, ranging from limited production capacities to outright halting operations in entire plants. Managers must implement supply chain innovations to continuously improve market performance (Baig, Ahmed and Najmi, 2022). The findings advance this conversation, shedding light on how the post-COVID-19 scenario, compounded by geopolitical events (e.g., Russia-Ukraine, Taiwan), has compelled the automotive industry to reassess and fortify its supply chain strategies.

Transparency and robustness within global supply chains constitute pivotal elements for effective crisis response (Adhi Santharm and Ramanathan, 2022; Ivanov, 2020). Transparent and robust supply chain structures with built-in redundancies can confer a competitive advantage as they allow companies to adapt more quickly than competitors without these capabilities to disruptions, such as crises or geopolitical tensions (Sawyerr and Harrison, 2023).

The observation aligns with Said et al. (2024, p. 399) in that "supply networks must become more efficient, secure, and dependable […] technology enables traceability, digitalization, disintermediation of the supply chain, and enhanced data privacy". Hu et al. (2023) found that the "COVID-19 pandemic has exacerbated weaknesses in the vaccine supply chain while presenting opportunities to apply digital technologies to manage it". Similar happened in the automotive industry, where the single sourcing of critical components (e.g., semiconductors) led to major global disruptions (Chang and Matsumoto, 2022).

The observations highlight the possible competitive advantage of transparency and robustness in global supply chains. The contention is that companies equipped with a clear view of their supply chains and fortified by redundancy mechanisms can navigate disruptions more efficiently. This trend aligns with contemporary discussions on supply chain resilience (Chopra, Sodhi and Lücker, 2021) and emphasises the strategic significance of proactive crisis response planning in the automotive context.

2.5.3. Criticality and rise of hardware-software integration capabilities

The third thematic focus centres on the pivotal role of hardware-software integration capabilities. This study scrutinises how integrating hardware and software becomes a linchpin for OEMs seeking to distinguish themselves in a milieu where the digital customer experience takes centre stage. The observations highlight the decoupling of physical and digital development cycles as a critical enabler for enhanced time-to-market and advanced customer experiences, offering a distinctive competitive advantage.

Integrating hardware and software within the automotive sector resonates with broader discussions on Industry 4.0, digital transformation, and the evolving nature of customer experiences (e.g., Kafetzopoulos and Katou, 2023; Llopis-Albert et al., 2021). This analysis bridges these strands, exploring how this integration emerges as a differentiator in the post-COVID-19 automotive landscape, where OEMs grapple with heightened competition, particularly from China.

Ethiraj et al. (2005, p.25) emphasised the importance of “deliberate and persistent investments in infrastructure and systems to improve the firm's software development process”, which has been confirmed by this study’s interviewees in the automotive context. Ojha et al. (2021, p. 1627) extended previous studies “in the manufacturing (product) context that suggests the importance of sequential congruence between two critical dynamic capabilities – innovation speed and operational flexibility – necessary to deliver competitive advantage”. This study confirmed the necessity to innovate (e.g., new services) and maintain operational flexibility (e.g., ways of working) in response to the COVID-19 pandemic.

This study found that decoupling physical and digital development cycles was crucial for successful crisis response. Businesses, especially OEMs, can enhance technology timing and delivery speed by uncoupling these cycles. This, in turn, facilitates improved time to market and cultivates advanced customer experiences, thereby establishing a potential competitive advantage. Decoupling physical and digital development cycles is a pragmatic manoeuvre and a strategic enabler. The observation aligns with discussions on agile methodologies, highlighting the critical role of flexibility and adaptability in navigating the swiftly changing automotive landscape.

2.5.4. Discussion summary

This research delves into the post-COVID-19 landscape of the automotive industry, exploring three capability assessment themes: (1) increased global competition from Asia, (2) global supply chain crisis response programs, and (3) hardware-software integration capabilities for OEMs. The observations illuminate the nuanced dynamics of heightened competition, effective crisis response strategies, and the strategic role of hardware-software integration in navigating the evolving industry landscape.

In the context of increased global competition (Theme 1), the study posits that the heightened global competition, accentuated by the COVID-19 crisis, catalyses companies endowed with competitive advantages, particularly in key BEV technologies. This proposition aligns with resource-based views (Barney, 1991) and dynamic capabilities theories (Teece, Pisano and Shuen, 1997), emphasising the strategic significance of unique internal resources and adaptability in the post-crisis recovery phase, grounded in the observation of the automotive industry in the COVID-19 context.

Moving to global supply chain crisis response programs (Theme 2), the research establishes that transparency and robustness within global supply chains are critical for effective crisis response (Hohenstein, 2022; Kumar Singh and Modgil, 2020). The observation suggests that these attributes can confer a competitive advantage, enabling companies, especially OEMs, to respond more adeptly to disruptions than their competitors. This argument extends the discourse on supply chain resilience, highlighting the strategic importance of proactive crisis response planning.

In exploring hardware-software integration capabilities (Theme 3), the study introduces the notion that decoupling physical and digital development cycles is a key enabler for improved time to market and advanced customer experiences (Collin et al., 2019). This strategic lever provides businesses, particularly OEMs, with a competitive edge. Aligned with discussions on Industry 4.0 and digital transformation (Culot et al., 2020; Warner and Wäger, 2019), this observation emphasises the critical role of flexibility, adaptability, and synchronisation of technology development.

These trends collectively advance our understanding of post-COVID-19 automotive industry dynamics. The study offers insights into leveraging distinctive resources, adaptability, transparency, and strategic synchronisation for competitive advantage. The findings add to the scholarly discourse on navigating challenges and seizing opportunities in an era of rapid technological advancements, global competition, and supply chain uncertainties.

2.6. Conclusion

The comparison between pre- and post-COVID findings provides insights into strategic management within the automotive industry, particularly concerning DCs in times of crisis. These insights highlight both similarities and differences between the two periods. The pre- and post-COVID findings on dynamic capabilities were similar in three ways.

First, in both pre- and post-COVID analyses, there is a shared emphasis on the significance of understanding DCs amidst industry transitions. This emphasis underscores the importance of factors such as temporal considerations, technological diversification, and the intricate interplay between internal capabilities and external VUCA factors. Such continuity suggests that DCs remain a pivotal aspect of firms' strategic responses to dynamic environments.

Second, there is a mutual recognition of the importance of resilient supply chains and proactive crisis response planning. Both periods highlight the necessity for robust and transparent supply chains to navigate disruptions effectively. This shared emphasis underscores the strategic imperative for firms to anticipate and mitigate risks amidst dynamic market conditions.

Third, pre- and post-COVID analyses converge on the significance of hardware-software integration capabilities in enhancing operational efficiency and customer experiences. They acknowledge the transformative potential of such integration in driving competitiveness and adapting to Industry 4.0 dynamics.

Notwithstanding these similarities, there are two notable differences between pre- and post-COVID analyses. Firstly, pre-COVID analyses primarily delve into the adoption of CASE technologies and extend Teece's (2018c) CASE capabilities framework, emphasising DCs' role in shaping firms' strategies and responses to industry shifts. In contrast, post-COVID analyses pivot towards a heightened awareness of global competition, particularly from Asia, and the implications of the pandemic on supply chain resilience. This extends discussions on supply chain resilience, emphasising the strategic imperative of proactive crisis response planning. They also delve deeper into the criticality of internal resources, particularly in key BEV technologies, aligning with resource-based views and dynamic capabilities theories.

Secondly, while both periods underscore the importance of strategic alignment with technological advancements and global competition, post-COVID findings accentuate the necessity for firms to adapt rapidly to changing environments. They delve into the strategic dynamics within the automotive sector, emphasising the imperative for agility amidst uncertainty.

These findings contribute to a more nuanced understanding of firm performance variations and the underlying dynamics shaping competitive advantage in dynamic environments. To further enrich the conceptual model of DCs, we need to acknowledge the evolving nature of global competition, technological development, and COVID-19 crisis induced disruption, requiring the extension of the DCs framework. This chapter's findings suggest that the core sensing, seizing, and reconfiguring components of DCs remain vital, while we need to account for the increased industry change and disruption caused by the pandemic. These developments suggest an expanded DCs concept that incorporates external factors such as global supply chain resilience and internal factors like agility in scaling new technologies. The automotive industry is an example where technological disruption plays a decisive role. The subsequent Chapters 3 and 4 will offer more nuanced DCs perspectives, reflecting how businesses respond to external disruptions while proactively capturing value from emerging technologies, collaborative partnerships, and leveraging adaptive internal processes. By linking findings to the existing literature on DCs, this chapter informs strategic decision-making and enhances firms' resilience. It underscores the need for ongoing research on DCs assessment approaches to navigate the complexities of rapid technological advancements, global competition, and uncertainty.

3. The case of sales in the automotive industry during the COVID-19 pandemic

3.1. Introduction

A key theme of this chapter is agile ways of working as a strategy tool, as summarised in Table 1.1. The recent COVID-19 crisis fundamentally changed the way car manufacturers operate. Although the automotive industry experienced disruption in CASE (Connectivity, Autonomy, Sharing, Electrification) over recent years, the implications of today's COVID-19 crisis for incumbent car manufacturers are unprecedented (Choi, 2020; Genzlinger, Zejnilovic and Bustinza, 2020; Ivanov, 2020; Venter et al., 2020; Wang and Wells, 2020). The unprecedented nature of this industry transformation is reflected in new ways of collaborating (in many business areas remote), change in risk tolerance (higher risk-taking by managers), increased time spent on strategic as opposed to operational challenges by top-management-teams (TMTs), and increased use of agile ways of working throughout the organisation as a strategy and implementation tool (Ivanov, 2020; Kano and Oh, 2020; Shepherd, 2020; Wang and Wells, 2020). This chapter focuses on the latter.

While there are various definitions and conceptualisations of agile ways of working, this chapter refers to approaches that reflect the three principles of agile: (1) "An obsession with continuously adding more value for customers", (2) "small teams working on small tasks in short iterative work cycles", and (3) "coordinating work in a fluid, interactive network" (Denning, 2018a, p.10). Agile ways of working aim at providing a result that better fits the customers' needs faster, thereby improving business effectiveness and efficiency (Ghezzi and Cavallo, 2020; Gomes, Sousa and Vendrell-Herrero, 2020; Roberts and Grover, 2012). Agile approaches can be found across organisational hierarchies and functions (Ivory and Brooks, 2018).

Recently, Koçak, Levinthal and Puranam (2023) highlighted the vital role agile ways of working play in understanding DCs. Agile ways of working consider adaptability and continuous value creation, which align with DC's sensing, seizing, and reconfiguring. Koçak, Levinthal and Puranam (2023) argue that agile ways of working can enhance businesses' three core DCs, especially in VUCA environments where responsiveness is of critical importance. Agile ways of working allow teams and executives to iterate quicker, decentralise decision-making, and foster collaboration between teams, thereby enhancing the capacity to respond to external shocks, like the COVID-19 crisis. Maintaining agility is crucial in times of VUCA and more extreme disruption to survive and continue innovating. Hence, agile ways of working go beyond operational efficiency improvements but are a strategic enabler in fast-paced environments like the automotive industry.

Agile ways of working were initially used in software development and are increasingly being employed in other business areas (Annosi, Foss and Martini, 2020). Beyond the established literature on agile in software development (Annosi, Foss and Martini, 2020; Ramesh, Mohan and Cao, 2012; Uludag et al., 2019), prior studies investigated how the concept of agile can be used in digital transformation (Al-Ali and Phaal, 2019; Ghezzi and Cavallo, 2020; Li et al., 2021; Moi and Cabiddu, 2020; Sjödin et al., 2020), international business (Shams et al., 2020), human resource management (Denning, 2018b; Xing et al., 2020), research and development (Pearson et al., 2020), and operations management, especially in the production and supply chain management context (Srinivasan, Srivastava and Iyer, 2020; Tavani, Sharifi and Ismail, 2014).

Although some publications addressed agile ways of working as a strategy tool, they lack empirical underpinning and do not cover firms experiencing unprecedented industry transformation. This chapter refers to the term strategy tool as a means of identifying and exploring market opportunities (Rengarajan, Moser and Narayanamurthy, 2021). Prior papers referring to agile approaches as a strategy tool are conceptual (Denning, 2018a; Holbeche, 2019; Ivory and Brooks, 2018; Srinivasan, Srivastava and Iyer, 2020; Thrassou, Vrontis and Bresciani, 2018), provide some examples but lack the depths a single case study can offer and do not explain how firms implemented agile in the strategy context (Annosi, Foss and Martini, 2020; Denning, 2017a, 2017b, 2019; Doz and Kosonen, 2010). Others focus on niche aspects of agility in the strategy context, like cultural barriers that constrain managers' agile decision-making (Hodgkinson, Ravishankar and Fischer, 2017) or evaluation of innovative ideas (Dziallas, 2020).

Beyond, scholars introduce terminologies and theorise about "organisational agility" (Walter, 2020) and "strategic agility" (Denning, 2017a; Doz and Kosonen, 2010; Xing et al., 2020), or more exotic terms, like "international marketing agility" (Gomes, Sousa and Vendrell-Herrero, 2020) and "strategic marketing multicultural agility pendulum" (Thrassou, Vrontis and Bresciani, 2018). Neither surprising nor novel, some papers suggest a positive correlation of adaptability and business performance (Ivory and Brooks, 2018; Srinivasan, Srivastava and Iyer, 2020) – the core argument of the dynamic capabilities literature (Teece, 2020; Teece, Pisano and Shuen, 1997).

How firms implement agile approaches as a strategy tool in the face of unprecedented industry transformation remains unexplored. As detailed earlier, this chapter does not refer to unprecedented industry transformation as upgrading of products, but to fundamentally changing ways of doing business (Pearson et al., 2020). It is important to investigate this issue as adaptability is at the core of agile (Conboy, 2009; Holweg, 2005). It is pressing to examine this issue now as agility is arguably more important for businesses' survival than ever given the unprecedented pace and magnitude of change (Buzzao and Rizzi, 2020; Kaviani et al., 2020; Teece, 2020). The current external dynamic provides an unparalleled opportunity to explore the concept of agile in the strategy context further.

This chapter explores how agile methods can be used as a strategy tool to manage incumbents through times of unprecedented industry transformation. Thereby, it goes beyond conceptualisations and prior attempts to improve empirical evidence of how firms use agile to explore and exploit market opportunities. The research question "How can agile ways of working be used as a strategy tool to respond to unprecedented industry transformation?" guides the pre-COVID research.

The research objectives guiding this study aim to provide a rich, in-depth narrative of how agile methods have been implemented at a particular car manufacturer, and to derive guiding management principles for the sustainable application of these methods. These objectives are motivated by the need to understand the mechanisms through which agile practices enable firms to navigate unprecedented industry transformations. Specifically, this study seeks to identify the challenges firms face when adopting agile approaches in the automotive industry, as well as the key success factors that contribute to effective implementation. It aims to uncover insights regarding how agile ways of working have been used to both explore new market opportunities and exploit existing capabilities, while also investigating the barriers encountered and strategies employed to overcome them. Overall, this study aims to provide a more empirical understanding of agile as a strategy tool, linking theoretical concepts to real-world practices in a rapidly evolving market environment.

This chapter uses the case of sales in the automotive industry during the COVID-19 crisis. The case is particularly well suited to study agile ways of working as a strategy tool since it is an established industry in terms of operations that did not experience disruption to the degree of the recent COVID-19 crisis before (Venter et al., 2020; Wang and Wells, 2020). The business area of sales is appropriate since it is most affected by the COVID-19 pandemic, received utmost management attention and required fundamental transformation (Gersdorf et al., 2020; Hausler et al., 2020). Specifically, the pre-COVID study draws on 18 interviews with managers at a premium manufacturer based in Asia, providing in-depth insights into the management of the COVID-19 crisis, focusing on but looking beyond sales. The post-COVID study revisits and complements the insights as detailed in section 1.6.2 and follows the consistent interviewee numbering style across the main chapters.

This study contributes twofold. Theoretically, this chapter contributes to our understanding of incumbents' adoption to unprecedented industry transformation by providing a rich narrative that details how a car manufacturer implemented agile ways of working as a strategy tool. It specifies the organisational design, leadership structures, goal setting, TMT time allocation, and the iterative strategy approach. Although earlier studies emphasised specific roles and agile management processes, this study finds that these frameworks are somewhat less important. Specifically, the case study highlights that it is crucial to focus on six fundamental principles. Empirically, the study contributes to our knowledge of car manufacturers' responses to the recent COVID-19 crisis, focusing on but not limited sales. Thereby, it might support business leaders in better understanding the implications of the crisis for their business and inspire approaches to responding to it. Besides, regulators might benefit from the study as it indicates how the regulatory framework might benefit from adaptation.

Following the pre-COVID exploration, the research proceeds with a post-COVID study, which revisits key questions and themes to examine the evolving landscape of agile working in the automotive industry. This post-COVID investigation captures shifts in strategies, practices, and organisational responses in light of the pandemic's ongoing impact. By comparing and contrasting findings from both phases of the study, this research offers a comprehensive understanding of the dynamic nature of agile methodologies as strategic tools in times of industry upheaval.

The post-COVID study delves into emerging trends and adaptations in agile approaches, shedding light on how car manufacturers have adjusted their strategies and operations in response to the unprecedented challenges brought about by the COVID-19 crisis. Through a nuanced analysis of post-pandemic developments, this research provides insights into the evolving role of agile methodologies in addressing contemporary business challenges within the automotive industry.

By encompassing both pre- and post-COVID perspectives, this research contributes to a deeper understanding of the strategic implications of agile methodologies in a rapidly changing business environment. It highlights the importance of agility and adaptability in navigating industry disruptions and offers insights for scholars and practitioners alike. Through its dual approach, this study offers a holistic examination of agile methodologies as strategic tools, providing perspectives for understanding and responding to industry transformations.

The remainder of this study is organised as follows. In section 3.2, the theoretical background and context of this study are provided. Section 3.3 details the methodology, specifying the research design, automotive case and interviews. Following this, section 3.4 presents the findings from both the pre-COVID and post-COVID studies. Subsequently, section 3.5 discusses the observed changes in the literature context. Finally, section 3.6 covers the conclusion, summarising the contributions of the study and providing an outlook on potential avenues for future research.

3.2. Literature review

Agility refers to the ability to adapt to dynamically changing environments (Conboy, 2009). Working in an agile way implies learning from recent experiences while applying knowledge acquired previously to deliver results that best meet customer needs, given time and budget constraints (Denning, 2018b). Hence, volatility, flexibility, learning, and adaption are characteristic of agile approaches (Shams et al., 2020). This section reviews the emergence and key characteristics of agile to lay the foundation for better understanding the concept in the strategy context, covering agile in software development and business research.

3.2.1. Agile in software development

Agile found first widespread adoption in software development. Agile development refers to a range of agility-facilitating practices for improving software development. They are characterised by customer-centricity (i.e. focusing actions on adding value to customers), continuous delivery and improvement, and collaboration within and across teams (Sambamurthy, Bharadwaj and Grover, 2003). In software development, agile is frequently used in combination with other methods, such as Kanban, Scrum, and Lean (Wolff et al., 2020). Although these methods are considered distinct, they share attributes, like “leanness”, i.e. maximising business outcomes while minimising waste, such as underutilised resources and unnecessarily complicated processes (Kumar Singh and Modgil, 2020).

Agile software development methods share an underlying philosophy. It covers four principles and values: (1) individuals and interaction, (2) working software, (3) customer collaboration, and (4) responding to change (Campanelli and Parreiras, 2015). Although these principles and values are abstract, they have been specified into today's widely used methods of agile software development (Ramesh, Mohan and Cao, 2012). The widely adopted methods are characterised by discovering customer needs and developing solutions through collaborative efforts of self-organising and cross-functional teams, engaging with end customers (Collier, 2011). Minimal upfront planning and maximal customer involvement in the development lifecycle are critical in agile software development (Overby, Bharadwaj and Sambamurthy, 2006).

Agile software development is associated with potential challenges. Some studies report that ambiguous benefits, lack of predictability, ownership and accountability, and deployment difficulties are among the potential shortcomings (Annosi, Foss and Martini, 2020; Conboy, 2009). However, these potential challenges might stem from implementation errors (e.g. lack of individualisation of agile guidelines) and are not agile methodology inherent (Campanelli and Parreiras, 2015).

Firms widely agree that the benefits of agile software development outweigh potential drawbacks. Among the reported benefits are faster product delivery (Gomes, Sousa and Vendrell-Herrero, 2020), cost savings (Pearson et al., 2020), improved customer satisfaction (McKinsey, 2017), and improved employee satisfaction (Denning, 2018b; Hodgkinson, Ravishankar and Fischer, 2017). As a result, agile ways of working are the status quo in software development today.

3.2.2. Agile in business research

Beyond software development, agile ways of working found their way into the domain of business research, including operations, organisations, and strategy research (Ghezzi and Cavallo, 2020; Holweg, 2005; Moi and Cabiddu, 2020; Tavani, Sharifi and Ismail, 2014; Uludag et al., 2019). However, the idea that adaption to changing business environments is critical for long term survival is not new and, among others, core to the dynamic capabilities concept (Helfat et al., 2007; Teece, Pisano and Shuen, 1997). Dynamic capabilities are defined as "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece, Pisano and Shuen, 1997, p.516). Earlier studies conceptualise strategic agility as a combination of different dynamic capabilities, such as strategic sensitivity and resource fluidity (Doz and Kosonen, 2010; Ivory and Brooks, 2018). Others highlight the blurred conceptual boundaries further and describe agility to be also "known as dynamic capability" (Gurkov, Goldberg| and Saidov, 2017, p.18).

Although the key message remains the same (agile firms are more successful), recently, agility has been specified in the context of organisational adaption and responding to changing customer needs. *Organisational agility* has been coined as companies' ability to adapt organisational structures flexibly and quickly to changes in the business environment (Teece, Peteraf and Leih, 2016; Walter, 2020). Associated challenges include managing the tension of running the core business while setting-up the organisation for exploring potential future profit pools (O'Reilly and Tushman, 2008). *Customer agility* has been defined as the "degree to which a firm is able to sense and respond quickly to customer-base opportunities for innovation and competitive action" (Roberts and Grover, 2012, p.580). These two and other specific conceptualisations of agility in business research highlight the importance of continuous adaption for innovating successfully and long-term firm survival (Björkdahl, 2020; Gordon et al., 2020).

The exploration of agile ways of working in the strategy context remains conceptual and lacks empirical underpinning. Earlier studies provide some examples but do detail how firms implemented agile in the strategy context (Annosi, Foss and Martini, 2020; Denning, 2017a, 2017b, 2019; Doz and Kosonen, 2010), or focus on niche elements in the context of strategy research, such as cultural barriers that constrain managers' agile decision-making (Hodgkinson, Ravishankar and Fischer, 2017) and evaluation of innovative ideas (Dziallas, 2020). Conceptual studies mainly rephrase the dynamic capabilities literature and do not add to our understanding of how firms use agile ways of working to improve strategy development and implementation iteratively. Particularly firms experiencing unprecedented external dynamism might be insightful to learn more about the concept as the adaption to change is at the core of agility; a quest this study has taken on.

3.3. Methodology

To explore how agile has been and can be used as a strategy tool in the face of unprecedented industry transformation, an in-depth, inductive single-firm pre-COVID case study has been conducted. Case studies allow the observation of complex relational processes and are well suited for discovering new insights in theoretically novel phenomena (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Miles and Huberman, 1994), such as agile ways of working as a strategy tool. The methodology allows exploring the phenomenon from a practical perspective, involving informants from a range of organisational hierarchies and functions. Additionally, secondary data, such as industry reports and insights from relevant conferences, were especially used in the post-COVID study to enrich and triangulate the interview findings, providing a broader industry context.

3.3.1. Pre-COVID case study

The following details the pre-COVID case selection, data collection, and analysis. The post-COVID review of the initial findings using

3.3.1.1. Case selection

Purposeful sampling has been used to identify a suitable case study that is informative about the phenomenon of interest (Strauss, 1987). The case study had to reflect certain characteristics. First, it had to be in a global industry to not be subject to local or regional specificities (e.g., regulation or unique consumer preferences) and embedded in global flows of goods and information to provide meaningful insights beyond the specific context. Second, the industry had to be well-established and relevant to many people (e.g., employees and customers) to provide rich insights that might hold true for other industries. Third, the company would have to be an orchestrating player in the industry that has been affected by unprecedented industry transformation since niche players are affected by major changes in different ways depending on their role in the value chains. Finally, the company must have used agile forms of working as a strategy tool in response to the unprecedented industry transformation to provide insights into the phenomenon of interest.

All of the criteria are met by an Asian-based car manufacturer. The car manufacturer is the national subsidiary of one of the ten largest car manufacturers in one of the world's largest car markets (International Organization of Motor Vehicle Manufacturers, 2018). The manufacturer used agile as a strategy tool to respond to the recent COVID-19 pandemic in their most affected business area, sales. Sales has been most affected by the crisis and promises to provide rich insights since it is the car manufacturer’s link to the end consumers, including the sales process and vehicle delivery, and involving their national dealership network (McKinsey, 2020; Wang and Wells, 2020).

3.3.1.2. Data collection

Primary data was collected via semi-structured interviews, involving different functions and organisational hierarchies, including the CEO. The questions asked in the interviews include:

- Where do you use agile ways of working as a market exploration and exploitation tool?
- What is your particular role in it?
- Why did you use this approach? What is the associated value for you and your customers?
- How do you collaborate internally and externally? How are you organised?
- What are the risks associated with this way of working?
- What did you learn from this way of working so far?
- Did you pivot how and/or where you use agile ways of working?

The CEO was the first interviewee and provided a strategic perspective on the three cases for which they used agile ways of working. He detailed aspects such as the strategic importance, financial benefits, customer value proposition, organisational structure, and internal collaboration challenges. Subsequent interviews with managers and individual contributors involved added perspectives from within the organisation on their perception of aspects, including internal collaboration, technology challenges, and engagement with external stakeholders. The initial interview guide and focus of the interviews evolved iteratively with increasing knowledge about the use of agile as a strategy tool at the car manufacturer (Eisenhardt, 1989; Miles and Huberman, 1994). A combination of purposive and snowball sampling has been used to identify the interviewees most knowledgeable about the construct of interest (Eisenhardt and Graebner, 2007). A total of 18 interviews was conducted. The interview duration averaged approximately one hour. All interviews were conducted via Zoom, recorded (audio and/or video), and transcribed verbatim (Bryman, 2012).

3.3.1.3. Data analysis

Within-case analysis was used to iteratively gather and analyse data (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). Supported by the software NVivo, data coding and analysis of the transcripts followed the subsequent steps: (1) coding by identifying key terms and assigning interview sections to them (Miles and Huberman, 1994), (2) identifying relationships between key terms and iteratively evolving the categorisations until data saturation is reached (Strauss and Corbin, 1994), (3) using thematic analysis to identify common meanings and patterns (e.g. “leadership”) in the themes emerged (Braun and Clarke, 2006), and (4) reflecting on and cross-checking of findings with interviewees. Table 3.1 illustrates the NVivo code structure.

First-order codes	Second-order codes
Online sales minimum viable product (MVP)	Customer journey transformation Dealership network collaboration Infrastructure re-design
No-hassle pricing MVP	Price-related pain points Dealership regulations Transformation program setup
Key learnings	MVP synergies Implementation over planning Performance management Empowering leadership

Table 3.1 NVivo code structure

The online sales MVP played a crucial role during the COVID-19 pandemic, allowing the manufacturer to continue selling cars when physical retailers were closed. It enabled the company to quickly establish a digital sales channel, building relationships with customers remotely and ensuring business continuity despite the lockdowns. On the other hand, the no-hassle pricing MVP streamlined the pricing structure by offering one standardised price across the country, eliminating the need for negotiations and resolving price discrepancies between different regions. Both MVPs were pivotal in adapting to the challenges posed by the pandemic while enhancing the customer experience. The overall lessons learned from these initiatives, amongst others, are captured in the third first-order code, which reflects key learnings made by teams and executives throughout the process. In section 3.4.1, a section is devoted to each theme.

3.3.2. Post-COVID interviews

After completing the pre-COVID single firm case study, a subsequent examination focused on the post-COVID period. This phase aims to reassess critical inquiries and themes to analyse the evolving landscape of agile practices within the automotive sector. Through this post-COVID inquiry, the study aims to capture the transformations in strategies, operational methodologies, and organisational responses prompted by the enduring effects of the pandemic. By juxtaposing findings from pre- and post-COVID phases, the research endeavours to provide a thorough understanding of agile methodologies' dynamic role as strategic instruments amidst industry disruptions.

Delving into the post-COVID landscape, the study examines emergent trends and adaptations in agile methodologies, illuminating how automotive manufacturers have recalibrated their approaches in reaction to the unprecedented challenges engendered by the COVID-19 crisis. Through a nuanced examination of developments following the pandemic, the research offers insights into the evolving significance of agile methodologies in addressing contemporary business obstacles within the automotive domain.

As detailed in section 1.6.2, qualitative interviews serve as the primary methodological approach employed in the post-COVID study. These interviews provide rich insights, allowing for in-depth exploration and understanding of participants' perspectives, experiences, and strategies in navigating the challenges posed by the pandemic within the automotive industry. An overview of all post-COVID interviewees is attached in Appendix 6. The qualitative nature of these interviews enables capturing nuanced insights, contextual factors, and multifaceted perspectives. Through rigorous analysis and interpretation of interview data, this study seeks to uncover patterns, themes, and implications relevant to the research objectives.

In addition to the qualitative interviews, secondary data sources such as industry reports, market analyses, and insights from relevant conferences (e.g., Financial Time's Future of the Car Conference) were utilised to enrich the findings in the post-COVID phase. This secondary data provided a broader context for interpreting the primary interview insights, particularly when exploring how the automotive sector adapted to the disruptions caused by the pandemic. By incorporating these external sources, the study ensured that the findings were not only grounded in the experiences of the interviewees but also aligned with larger industry trends and challenges. The combination of primary and secondary data offered a more complete understanding of how agile methodologies were implemented and adapted post-COVID, ensuring that the analysis captured both micro-level organisational changes and macro-level industry shifts.

By integrating pre- and post-COVID perspectives, this research enriches our understanding of the strategic implications of agile methodologies within a rapidly transforming business milieu. It underscores the importance of agility and adaptability in navigating disruptions within the industry, providing valuable insights for both academic scholars and industry practitioners. Through its approach spanning pre- and post-COVID phases, this study offers a holistic exploration of agile methodologies as strategic tools, furnishing perspectives for comprehending and responding to industry metamorphoses.

3.4. Findings

3.4.1. Pre-COVID findings on agile ways of working as a strategy tool

During the COVID-19 crisis, car manufacturers experienced disruption in various business areas. The crisis has accelerated online and direct-to-consumer sales as people have become more comfortable working from home and buying remotely (McKinsey, 2020; Wang and Wells, 2020). This study's car manufacturer case acknowledged the need to transform its business fast. To transform its business, the company shifted to an agile management type system. The strategic direction (“where to change”) was set by the TMT, and they still had the conventional vertical departments (e.g., marketing, sales, service, finance). However, horizontally they worked with transformational teams. These cross-functional teams created MVPs to understand the implications of recent developments by iteratively testing and learning in the market.

The TMT time allocation shifted from 10 per cent on strategic issues pre-COVID-19 to about 60 per cent on strategic issues during the crisis. In this respect, COVID-19 has been driving the transformation. Managers were sitting at home, had time to think about, talk about and clarify strategic issues. They run the cross-functional teams with MVPs and quarterly objectives and key results (OKRs). OKR is a goal-setting framework for defining and tracking goals and business outcomes (Zhou and He, 2018). Thereby, the company uses Silicon Valley software development type tools to transform their business (Charan, Barton and Carey, 2018).

The car manufacturer ran five MVPs in total. This study looks deeper into two of them: “online sales” and “no-hassle pricing”. The five MVPs run in parallel to the core business.

3.4.1.1. Online sales MVP

Their first MVP was an early version of “online sales” – a button on their website that says “buy online”. When customers pressed that button, they were connected to a dealership via phone or Skype, doing everything they would normally do (offline), just online. The car manufacturer trained their dealers and sales consultants on using video calls to build a relationship with their customers. Thereby, it was essential to acknowledge that this first MVP for selling cars online was not perfect, but an adapted and working version of the status quo. To implement their first MVP, the car manufacturer mapped out an entire customer journey regarding how this new system should work, using components they already have, instead of investing in new features (Deloitte, 2018). After the second lockdown (Dec 2020), over half of all inquiries were still coming to the car manufacturer via this new online channel. As a result of the COVID-19 crisis, and the online sales MVP, the number of visits on the car manufacturers website increased. In contrast, the visits to showrooms went down dramatically.

From this online sales MVP, the car manufacturer learned a few things. First, it is not so important to get the technology and everything else entirely right. Important is to run experiments that add value to the end customer and enable organisational learning. A lot of the purchase journey can happen online using the tools already available. Second, their customers want a blending of an online and offline journey. Before the lockdown, customers wanted to see the car and a salesperson prior to buying a vehicle since spending this amount of money without human contact is tough for customers (Joast and Deinlein, 2019). When someone walks into a showroom now, they are ready to buy. Besides, customers only go there once in their customer journey now. As a result, customers are willing to travel longer distances to purchase the vehicle instead of just looking at them. Hence, the proximity to the end customer via the dealership network is not that important anymore. Additionally, car manufacturers need fewer showrooms and salespeople. However, what employees have to do is different since customers are already willing to buy when they walk into the showroom. As a result, the car manufacturer started building service-only facilities that do not sell vehicles, because customers are unwilling to travel longer distances to get their cars fixed.

3.4.1.2. No-hassle pricing MVP

Another of the car manufacturer's MVPs is "no-hassle pricing", offering one fixed price per vehicle model, as Tesla has been from the beginning. Conventionally, customers walk into the dealership and have to negotiate (Wesseling et al., 2015). Most people seem to dislike it, but no one seems to be ever-changing it (Schmidt, 2020). One key enabler of online sales is pricing since negotiations are no longer feasible, and customers appreciate price certainty.

By offering the MVP, they had to comply with regional price legislation. Specifically, they cannot dictate dealers for what price to sell the car (Bansal and Kockelman, 2017). However, they can set up their margin system so that it does not help dealers to negotiate. Hence, they shifted to a paper activity model as opposed to a margin model for cars. Thereby, they paid dealers for offering services, like test drives and vehicle deliveries, instead of giving them margin for it. At the same time, they announced the final vehicle price on their website.

Changing the car manufacturer's contracts with the dealerships and the relationship to them tests their trust. It is a tough decision for the dealers because it affects their margin. They are scared and do not think "the car manufacturer wants the best for us", but rather "I hear that they want to sell cars direct to end consumers". Hence, the car manufacturer designed the system in collaboration with the dealers and started small with the rollout. Critical in the program setup was the communication and close engagement with the dealerships.

As a result of the new model, (1) dealers are making more money, (2) more cars are being sold, and (3) the customers are happier because they have price certainty. The wider aim of this MVP was to learn how to execute pricing in a digital environment and how to remunerate dealers. Now, every time the car manufacturer launches a new car, they introduce it with this new model. Then, they integrate it in the end-to-end process until they have the one price logic for all models and with the same remuneration model for all dealers.

3.4.1.3. Key learnings

The car manufacturer uses the MVPs to develop and improve their systems continuously. For example, they learned that they will introduce online car purchase, but will keep the option to talk to employees online since customers seem to like it. They discovered that they need to ramp up their call centres, what technical system requirements they need, and what service capabilities are required to care about customers online.

The car manufacturer also sought to create synergies between MVPs. For example, one of the other MVPs is "direct to consumer relationships", building on learnings from online sales and no-hassle pricing. There they picked 100 customers and serviced all of their vehicles directly, instead of the dealership. Now they are implementing a second and more advanced version of the MVPs.

A key takeaway for the car manufacturer was how to learn through MVPs by actually implementing agile ways of working as a strategy tool. A manager stated that "*People spend too much time on strategy. The strategy is set. We know where the industry is going. Now, how do we get there? You have to stop planning and start doing and learning. When the plan hits the real world, that is where the learning is happening. You learn about what kind of capabilities you are missing; you learn about* *these gaps. And you are doing it at a small scale, so you are not messing up the rest of the business.*". The TMT laid out the framework, and the people lit up by it by not doing the mundane work. Their day job became to reinvent. The framework refers to the Key Performance Indicator (KPI) system the TMT laid out, covering three KPIs the firms had to hit every month: A profit number, a car (sales) number and a service number. Meeting the three KPIs was everyone's day job, and no one lost track of that.

Another manager emphasised that "*When you get people doing things in a transformation instead of just planning and thinking about it, it is a completely different feel.*". For example, the cross-functional teams working on the remuneration model had to call and convince the dealers. They had to listen to what the dealers say, designing the system with them. They could do this on a smaller scale and in a low-risk environment. Thereby, they learned and gained the dealers' trust and then rolled the MVP out. Another manager added, "*Although there were some tensions along the way, it is exciting for the employees. They do not want to do the same things month on month. They want part of their job to be interesting, innovative, different and challenging.*".

Bringing line employees to do strategic work proved to be important in the transformation. Line employees are good at executing work, but a detailed plan put together by the TMT does not provide them a lot of excitement. Asking them to take responsibility and explore something new does energise them. One employee referred to this change as "*the real transformation*". The TMT described agile as a great tool that enabled human capital to drive the transformation. The CEO summarised: "*Agile has been a game-changer for us. I just went out there and felt like I have to make some sense of it. How am I going to do this? I just started with a quick Google search to learn about agile, and now we are deep into it. I think we are onto something here. Using agile principles to turn strategy into reality by doing it is something all leaders have to figure out. The days of building a massive plan and hoping that you made all the right decisions before any customer sees it are gone. You are never going to keep up with the speed of change if you are operating like that.*"

3.4.2. Post-COVID findings on agile ways of working as a strategy tool

Revisiting the pre-COVID findings, the post-COVID analysis provide additional insights across a range of dimensions. Interviewees discussed the implications of the COVID pandemic and how managers responded to them, how other automotive firms manage the transition from a retail-based sales model to direct-to-customer, where and how other firms use agile ways of working, and changes in business success metrics across firms. Moreover, the interviews broadened the perspective beyond the focus areas of the initial case study, exploring how automotive firms change their product development and go-to-market to respond faster to changing market conditions, how organisations improved their responsiveness internally, and new ways of collaborating externally and changes in industry structures.

3.4.2.1. COVID-19 response

Interviewees 37 and 55 described the COVID pandemic as unpredictable and new to everyone in the industry, meaning no one knew how to respond. Managers described their responses as the constant need to improvise. Measures they implemented included global, daily call conferences to stay aligned in terms of changing regulations and new ideas. In many countries, managers described the need to maintain some cash flow as existential to families' survival. Therefore, businesses established new, local processes to sell existing stock. Managers also emphasised the globally varying levels of established online communication with customers.

Businesses also saw the pandemic as an opportunity to cut costs by renting fewer office spaces while providing employees the flexibility to work remotely but potentially at the loss of personal connections. Interviewee 47 emphasised that in-person collaboration can be important "to get things done" and that "we are human beings that sometimes do our best work in the same room together […] we used to call it the one room concept when problems occurred in supply chain disruptions". For production environment roles, it is often not possible to work remotely, given the physical nature of their work. Hence, the COVID pandemic significantly disrupted the physical business areas and reduced production output.

At the same time, customer demand slowed as people were more uncertain about their economic outlook. As customers were not using their vehicles as much, they started to rethink the number of cars they needed in their households. Increasing fuel and electricity prices increased customer uncertainty regarding when to buy a new vehicle and which one.

Besides the COVID pandemic, which disrupted silicon chips from South Korea especially, the Russia-Ukraine conflict disrupted other supply chain areas, like wiring looms and neon manufactured in Ukraine.

3.4.2.2. Direct-to-customer

The pre-COVID study focused on transitioning from a retail-based sales model to a direct-to-customer during the early stages of the COVID pandemic. This development was still a key topic in the second round of interviews. The interviewees emphasised OEMs' challenge of exploring new, direct sales channels while selling most stock globally through national sales organisations and dealership networks. This is different for new automotive entrants that do not have retailer networks and have to build strong relationships with end customers. Overall, there seems to be a trend towards fewer and more consolidated dealerships. However, interviewees also emphasised some associated challenges, such as manufacturers limited experience selling and servicing vehicles. The new sales models also have implications regarding vehicle ownership and financing up to the point of ownership by the end customer, as the manufacturer owns the vehicle up to the point of purchase when selling directly. Interviewee 71 argued that "*I think the dealers are fulfilling a role within the process that actually is a bit misunderstood by the OEMs and a little bit kind of downplayed in terms of the value that they're adding to the supply chain […] They're dealing with a lot of customer experience issues that I do think that manufacturers just don't appreciate*".

Additionally, the technological integration of systems to sell directly is a major challenge for manufacturers. Data and systems often lack global integration, not allowing manufacturers to have consistent inventory and customer information across markets. Today, national sales organisations within a manufacturer often have individual and inconsistent customer relationship management and inventory systems. These challenges must be resolved to deliver a seamless customer experience that organisations strive to achieve, and customers demand globally. One challenge is that a vehicle purchase is emotional; some customers like to see, touch, and customise it.

In contrast, other customer groups might be happy with a digital configurator and streamlined, not overwhelming options. Interviewee 62 concluded that "end-to-end digital retailing is still a long way off". Manufacturers must also build capabilities in related areas to offer the end-to-end retail experience, such as vehicle trade-in, used car assessment and valuations.

Interviewee 66 pointed out that trying to sell cars directly to customers is not new in automotive: "Ford tried going direct in the late 1990s, started buying out their dealerships in certain cities and owning their distribution and abandoned it". The interviewee explains two key challenges that might be overlooked in the transition to direct sales. First, dealerships are adaptable to changing market conditions and add great value for customers. From the interviewee's perspective, "manufacturers use them basically to price discriminate, and as an inventory stock buffer; they have an economic purpose". They provide vehicle servicing, repairs, and physical locations that customers value. With the transition from ICE to EV, warranty claims of BEVs are also higher (so far), and issues are more complex to fix. Second, politically, car dealerships are amongst the highest sales tax contributors in many countries. Hence, dealerships received political protection in regions globally due to their economic power.

Interviewees 38 and 54 also emphasised the link of direct-to-customer sales to implementing price changes more effectively and efficiently. If manufacturers own end customer relationships, they will have better control to manage prices and provide the right offering across customer groups, e.g., more attractive leasing options based on monthly payments and additional services, like insurance products. Interviewee 46 argued that "*OEMs need to do a better job of thinking about pricing […] that's your number one lever if you run a company, the easiest way to make more money is to change your price […] everything else is work*".

3.4.2.3. Agile ways of working

Agile ways of working were the focus of the pre-COVID study, which the post-COVID enriches through additional perspectives summarised hereafter.

Managers across firms agreed that agile ways of working would be used more to test and learn faster. For example, they use it to integrate AI into customer service functions (e.g., factually correct customer service bot responses). Interviewee 43 explained how they learned in practice through agile ways of working that customers do not like being sold but that a tactful and informative engagement is important.

Another example published in the media is SIXT, which tried to identify where it makes sense to open new branches using an agile approach. They allowed customers to request vehicles from fake locations on their website. Based on the number of requests, they decided where to open additional branches while collaborating with a taxi company to fulfil the requests during the exploration phase. This was a fast and low-resource way of answering their new location questions. One interviewee highlighted that automotive managers could use similar approaches to understand the implementation of their new agency sales models, seamless omnichannel experience (e.g., between physical store and online) and how to market vehicles to end customers. As all transformation areas have considerable digital components, multiple interviewees argued that agile ways of working will be required to deliver them successfully. Interviewee 64 concluded that "*all these areas are really impacted, and everywhere agile ways of working are required. So, it's actually a very foundational and existential question for* *automotive OEMs as a whole. It's not like if I don't get into this way of working, I might lose some revenue. It is more like if I don't do it, I might not exist tomorrow*".

A consulting partner interviewee 53 highlighted that engineering and product development stand out as areas that will be affected considerably through agile ways of working: "*A lot of this does get into more agile working in more scrums, breaking down kind of traditional, very siloed engineering type roles that existed within OEMs*". He sees AI as a critical enabler to develop better, faster and cheaper products to free up resources to fund other monumental investments, e.g., in battery technology, connectivity, and vehicle autonomy. Specifically, product development cycles have to change to a more agile model: "*How do we do product development at the speed of tech? How do we go from designing and launching vehicles in a seven to 10-year period to a two-to-three-year period? Cause if you think about it, a vehicle for the point it gets into really truly get into the actual starting to work with suppliers and work with the final engineering designs and things, that's where you're typically looking at a five to seven-year to start production. But when you took a look at when those vehicles were initially conceptualised, you're going back to 10 years out. The rate of change is so fast. If somebody right now today is trying to design the winning vehicle that's not going to hit the market until 2033, they're likely going to find that things have changed quite a bit in those following ten years*". Interviewees 68 and 74 point to, for example, battery technology and connectivity features that need to be updated much quicker than a seven-year product development cycle. Similarly, agile ways of working allow OEMs to explore service offerings for customers that could be updated over the air or similar business-to-consumer explorations, e.g., pricing and leasing. Overall, OEMs use agile ways of working to align their offerings more closely with changing customer demands.

3.4.2.4. Success metrics

Traditionally, OEMs were, in terms of objectives, mostly profit-focused, based on yearly volumes, costs and margins for each vehicle. In reasonably stable times, this allowed OEMs to introduce a level of stability and optimise costs to increase profits. This linear planning and optimisation process has been disrupted during the COVID-19 pandemic. Interviewee 69 explained a challenge: "*During the pandemic, we started to cut advertising, for example, to still achieve the profit. Since cars were not arriving, you started to sell the cars that were more profitable. So, you start to advertise or to push the cars that are richer. So, you start moving the whole situation, but the profit target kind of never moves, seldom moves*". Widely, automotive managers described a shift from an obsession with selling more cars, e.g., whether Volkswagen and Toyota are leading in the number of vehicles sold, to improving the margins per sale; "*sales and profitability are still the undisputed leading KPIs*" (interviewee 41). Overall, interviewee 40 and 58 emphasised that shareholders, often irrespective of external disruptions, expect OEMs to hit profit targets.

Besides the profit focus, stakeholders expect automotive companies to operate more fairly and sustainably while providing clear evidence for this. OEMs, suppliers, and other smaller businesses are expected not to take unfair advantage of nature and its resources. Businesses are also likely to behave fairly in other areas, like hiring practices, diversity, value recognition, and customers they serve. Interviewee 60 stated that "*it's really a matter of doing the right thing [...] really recognise the integrity of the person when they're doing something when no one is watching*". Managers also emphasised the integrity towards customers in being honest, and admitting failure when they face challenges (e.g., recalls) as opposed to downplaying managerial shortcomings. Internal integrity also became more important in transitioning from a 40-hour office-based job to a post-COVID work environment where boundaries between work and personal life became blurry and arguably fluid. Interviewee 38 emphasised that "*in the new workforce, everyone is a free agent, and then the boundaries between work life and personal life are very blurred, and that is going to be the future*". Another interviewee explained, "*As an employer, you're dealing with your workforce at some point in the day; they always have some influence from the company in their personal life. It makes it very, very important for them to behave in an ethical, sustainable, and fair way*". There seems to be an increased importance of having the ability to be one's true self at work, as boundaries are more blurred.

In managing objectives, organisations moved from annual KPIs to quarterly OKRs. With qualitative descriptions and quantitative measurements, OKRs allow managers to show organisational progress and pivot quickly. Amongst others, OKRs enabled OEMs to invest in disruptive technologies (e.g., autonomous driving) and explore new business models (e.g., mobility services). Interviewee 71 emphasised that "*the key objective has to be far enough out of reach that you're still striving for it rather than a gateway on the roadmap towards the end goal […] I think it generates great conversations, line manager to employee, and it brings about a better assessment*". While some managers described the transition from KPIs to OKRs as providing a more realistic and useful tool for optimising organisational performance, interviewee 43 highlighted the challenge of long lead times in automotive that provide challenges with implementing frequent reviews, e.g., "*the problem in the automotive industry is that they have very, very long product cycles and therefore the results only become visible much later and these short-term KPIs become problematic*". Interviewee 48 pointed out the challenge of operationalising OKRs in a direct-to-customer context, e.g., the effectiveness of a particular advertisement in terms of conversion.

Managers emphasised additional metrics that emerged or gained importance during the COVID-19 pandemic. These include metrics in areas like digitisation (e.g., digital customer engagement), customer-centricity (e.g., monitoring customer satisfaction more closely), and supply chain (e.g., chip supply). Automotive OEMs monitored production outputs more closely than before the pandemic as the market remained tense regarding supply and demand disruptions. With the shift towards more outcome-based frameworks, OEMs can monitor and adjust more closely towards their relevant metrics.

The current state of measuring and improving success amongst automotive OEMs seems in need to catch up to other industries. Interviewee 77 argued that "*the way a software company approaches a problem and approaches their business is very different from what an automotive OEM does*". He goes on to explain that automotive OEMs are culturally still hierarchical in some business areas, in some cases preventing them from successfully launching digital products. Similarly, OEMs need flexibility regarding their future product mix, given technological uncertainty (e.g., hydrogen and battery technology).

Smaller organisations described that they had to focus more on financial metrics and shareholder returns during and after the COVID-19 pandemic. At the same time, they could get access to capital more easily before the pandemic. To reduce the associated risk and increase the likelihood of positive returns, some smaller organisations decided to vertically integrate less and partner more, e.g., with OEMs to manufacture electric vehicles. Thereby, they reduced risks but also potential financial returns.

3.4.2.5. Product development and go-to-market

With the increased demand to shorten time to market while technical product complexity increases, OEMs need to find ways to decouple traditional hardware and software development cycles. Engineers have advocated adopting systems engineering approaches, e.g., defining control systems. A challenge for many organisations seems to be maintaining a start-up culture and innovation while working in a larger organisation, i.e., maintaining the brand values and building on the company's heritage while integrating the latest technology. The increased product complexity also demands engineering teams to ensure efficient and robust operation. While virtual simulations can help with some aspects of product development, human emotions cannot be simulated today. Elements customers perceive to be brand-defining need to be developed and controlled company internally.

Simulation of software solutions allows automotive OEMs to go through the software development lifecycle before safely deploying it to the vehicle while enabling OEMs to iterate faster and putting cloud-based data platforms at the centre of important decisions. Given the solution complexity, OEMs seek strategic partnerships with technology providers to compress development timelines by going through the software development lifecycle before the hardware exists. OEMs also continue integrating brand values into software solutions to avoid brand commoditisation. Some OEMs announced no longer performing physical tests after 2025 by relying on virtual simulations (HM Government, 2022).

An essential enabler of faster and safer software is the change from traditional in-vehicle IT architectures (e.g., 80 electronic control units) to new, centralised architectures (e.g., 3 to 4 electronic control units) by collaborating with tier-one suppliers and chip manufacturers (Bosch, 2023; Continental, 2023; 3M United Kingdom, 2023). A challenge for OEMs in working with large technology companies is that the technology companies need to standardise their solutions across many vehicles. In contrast, OEMs try to differentiate through individual requirements. There is also a clash of different evolution speeds as AI is developing rapidly while manufacturing has traditionally changed slowly. However, AI can help firms optimise manufacturing processes by making dynamic changes. Tesla's approach to hardware and software development is arguably to build a white box and flash it with the latest software, providing the opportunity to simplify manufacturing.

Volkswagen's software organisation CARIAD is a sign that software is a strategic pillar while illustrating the recent trend towards increased collaboration and partnerships. Within CARID, Volkswagen recently moved some make-or-buy decisions towards "make" while relying more on collaborations instead of internal competencies to achieve sooner start of productions. Similarly, with PowerCo SE, Volkswagen bundles battery technology as a strategic pillar.

OEMs follow different approaches to reduce some of the constraints. For example, when General Motors entered the European market with their BEV offering, it separated this operation from the legacy offering and started with a greenfield approach. They reassessed their customer's pain points and defined a new go-to-market approach while focusing on improving the customer experience. This General Motors entity agreed on principles with the General Motors headquarter (e.g., "fail fast but fail forward"), hired talent from start-ups and developed partnerships with start-ups while maintaining decision autonomy. The CEO of this new business unit said in an interview that "you cannot move fast if you are seeking approval for every decision", acknowledging the senior leadership trust and support needed for this venture (Financial Times, 2023). Finally, the CEO emphasised the importance of "testing and learning fast: get and accept customer feedback; do not slice and dice feedback but accept and work on it". Similarly, Renault created a BEV business unit called Ampere to accelerate BEV developments, especially software and connectivity integration into the vehicle. The Renault CEO also emphasised the importance of Ampere for collaborations with technology companies like QUALCOMM and Google (Financial Times, 2023).

3.4.2.6. Internal changes

3.4.2.6.1. Organisational culture

Organisational culture has been emphasised across the interviews as a challenge for automotive OEMs in accelerating BEV. Company culture is more than an elusive management term but at the core of strategy-making at automotive companies today. For example, building on its rich racing heritage, Ferrari develops ICE, BEV, and hybrid vehicles focused on different market segments, emphasising what sensations their products create for customers and "touching their customers' soul". Ferrari's CEO said in an interview that Formula 1 racing is part of their DNA, and through that, they "keep alive the will to progress" (Financial Times, 2023).

AWS's automotive services division is embedded in the broader Amazon ecosystem with a strong-rooted culture and values, such as customer obsession (e.g., customer journey focus) while taking calculated risks (e.g., iterating on customer pain points). Thereby, Amazon sees itself as a large company of start-ups that does not focus on short-term financial gains but on company values. For example, an AWS automotive solutions manager was asked in a recent interview if he would not be worried about enabling customers so that AWS's services are no longer needed. The manager replied instantly: "Perfect if they can do everything themselves, and we might get back engaged later to discuss the next transformation phase" (Financial Times, 2023).

Renault recently designed a new, flatter corporate structure to allow better decision-making, e.g., providing independence to the Alpine racing brand ecosystem that focuses on its circular economy.

Similarly, they acknowledge that mobility services are changing significantly and build a separate business unit focused on this. In an interview, Renault's CEO recently explained that the culture in automotive companies is challenging to change, needing patience and clear messages from the TMT (Financial Times, 2023). They establish a culture of excellence while ensuring they participate in technology evolutions. While the automotive industry historically has been about scale, size, and volume, automotive companies nowadays need to change more with technological developments and take more risks. Overall, the Renault CEO aims to build an organisation that is focused but agile in exploring opportunities while providing a workplace where people are motivated to innovate. However, he concludes that "we are making money, and that's the most important thing", indicating that financial gains are at the core of their transformation.

Geely takes a humble approach to its automotive expansion, acknowledging the lack of experience in Western markets and focusing intensely on gratefulness for its partners. The Geely holding CEO said in a recent conversation that there is a solid need to understand products and customers, e.g., in China deeply, BEVs need to be smart and not just electrified ICE vehicles, detailing that customers in China have a different understanding of smart vehicles compared to European customers and that Geely relies on partners to understand those customers better (Financial Times, 2023). The CEO emphasised collaboration, synergies and trust.

3.4.2.6.2. Vertical integration

As OEMs lose value creation from ICE, they try to integrate vertically into other fields, especially BEV technology. For example, Peugeot builds five giga factories to control battery supply where they produce vehicles. They aim to improve battery and logistics costs through vertical integration in batteries. However, vertically integrating into battery technology is challenging as technology (e.g., battery chemistry to improve battery performance) changes fast. A Renaults manager stated in an interview that it is important to source components as close as possible to where vehicles are being produced (Financial Times, 2023).

Bentley can tap into the Volkswagen group ecosystem for technology and adapt it where needed. For example, the Volkswagen group has a unified cell strategy, while Bentley needs to find the previously V12 ICE differentiator equivalent in batteries (i.e., high power and energy density). In Bentley's case, while their origin and heart are in the UK and being British is part of their heritage, also with a British CEO, they will import batteries into the UK as it is not financially viable for them to establish a local battery production. However, Bentley will continue to develop, produce, and sell Bentleys in the UK. Other locations in the broader Volkswagen group ecosystem have been chosen for battery investments (e.g., Belgium, Spain, Poland, and Germany). According to Bentley, the COVID pandemic highlighted the need to understand supply chain risks better and, in some cases, vertically integrate to mitigate some of the risks. However, Bentley acknowledges that partners and their capabilities can become future differentiators. Similar to the smartphone industry, Volkswagen considers developing partner systems critical for the next ten-plus years.

Renault considers their alliance with Geely strategically important to address capability gaps. For example, Renault partners with Geely to identify suitable leasing models and charging infrastructure partners. As the automotive OEM business is scale-dependent and capital-intensive, partnerships are required to succeed. Geely aims to become a high-tech and mobility provider with its partners. They aim to sell 4 million BEVs annually by 2025 (electrive.com, 2021; Kang - CnEVPost, 2023). The Geely group consists of many brands, and the group CEO considers it necessary to leverage each brand's history (e.g., Geely Automotive, Lotus, Volvo, and Polestar), develop unique product characteristics, and provide autonomy to each brand (Financial Times, 2023). Examples of this were Geely's listings of Volvo in 2021 and Polestar in 2022 (Volvo Cars, 2022), as, from their perspective, it seemed the best way to satisfy customers and provide returns to investors. Geely seeks synergies across brands within the group and with partners, which, from the CEO's perspective, are fundamental to their success. As scale economies are the most critical competitive factor in automotive, Geely is entering partnerships in many areas, such as R&D and procurement, while centring activities around the customer.

3.4.2.6.3. Talent and reskilling

With the transition from ICE to electric vehicles, OEMs look to systematically retrain talent from traditional business areas to address current and future capability gaps. Volkswagen builds capability through new talent and retraining in BEV and digital domains. In digital business areas, Volkswagen is building up data analysis capability and moving from traditional software development to AI applications. Volkswagen's Member of the Board of Management for People and Transformation speaks about a "war for talent," while the company culture needs to be diverse and inclusive (Financial Times, 2023). Their new AI software engineers approach work with an "I am not writing code; I am writing history" mentality. Volkswagen also builds up more data-type roles across departments.

General Motors also considers re-skilling from ICE to BEV important while not phasing out talent but teaching skills to existing employees who already share their values and company cultural understanding. At General Motors, new post-COVID hires come especially from digital, start-up, and automotive industries.

Jaguar Land Rover is analysing the supply chain end-to-end to identify talent gaps while trying to tap into talent pools worldwide (e.g., talent hub in Tel Aviv). The company's director for industrial operations described that younger employees especially want a purpose and that the organisation developed a creator's code and purpose to engage with younger talent and have a modern appeal.

Overall, the interviewees emphasised that the automotive industry needs to do more to appear attractive in competition for rare and valuable talent. For example, roles could be more attractive by linking them to sustainability and improving international mobility.

3.4.2.6.4. Internal collaboration

Some interviewees emphasised that OEMs face cultural barriers to successfully manage some transformations. For example, interviewee 45 highlighted regarding the transition from ICE to BEV vehicle: "*so lightweight and efficient as opposed to I've got a thousand horsepower on the press of a button. I think that's where we'll see new entrance. Many OEMs are switching from their very proud background into EVs, but they're doing the same things over again*". Other managers highlight the slow transition to direct-to-customer sales channels and product offer complexity that overwhelms customers.

Most interviewees described elements of an innovation culture as being particularly important. Elements mentioned include distributed intellectual networks amongst employees instead of isolated senior leaders and connecting with everybody around brand values as a common north star for product and service development. Interviewee 49 pointed out that amongst automotive OEMs, the common approach of a central innovation hub or incubator that only a few seemingly elite are worth participating in is not promising. He explains that engaging and empowering everyone in the organisation to participate is much more promising, creating an innovation culture that is "fuelling itself" with a continuous improvement mindset. One beneficial outcome of such a culture is patents that provide innovations and corporate tax benefits. Interviewee 55 summarised that "*automotive groups are very much organised into silos […] there are always top-down attempts to break it up in the sense of cross-functional teams, etc. It still doesn't work perfectly.*"

Managers emphasised that the transition to hybrid work during and after the COVID-19 pandemic, i.e., combining work from home with occasional office visits, has changed organisational culture. Interviewees 38 and 61 highlighted that hybrid work is a development common in most technology companies and has been driven by CEOs in the automotive industry as digital business areas are increasingly important. Digital collaboration has proven to work in many areas, such as digital product development, while providing challenges in others, e.g., the partnership between hardware manufacturing and digital sales.

Besides general industry trends, managers emphasised that the headquartering country heavily influences organisational culture in automotive. For example, interviewee 36 described Korean and Japanese automotive OEMs as surprisingly hierarchical. Interviewee 69 suggests that "*I expect that the knowledge and R&D centres to be at locations where there is more flexibility and flat hierarchy because the decision making needs to be innovative, nimble, and very quick […] R&D centres located in the US, like Apple's design studio, and manufacturing in China*". Overall, managers emphasised the importance of leveraging cultural attributes that can help improve innovation output, like product quality and technological advancement. They also emphasised the importance of recruiting the best talent globally and providing a workplace mostly aligned with their values, e.g., flexibility and individual appreciation.

Interviewee 47 emphasised that a culture of reinvention is important to continuously adopt new technologies that customers expect, which might be more challenging for incumbents than new entrants. For example, global, digital collaboration within and across businesses is a critical enabler.

A frequently discussed challenge is the move towards more software-centric vehicles that require a different culture. Closer internal collaboration between software and hardware teams is needed. Some interviewees referred to a hybrid process that is required to align software and hardware developments more closely. Interviewee 44 described that "*people at OEMs have a couple of models in their heads […] I define specifications, develop a solution and have a product […] that is not how it works in the current processes*". Other managers emphasise that traditional, hierarchical reporting structures can be challenging in a digital environment that is highly uncertain and requires cross-functional collaboration, e.g., for the development of in-vehicle software architecture. OEMs are still exploring how best to integrate these developments with the traditional hardware development cycles while providing the needed alignment and degree of freedom. Interviewees 50 and 66 described that the digital ecosystems are critically important and vary considerably globally, e.g., are more developed in China than in Germany. Additionally, managers pointed out that companies need a higher risk tolerance as advanced technologies are associated with greater risks and experimentation. A cultural challenge is that automotive OEMs have been successful with similar technologies for long periods and are not used to reinvent fundamental business areas as needed in disruptive transformations.

Interviewee 75 added that "*there is a lot of difference between OEMs in terms of what decisions get made on what kind of management level; one might be more painful than the other […] there are certain cultures where the decision-making process is much faster*". Interviewees 51 and 63 highlight the different degrees of open debate and diversity of thought encouraged across geographies.

Interviewee 35 summarised the organisational tension regarding decision autonomy and control in automotive: "*I don't want to criticise the auto industry for this hierarchical approach of going up and down. I think there is a need for that. Can they be nimbler? Yes, there's always an opportunity to be nimbler, but not all decisions can be made at the bottom of the organisation of the bottom of the pyramid. […] I wish we loosen up a little bit, but I also wish that we don't give up on it completely and be very flat and allow anybody to make any design change on a car and tomorrow has a significant impact, and all of a sudden, you realise somebody made a bad decision, and we have to recall 10 million cars. You don't want that either.*"

3.4.2.7. External changes: partnerships and industry consolidation

As industry speed and product complexity increase, automotive OEMs increasingly rely on partnerships to deliver customer value. Partnerships allow firms to leverage their strength better while adapting faster to changing market conditions. For example, in BEVs, OEMs closely analyse strategic areas they want to own versus others where they can partner, e.g., Volkswagen collaborating with Ford in BEV development. OEMs collaborate closely to deliver advanced technologies and are more open to collaborations with technology partners like Amazon and Foxconn. Especially integrating batteries into the vehicle is a crucial challenge OEMs face. As vehicles are more software-defined, OEMs rely increasingly on external capacities and specialists to address complex subjects. Autonomous driving is one area where OEMs increasingly rely on partners, collaborating with companies like Mobileye and Waymo. Interviewee 64 said, "*I think there's finally an acknowledgement that a much more technical collaboration and way of working with capable suppliers is a way forward for these OEMs because they're not going to be able to do it on their own*". Others also emphasised that BEV require additional partnerships, such as energy and charging infrastructure.

OEMs also attempt to improve economies of scale, e.g., in R&D through consolidations (e.g., Stellantis). Nissan recently partnered with Renault in India to launch six new models for the Indian market and considers their alliance one of their greatest strengths, rooted in equal shareholder rights. The Nissan CEO also explained that with the BEV adoption and the time it takes to scale operations, more partnerships are needed to cover geographies and create synergies (Financial Times, 2023). Interviewee 38 suggested that "*there might be some further consolidation among the traditional OEMs […] that was also the result of economies of scale […] now joined forces to be able to use the vehicle platform and production networks in complementary terms of regional coverage*".

General Motors focuses their collaborations around the customer value proposition and collaborates with partners with the same values (e.g., zero incidents and emissions). General Motors partners when it is more efficient to externalise capabilities as speed and timing are critically important in automotive (Financial Times, 2023). Companies are looking for partners with an equal desire to make the relationship succeed while aligning on the long-term vision but being flexible on the short-term details (e.g., A-B-testing results).

Collaborations with start-ups are as much about the willingness to fail as they are about conscious and ruthless testing of assumptions while focusing on mission-critical aspects (e.g., safety capabilities). For example, partnerships should focus on solving real customer problems instead of finding use cases for particular technologies that potentially worsen a product due to additional complexity. Companies are focused on providing more straightforward and seamless integration, e.g., with home charging.

Partnerships also allow OEMs to address other challenges, such as connecting the car to the cloud and infrastructure, supply chain transparency and supply shortages, driver assistant systems safety challenges, software accessibility of products and services, regulatory challenges, and other technology interdependencies. All parties must understand what they are getting into to make collaborations successful.

In the post-pandemic environment, there is an increased need for global collaboration in automotive. Interviewee 60 argued that "*a big question in my mind is what's going to happen with China and Vietnam […] China is investing an incredible amount of engineering and finances into BEVs […] they have with their government cooperation*". Interviewees 48 and 73 also emphasised the magnitude and scale of BEV investments across Asia, with many players starting to introduce products to the European and American markets. Interviewee 34 emphasised the importance of entering the right strategic partnerships with some of these new players: "*If they don't manage that potential collaboration correctly, I think they're going to get squashed in the market, particularly if there's a battery technology advantage that is developed in that region […] it's going to be a very challenging environment I think in the next two to five years*".

There seems to be a cultural shift and opening across OEMs regarding their collaboration with external suppliers. Interviewee 71 described that "*historically, there has been a bit of hubris from certain OEMs that it's them and nothing else. I think what we're seeing, though, is that there are a number of large global suppliers who have truly differentiated capabilities that make them essential. And OEMs need to partner with those suppliers; they need to have a strong relationship with those suppliers*". OEMs across the board seem to be recognising the need to partner more due to COVID-19 developments like the chip crisis that led to considerable shortages across manufacturers. Automotive OEMs also learned during this period about the importance of bundling capacities with partners as consumer technology companies managed to access more chip supplies due to volumes and by approaching the foundries directly. For some OEMs, this seemed to be a cultural shock as they were used to being the most important customer for their suppliers and were suddenly competing with much larger chip customers for chip supplies. Interviewees 51 and 67 suggested that OEMs have become better at recognising complementary needs and capabilities during the COVID-19 pandemic while breaking down combative tensions to find better collaboration methods.

Interviewee 56 argued that the main challenge in automotive partnerships is not a lack of intent but executing correctly. He argues that "*some of these partnerships, looking back at the last few years, have not always delivered the returns initially expected from them […] less due to the fact that these partnerships are not strategically correct, but rather to the fact that then two worlds collide that do not yet interact well with each other [...] that is the core problem*". Interviewee 35 highlight that this challenge is particularly evident in areas where hardware-oriented development processes must integrate with software-oriented development processes, highlighting Tesla as one example that manages the two well in parallel.

3.5. Discussion

This study was designed to explore the use of agile ways of working as a strategy tool in the face of unprecedented industry transformation. The automotive industry provided rich empirical insights into how car manufacturers used agile ways of working during and after the COVID-19 pandemic to identify and explore market opportunities.

The main takeaway from the pre-COVID study is that agile can be used as a strategy tool by involving capabilities across the organisation in an iterative strategy process. Theoretically, this study adds to our understanding of agile ways of working in the strategy context. Although prior studies introduced terms like "organisational agility" and "strategic agility" (Denning, 2017a; Walter, 2020), they lack empirical underpinning and do not cover firms involved in unprecedented industry transformation.

This section provides a rich narrative, detailing how car manufacturers implemented agile ways of working as a strategy tool. It specifies the organisational design, leadership structures, goal setting, TMT time allocation, and iterative strategy process.

Although earlier studies emphasised specific team roles and agile management processes, this study finds that these frameworks are somewhat less important. Specifically, the case study highlights that it is crucial to consider six fundamental principles: (1) having a clear direction of where to take the company, underpinned by TMT commitment, (2) having a small set (e.g. three) of KPIs that all employees work towards and that are reflected in their daily activities, (3) collaborating sensitively with key partners, (4) choosing MVPs that add value to customers and enable organisational learning, (5) listening to employees in terms of their preferences to get involved in and contribute to the agile strategy process, and (6) getting started and ensuring continuous learning about improving the agile strategy process. Thereby, this study complements earlier and mainly conceptual work.

In terms of managerial implications, this study provides automotive managers concrete examples of how to implement agile as a strategy tool, detailing the automotive industry's specificities (MacDuffie, 2013; MacDuffie and Fujimoto, 2010). Hence, this study might be relevant for managers at car manufacturers and other automotive stakeholder, such as suppliers and regulators, by offering insights into nuances of the recent automotive developments during the COVID-19 crisis, including automotive sales. Specifically, the chapter might be useful for suppliers by inspiring ideas for positioning their companies well in the transition towards online sales and fixed vehicle prices (Poberschnigg, Pimenta and Hilletofth, 2020; Tordjman and Rehberg, 2019). Regulators might benefit from the study by better understanding car manufacturers' measures to implement these two developments and derive how the regulatory framework might benefit from adaptation (Harrison and Thiel, 2017).

The findings highlighted that in the post-COVID-19 automotive industry landscape, adopting agile ways of working emerges as a transformative and strategic imperative. This paradigm shift reflects a dynamic response to the multifaceted challenges and opportunities arising from the global crisis.

Across several key trends, organisations within the automotive sector are strategically leveraging agile methodologies to enhance their adaptability, responsiveness, and overall competitive positioning. These trends encompass a spectrum of strategic initiatives, ranging from an accelerated transition to direct-to-customer sales to decoupling hardware and software development cycles. The key themes this discussion is structured around are summarised in Table 3.2.

New post-pandemic trend	**Underlying reasons**	**General learning**
Accelerated transition from retail-based sales model to direct-to-customer	Need to adapt product offering quicker to changing market conditions (e.g., price and specification changes, supply disruptions) Ability to learn (e.g., through A-B-tests) more about end customers to improve products and services (e.g., more seamless and individualised)	Businesses are moving closer to end customers to be able to sense and seize demand changes quicker
Use of agile ways of working across more business areas (e.g., product development) to improve business responsiveness	Constant need to quickly respond to external changes while reducing costs (e.g., for BEV development) AI is a key enabler to better, faster, and cheaper product development	Internal processes need to allow responsiveness, allowing to test and learn faster (e.g., quicker engineering and product development) The ability to respond to change across business areas is a key differentiator
Changes in business success metrics from traditional volume, costs, and margins to per unit profitability and sustainability (e.g., environment, diversity, fair work conditions)	Increased demands to improve sustainability from stakeholders (e.g., customer, shareholders, policy) due to increased awareness Internal integrity grew in importance as remote and hybrid working blurred boundaries between work and personal life ("be one's true self at work")	The planet is becoming another key stakeholder for businesses The increased war for top talent that can demand workplace improvements as "doing things right" is a key challenge in critical and competitive business areas e.g., digital (especially AI)
Changes in business management from annual KPIs to quarterly business reviews	Need to combine qualitative and quantitative success metrics (e.g., digitisation, customer centricity, supply chain) while pivoting quicker during the year in response	Business management frameworks for improved responsiveness contribute to competitive advantage

New post-pandemic trend	Underlying reasons	General learning
	to external change (e.g., technological advancement)	
Hardware-Software decoupling	Increased product complexity Pressure to reduce time-to-market More efficient and effective hardware-software development required Virtual software simulation and centralisation of in-vehicle IT-architecture enable decoupling	Two key challenges in hardware-software decoupling: Maintaining a start-up and innovation culture in a larger organisation Building on heritage while integrating the latest tech
OEMs are more open to external collaborations (e.g., strategic partnerships and alliances)	Partnerships are required for faster delivery with advanced technology (e.g., AI) and to share CASE investments with other OEMs Partnering for crisis response (e.g., chip shortage)	Area of tension: software as a strategic pillar and differentiator while technology choices are required faster and are riskier - technology bets are quicker and more impactful COVID pandemic led to OEMs becoming better at recognising complementary needs and capabilities

Table 3.2 Post-COVID-19 agile ways of working discussion themes

The trends shed light on the strategic advantages gained through closer customer engagement, the adaptability of organisations to external changes, the evolving metrics for business success, the dynamic nature of business management practices, and the intricate dynamics of hardware and software development. As the automotive industry navigates this transformative phase, understanding the theoretical underpinnings of agile working becomes paramount for scholars and practitioners seeking to thrive in this dynamically evolving landscape.

3.5.1. Accelerated transition to direct-to-customer sales

This research delves into the post-COVID-19 dynamics of the automotive industry, scrutinising the strategic impact of agile methodologies, particularly in the accelerated transition from traditional retail-based sales models to direct-to-customer sales. The study unpacks the imperative for adaptability in product offerings and the pursuit of richer customer insights, contextualising these findings within the existing literature. The findings highlight the strategic repositioning of businesses closer to end customers, leveraging agile practices for heightened sensing and seizing capabilities in a rapidly evolving automotive landscape.

Positioning itself within the literature on agile methodologies (Srinivasan, Srivastava and Iyer, 2020; Denning, 2017b), strategic management (Helfat and Peteraf, 2003; Teece, 2007), and post-pandemic business adaptations (Sarkis, 2021; Zahoor et al., 2022), this research extends existing discussions by providing nuanced insights into the specific manifestation of agility in the customer-facing domain of automotive business models. Building upon the works of scholars like Doz and Kosonen (2010) and O'Reilly and Tushman (2008), this study discusses the interplay between agile methodologies and the recalibration of sales strategies in response to the unique challenges posed by the post-COVID-19 era.

Zabel et al. (2023) argue that dynamic seizing capability is required in digital business ecosystems to develop differentiating value propositions. For example, Chatterjee et al. (2022, p. 455) emphasised the importance of "marketing capability to use social media services and technologies to connect more closely with their customers and meet customers' needs […] that has a significant moderating role in the relationship between organizations' dynamic capability and business sustainability". Straightforward and sharable, explicit knowledge seems important as "with the advent of digital technologies and algorithms that can extract deep customer insights and organizational experiences which are highly tacit in nature and codifying the same into explicit knowledge, the importance of explicit knowledge is further enlarged" López-Cabarcos et al. (2020, p. 1037).

In response to the difficulties imposed by the COVID-19 pandemic, the automotive industry is undergoing a seismic shift, rapidly transitioning from conventional retail-based sales to a direct-to-customer model. This strategic evolution is propelled by a dual necessity: adapting product offerings with alacrity to dynamic and volatile market conditions and pursuing deeper customer insights.

Dynamic market factors, such as pricing adjustments, flexible financing options, product specifications, and supply chain disruptions, necessitate a more agile approach to sales.

A trend emerges from the findings, positioning businesses strategically closer to end customers and portraying direct-to-customer sales as a manifestation of agile working methods. This proximity is posited to amplify the sensing and seizing capabilities of businesses. By gaining direct access to higher-quality data, companies can respond swiftly to market changes and engage in accelerated testing and learning cycles. This improves our understanding of how agile methodologies intricately shape customer-centric transformations in the automotive industry.

3.5.2. Agile ways of working across the business

The second trend is the pervasive adoption of agile methodologies, building on the Japanese lean methodology (Srinivasan, Srivastava and Iyer, 2020), beyond IT domains to encompass diverse business areas, notably product development. The analysis elucidates the driving forces behind this trend, emphasising the need for constant improvisation, the role of technological advancements, and the financial pressures exerted on OEMs. The observation underscores the pivotal role of strategic change implementation across all business facets as a critical determinant of organisational responsiveness, thus conferring a competitive advantage.

Situating within the literature on agile methodologies and organisational responsiveness, this research extends existing discussions by exploring the multidimensional application of agile working methods across diverse business areas in the automotive industry. Building on works by Annosi et al. (2020) and Denning (2018), this study provides novel insights into how the strategic use of agile methodologies reflects an organisation's capacity for responsiveness and adaptability in the post-COVID-19 era in the automotive industry context.

In the post-COVID-19 automotive industry, widespread adoption of agile methodologies can be observed across various business domains beyond IT, particularly focusing on product development.

This strategic shift is underpinned by several factors: a persistent need for organisations to improvise and respond rapidly to external changes, requiring internal processes that facilitate responsiveness and accelerated testing and learning cycles. Zahoor et al. (2022, p. 502) highlighted that "agile adaptation and new opportunity utilization were the primary means of dealing with the disruptions the COVID-19 pandemic […] sensing and seizing capabilities and engagement with opportunity recognition and discovery to capture opportunities and deal with the impact of the pandemic on their businesses". Technological advancements, particularly in AI, also emerge as key enablers for achieving more efficient, faster, and cost-effective product development. Furthermore, financial pressures on automotive OEMs, stemming from capital-intensive future investments in BEV, advanced driver assistance systems, and connectivity, intensify the imperative for agile methodologies.

Asserting that the ability to implement strategic change across all business areas is a crucial determinant of organisational responsiveness, thereby conferring a competitive advantage. Agility, particularly in product development, is not solely a technical domain concern but a holistic organisational imperative. The success factor lies in a company's comprehensive and cohesive adoption of agile working methods across diverse facets, reflecting a strategic approach to navigating the dynamic post-pandemic landscape.

3.5.3. Evolving success metrics

The third post-pandemic trend unravels the paradigm shift in business success metrics from traditional volume, costs, and margins to per-unit profitability and sustainability. The findings highlight the driving forces underpinning this trend, including the escalating demands from stakeholders for improved sustainability and the heightened importance of internal organisational integrity. The post-pandemic observations underscore the planet's emergence as a stakeholder in business strategy, coupled with the increasing significance of workplace improvements as a potential competitive advantage, especially in talent-scarce digital domains.

Situating itself within the literature on business success metrics and the evolving role of stakeholders (Buzzao and Rizzi, 2020; Sarkis, 2021; van Lieshout et al., 2021), this research extends existing discussions by exploring the nuanced shift from traditional financial metrics to a more holistic evaluation incorporating sustainability and organisational integrity. Building on works by authors such as Porter and Kramer (2011), Amui et al. (2017) and Kester et al. (2020), this study provides insights into the redefined success metrics in the post-COVID-19 automotive industry, acknowledging the emergence of the planet as a pivotal stakeholder alongside human constituents.

Fuller and Tian (2006) found that social relations for ethical behaviour can lead to the development of social capital that may provide a competitive advantage for global firms. Similarly, Santa-Maria et al. (2022, p. 1308) argue that “the most relevant practices for circular business model innovation processes are adopting a lifecycle perspective, employing sustainability-oriented instruments, ideating sustainable value propositions, developing a sustainability strategy and culture, and engaging and coordinating stakeholders in the business ecosystem”.

Traditionally focused on volume, costs, and margins (Gereffi and Güler, 2010; Sturgeon, Biesebroeck and Gereffi, 2007), the findings indicate that the automotive industry now gravitates towards per-unit profitability and sustainability. Two interlinked factors propel this paradigm shift. Firstly, there is a surge in demands from diverse stakeholders, including customers, shareholders, and policymakers, urging businesses to enhance sustainability practices in response to heightened global awareness. van Riel et al. (2021, p. 389) argue that the customer drives the sustainability transition as “consumers’ sustainability-focused behaviours drive the market for sustainable products and services, leading to sustainable firm and investor behaviour”. Secondly, internal organisational integrity gains prominence, driven by the blurring boundaries between work and personal life, especially in remote and hybrid working scenarios. Interviewees emphasised that employees now expect a culture that encourages authenticity and aligns with their employer's purpose, thereby making "doing things right" a potential competitive advantage.

In the post-pandemic context, the planet has evolved into a critical stakeholder in business strategy. Coupled with a fierce war for top talent in talent-scarce digital domains, workplace improvements and sustainable practices become potential competitive advantages. The trend underscores the convergence of external demands for sustainable practices and internal expectations for organisational integrity, shaping a new landscape where ethical business conduct is not only socially responsible but also strategically advantageous.

3.5.4. Agile business management strategies

The fourth post-COVID business management trend is the shift from annual KPIs to OKRs coupled with quarterly business reviews. The analysis unveils the drivers behind this paradigm shift, emphasising the imperative to amalgamate qualitative and quantitative success metrics and pivot swiftly in response to external changes. Managerial approaches evolved to align with stakeholder demands, fostering dynamic adaptability through frequent review and adjustment cycles across business areas and organisational hierarchies.

Rooted in the literature on business management and the evolution of performance metrics (Roberts and Grover, 2012, p.580; Rompho, 2023; Teece, 2007), this research extends existing discussions by exploring the nuanced shift from annual KPIs to OKRs and quarterly business reviews in the post-COVID-19 automotive industry. Drawing insights from works by Robinson and Pearce (1988) and Doerr (2018), this study observes how contemporary managers are redefining their approaches to embrace agility, responsiveness, and long-term strategic alignment in an ever-changing business landscape.

Funke et al. (2023) argued that employees across organisational hierarchies are part of businesses' dynamic capabilities, i.e., the sensing, seizing and reconfiguration engine, reinforcing the need to dynamically cascade changes in business objectives. A tool to achieve this is OKRs, which "facilitate the acceptance of performance indicators and help solve issues of alignment between indicators and organizational strategies as well as improper target setting" (Rompho, 2023, p.1). Herkenrath et al. (2023) highlight the importance of adopting the implementation of the OKR framework to the specific business context.

The strategic KPI to OKR and quarterly review shift is propelled by the imperative to integrate both qualitative and quantitative success metrics, encompassing crucial aspects such as digitisation, customer centricity, and sustainability (López-Cabarcos, Srinivasan and Vázquez-Rodríguez, 2020; van Riel et al., 2021). The need for swift pivoting during the year to respond dynamically to external changes, including technological advancements and supply chain disruptions, underscores the agility required in contemporary business management.

Managerial approaches are evolving to align with current stakeholder demands and dynamically adapt to external changes (Teece, 2007; van Lieshout et al., 2021). Implementing frequent review and adjustment cycles across business areas and organisational hierarchies becomes pivotal. In response to heightened expectations for agility and responsiveness, managers embrace OKRs and quarterly reviews, integrating metrics that align with their long-term ambitions. This observation positions agile business management as an essential component for organisations navigating the complexities of the post-COVID-19 era.

3.5.5. Decoupling hardware and software development

The fifth post-pandemic trend suggests utilising agile methods to decouple hardware and software development. The analysis elucidates the driving forces behind this strategic shift, highlighting heightened competition, evolving consumer expectations, and technological advancements necessitating the decoupling of hardware and software development cycles. The trend underscores how incumbents leverage systems engineering approaches to expedite time to market and grapple with implementation challenges arising from diverse organisational cultures and legacies across physical and digital development domains.

Positioning itself within the literature on agile methodologies (Denning, 2018a; Ghezzi and Cavallo, 2020), technology management (Adner and Levinthal, 2001; Lanzini, 2018), and organisational challenges (Andriopoulos and Lewis, 2009; O'Reilly and Tushman, 2008), this chapter's findings extend existing discussions by exploring the nuanced applications of agile ways of working in decoupling hardware and software development cycles. Drawing insights from works by Reifer (2002) as well as Campanelli and Parreiras (2015), this study focuses on the dynamics and challenges associated with decoupling physical and digital development cycles in the post-COVID-19 automotive industry.

Orosz et al. (2023b, p. 665) referred to mission engineering as the application of "systems engineering processes and principles to the complete product lifecycle - requirements analysis, design, development, integration, testing, deployment, and sustainment of a complex system of a systems project. Such processes and principles include DevSecOps[4], digital engineering, model-based systems engineering, Agile and other systems design and development processes". Especially in complex environments like automotive manufacturing, a challenge is "how to manage the agile development process to ensure that all components are developed as a system of systems and not as independent and isolated entities. Multiple vendors, differing timelines, delays in releases, changing requirements, the availability of reliable supply chains, and various internal and external dependencies will need to be considered" (Orosz et al., 2023a, p.201).

Some manufacturing firms have attempted to integrate agile practices into hardware design and manufacturing. Cooper and Furst (2023, p. 1) observed that "leading manufacturers have borrowed agile development from the software world and integrated it with their stage-gate method. Typically, physical-product firms embed them into the stages of their familiar gating process to replace the

[4] DevSecOps, an amalgamation of Development, Security, and Operations, is an approach that integrates security practices into the DevOps process. It emphasises collaboration, automation, and continuous monitoring, ensuring that security is ingrained throughout the software development lifecycle (Rahman, Parnin and Williams, 2019).

traditional product management methods. The resulting hybrid agile–stage-gate model delivers positive performance results: faster response to change, higher customer satisfaction, and increased team motivation”.

The strategic use of agile ways of working to decouple hardware and software development cycles is imperative and driven by intensified competition and consumer expectations for regular vehicle updates, necessitating a dynamic and independent progression of hardware and software throughout the product lifecycle. Additionally, technological advancements, including virtual simulation and the centralisation of in-vehicle IT architecture, provide the means to decouple these development cycles effectively.

Two distinct findings emerge from this trend, as identified in section 3.4.2.5. Firstly, incumbents strategically decouple physical and digital product and service development cycles by deploying systems engineering approaches, aiming to shorten the time to market. This aligns with the broader discourse on agility, adaptability, and responsiveness in technology-driven industries (Beier et al., 2017; Easingwood, Moxey and Capleton, 2006). Secondly, the research highlights the implementation challenges arising from the different organisational cultures and legacies across physical and digital development organisations. This development underscores the need for a nuanced understanding of organisational dynamics to effectively navigate the complexities associated with the decoupling process.

3.5.6. Rethinking external collaborations

The sixth observation is OEMs embracing external collaborations, such as strategic partnerships and alliances, to enhance the delivery of products and services in alignment with evolving customer expectations. Previously discussed by MacDuffie and Fujimoto (2010) and MacDuffie, (2013), this chapter emphasises the complexity, speed of change, capital intensity, and specialisation required for advanced technologies, including AI and connectivity. The trends underscore how technology implementation has become a pivotal differentiator while investments in tech capabilities have become riskier. This shift has made OEMs recognise external complementary needs and capabilities, a trend amplified by the challenges posed by the COVID-19 crisis.

This research is positioned within strategic collaborations, technology implementation, and organisational responsiveness studies. Building on works by authors such as Teece (1986) and Powell et al. (1996), this study explores the nuanced dynamics of external collaborations in the post-COVID-19 automotive industry, especially in the context of rapidly evolving technology landscapes and the recognition of complementary capabilities.

Manufacturing firms attempt to bring in external insights to improve what they do and how they operate. For example, they "pursue business model innovation through outside-in thinking, e.g., by interacting with customers and sharing information with suppliers" (Wu, Liu and Bao, 2022, p.1745). To partner externally, manufacturing firms employ various strategies, including forming strategic alliances to reduce risks and costs while improving the technology integration into the products (Easingwood, Moxey and Capleton, 2006).

Recognising the complexity and speed of technological advancements and the capital intensity and specialisation needed for technologies like AI and connectivity, OEMs increasingly turn to strategic partnerships and alliances (MacDuffie, 2013; Macduffie, 2018). These collaborations extend beyond traditional supplier relationships and are driven by the imperative to navigate the rapidly evolving technological landscape. Notably, the COVID-19 crisis, including the chip shortage, has heightened the urgency for OEMs to seek specialised technology partners to mitigate risks and accelerate innovation.

As illustrated in section 3.4.2.5, technology implementation has shifted from a mere enabler to a pivotal differentiator. Simultaneously, investments in tech capabilities have become riskier due to technology's rapid evolution and increasing fundamental role in business success. Heightened by the challenges posed by the COVID-19 crisis, OEMs have developed a heightened understanding of recognising complementary needs and capabilities through strategic collaborations. This recognition is crucial in navigating the complexities of the contemporary automotive landscape.

3.5.7. Discussion summary

Within the context of agile ways of working as a strategic tool in the post-COVID-19 automotive industry, this research identifies several trends across key themes.

The first post-pandemic trend explored is the accelerated transition from a retail-based sales model to direct-to-customer sales. This shift is attributed to the imperative to adapt product offerings quickly to changing market conditions and the ability to learn more about end customers for product and service improvement. The observation underscores that businesses are moving closer to end customers to sense and seize changes better and faster (Matarazzo et al., 2021; van Riel et al., 2021), emphasising the strategic advantages gained through direct access to high-quality data and the ability to expedite testing and learning processes.

A second trend involves implementing agile working methods across more business areas beyond IT, such as product development (Gharakhani et al., 2013; Tavani, Sharifi and Ismail, 2014). This shift is motivated by the constant need for improvisation and response to external changes, technological advancements as key enablers, and financial pressures on automotive OEMs. The findings assert that a key business success factor and competitive advantage lies in an organisation's ability to implement strategic change within and across all business areas, reflecting adaptability to external changes.

The third post-pandemic trend centres around changes in business success metrics, moving from traditional volume, costs, and margins to per-unit profitability and sustainability (Lu, Chen and Shen, 2018; van Riel et al., 2021). Stakeholder demands, including customers, shareholders, and policymakers, drive this shift towards increased sustainability and ethical business practices. The shift emphasises that the planet has become another stakeholder for businesses, and adherence to sustainable practices can be a potential competitive advantage, especially in digital areas where talent shortages and employee demands are more pronounced.

The fourth trend involves a shift in business management practices from annual KPIs to OKRs and quarterly business reviews (Doerr, 2018; Stray et al., 2022). This change is driven by the need to adapt more dynamically to external changes and to combine qualitative and quantitative success metrics. The trend posits that to reflect current stakeholder demands and adapt more dynamically, managers are changing how they manage their businesses, implementing more frequent review and adjustment cycles.

The fifth trend explores using agile methods to decouple hardware and software development. This is motivated by increased competition and consumer expectations for regular updates throughout a vehicle's lifecycle (Pütz et al., 2019; Taiebat et al., 2018), necessitating the decoupling of hardware and software development cycles. The trend highlights that incumbents achieve this through deploying systems engineering approaches to shorten time to market while acknowledging the implementation challenges stemming from organisational cultural differences.

The sixth trend identifies a greater openness among OEMs to external collaborations, such as strategic partnerships and alliances, to deliver products and services better and faster (e.g., Alliance RNM, 2023; Patel and Cehic, 2020). The complexity and speed of technological change and capital-intensive requirements drive OEMs to partner with specialised technology partners (Cepa, 2021; Llopis-Albert, Rubio and Valero, 2021). Technology implementation has become a differentiator, and OEMs have become adept at recognising complementary needs and capabilities through collaborations.

In summary, these observations illuminate the multifaceted landscape of agile working as a strategic tool in the post-COVID-19 automotive industry. They provide insights into the strategic advantages gained through closer engagement with end customers, the adaptability of organisations to external changes, the evolving metrics for business success, the dynamic nature of business management practices, the dynamics of hardware and software development, and the strategic implications of external collaborations. This chapter offers perspectives for scholars and practitioners navigating the dynamic environment of agile working in the contemporary automotive landscape.

3.6. Conclusion

This study has offered insights into the utilisation of agile ways of working as a strategic tool in the automotive industry, both before and after the COVID-19 crisis. The pre- and post-COVID findings on agile ways of working as a strategic tool were similar in two ways.

First, agile methodologies' importance is emphasised in pre- and post-COVID discussions. Agile methodologies were seen as crucial in navigating industry transformations, especially evident in sales during the pandemic. Second, key principles such as clear direction, focused KPIs, collaboration, MVP selection, employee involvement, and continuous learning were underscored in both analyses.

The pre- and post-COVID findings on agile ways of working as a strategic tool were different in one main way. The post-COVID analysis delved into emerging trends in agile working in response to the pandemic's impact, highlighting a rapid and global transition to direct-to-customer sales, broader implementation of agile methods, changes in success metrics, a shift in management practices towards dynamic evaluation cycles, decoupling hardware and software development, and increased openness to external collaborations.

By bridging the pre- and post-COVID discussions, this study contributes to the existing literature by providing a comprehensive examination of agile strategies in the automotive context. It highlights organisations' adaptability in response to external disruptions and underscores the strategic advantages gained through closer engagement with end customers, dynamic management practices, and strategic collaborations. Furthermore, it emphasises the importance of aligning organisational strategies with evolving market dynamics and stakeholder demands.

Opportunities for future research abound to explore the nuanced implications of agile methodologies in different industries and organisational contexts. Future studies could delve deeper into the specific roles and functions involved in agile strategy implementation and investigate the causal relationships between agile methodologies and performance outcomes. Additionally, investigating the long-term effects of agile strategies on organisational resilience and competitiveness would provide valuable insights for scholars and practitioners alike.

In summary, this chapter offers a timely and holistic perspective on the multifaceted landscape of agile working as a strategy tool in the automotive industry, paving the way for future exploration and application in the dynamic and ever-evolving business environment.

4. The three dimensions of strategic flexibility

4.1. Introduction

As per Table 1.1, a key theme of this chapter is strategic flexibility. Meeting customer needs profitable is vital for long-term firm survival. Today, customer needs change dynamically, requiring firms to continuously adapt their strategies (Hawk, Pacheco-De-Almeida and Yeung, 2013; Teece, Peteraf and Leih, 2016). Strategic flexibility is fundamental to organisational adaption. The concept refers to firms' ability to sense strategic opportunities in dynamic environments and readjust the strategic orientation accordingly (Sanchez, 1995). Given investment capital, technological, talent, and cultural constraints, this exercise is not trivial. In the automotive industry, incumbents try to meet customer needs for cheaper and better-equipped vehicles while complying with zero or low-emission vehicle regulations and competing with new entrants (Macduffie, 2018; Songthaveephol and Mohamad, 2020). Car manufacturers adapted their strategies to increase the number of BEVs and improve connectivity but must demonstrate strategic flexibility to address future-oriented issues like mobility services and autonomous driving.

The debate on strategic flexibility has been going on for decades, originating in the concept of time-based competition (Bower and Hout, 1988; Stalk, 1988). The idea received interest from academics and found application in managerial practice. One initiative was the quick response programme to efficiently react to changing customer needs (Lowson, King and Hunter, 1999). While strategic flexibility is focused on institutions' strategic direction, other concepts, like dynamic capabilities, are concerned with the continuous adaption of organisations and reconfiguration of resources (Teece, Pisano and Shuen, 1997; Teece and Pisano, 1994).

Prior studies identified individual contributors to strategic flexibility and dynamic reconfiguration of resources, such as top-management-team sensing abilities and an open failure culture (Brinckmann et al., 2019; Ghemawat, 1991; Lubatkin et al., 2006). This chapter challenges the assumptions that (1) a single contributing factor can lead to a firm’s success or failure without considering the interplay with other factors[5], and (2) there is one factor or uniform configuration of factors that lead(s) to success across industries (Beach et al., 2000; Combe, 2012; Hess and Flatten, 2019). Recent research, such as the systematic literature review by Herhausen et al. (2021), highlights mixed outcomes of strategic flexibility, indicating that its positive impact depends on context and alignment of various internal (e.g., resource configuration) and external (e.g., market conditions) factors. To address these complexities, a strategic flexibility model based on product, process, and customer is proposed, drawing upon empirical evidence from three automobile manufacturers, synthesising existing literature on systems thinking, dynamic capabilities, and new ways of working.

The approach presented in this chapter is different from existing frameworks in its focus on the interconnectedness of various strategic elements and its emphasis on the need for a nuanced, multi-agent perspective. Unlike traditional models of dynamic capabilities that often centre around isolated factors like leadership or resource allocation, this approach recognises the importance of coordination across multiple agents within the firm - such as cross-functional teams, middle management, and top-management teams - in fostering strategic flexibility. By highlighting the role of strategic empowerment, where decision-making is distributed throughout different levels of the organisation, this approach accounts for the diverse contributions of various actors in adapting to change. Additionally, the framework underscores the necessity of aligning these empowered agents through effective coordination mechanisms, ensuring that individual actions contribute to a cohesive, organisation-wide strategy.

[5] While perhaps no reputable study would explicitly argue that a single factor determines firm survival and success, there is an evident tendency of studies to over-emphasise one particular factor and not necessarily acknowledge the full breadth and depth of dependencies to other factors. For example, Riesener *et al.* (2020) focus on firm internal implementation processes while potentially not acknowledging the full extent to which strategising the right way is mission-critical. Contrarily, Hahn *et al.* (2020) strongly emphasise the customer and product while not fully detailing the vastly different ways firms implemented similar strategies and achieved varying levels of market success.

The remainder of this chapter is structured as follows. Section 4.2 covers central definitions and related concepts from existing literature. The methodology is detailed in section 4.3. Pre- and post-COVID findings are presented in section 4.4. Section 4.5 discusses the findings in the literature context and highlights implications for managerial practice before section 4.6 concludes the chapter.

4.2. Definition and related concepts

4.2.1. The origin of strategic flexibility: systems thinking

The concept of flexibility originates in the general systems theory. In systems theory, a response can be defined as "a system event for which another event that occurs to the same system or to its environment is necessary but not sufficient; that is, a system event produced by another system or environmental effect (the stimulus). Thus a response is an event of which the system itself is the co-producer" (Ackoff, 1971, p.664). Although flexibility comprises set of responses, it is closer to the concept of responsiveness, defined as "the ability to react purposefully and within an appropriate timescale to significant events, opportunities or threats (especially from the external environment) to bring about or maintain competitive advantage" (Kritchanchai and MacCarthy, 1999, p.814). Responsiveness received particular attention in the operations and production management literature (Dey et al., 2019; Holweg, 2005; Vishnevskiy, Karasev and Meissner, 2016). Strategic flexibility can be considered as its antecedent.

4.2.2. Hierarchy of strategic flexibility

According to the Oxford Dictionary, flexibility can be understood as the "ability to bend" or "ability to adapt". Management scholars refer to the latter when considering flexibility as an adaptive response to external uncertainty (Barrales-Molina, Bustinza and Gutiérrez-Gutiérrez, 2013). Both the strategic flexibility and dynamic capabilities literature consider the ability to respond internally to dynamic externalities as a potential source of competitive advantage (Collis, 1994; Ethiraj et al., 2005; Grøgaard, Colman and Stensaker, 2022). Although debates are concerned with various external dynamics, scholars showed particular interest in dynamic responses to changing customer needs (Johnson, Christensen and Kagermann, 2008; Vinokurova, 2019).

Motivators to seek strategic flexibility are likely to vary across firms and industries, depending on external dynamism. Earlier studies focused particularly on operations-related benefits, such as faster deliveries as a potential source of competitive advantage (Slack, 1991). Later studies paid closer attention to technological flexibility, the ability to flexibly adapt technologies according to changing business needs (Zhou and Wu, 2010). Recent literature is especially concerned with firms' ability to adapt talent pools dynamically (Haarhaus and Liening, 2020; Zhao and Wang, 2020). Figure 4.1 attempts to contextualise strategic flexibility by adapting a framework to link dimensions of operational responsiveness introduced by Slack (1991). The illustration conceptualises the link of strategic flexibility to pursue a guiding vision by implementing resource flexibility (dynamic capabilities) in the three key dimensions of talent, technology, and operations.

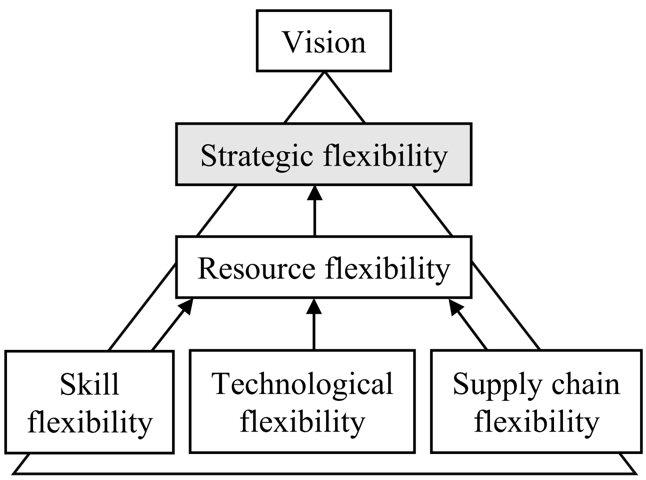

Figure 4.1 Hierarchy of strategic flexibility, adapted from Slack (1991)

Slack (1991) focuses on operations and argues that high levels of external uncertainty require a high degree of operational flexibility regarding technology, labour and supply networks. However, he acknowledges that a higher degree of flexibility might be associated with efficiency trade-offs. Hence, he refers to the ideal factory as one that manages the tension of flexibility and efficiency in light of external sensing. Figure 4.1 expands his elaborations by introducing a strategic layer that mediates a firm’s vision and operations. This chapter argues that system flexibility, across all layers, is required to adapt successfully to external volatility, uncertainty, complexity and ambiguity (Schoemaker, Heaton and Teece, 2018; van Tulder, Jankowska and Verbeke, 2019). An example from the automotive industry demonstrating flexibility across all layers is the shift by most incumbent car manufacturers from aspiring to become a mobility service provider to a wide range of different approaches, once they recognised the challenging economics associated with mobility services (Ensslen et al., 2020; Pütz et al., 2019).

4.2.3. Strategic flexibility, new ways of working and the automotive industry

The idea of strategic flexibility as the ability to respond quickly to changing externalities is somewhat generic and abstract, partly overlapping with some interpretations of concepts like dynamic capabilities. Concrete and actionable approaches to implementing strategic flexibility emerged over the recent year. Two concepts to potentially implement strategic flexibility are lean (start-up / entrepreneurship) and agile (development / manufacturing). While the former often refers to a set of principles for continuous improvement, the latter provides processes to dynamically adapt (Brinckmann et al., 2019; Dey et al., 2019; Yusuf et al., 2014). Both concepts aim to create greater value for stakeholders by using fewer resources to bring a superior product to the market.

Scholars have been particularly interested in lean and agile practices in the automotive industry. Debates centred around whether the practices are appropriate ways to achieve flexibility both on a strategic but mainly operational level. A lean variation focused on lead time reduction and manufacturing efficiency is lean production, especially the Toyota Production System (Dey et al., 2019). Agile practices found widespread adoption in software developments but are also increasingly being employed in hardware development and manufacturing. Different to lean, agile focuses on product-market fit and increasing customer value. In the automotive industry, both lean plants and agile manufacturing approaches correlated positively with efficiency gains by enabling faster responding to changes in demand and improved productivity (Conboy, 2009; MacDuffie, 2013; MacDuffie and Fujimoto, 2010). The ability to adapt in these dimensions may be critical to survival, especially in times of unprecedented industry transformation, such as for the automotive industry during the COVID-19 pandemic (Choi, 2020; Ivanov, 2020; Wang and Wells, 2020). While lean and agile may appear contrasting to some, they are complementary, and firms need to adopt elements of both components, particularly to achieve both strategic and operational flexibility.

4.2.4. Synthesis

Several debates contribute to discussions of strategic flexibility and adaption of firms to external dynamism. Although prior studies focused intensely on operational flexibility, strategic flexibility lacks empirical evidence underpinning. However, the idea of time-based competitiveness demonstrates the need for a conceptualisation of strategic flexibility.

This chapter aims to identify the key factors influencing strategic flexibility to respond to changing customer needs. A great variety of related concepts and debates reflect the wide range of relevant factors. Prior studies identified the nature of demand sensing, product variety management, lead-time adoption, product life cycle management, supply chain responsiveness and customer expectation management to be among the relevant aspects (Herhausen et al., 2020). Most studies of these specific issues overemphasise the importance of the influences under consideration. Reflected in the diversity of influencing factors, a considerable ambiguity regarding their interplay remains, highlighting the need for a holistic approach to strategic flexibility. Although prior studies appear fragmented, there are underlying commonalities. These can be grouped into three dimensions of strategic flexibility. The three dimensions conceptualise firms following a systems approach, considering input (customer), intermediary (process), and output (product).

1. The *customer* dimension includes nature and variability of demand (Claussen, Essling and Peukert, 2018). It covers customer expectations concerning time-to-market, product variety, customer interface, and product distribution. Key contributors include (Day, 1994; Enders et al., 2009; Johnson, Christensen and Kagermann, 2008; Vinokurova, 2019).
2. The *process* dimension mediates the product-customer relationship, covering aspects like time-to-market, supply chain management and supplier management (Ivanov and Dolgui, 2020; Krause, Handfield and Tyler, 2007). Key contributors include (Dey et al., 2019; Holweg, 2005; Kritchanchai and MacCarthy, 1999; Robinson and Malhotra, 2005).
3. The *product* dimension covers factors like product architecture, product customisation, product variety and product lifecycle management. Key contributors include (Jacobides, Macduffie and Tae, 2013; Lee and Tang, 1997; MacDuffie, 2013).

Three case studies will be presented in the pre-COVID findings that highlight the three dimensions and their relevance to strategic flexibility. The cases help to quantify the factors identified above and discuss their impacts on particular automotive manufacturers' strategic flexibility. The objective is to elevate the fragmented debate from the realms of mainly qualitative descriptions (Herhausen et al., 2020; Nadkarni and Narayanan, 2007).

4.3. Methodology

For the pre-COVID study, a multi-method approach was chosen to collect data from three categories of automobile manufacturers. Semi-structured interviews with key employees from departments including business development, production, sales and human resource, identified using purposive sampling, were carried out between December 2019 and July 2020. A total of 26 interviews were conducted until data saturation was reached. The interviews were complemented by value stream mapping. Value stream mapping followed Rother and Shook (1998) “learning to see” methodology, as it shows the entire delivery process on one map as opposed to separate illustrations. Thereby, interdependencies of the three dimensions of strategic flexibility are more clearly identifiable. Besides, the automotive market and customer data were triangulated with primary data for a holistic and more conclusive picture (Jick, 1979; Morse, 1991).

In the post-COVID study phase, a methodologically rigorous approach akin to the previous chapters was adopted to gather data from various automobile manufacturers and other industry stakeholders. The research employed semi-structured interviews conducted with key personnel involved in automotive strategy making. Utilising purposive sampling, interviewees were selected based on their roles and expertise relevant to the study's objectives. As detailed in section 1.6.2, the interviews were conducted between April and June 2023 to capture insights into the strategic adaptations and responses of automotive manufacturers in the aftermath of the pandemic-induced disruptions.

Similar to the pre-COVID phase, the post-COVID interviews aimed to delve deeply into participants' perspectives, experiences, and strategies in navigating the challenges brought about by the pandemic. By employing purposive sampling, the study ensured that interviewees possessed valuable insights and first-hand knowledge pertinent to the research objectives, thus enriching the depth and breadth of the data collected.

NVivo software was utilised for data analysis, facilitating systematic organisation, coding, and thematic exploration of the interview transcripts. This analysis approach allowed for rigorous examination and interpretation of the data, uncovering patterns, themes, and insights relevant to the study's focus on strategic flexibility and adaptations within the automotive industry.

Furthermore, the post-COVID methodology embraced the principles of triangulation, whereby the insights gleaned from interviews were corroborated and enriched by complementary data sources. Triangulation involved integrating qualitative interview data with other primary and secondary data, such as market trends, industry reports, and industry conference presentations. This holistic approach aimed to provide a comprehensive and nuanced understanding of the evolving landscape of agile working practices within the automotive sector during the COVID-19 crisis.

4.4. Findings

4.4.1. Pre-COVID findings on strategic flexibility

The pre-COVID findings section is broken down into key factors and observations. Considering various factors is required to provide a balanced view of all three dimensions of strategic flexibility. Across markets, customer expectations and preferences, product configurations and delivery process vary. Hence, the descriptions of all three dimensions within a single chapter remain on a necessarily high level.

4.4.1.1. Key factors

Three cases from the "industry of industries", as Drucker (1946) coined the automotive industry, were chosen. Over decades and increasingly in recent years, the automotive industry has received attention from strategy scholars (Al-Shaghroud, 2013; Genzlinger, Zejnilovic and Bustinza, 2020; Holweg, 2005; MacDuffie, 2013; Teece, 2018c). Yet, research and managerial practice seem to be puzzled about adopting the strategic flexibility concept to car manufacturers and vice versa. Over recent years, car manufacturers demonstrated a vulnerability in sensing and profitably fulfilling customer needs by entering the mobility service market unsuccessfully and paddling back in autonomous driving deployments (Figliozzi, 2020; Narayanan, Chaniotakis and Antoniou, 2020). Besides, BEV adoption proved to be only in regions with substantial governmental subsidies a success, highlighting challenges car manufacturers face in successfully delivering innovations (Wesseling et al., 2015). At the same time, customers complain about old in-vehicle technology and long order-to-delivery waiting times (Ganji et al., 2020; Mehdizadeh and Ermagun, 2020). Although both incumbent car manufacturers and new entrants respond to these challenges, the industry so far failed to demonstrate strong strategic flexibility. Therefore, three automobile manufacturer cases from the three different categories of mass-market manufacturer, premium manufacturer, and new entrant are being analysed to better understand the varying degrees of strategic flexibility. Table 4.1 highlights the key factors in the three dimensions of customer, process and product.

Key factor	Mass manufacturer	Premium manufacturer	New entrant
Customer			
Expectations	Medium defect tolerance, expecting product recall and compensation	Low defect tolerance	High defect tolerance but expecting a timely repair or update
	Focus on price, reliability and practicality	Focus on brand status, vehicle equipment and premium feel	Focus on the most recent vehicle technology and customer engagement
Demand variability	Fragmented brand loyalty	Traditionally high brand loyalty but decreasing	Brand advocates: Very high brand loyalty
Process			
Innovation approach	Top-down and bottom-up Risk tolerance: Moderate	Middle-out and partnership-oriented Risk tolerance: Conservative	Top-down and radical innovation-focused Risk tolerance: Aggressive
Complexity management	Successively reducing complexity (models and variations) of legacy ICE vehicles, legacy IT systems and initially higher complexity BEVs using systems engineering		Focus on reducing complexity in the development and from the ground up using systems engineering
Time-to-market	3 to 4 years		1.5 to 3 years
Product			
Product lifecycle	Strategic focus on the next 4 to 5 years		Focus on value creation over the vehicle lifetime Strategic focus on the next 18 months
Differentiation	Focused on price/ economies of scale and vehicle platforms	Focused on advanced customer experience and vehicle ecosystems	Focused on brand and advanced vehicle technology in all CASE dimensions
Alternatives	High competition in the mass market for BEVs and ICE vehicles	Medium competition in the more specialised premium segment for BEVs and ICE vehicles	Low but increasing competition in the advanced technology BEV market Fragmented competition in autonomous driving and shared mobility

Table 4.1 Quantifying key factors

4.4.1.2. Key observations

Several conclusions can be reached from comparisons. First, customers from the three manufacturer categories have different expectations. The new entrant's customers have a comparatively high defect tolerance but expect a timely repair or update. The defect tolerance of incumbent's customers is low in the premium and medium in the mass market segment. Defect tolerance directly links to manufacturers possibilities to test innovations in the market (Heineke et al., 2020; Skrickij, Šabanovič and Žuraulis, 2020). Hence, the new entrant is better positioned to iterate and learn faster from innovations in the market, potentially leading to improved innovation outcomes. The different expectations are also reflected in the focus of customers. Incumbent's customers focus on more conventional attributes, like price, reliability, practicality and brand status. The most recent vehicle technology and customer engagement are the focus of the new entrant's customers. The focus on engagement is also reflected in closer intimacy with the customer and high brand loyalty.

Second, the three manufacturers approach the process dimension partly differently. The ways to innovate vary and link to the companies' risk tolerance as well as stakeholders. The risk-capital backed new entrant is innovating more aggressively by focusing top-down on radical innovation. In terms of risk tolerance, the mass and premium manufacturers are rather moderate and conservative, respectively. Given the higher vehicle volume and operating cash flow, the mass manufacturer can afford to approach innovations simultaneously top-down and bottom-up (Bauer et al., 2020; Sovacool et al., 2020). Radical innovations are being developed top-down based on a greenfield approach, while short- and medium-term oriented innovations are being developed bottom-up based on existing products and technologies. The premium manufacturer sits somewhat in the middle and instead focuses on developing partnerships with leading innovators in relevant domains. Complexity management is a challenge for all players, but particularly for incumbents given their legacy vehicles and IT systems (Möller and Haas, 2019; Yuen et al., 2020). All three players use systems engineering to reduce complexity and interdependencies, thereby improving cost structures and scalabilities of solutions.

Reduced complexity is also associated with a shorter time-to-market. Time-to-market has increased in importance as a competitiveness differentiating factor over recent years as consumers demand newer in-vehicle technologies and faster vehicle updates (Beak et al., 2020; Ganji et al., 2020). The new entrant has a considerable advantage and brought vehicles to market in between 1.5 and 3 years, instead of the 3 to 4 years of incumbents.

Third, all three players demonstrated strategic flexibility in the product dimension differently. Fundamentally, the strategic focus differs. While the incumbents are 4 to 5-year plan-oriented, the new entrant focuses on the next 18 months. The more near-term oriented strategic focus is reflected in a product lifecycle management geared towards continuous value delivery to customers (Tirachini, 2020). The three players also have different views on how to differentiate. While the mass manufacturer focuses on economies of scale and vehicle platforms, the premium manufacturer pays particular attention to an advanced customer experience and vehicle ecosystem. The new entrants' more aggressive innovation approach is also reflected in its differentiation. The company attempts to lead with advanced vehicle technology in all four CASE dimensions. Moreover, it emphasises brand differentiation, reflected in different values such as a disruptive challenger mentality. Finally, incumbents are simultaneously competing in their legacy ICE markets and successively increasing the share of BEV sales, not demonstrating attempts to lead in autonomous driving and mobility services. However, the new entrant follows a bigger vision of leadership in a world of widespread adoption of connected autonomous vehicles, underpinned by investments in all domains.

4.4.2. Post-COVID findings on strategic flexibility

This section summarises the key findings from the post-pandemic interviews, building on the pre-COVID findings. Interviewee 46 summarised the overall theme of strategic flexibility by stating that "*as a manager, my view is that the only thing certain in our lives is change. What we do is manage change. Some change can be planned, and change can be unplanned. You need to manage both*". He further describes that financial, production and other targets usually change throughout the year in response to external changes while managers focus on remaining profitable. Hereafter, the post-COVID findings are summarised across key main themes: strategy programmes, success metrics, and positioning.

4.4.2.1. Strategy programmes

Across the interviews, it remained evident that automobiles are complex, engineering-heavy products that take a long time and a lot of resources to design, manufacture and bring to market. This limits the strategic flexibility once investments in particular vehicle programmes have been made. Interviewee 34 summarised that "*the planning horizon has always been long. Such an average car has a life cycle of seven years. And then the successor also has to plan for a seven-year vehicle project. That means we are already talking about a planning horizon beyond ten years*". Interviewee 62 described that sales and internal investment planning are still traditional as OEMs have been operating with ICE vehicles for decades, writing off investments over 20 years. He further adds that this implies that OEMs have to plan sales long-term for 20 years while acknowledging that drive train technologies will become more sustainable.

Interviewee 42 referred to the area of tension between flexibility and scale: "*To be able to cover the uncertainty of consumer behaviour, you have to invest heavily in flexibility. […] But what has always given automobiles a very strong competitive advantage was economies of scale, producing much on the same line so that the investment pays for itself quickly*". He continues to describe how flexibility reduces margins, especially in the post-pandemic climate. There have been efforts to reduce costs and only keep flexibility where it's needed in terms of responsiveness and where margins allow it. Interviewee 53 added that, therefore, OEMs standardise hardware more while trying to differentiate through software, which is more adaptable. He concluded that "*you need a certain flexibility and have innovations in a high number of cycles that it's not even possible to plan it that way […] you have to remain flexible and reflect that in corporate planning and in a strategy*".

Given the increased post-pandemic VUCA environment, market sensing has become more important. Interviewee 66 argued that "*consumer research has never been more important and mapping trends and particularly country by country as an OEM […] it's absolutely critical that market needs are assessed and delivered upon*". Similarly, interviewee 77 highlighted the necessity of regulatory sensing: "*Regulation is making it very difficult for the industry because regulators just keep coming up with one thing after the other to keep the OEMs busy that distracts from the real issues. We are having discussions in Europe now with this monolithic focus on e-mobility, that is actually almost nowhere in the world. And the reason for this is that there are politicians who believe they can anticipate technological developments better than others*". He goes on to provide examples of challenging regulation – due to the global uncertainty and unpredictability – in terms of their role as technology decision-makers, which might be better placed with businesses. Furthermore, the manager describes some of the global disparities in terms of regulatory requirements, which might be considerably stricter for Europeans compared to some OEMs from Asia, affecting their global competitiveness.

One framework OEMs use more in the post-pandemic context are tactical quarterly reviews to complement the strategic direction. Interviewee 58 described that the strategic direction is about what the business wants to be and how it is going to get a competitive advantage that needs to be much longer than a quarter: "*You need a combination of both strategic and tactical execution, executing the strategy and having tactical plans to be able to iterate […] it is not wrong to have a 10 year plan but do not invest heaps of money on a 10 year plan. Try and take it one or two years, have a vision for what you want to be in 10 years*". He provides the historical example of Volvo, which had the vision of becoming a leader in vehicle safety. Tactical decisions are more about product plans and other how-related factors. In a post-COVID environment, quarterly reviews are important as they provide flexibility, helping businesses understand where and how to adjust the implementation.

Interviewee 45 explained why he believes OEMs should adopt more systems engineering to understand the implications of supply disruptions: "*Everything is a system of systems in the sense that ripples in the transportation market will affect the price per unit for suppliers that will affect the price per unit for a bill of materials. Impacts on materials will impact the price of the batteries […] I think access to resiliency when black swan events or several black swan events happen is key*". He further describes how OEMs have been more careful in selecting suppliers based on their location, which provides additional supply chain resilience.

Interviewee 68 described how they use the STEEP (Social, Technical, Economic, Ecological, and Political) framework to sense short, medium, and long-term external changes that could disrupt the business. He also explained that he is seeing a difference in how businesses respond now compared to the last financial crisis: "*If I go back to say the 2010s after the financial crisis, everyone fell back into much the same pattern as before. But now we've had Brexit, now we've had pandemic, now we've had war in Ukraine, everyone's more disrupted. VUCA is now a reality*". He adds further that strategic frameworks like STEEP have become more important and widely used amongst senior leaders to manage unexpected changes.

4.4.2.2. Success metrics

Historically, OEMs have been focusing on maximising their production capacity while minimising production costs. OEMs' management set annual revenue and profit targets based on assumptions of costs that the organisation – irrespective of disruptions throughout the year – tried to hit to meet investors' expectations. Interviewees 37 and 55 described how a new trend emerged during the pandemic of OEMs focusing more on building cars that are desirable for customers, and that can be sold at a price premium. Manufacturers have also focused on reducing inventory and integrating connected services into the vehicle to achieve price premiums. In the post-COVID environment, OEMs are also more conscious about where they sell their vehicles and focus on growth markets, like China.

Overall, interviewees described that OEMs are more sustainability-focused and especially environmentally conscious in the post-COVID context. Interviewee 63 described: "*I definitely see a lot more focus not only from OEMs, but tier ones and even small businesses saying that sustainability is another metric of a successful business that is not taking advantage of nature and its resources, but also behaving in a fair way in terms of their hiring practises, in terms of fostering diversity in their workforce and recognising the value of everybody, not only within the company but in terms of the customer base that they serve*". Across the interviews, managers emphasised that customers are spending increasingly more time and attention on sustainability metrics and are looking for evidence to underpin claims.

On the notion of "doing the right thing", interviewees described the importance of integrity and honesty with employees and customers. For example, towards customers, automotive OEMs should openly admit and address issues with vehicles they become aware of. Towards employees, leaders should behave integer and supportive. While the interviewees acknowledge that these metrics are not new, they have increased in importance in the post-COVID context: "*It is a way of working in the future that is going to be more and more critical […] Everything's fluid. There's no wall between work life and personal life. It makes it very, very important for them to behave in an ethical, sustainable, fair way*", summarised by interviewee 59. Interviewee 57 also mentioned that diversity, equity, and inclusion have increased in importance within organisations, although the level of measurable commitment varies across manufacturers.

In terms of management systems, OEMs have moved from traditional KPIs to OKRs. Interviewees described that progress, especially in the digital world, cannot fully be covered by traditional metrics. To reflect the long-term nature of some of these investments into new, digital, disruptive technologies (e.g., autonomous driving) or business models, OEMs need to redefine success metrics (e.g., process goals). Interviewee 49 described, "*I've recently worked with a couple of organisations where OKRs are standardised, and I think it generates great conversations, line manager to employee, and it brings* *about a better assessment. It's very easy to set KPIs which don't really mean anything, and then you get a great report when it's actually against the big objective, and you've not made much progress*". Interviewees 39 and 65 described that OEMs in the post-pandemic context add digitisation, customer-centricity (e.g., conversion and satisfaction), and supply chain metrics to traditional production and sales targets. Interviewee 76 summarised that "*the problem in the automotive industry is that they have very long product cycles and therefore the results only become visible much later and these short-term KPIs become problematic anyway. I believe that in such a dynamic environment, they are even less suitable*".

While cost reduction programmes are not new in the automotive industry, a post-pandemic trend of OEMs leveraging global capability pools more effectively emerged. For example, as OEMs have become more used to hybrid ways of working, they use resource pools from lower-cost locations like Eastern Europe and India in areas like software development.

Overall, the interviewees agree that traditional financial metrics remain relevant in automotive, irrespective of external disruptions. Interviewee 52 exemplified: "*You can only eat for breakfast what you have hunted before*". However, the interviewees also agree that there have been complementary post-COVID developments where some of the other types of metrics above have been added as organisational success metrics.

4.4.2.3. Positioning

The third post-pandemic trend area is positioning as OEMs are revisiting their uniqueness in the marketplace and partnership models. With the VUCA pressure heightened by the pandemic, OEMs had to be more selective in where to focus their energy. Interviewee 74 described that they had to decide as much what to do as much as what not to do. He advocated: "*When you make those choices really challenge yourself to answer as a result of these choices, is this helping me become truly essential in the segments that I compete?*". Interviewees 43 and 70 also described that not being essential makes OEMs vulnerable and presents a risk. In the post-pandemic context, OEMs have been more selective when making strategic decisions (e.g., partnerships, new products, long-term investments) and had to provide clearer answers to why they would win in a market segment.

The COVID pandemic has shaken up the market and created novel opportunities in response to which OEMs had to position themselves, opting for segments where they can become essential. Some managers described while most automotive start-ups failed, especially under the increased COVID-19 pressures, they have been a positive impetus for change in action on behalf of the traditional players. For example, some OEMs focused on developing infotainment systems to differentiate through unique customer experience, while others partnered with companies like Apple. Similarly, some OEMs are investing in bespoke battery technology as a differentiator, while others partner with large suppliers.

The pandemic also disrupted supply chains, like semiconductor supply. As a result, OEMs paid more attention to supply chain resilience when selecting semiconductor suppliers and diversified their suppliers. Some companies, like Bosch, went so far as to acquire semiconductor suppliers to increase their level of control. However, all these types of decisions circle back to the question of differentiation and competitive advantage, where OEMs invested only in long-term, strategically relevant areas.

Technologically, AI advanced heavily during the COVID-19 pandemic. Automotive OEMs explored use cases (e.g., in product development) to do things cheaper, better, and faster to free up resources. While some manufacturers focused more on partnerships with leading players others invested in developing internal capabilities, assuming they can develop a competitive advantage.

The interviewees described how OEMs have become more open to external partnerships during the pandemic. Interviewee 72 explained: "*historically, there times has been a bit of hubris from certain OEMs that it's them and nothing else. I think what we're seeing, though, is that there are a number of large global suppliers who have truly differentiated capabilities that make them essential. And OEMs need to partner with those suppliers; they need to have a strong relationship with those suppliers*".

During the crisis, OEMs tried, for example, to partner with large technology companies (e.g., IBM, Nvidia, Qualcomm) to access additional semiconductor ships, reduce costs, and reduce vulnerability.

4.5. Discussion

The pre-COVID study's three cases reveal several novel insights prior studies alluded to, but which lacked empirical underpinning (Brozovic, 2018). Overarching and most important is the interplay and interdependence of the three dimensions of strategic flexibility. A manufacturer might be able to invest in innovation capabilities, but if the innovation outcomes do not meet customer expectations, e.g., due to a time-to-market that is too long, a financial return on the investment is unlikely. Similarly, if incumbents' complexities of vehicle models, variations and propulsion systems are too high, spreading forces across all of them opens questions about the competitiveness with more specialised new entrants. Simultaneously, competing intensively in all four CASE dimensions is a higher risk but potentially higher reward endeavour.

However, more modular approaches might be reasonable in terms of the flexibility-efficiency trade-off (Bock et al., 2012). The mass-market manufacturer invested heavily in BEV technologies instead of the partnership-oriented premium manufacturer but pursued a flexible investment structure. Hence, the mass manufacturer can adapt how much and where to invest based on the still dominant ICE business's profitability. During the coronavirus pandemic, multiple manufacturers benefited from this flexibility and focused on the short to medium-term while cutting down longer-term autonomous driving investments (McKinsey, 2020; Wang and Wells, 2020). During this time, the new entrant had to stick to the investment commitment in BEVs and advanced vehicle technology due to a lack of alternatives.

Continuous value delivery along the product lifecycle and shortening time-to-market seem vital to capitalise on a wide range of automotive trends (D'heur, 2015; Gharakhani et al., 2013). Although incumbents might have more financial resources to invest in innovations today, adapting the organisational clock speed of operating, speed to delivery and corporate policies to improve the decision-making time will be required to generate sufficient returns. As the new entrant case study highlights, automotive quality today is not solely about superior hardware but superior engagement with the customer and expectation management. Hence, a tighter bond and communication loop with customers will reverberate over operations optimisation-focused tactics and traditional "know-it-all" strategies.

The cases highlight that excelling in either dimension of strategic flexibility is likely to be fruitless. Rather, an alignment of factors across dimensions is promising and potentially leads to a competitive advantage. Contrarily, misalignments between product, process and product lead to strategic conflicts, inefficiencies and performance compromises. Aligning the three dimensions in the automotive industry is challenging due to the dynamism originating from dynamically changing customer needs and the large scale and interconnectedness of major players (MacDuffie, 2013; Macduffie, 2018). Hence, car manufacturers are well-advised to implement modularity in their structures to ensure adaptability in key dimensions.

Prior debates were limited to qualitative descriptions' realms or the focus on individual dimensions; a gap this chapter attempts to address. Based on the literature review and empirical evidence from the three automotive case studies discussed above, three conclusions could be reached.

First, the concept of strategic flexibility has a simple logic that aligns with a wide range of firms and company visions. Most strategy scholars might agree that sensing and fulfilling customer needs in line with key stakeholders' expectations is vital to establishing and maintaining a competitive advantage (Akter et al., 2020; Barney, 1991). Underlying this remit is an interplay of factors that previous studies only partially addressed.

Second, these factors can be grouped into three dimensions of strategic flexibility, providing a holistic understanding of the concept and its key determinants. Figure 4.2 illustrates the three dimensions of customer, process and product. The customer dimension is about expectations and demand variability, especially loyalty. Process mediates the customer-product relationship, and key factors include the innovation approach, complexity management (e.g., systems engineering) and time-to-market. The product dimension covers aspects like product lifecycle management, product differentiation and alternative solutions.

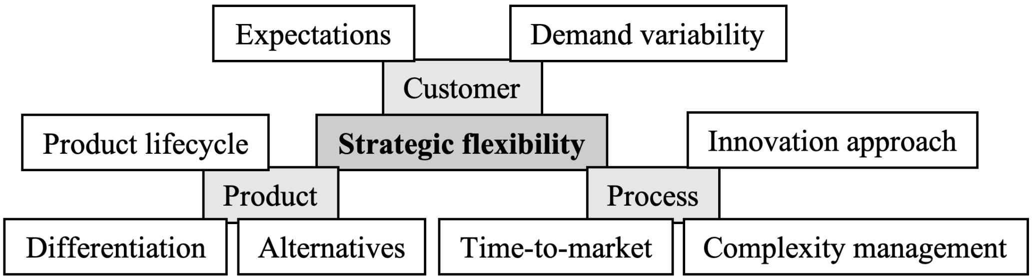

Figure 4.2 Conceptual model of strategic flexibility

Third, due to the uncertainty and complexity involved, depending on the firm and industry characteristics, there cannot be a one-fits-all configuration of the strategic flexibility conceptualisation to pursue diverse company visions (Beach et al., 2000; Combe, 2012; Hess and Flatten, 2019). Instead, similar firms in one industry, as illustrated using the two incumbent automotive cases, might demonstrate similar configurations in some but perhaps not all dimensions. Similarities might stem from and be required given similar contingency factors. The proposed conceptualisation provides an initial step towards a more nuanced and diverse view of strategic flexibility.

As the automotive industry grapples with the transformative effects of the post-COVID-19 era, strategic flexibility emerges as a linchpin for adaptation and success. This discussion explores key findings within this dynamic landscape, unravelling insights into how organisations navigate challenges and seize opportunities. The key themes this discussion is centred around are illustrated in Table 4.2.

New post-pandemic trend	Underlying reasons	General learning
Businesses revisited their unique differentiators (i.e., what makes them essential in a given market segment)	Markets are more crowded Increased time-to-market improvement pressure Technological advancement and ICE to BEV transition leading to new product differentiation Financial pressures due to COVID-19 disruption require businesses to focus efforts	Firms are focusing resource allocation more consciously in areas that are strategic differentiators and can be a competitive advantage (i.e., makes them essential in a given market segment)
More data driven decision making across business areas	Increased need to improve decision quality by leveraging data across business areas (e.g., manufacturing, supply chain, pricing, incentivisation) Data availability and improved data analysis capability to improve products and services	Data capabilities (e.g., data engineering, -science, and -analytics) are key organisational differentiators
OEMs reduce operational and product complexity	Pressure to increase market response time and reduce costs Customers demand simpler experience (e.g., easier purchasing decision making)	Simplification is required to enable improved business responsiveness (strategic flexibility)
Improvements of synergetic relationships with external partners	External partners are needed to increase responsiveness and modularity Incumbents are more open to partner to deliver digital solutions (e.g., autonomous driving) and leverage economies of scale (e.g., access semiconductor chips)	Business ecosystem design is a key enabler for the implementation of strategic flexibility
Establishing a change culture across the organisation	Competing in advanced technologies (e.g., AI, connectivity, BEV) requires organisations to innovate and reinvent more, break down silos and remove hierarchical barriers to improve decision making and execution	Organisational culture is embedding and enabling the implementation of strategic flexibility

New post-pandemic trend	Underlying reasons	General learning
Organisations aspire to become end to end supply chain sustainable and robust	More local sourcing and production (e.g., "in China for China") Stakeholders (e.g., customers and shareholders) demand improved sustainability Technological advancements enable supply chain traceability	Systems engineering is a key approach to improving supply chain transparency

Table 4.2 Post-COVID-19 strategic flexibility discussion themes

The observations shed light on the industry's strategic responses, from redefining unique differentiators and embracing data-driven decision-making to streamlining operational complexities and fostering external collaborations. These insights, encompassing organisational culture shifts and sustainable supply chain practices, collectively contribute to a nuanced understanding of strategic flexibility in the contemporary automotive milieu. For scholars and practitioners alike, this exploration serves as a compass for navigating the complexities of an industry in flux.

4.5.1. Revisiting unique differentiators

The first post-pandemic trend is that businesses revisited their unique differentiators, redefining their purpose and reason for being in a given market segment. This strategic recalibration is driven by industry-wide transitions, such as the shift from ICE to BEV, necessitating OEMs to identify new differentiators (Bohnsack et al., 2020). Additionally, the heightened market competition, intensified by technological advancements and the accelerated pace of change, amplified by COVID-19 disruptions and financial pressures, prompts businesses to reassess their value propositions strategically (Athanasopoulou et al., 2019; Zahoor et al., 2022). The observations of this research centre on how firms, in response to these dynamics, consciously focus resource allocation on strategic differentiators and competitive advantages, relying on strategic partnerships in complementary areas.

Building on works by Porter (1985) and Barney (1991), this study explores the nuanced dynamics of strategic flexibility in the post-COVID-19 automotive industry. Pham et al. (2023, p. 1009) advocated that during the recent crisis, firms demonstrated “the allocation of scarce resources to adopt the supply chain strategies of avoidance, speculative and postponement”. Similarly, “supply uncertainties (induced by COVID-19 epidemic) are incorporated into the supply chain resource allocation problem […] failing to account for supply uncertainty could lead to intolerable losses and compromise the sustainability of the business” (Ghasemy Yaghin and Farmani, 2023, p.1). Soluk (2022) found that entrepreneurs invested particularly in digital innovations, such as digital process, product, and business model innovation during the crisis.

Two primary factors drive this strategic realignment of businesses, revisiting their unique differentiators. Firstly, overarching industry trends, such as the shift from ICE to BEV, compel OEMs to seek new and innovative differentiators (Budde Christensen, Wells and Cipcigan, 2012; Ji and Tal, 2020). Secondly, markets are witnessing increased crowding and heightened competition, accelerated by technological advancements and the swift pace of change (Geels, 2018). The disruptions induced by the COVID-19 crisis, such as supply chain challenges and financial pressures, amplify the need for businesses to re-evaluate their strategic positions in the market.

Firms allocate resources more consciously in areas that serve as strategic differentiators and potential competitive advantages. This conscious allocation is underscored by the acknowledgement that not all aspects of the business can be a unique differentiator. In response to intensified market competition and industry shifts, enterprises leverage strategic partnerships to fill the gaps in areas outside their strategic differentiation.

4.5.2. Data-driven decision-making and business requirements

The second post-pandemic strategic flexibility trend involves a pervasive shift toward more data-driven decision-making across various business areas and integrating data-driven business requirements (Rialti et al., 2020). Two interconnected factors propel this transformation. Firstly, businesses recognise the imperative to harness data comprehensively, spanning manufacturing, supply chain, pricing, and incentivisation, to elevate decision quality (Adhi Santharm and Ramanathan, 2022; Ivanov, 2020). The need for supply chain transparency, exemplified by avoiding single-sourcing vulnerabilities highlighted by events like the Russia-Ukraine war, underscores the strategic importance of data in enhancing resilience. Secondly, evolving customer expectations for a more targeted and personalised experience compel businesses to rely on data to refine and tailor products and services to individual preferences.

Contreras Pinochet et al. (2021, p. 1406) found that firms focus on "big data analysis is evident from firms' growing investments, particularly those that operate in complex and fast-paced environments […] whether they are better positioned to analyze customer data and information in real-time, generate insights and implement solutions to maintain and improve their market position". Data-driven business transformation also enables new business models, such as crowdsourced deliveries (Yuen et al., 2023). Chen et al. (2023, p. 1) uncovered that the "development of data intelligence provides opportunities for implementing servitization[6] strategies, and the concept of digital servitization is attracting increasing attention […] enhancing firm competitiveness […] firms should therefore not only develop data-driven digital capabilities but also further learn from the services that support their products".

Data capabilities, comprising data engineering, data science, and analytics, emerge as key differentiators crucial for addressing the most pressing business challenges. Drawing on the literature on strategic capabilities and competitive advantage (Haarhaus and Liening, 2020; Teece, Pisano and Shuen, 1997), this research posits that businesses can establish a competitive edge by strategically implementing robust data capabilities. The findings align with Cepa's (2021, p. 1761) observation that

[6] Servitization involves the shift from product-centric to service-oriented business models. In the given context, the development of data intelligence is seen as a key enabler for implementing servitization strategies and enhancing firm competitiveness through digital services (Chirumalla, Leoni and Oghazi, 2023).

“big data technologies accelerate interorganizational learning, but that collaborative dynamics depend on organizations’ technology adoption motivations”. The current landscape's scarcity amplifies these capabilities' strategic importance, underscoring their potential as a source of sustained competitive advantage.

4.5.3. Complexity reduction

The third post-COVID-19 observation focuses on OEMs strategically reducing operational and product complexity. This strategic simplification aims to shorten market response times, reduce costs, and enhance the simplicity of the customer experience, drawing inspiration from industry leaders like Tesla, renowned for their straightforward product offerings (Teece, 2018c). The findings emphasise that simplification is imperative for improved responsiveness, aligned with advanced strategic flexibility. The ability to streamline complexity in internal processes and customer-facing solutions emerges as a potential source of competitive advantage in the post-pandemic era.

This research embeds itself within the literature on strategic flexibility, organisational simplification, and competitive advantage. Building on works by Porter (1996), Eisenhardt and Martin (2000), and Teece (2007), this study explores the nuanced dynamics of complexity reduction in the post-COVID-19 automotive industry, linking it with advanced strategic flexibility and its potential as a competitive advantage. Kuiper et al. (2023) highlight the importance of simplification to operationalise strategies effectively. Bock et al. (2012, p. 279) found that “CEOs perceive that structural flexibility requires structural simplification while retaining control of non-core functions. We find that the relative magnitude of business model innovation effort moderates the effect of reconfiguration on strategic flexibility”.

Multifaceted objectives drive the strategic move of reducing both operational and product complexity. Firstly, the aim is to enhance market responsiveness by simplifying internal processes and shortening the time to bring products to market. Secondly, reducing complexity contributes to cost savings, aligning with the broader literature on operational efficiency and cost leadership. Lastly, simplifying the customer experience, exemplified by industry leaders like Tesla with straightforward product offerings, aims to facilitate purchasing decisions and enhance overall customer satisfaction (Teece, 2018c; Lei, Wang and Law, 2022).

Simplification, encompassing internal processes and customer-facing solutions, is essential for achieving advanced strategic flexibility. This notion aligns with the broader discourse on organisational simplification and its role in fostering adaptability and responsiveness (Bodlaj and Čater, 2022; Trieu et al., 2023). Moreover, the observation posits that the ability to streamline complexity in internal processes and customer-facing solutions can be a potential competitive advantage in the post-COVID-19 era. This builds on literature discussing the strategic value of simplicity in product and service offerings.

4.5.4. Enhanced external partnerships

OEMs investing in enhancing synergetic external partnerships is the fourth post-COVID trend. OEMs augment business responsiveness and modularity, particularly in digital solutions such as autonomous driving (An et al., 2020). The implications of the COVID-19 crisis, including operational pressures such as access to critical components like chips, underscore the vital role of external partnerships (Armstrong, 2022; Schippl and Arnold, 2020). This finding underscores that the design of business ecosystems is a crucial enabler for implementing strategic flexibility, especially in domains demanding high levels of external capabilities, such as digital expertise and supply chain responsiveness. The design of a business ecosystem involves orchestrating the interdependencies and relationships among various stakeholders, such as suppliers, partners, customers, and competitors, to create a mutually beneficial environment (Helfat and Raubitschek, 2018; Wormald et al., 2023). For instance, a technology company may design its ecosystem to include app developers, device manufacturers, and users, fostering collaboration and innovation that enhances the overall value of the ecosystem.

This trend weaves itself into strategic flexibility, business ecosystems, and external partnerships literature. Drawing insights from works by Moore (1993), Iansiti (2004), and Gulati et al. (2012), this study details the nuanced dynamics of synergetic external partnerships in the post-COVID-19 automotive industry, emphasising their role in advanced strategic flexibility. Business digital ecosystems are one way to implement dynamic capabilities to improve ambidexterity (Buyukbalci and Dulger, 2023). In the automotive industry, business digital ecosystems refer to interconnected networks of stakeholders, such as manufacturers, suppliers, and technology partners, leveraging digital technologies to enhance collaboration and adaptability. These ecosystems play a crucial role in post-COVID-19 strategies, providing advanced strategic flexibility and improving ambidexterity by fostering synergistic external partnerships within the industry (Qamar et al., 2021).

These digital ecosystems can also be leveraged by intrapreneurs, i.e., entrepreneurs within organisations (Inoue et al., 2023). Gomes et al. (2023, p. 543) argue that "the ecosystem management requires focal firms to measure and manage the overall ecosystem's performance, and it varies according to the type of strategy adopted in each case […], especially in uncertain business contexts".

The imperative for improving synergetic external partnerships arises from enhancing business responsiveness and modularity, particularly in the era of digital solutions like autonomous driving. Digital expertise, often residing externally, becomes a critical component for OEMs. Moreover, the implications of the COVID-19 crisis, including operational pressures such as access to chips that demand economies of scale, underscore the strategic importance of cultivating synergistic partnerships.

The notion that the design of business ecosystems is a pivotal enabler for implementing strategic flexibility aligns with the broader literature on business ecosystems (Iansiti, 2004; Pütz et al., 2019) and their role in fostering adaptability and responsiveness (Hess and Flatten, 2019; Saïah et al., 2022). In domains requiring high levels of external capabilities, such as digital expertise and supply chain responsiveness, the cultivation of synergetic external partnerships emerges as a strategic imperative.

This builds on existing literature discussing the strategic value of external collaborations (Foss, Schmidt and Teece, 2023; Jacobides, Macduffie and Tae, 2013).

4.5.5. Emphasis on organisational culture

The fifth post-pandemic observation spotlights the trend of OEMs' management placing heightened emphasis on establishing an organisational change culture. A change in organisational culture refers to a deliberate shift in a company's shared values, beliefs, and behaviours to adapt to new challenges, opportunities, or strategic goals (Bock et al., 2012; Evans, 2023). OEMs are prioritising a cultural shift within their management, aiming to foster adaptability, innovation, and resilience in response to the evolving business landscape influenced by the pandemic. This change involves encouraging a mindset of continuous improvement, flexibility, and openness to new ideas.

This strategic shift is propelled by the imperative for OEMs to enhance business responsiveness, necessitating the breakdown of organisational silos, implementation of flatter hierarchies for improved decision-making, and the establishment of continuous innovation and reinvention as keystones in competing on a digital playing field (Kang and Kim, 2020). This observation underscores that organisational culture serves as a foundational element embedding and enabling the implementation of strategic flexibility. Without a robust change culture, achieving business responsiveness in a crisis context (e.g., COVID-19) across departments and hierarchies becomes an insurmountable challenge.

This development immerses itself in the literature on strategic flexibility (Zhou and Wu, 2010), organisational culture (Bock et al., 2012), and change management (Tushman and O'Reilly, 1996). The post-pandemic analysis surfaces nuanced dynamics of emphasising organisational culture in the post-COVID-19 automotive industry, linking it with advanced strategic flexibility and its foundational role in business change implementation.

Evans (2023) summarised that "a positive organizational culture can help strengthen strategic flexibility and its impact can be increased through adoption of Industry 4.0 capabilities and high levels of market orientation”. Kafetzopoulos and Katou (2023, p. 1) also show that “organizational culture drives firms to strategic flexibility, but the introduction of industry 4.0 capabilities and market orientation fully mediate this relationship, revealing their significance to strategic flexibility”. Leaders in digital-product businesses should invest in a culture of continuous learning to improve their innovation capability (Evans, 2022).

The imperative for OEMs' managements to place a heightened emphasis on establishing a change culture arises from the need to enhance business responsiveness, necessitating the breakdown of organisational silos, the adoption of flatter hierarchies, and the integration of continuous innovation and reinvention as central tenets in navigating the digital landscape (Cramer, 2000; Saïah et al., 2022). This strategic move is crucial for developing cutting-edge technologies such as AI, advanced connectivity, and electric vehicles.

Organisational culture serves as a foundational element for the implementation of strategic flexibility. This aligns with the broader literature on organisational culture and its role in fostering adaptability and responsiveness. Achieving business responsiveness across diverse departments and hierarchical structures becomes a formidable challenge without a robust change culture. The research builds on existing literature discussing the strategic importance of organisational culture in navigating change and fostering innovation (Bock et al., 2012; Kafetzopoulos and Katou, 2023).

4.5.6. Enhanced supply chain transparency

The sixth trend highlights that OEMs strategically invest in improving their end-to-end supply chain sustainability and robustness. This strategic imperative for OEMs arises from stakeholders' demands for sustainability, local sourcing, and production, coupled with technological advancements enabling enhanced supply chain transparency (Adhi Santharm and Ramanathan, 2022; Duan, Aloysius and Mollenkopf, 2021). The development underscores that transparency in supply chains is a prerequisite for implementing strategic flexibility and advocates for a systems engineering approach in managing supply chains to achieve robustness in VUCA environments.

This trend embeds itself in the literature on strategic flexibility (Kafetzopoulos and Katou, 2023; Zhou and Wu, 2010), supply chain sustainability (Duan, Aloysius and Mollenkopf, 2021; Sarkis, 2021), and robustness (Adhi Santharm and Ramanathan, 2022). This study explores the nuanced dynamics of supply chain transparency in the post-COVID-19 automotive industry, emphasising its role in advanced strategic flexibility and the systems engineering approach needed for robustness.

Supply chain disruptions are a challenge for businesses that can considerably affect business performance (Azadegan, Modi and Luccianetti, 2021). Saïah et al. (2022, p. 1490) show that "despite severe disruptions, process modularity—based on a modular architecture, interfaces, and standards—has helped maintain supply chain responsiveness. Specifically, it (1) enabled time-consuming, nonessential tasks to be skipped, (2) relieved internal and external bottlenecks, and (3) facilitated better allocation and prioritization". In the post-COVID-19 automotive industry, a modular approach to processes, architectures, interfaces, and standards can be a strategic response to the challenges brought about by the pandemic. Process modularity becomes a valuable tool for enhancing resilience and adaptability in the automotive supply chain after the impact of COVID-19 by allowing for the skipping of nonessential tasks, relieving bottlenecks, and improving allocation and prioritisation.

Shamsuddoha et al. (2022, p. 823) provide an example in that "an integrated model for poultry supply chains that incorporate reverse flows of wastes using system dynamics engineering with empirical simulations […] several current poultry waste production problems are solvable through an integrated approach that generates viable new marketable products with substantial profitable opportunities that also contributes to reductions in industrial pollution". Like physical supply chains, businesses also need to manage service supply chains innovatively (Choi, 2016). Just as in poultry supply chains, the automotive sector may benefit from innovative approaches to supply chain management. Embracing system dynamics engineering and empirical simulations can help the automotive industry tackle disruptions caused by the pandemic, explore new opportunities, and contribute to sustainability goals, aligning with the need for creative solutions highlighted by Choi (2016) in managing service supply chains.

The move of OEMs strategically investing in improving their end-to-end supply chain sustainability and robustness is driven by a dual imperative. Firstly, stakeholders, including customers, governments, and strategic partners, increasingly demand sustainability and, in some instances, advocate for local sourcing and production, exemplified by Volkswagen’s (2023) "in China for China" approach, referring to their localised manufacturing and distribution. Secondly, technological advancements during COVID-19 empowered OEMs to enhance supply chain transparency through improved data availability, accessibility, processing, and sense-making capabilities. These technologies have played a crucial role in helping OEMs navigate and respond to disruptions caused by the pandemic, ensuring more resilient and transparent supply chains.

Transparency in supply chains is a fundamental prerequisite for successfully implementing strategic flexibility. This aligns with the broader literature on supply chain management and its pivotal role in fostering adaptability and responsiveness (Choi et al., 2023; Saïah et al., 2022). Additionally, this research posits that achieving robustness in VUCA environments necessitates a systems engineering approach to supply chain management. This approach involves a comprehensive and integrated perspective, emphasising the interconnectedness of various elements within the supply chain. By applying systems engineering principles to supply chain management, organisations can better navigate and respond to the challenges presented by VUCA conditions, enhancing their supply chains' overall resilience and robustness.

4.5.7. Discussion summary

This research has unearthed trends across multiple strategic flexibility post-COVID-19 automotive industry themes. Firstly, the study delves into the need for businesses to revisit their unique differentiators, essentially their purpose or reason for being. The examination reveals that this reassessment is catalysed by industry trends, such as the transition from ICE to BEV (Figenbaum, 2017; Ji and Tal, 2020), and intensified market competition due to increased technological advancements and speed (Akter et al., 2020; Lin et al., 2020), further amplified by the disruptions caused by the COVID-19 pandemic. The development underscores that firms strategically focus resource allocation on areas that serve as strategic differentiators, emphasising the essential role of strategic partners in complementary areas. Collaborative relationships, e.g., strategic partners in complementary areas, are essential to navigate and excel in the evolving landscape influenced by technological changes and pandemic-related disruptions (Hilbolling et al., 2021; Kindermann et al., 2022).

Secondly, businesses increasingly embrace data-driven decision-making across various activities (Brewis, Dibb and Meadows, 2023), from pricing and specifications to broader business requirements like supply chain transparency and live business performance updates. The findings show the constant need for improvisation and response to external changes, technological advancements, and financial pressures on automotive OEMs. Theoretical implications highlight that data capabilities, including data engineering, data science, and analytics, have become key differentiators that can establish a competitive advantage. However, the extent to which these capabilities provide a sustainable competitive advantage remains a point of debate. While data capabilities can initially differentiate a firm, they can be subject to erosion as competitors develop similar technologies, commoditise analytics tools, and hire specialised talent. As a result, a question becomes not only how firms can build up these data capabilities, but how they can continuously innovate, integrate data into their broader strategic frameworks, and maintain organisational learning to stay ahead of rivals. The challenge lies in evolving these capabilities in a way that remains agile, adaptable, and aligned with changing market conditions.

Thirdly, the study explores OEMs' operational and product complexity reduction to enhance market response time, reduce costs, and simplify customer experiences (Ali et al., 2022; Saïah et al., 2022). An observation has been made that in the post-COVID-19 automotive context, simplification is a requisite for improved responsiveness and that the ability to simplify internal processes and customer-facing solutions can be a competitive advantage.

Fourthly, investments in synergetic external partnerships are driven by the need for increased business responsiveness and modularity. OEMs recognise that advanced technologies, such as AI and connectivity, demand external expertise, and operational pressures, such as the chip shortage exacerbated by COVID-19 implications, further emphasise the need for strategic collaborations (Jun Kang, Diao and Zanini, 2020; Sanasi and Ghezzi, 2022). Theoretical implications underline that business ecosystem design is a key enabler for implementing strategic flexibility, particularly in areas requiring high levels of external capability.

Fifthly, the research explores the emphasis on establishing a change culture within OEMs' management. This strategic move is deemed essential to break down organisational silos, implement flatter hierarchies for improved decision-making, and foster continuous innovation and reinvention. Organisational culture is pivotal in embedding and enabling the implementation of strategic flexibility (Bock et al., 2012; Sarkis, 2021).

Lastly, the study investigates OEMs' investments in improving end-to-end supply chain sustainability and robustness (Hohenstein, 2022). This strategic move is propelled by stakeholder demands for sustainability and local sourcing (Adhi Santharm and Ramanathan, 2022), coupled with technological advancements enabling better supply chain transparency (Said et al., 2024). This study's findings highlight the necessity of transparency in supply chains as a prerequisite for implementing strategic flexibility in manufacturing firms. This study emphasises that, alongside investments in end-to-end supply chain sustainability, adopting a systems engineering approach to supply chain management is crucial (Choi, 2016). This strategic combination responds to stakeholder demands for sustainability and local sourcing. It aligns with technological advancements, thereby fortifying supply chain transparency and resilience, ultimately enabling manufacturing firms to navigate the complexities of VUCA environments more effectively.

The conceptualisation of strategic flexibility closely relates to the notion of ambidexterity. Strategic flexibility enables organisations to adapt to changing environments by reallocating resources, fostering innovation, and adjusting to market dynamics. In the post-COVID-19 landscape, firms must not only exploit their existing capabilities to maintain efficiency but also explore new opportunities to remain competitive, particularly with the transition to BEVs and the integration of advanced data capabilities. Ambidexterity, therefore, becomes vital as OEMs seek to optimise their internal processes while simultaneously driving innovation through external collaborations and partnerships.

These findings shed light on the dynamic landscape of strategic flexibility in the post-COVID-19 automotive industry. They offer insights into the strategic reassessment of differentiators, the embrace of data-driven decision-making, the significance of simplification, the role of external partnerships, the importance of a change culture, and the imperative for sustainable and robust supply chains. This research paints a nuanced picture of the theoretical underpinnings guiding strategic flexibility in the contemporary automotive landscape.

4.6. Conclusion

The pre- and post-COVID findings on strategic flexibility were similar in three ways. First, both phases provided insights into the fundamental principles of strategic flexibility, emphasising its simple logic and the interplay of factors across dimensions such as customer, process, and product. Second, the pre- and post-COVID findings together addressed a gap in the literature by offering a conceptual model that identified key factors determining strategic flexibility, based on empirical evidence from the automotive industry. Third, the pre- and post-COVID findings underscored the importance of aligning firm strategies with product and process contingency factors to satisfy customer needs in line with the company vision.

The pre- and post-COVID findings on strategic flexibility were different in three ways. First, building upon the pre-COVID research, the post-COVID study delved into the dynamic landscape of strategic flexibility in the automotive industry, elucidating emerging trends and responses to unprecedented disruptions. Second, it highlighted the need for businesses to reassess their unique differentiators, embrace data-driven decision-making, simplify operational and product complexities, invest in synergetic external partnerships, foster a change culture, and prioritise end-to-end supply chain sustainability and robustness. Third, these findings expanded the theoretical understanding of strategic flexibility and its key determinants, providing nuanced insights into navigating contemporary challenges in the automotive landscape.

By comparing the pre and post-COVID studies, it is evident that while the fundamental principles of strategic flexibility remain relevant, there have been notable shifts and adaptations in response to the changing business environment. The COVID-19 pandemic has accelerated the pace of change and heightened the importance of strategic agility and adaptability. Businesses are increasingly embracing digital transformation, data-driven decision-making, and collaborative partnerships to enhance their competitiveness and resilience in the face of uncertainty.

Looking ahead, the research field of strategic flexibility is poised for further exploration and innovation. Future studies should continue to examine how firms adapt their strategies to dynamic environments, incorporating insights from both pre and post-COVID studies to provide guidance for practitioners and scholars. Additionally, there is a need to explore the long-term implications of strategic flexibility beyond the immediate response to crises, considering its role in shaping sustainable business practices and fostering innovation in the automotive industry and beyond.

Overall, this study contributes to advancing our understanding of strategic flexibility and its implications for business strategy in a rapidly changing world.

5. Fun to drive? Dynamics of car manufacturers' differentiation strategies in sustainability industry transitions

5.1. Introduction

A key theme of this chapter, as per Table 1.1, is differentiation strategies and underlying motivations, including sustainability improvements. Many industries face pressures to improve sustainability. Sustainability is vital for many reasons, including long-term economic viability, social justice and ecological quality (Rennings, 2000). Sustainability industry transition literature is concerned with industries' transitions to more sustainable operations and products (Bohnsack et al., 2020; Smink, Hekkert and Negro, 2013). Prior studies identified firms' innovations as a means to improve sustainability (Cramer, 2000; Lüdeke-Freund, 2020; Rezvani, Jansson and Bengtsson, 2018). They explored different kinds of innovation, how firms approach innovations to improve sustainability, and how innovation activities develop from individual firm's actions to industry-wide engagement.

In the industry transition literature, the underlying rationale of why firms innovate has only been partially explored. Previous industry transition studies found that companies innovate to improve competitiveness or meet sustainability demands (Bohnsack et al., 2020). Sustainability is demanded by various stakeholders, especially regulators and customers, but increasingly also employees (Wolff et al., 2020). Industry transition scholars paid particular attention to why some firms engage first in certain innovations – so-called first movers – while others follow. They observed that first movers "put greater emphasis on the higher cause of sustainable development as driving their efforts, and followers on competitive dynamics" (Bohnsack et al., 2020, p.733).

Strategy scholars investigated competitive advantages over decades (Dyer and Singh, 1998; Porter, 1980, 1985; Stalk, 1988). They argue that companies pursue competitive advantages by having lower costs, being more differentiated or being more focused than competitors (Porter, 1980). Differentiation of products and services refers to the process of creating a distinguished and more attractive offering over competitors' alternatives for the target market (Lee and Tang, 1997). Differentiation can also involve early adoption of new technologies or innovations, enabling firms to lead in emerging markets by establishing a strong foothold before competitors enter. Early adopters can gain first-mover advantages, such as securing customer loyalty, setting industry standards, or achieving higher market visibility. Beyond this, differentiation entails the pursuit of a sustainable position in a new market segment by continuously evolving offerings and aligning them with changing customer preferences, market trends, and technological advancements. By innovating not just in product design but also in business models, service ecosystems, and customer experiences, companies can build a long-term competitive edge in new or underserved market segments, thus securing a more defensible and sustainable position.

However, differentiation remains unexplored in the sustainability industry transition literature. Investigating the issue is important for several reasons. First, the desire to differentiate is a key motivator for firms to innovate (Andriopoulos and Lewis, 2009). Hence, it helps scholars to understand better how and why firms innovate in sustainability industry transitions. Second, it allows scholars to add to industry dynamics literature in terms of evolvements of differentiation efforts. Third, it helps practitioners better understand market mechanics and find the most suitable differentiation strategy that best matches their intended outcome. It is urgent to investigate the issue now, as the pressure to improve sustainability is growing (Bettinazzi, Massa and Neumann, 2020; Taiebat et al., 2018). The complexity and dynamics of the global business environment require a more subtle understanding of differentiation (Schoemaker, Heaton and Teece, 2018).

To understand product differentiation in sustainability transitions, mediated by product innovation, this study addresses two research questions: (1) How do differentiation efforts disseminate from individual firms to industry-wide engagements? (2) What is first movers' rationale for their type of differentiation?

This study addresses the research questions by presenting recent insights from the automotive industry, focusing on car manufacturers. Sustainability transition is a key issue in the automotive industry

(Yadav et al., 2020). Main developments in the industry, such as vehicle electrification and autonomous driving, are driven by demands for improved ecological, social, and economic sustainability (Bohnsack, Kolk and Pinkse, 2015; Bohnsack et al., 2020). Car manufacturers received particular attention in prior sustainability transition studies, given their powerful and orchestrating role in the industry (Geels et al., 2012; Songthaveephol and Mohamad, 2020). The complexity and richness of external dynamism car manufacturers are facing support their suitability as a case to investigate differentiation in sustainability transitions.

This study contributes to the literature on sustainability industry transitions in several ways. First, a conceptual framework is developed that links differentiation to sustainability transitions, mediated by innovation. The framework visualises how and why firms differentiate, leading to innovation and improved sustainability. Second, the study contributes to our understanding of industry dynamics. Specifically, the study highlights how and why differentiation efforts of individual firms disseminate to industry-wide engagements. Thereby, particular attention is paid to first movers' rationale to differentiate. Third, the study provides a nuanced understanding of the differentiation-innovation link by conceptualising what differentiation rationale requires what type of innovation.

In examining the post-COVID-19 landscape of the automotive industry, it becomes evident that the pandemic has catalysed significant shifts in differentiation strategies. The disruption caused by COVID-19 has accelerated the adoption of digital technologies and reshaped consumer preferences, necessitating a re-evaluation of traditional differentiation approaches. This post-pandemic study investigates how car manufacturers have responded to these challenges by integrating enhanced digital capabilities, orchestrating digital ecosystems, and emphasising sustainability as core elements of their differentiation strategies. Furthermore, the study delves into the importance of personalised customer experiences and the anticipation of future needs as crucial facets of differentiation in the evolving automotive landscape.

These trends underscore a paradigm shift in the automotive industry's differentiation strategies, emphasising the strategic importance of digital transformation, sustainability integration, and customer-centric approaches post-COVID-19. The study provides valuable insights into how firms are navigating the contemporary business landscape and offers guidance for scholars and practitioners seeking to understand and adapt to these changes.

The inclusion of post-COVID-19 insights enriches our understanding of differentiation strategies in the automotive industry, complementing the pre-COVID focus on sustainability transitions. By capturing the industry's response to the pandemic and its implications for differentiation, this study contributes to the broader literature on industry dynamics and strategic management.

The remainder of the chapter is structured as follows. The literature section 5.2 hereafter covers differentiation, innovation, and drivers for converging and diverging behaviour. Following this, the methodology section 5.3 details the data collection and analysis processes. Subsequently, the findings section 5.4 is divided into two parts: the presentation of findings from the pre-COVID study and the post-COVID study. Following the presentation of findings, the discussion section 5.5 examines the changes observed between the pre- and post-COVID studies and contextualises them within the existing literature. Finally, the conclusion section 5.6 highlights the overall contributions and provides an outlook for future research directions.

5.2. Literature review

5.2.1. Differentiation

Although novel to the industry transition literature, the concept of differentiation attracted attention from strategy scholars for decades. The concept appears in the strategy literature in two main contexts: First, differentiation as a driver of Porter's (1979) five forces in industry analysis, where differentiation restrains rivalry by raising barriers to entry and compete economically viable (Bain, 1956; Sashi and Stern, 1995). Second, differentiation can be a source of competitive advantage by enabling firms to serve customers more effectively and/or efficiently than competitors (Porter, 1985; Scherer and Ross, 1990).

Hence, differentiation can (1) enable firms to create and capture more economic value, the difference between a firm's cost to provide the product and customers' willingness to pay, than competitors (MacDonald and Ryall, 2004; Peteraf and Barney, 2003), and (2) raise an industries total profits by making price cutting a less effective means to gain market share (Caplin and Nalebuff, 1991).

One way to understand differentiation is as a value-capture mechanism for new product development, which makes it conducive to dynamic capabilities. Differentiation, in this context, allows firms to adapt and innovate by offering unique products or services tailored to specific customer needs, thereby capturing value from new market opportunities. By aligning new product development with a firm's dynamic capabilities, differentiation becomes a means of responding to technological advancements, shifting consumer preferences, and evolving competitive landscapes. This interplay between differentiation and dynamic capabilities facilitates not only competitive advantage but also sustained innovation, as firms continuously evolve their offerings to maintain market relevance and profitability.

5.2.2. Innovation

Differentiation and innovation are intertwined as innovating is one way to create a subjectively differentiated customer perception. However, a multitude of innovation definitions exist. Some refer to something new that improves the status quo and is financially viable (Christensen, Suárez and Utterback, 1998; Gao et al., 2017). Hence, innovation can result from a fundamentally new invention or a new combination of existing elements (Christensen and Raynor, 2003).

A variety of innovation classifications have emerged. This study focuses on two typologies: the development process and the innovation's nature. Chesbrough and Teece (2002) describe that some innovations can be pursued independently from other innovations, referred to as autonomous, while others can be realised only in conjunction with related, complementary innovations, denoted as systemic. Both are inherently different, as the latter requires multiple firms or a whole industry to engage in the transition (Geels, 2018; Planko et al., 2019). Hence, distinguishing the two is important as theoretical explanations for one may not hold for the other.

The nature of innovations may be typologised as incremental, architectural, and discontinuous. Incremental innovation refers to making an existing product cheaper, better, or faster (Nelson and Winter, 1983). Architectural innovations are seemingly minor improvements to current technologies that dramatically improve the performance of existing products (Henderson and Clark, 1990). Discontinuous innovations are typically major and competence-destroying improvements in technology (Schumpeter, 1942; Tushman and Anderson, 1986). All three types of innovation emerge differently and have different effects as sources of differentiation and contributors to sustainability.

5.2.3. Drivers for converging and diverging behaviour

Sustainability scholars investigated why and when firms invest in innovation to improve sustainability (e.g., Markard et al., 2012; Skeete et al., 2020; Smith et al., 2010). Recent studies found that there is a link between the types of innovations firms develop and their contributions to improving sustainability (Pinkse, Bohnsack and Kolk, 2014). Companies engage in autonomous rather than systemic innovation to improve sustainability, as systemic innovation requires the involvement of external partners and thus poses greater uncertainty (Sarasini and Jacob, 2014). Studies argue that systemic innovations require regulatory pressure to achieve industry-wide engagement (Geels, 2014a; Rennings, 2000), such as widespread BEV efforts. Although similar external forces (e.g., regulation) lead to similar firm strategies in some areas, firms' responses differ in others.

Firms' desire to differentiate is a primary reason for heterogeneous innovation behaviour. Firms can benefit relatively more from differing from competitors and thus have an inherent disincentive to improve sustainability collectively (Bohnsack et al., 2020). They are motivated to engage in autonomous and systemic innovations by the potential to differentiate and gain a competitive advantage (Cramer, van der Heijden and Jonker, 2006).

Systemic innovation usually does not allow firms to benefit from a first mover advantage as they are associated with high customer demand volatility and technological uncertainty (Lieberman and Montgomery, 1998). Besides, followers might leverage costly groundwork investments, such as BEV charging infrastructure (Charan, 2015; Christensen, 1997). However, firms benefited from investing first in innovations in some instances by establishing and maintaining learning-based and technological advantages (Bohnsack et al., 2020). Hence, investing in innovation to differentiate and potentially improve sustainability remains a firm and context-specific challenge.

In summary, differentiation stems from strategy research that remains largely unexplored in the sustainability industry transition literature. As firms' desire to differentiate is a primary reason for them to engage in innovations that potentially lead to improved sustainability, it is a promising area to explore. Specifically, heterogeneous firm behaviour in differentiating and thereby engaging in sustainability innovation is a promising avenue. Hence, this study investigates evolvements of differentiation efforts and first movers' rationale to differentiate.

5.3. Methodology

To explore differentiation strategies and initiatives of incumbent car manufacturers, a two-phase pre-COVID study was conducted. First, secondary sources, such as media, industry, and annual reports, are being used to provide an overview of differentiation efforts in the automotive industry. Document analysis was used to extract information about market entries by differentiating product offerings and publicly available data on the rationale (Bowen, 2009). In a manual process, the information was collected online, structured by topic, and analysed. The secondary sources were used to construct a product differentiation timeline and provided background data for the second phase.

Second, semi-structured interviews with automotive managers and further automotive stakeholders were conducted. In-depth interviews are best suited as the research questions are explorative. Specifically, they were conducted to gain in-depth insights into incumbents' differentiation strategies and tactics, as well as the underlying rationale. Interviewees are senior automotive managers, members of the management boards or one level below, and further senior automotive stakeholders, such as managers at suppliers, consultancies, research institutions, and energy companies. They enabled reconstructing the *how* and *why* of incumbents' differentiations. The interviews reflected historical perspectives as well as the recent unprecedented magnitude and pace of change in the automotive industry.

A total of 18 semi-structured interviews with industry-wide recognised individuals directly involved in strategic issues of incumbent car manufacturers have been conducted. The number of interviews resulted from data saturation, highlighted by no new insights in additional interviews. The interviews were conducted between 21 April and 3 June 2020. The interview period, notably the impact of the Coronavirus pandemic, was considered in the analysis and discussion. As detailed in Table 5.1 below and included in Appendix 5, eight interviewees were senior executives at car manufacturers, five were consultancy partners, one was a regulatory authority, three represented research institutions, and one was the leader of a tier-1 supplier. Purposive sampling, complemented by snowball sampling where applicable, has been used to ensure that the sample includes the most knowledgeable participants. The interviews lasted between 50 and 90 minutes (65 minutes on average), were conducted online (via Zoom) by the author, tape- and/or video-recorded and transcribed verbatim to provide reliability (Eisenhardt and Bourgeois, 1988).

No.	Date	Affiliation	Position	Country	Justification
1	21/04/2020	Research institution	Professor	UK	Automotive research group leader at a highly ranked university
2	22/04/2020	Tier-1 supplier	Chief Executive Officer	UK	Leader of one of the largest automotive suppliers
3	23/04/2020	Consultancy	Partner	Germany	Expert in automotive and operations at a leading management consultancy
4	05/05/2020	Energy company	Project Director	UK	Transport decarbonisation head at a UK-wide leading utility company
5	27/04/2020	Consultancy	Partner	Germany	Automotive expert at a leading management consultancy
6	30/04/2020	Car manufacturer	Outside Director	Japan	Outside director to the management board at one of the largest car manufacturers
7	29/04/2020	Consultancy	Senior Partner	Germany	Automotive expert at a leading management consultancy
8	01/05/2020	Consultancy	Partner and Member of the Management Board	Germany	Automotive practice head at a leading management consultancy
9	27/04/2020	Car manufacturer	Vice President	USA	Information systems lead at one of the largest car manufacturers
10	30/04/2020	Research institution	President and Chief Executive Officer	USA	Head of one of the most influential automotive research institutions
11	28/04/2020	Car manufacturer	President and Chief Executive Officer	Russia	Manager responsible for the national operation at one of the largest car manufacturers
12	25/04/2020	Car manufacturer	Chief Marketing Officer	UK	Marketing lead at one of the largest car manufacturers
13	30/04/2020	Car manufacturer	Senior Director	Germany	Digital strategy and analytics head at one of the largest car manufacturers
14	13/05/2020	Car manufacturer	Senior Manager	Germany	Head of the group-wide strategic initiatives at one of the largest car manufacturers
15	07/05/2020	Car manufacturer	Vice President	USA	Corporate planning and strategy leader at one of the largest car manufacturers
16	08/05/2020	Consultancy	Director	Germany	Automotive expert at a leading management consultancy
17	14/05/2020	Research institution	Senior Research Associate	UK	Sustainability researcher at one of the most prestigious universities
18	03/06/2020	Car manufacturer	Chairman and Managing Director	South Africa	Manager responsible for the national operation at one of the largest car manufacturers

Table 5.1 Participants sampling table

Thematic analysis enabled the sensemaking of the data. This study adopted a four-step process inspired by Glaser and Strauss (1967) and refined by Miles and Huberman (1994) as detailed in section 1.6.2. NVivo was used for the thematic analysis. First-order codes that appeared in the interviews have been clustered and related to eight second-order differentiation categories (Strauss and Corbin, 1994). The data structure and analysis are detailed hereafter. An NVivo coding overview (Figure 5.1) and hierarchy chart overview (Figure 5.2) based on the length of coded references are provided below.

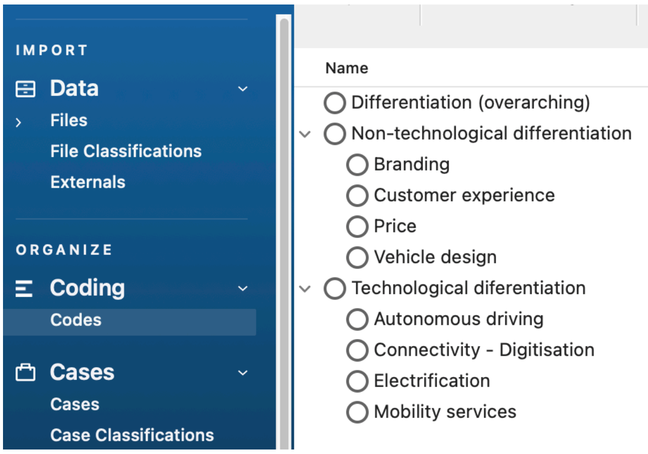

Figure 5.1 NVivo codes overview

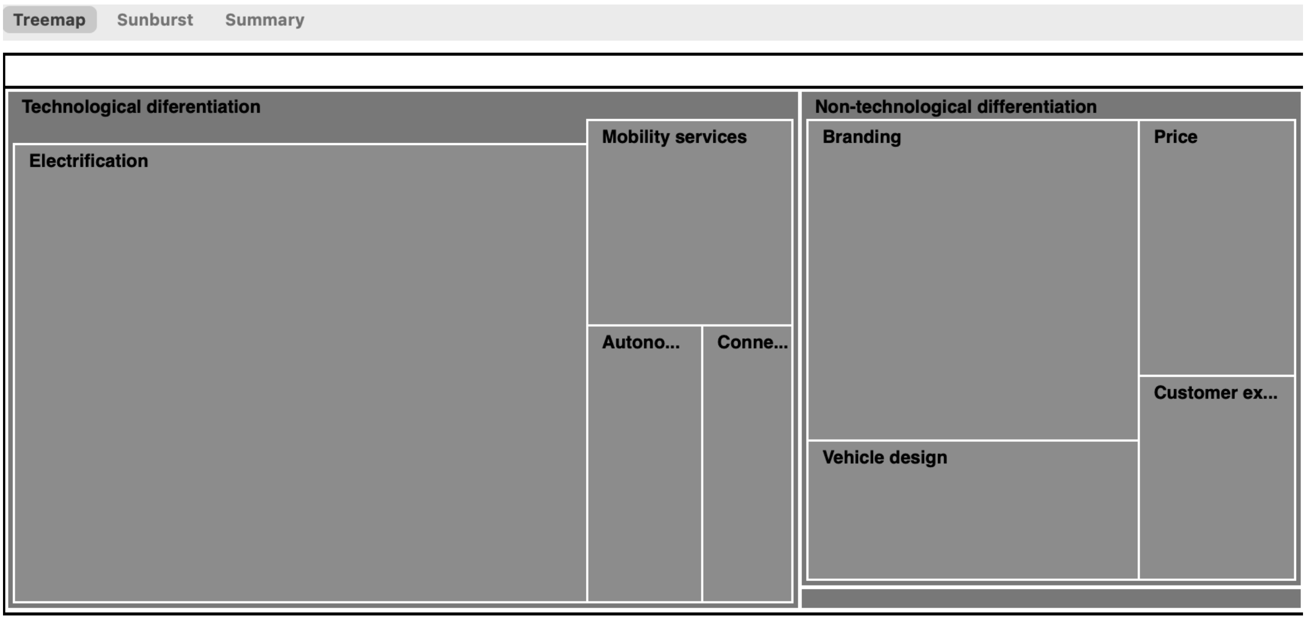

Figure 5.2 NVivo hierarchy chart

In building upon the groundwork laid by a pre-COVID study, as detailed in section 1.6.2, the post-COVID study investigates the evolution of differentiation strategies among incumbent car manufacturers in the post-pandemic era. Drawing on the insights gleaned from the pre-COVID analysis, the post-pandemic investigation sought to identify shifts, adaptations, and novel approaches adopted by car manufacturers in response to the challenges posed by COVID-19. Through semi-structured interviews with industry stakeholders, the study aimed to deepen our understanding of how differentiation strategies had evolved in light of the pandemic-induced disruptions. The post-COVID interviewee overview is included in Appendix 6.

By integrating insights from both pre-COVID and post-COVID studies, this research methodology facilitated a longitudinal examination of differentiation strategies in the automotive industry. By tracing the trajectory of industry developments from before the pandemic to the present day, the study sought to offer a comprehensive and nuanced understanding of how car manufacturers were navigating the unprecedented challenges and opportunities of the post-COVID landscape.

5.4. Findings

5.4.1. Pre-COVID findings on differentiation strategies

The pre-COVID findings section is organised into three sub-sections. First, differentiation in the automotive industry is analysed following the NVivo coding. Second, building on the analysis, a conceptual framework is introduced that links differentiation to sustainability industry transitions. Third, differentiation first mover and follower behaviour is analysed.

5.4.1.1. Differentiation in the automotive industry

The iterative coding process led to an inductively evolved code structure. NVivo functionalities, such as word frequency queries and word trees, supported the analysis to identify key themes and derive meaning. Three first and eight second-order codes emerged, detailed in Table 5.2. Besides, the table quantitively highlights how many references from different interview transcripts (files) have been assigned to a code to indicate its representation in the interviews.

1st and 2nd order codes	Description	Files	References
Differentiation (overarching)	Overarching factors not clearly attributable to a single differentiator	10	13
Technological differentiation	Set of (mainly) technological differentiators	14	156
- Autonomous driving	Differentiation via vehicle autonomous driving capabilities	10	19
- Connectivity - Digitisation	Differentiation via vehicle connectivity and further digitisation features	10	17
- Electrification	Differentiation via BEV attributes, e.g., weight, range, in-vehicle space, and efficiency	14	80
- Mobility services	Differentiation via offering of or integration with (on-demand) mobility services	13	25
Non-technological differentiation	Set of (mainly) non- technological differentiators	14	76
- Branding	Differentiation via brand, i.e., name, value associations or any other feature that identifies one car manufacturer's products as distinct from those of others	11	31
- Customer experience	Differentiation via customer journey, i.e., interaction with the customer along all (online and offline) customer touchpoints	12	29
- Price	Differentiation via price, covering initial and over the customer lifetime recurring revenue	1	2
- Vehicle design	Differentiation via (non-)functional product design elements	10	14

Table 5.2 Code structure

The three first-order codes cover (non-)technological differentiators and relevant overarching aspects that cannot be clearly assigned to a category. The first and second-order codes are analysed hereafter.

5.4.1.1.1. Differentiation (overarching)

Differentiation is of major importance to automotive firms, given the industries premium nature. The global profit pool of the automotive industry is between 100 and 130 billion euros per year, growing by about five per cent annually (Deubener, Gakhar and Kohn, 2019; Vega, 2020). About 55 per cent of the profitability stems from premium (Statista, 2021). Premium refers to all cars in all segments, for which customers are prepared to pay more than for a comparably equipped model of a competitor in the same segment (Desai et al., 2001). The price difference is the premium because customers pay it despite objectively having the same specification as the cheapest model in the segment.

Both technological and non-technological differentiators shape the subjective customer perception, illustrated by interviewee 6, stating "*why people are willing to pay premium right now in the car industry has something to do with brands are cool, design is great, people want technology, innovation, and they want driving behaviour*". The interview participants were divided on whether (non-) technological differentiators are more important. However, the consensus was that the automotive industry would remain a premium industry for the foreseeable future. They argue that the automobile will not be commoditised, as suggested by some technology firms (IBM, 2019). Hence, (non-) technological differentiation might remain vital in the automotive industry.

5.4.1.1.2. Technological differentiation

Technologically, car manufacturers can differentiate in the four domains of connectivity - digitisation, autonomous driving, shared mobility, and electrification. CASE are referred to as technological differentiators as technology is vital to a successful differentiation in these areas. Incumbent car manufacturers are operating in all four domains; in some of them more successful than in others (Heineke et al., 2019; Pütz et al., 2019).

Connectivity offers automotive customers closer integration into their lives and enables other technologies, such as autonomous driving. It facilitates digital service offerings, such as differentiation via software and over-the-air updates of functionality (Balasubramanian et al., 2016; Korper et al., 2019).

A key connectivity challenge of incumbent car manufacturers is old in-vehicle technology. In-vehicle technology refers to elements such as digital control instruments, software and IT architecture (Abboud, Omar and Zhuang, 2016; Macduffie, 2018). Interviewee 11 emphasised that "*there are challenges with regards to the central computer logic and integration of the software in the 80 to 100 decentralised electronic control units today*". New entrants, such as Tesla, seem to have an edge in in-vehicle IT architecture today and hence the ability to scale vehicle connectivity solutions.

Possible differentiation in **autonomous driving** ranges from driver assistant systems to fully autonomous vehicles. Advanced autonomous driving promises productive travel time and more economical transportation (Choi and Mokhtarian, 2020). So-called (fully autonomous) robo-taxis are the basis for various future business models, such as autonomously operating taxi services (Liu and Xu, 2020; Nunes and Hernandez, 2020).

However, the technical development of advanced autonomous driving is challenging and remains uncertain. Interviewee 4 pointed out that "*a certain disillusionment has just set in. A lot of things, like artificial intelligence, just cannot learn as fast as we thought; especially when such a car is supposed to drive autonomously in cities*". The interviewees agreed that incumbents ought not to leave the playground of autonomous driving to new entrants like Waymo. Rather, they consider autonomous driving capabilities a key future differentiator due to the potential added value for consumers.

Mobility services – a type of digital service that allows users to book forms of mobility as a service, such as Uber rides through an app (Alyavina, Nikitas and Tchouamou Njoya, 2020; Gilibert and Ribas, 2019) – challenge car manufacturers and continue to divide opinions among them. Some manufacturers aimed at becoming mobility service providers a few years ago (Firnkorn and Müller, 2012; Jungwirth, 2018). Today efforts in the mobility service domain are rather limited (Hörcher and Graham, 2020; Miao et al., 2019). No car manufacturer managed to establish a financially viable mobility service business. Like Uber and Lyft, new mobility services entrants also struggle with financial sustainability (Paik, Kang and Seamans, 2019).

Moreover, mobility services challenge the competitiveness of car manufacturers. Manufacturers are in a power struggle with other service providers, especially over the end-user interface. All players attempt to have first-hand access to the end customer and his data. While managers at car manufacturers expressed optimism about their superiority in the interviews, other automotive stakeholders have been more sceptical. For example, interviewee 2 highlighted, "*car manufacturers try to develop closer intimacy with the end customer because the power struggle around proximity to them is already underway. Mobility service providers are dangerous players for car manufacturers if they manage to own the customer interface, have access to the customer data, and push towards vehicle commoditisation*".

Electrification offers car manufacturers the opportunity to differentiate their vehicles in ways that did not exist with internal combustion engines (ICE; Figenbaum, 2017; Song and Aaldering, 2019). For example, vehicle range and charging infrastructure availability were not as relevant with ICE cars (Bauer et al., 2020; Beak et al., 2020). Hence, the development of advanced vehicle platforms might be a promising BEV differentiator, as illustrated by interviewee 14, stating, "*whoever has the best platforms, the most attractive platforms for the customers, and the most cost-effective platforms will win the game*". However, other interviewees partly disagreed. They argued that platform differentiation is difficult once advanced platforms are widely available.

Defending BEV differentiation is a challenge for manufacturers. Car manufacturers protect ICE vehicle differentiations of, for example, engines with intellectual property rights. BEV components, such as batteries, are mainly purchased by car manufacturers today (Dunn et al., 2015; Rafele et al., 2020). Thus, intellectual property rights are, to a greater extent, held by partners.

All four CASE domains individually provide opportunities for car manufacturers to differentiate. However, particularly the interplay of CASE promises synergetic effects and potentially attractive differentiation.

5.4.1.1.3. Non-technological differentiation

Branding, customer experience, vehicle design and price are classified as non-technological differentiators. Although they are partly supported by technology, the findings suggest that the technological component is not considered to be core to successful differentiation. Non-technological differentiators are somewhat less tangible and objectifiable than technological differentiators.

The challenge of measurability was reflected in the interviews. **Brand** values may seem particularly subjective. For example, a disagreement arose over whether brands of some new BEV manufacturers or incumbents were more valuable. According to Statista (2022), the most valuable automotive brands in 2020 in USD bn are Toyota (28.39), Mercedes-Benz (21.35), BMW (20.52), and Tesla (11.35). Similarly, **customer experience** and **vehicle design** rankings are difficult to objectify and vary considerably (Bolger et al., 2019; Thiel, Tsakalidis and Jäger-Waldau, 2020). However, interviewee 16 argued that "*as long as people perceive fun to drive, and consumers are having a relationship with their car, vehicles will not be a commodity.*"

Price is a more tangible differentiator but also not trivial. Prices and sales figures of similarly equipped vehicles can be compared to determine the premium customers are willing to pay for a certain vehicle model. However, the customer accepts to pay a certain price and premium depends on the right development of all other (non-) technological differentiators.

5.4.1.2. Conceptual framework

The analysis of (non-)technological differentiators highlights that firms' desire to differentiate leads to improved industry-wide sustainability, mediated by innovation. The conceptualisation below illustrates the relationship.

Figure 5.3 Conceptual framework

Figure 5.3 can be complemented by adding details on the differentiators and underlying rationale identified in the qualitative data analysis. Car manufacturers are motivated by both sustainability and competitive advantages ambitions to differentiate. The two motivators are not mutually exclusive. Figure 5.4 visualises the link of the differentiators identified and the underlying rationale to the sustainability transition of the automotive industry.

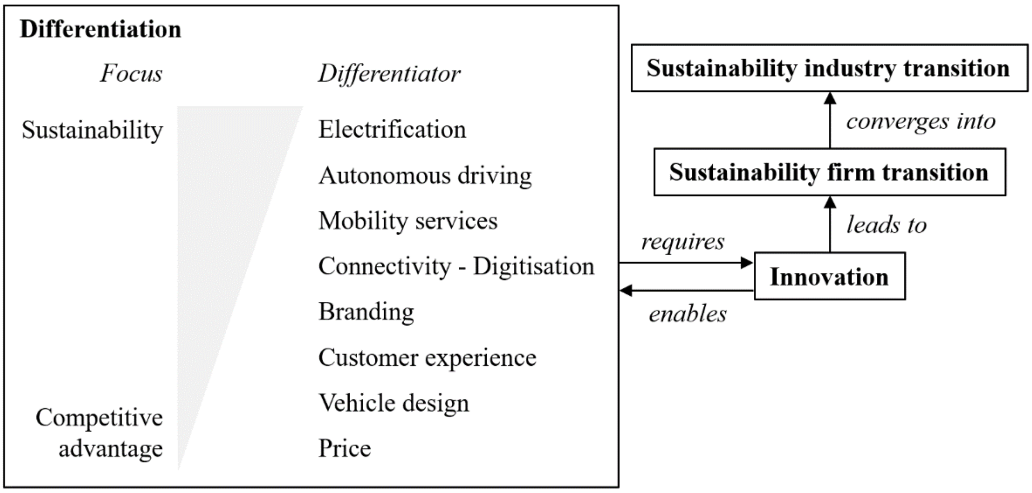

Figure 5.4 Differentiation in the automotive sustainability transition

The illustration indicates the rather sustainability or competitive advantage-oriented nature of the eight differentiators introduced. Although some differentiators are more sustainability-motivated than others, this chapter aligns with prior industry transition studies (Geels, 2014a; Bohnsack et al., 2020; Lüdeke-Freund, 2020) in the respect that reasons to innovate are mainly instrumental, competitive advantage and shareholder value-driven. However, interviewee 7 pointed out that "*environmental, raw materials, sustainable sources in terms of labour, et cetera, are going to be looked at very carefully by consumers already. It is also going to be looked at by shareholders or potential investors. So that is going to become even more important in the future than today*". Hence, sustainability and competitive advantage motivators are interconnected and may intertwine even more in the future.

Besides, the analysis highlights that differentiation in the automotive industry requires innovation. Technological innovations are critical in the CASE domains. However, not only technological innovation is relevant as illustrated by interviewee 9, stating the "*disruption has to happen because if you do not innovate, you will die. Innovation can be both technological-digital or business model innovation. And I think it is a bit of both*". Successful differentiation, enabled by innovation, of individual firms led to sustainability firm transitions. Widespread adoption of these innovations across firms converges into a sustainability industry transition.

5.4.1.3. First mover and follower behaviour

To better understand how, when and why some firms engaged first in certain differentiators, Figure 5.5 provides a high-level timeline for CASE differentiators. The timeline focuses on technological differentiators, as leader-follower behaviour can be distinguished more clearly than of non-technological differentiators. It highlights first movers, followers, and leaders in each differentiator. Specifically, the illustration covers the five leading companies today per differentiator and when they entered the market with a first version of the offering leading today. The five leading companies per segment are considered sufficient for indicating differentiation developments and investigating the underlying leader-follower rationale. Data stems from secondary sources (e.g., media, industry and annual reports) and qualitative interviews. Table 5.3 below provides an overview of the companies, data, justifications for classification and sources.

Differentiator	Company name	Description	Market position	Year	Reason for classification
Connectivity - Digitisation	Tesla	Tesla launched its advanced infotainment system with the introduction of the Model S in June 2012 (TechRadar, 2013; Tesla, 2020b)	First mover & leader	2012	Tesla is widely considered leading in digital in-vehicle customer experience and value-add connectivity services (Financial Times, 2020; Holter, 2020; Macduffie, 2018; Miao et al., 2019)
	Mercedes me	Mercedes digital connectivity solution (Mercedes-Benz, 2023)	Follower	2015	
	Sensus Connect (Volvo)	Volvo's entertainment, navigation, and value added services solution (Volvo Cars - Sensus Connect for older car models, 2023)	Follower	2015	
	NissanConnect	Nissan's smartphone-vehicle interface (Nissan, 2023b)	Follower	2015	
	Audi connect	Audi's entertainment and information digital solution (Audi, 2023)	Follower	2019	
Mobility services	Uber	Uber founded in March 2009 (Uber, 2018)	First mover & leader	2009	Uber is the eader by market cap (in mid 2020) and widely considered technical and market adoption leader (Bergen, 2019; companiesmarketcap.com, 2023; Russel, 2019)
	ShareNow	Share Now (Predecessor: car2go, DriveNow) entered their first markets in late 2011 (SHARE NOW, 2023)	Follower	2011	
	Moovit	Mobility services company that offers a public transportation app (Moovit, 2023)	Follower	2011	
	Lyft	Mobility service company; HQ in US (GlobalData, 2023)	Follower	2012	
	Zoox	Mobility service company; HQ in US (Zoox, 2023)	Follower	2014	
Autonomous driving	Waymo	Self-driving company; Google spin-off (Waymo, 2023)	First mover & leader	2009	Waymo is widely considered leading in autonomous driving technology, e.g., based on miles driven, technological advancement, and market adoption (Etherington, 2019; Financial Times, 2019b; Korosec, 2018; Preetipadma, 2020)
	Tesla Autopilot	Tesla first publicly discussed their Autopilot system in 2013 (Barry, 2021;	Follower	2013	

Differentiator	Company name	Description	Market position	Year	Reason for classification
		Bloomberg.com, 2013)			
	General Motors Cruise	Autonomous driving company (CNBC, 2020)	Follower	2013	
	Argo AI	Software conglomerate developing autonomous driving software for OEMs (Korosec, 2020)	Follower	2016	
	Baidu Apollo	Baidu Apollo started production of their autonomous bus in 2017 (James, 2022; Russell, 2017)	Follower	2017	
Electrification	Nissan Leaf	Nissan Leaf launched in December 2010 and is the (Nissan, 2020)	First mover	2011	Tesla is the best-selling BEV of 2019 with approx. 300,000 units sold followed by the BAIC EU-Series, Nissan Leaf, BYD Yuan EV, and SAIC Baojun E-Series (Shahan, 2020)
	BYD Yuan EV	BYD Yuan EV / S2 BEV launched in March 2016 (Ning, 2016)	Follower	2016	
	BAIC EU-Series	BAIC EU-Series: Launch in June 2017 (McHarris, 2019)	Follower	2017	
	Tesla Model 3	Tesla Model 3 launch on July 28, 2017 (Russel, 2017)	Leader	2018	
	SAIC Baojun E-Series	SAIC Baojun E-Series launched in September 2019 (fairwheels.com, 2020)	Follower	2019	

Table 5.3 Company and classification overview

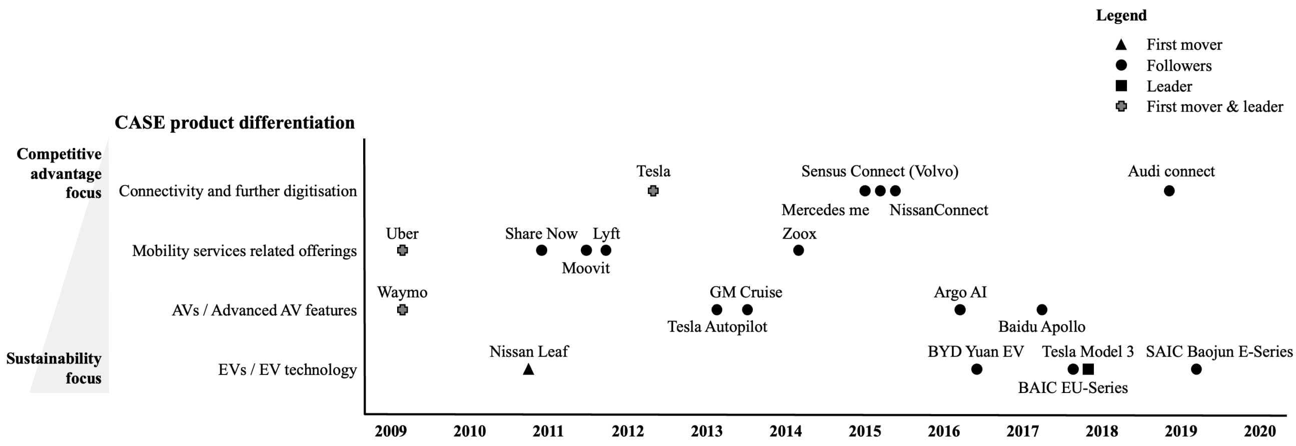

Figure 5.5 Automotive technological differentiation timeline

The analysis highlights, also visually with grey-filled icons, a considerable first mover advantage and follower disadvantage. In three instances, the first mover is the current leader in the differentiator, namely Tesla in connectivity, Uber in mobility services, and Waymo in autonomous driving (Financial Times, 2019b; Ke et al., 2020; Korosec, 2018; Paik, Kang and Seamans, 2019). Although the Nissan Leaf was the BEV of the current BEV wave introduced first (Tamayao et al., 2015), Tesla's Model 3, launched in July 2017, is leading today. Tesla sold over 300,000 units of the model, and it was the best-selling BEV in 2019 (Statista, 2020; Tesla, 2020a).

The companies compared across the four differentiators are considered competitors and regarding the differentiator considered operate in the same industry. While all the companies considered aim to be leaders in their respective segments, it is worth acknowledging that they might have chosen different strategies to achieve this and thereby, at least initially, in some cases, addressed different market segments. For example, while the Nissan Leaf was aimed at the lower end of the BEV market, while Tesla aimed to enter the market at a higher and more exclusive price point and then work downwards to penetrate the market more broadly. The data considered for the illustration above focuses on the as-is outcomes in terms of sales, market capitalisation, and technological advancement, amongst others, at the point of writing (mid-2020).

Besides, interviewees highlighted why some perceive Tesla to be leading over incumbents in BEVs and beyond, making statements like "*Tesla has a huge lead here, because they did not focus on this supplier industry from the beginning, not on Continental or Bosch, or told others to do this and that [...] They developed their whole IT architecture themselves; got some good people from the tech industry and developed this central computer logic*", "*Tesla already feels like mobility as a service*", "*Tesla is selling cars online*", "*Tesla has a competitive advantage in charging infrastructure*", and "*Tesla's vehicles already have autonomous driving capabilities*".

Although incumbents invested in CASE quite early, those initiatives have been somewhat isolated side-projects, receiving limited management attention. Within a relatively short period of a decade, companies like Tesla, Uber, and Waymo, managed to gain considerable traction and get ahead of incumbents (Paik, Kang and Seamans, 2019; Teece, 2018c). Whereas the three venture capital-backed challengers acknowledged the business opportunity despite tremendous uncertainty and took a substantial risk, incumbents' CASE engagements appeared rather sluggish (Mordue and Sweeney, 2020; Songthaveephol and Mohamad, 2020). Today, driven by regulatory incentives, incumbents attempt to catch up with Tesla in BEVs and invest heavily in vehicle connectivity capabilities (Lopes and Pires, 2020; Schwabe and Hassler, 2020). Despite incumbents' investments in autonomous driving and mobility services, their efforts are still rather moderate. The risk profiles and return-on-investment periods seem to be unsuitable for incumbents' present organisational and decision structures.

5.4.2. Post-COVID findings on differentiation strategies

In the aftermath of the COVID-19 pandemic, businesses worldwide have undergone significant transformations, prompting a reassessment of differentiation strategies to adapt to the new normal. This section revisits the pre-COVID findings while examining the shifts that have occurred in light of the pandemic's impact. Focusing on key areas such as enhanced digital capabilities, leveraging external partners for digital differentiation, core integration of sustainability, enhancing customer experiences, and anticipation of future customer needs, this analysis seeks to uncover how these strategies have evolved in response to the challenges and opportunities presented by the pandemic. By exploring these changes, this section aims to glean insights into crafting resilient and effective differentiation strategies in the post-COVID era.

5.4.2.1. High-level differentiation approaches across automotive firms

With the transition from ICE to BEV and changing consumer preferences, some traditional vehicle attributes (e.g., engine characteristics) have become less relevant. In contrast, other offer attributes receive increased attention (e.g., connectivity, range, digital integration). OEMs try to differentiate their brands and products differently and align with their brand values.

As part of the vehicle experience improvement, Nissan invests in solid-state batteries with planned pilots from 2024 and full commercialisation by 2028 to improve energy density, weight, and size (Nissan, 2023b). Nissan has also launched a vehicle-to-everything solution to integrate vehicle batteries with the energy grid. Battery improvements also allow OEMs to be cost-competitive. Software is considered relevant across markets, and OEMs enter partnerships depending on pertinent market needs. Vehicle adaptability through software improves multi-generational ownership.

Renault mainly focuses on transitioning fast to BEVs and attempting to reduce costs. However, OEMs do not control BEV raw material prices. With Dacia, Renault targets the lower price segment of the market. The Dacia Spring EV is currently manufactured in China. Renault also invests in generating additional revenue and improving residual value through software, enabled by their modernised electronics architecture with fewer, more sophisticated chips. Manufacturers try to mitigate the ICE after-sales reduction through the additional software revenue. The Renault CEO said in an interview that he believes that automotive brands will continue to exist in the future and does not worry about the commoditisation of the product, which would create lower value for customers (Financial Times, 2023). He believes that brands can innovate successfully to differentiate.

Ford argues that price pressure has always been there in automotive but is especially present in BEVs in China. Ford attempts to differentiate through (1) vehicle discovery and shopping, which will be more digitally centric and simplified, (2) improved post-purchase experience enabled by technology the customer expects, and (3) BEV digital in-vehicle experience that is fundamentally different from ICE vehicles. The company also established a separate business unit focused on BEVs with new hires from the consumer technology sector, including entrepreneurs experienced in bringing customer technology to market, to understand how customers engage with technology.

5.4.2.2. Digital customer experience

OEMs widely agree that the product offering and customer experience must be simple. Mavi.io's CEO said in a recent interview that OEMs should focus on what customers want from their lives instead of what they want from their cars, thereby integrating the vehicle better and adding more value (Financial Times, 2023). With the transition from wholesale to a retail model, OEMs get more opportunities to use customer data better. OEMs could learn from other industries, like retail, to understand what customers want (e.g., where they would (not) like to see advertisements and what apps should (not) remember). Based on current developments, the primary vehicle control screen seems to be one large in the middle of the vehicle. To improve products, it is vital to feedback data from vehicle usage into the product development processes.

Interviewee 63 argues while customers need help understanding battery electric vehicle technology, there are two main differentiators: (1) brand imagery and (2) customer experience. Regarding customer experience, he highlights that it is important to create a seamless omnichannel experience and think beyond the vehicle product about additional value-added services to lock customers into the vehicle ecosystem, like Apple in the consumer electronics market. Interviewee 36 agreed that "*customers clearly want connectivity […] have Netflix, Alexa, Zoom […]*". OEMs also seem to tailor customer experiences more, e.g., Ford responded to feedback from their camping customers and integrated a power jack to electrically power campsites.

Interviewee 58 summarised the challenges with delivering advanced digital customer experiences: "*There is a shortage of skilled workers in the entire digital topic of connectivity software […] it has failed in the last few years […] the only differentiating factor is the software, the digital experience and connectivity, that will be the challenge. And the abilities are still massively missing, not only with us [OEMs], also with suppliers*".

Interviewee 50 explained how OEMs can enable differentiated digital experiences by building the required internal operating model and technical infrastructure. First, OEMs must ensure that they decouple hardware and software development – i.e., allow both to be developed independently while working integrated – while not antagonising the current workforce but developing the required digital capabilities. Decoupling the two enables faster iteration (development and deployment) cycles, building on agreed standards for both hardware and software while minimising dependencies. Second, OEMs need to have control over their software stack, especially in-vehicle electronic control units, that allows them to be agile at scale and deploy digital solutions quickly. A solid technical foundation will enable OEMs to experiment faster in the market, e.g., segment customers, run A-B-tests, understand customer habits and willingness to pay, etc. This more data-driven approach enables OEMs to invest more in a premium experience for customers with a higher willingness to pay while deploying more generic solutions for a wider audience.

5.4.2.3. Connected car data

Connected car data enable product and service optimisation. The value of connectivity is greater for BEVs than ICE vehicles to address issues like range anxiety. Regulation of customer data is critical, e.g., privacy underpins all connected car data use, and data needs to be stored in line with legislation, such as remaining in data centres in Europe. Data also underpins external solutions such as Apple CarPlay, while manufacturers attempt to monetise data. Data pricing depends on availability (e.g., real-time vs non-real-time), use cases (e.g., potential value generation from data), and data complexity (e.g., identifying actual accidents is complex and expensive). Telematics data can help with fleet management and enable vehicle-to-everything use cases.

Nissan explained their customer-centric approach in that it starts with use cases, decides on the relevant ones and then develops capabilities and partners (e.g., for usage-based insurance) accordingly. In an interview, Nissan's global customer journey director explained that they could rely on partners to deliver service solutions and select technology use-case driven as the customer does not care about who developed them but only what the service does for them (Financial Times, 2023). Nissan sees their competitive advantage in the speed of bringing those technologies to market. They incrementally generate revenue from connected vehicle data through subscription services and at the point of purchase through higher manufacturers' suggested retail prices due to the higher residual value from personalisation and continuous upgrading.

Through connected vehicles, OEMs move from selling a product to managing a product lifecycle seamlessly integrated into customers' lives. Where OEMs differentiate and where they can reuse building blocks remains unanswered. Connect mobility services, charging infrastructure, and cyber security are increasingly important. OEMs are still learning about the areas (i.e., pain points and use cases) of potential commercialisation. Value-added services are likely additional software features (e.g., music services or coffee at charging stations), but perhaps not hardware unlocking customers have already paid for (e.g., heated seats).

Advanced autonomous driving (e.g., level 4) attracts considerable investments—companies like Ghost Autonomy partner with OEMs to deliver level 4 autonomy through hardware and software. Regarding sensors, these firms assess accessibility (e.g., cameras are cheaper and multiple can be fitted for redundancies compared to lidar) and technology development speed (e.g., cameras are improving faster than lidar). Regarding software, general purpose models are being trained on the totality of human knowledge irrespective of use cases before special purpose applications are built on top of these (e.g., generative pre-trained transformer models). At the same time, automotive models today understand where the car is, and future embodiment layers currently being researched aim to predict motions. Given the complexity and noise in the real world, AI can help sense-making based on a wide range of data. OEMs are still challenged by providing advanced AI in their central compute units and are responsible for certifying advanced driver assistance systems software. The main challenges with advanced autonomous driving are engineering challenges due to the subtilities of traffic and driving behaviour. At the same time, recognition mainly happens through geometry (e.g., roads to drive on are flat).

Interviewee 69 argued that "*the clever OEMs are going the data way*". He details that OEMs should use connected vehicle usage data rather than ask customers for feedback. Instead of a staged customer feedback and product development process, he argues to implement linear and seamless improvement loops based on usage data.

Customer data monetisation is an area OEMs approach carefully as trust is vitally important in automotive. While direct monetisation, e.g., selling, of customer data might be challenging regarding customer acceptance, most OEMs might start making more usage-based product decisions while closely monitoring associated regulation changes.

5.4.2.4. Pricing and financing

Many argue that the acceptance of BEVs will increase considerably once manufacturers level initial purchase prices of BEVs with similar ICE models. Thus, manufacturers like Volkswagen and Tesla announced they are working on and feel confident about achieving an approximately 25k Euro price point (carbuyer, 2023; Volkswagen, 2023). Approaching the issue somewhat differently, Renault's strategy is to focus on financially more affluent markets for BEVs first, as they need to sell large vehicles to improve BEV profitability. The recent increase in interest rates also increases the pressure on OEMs to demonstrate short-term profitability.

OEMs are trying to improve the affordability and accessibility of their vehicles by reducing costs and opening their offerings to more customers (e.g., charging and financing options). However, price volatility, as seen recently with Tesla's pricing (discounts), is unsuitable for the customer regarding certainty, brand perception, and residual value. As customers are used to subscription models from models like Netflix and Amazon, automotive OEMs need to adopt new ways of financing. Importantly, OEMs need to look at the total costs of ownership for customers and provide solutions across the product lifecycle, i.e., the initial purchase and ownership (e.g., subscription finance options and cost transparency). Residual value improvements also help to make a more compelling case for financing options. With increasing total costs of ownership focus, mobility services might become more attractive and are currently growing with more pay-per-use models that can improve vehicle utilisation.

5.4.2.5. Direct sales model transformation

Selling directly to consumers is one way OEMs are trying to simplify the customer journey, acknowledging that some customers still prefer the in-person experience and advice. Between 30 and 40 per cent of customers are prepared to buy purely online, saving OEMs about 6 per cent of total costs (Accenture, 2022; BCG, 2023a). As the transparency is higher online, OEMs must offer a straightforward customer journey, especially for financing options. Some premium brands recently announced opening flagship stores in key cities, such as Aston Martin in New York, where customers can experience their products, and the OEM demonstrates to retailers how to communicate their brand.

Interviewee 58 highlighted the challenge of incumbents that "*got a status quota to keep happy, which is their dealer networks and national sales companies, they're walking a tightrope trying to work direct to the consumer, not hand them over to their dealer networks and keep that relationship going […] traditional companies are still struggling to move the needle towards having that customer relationship because they still have great big legacy networks and ecosystems that they've got to keep pacified because they've been invested in over a long time*".

5.4.2.6. Battery electric vehicle engineering and design

Vehicle design has been a differentiator in automotive since the early stages of the industry. With the move from ICE to BEV and the loss or considerable reduction of the cooling grill, some vehicle designers discussed the identity crises some brands faced. Designers also explained how the transition to BEVs liberated vehicle design as the new technology components provided additional options to design vehicles uniquely. For example, Polestar made headlines for not having a back window, a design innovation that provided practical utility benefits. While some early BEVs are optimised for range and energy efficiency, some brands might be willing to lose some efficiency to communicate their brand identity. However, legislation still limits the design space to standardise safety requirements. Designers must balance staying true to their roots (e.g., the identity from their home market) while getting inspiration from novel designs (e.g., some of the new Asian BEV entrants). With the widespread adoption of over-the-air updates, hardware redesigns are no longer expected as frequently (e.g., yearly), but OEMs have software options to make a vehicle feel fresh and exciting.

Interviewee 48 highlighted that some BEV start-ups, like Tesla, are designing vehicles with more of a system engineering approach than incumbents. This allows the new entrants, for example, to reduce weight, increase range and reduce costs by making batteries a structural component. Interviewee 41 adds that "*customers might become different because if more and more cars will be handled by fleets, then the customers are not owning the car, they are just a user*". He suggests that traditional vehicle characteristics, like design and prestige-related features, will become less important, and vehicles might become more functional and customers more price-sensitive.

5.4.2.7. New approaches to customer feedback

In the post-pandemic context finding the balance between integrating customer feedback in product development and anticipating developments has become a key success factor. Interviewee 54 argued that "*if you're always relying on the customer to tell you what the next, let's say, technology innovation is, maybe, a little short-sighted. It's the unintended crossover technologies from one market to another that create differentiation*". He explains how organisations need a robust but free-thinking innovation process to ensure they're not overlooking potential collaborations and synergies from the markets. Interviewee 67 illustrates that "*looking at what a car has become in the last 15 or 20 years, totally different. It went from something people play with and enjoy to an appliance, and now to something that connects the customer to the outside world in many ways*".

Interviewee 61 explained that consumer research and mapping out trends has never been more important than today. Customers across countries and regions demand a more tailored experience, requiring OEMs to better understand and integrate local preferences. Traditional OEM customer clinics are not effective for gathering relevant insights as customers often give the answer they are being nudged to provide under observation. Interviewee 36 emphasised that "*it needs to go beyond that. What are their expectations? And it's almost like a list of things that they haven't even considered yet. Would they consider them important in the future?*". Interviewee 55 emphasised the more collaborative relationship between OEM and end customer: "*It's about offering service alongside the vehicle […] there is more developed collaboratively through the relationship with the customer.*"

Interviewee 42 discusses that some automotive managers seem to think they can succeed by doing things differently. However, he explains that in automotive, it is difficult to find the sweet spot and balance in trying new approaches and robustness with the right level of sault tolerance. The interviewee argues that "*like in agile development, they have to try things out quickly and discontinue if they don't work […] an agility that the organisation needs in its decision-making processes and also in its strategic planning, which perhaps is not yet the case for everyone*". The subsequent section discusses the findings in the literature context.

5.5. Discussion

Prior studies suggest that entrants trigger sustainability change, and incumbents follow by focusing on costs and mass-market viability (Hockerts and Wüstenhagen, 2010). This study finds that automotive entrants, like Tesla and Uber, transitioned from niche to cost-focused mass-market appeal themselves, leaving incumbents as followers that try to catch up. Entrants' engagements in more sustainability than competitive advantage focused differentiators suggest that financially viable and sustainable business models correlate positively.

Entrants' engagements in sustainability-focused differentiators are moving the whole industry towards improved sustainability. Taking BEVs as an example, although the underlying motivation is lower carbon dioxide emissions, both entrants and incumbents engage with the technology for instrumental reasons through governments' coercive pressure (Harrison and Thiel, 2017; Wesseling et al., 2015). Normative and mimetic forces from companies like Tesla then created the pressure for incumbents to make bigger and bolder moves towards BEVs, as highlighted by Volkswagen's Chairman Herbert Diess, stating that "*he [Elon Musk] is pulling ahead and we are fast followers, we try to keep as close as possible*" (Financial Times, 2020). The normative and mimetic pressures led to industry-wide engagements in technological differentiations.

However, industry-wide waves of technological differentiation were only made where sustainability-oriented differentiation represented a medium-term, not only a long-term potential competitive advantage. Connectivity and electrification are potentially viable financial cases in the medium term and can provide competitive advantages (Akter et al., 2020; Ji and Tal, 2020). The financial cases for mobility services and autonomous driving are long-term, if existent (Genzlinger, Zejnilovic and Bustinza, 2020; Oh et al., 2020). Recent developments confirmed incumbents' looser ties to potential long-term business cases. During the Coronavirus crisis, incumbent car manufacturers cut their investments in and ties to long-term opportunities (Financial Times, 2020; Volkswagen AG, 2020).

Those industry dynamics have technological implications. Earlier studies identified that autonomous innovations, like mobility services and connectivity, may replace established technologies if incumbents engage in the new technology (Geels, 2014b, 2018). This study confirms that connectivity improvements, like 5G and advanced computing technologies, replace preceding technologies. Besides, mobility services have led to a shift in incumbents' ways to engage with customers by increasing the pressure to shift technology-driven from business-to-business to a business-to-consumer business model (Harrison and Thiel, 2017; Joast and Deinlein, 2019).

Moreover, this study provides insights into what type of differentiation focus led to what type of innovation, illustrated in Figure 5.6. The categorisations are based on statements in the qualitative interviews and reflect the perception during the time of data collection (early to mid-2020).

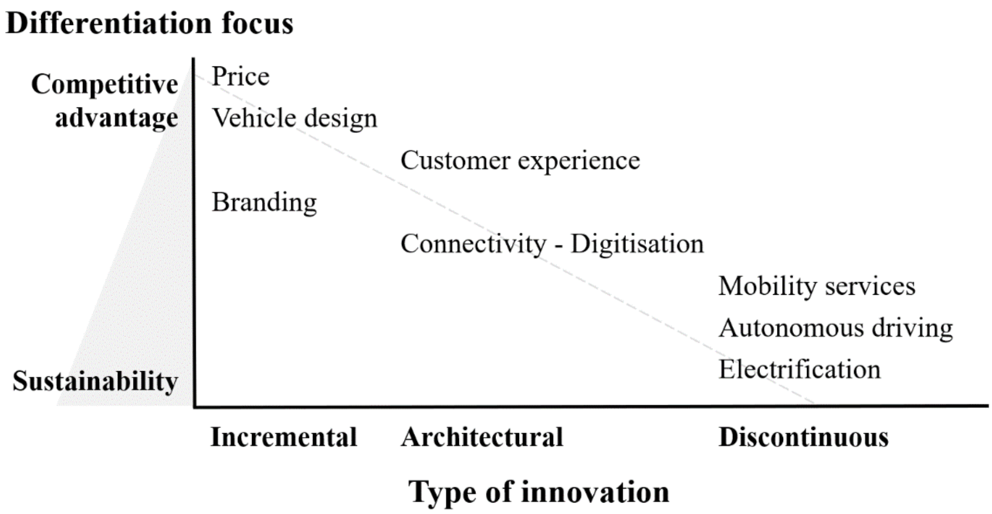

Figure 5.6 Differentiation focus and types of innovation

Incumbents have been focusing on rather incremental, more recently to some extent on architectural and a limited degree on discontinuous innovation. New entrants, however, concentrated on discontinuous innovation from the beginning. The analysis suggests that sustainability-oriented differentiations instead require discontinuous, disruptive innovation. The observation is in line with earlier studies suggesting that incumbents find it harder to innovate radically than new entrants (Christensen, 1997).

Amidst the transformative aftermath of the post-COVID-19 era, the automotive industry is undergoing a profound shift in its strategies for differentiation. The following discussion explores key themes within this evolving landscape, unravelling insights into how organisations strategically redefine their competitive positioning. The key themes of this discussion are summarised in Table 5.4 below.

New post pandemic trend	Underlying reasons	General learning
Focus on digital to enable differentiation across the customer journey (e.g., vehicle discovery and shopping, post-purchase experience, and in-vehicle experience)	ICE-EV transition Technological advancement (e.g., AI) Increased customer expectations (e.g., simplified and seamless integration)	Digital capability within a company and its' ecosystem is a leading indicator for future success ("every business is becoming a technology business")
More collaborations with partners to deliver digital differentiators (e.g., advanced driver assistance systems)	OEMs are more reliant on partners to deliver digital solutions given their complexity, specificity, and pace of change that requires more focused capability	Competition moves away from individual firms to competition of digital ecosystems in which highly skilled digital talent is scarce and valuable
Sustainability has become a core element of more OEMs' brand identities	Stakeholders are more aware of and demanding sustainability Advancements in technologies to demonstrate end-to-end sustainability (e.g., traceability)	Minimum standards of sustainable practices are a license to operate. However, through high levels of sustainability, OEMs can differentiate internally (e.g., employees) and externally (e.g., shareholders and customers)
Automotive businesses implement more personalised customer experience	Increased customer expectations from other areas of their lives (e.g., social media) OEMs have more data (e.g., connected car and customer data) and capability (internally or externally) available to provide a more targeted experience (e.g., total cost of ownership focused pricing)	Focus on demand-driven, customer use cases over OEM-driven exploration to improve customer experience personalisation
Increased anticipation of future customer needs to inform product and services decisions	Increased VUCA means OEMs can rely less on historical data to make product and services decision while having to respond faster to external changes Technological advancement helps OEMs to anticipate trends	Traditional DCs (sensing - seizing - transforming) are changing to "sensing and anticipating" - seizing - transforming

Table 5.4 Post-COVID-19 differentiation discussion themes

From the recalibration of unique differentiators and the pivotal role of digital capabilities to the emphasis on sustainability, personalised customer experiences, and anticipatory approaches, this discussion sheds light on the nuanced dimensions of differentiation strategies. For scholars and practitioners navigating the dynamic terrain of the contemporary automotive milieu, these theoretical insights offer guidance in understanding and adapting to the changing strategies within the industry.

5.5.1. Enhanced digital capabilities

This discussion delves into the post-COVID-19 changes within the differentiation strategies of the automotive industry, spotlighting the trend of OEMs strategically investing in digital capabilities to differentiate across the customer journey. This strategic imperative stems from the growing customer expectations for advanced digital experiences and the technological advancements that empower digital differentiation (Blümel, Zaki and Bohné, 2023; Matarazzo et al., 2021). This discussion emphasises that, in an era where every business is evolving into a technology-driven entity, digital capabilities within a company and its ecosystem emerge as primary competitive advantages and leading indicators for future success.

The findings integrate with the literature on differentiation strategies, digital capabilities, and competitive advantage. Drawing insights from works by Porter (1980), McAfee and Brynjolfsson (2008), and Teece (2018c), this study explores the nuanced dynamics of digital differentiation in the post-COVID-19 automotive industry, emphasising its strategic significance and aligning it with the broader discourse on the role of technology in business competitiveness.

For example, Chaudhuri et al. (2023, p. 46) find that “AI customer relationship management technology significantly and positively impacts dynamic capabilities of the family businesses, such as sensing, seizing and transforming capabilities, which in turn positively and significantly influences their sustainability during crises”. Audretsch et al. (2023) and Zabel et al. (2023) highlight the importance of digital technologies to improve customer orientation and innovation outcomes, involving integration with external partners (Wormald et al., 2023). Zia et al. (2023, p. 14) describe the "COVID-19 pandemic as a digital accelerator […] capitalizing on digital DCs—digital sensing (i.e., digital mindset crafting and digital scenario planning), digital seizing (i.e., engaging in strategic agility and balancing a digital portfolio), and digital transformation (i.e., navigating the innovation ecosystem, redesigning the internal structure, and improving digital maturity), […] to prevent business failure during a pandemic".

Song et al. (2023, p. 1) highlight that "in the digital economy, innovators have to deal with the value-capture problem, which necessitates different capabilities. They need to be fully aware of the dynamics of platforms and ecosystems. […] The current digital economy (where businesses are experiencing a big shift from a traditional setting to a widely-digitalized setting) requires companies and enterprises to incorporate innovation into their performance". Additionally, studies highlight best practices to orchestrate digital ecosystems, including "co-creating architectural knowledge, cultivating boundary objects, renegotiating system integration, screening complementors, co-specializing interfaces, and restructuring complementarities" (Kindermann et al., 2022, p.1).

OEMs' strategic investment in digital capabilities to differentiate across the customer journey is motivated by two intertwined factors. First, customers increasingly expect advanced digital experiences that mirror the seamless, simplified, and personalised interactions they encounter in other industries. For example, there is a growing demand for seamless vehicle charging and home connectivity integration. Second, technological advancements, including battery technology, AI, and connectivity, enable OEMs to differentiate digitally, providing unique and enhanced experiences throughout the customer journey.

In the contemporary business landscape, digital capabilities within a company and its ecosystem are crucial competitive advantages and serve as leading indicators for future success. This aligns with the broader literature on digital transformation and its role in shaping competitive advantage (Hanelt et al., 2020; Li et al., 2021). As every business becomes a technology business, the findings posit that strategic investment in digital capabilities is a cornerstone for achieving differentiation, particularly in industries undergoing rapid technological evolution.

5.5.2. External partners for digital differentiators

The second post-COVID trend within the domain of differentiation strategies involves OEMs increasingly relying on external partners, especially through longer-term strategic collaborations, to deliver digital differentiators. Multifaceted imperatives propel this strategic move. The complexity and rapid development speed of digital differentiators demands swift delivery, specialised focus, and access to scarce digital talent (Pesch, Endres and Bouncken, 2021; Wang, 2022). Furthermore, the capital-intensive nature of digital advancements necessitates collaboration with partners possessing the requisite financial resources (Dal Mas et al., 2023). In this landscape, OEMs acknowledge the transformative shift from competing primarily with internal capabilities to actively participating in digital ecosystems.

For example, the consulting industry is changing with consulting firms acquiring “new knowledge and digital assets through talent scouting, and mergers and acquisitions […] rely heavily on complementary knowledge and capabilities of actors within ecosystems; thus, they focus on expanding, creating their ecosystems and adopting platforms' configuration and characteristics” (Tavoletti et al., 2021, p.612). Also in other industries “digitalization should be addressed early on while continuing to renovate the IT […] fostering cultural change to be an attractive employer for new digital talents, which are required on all levels to make the digital transformation a success” (Weingarth et al., 2019, p.249). External engagement is critical to remain competitive today “enabling access to new and untapped talent pools and expanding previously unexplored modes of innovation” (Dencik, Marshall and Parham, 2023, p.37).

In traditional manufacturing industries venturing into the digital realm, the competition has evolved from internal capabilities to active engagement in digital ecosystems (Helfat and Raubitschek, 2018;

Kindermann et al., 2022). In this shift, where highly skilled digital talent is a scarce and invaluable resource, the orchestration capability within a digital ecosystem emerges as a potential competitive advantage. This aligns with the broader literature on digital transformation and ecosystem competition, emphasising the strategic significance of external partnerships in shaping differentiation strategies.

5.5.3. Differentiation through core integration of sustainability

The third differentiation observation focuses on the sustainability trend becoming a core element of more OEMs' purposes and brand identities. This strategic shift is motivated by the demands of stakeholders, including customers, employees, shareholders, and governments, for comprehensive sustainability practices (van Riel et al., 2021). This research highlights the substantial increase in minimum standards for sustainable practices, accentuated by the COVID-19 pandemic's amplification of awareness. Furthermore, it emphasises the potential for businesses to differentiate internally, towards employees, and externally, towards shareholders and customers through high levels of sustainability.

This research engages with the literature on sustainability, corporate social responsibility, and brand identity. Drawing insights from works by Elkington (1997), Morsing and Schultz (2006), and Porter and Kramer (2011), this study explores the nuanced dynamics of sustainability becoming a core element of brand identities in the post-COVID-19 automotive industry, aligning it with the broader discourse on corporate responsibility and differentiation.

Different areas contribute to businesses' sustainability, such as IT and human resource management (Tari and Nirmala, 2023). Improving sustainability is important as "going beyond the standard requirements of corporate social responsibility and acting as conscientious organizations that advance the balanced creation of value for different stakeholders has been called for. Organizations should advance behaviors based on their purpose and distinctive capabilities, especially focusing on the long-term effects of their actions” (Keränen et al., 2023, p.188). Stakeholders hold firms more accountable for operating sustainably, aligning with wider societal developments (Gruchmann et al., 2021).

Sustainability is becoming a core element of more OEMs' purposes, and dual imperatives drive brand identities. Firstly, stakeholders are increasingly aware of and demanding sustainability in both environmental and social aspects, such as fair work conditions as well as diversity and inclusion. Secondly, technological advancements and robust approaches, exemplified by initiatives like the Science-Based Targets initiative (SBTi, 2023), enable OEMs to demonstrate end-to-end sustainability, including supply chain traceability.

The minimum standards for sustainable practices have significantly increased in recent years, amplified by the COVID-19 pandemic's impact on global awareness. Furthermore, this research posits that businesses can achieve differentiation internally, fostering a positive workplace culture and attracting top talent, and externally, enhancing their appeal to shareholders and customers through high levels of sustainability (van Riel et al., 2021). This aligns with the broader literature on sustainability and its role in shaping corporate identity and competitive advantage (Buzzao and Rizzi, 2020; Danso et al., 2019).

5.5.4. Differentiation through enhanced customer experiences

The fourth trend focuses on OEMs investing in and providing more personalised customer experiences. This strategic shift is propelled by heightened customer expectations for tailored interactions, influenced by experiences in other industries such as Amazon and Instagram and facilitated by the abundance of data available to OEMs for crafting personalised experiences (Jain, Aagja and Bagdare, 2017; Lei, Wang and Law, 2022). This research underscores a transformative shift from internally driven to demand-driven digital product development, aligning it with the broader discourse on customer-centricity and the role of personalised experiences in shaping differentiation strategies (López-Cabarcos, Srinivasan and Vázquez-Rodríguez, 2020; van Riel et al., 2021).

This analysis engages with the literature on customer experiences, digital product development, and demand-driven strategies. Drawing insights from works by Von Hippel (1986), II and Gilmore (1998), and Pinegar (2006), this study discusses the nuanced dynamics of personalised customer experiences in the post-COVID-19 automotive industry, aligning it with the broader discourse on customer-centricity and the evolution of product development strategies.

Blümel et al. (2023, p. 1) investigated individualised customer communication. They found that "customer service conversations are becoming increasingly digital and automated [...] expression needs to be personalized to provide a personal touch and improve the customer experience in service. The personalization of these conversation styles depends on available psychological and individual customer knowledge, contextual factors such as the interaction and service type, as well as the freedom of communication the conversational AI or customer service agent has". Similarly, "collecting information from and interacting with customers through mobile platforms for personalization purposes have become a trend" (Lei, Wang and Law, 2022, p.1153).

Technological advancement is a key enabler for personalised customer engagement. Dhote et al. (2020, p. 2196) highlight that "with their ability to map, analyze and leverage big data across social media, smart phones, customer purchase information, and expectations of retail banking services, Google, Apple, Facebook and Amazon can provide a high quality personalized customer experience. [...] The digital as well as physical environments need to be integrated. Advanced information and communication technologies such as artificial intelligence can provide better insights into individual customer preferences".

Two key factors drive OEMs to invest in and provide more personalised customer experiences. First, customers now expect a more personalised experience, influenced by their interactions in other industries and aspects of their lives (Jain, Aagja and Bagdare, 2017; Lei, Wang and Law, 2022). For instance, the personalised shopping experience on Amazon or tailored social media feed recommendations on platforms like Instagram have set new standards. Second, OEMs possess more data than ever to provide personalised experiences, ranging from connected car usage data to digital channel engagement data, coupled with improved internal or external capabilities to deliver targeted experiences through digital products (Bauer et al., 2020; Hemphill, Longstreet and Banerjee, 2022).

Businesses are moving away from internally driven digital product development, primarily influenced by management suggestions, to demand-driven development based on customer pain points and use cases. This aligns with the broader literature on customer-centricity and the pivotal role of personalised experiences in shaping differentiation strategies (e.g., Blümel, Zaki and Bohné, 2023; López-Cabarcos, Srinivasan and Vázquez-Rodríguez, 2020; van Riel *et al.*, 2021). This research highlights the transformative shift in product development strategies, emphasising the need to align digital offerings with customer demands for enhanced differentiation.

5.5.5. Anticipation of future customer needs

The final differentiation trend highlights OEMs moving away from over-relying on traditional customer research. Instead, they supplement it with anticipating future customer needs that cannot be extrapolated from historical data (Hemphill, Longstreet and Banerjee, 2022). This strategic shift is propelled by the increased VUCA in the digital world, necessitating a departure from solely historical data reliance. Furthermore, technological advancements, such as big data availability, advanced analytics tools, cloud computing, and AI models, facilitate OEMs anticipating trends (Brewis, Dibb and Meadows, 2023; Cepa, 2021). Traditional DCs are evolving to "digitally enabled sensing and anticipating - seizing – transforming," emphasising the anticipation of future customer preferences as a capability that can serve as a competitive advantage in differentiating within the market.

The findings integrate with the literature on dynamic capabilities, customer research, and digital anticipation. Drawing insights from works by Winter (2003), Teece (2007), and Rothaermel and Hess (2006), nuanced dynamics of anticipating future customer needs in the post-COVID-19 automotive industry have been discussed. The findings align with the broader discourse on dynamic capabilities in the digital era and the strategic role of anticipation in shaping differentiation strategies.

The importance of anticipating change can be found across a range of domains. For example, Hohenstein (2022, p. 1336) observed in the supply chain management context "that robustness and agility demonstrably strengthen business performance, while learning from experience proves key to reconfiguring a supply chain risk management design in response to acute disruption". Anticipating competitors' actions is also a key component of strategic decision-making to create innovations rewarded by the market (Day, 1994; Hajiheydari et al., 2023).

Anticipation capabilities are important for different types of businesses, including start-ups, in the current post-pandemic business climate. Sreenivasan et al. (2023, p. 2085) found that "resilience, the ability of start-ups to deal with anticipated instabilities and probable disruptions, is becoming an important success element during coronavirus disease 2019 (Covid-19). To survive in this pandemic situation, resilience is an important concept for start-ups".

Technology is a key enabler to anticipate trends for strategic decision-making. "Firms invest heavily in developing technological aspects of big data analytics capabilities as a dynamic strategic capability that facilitates tracking and anticipating the future behavior changes of customers, competitors and market demands. big data analytics capabilities also allows firms to upgrade and reconfigure their dynamic capabilities by responding to managerial, operational and strategic necessities" (Makhloufi, 2023, p.1). Anticipating a range of possible scenarios is especially important to respond quickly to unexpected events (Trieu et al., 2023, p.1).

Automotive OEMs are moving away from over-relying on traditional customer research. Instead, they supplement it with anticipating future customer needs that cannot be extrapolated from historical data. Two key factors drive this strategic shift. Firstly, the heightened VUCA nature of the digital world necessitates less reliance on historical data for making product and service decisions, especially when facing faster and more unpredictable changes (Chen et al., 2023). Secondly, technological advancements, including the availability of big data, advanced analytics tools, cloud computing, and AI models, enable OEMs to anticipate trends somewhat (Brewis, Dibb and Meadows, 2023).

Traditional DCs, encompassing sensing - seizing – transforming (Teece, 2007), are evolving in the digital era to "digitally enabled sensing and anticipating - seizing – transforming." This research emphasises the strategic significance of anticipating future customer preferences as a dynamic capability that can serve as a competitive advantage in market differentiation. This aligns with the broader literature on dynamic capabilities, emphasising their adaptability and evolution in response to changes in the business environment (Achtenhagen, Melin and Naldi, 2013; Eisenhardt and Martin, 2000).

5.5.6. Discussion summary

This research has uncovered trends across several domains that shape differentiation strategies in the automotive industry's post-COVID-19 landscape.

Firstly, the study delves into integrating enhanced digital capabilities as a primary competitive advantage within the automotive sector. The findings underscore the pivotal role of strategic digital investments in shaping differentiation strategies (Li et al., 2021; Moi and Cabiddu, 2020), emphasising the necessity for these investments to attain sustained success in the evolving business landscape.

Secondly, this research explores the orchestration of digital ecosystems as a critical aspect of differentiation (Helfat and Raubitschek, 2018; Hilbolling et al., 2021). This involves shifting from internal capabilities competition towards active participation in digital ecosystems through external partnerships, especially longer-term collaborations. This research identifies this orchestration as a potential competitive advantage in the rapidly evolving digital context.

A third observation arises from investigating the integration of sustainability as a core element in OEMs' purposes and brand identities (van Riel et al., 2021). This research highlights a notable increase in the minimum standards for sustainable practices, identifying high levels of sustainability as a potential differentiator for OEMs internally (e.g., towards employees) and externally (e.g., towards customers).

Furthermore, this study delves into personalised customer experiences as a crucial facet of differentiation (Lei, Wang and Law, 2022). It investigates how OEMs invest in and provide more personalised customer interactions, marking a transformative shift from internally driven to demand-driven digital product development. This research underscores the strategic significance of these personalised experiences in shaping differentiation strategies.

Lastly, this research explores the anticipation of future customer needs as a dynamic capability for differentiation. The shift from over-reliance on traditional customer research to supplementing it with anticipation of future needs is discussed (Blümel, Zaki and Bohné, 2023; Matarazzo et al., 2021). This study positions this anticipation of future customer preferences as a competitive advantage, indicating the evolution of traditional Dynamic Capabilities to "digitally enabled sensing and anticipating - seizing – transforming."

These trends illuminate a paradigm shift in the automotive industry's differentiation strategies post-COVID-19. They provide a perspective of the transformative role of digital capabilities, the orchestration of digital ecosystems, sustainability integration, personalised customer experiences, and the anticipation of future customer needs.

5.6. Conclusion

The pre- and post-COVID-19 findings offer insights into the evolution of differentiation strategies in the automotive industry, highlighting both continuities and transformations.

The pre- and post-COVID findings on differentiation were similar in three ways. First, both periods revealed that car manufacturers differentiated through a mix of technological and non-technological means, driven by sustainability and competitive advantage motives. This is directly linked to our research question regarding the first movers' rationale for their type of differentiation, as it underscores how early adoption in these areas can establish a competitive edge. Second, a notable finding was the first-mover advantage observed in technological advancements, particularly in domains like autonomous driving, connectivity, electrification, and mobility services. Third, both phases emphasised the challenges incumbent manufacturers faced in engaging with sustainability-focused differentiation, requiring more disruptive innovations.

The pre- and post-COVID findings on differentiation were different in three ways. First, post-COVID, the landscape witnessed a paradigm shift in differentiation strategies, marked by the integration of enhanced digital capabilities, orchestration of digital ecosystems, emphasis on sustainability, personalised customer experiences, and anticipation of future needs. This transformation also speaks to our other research question about how differentiation efforts disseminate from individual firms to industry-wide engagements, reflecting a broader trend towards collaborative approaches in response to evolving consumer demands and sustainability pressures. Second, this transformation underscores the dynamic response of the automotive industry to the pandemic's disruptions and changing consumer behaviours. Third, post-COVID the pivotal role of strategic digital investments and external partnerships in shaping differentiation strategies was highlighted, along with the increasing importance of sustainability as a differentiator.

Comparing the two interview periods, it is evident that while the pre-COVID focus was on understanding differentiation within the sustainability transition, the post-COVID research expands insights in areas like the integration of digital technologies and changing consumer dynamics in shaping differentiation strategies. This shift reflects the industry's adaptation to the challenges posed by the pandemic and the acceleration of digital transformation trends. This analysis demonstrates how the motivations behind differentiation strategies and the dissemination of best practices have evolved, fully addressing our research questions.

This chapter contributes to a more nuanced understanding of differentiation strategies in the automotive industry, both before and after the COVID-19 pandemic. It sheds light on the interplay between technological innovation, sustainability imperatives, and digital transformation, offering insights for scholars and practitioners.

Future research avenues could further explore the long-term impacts of COVID-19 on differentiation strategies and the sustainability transition in the automotive industry. Additionally, comparative studies across different industries could provide insights into how differentiation strategies vary in response to external shocks and technological disruptions. Moreover, longitudinal studies tracking the implementation and effectiveness of digital capabilities and sustainability initiatives could offer valuable insights into their evolving role in shaping competitive advantage in the automotive sector.

6. Conclusion

As stated in Chapter 1, this thesis focuses on firms encountering multifaceted challenges in effectively navigating challenges in our VUCA world. The recent COVID-19 pandemic served as a vehicle to study firms' strategic crisis responses. By integrating pre- and post-crisis analyses, this thesis captures the dynamic nature of organisational adaptation, offering nuanced perspectives on how firms navigate and evolve in response to disruptive events and the resulting VUCA environments. The research questions centred around four issues: the assessment of dynamic capabilities, agile ways of working as a strategy tool, conceptualisation of strategic flexibility, and product differentiation in dynamic environments. – before and after a catastrophe, focused on the COVID-19 pandemic. The five main Chapters 2 to 5 considered several aspects of the dynamic capabilities concept as studied by Lin and Wu (2014), Teece (2018c), and Kurtmollaiev (2020). Therefore, this chapter aims to integrate the thesis by highlighting links between and differences across the chapters.

In this dissertation, the convergence between traditional strategy-making, as examined in works by Porter (1980) and Barry and Elmes (1997) among others, and implementation concepts, analysed by scholars such as Denning (2018) and Stewart et al. (2017), is synthesised in the concluding overall theoretical contribution section 6.2. This examination challenges prevailing problem-solving approaches in the research field, emphasising the significance of ambidexterity - managing both exploration (innovation and adaptation) and exploitation (efficiency and refinement) concurrently (O'Reilly and Tushman, 2008) - in theoretical constructs within management studies. The research underscores the shifting landscape of strategic management paradigms, particularly in response to the dynamics of the VUCA world.

Section 6.1 revisits the overall approach and research questions. Section 6.2 summarises this thesis' overall theoretical contributions. Overall managerial and policy implications are consolidated in section 6.3. Section 6.4 covers reflections on the approach and overall contributions. Overall limitations and opportunities for future research are discussed in section 6.5.

6.1. Approach summary and cross-chapter comparison

As delineated in Chapter 1, this thesis confronts the overarching research problems of uncertainty regarding future developments and the challenge of predicting firm success in dynamic environments. By focusing on firms grappling with multifaceted challenges in our VUCA world, particularly in the wake of the recent COVID-19 pandemic, this study aims to shed light on how organisations adapt and evolve amidst disruption. Integrating pre- and post-crisis analyses, the thesis captures the dynamic nature of organisational adaptation, providing nuanced insights into firms' strategic responses to disruptive events and the resulting VUCA environments. The research questions, anchored in the two overarching challenges, centre around four key issues: the assessment of dynamic capabilities in a non-VUCA versus VUCA environment, the utilisation of agile ways of working as a strategic tool to deal with VUCA environments, the conceptualisation of strategic flexibility in a turbulent world, and product differentiation in dynamic environments – both before and after the catastrophic event, focusing on the COVID-19 pandemic. Specifically, all studies contribute to our understanding of how companies can improve their DCs – their capacity to adjust to rapid, significant, and unpredictable external changes successfully and sustainably – by engaging with the DCs literature and beyond. Engaging with literature beyond DCs was necessary as the concepts investigated and specific research gaps addressed remained underrepresented and unexplored in the DCs literature but are essential aspects for firms demonstrating DCs.

The introductory **Chapter 1** lays the foundation for the dissertation, elucidating the theoretical framework and rationale behind selecting the automotive industry as the focal point of study, addressing the research questions: RQ 1.1: What are the strategic implications of CASE for incumbent car manufacturers? RQ 1.2: How can their DCs be assessed holistically? Drawing from existing literature, the chapter identifies key challenges faced by firms in dynamic environments, including uncertainty in future developments (e.g., Sakellariou and Vecchiato, 2022), the complexity of predicting firm success (e.g., Zia et al., 2023), and the dearth of implementation-oriented guidance (e.g., Eisenhardt and Martin, 2000; Stewart et al., 2017).

Chapter 2 conducts a comprehensive literature review on DCs, synthesising seminal contributions by Teece (2007), Eisenhardt and Martin (2000), Helfat and Peteraf (2009), and others. The chapter addresses research question RQ 2: How can agile ways of working be used as a strategy tool to respond to unprecedented industry transformation? This review consolidates the foundational theories of DCs and integrates insights from related fields such as strategic management, organisational theory, and innovation management. Drawing upon Teece's (2007) seminal work on dynamic capabilities, the framework emphasises the importance of organisational learning, sensing, seizing, and reconfiguring capabilities in responding to environmental dynamism and uncertainty. Eisenhardt and Martin's (2000) strategy-as-learning perspective further underpins the framework by highlighting the iterative nature of strategic decision-making and the need for continuous experimentation and adaptation. Moreover, Helfat and Peteraf's (2009) RBV extensions provide theoretical grounding for understanding how firms leverage their unique resources and capabilities to achieve sustained competitive advantage. The framework also incorporates insights from the ambidexterity literature, emphasising the importance of balancing exploration and exploitation activities to achieve innovation and efficiency (Andriopoulos and Lewis, 2009; O'Reilly and Tushman, 2008; Qamar et al., 2021). By synthesising these diverse theoretical perspectives, the framework offers a holistic understanding of DCs and their role in driving organisational resilience and competitive advantage in dynamic environments. Specifically, the framework illuminates how adaptability, innovation, and strategic agility enable firms to proactively sense and respond to market opportunities and threats, thereby enhancing their capacity to thrive amidst turbulent industry landscapes. This integrative approach, which includes empirical analysis of qualitative interviews, equips managers with actionable tools and insights to navigate uncertainty and complexity effectively, guiding strategic decision-making and resource allocation in a VUCA environment.

Chapters 3, 4 and 5 build on the DCs literature review and automotive industry CASE consolidation in Chapter 2 by providing the theoretical fundament of how firms respond to dynamic external changes and how automotive companies specifically have done so recently. For example, sustainability and competitive advantage are emphasised as reasons to develop CASE (Connected, Autonomous, Shared, and Electric) amongst car manufacturers, and both are examined closer as reasons to differentiate in Chapter 5. What is new in this work is the integration of these well-established concepts within the framework of VUCA, highlighting how adaptive strategies must evolve to address unprecedented levels of environmental dynamism and uncertainty. This approach not only revisits sustainability and competitive advantage but also redefines them in the light of current and future challenges in the automotive industry, providing fresh insights into how firms can thrive in rapidly changing conditions.

This emphasis draws upon strategic management theories such as the RBV and Porter's (1980) Generic Strategies. RBV suggests that sustainable competitive advantage arises from the possession of valuable, rare, inimitable, and non-substitutable resources and capabilities. In the automotive industry, the development of CASE technologies, particularly BEVs, represents a strategic response to environmental sustainability concerns, aligning with the principles of corporate social responsibility and environmental stewardship (Amui et al., 2017; Sendlhofer and Tolstoy, 2022). Moreover, the pursuit of CASE technologies in VUCA environments enables firms to differentiate themselves from competitors by offering innovative products and services that meet evolving consumer preferences for environmentally friendly and technologically advanced transportation solutions. What's new in this VUCA COVID-19 context is the heightened importance of agility and resilience in strategic planning. The pandemic has accelerated shifts in consumer behaviour and regulatory landscapes, compelling firms to rapidly adapt their strategies to maintain competitive advantage. This context underscores the need for continuous innovation and flexibility, as traditional strategic approaches are increasingly inadequate to cope with the speed and unpredictability of changes brought about by such global disruptions.

This strategic differentiation is rooted in Porter's Generic Strategies, particularly the focus differentiation strategy, which involves offering unique products or services that target customers perceive as superior. Thus, Chapter 5 examines sustainability and competitive advantage as key drivers for differentiation strategies within the automotive industry. One concrete manifestation of a sustainability-driven development is the widespread adoption and development of electric vehicles, which exemplifies how firms leverage CASE technologies to achieve strategic differentiation and competitive advantage. The uniqueness of this contribution lies in the analysis within the COVID-19 VUCA context, where the pandemic has significantly accelerated the adoption of these technologies. This context highlights the necessity for automotive firms to not only innovate but also to be agile and resilient in response to rapid shifts in consumer behaviour and regulatory changes. The study provides fresh insights into how firms can effectively navigate and thrive in such unprecedented and volatile conditions, emphasising the critical role of adaptability in achieving sustainable competitive advantage.

Another finding in Chapter 2 is the need for more consideration of non-technological capabilities when assessing DCs, which is developed further in Chapter 3, where non-technological capabilities are described and explained when using agile ways of working as a strategy tool. This recognition aligns with the RBV literature, which emphasises the significance of intangible resources such as human capital, organisational culture, and managerial capabilities in driving firm performance and adaptation. As discussed by Barney (1991) and Grant (1996), non-technological capabilities, including leadership commitment, employee involvement, and organisational culture, play a crucial role in shaping a firm's ability to sense the external environment, seize opportunities, and reconfigure resources in response to environmental changes. In Chapter 3, these non-technological capabilities are explored in the context of agile ways of working, which draws upon theories of organisational learning, participative management, and employee empowerment. For example, the identification of top management commitment and employee involvement as critical factors in the innovation iteration process resonates with the literature on organisational change and innovation management. According to theories of transformational leadership (Bass, 1995) and participative decision-making (Vroom and Yetton, 1973), top management support and employee involvement are essential for fostering a culture of innovation and facilitating organisational change. Furthermore, the concept of employee involvement as a dynamic capability aligns with the ambidexterity literature, which emphasises the importance of balancing exploration and exploitation activities to achieve long-term success (March, 1991; Tushman and O'Reilly, 1996).

A third finding in Chapter 2 is the potential for improving the assessment of DCs by considering a range of potential future scenarios instead of making assumptions about the status quo or specific future developments. This observation aligns with scenario planning literature, which emphasises the importance of anticipating and preparing for alternative futures to enhance organisational resilience and adaptability (Bañuls, Turoff and Hiltz, 2013; Schoemaker, Heaton and Teece, 2018). Scenario planning enables firms to explore different plausible futures, identify potential challenges and opportunities, and develop robust strategies to navigate the uncertainty and complexity characteristic of VUCA environments (Dong, 2021; Merendino and Sarens, 2020). Chapter 4 responds to this observation by introducing the conceptual strategic flexibility model, which comprises customer, product, and process dimensions. This model draws upon theories of strategic flexibility and organisational ambidexterity, which advocate for the development of capabilities that enable firms to respond effectively to changing environmental conditions by balancing exploration (innovation and adaptation) and exploitation (efficiency and refinement ;Sanchez, 1995; Tushman and O'Reilly, 1996). Specifically, the customer dimension emphasises the importance of understanding evolving customer needs and preferences, aligning with theories of customer-centricity and market orientation (Day, 1994; Narver, Slater and MacLachlan, 2004). The product dimension focuses on product innovation and differentiation, drawing upon theories of product development and innovation management (Teece, 1986; Ulrich and Smallwood, 2004). Finally, the process dimension highlights the significance of organisational agility and efficiency in responding to dynamic market conditions, reflecting theories of lean management and agile methodologies (Annosi, Foss and Martini, 2020; Womack, Jones and Roos, 1990), as detailed in section 4.4. By delineating these key components and detailing their application in the automotive context, Chapter 4 provides a comprehensive framework for enhancing strategic flexibility and adaptive capacity in dynamic VUCA environments.

Chapters 2 and 5 share a common dataset derived from qualitative interviews, and their development was closely intertwined. The assessment of DCs and differentiation constituted distinct sections within the interview guide, yet they are inherently interconnected. This linkage stems from recognising that a thorough understanding of an organisation's capabilities is pivotal for successful differentiation strategies. The interviews conducted with senior executives offered invaluable top-management perspectives on organisational dynamics and strategy formulation processes. These insights enriched the examination of differentiation strategies in a VUCA environment in Chapter 5, expanding upon the foundational understanding of capabilities, agility, and strategic responses discussed in Chapter 2. Moreover, the interviews involving executives from diverse companies underscored the importance of delving deeply into DCs within specific organisational contexts. This need for context-specific analysis was further emphasised in Chapter 3, which delves into the nuances of strategy-making and implementation processes. The formulation of nuanced questions during the interviews was informed by an understanding of the ongoing transformation within the automotive industry, as elucidated in Chapter 2. This transformation, which impacts various facets of business operations, including sales, underscores the necessity for a nuanced approach to investigating DCs and differentiation strategies within the sector.

Chapter 3 presents a qualitative case study that delves into the response of an Asian-based car manufacturer to the COVID-19 pandemic. The chapter addresses the following research question: How can agile ways of working be used as a strategy tool to respond to unprecedented industry transformation? Through in-depth interviews and analysis, the study sheds light on how the manufacturer strategically employed agile methodologies to navigate and transform its sales model in the face of the crisis. Drawing from established theories of organisational agility and strategic flexibility (Sanchez, 1995; Teece, Peteraf and Leih, 2016), the case study highlights the effectiveness of agile strategies in enhancing adaptability and resilience within dynamic VUCA environments. By examining the real-world application of agile methodologies during a period of significant disruption, the study provides insights into the practical implications of these strategies for organisational response and survival in times of crisis.

Chapter 3 informs Chapter 4 by focusing on new ways of organising work in firms. This is achieved through an in-depth exploration of agile methodologies and their implications for redefining traditional work practices. Specifically, the examination of new, agile work methods in VUCA environments sheds light on novel ways of coordinating activities, fostering collaboration, and enhancing responsiveness to market demands. These insights are then integrated into the conceptual strategic flexibility model introduced in Chapter 4. Here, the process dimension of the model is enriched with findings from Chapter 3, which elucidate how agile principles are reflected in automotive processes during and after the pandemic. This includes insights into how these methodologies influence innovation approaches, accelerate time-to-market strategies, and streamline complexity management within automotive operations. Chapter 3 serves as a foundational exploration of agile organisational paradigms, offering valuable insights that directly inform the conceptualisation and understanding of strategic flexibility within the automotive context. For example, the strategic flexibility customer-process-product-framework detailed in section 4.4 is informed by the six principles in that it focuses on continuous testing and learning over rigid processes, centres around the customer instead of internal demands, and emphasises launching products with the right time to market. This strategic flexibility model enhances a firm's ability to adapt swiftly to market changes, meet evolving customer needs, and maintain competitive advantage in dynamic environments. The strategic flexibility product insights, with product differentiation being one area of the conceptual model, is the foundation for the product differentiation focus of Chapter 5.

Building upon empirical data collected from international automotive managers, **Chapter 4** delves into the concept of strategic flexibility, which involves the ability of firms to adapt swiftly to changing market conditions and customer needs by maintaining a balance between exploration (innovation and adaptation) and exploitation (efficiency and refinement; Sanchez, 1995). Through interviews and value stream mapping, the research conceptualises strategic flexibility dimensions and explores their firm-specific determinants. Grounded in theories of organisational adaptation and strategic decision-making (Calabretta, Gemser and Wijnberg, 2017; Teece, Peteraf and Leih, 2016), the research uncovers the underlying mechanisms that drive strategic flexibility strategies and their efficacy in navigating dynamic environments. Additionally, the chapter examines the impact of the COVID-19 pandemic on strategic flexibility strategies, providing insights into their adaptability and resilience in the face of unprecedented disruption. For instance, one finding reveals that firms with decentralised decision-making processes and cross-functional teams were more successful in pivoting their production lines to meet the sudden demand for medical equipment during the COVID-19 pandemic. This adaptability highlights the importance of fostering a culture of agility and innovation within organisations. The research shows that companies investing in digital transformation and flexible supply chain management were better equipped to handle the disruptions caused by the pandemic, thereby illustrating the practical benefits of strategic flexibility in real-world scenarios.

The final **Chapter 5** synthesises differentiation theory and DCs research to discern how automotive firms differentiate themselves in dynamic environments, addressing the following research questions: RQ 4.1: How do differentiation efforts disseminate from individual firms to industry-wide engagements? RQ 4.2: What is first movers' rationale for their type of differentiation? Leveraging secondary data and interview insights, the dissertation investigates firms' pursuit of technological and non-technological differentiators, particularly in response to market dynamics amplified by the

COVID-19 pandemic. Chapter 5 found a positive link between first movers and technological differentiation. This confirmed the focus on technological capabilities evident in the analysis of automotive DCs (Chapter 2) that essentially sparked the Tesla-centric debate on the future of the automotive industry. Technological enablers, such as advanced analytics and AI-driven customer insights, also played an important role in developing the MVPs through agile ways of working to respond to the COVID-19 changes by transforming the sales model (Chapter 3).

This thesis addresses the overarching research question: “How do unprecedented disruptions (COVID-19 pandemic) change firms' dynamic capabilities approach?” The analysis across the main chapters has consistently illustrated how the COVID-19 pandemic served as a significant catalyst for firms to reassess and recalibrate their dynamic capabilities. By examining both pre- and post-crisis environments, the findings highlight that firms not only adapted their strategic approaches but also enhanced their capabilities to respond effectively to unforeseen challenges. Each chapter has contributed to an understanding of the evolution of dynamic capabilities in the context of the pandemic, ultimately demonstrating that organisations can thrive amidst disruption by cultivating resilience and agility. Thus, the main chapters fully address the overarching question, providing valuable insights into how firms can successfully navigate the complexities of a VUCA world.

This dissertation underscores the importance of integrating theoretical insights with empirical evidence to address the identified research gaps. Elucidating firms' responses to dynamic environments and the impact of disruptive events such as the COVID-19 pandemic provides valuable insights for both managerial practice and scholarly discourse. Moreover, it emphasises the imperative of adapting existing theories on DC and RBV to account for evolving industry dynamics, thereby contributing to a nuanced understanding of firms' strategies in the face of uncertainty. Through this approach, the dissertation aims to offer actionable recommendations and theoretical advancements to enhance firms' adaptive capabilities and foster sustainable growth in dynamic industries like automotive.

Table 6.1 summarises the main **differences** between the semi-independent chapters, falling into conceptual, methodological, and presentation differences. Each row in the table represents a specific aspect of the chapters, providing a clear comparison of their unique approaches and focuses. The categories include the concept focus, level of analysis, methodology (unit of analysis, firms studied, and data), and findings presentation. This comparison helps to understand how each chapter contributes to the overall thesis while maintaining its distinct perspective.

		Chapter 2 (DCs assessment)	**Chapter 3 (Agile ways of working in strategy)**	**Chapter 4 (Strategic flexibility)**	**Chapter 5 (Differentiation)**
Concept	**Focus on DCs**	Direct	Indirect	Indirect	Indirect
	Level of analysis	Strategy and implementation	Strategy and implementation	Strategy	Strategy
Methodology	**Unit of analysis**	Industry and micro-level	Micro-level	Micro-level	Industry and micro-level
	Firms studied	Multiple	Single	Multiple	Multiple
	Data	Interviews and industry data	Interviews and internal documents	Interviews and value stream mapping	Interviews and industry data
Findings	**Presentation**	Conceptual model	Narrative	Conceptual model	Narrative

Table 6.1 Differences between chapters

Two differences between the chapters are in the conceptual orientation. First, the focus of Chapter 2 is on the DCs literature and concept. To better understand how firms respond to high levels of external change, the chapters thereafter engage with the DCs literature but focus on other core concepts to investigate firms more nuanced and on a deeper level while engaging with the literature relevant to the specific issue explored. Second, Chapters 2 and 3 cover both aspects of strategy making and implementation, as these were previous literature gaps concerning the problems in the chapters. Chapters 4 and 5 focus on strategy-making regarding flexibility and differentiation in a VUCA world, respectively. In light of the issues addressed, a broader scope would have led to a need for more depth and nuance in exploring the strategy-making processes.

There are also methodological differences across the chapters. Chapters 2 and 5 focus on industry and micro-level developments as considering competitors is vital in the DCs assessment and differentiation (from competitors) analysis. Chapter 4 focuses on the micro-level, while chapter 3 delves into the involvement and leadership of individual teams. Investigating different levels seems vital to understand firms' responses to external change more deeply and critically. The need for deeper insight is also reflected in the single firm case study focus of Chapter 3. Furthermore, the single firm case study allowed exploring implications of firm-specific environmental factors, like geo-political COVID-19-related changes, and the firm's responses to them. While all chapters address explorative research questions and use interview data, they are complemented by various secondary sources in the form of publicly available firm and industry data. By triangulating interview data with other data sources, findings could be assessed more critically and might be closer to being potentially generalisable.

Finally, Chapters 2 and 4 present findings centred around the conceptual models developed, while Chapters 3 and 5 use a narrative form to present data. The conceptual models answer the specific research gaps identified, engaging with works of Teece et al. (1997) and Teece (2018c) in Chapter 2 and Herhausen et al. (2020) and Sanchez (1995) in Chapter 4, and presenting the data following the model structure helps to illustrate how the concept emerged from the data. To answer the research questions of Chapters 3 and 5, it was vital to provide a rich account of data and detail the nuanced decision structures within the organisations studied. Therefore, a narrative presentation was better suited to reflect this deeper level of insight gathered through the specific interview guide and probing questions, as it allows for a richer, more detailed exploration of participants' experiences and perspectives, capturing the complexities and nuances that a conceptual model might overlook. This approach provides a comprehensive understanding of the contextual factors and personal insights that influence strategic decision-making within firms.

While there are interdependencies and differences between the chapters, it is worth reemphasising that all issues explored spring from the strategic management RBV that highlights the importance of valuable, rare, inimitable, and non-substitutable resources to establish and maintain competitive advantage (Barney, 1991; Wernerfelt, 1984). These resource characteristics might be particularly important in dynamic environments where the highly turbulent competitive landscape can change quickly and demands on managers to continuously reallocate resources to flexibly adjust strategies and remain competitive are high. However, as transaction costs are associated with contractual relations and resource reallocations, leaders must find a balance between the stability of long-term commitments and the flexibility of adapting to changing market conditions (Argyres, Mahoney and Nickerson, 2019; Asmussen et al., 2021; Jacobides, 2008), as illustrated in Chapter 3, with the technological choices to develop the online sales model MVP.

The different levels of analysis across the chapters also highlight that decisions can look promising on one level but are relativised by considering further levels of analysis. For example, a technological choice can seem promising on the team level, but if other teams in the same firm or competitors use more advanced technology, it might not be ideal for establishing a competitive advantage as the superior technology likely leads to more desirable outcomes (e.g., better decisions, higher quality products, faster and less resource-intense processes). Similar logic about levels of analysis applies to product features that require an analysis of competitors. Customers likely do not care about firm internal decision processes and firm-internal alternatives but compare available product alternatives in the marketplace. Thus, analysis of strategic positioning and competitive dynamics at the micro level is insufficient. Instead, industry-level or, in some cases, cross-industry analysis is needed, particularly if a customer problem can be solved by solutions from different industries, as detailed in the differentiation Chapter 5. For example, a customer seeking sustainable transportation might compare electric vehicles from automotive firms with emerging alternatives like e-bikes or public transport solutions. In a VUCA environment, this broader analysis helps firms understand competitive threats and opportunities beyond their traditional industry boundaries, allowing them to adapt and differentiate more effectively.

The continuous resource reallocation need also challenges leaders in that it requires ongoing internal coordination and alignment to identify implementation gaps and leverage potential synergies, potentially increasing the overall demand for – arguably rare and inimitable – socially and technologically skilled managers in organisations. In a VUCA environment, the ability to swiftly reallocate resources in response to rapid changes is crucial. Skilled managers who can navigate these complexities and drive coordination are essential for maintaining organisational agility and achieving strategic goals. Their expertise in both social and technological domains enables them to bridge gaps and create synergies that enhance the firm's adaptive capacity.

6.2. Overall theoretical contributions

This thesis addresses two overarching research gaps identified in the literature on firms operating within dynamic environments. Firstly, it aims to bridge the ambiguity in analytical levels by providing a structured framework for analysing firms in dynamic contexts, differentiating between micro-level factors (e.g., internal firm dynamics) and macro-level factors (e.g., industry-wide trends). Unlike traditional analyses such as SWOT, which also link micro and macro factors, the findings account for VUCA environmental factors, offering a more dynamic and iterative approach to understanding how these factors interact and evolve over time. This allows for a nuanced understanding of how firms can adapt their strategies in real-time to maintain competitiveness and resilience within rapidly changing VUCA ecosystems.

Secondly, it seeks to broaden the scope of resource considerations by exploring the role of non-technological resources, such as human capital, organisational culture, and brand reputation, in shaping firms' adaptive strategies. This is particularly significant in VUCA environments, where the dynamic and unpredictable nature of these settings requires firms to rely not just on technological assets but also on their ability to leverage intangible resources effectively. By adopting a dynamic view of the RBV, the thesis aims to enrich our understanding of firms' adaptive responses in such contexts. Structured around these aims, the thesis makes theoretical contributions related to strategic empowerment, strategic flexibility configurations, and agile working for business strategy. These contributions aim to enhance the practical relevance of research findings, advancing strategic management practices by providing insights into how firms can better navigate and thrive in volatile, uncertain, complex, and ambiguous environments. This focus on non-technological resources and their integration into adaptive strategies is a novel approach that underscores the importance of a holistic resource perspective in VUCA conditions.

6.2.1. Strategic empowerment and implementation independence

First, this research complements existing studies focusing on strategic empowerment and implementation independence within large organisations (Stewart et al., 2017; Sting and Loch, 2016). While prior literature recognises the importance of strategic empowerment and implementation independence, this study explicitly emphasises their significance based on empirical insights from interviews conducted with industry professionals. This empirical support adds depth to our understanding, aligning with previous research conducted by scholars such as Sirmon et al. (2010) and Stewart et al. (2017), among others, who have explored related themes in organisational strategy and implementation.

The concept of strategic empowerment builds upon various findings discussed in prior chapters, particularly in relation to agile working as a key practice, the multi-agent perspective on strategic flexibility, and the reinforcement of differentiation as a value-capture mechanism. Agile working, as explored in earlier chapters, emerged as a critical tool for empowering teams and enabling more responsive decision-making, which directly aligns with the principles of strategic empowerment by decentralising authority and fostering autonomy. The multi-agent perspective on strategic flexibility underscores how empowerment across different organisational levels can enhance the firm’s ability to adapt to changing environments, reflecting a broader, more dynamic approach to flexibility. Differentiation, as a value-capture mechanism, is reinforced through empowered teams that have the independence to innovate and implement tailored strategies, ensuring that firms can effectively distinguish themselves in competitive markets.

By underlining the necessity of seamless integration between strategy formulation and implementation processes, this research extends the existing body of knowledge, shedding light on the practical implications of this integration for reducing transaction costs and ensuring alignment of organisational objectives in large organisations, as discussed by scholars like Jones (1997) and Rompho (2023). The findings address the overarching research problem outlined in Chapter 1, particularly in the context of VUCA environments. By providing empirical evidence, this study highlights the critical role of integrated strategic processes in predicting firm success under conditions of VUCA. Through interviews with industry professionals, key factors that enhance the predictability of firm success in such dynamic settings have been identified. These factors include effective communication, alignment of strategic goals with operational practices, and adaptive capabilities, which are crucial for navigating unpredictable market dynamics and rapid changes in customer preferences and regulatory landscapes. This empirical support reaffirms established principles and underscores their heightened relevance and application in today's turbulent business environments. It enriches our understanding of how strategic empowerment and implementation independence can serve as robust indicators of a firm's potential for sustained success amidst the challenges posed by VUCA conditions.

This research also extends the current understanding of strategic capabilities by situating them within the dynamic environment of large organisations, aiming to address the overarching gaps identified in Chapter 1 (Adner and Helfat, 2003; Ahmad Husairi, Morgan and De Luca, 2021). By delving into the context of the automotive industry, this study illuminates the significance of agility and adaptability as paramount strategic imperatives. For instance, in response to the COVID-19 pandemic, automotive companies swiftly adapted their manufacturing processes to produce essential medical equipment, such as ventilators and personal protective equipment, showcasing their agility in responding to unforeseen challenges. Additionally, the automotive industry's unique combination of technological innovation, supply chain complexity, and consumer demands makes it an ideal setting to analyse the nuanced approaches required for integration and ambidexterity in complex environments (Qamar et al., 2021). This research thus sheds light on a pivotal shift observed during the pandemic, where agility and adaptability emerged as critical drivers of strategic success, reshaping the landscape of strategic priorities amidst unprecedented disruption (Adner, 2002; Gans, 2016).

Examining country-specific nuances within the empirical data reveals interesting patterns in strategic approaches across different regions within the automotive industry. For instance, interviews conducted with industry professionals from developed countries like Germany and Japan highlight a stronger emphasis on precision engineering and quality control in strategic decision-making processes. In contrast, interviews with professionals from emerging markets such as India and South Africa underscore the importance of cost-effectiveness and market adaptability as key drivers of strategic success. These differences reflect variations in regulatory frameworks, cultural norms, and market dynamics (Barnes and Morris, 2008; Kato, 2020), shaping firms' responses to external disruptions like the COVID-19 pandemic. For example, German automotive companies demonstrate a robust capacity for innovation and rapid adaptation, leveraging advanced manufacturing technologies to pivot production lines towards essential medical equipment during the pandemic. Conversely, Indian automotive firms showcase resilience through agile supply chain management and flexible production processes, enabling them to navigate supply chain disruptions and meet shifting consumer demands amidst the crisis. These observations highlight the diverse strategic responses of automotive firms in different regions. Such country-specific insights underscore the significance of contextual factors (Lin et al., 2020), such as technological infrastructure, regulatory environments, and cultural influences, in shaping strategic capabilities and resilience within the automotive industry.

By examining pre- and post-crisis scenarios, including the COVID-19 pandemic, this study offers nuanced perspectives on organisational adaptation, addressing the ambiguity in analytical levels and the limited consideration of non-technological resources outlined in the overarching research gaps (Adner and Helfat, 2003; Ahmad Husairi, Morgan and De Luca, 2021). Through issue-specific exploration, this thesis bridges the divide between theoretical conceptualisations and managerial implementation, thereby advancing strategic management practices in dynamic contexts. Table 6.2 summarises this thesis's overarching theoretical contributions related to senior leaders' strategic empowerment and implementation independence of individuals and teams.

Existing Knowledge	New Findings
Previous studies acknowledge the importance of senior leaders' strategic empowerment of individuals and teams, and the concept of implementation independence within large organizations, particularly in dynamic and complex environments (Stewart et al., 2017; Sting and Loch, 2016; Sirmon et al., 2010).	Chapter 3 underscores the significance of strategic empowerment and implementation independence in the automotive industry amidst the VUCA COVID-19 context. Insights from interviews with professionals provide a deeper understanding of these concepts specific to automotive firms, offering new perspectives and practical implications for navigating dynamic challenges.
Scholars have discussed the necessity of seamless integration between strategy formulation and implementation processes, particularly in dynamic and uncertain environments, to reduce transaction costs and ensure alignment with organisational objectives (Jones, 1997; Rompho, 2023).	Chapter 4 sheds light on the practical implications of such integration by exploring real-world examples within large organisations, thereby providing detailed insights into how seamless integration between strategy formulation and implementation can drive organisational effectiveness and agility. The chapter's focus on illustrating specific strategies and outcomes in dynamic contexts enhances understanding of the challenges and benefits associated with integrating strategy formulation and implementation amidst evolving market conditions and disruptions like those seen during the COVID-19 pandemic.
Studies recognise the importance of agility and adaptability in large organisations, but may not emphasise their strategic imperatives, especially within the automotive industry, where these traits are crucial for responding to market shifts, technological advancements, and changing consumer preferences (Adner, 2002; Gans, 2016).	Chapter 3 highlights agility and adaptability as critical drivers of strategic success within the automotive industry, particularly in response to the COVID-19 pandemic, which reshaped strategic priorities by necessitating rapid adjustments in production, supply chain management, and customer engagement strategies.
Previous studies may not extensively explore country-specific nuances in strategic approaches within the automotive industry (Lopes and Pires, 2020; MacDuffie, 2013).	Chapters 3 and 5 examine country-specific patterns, revealing differences in strategic decision-making processes between developed and emerging markets, particularly in how regulatory environments and market dynamics shape firms' strategic choices.
Existing research may not thoroughly address the ambiguity in analytical levels and the limited consideration of non-technological resources in organisational adaptation (Adner and Helfat, 2003; Ahmad Husairi, Morgan and De Luca, 2021).	Chapters 2 and 3 offer nuanced perspectives on organisational adaptation by integrating theoretical conceptualisations with practical managerial implementation, thereby addressing gaps in analytical levels related to firm dynamics and resource considerations.

Table 6.2 Strategic empowerment and implementation independence overarching theoretical contributions

6.2.2. Strategic flexibility configurations

Second, this research enriches existing knowledge by emphasising the context-specific nature of strategic flexibility configurations, challenging the conventional wisdom of applying a one-size-fits-all approach (Amaral et al., 2023; Chirumalla, Leoni and Oghazi, 2023). For instance, in the automotive industry, strategic flexibility may involve establishing collaborative partnerships with suppliers, enabling firms to quickly adjust production processes and respond to fluctuations in demand. While prior literature acknowledges the importance of strategic flexibility (Aaker and Mascarenhas, 1984; Sanchez, 1995; Zhao and Wang, 2020), this research provides empirical evidence to suggest that different approaches, such as orchestrating networks of partners, can also be effective in adapting to changing market conditions. This orchestration of networks allows companies to leverage external expertise and resources, enhancing their agility and resilience in dynamic environments. Additionally, strategic flexibility configurations may include modular production systems, enabling firms to reconfigure production lines rapidly to accommodate shifts in consumer preferences or technological advancements. Such context-specific strategies underscore the importance of tailoring flexibility initiatives to organisations' unique challenges and opportunities within their respective industries and markets.

This thesis advances existing knowledge by highlighting the role of strong product differentiation alongside the orchestration of networks in mitigating the need for internal changes in response to external disruptions, building upon the insights derived from the discussions on strategic flexibility configurations. The study offers deeper insights into the mechanisms that facilitate strategic flexibility and resilience, thus directly addressing the research problem of limited implementation-oriented guidance (Hermawati, 2020; Kor and Mesko, 2013; Woiceshyn, 2009). Specifically, the orchestration of networks allows firms to tap into external expertise and resources swiftly, enhancing their adaptability and resilience. Simultaneously, robust product differentiation strategies enable companies to maintain a competitive edge by offering unique value propositions that cater to specific market segments. These dual strategies provide comprehensive frameworks for firms to navigate dynamic environments effectively, offering actionable insights for implementation and strategic decision-making, thereby bridging the gap between theoretical concepts and practical applications.

Moreover, this research extends current understanding by emphasising the significance of factors beyond technical capabilities, such as culture and collaboration, in fostering sustainable competitive advantage (Moeen and Mitchell, 2020). Doing so bridges the gap in the consideration of non-technological resources, as detailed in Chapters 2 and 4 (Amaral et al., 2023; Teece, 2018c). This holistic view of strategic flexibility aligns with the necessity for nuanced insights into organisational capabilities, as identified in Chapter 1. Specifically, this approach challenges the traditional focus solely on technical capabilities. It underscores the importance of considering a broader array of resources and capabilities, including intangible assets like organisational culture and collaborative processes. This broader perspective offers a more comprehensive understanding of how firms develop and leverage strategic flexibility to navigate dynamic environments effectively.

Furthermore, the thesis identifies a strategic shift towards operational simplification and collaborative partnerships during the COVID-19 pandemic, distinct from the orchestration of networks highlighted earlier. While the orchestration of networks emphasises the strategic coordination and management of inter-organisational relationships, operational simplification and collaborative partnerships focus on streamlining internal processes and forming collaborative alliances with external entities to adapt to market uncertainties. This strategic shift underscores the necessity for adaptability in the face of intensified industry shifts and market uncertainties, addressing the uncertainty of future developments and the importance of knowledge utilisation (El-Kassar et al., 2022; Tsai, 2016; Zheng, Zhang and Du, 2011). This finding enhances our understanding of organisational strategies in times of crisis by highlighting the significance of leveraging operational simplification and collaborative partnerships to enhance adaptability and resilience. Moreover, it contributes to filling the overarching knowledge gap regarding the utilisation of knowledge in dynamic contexts by illustrating how organisations employ operational simplification and collaborative partnerships as strategic responses to navigate uncertainties and disruptions effectively (Brown and Rocha, 2020; Merendino and Sarens, 2020).

This thesis provides concrete empirical evidence derived from qualitative interviews and analysis, shedding light on the nuanced interplay of contextual factors that influence strategic flexibility and resilience. Through a detailed examination of organisational responses to the COVID-19 pandemic, it uncovers key insights into the strategic decisions made by firms, such as the shift towards operational simplification and collaborative partnerships. These insights offer a deeper understanding of how organisations adapt their strategies amidst industry shifts and market uncertainties, thereby advancing strategic management practices in dynamic contexts. Table 6.3 summarises the strategic flexibility configurations overarching theoretical contributions detailed above.

Existing Knowledge	New Findings
Previous research acknowledges strategic flexibility as important for enhancing organisational resilience and responsiveness, but does not always emphasise the context-specific nature of flexibility configurations tailored to specific industry challenges and dynamic environments (Aaker and Mascarenhas, 1984; Amaral et al., 2023; Chirumalla, Leoni and Oghazi, 2023; Sanchez, 1995; Zhao and Wang, 2020).	Chapter 4 highlights the context-specific nature of strategic flexibility configurations within organisations, challenging the one-size-fits-all approach. It provides empirical evidence for alternative approaches, such as orchestrating networks of partners, and discusses the implementation of modular production systems specifically tailored to dynamic market conditions and uncertain environments, such as those exacerbated by the COVID-19 pandemic.
Literature recognises the importance of product differentiation and the orchestration of networks in strategic flexibility but may not extensively discuss their role in mitigating the need for internal changes during disruptions (Hermawati, 2020; Kor and Mesko, 2013; Woiceshyn, 2009).	This study emphasises the role of strong product differentiation alongside orchestrating networks in mitigating the need for internal changes, offering a framework that integrates innovative strategies with practical applications. This framework provides novel insights by demonstrating how firms can strategically leverage both differentiation strategies and collaborative networks to enhance resilience and adaptability in dynamic environments, such as those influenced by the challenges of the VUCA landscape.
Existing literature may primarily focus on technical capabilities in discussions of strategic flexibility, overlooking the significance of non-technological resources (Amaral et al., 2023; Moeen and Mitchell, 2020; Teece, 2018c).	Chapters 2 and 5 highlight the importance of considering variables beyond technical capabilities, such as culture and collaboration, in fostering sustainable competitive advantage, which when combined provide a more holistic view of strategic flexibility and addressing gaps in the consideration of non-technological resources.
Previous studies may not extensively explore strategic shifts towards operational simplification and collaborative partnerships during crises (El-Kassar et al., 2022; Tsai, 2016; Zheng, Zhang and Du, 2011).	Chapters 3 and 4 identify a strategic shift towards operational simplification and collaborative partnerships during the COVID-19 pandemic, offering insights into how organisations employ these strategies to enhance adaptability and resilience amidst market uncertainties and disruptions.

Table 6.3 Strategic flexibility configurations overarching theoretical contributions

6.2.3. Agile working for business strategy

Third, the findings complement previous research by providing nuanced insights into agile working and its impact on business performance (Annosi, Foss and Martini, 2020; Denning, 2017a; Holbeche, 2019), particularly in the context of extreme unpredictable risks like the COVID-19 pandemic. While prior literature acknowledges the benefits of agile principles in enhancing adaptability and responsiveness (e.g., Moi and Cabiddu, 2020; Orosz *et al.*, 2023a), this research goes further to explore the differential impact of various factors during such unprecedented crises. It highlights that while factors like organisational culture, leadership support, team dynamics, and resource allocation remain critical, certain factors may assume greater importance during extreme crises. For instance, the ability to swiftly adapt to changing market dynamics, respond to competitive pressures, navigate regulatory environments, and meet evolving customer expectations becomes paramount during times of crisis, influencing the effectiveness of agile methodologies. Thus, this research underscores the dynamic nature of agile practices and the need for organisations to tailor their approach based on the specific challenges posed by unpredictable risks.

This thesis advances existing knowledge by pinpointing clear communication of objectives and resource requirements, as well as a balanced approach to performance metrics, as critical success factors for agile initiatives (Srinivasan, Srivastava and Iyer, 2020). In addressing these aspects, the study responds to the need for implementation-oriented guidance highlighted in Chapter 1, offering practical insights for managers navigating dynamic landscapes (Hermawati, 2020; Kor and Mesko, 2013; Woiceshyn, 2009).

The research contributes to current understanding by underlining the importance of aligning agile ways of working with overarching strategic objectives to maximise benefits and mitigate potential pitfalls of agile implementation. This strategic perspective on agile implementation fills a gap in the literature, emphasising the need for alignment with broader organisational goals of agile methodologies (Doerr, 2018; Stray et al., 2022), which directly addresses the challenges outlined in Chapter 1 regarding limited guidance for effective organisational adaptation.

The thesis identifies a notable re-evaluation of business objectives and resource allocation during the COVID-19 pandemic, indicating a strategic shift towards clarity and alignment in agile initiatives amidst heightened uncertainty and disruption. This finding contributes to a deeper understanding of how organisations adapt their agile practices in response to external shocks and crises (Ramesh, Mohan and Cao, 2012; Srinivasan, Srivastava and Iyer, 2020). It also responds to the overall research problem outlined in Chapter 1 regarding the uncertainty of future developments and the utilisation of knowledge.

These overall observations contribute to our theoretical understanding of strategic management by taking into account high-risk situations. By shedding light on the nuanced interplay between strategy-making and implementation, context-specific configurations of strategic flexibility, and the complexities of agile working (Annosi, Foss and Martini, 2020; Denning, 2017a; Holbeche, 2019), the research offers insights for scholars attempting to understand dynamic VUCA environments. Moreover, the findings underscore the need to adapt existing theories and concepts to address emerging challenges, particularly in the wake of disruptive events such as the COVID-19 pandemic, highlighting the imperative of resilience and adaptability in contemporary strategic management practices. Table 6.4 summarises the agile working for business strategy overarching theoretical contributions.

Existing Knowledge	New Findings
Previous research acknowledges the benefits of agile principles in enhancing adaptability and responsiveness (Moi and Cabiddu, 2020; Orosz et al., 2023a).	This research delves deeper into the differential impact of various factors on agile methodologies during extreme crises, emphasising the need for organisations to tailor their approach based on specific challenges posed by unpredictable risks.
Literature recognises the importance of clear communication of objectives and resource requirements for agile initiatives (Srinivasan, Srivastava and Iyer, 2020).	This study identifies clear communication of objectives and resource requirements, along with a balanced approach to performance metrics, as critical success factors for agile initiatives, addressing the need for implementation-oriented guidance and offering practical insights for managers navigating dynamic landscapes.
Existing knowledge acknowledges the importance of aligning agile ways of working with overarching strategic objectives (Doerr, 2018; Stray et al., 2022).	The research emphasises the strategic perspective on agile implementation, filling a gap in the literature by underlining the necessity of alignment with broader organisational goals of agile methodologies, thereby addressing challenges related to effective organisational adaptation.
Previous studies discuss the adaptation of agile practices in response to external shocks and crises (Ramesh, Mohan and Cao, 2012; Srinivasan, Srivastava and Iyer, 2020).	This thesis identifies a strategic shift towards clarity and alignment in agile initiatives amidst heightened uncertainty and disruption during the COVID-19 pandemic, contributing to a deeper understanding of how organisations adapt their agile practices to address emerging challenges and uncertainty.
Previous literature may not extensively discuss the theoretical understanding of strategic management in high-risk situations or the imperative of resilience and adaptability (Annosi, Foss and Martini, 2020; Denning, 2017a; Holbeche, 2019).	The research contributes to our theoretical understanding of strategic management by considering high-risk situations and highlighting the imperative of resilience and adaptability in contemporary strategic management practices, offering insights for scholars attempting to understand dynamic VUCA environments.

Table 6.4 Agile working for business strategy overarching theoretical contributions

6.3. Overall managerial and policy contributions

This section delves into key insights relevant to managerial practice and policy development within the automotive industry. These overall contributions span a range of areas, including strategic agility, adaptability, resource optimisation, industry collaboration, research and development incentivisation, regulatory frameworks, and sustainability initiatives. Through an exploration of these categories, this section offers guidance for stakeholders seeking to navigate the evolving landscape of the automotive sector while enhancing competitiveness, resilience, and sustainability.

6.3.1. Strategic adaptation in disruptive environments

This thesis underscores the imperative for strategic agility and adaptability in turbulent times, exemplified by the COVID-19 pandemic. Managers can employ these insights to develop proactive strategies that facilitate swift responses to unforeseen disruptions, ensuring organisational resilience and sustainability. Policymakers, on their part, can devise policies aimed at promoting a culture of innovation and adaptability within the automotive industry. This may involve incentivising research and development investments, fostering collaboration between industry stakeholders, and implementing agile regulatory frameworks that accommodate rapid changes in market dynamics.

6.3.2. Enhancing organisational capabilities

A takeaway from this research is the critical importance of nurturing both internal and external capabilities to remain competitive in the COVID-19 VUCA environment. Managers can apply these insights to assess and strengthen their firms' skill sets, knowledge bases, and operational efficiencies amidst unprecedented disruptions. Policymakers also play a crucial role in fostering skill development initiatives, promoting knowledge-sharing platforms, and cultivating collaborative networks within the automotive ecosystem. By investing in human capital and promoting a culture of continuous learning, both managers and policymakers can enhance the industry's collective resilience and adaptive capacity, effectively navigating the uncertainties brought about by the pandemic and positioning the sector for sustainable growth in a rapidly changing landscape.

6.3.3. Strategic resource allocation and collaboration

This thesis underscores the increasing strategic importance of judicious resource allocation and collaborative partnerships in navigating volatile market conditions. Managers can utilise these insights to optimise resource allocation processes, prioritise investments in critical areas, and forge strategic alliances that amplify their firms' strengths. Policymakers can support these endeavours by creating an enabling environment for industry collaboration, offering financial incentives for strategic investments, and facilitating knowledge exchange platforms. By fostering a culture of cooperation and synergy, both managers and policymakers can enhance the industry's resilience and competitiveness in the face of uncertainty.

6.3.4. Digitalisation and sustainability

Another key finding of this research is the transformative potential of digitalisation and sustainability initiatives in driving competitive advantage amidst disruption. Managers can capitalise on these insights to embrace digital technologies, integrate sustainability principles into their business models, and deliver enhanced value propositions to customers. Policymakers can complement these efforts by promoting digitalisation and sustainability through regulatory frameworks, funding mechanisms, and industry standards. By fostering innovation and sustainability in tandem, both managers and policymakers can pave the way for a more resilient and future-ready automotive industry.

6.3.5. Agile working practices

This thesis offers insights into the adoption of agile working practices as strategic tools for organisational agility and innovation. Managers can leverage these insights to foster a culture of agility, empower cross-functional teams, and streamline decision-making processes. Policymakers can support these initiatives by providing training programs, funding schemes, and regulatory frameworks that facilitate flexible work arrangements and collaboration. By embracing agility as a core organisational value, both managers and policymakers can enhance the industry's responsiveness to changing market dynamics and fuel innovation-driven growth.

6.3.6. Strategic alignment and ambidexterity

Moreover, the importance of strategic alignment and ambidexterity in navigating complexity and uncertainty has been highlighted. Managers can utilise these insights to ensure coherence between their firms' strategies and external market dynamics, fostering strategic resilience and adaptability. Policymakers can complement these efforts by fostering cross-sector collaboration, facilitating knowledge exchange, and creating platforms for industry-wide coordination. By promoting alignment and ambidexterity, both managers and policymakers can enable the automotive industry to thrive in an increasingly dynamic and interconnected global landscape.

The overall managerial and policy contributions outlined above provide guidance for stakeholders in the automotive industry and beyond. By leveraging these insights effectively, managers and policymakers can foster a culture of innovation, collaboration, and resilience that positions the industry for sustainable success in the face of evolving challenges and opportunities.

6.4. Reflection on approach and overall contributions

This thesis premise was to add academically interesting and relevant theoretical contributions while providing novel and helpful guidance for management practice. The following elements have been emphasised.

6.4.1. Multi-levels and -angles studying of firms in dynamic environments

The research presented in this thesis covers varying levels of detail and abstraction. For example, wider environmental dynamics have been considered when studying team and firm-level behaviours. Moreover, insights generated from primary data (e.g., interviews) were generally triangulated using widely accessible secondary data and multiple perspectives (e.g., firm internal and external stakeholders). Data collected and analysed were generally not limited to one stakeholder group (e.g., incumbents), but insights have been generated for different industry players and to attempt to explain the wider industry and general firm dynamics. Narratives developed as part of this research, e.g., on agile ways of working as a strategy tool in the context of automotive sales, were based on empirical findings and retrospectively validated with stakeholders (e.g., industry experts). The contributions also cover ways in which firms in dynamic environments can be analysed, thereby providing methodological guidance. While this framework was developed and used for analysing firms, it might reveal insights into wider industry developments.

Other studies referred to this type of systematic breakdown and analysis as a system engineering approach (e.g., Choi, 2016), where socio-technical systems are defined and explained on a higher level and into constituting elements. Depending on the task at hand, researchers then zoomed in on elements of interest while highlighting and trying to close unknown areas. One example from this research is that in the context of analysing firms' dynamic capabilities, not only can firm internal capabilities be assessed and evaluated, but it is as vital to understand competitors' capabilities and other external factors. Another example from this research would be that it is not sufficient to describe the type of strategic decisions made and what teams implemented based on it but also to understand the teams' decision-making processes and how specifically the solution evolved over time.

6.4.2. Dynamic resources and capabilities lens

During this research, a common theme has been the emphasis on viewing firms as an amalgamation of resources and capabilities. This research suggests that resources and capabilities are not only aligned according to a firm's strategy (e.g., product differentiation strategy) but that they also inform the firm's decision-making to pursue a particular strategy and are thus of paramount strategic importance. In today's business environment, technology-related resources and capabilities might be particularly important and allow firms to differentiate. In combination with industry-specific knowledge (e.g., competitors' capabilities and customer needs), firms can leverage technology resources and capabilities to effectively demonstrate dynamic capabilities, i.e., identify opportunities, define and redesign the business model and resource allocation, and realign the organisational structure and culture (Teece, 2018c). In doing so, firms can improve their risk management by knowing more about themselves and firm externalities and acting on the knowledge advantage more efficiently.

This research adds texture to the assessment of dynamic capabilities by complementing existing theory with additional dimensions (Teece, 2018c). I argue that it is critical to consider data on the firm's external environment (e.g., customers and competitors) in assessing DCs (e.g., their market value). The automotive data also highlights the relevance of considering non-technological capabilities (e.g., management and leadership) in the DCs assessment while following a transparent and scenario-based assessment approach. Considering various external scenarios helps firms discuss potential developments and manage associated uncertainty, especially Knightian uncertainty (also referred to as unknown uncertainty), which is uncertainty that is not quantifiable.

6.4.3. Intra-organisational dynamics are more important than commonly suggested.

This thesis argues that business success in VUCA environments of the digital era often hinges not solely on unique technologies or entrepreneurial heroics but rather on the continuous organisational effort to efficiently align with strategic objectives. Specifically, successful businesses may not always be the originators of ground-breaking technologies; rather, their intra-organisational dynamics—such as decision structures, knowledge management, and a culture that embraces learning from failures—enable them to derive exceptionally high utility from these technologies, thereby delivering greater value to customers. This capability is closely tied to the organisation's ability to sense technological trends and make informed, value-driven decisions about technological investments and divestments.

One example discussed as part of this research (see Chapter 3) is the development of direct sales models and customer interfaces in the automotive industry during the COVID-19 pandemic. Here, it was imperative to iterate with customers and pivot solutions quickly to allow the company to continue to sell cars while car dealerships were closed. Another success-determining factor was the alignment with broader societal narratives, in this case, especially offering the solution environmentally and inclusively.

It seems like there are some commonalities between a game of tennis and competition in the business environment. In both cases, players' odds of success are improved by addressing information asymmetry, a concept extensively discussed in literature such as transaction cost economics, which emphasises the importance of knowing more about themselves and their competitors, particularly their strengths and weaknesses. Players need to sense the environment, whether geo-political tensions in the supply chain or the wind on the tennis court. Players must make an informed decision about their next move based on knowledge about themselves and the opposition. While they can prepare for different scenarios, like a serve down the "T" or out wide, they need to prepare, eventually, make a decision, move in a specific direction, and make a shot that they think will be difficult for their opponents to return. Like in tennis, there are many battles in business, and it seems most promising to approach the game of business sustainably, potentially with an "infinite game" mindset to ensure decisions set up the organisation for long-term survival (Sinek, 2019).

6.5. Overall limitations and future research

This research, while comprehensive in its exploration of dynamic capabilities and strategic flexibility within the global automotive industry, is subject to several overall limitations that offer avenues for future research. In addition to the overarching limitations discussed in this chapter, specific study-related limitations have been identified and discussed in Chapters 2 to 5.

6.5.1. Industry-specific context of the automotive sector

One overarching limitation pertains to the industry context itself. While the findings of this research shed light on the relevance of strategic flexibility and dynamic capabilities before, during, and after the COVID-19 pandemic, it is important to recognise that the automotive industry possesses unique characteristics that may not fully translate to other sectors. For instance, the automotive industry's configuration intensity, characterised by a plethora of possible feature combinations and stringent regulations governing fast-moving objects in public spaces, sets it apart from industries like smartphones (Jacobides, Macduffie and Tae, 2013; Koplin, Seuring and Mesterharm, 2007). Consequently, findings from this study may not be directly transferable to contexts with different regulatory landscapes and product configurations. However, insights from this research could potentially find applicability in industries such as aerospace, which also operate in highly regulated environments with complex product configurations and technological advancements (Claussen, Essling and Peukert, 2018; Prince and Simon, 2015). Currently, no research in this area has been done on the impact of the COVID-19 pandemic.

Future research could attempt to understand how firms respond to dynamic external changes in other industries and contexts. Specifically, the strategic flexibility configurations discussed in Chapter 4 and the agility and adaptability frameworks highlighted in Chapter 3 could be explored in industries with different structural characteristics. This research could be replicated in other sectors to understand how specific industry characteristics affect the results and how the phenomena explored in the automotive industry manifest in other contexts. The automotive industry, characterised by a few large manufacturers that account for most vehicles sold, provides a unique backdrop. Additional knowledge could be generated by focusing on industries with different characteristics, such as those with numerous smaller players or highly fragmented markets, to determine how strategic empowerment and implementation independence (discussed earlier in Chapter 6) vary across different industry landscapes. For example, the building sector is more fragmented and involves more smaller firms (Leising, Quist and Bocken, 2018). Other potentially insightful industries that differ from automotive might be consulting, which might be more nebulous in terms of client relationships (Mason, 2010), and fast-moving consumer goods, which operates at a different price point, product turnover speed and customer relationship (Sarangi, Chakraborty and Triantis, 2021). Thereby, findings could be richer and more nuanced, while being closer to potential generalisation.

Other contexts might also include focusing on different types of firm relationships. For example, Foss et al. (2023) focused on dynamic capabilities of firm ecosystems, describing that adaptable ecosystems are characterised by "facilitating the formation of a shared vision (sensing), inducing others to make ecosystem-specific investments (seizing) and engaging in ad hoc problem solving to create and maintain stability (reconfiguring/transforming)" (Foss, Schmidt and Teece, 2023, p.1). Chapter 2 also emphasised the importance of considering the wider firm ecosystem in the dynamic capability assessment, such as charging infrastructure for electric vehicles in the automotive industry. A product well-integrated with a wider support network could be a form of competitive advantage in a dynamic environment. Future research could focus on linking some of the findings from this research on the team and firm level to ecosystems or other forms of firm partnerships. For example, this could also include investigating continuous product differentiation (Chapter 5) as a dynamic capability within ecosystems or similar forms of partnerships.

As general concepts, strategic flexibility and dynamic capabilities might be applicable to any business, irrespective of the industry. However, factors like the industry structure and global orientation affect which types of characteristics are more important. For example, a recent study investigating the dynamic capabilities of firms participating in global value chains found that "firms with domestic plus global value chain partners are more resilient than those having only global business partners" (Ali et al., 2022, p.1). Similarly, the strategic flexibility concept (Chapter 4) illustrated the different configurations required depending on firm internal and external factors. Future research could explore desirable configurations in other contexts, such as the technology, healthcare, and finance industries, providing a deeper understanding of the particular success factors in these varied environments.

6.5.2. Focus on the COVID-19 pandemic as a disruptive event

Future research endeavours could extend beyond the examination of responses to the COVID-19 pandemic to encompass a broader spectrum of crises and disruptions. By exploring how firms adapt to various types of crises, such as economic recessions, natural disasters, geopolitical tensions, or technological disruptions, researchers can uncover nuanced insights into adaptive strategies across diverse contexts. For instance, comparing how firms navigate through a financial crisis versus a public health crisis could reveal distinct patterns of strategic response and resource allocation. Additionally, investigating how firms in different industries respond to specific types of disruptions could shed light on industry-specific challenges and opportunities. For example, studying how firms in the hospitality sector respond to natural disasters versus regulatory changes could provide valuable insights into the role of resilience and agility in mitigating the impacts of external shocks. By broadening the scope of research to encompass a variety of crises and disruptions, scholars can deepen their understanding of adaptive capabilities and strategic responses in dynamic environments across industries and contexts.

6.5.3. Sample size and bias towards developed countries in automotive industry research

The sample’s size and composition, predominantly from developed countries within the automotive industry, introduces a bias that may influence the generalisability of findings. Including more companies from emerging markets and the potential impact of altering the regional representation within the sample could enrich the study's insights. By diversifying the sample to include companies from a broader range of regions, researchers can gain a more nuanced understanding of how contextual factors shape strategic responses to dynamic environments.

Future studies could also delve deeper into the role of organisational design in fostering strategic flexibility. While existing literature has highlighted the importance of modular organisational structures in adapting to dynamic external changes (e.g., Brozovic, 2018; Sanchez, 1995), there remains a gap in comparative studies examining the effect of organisational design on strategic flexibility within similar industry settings. By conducting empirical research comparing two firms facing similar external changes but employing different organisational structures, scholars can elucidate the impact of organisational design on strategic outcomes. Drawing on the conceptual model developed in my dissertation, which underscores the significance of tailored approaches and collaborative partnerships in navigating industry shifts, future studies could explore how variations in organisational design influence firms' abilities to respond to disruptions effectively. By bridging organisational studies with dynamic capabilities strategy research, such comparative analyses can offer nuanced insights into the often-overlooked yet crucial role of organisational design in enhancing strategic flexibility and driving positive firm performance outcomes in dynamic environments.

Table 6.5 summarises the limitations and avenues for future research described above.

Limitation	**Future research directions**
Industry-specific context of the automotive sector	- Explore responses to dynamic external changes in other industries.
	- Investigate the dynamic capabilities of firms in industries with different characteristics.
	- Focus on different types of firm relationships and their impact on dynamic capabilities.
Focus on the COVID-19 pandemic as a disruptive event	- Examine responses to a broader spectrum of crises and disruptions beyond the COVID-19 pandemic.
	- Compare how firms navigate through various types of crises to reveal distinct patterns of strategic response.
Sample bias towards developed countries in automotive industry research	- Explore the inclusion of more companies from emerging markets in the sample to understand the impact of regional diversity on strategic responses.
	- Conduct empirical research comparing the impact of different organisational structures on strategic outcomes.
	- Explore how variations in organisational design influence firms' abilities to respond to disruptions effectively.

Table 6.5 Limitations and future research directions

Beyond addressing the limitations of this study, next steps if continuing research in the industry, could involve delving into new areas of investigation to broaden the scope of understanding. One avenue could involve exploring responses to dynamic external changes in industries beyond the automotive sector, examining how firms in diverse contexts adapt to disruptions. This expansion would provide insights into the applicability of strategic responses across various industries and shed light on sector-specific challenges and opportunities. Additionally, investigating the dynamic capabilities of firms in industries with different characteristics would offer comparative analyses, enriching our understanding of adaptive strategies. Another promising direction would be to focus on different types of firm relationships and their impact on dynamic capabilities, exploring how collaborative partnerships, supply chain dynamics, and ecosystem interactions influence firms' resilience and competitive advantage. These explorations would contribute to a more comprehensive understanding of strategic adaptation in dynamic environments and pave the way for further advancements in strategic management theory and practice.

6.5.4. Final remarks

Addressing the question "How can incumbents survive in dynamic environments?" this thesis highlights the importance of strategic adaptability, continuous innovation, and leveraging existing competencies and new opportunities. By exploring how firms can navigate and thrive amidst rapid changes, the thesis identifies critical factors such as organisational agility, leadership vision, and the ability to integrate emerging technologies and business models.

This thesis followed a somewhat unconventional business and management sciences approach by presenting four semi-independent issues about firms' adaption to dynamically changing environments. Using predominantly qualitative interview data, the contributions provide exciting and relevant ground for further testing. Overall, this thesis generated value by building on seminal strategic management works by Christensen (1997), Teece (2007), MacDuffie (2013), Tushman and O'Reilly (1996), and many more through empirical insights from recent developments in the automotive industry (e.g., Bohnsack et al., 2020; Jacobides, Macduffie and Tae, 2013; Perkins and Murmann, 2018). By doing so, it aspires to offer a forward-looking perspective that inspires future research and practical applications in the realm of strategic management.

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Appendices

Appendix 1: GDPR compliant participant information sheet

Participant Information Sheet

Background

You are invited to take part in the research project carried out by Fabian Hoeft as part of his PhD program at the University of York.

Before agreeing to take part, please read this information sheet carefully and let us know if anything is unclear or you would like further information.

What is the purpose of the study?

This study is designed to investigate how incumbent car manufacturers can establish and maintain sustained competitive advantages in the face of current influencing factors.

How long will the interview take?

The interview will last between half an hour and two hours, depending on the interview flow and time restrictions of the interviewee.

Why have I been invited to take part?

You have been invited to take part because you are considered a relevant stakeholder and expert through your professional experience to explore the research questions.

Do I have to take part?

No, participation is optional. If you do decide to take part, you will be given a copy of this information sheet for your records and will be asked to complete a participant information form. If you change your mind at any point during the study, you will be able to withdraw your participation without having to provide a reason. The time limit for withdrawal is three months after the date of the interview.

If you withdraw midway, the partial data recorded until that point will be destroyed immediately.

On what basis will you process my data?

Under the General Data Protection Regulation (GDPR), the University has to identify a legal basis for processing personal data and, where appropriate, an additional condition for processing special category data.

In line with our charter which states that we advance learning and knowledge by teaching and research, the University processes personal data for research purposes under Article 6 (1) (e) of the GDPR: Processing is necessary for the performance of a task carried out in the public interest

Special category data is processed under Article 9 (2) (j): Processing is necessary for archiving purposes in the public interest, or scientific and historical research purposes or statistical purposes

Research will only be undertaken where ethical approval has been obtained, where there is a clear public interest and where appropriate safeguards have been put in place to protect data.

In line with ethical expectations and in order to comply with common law duty of confidentiality, we will seek your consent to participate where appropriate. This consent will not, however, be our legal basis for processing your data under the GDPR.

How will you use my data?

Data will be processed for the purposes outlined in this notice.

Will you share my data with 3rd parties?

Anonymised data may be reused by the research team for secondary research purposes.

How will you keep my data secure?

The University will put in place appropriate technical and organisational measures to protect your personal data and/or special category data. The data collected in this study is stored in the University's cloud storage. Sensitive data, e.g. email addresses, are stored only on password protected and encrypted machines.

Information will be treated confidential. Raw data will only be seen by the researcher and his two supervisors. The University is committed to the principle of data protection by design and default and will collect the minimum amount of data necessary for the project. In addition, we will anonymise or pseudonymise data wherever possible.

Will you transfer my data internationally?

Possibly. The University's cloud storage solution is provided by Google which means that data can be located at any of Google's globally spread data centres. The University has data protection compliant arrangements in place with this provider. For further information see, https://www.york.ac.uk/it-services/google/policy/privacy/.

Will I be identified in any research outputs?

All data collected in the course of this study will be anonymised or pseudonymised for publication purposes. However, a non-identification of individuals cannot be guaranteed, as it is possible that industry experts of a certain stakeholder group may be associated with particularly characterising statements due to their publicity.

How long will you keep my data?

Data will be retained in line with legal requirements or where there is a business need. Retention timeframes will be determined in line with the University's Records Retention Schedule.

What rights do I have in relation to my data?

Under the GDPR, you have a general right of access to your data, a right to rectification, erasure, restriction, objection or portability. You also have a right to withdrawal. Please note, not all rights apply where data is processed purely for research purposes. For further information see, https://www.york.ac.uk/records-management/generaldataprotectionregulation/individualsrights/.

In case of withdrawal from study participation within three month after the date of the interview, all data collected until then will be deleted.

Questions or concerns

If you have any questions about this participant information sheet or concerns about how your data is being processed, please contact Fabian Hoeft (fabian.hoeft@york.ac.uk) in the first instance. If you are still dissatisfied, please contact the University's Acting Data Protection Officer at dataprotection@york.ac.uk.

Fabian Hoeft is the researcher carrying out the research project. He is supervised by Professor Teresa da Silva Lopes (teresa.lopes@york.ac.uk) and Dr Snehasish Banerjee (snehasish.banerjee@york.ac.uk). Professor Tony Royle (tony.royle@york.ac.uk) is the Chair of the Economics, Law, Management, Politics and Sociology Ethics Committee.

Right to complain

If you are unhappy with the way in which the University has handled your personal data, you have a right to complain to the Information Commissioner's Office. For information on reporting a concern to the Information Commissioner's Office, see www.ico.org.uk/concerns.

Appendix 2: Consent form for participants

Consent form for participants

This form is for you to state whether or not you agree to take part in the study. Pleaseread and answer every question. If there is anything you do not understand, or if you want more information, please ask the researcher.

Have you read and understood the information leaflet about the study?	Yes □ No □
Have you had an opportunity to ask questions about the study?	Yes □ No □
Do you understand that the information you provide will be held in confidence by the research team?	Yes □ No □
Do you understand that all data collected will be anonymised or pseudonymised wherever possible, but that a non-identification of individuals cannot be guaranteed?	Yes □ No □
Do you understand that you may withdraw from the study for any reason?	Yes □ No □
Do you understand that the information you provide may be used in future research?	Yes □ No □
Do you agree to take part in the study?	Yes □ No □
If yes, do you agree to your interviews being recorded? *(You may take part in the study without agreeing to this).*	Yes □ No □

Fabian Hoeft (fabian.hoeft@york.ac.uk) is the researcher carrying out the research project and conducting the interviews. He is supervised by Professor Teresa da Silva Lopes (teresa.lopes@york.ac.uk) and Dr Snehasish Banerjee (snehasish.banerjee@york.ac.uk). Professor Tony Royle (tony.royle@york.ac.uk) is the Chair of the Economics, Law, Management, Politics and Sociology Ethics Committee.

Your name (in BLOCK letters):

____

Your signature:

____

Interviewer's name: Fabian Hoeft

Date:

Appendix 3: Thematical interview guide

1. **Warm-up: Review of quotation and thematical introduction**

- *Brief self-introduction of the interviewer and introduction to topics, goals and procedure of the interview*
- *Review of roles and responsibilities of the interviewee*

2. **Automotive industry and current influencing factors**

- In your opinion, what characterises today's automotive industry most distinctly? What is particularly distinguishing about established car manufacturers today (compared to incumbents in other industries)? *Link to and discussion on CASE trends // Current strategic key concerns of incumbents*
- *Link to social problems, incl. regulation and technological enablers* What are the key factors influencing the automotive industry at present? How do you think these will change in the next three to five years? What developments of substantial changes in the influencing factors or even new influencing factors do you perceive to be emerging?
- Which of these influencing factors do you think are particularly relevant (influential) for incumbent car manufacturers? How would you prioritise the influencing factors in terms of their importance for (potential impact on) incumbent car manufacturers?

3. **Implications for incumbent automakers**

- What implications do these influencing factors have, in your perception, already today for incumbent automobile manufacturers? How do you estimate the form and extent of future implications? *Depending on the course of the conversation: ask questions concerning the CASE factors dimensions and the implications for the three dimensions of technology, market and business model*
- What effects will the influencing factors (and already discussed implications) have on the value chains, resources (in particular capabilities) and strategies of incumbent car manufacturers? Clarifying concepts of three dimensions, esp. capabilities; *Link to new requirements and current resources that are not required anymore; on a higher level as in-depth capabilities consideration follows*

4. **Organisational capabilities assessment**

- *Practitioner-oriented clarification of the core concept of organisational capabilities*
- How relevant do you consider the concept of capabilities to be for your employer/clients? What relevance do capabilities and their consideration have for your professional practice? How do you apply the capabilities concept in your professional practice?
- *Transition to the assessment of capabilities*
- How important do you consider the assessment of capabilities?
- How are capabilities assessed at your employer/clients? How are you involved in assessing capabilities, or what is your relationship to it? *Asked for detailed explanations*

- What is done with the result of the capability assessment? What influence does the result of the capability assessment have (on, e.g., resource (re)allocation and strategy)?
- *Maybe introduce to and get feedback on my initial approach to assessing capabilities*

5. Current capabilities of incumbent automakers

- What are the classifications of capabilities at your employer/clients (or which ones do you use and/or consider useful)? *If none: continue with classification into technical (e.g., AI) and non-technical capabilities (e.g., leadership)*
- What capabilities do(es) your firm/clients have in these categories? What do other incumbent car manufacturers have? How pronounced/developed are these capabilities (capabilities assessment)? *If it is not addressed: consider the four CASE dimensions in terms of market, business model and strategy, costs, etc.*

6. Capability gaps in establishing and maintaining sustained competitive advantages

- *Brief practical introduction to the concept of sustained competitive advantages*
- From the perspective of an incumbent automaker, what do you think is necessary to establish and maintain sustainable competitive advantages?
- Which capabilities in the light of current influences (e.g., competition, regulation, customer needs etc.) are necessary to establish and maintain sustained competitive advantages?
- What gaps do you currently observe/perceive in your employer's/client's capabilities in this regard? What gaps in the capabilities of other incumbent car manufacturers do you recognise?
- Ambidexterity – How do you manage the tension between exploiting/running the cash-producing core business while exploring the future (innovative future profit pools)? [e.g., Running experiments? How do car manufacturers' organisations learn? How do they identify and explore potential future profit pools?]

7. Closing capability gaps

- What is currently being done at your employer/clients to close these capability gaps?
- What else do you think should be done to close gaps in capabilities?
- What do you consider to be the greatest challenges in closing gaps in capabilities? If no suggestion: reference to the consideration of current developments (future scenarios) and associated risks (including the costs involved for car manufacturers)

8. Present debates and implications

- (De-) Globalisation and supply chain robustness
- New entrants
- Key constraints
- Differentiation
- Geographical shifts to Asia
- Technological flexibility

Closing/Final question: In your opinion, what else could be interesting and/or useful for my research regarding the topics discussed? *Thanking the interviewer for their time and insights*

Appendix 4: Ethics approval

ELMPS decicion Fabien Hoeft Capabilities and sustained competitive advantages

Tony Royle <tony.royle@york.ac.uk> Thu, 26 Mar 2020, 11:22
to Fabian, Debbie

Dear Fabien

Your ethics application can be approved, but subject to you adequately addressing the following remaining issues:

1) Anonymity should be the default option, however, it is not clear how you will guarantee the anonymity of participants e.g. use of pseudonyms, removing all identifying data? This needs proper discussion and to be treated in a consistent manner in the application. It also seems quite likely that it may be possible to identify some respondents and therefore they should be consenting to take part on this basis (that they might be identifiable) this needs to be reflected in the information and consent forms with an explanation as to why anonymity might not always be possible if this is the case
2) Amend the information sheet and consent form to make it clearer that all information will be anonymized
3) Make it clear that raw data will only be seen by you and your supervisors (you cannot say 'sharing on a need to know basis')
4) Remove inconsistencies regards storage of sensitive data e.g. email addresses kept only on password protected and encrypted machines
5) Make it clear on the information sheet whose is doing the research and why e.g. that this is your PhD research and not an invitation from the University of York
6) There should be a clear and consistent time limit for withdrawal we usually suggest about 3 months from date of interview for example

You can respond to me with a covering email addressing each point above and attach your amended application using track changes for any amendments. If needed additional advice can also be obtained from your departmental ethics representative (Nadina Luca).

For your information please also note the information below regards the Covid-19 virus:

In light of the coronavirus epidemic and UK governmental guidance which must be followed regarding in-person research: limiting all social contact, which means no in-person interviews, no focus groups, and avoiding direct contact with research participants and third parties. You will need to observe any future changes in this respect by abiding by UK governmental guidelines.

*Similar restrictions may or may not apply in **overseas countries**, but we would **expect you to comply with any existing and any revised national guidelines**, as well as to follow the advice of the World Health Organization and the UK Foreign and Commonwealth Office for those countries.*

The following links may be helpful:
https://www.nhs.uk/conditions/coronavirus-covid-19/self-isolation-advice/ https://www.gov.uk/government/publications/covid-19-guidance-on-social-distancing-and-for-vulnerable-people/guidance-on-social-distancing-for-everyone-in-the-uk-and-protecting-older-people-and-vulnerable-adults

Best wishes

Tony

Professor Tony Royle
Chair ELMPS Ethics Committee

Fabian Hoeft 26 Mar 2020, 23:52
Dear Tony Thank you very much for your feedback. Please find my comments below in red and the revised documents using track changes attached. Please let me know

Tony Royle <tony.royle@york.ac.uk> Fri, 27 Mar 2020, 14:53
to me, Debbie

Dear Fabien

Your ethics application is now approved, but please remove the following words from your consent form: 'without affecting any services you receive'

Best wishes

Tony

Appendix 5: Interviewee overview pre-COVID (2020-2021)

No.	Date	Country	Value chain role	Position
1	21/04/2020	UK	Research institution	Professor
2	22/04/2020	UK	Supplier	CEO
3	23/04/2020	Germany	Consultancy	Partner
4	05/05/2020	UK	Supplier	Project director
5	27/04/2020	Germany	Consultancy	Partner
6	30/04/2020	Japan	OEM	Outside director
7	29/04/2020	Germany	Consultancy	Senior partner
8	01/05/2020	Germany	Consultancy	Partner and CEO
9	27/04/2020	USA	OEM	VP
10	30/04/2020	USA	Research institution	President and CEO
11	28/04/2020	Russia	OEM	President and CEO
12	25/04/2020	UK	OEM	CMO
13	30/04/2020	Germany	OEM	Senior director
14	13/05/2020	Germany	OEM	Senior manager
15	07/05/2020	USA	OEM	VP
16	08/05/2020	Germany	Consultancy	Director
17	14/05/2020	UK	Research institution	Senior researcher
18	03/06/2020	South Africa	OEM	CEO
19	27/10/2020	USA	OEM	CEO
20	28/10/2020	Germany	Automotive association	Chief economist
21	02/11/2020	USA	OEM	Senior manager
22	20/11/2020	Germany	Supplier	CEO
23	01/12/2020	UK	OEM	Senior manager
24	06/12/2020	India	OEM	Senior expert
25	09/12/2020	China	OEM	Senior manager
26	06/01/2021	USA	Consultancy	Partner
27	10/12/2020	Canada	Dealership network	President and CEO
28	18/12/2020	UK	OEM	Senior manager
29	10/12/2020	Germany	Mobility services provider	Senior expert
30	14/12/2020	India / Japan	OEM	Managing director
31	11/01/2021	Israel	OEM	Senior manager
32	06/01/2021	Belgium	OEM	Senior manager
33	22/02/2021	USA	OEM	Senior manager

Appendix 6: Interviewee overview post-COVID (2023)

No.	Date	Country	Value chain role	Position
34	24/04/2023	Italy	Supplier	Operations coordinator
35	25/04/2023	South Korea	Manufacturer	Former president and CEO automotive OEM
36	25/04/2023	USA	Consultancy	Principal consultant
37	26/04/2023	UK	Manufacturer	VP customer experience and innovation; former Chief Digital Officer at OEM
38	26/04/2023	Germany	Supplier	Digital advisor automotive
39	05/05/2023	Germany	Consultancy	Consulting partner, automotive
40	29/04/2023	Dubai	Consultancy	Automotive consulting director
41	27/04/2023	India	Consultancy	Automotive consulting practice lead
42	26/04/2023	Czechia	Consultancy	Automotive consulting director
43	28/04/2023	USA	Consultancy	Senior partner, automotive consulting lead
44	16/05/2023	Germany	Consultancy	Global automotive consulting lead
45	28/04/2023	Germany	Supplier	Partner and chief operating officer
46	02/05/2023	UK	Consultancy	Director automotive consulting (former OEM mobility services manager)
47	03/05/2023	UK	Consultancy	Senior automotive consultant
48	01/06/2023	Germany	Consultancy	Partner and head of IT (ex. CEO of OEM IT software organisation)
49	25/05/2023	UK	Industry association	Policy manager
50	14/05/2023	India	Consultancy	Director
51	28/04/2023	USA	Consultancy	Consultant, global automotive
52	28/04/2023	Canada	Research institute	Professor and associate dean of engineering
53	17/05/2023	Germany	Consultancy	Managing director and partner
54	02/05/2023	UK	Industry association	Presenter and producer
55	02/05/2023	Germany	Consultancy	Managing director
56	02/05/2023	USA	Supplier	Director
57	05/05/2023	UK	Manufacturer	Senior market intelligence associate
58	04/05/2023	France	Supplier	Sales director automotive
59	05/05/2023	USA	Supplier	President
60	03/05/2023	India	Consultancy	Director automotive strategy
61	04/05/2023	UK	Supplier	International M&A
62	17/05/2023	Germany	Supplier	Digital strategy lead Central Europe and automotive lead EMEA
63	12/05/2023	UK	Research institute	Automotive trend strategist
64	04/05/2023	UK	Supplier	Strategy consultant mobility and automotive
65	12/05/2023	Germany	Consultancy	Director automotive
66	12/05/2023	Netherlands	Supplier	Head of customer solution management
67	22/05/2023	UK	Manufacturer	CEO
68	16/05/2023	UK	Manufacturer	Former CEO
69	24/05/2023	Germany	Supplier	Chief technology officer
70	25/05/2023	Italy	Supplier	Group senior VP and chief strategy officer

71	15/05/2023	Germany	Supplier	Chief operating officer
72	18/05/2023	Australia	Industry association	CEO
73	19/05/2023	UK	Consultancy	Senior business consultant
74	19/05/2023	USA	Supplier	Chief operating officer
75	19/05/2023	UK	Consultancy	Senior director
76	20/06/2023	Netherlands	Supplier	VP business development
77	08/06/2023	UK	Supplier	Chief people officer