Corporate Agility – A Framework to Compete in High-Velocity Markets

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Candidate Declaration

I hereby declare that:

1. I have not been enrolled for another award of the University, or other academic of professional organisation, whilst undertaking my research degree.
2. None of the material contained in the thesis has been used in any other submission for an academic work.
3. I am aware of and understand the University's policy on plagiarism and certify that this thesis is my own work. The use of all published or other sources of material consulted have been properly and fully acknowledged.
4. The work undertaken towards the thesis has been conducted in accordance with the SHU Principles of Integrity in Research and the SHU Research Ethics Policy.
5. The word count of the thesis is 79,067.

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Abstract

Over the past 30 years, strategic and operating conditions have become increasingly turbulent for private industrial companies. The main causes were factors such as hyper-competition, increasing customer demands, regulatory changes, and/or technological advancements. Consequently, the ability to sense these changes and respond readily became an important determinant for firm success.

Simultaneously, the question of how to describe and develop this kind of ability became a dominant topic for both scholars (particularly related to management science) and practitioners along all hierarchy levels. As a result, the notion of enterprise agility is among the most predominant and popular approaches of how organisations can successfully establish such ability in order to deal with dynamic and constantly changing environments. Considering contemporary firms and current impacts like the COVID-19 pandemic, extremely tensed global supply chains, and geopolitical events like the Russian invasion into the Ukraine, one could assume that the concept of agility is of unprecedented relevance.

Therefore, this study aims to understand how agility is constituted in a corporate context, what are the main enablers behind, and in particular what are the maturity levels within these enablers. The primary scope is related to the automotive supplier industry, as this sector is facing a transformation like never before. A pragmatist philosophical position has been characterised to be appropriate for conducting the research, as the main goal was to translate the collected management knowledge into efficacious practical realisation.

The study has found the logic of maturity models as suitable in order to develop an appropriate framework and concludes with the Maturity Model of Corporate Agility. Following this, agility is characterised by six key elements: two first-order capabilities and four second-order capabilities. These are grounded in a set of 30 enablers. Each of them has been defined from poor or rudimentary practice to best practice while the different levels automatically indicate the progression on the improvement path. Even if the developed maturity model might be limited in its applicability to other industries beyond automotive, practitioners can apply this framework as a managerial tool to manoeuvre in today's high-velocity markets.

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List of Abbreviations

BDA	Big data analytics
CAD/E/M	Computer-aided design/engineering/manufacturing
CEO	Chief Executive Officer
CMMI	Capability Maturity Model Integrated
CNC	Computer numerical controlled
ECU	Electronic control unit
EDI	Electronic data interchange
ERP	Enterprise resource planning
ESM	Enterprise social media
IATF	International Automotive Task Force
IFRS	International Financial Reporting Standards
IS	Information systems
ISO	International Organisation for Standardisation
I(C)T	Information (and communication) technology
JIT	Just-in-time
LEG	Lead engineering group
MIT	Massachusetts Institute of Technology
MVP	Minimum viable product
M&A	Mergers and acquisitions
OEM	Original equipment manufacturer
P&L	Profit and loss
QFD	Quality Function Deployment
RFQ	Request for quotation
RQ	Research question
R&D	Research and development
SC	Supply chain
SME	Small and medium-sized enterprise
USP	Unique selling point
VP	Vice President

CHAPTER ONE

Overview of the Thesis

> Knowledge has no value until it is applied. When new knowledge is applied, it introduces a change into the environment, which generates a value. (Dove, 1999, p. 19)

1.1 Introduction

This study aims to present an understanding of the agility approach utilised in private enterprises with a specific focus on making the research applicable for practitioners. Chapter one outlines the motivation and background before presenting the subsequent objectives and research questions. This chapter also gives a preview of the selected methodology, the results, and expected contributions for both management practice and theory.

1.2 Motivation and Background

The starting point of this thesis was a turbulent environment within the automotive industry and the resulting challenge for automotive suppliers how to thrive in such business surroundings in 2017. The trends towards *electrification* and *autonomous driving* led to rapid changes in competition, demand, technology, and regulations that made it more important than ever for firms to be able to respond and adapt quickly. From today's perspective in 2022/23 and considering the COVID-19 pandemic, the global shortage of semiconductors, and geopolitical events like the Russian invasion into the Ukraine, the automotive industry is facing a never-existing-before *technological transformation* and a never-existing-before *crisis* at the same time. The former Bosch CEO Volkmar Denner worriedly stated in a recent newspaper article in the "Welt am Sonntag" that the biggest challenge for companies is the simultaneous occurrence of these events (Gersemann & Zwick, 2020). Matthias Zink, Automotive CEO from Schaeffler, emphasised in an "Au-

tomobil Industrie" article the enormous challenge of balancing the required innovation-pressure with the given cost-pressure (Köth, 2021). Wolfgang Reitzle – who held several chairman positions – even predicted that the future of today's automotive industry will be decided in the next two to three years with regards to the many new players that stem from the software industry and enter this field now (Boldt, 2021). Thus, the necessity for sound managerial approaches in order to efficiently adapt to discontinuous change is more relevant than ever.

Among proposals of how organisations can successfully deal with unpredictable, dynamic, and constantly changing environments, the notion of *enterprise agility* is among the most predominant and popular (Overby, Bharadwaj, & Sambamurthy, 2006; Sambamurthy, Bharadwaj, & Grover, 2003; Teece, Peteraf, & Leih, 2016; Van Oosterhout, Waarts, & Van Hillegersberg, 2006; Yang & Liu, 2012). Agile firms are characterised by continually *sensing* opportunities for competitive action in their business environment and arrange the necessary knowledge and assets for *seizing* these opportunities (Sambamurthy et al., 2003). Thus, enterprise agility represents "[…] a firm's capability to detect external unanticipated changes and opportunities as well as threats, and then to reconfigure, assemble, and exploit its own resources, processes, knowledge, and relationships in order to respond quickly to external changes" (Yang & Liu, 2012, p. 1023). Overby et al. (2006) ground the agility-construct on four underlying management theories, namely *dynamic capabilities*, *market orientation*, *absorptive capacity*, and *strategic flexibility*. In order to address rapidly changing environments, Teece, Pisano, and Shuen (1997) define *dynamic capabilities* as the firm's ability to integrate, build, and reconfigure internal and external competencies. A basic tenet is that companies must continuously adapt their capabilities to maintain competitiveness. Although the concept has many parallels with enterprise agility – in particular its relevance to rapid change – dynamic capabilities is a much broader concept valid for all types of firm processes (Overby et al., 2006). The second concept, *market orientation*, is reflected in an "organisation-wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligences across departments, and organisation-wide responsiveness to it" (Kohli & Jaworski, 1990, p. 6). The authors' proposed definition suggests that the

degree to which a company is market orientated can be assessed how it generates intelligence, disseminates it, and takes actions based on it. While the focus is very much on information processing, the concept of enterprise agility not necessarily presumes information dissemination. Rather, it sets a similar emphasis on efficacious action in a timely manner. Third, *absorptive capacity* pursues the basic idea that prior related knowledge leads to an ability of recognising the value of new information, including its assimilation and application to commercial ends (Cohen & Levinthal, 1990). By linking it to the dynamic capabilities framework, Shaker A. Zahra and Gerard George describe absorptive capacity as "[…] a set of organisational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic capability" (Zahra & George, 2002, p. 186). While there are some similarities to agility, the main difference between the both concepts is that absorptive capacity refers predominantly to a firm's ability to manage knowledge, whereas enterprise agility refers mainly to a firm's ability to manage change (Overby et al., 2006). Finally, *strategic flexibility* reflects the managements' capacity to react in unstructured non-routine unfamiliar changes that have far-reaching consequences and require a quick response (Van Oosterhout et al., 2006). As incorporated in the name itself, strategic flexibility refers to strategic issues and – commonly to enterprise agility – how companies can create competitive advantages in the affected businesses. However, as firms can be agile in operational and strategic issues, enterprise agility applies to both (Overby et al., 2006). Consequently, Van Oosterhout et al. (2006) conclude that agility can be seen to envelope and extend the concept of strategic flexibility.

Surprisingly, despite the sound foundations and the on-going research in this topic, we lack a clearly defined framework for explaining agility from an enterprise-holistic perspective (Bottani, 2009a; Sherehiy, Karwowski, & Layer, 2007; Wendler, 2016). The result is that "identifying and implementing meaningful change in many, if not most organisations, is more like stopping a super tanker and then manoeuvring it in a small harbour rather than closing in for a kill at supersonic speeds in a jet fighter" (Nold & Michel, 2016, p. 342). For instance, Worley and Lawler (2010) emphasise the call from both management theorists and executives for a better understanding of agility's genesis, development, and

consequences. Marcel van Oosterhout and his colleagues claim that "[…] there is by far no consensus as to what exactly agility is, nor on how one could assess and achieve agility. Very few studies have attempted to empirically study the need for agility. […] Moreover, research that assesses the current level of agility is scarce" (Van Oosterhout et al., 2006, p. 133). Although several frameworks are available, they are ambiguous and vary strongly from each other, which suggests that the scientific debate on consensus about the determinates and dimensions of enterprise agility is still going on (Wendler, 2016). As Eleonora Bottani puts it, "few studies, however, provide empirical evidence about the main characteristics of agile enterprises and tools practically exploited by companies to achieve agility" (Bottani, 2010, p. 251). Consequently, also methodologies that continuously measure the gap between current and desired agility levels along with the changes in the firm's environment are missing (Nejatian, Zarei, Nejati, & Zanjirchi, 2018). Overall, this lack of precision restricts the potential for operationalisation (Charbonnier-Voirin, 2011) and thus limits the possibility to develop applicable assessment tools. Hence, of importance would be qualitative in-depth analysis, for instance by case studies or action research approaches (Wendler, 2014).

1.3 Objectives and Research Questions

In this thesis, I argue that enterprise agility can play a decisive role for firms when markets are very dynamic or what is termed *high-velocity*, i.e. when change becomes non-linear and less predictable (Eisenhardt & Martin, 2000). The authors classify high-velocity markets as those where market boundaries are blurred, business models are underlying constant change, and market players are ambiguous and shifting. Other scholars refer to *hypercompetitive markets* when the environment is characterised by strong doses of dynamism, complexity, and uncertainty (Felipe, Roldan, & Leal-Rodriguez, 2017). As the essence is identical, I will use the terms interchangeable throughout this research together with *highly turbulent environments* and *rapidly changing environments*. Furthermore, I choose the term *corporate agility* in this study to underline the aim of holistically understanding the agility concept utilised in private enterprises instead of the public domain. To do so, more knowledge is needed about the *key elements* of corporate agility

and the *main enablers* behind. In order to assess a certain agility level, several *levels of proficiency* are needed within these enablers. To further promote the practical implementation, a common framework would help.

Following the advice of Hopp and Oyen (2004), such a framework should accomplish three main things if it is to be successful: First, it should break new ground in carefully defining the *terms*, *concepts*, and *structures* that are sufficient to analyse a broad range of dimensions with regard to their potential for agility. Second, it should be simple and traceable enough for practitioners to be *applied to a real-world problem*. Third, the framework should be an asset in *categorising the extant research literature* and in *identifying new research opportunities*. Transferred to a practical context, so-called *maturity models* offer a simple but effective possibility to fulfil the requirements above. The objective of those models is to describe the path towards a final state of maturity from where no further development is possible (Henriques & Tanner, 2017). Thus, they usually provide useful benefits through (1) generating an awareness of the examined objects (e.g. requirements and complexity), (2) serving as a reference frame to implement a systematic approach for improvement, and (3) assessing a firm's capabilities on a comparable basis (Wendler, 2012). As this study aims at enhancing corporate agility practices, a maturity model will be developed for its facilitation. In consequence, this thesis is guided by the following three research questions:

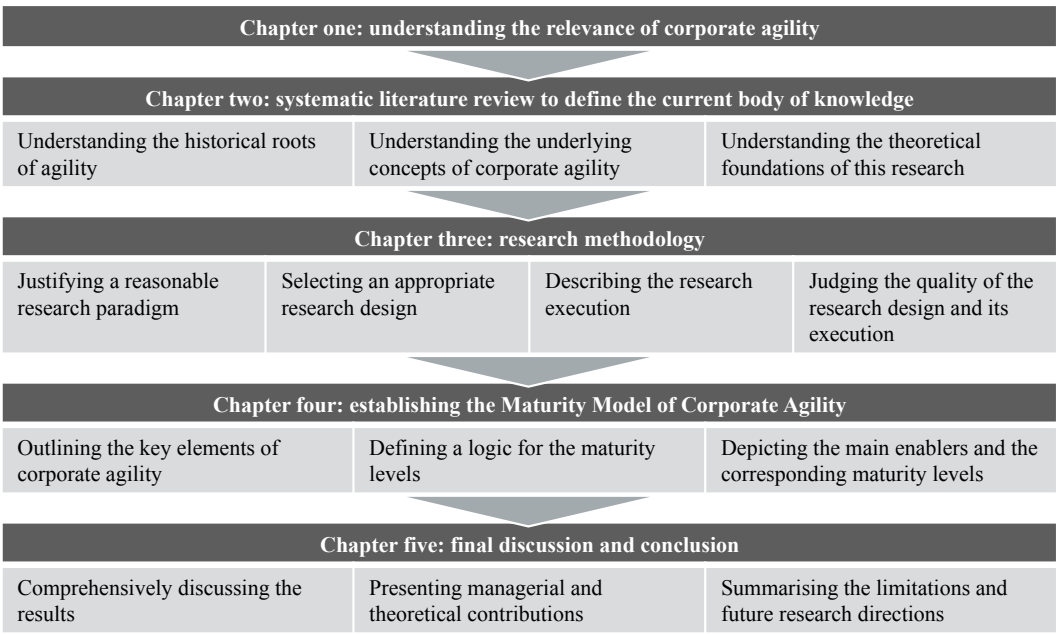
RQ1: How is agility *constituted* in a corporate context?
RQ2: What are the *main enablers* for the key elements?
RQ3: What are the *maturity levels* within these enablers?

1.4 Structure of the Thesis

This thesis has been structured into five parts and the chapters have been accordingly chosen (see figure 1.1). In the first part, the motivation for the research and the objectives are explained in order to understand the *relevance of corporate agility* and derive subsequent research questions. The second part consists of a systematic literature review to define the *current body of knowledge* and draft a *conceptual model*. First, the historical roots of agility are outlined before a corporate perspective is applied to direct the literature review to the context of this

study. Second, fundamental management theories are introduced that have been taken as an underlying framework to study the phenomenon of corporate agility. In the third part, the selected *research methodology* is discussed. Here, main scientific research paradigms are presented in order to select the philosophical stance for this research. Afterwards, an appropriate research design is described including its execution, which is judged on the basis of four quality criteria. The fourth part is aimed at establishing the *Maturity Model of Corporate Agility*. At first, the conceptual model from chapter two is further developed towards the Diamond of Corporate Agility as foundation for the enquiry. After and based on the collected data, the key elements of corporate agility are outlined, a logic for the maturity model is defined, and the main enablers including the corresponding maturity levels are depicted. In this context, I explain how the model can be used to assess the existing agility level, how a target level can be identified, and how the model can be used as a guiding framework towards the aspired target state. The fifth and last part is the *final discussion*, where the results are critically and comprehensively reviewed. Both contributions for management practice and theory are presented before I summarise the limitations of this study. The thesis closes with some personal final thoughts of mine.

Figure 1.1: Structure of the thesis



The major aim of this study is to contribute to management practice. Nevertheless, some additional theoretical contributions can also be expected.

As practitioners lack a comprehensive understanding of agility, anticipated contributions comprise 1) practical insights into the *main enablers* behind agility relevant for its application in a corporate automotive context, 2) the development of a *maturity model* that can be used for benchmarking and planning an appropriate improvement path, and 3) the identification of the enablers' proficiency levels, i.e. a range from rudimentary practice towards *best practice*.

An expected contribution to theory is in general the extension of knowledge regarding the understanding of the *terms*, *concepts*, and *structures* underlying agility in private enterprises, hence enlarging the body of literature dealing with agility from a company-wide perspective. In addition, qualitative in-depth data will help to shed light on the main enablers of corporate agility in order to critically review or expand previous findings. Furthermore, the existing body of knowledge for *agility frameworks* will be broadened. Eventually, it is also expected to extend theory by assessing the *applicability of management theories* such as the contingency theory, the concepts of organisational flexibility and leanness, the resource-based view, and the dynamic capabilities framework.

Finally it is worth to mention that this thesis has been written with a high dose of intrinsic motivation of myself. I hold a management position in the company where the data collection took place and therefore I am daily confronted with the challenges mentioned before. The long affiliation with the company, and thus the research environment, led to an exclusive access to in-depth data from various informants across all hierarchy levels. Consequently and contingent on the nature of the research questions, a qualitative-subjective approach has been taken. To bring the reader similarly close to the research as I felt during the enquiry, I decided to write also in the first person throughout the thesis. As my perspective and experience is part of the analysis as well, I would hereby like to emphasise that I take the accountability for my stances, ideas, and choices. Accordingly, depth and detail have been considered more important than generalisation of results. A last remark is dedicated to the words presented in italics, which is meant to highlight several terminologies, aspects, or phrases in order to facilitate the readability.

CHAPTER TWO

Literature Review

There is nothing as practical as a good theory. (Lewin, 1951, p. 169)

2.1 Introduction

The research on corporate agility is grounded in the term *agility*, which describes a way of designing organisations in a flexible, lean, and customer oriented manner in the field of organisation theory. The reason for choosing the term *corporate agility* in this thesis is to underline that this research aims to understand the agility approach utilised in private enterprises instead of an application in the public domain.

This chapter provides a systematic literature review to explore the underlying concepts of corporate agility. Executed correctly, systematic literature reviews provide a rigorous and unbiased method to synthesise and assess the quality of the current body of knowledge. Furthermore, knowledge gaps and methodological inconsistencies can be identified, which are critical to direct the research in this study (Tranfield, Denyer, & Smart, 2003). I start with the historical roots of agility and some general definitions of the concept, as this is a necessary first step for research progress in any field. Afterwards, a corporate perspective is applied to direct the literature review to the context of this study, the automotive supplier industry. Here, I present a conceptual model of corporate agility that is derived from the literature and reflects my understanding of the construct. This is used as the framework for my research. Subsequent sections deal with the single elements of the conceptual model. In addition, fundamental management theories are introduced, which I have taken as an overarching framework for studying the phenomenon of corporate agility. At the end of each sub-section, major theoretical conclusions are drawn, which will be used to define the current body of knowledge, make the research gap more precise, and guide the research design.

2.2 Agility

Defining *agility* requires first examining its historical evolution and identifying the different perspectives that are commonly invoked in describing it. Looking up the term *agile* in a dictionary delivers:

> "Able to move quickly and easily; nimble, dexterous", whereby agility is the "quality of being agile" (Oxford English Dictionary, 2018).

Given this explanation as a starting point, it becomes clear that the agility concept can be considered from a variety of application domains and thus is strongly context dependent. Applied in a corporate setting, an early definition can be found in a work of John L. Brown and Neil McK. Agnew:

> "Corporate agility, the capacity to react quickly to rapidly changing circumstances, requires a focus on clear system output goals and the capability to match human resources to the demands of changing circumstances" (Brown & Agnew, 1982, p. 29).

The authors' definition of agility is based on the assumption that the modern corporation operates in a world characterised by uncertainty. In order to maintain competitiveness, flexibility is not enough (the concept of flexibility will be described later on in this chapter). To effectively cope with constantly changing contingencies, firms must be able to match their key resources, namely *people*, to output oriented goals. These elements are often main characteristics of even today's descriptions of agility.

However, the point of departure of linking agility with organisation theory is mainly traced back to the 1990s and in particular to the so-called *Lehigh report* (Nagel & Dove, 1991). After the U.S. industry adhered too long to the principles of mass production and lost its leading role in world-class manufacturing in the 1970s and '80s, the Department of Defence awarded Lehigh University with the assignment of creating a new concept of manufacturing strategies. The key finding of this study was that competitive advantage would be achieved by an increasing emphasis on customer orientation and proactivity instead of reactivity. Thus, the *agile manufacturing enterprise* was defined by its capability to (1) develop *customised products* that are configured at the time of order, (2) cope with *evolving requirements* through configurable product designs, and (3) establish *long-term relationships* with customers who are committed to the evolving products

they order. Also referring to the Lehigh report, a comprehensive definition of agility is provided by Mark J. Hooper, Derek Steeple, and Clive N. Winters:

> "A manufacturing system with extraordinary capability to meet the rapidly changing needs of the market place. A system that can shift quickly amongst product models or between product lines, ideally in real-time response to customer demand" (Hooper, Steeple, & Winters, 2001, p. 632)

This makes the work of Nagel and Dove (1991) the first that details the agile manufacturing approach, explains its application in an organisational context, and links its to the process of managerial decision-making – which summarises the understanding of agility at that time. However, some authors argued that agility was yet ill-defined and needs more refinement: "[…] the concept of agility as expounded in the report lacked solid grounding in management theory. The work also did not take account of the differences between organisations, for example, incorporate culture or philosophy" (Yusuf, Sarhadi, & Gunasekaran, 1999, p. 34). This led to an increasing number of scientific publications during the 1990s with the common endeavour to define and operationalise the agility concept in manufacturing organisations. Particularly worthwhile mentioning is on the one hand a publication in book form by Goldman, Nagel, Preiss, and Warnecke (1996), because they understood agility as a generic term, which spans a spectrum of correlating developments on various levels. Consequently they characterised it from the perspectives of (1) *marketing*, i.e. individualised combination of products and services to maximise customer value, (2) customer-oriented *manufacturing* in different lot sizes, (3) *design*, i.e. holistic view and integration of all processes along the whole lifecycle, (4) the *organisation* in terms of its capability to constantly merge the necessary resources independently from its geographic location, (5) a supportive and trustful *management* philosophy, and (6) *humanity* as the ultimate factor for entrepreneurial success. This is also reflected in their definition of agility:

> "Agility means delivering value to customers, being ready for change, valuing human knowledge and skills, and forming virtual partnership" (Goldman et al., 1996, p. 35).

On the other hand, another school of thought in the agile manufacturing domain came up in the late 1990s, mainly influenced by scholars based in the United

Kingdom (Sharifi & Zhang, 1999; Yusuf et al., 1999; Zhang & Sharifi, 2000). Agility is described in the context of fast paced market change emphasising the role of customers and the importance of internal capabilities, structures, and people:

> "Agility is the successful exploration of competitive base (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast changing market environment" (Yusuf et al., 1999, p. 37).

Sharifi and Zhang (1999) broaden this understanding by introducing a conceptual model with four *agility capabilities* at its heart: (1) responsiveness, (2) competency, (3) flexibility, and (4) speed. The necessity for these capabilities comes from the so-called *agility drivers* in the business environment that impose pressure on the activities of a company to maintain their competitive advantage. Finally, *agility providers* describe the means by which the above listed capabilities could be achieved. Building on this, Zhang and Sharifi (2000) provide a methodology to help manufacturing companies formulating strategic policies in their pursuit of implementing agility. Based on an industrial questionnaire survey and a number of in-depth case studies, they further identified a change of customer requirements as the most important one among the changes from business environment. Out of the four types of capabilities, *responsiveness* is the essential capability for any organisation, which needs to be agile; the others are necessary in order to achieve responsiveness. The distinction in agility providers, capabilities, and drivers was widely accepted and applied in later publications as well, whereby the term *agility enablers* is used synonymously to describe the providers, e.g. in the work of Eshlaghy, Mashyyekhi, Rajabzadeh, and Razavian (2010).

During the decade between 2000 and 2010, research on agility has mainly been directed towards two goals: extending the concept from the manufacturing domain to the whole enterprise and grounding it in underlying management theories. In most cases, the former led to frameworks describing the characteristics of enterprise agility. For example, Sambamurthy et al. (2003) argue that agility is comprised by three interrelated capabilities: *customer agility*, *partnering agility*, and *operational agility*. In comparison, Sherehiy et al. (2007) define three dimensions,

namely *global strategies*, *organisation*, and *workforce*. Again differently, Sarker and Sarker (2009) describe agility in terms of the source in an organisation where it originates, which brings them to the dimensions of *resource agility*, *process agility*, and *linkage agility*. Moreover, a first reference model for agility development within organisations was provided by Bessant, Knowles, Briffa, and Francis (2002). The underlying assumption is that agility is a capability of the organisation, which is expressed in terms of *behavioural routines* across an organisation's operational procedures and structures. The study highlights the complex nature of agility and its multidimensionality both within and external to an enterprise. This is expressed in the following definition:

> "[…] agility is concerned with the organisation's capacity to gain competitive advantage by intelligently, rapidly and proactively seizing opportunities and reacting to threats. At its heart it involves the capability for strategic direction of innovative capacity on a continuing basis" (Bessant et al., 2002, p. 487).

As described above, the term agility is commonly used to describe firms that are able to adapt to and perform well in an unpredictable and dynamically changing environment. Thus, the concepts of *organisational adaptability* and *flexibility* are often applied in research about enterprises coping with this kind of environment (Van Oosterhout et al., 2006). One of the central tenets of agility, delivering value to the customer, is also a key element of *leanness* (Conboy, 2009). Like agility, the idea of the lean enterprise is rooted in manufacturing and intents "to achieve perfect first-time quality as well as waste minimisation by removing all activities that do not add value, continuous improvement, flexibility, and long-term relationships" (Ganguly, Nilchiani, & Farr, 2009, p. 413). Another concept addressing a firm's ability to maintain competitiveness in rapidly changing environments is the one of *dynamic capabilities*, which builds upon the *resource-based view* of the firm (Teece et al., 1997). Ashrafi et al. (2005) make use of this approach by developing a conceptual model where dynamic capabilities are identified as an enabler of agility. In a similar way, Overby, Bharadwaj, and Sambamurthy (2006) use this path to operationalise agility in a corporate context and define it as:

> "[…] the ability of firms to sense environmental change and respond readily" (Overby et al., 2006, p. 121).

With this definition, the authors point to two main components of agility, namely *sensing* and *responding*. For my study, the theoretical frames of (1) the adaptive and flexible organisation, (2) leanness, (3) the resource-based view, and (4) dynamic capabilities are used to guide and position the research. These management theories are discussed in detail in section 2.4.

Finally, research in the recent past increasingly considered agility as an important dynamic capability for survival and competiveness in a continuously changing and unpredictable business environment: "The embracing of agile strategies has several benefits for companies, including quick and efficient reaction to changing market requests, the capability to customise products and services to customers, the capability to produce and deliver new products in a cost-efficient manner, decreased manufacturing costs, increased customer satisfaction, removal of non-value-added activities and increased competiveness" (Tseng & Lin, 2011, p. 3694). Under the rubric of the dynamic capabilities framework, agility is not only represented by the capacity to sense and respond to opportunities and threats when changing circumstances arise. Rather, it allows an enterprise to re-arrange its resource base in order to make effective and sustained change in a timely manner (Winby & Worley, 2014). Also Teece et al. (2016) suggest the dynamic capabilities perspective as a theoretical framework to analyse the development of agility and provide a comprehensive definition:

> "[…] we refer to agility as the capacity of an organisation to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant" (Teece et al., 2016, p. 17).

Thus, agility as a business paradigm of the 21th century was fast becoming a crucial factor for a firm's ability to survive and thrive in uncertain and highly turbulent markets. In the early years, research focused on speed and responsiveness through the manufacturing function. Over time, the endeavour to achieve agility began to encompass the dimensions of cost and quality as well as delivering value to customers. Table 2.1 on the next page summarises the essential characteristics of agility embedded in the definitions above:

Table 2.1: Definitions of agility and key characteristics

Reference	Characteristics					
	Speed/ time	Cost	Respon-siveness	Flexibility	Quality	Customer needs
Brown and Agnew (1982)	×		×	×		
Hooper et al. (2001)	×		×	×		×
Goldman et al. (1996)			×	×		×
Yusuf et al. (1999)	×	×	×	×	×	×
Bessant et al. (2002)	×		×	×		
Overby et al. (2006)			×			
Teece et al. (2016)		×	×	×		×

In this research in general I follow the understanding of agility as an organisational *capability*: "[…] a set of organisational routines and processes that produces a particular output" (Roberts & Grover, 2012 b, p. 580). This section aims to provide a basic understanding of agility and is the starting point for developing a comprehensive understanding of corporate agility, which is a key issue of the next section.

2.3 A Corporate Perspective on Agility

Despite the existing research on agility, we still lack a comprehensive understanding of corporate agility. Studying the available literature in terms of agility applied to the whole organisation, usually the terms *enterprise* or *organisational agility* are chosen (Dove, 2006; Eshlaghy et al., 2010; Felipe, Roldán, & Leal-Rodríguez, 2016; Overby et al., 2006; Sherehiy et al., 2007; Teece et al., 2016). Wendler (2013) systematically compared eleven frameworks in this domain and revealed that the underlying concepts vary a lot because some, for instance, operate at a higher level and thus have further sub-concepts or the concepts share several interdependencies. This lack of consensus has significant implications for my research because it is crucial for a developing perspective to reach consensus on core theoretical elements (such as assumptions, definition of terms, core relationships between variables, and boundary conditions). Hence, it is difficult to develop a maturity model for corporate agility without having a solid framework in place where the underlying concepts are at least covered to a certain extend.

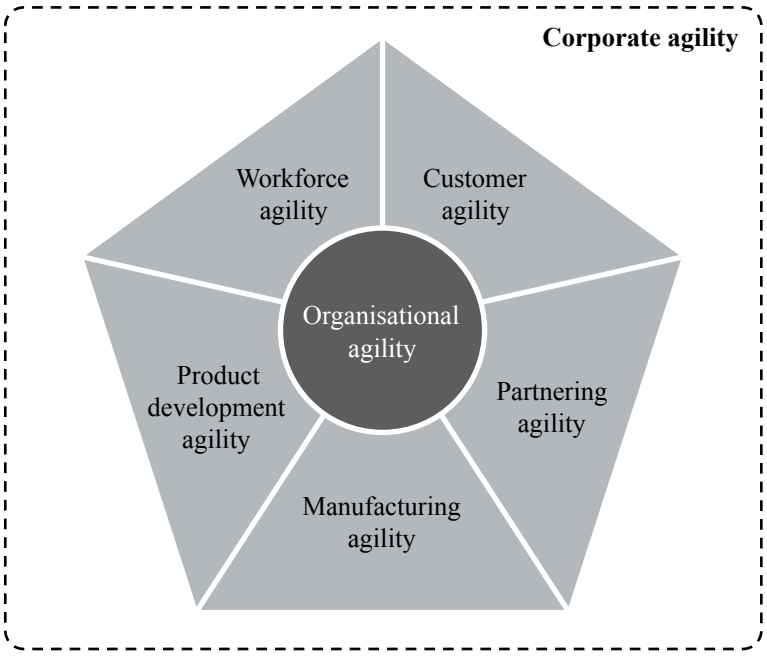
While this should be recognised, it is not to suggest that there is only one framework that has value. Indeed, complex problems are likely to benefit from insights obtained from all of the paradigms we have identified plus more. Nevertheless, a framework appropriate for the problem at hand will be developed in the following.

Adopting a capability perspective, I follow the understanding of Winter (2003) who states that capabilities exist on different levels in an organisation. On the one hand, *zero-level capabilities* ensure how firms earn a living now, i.e. producing and selling a constant amount of the same product to the same customers. However, this is of limited relevance to my research as agility is mainly driven by change. Of greater interest are those, which will thrive change, for instance regarding the product, the customers, or even the competitive base. Winter (2003) refers to them as *higher-order capabilities*, whereby these exist as first-order capabilities, second-order capabilities etc. and typically involve long-term commitments to specialised resources.

To design my theoretical model of corporate agility in a way that it can serve as basis for a maturity model (which will be developed during the course of this DBA study), I will keep it as applicable as possible. First, I build upon the framework of Sambamurthy et al. (2003) who understand agility as a construct of three interrelated capabilities: customer agility, partnering agility, and operational agility. This approach offers a promising starting point, because it treats a firm's ability to leverage the voice of the customer as a separate pillar and emphasises the role of joint collaboration via partnerships or joint ventures within the widely used dimension of supply chain agility (which is summarised in partnering agility). Only the aspect of operational agility seems to bundle too many sub-constructs to operationalise it efficiently in the maturity model: "Operational agility reflects the ability of firms' business processes to accomplish speed, accuracy, and cost economy in the exploitation of opportunities for innovation and competitive action" (Sambamurthy et al., 2003, p. 245). Thus, I refer to Wendler (2013) who demonstrates that existing agility frameworks mainly focus on four domains: manufacturing, development, workforce, and the entire enterprise. The first three seem to be appropriate to cover the dimension of operational agility. However, the domain

of the agile organisation will be treated separately in my research because it considers the entire organisation and thus indirectly the dimensions mentioned before. Taking the above arguments by Winter (2003), Sambamurthy (2003), and Wendler (2013) as my point of departure, I herewith propose to treat organisational agility as a first-order capability, which is strongly interrelated to the second-order capabilities of customer agility, partnering agility, manufacturing agility, product development agility, and workforce agility. All six dimensions are treated equally important regarding the overall agility of an enterprise. Together, this reflects my understanding of corporate agility (see figure 2.1) and provides the theoretical underpinnings where the maturity model will be build upon.

Figure 2.1: Conceptual model of corporate agility developed by Markus Holzberger based on the works of Winter (2003), Sambamurthy (2003), and Wendler (2013)



Relevant findings within each of these agility dimensions will be highlighted and discussed in sub-sections 2.3.1 - 2.3.6. The guidelines on conducting a systematic review were followed in order to ensure unbiased results (Tranfield et al., 2003). A comprehensive review of the existing bodies of literature on the agility dimensions above was conducted beginning with a search of the library database of Sheffield Hallam University. Key search terms (and variations thereof) for each of the areas of interest were used to examine peer reviewed (journal) articles pub-

lished particularly from 1991 through 2020. My attempt was to include the latest reports as well as seminal works, which laid important foundations in the respective field. In order to further decide on the relevance of the literature, the Chartered Association of Business Schools' journal ranking was considered and particular attention was paid to the studies revealing sound empirical evidence. Studies that have tackled the same or a similar problem (like my research questions) have been carefully analysed regarding its strengths and weaknesses to ensure the novelty of my research. Regarding the findings in these research streams, I will focus on internal or external factors to the organisation indicating support to achieve the particular agility dimension; i.e. the critical success factors for implementation that may impact the performance. In the following, this is referred to as *enablers*. This seems to be the most promising way to establish the theoretical framework for developing the maturity model.

A tabular display of the main agility enablers including its data source and type of research is integrated at each end of the following sub-sections (as opposed in the appendix). This is important because in this way it will be possible for the reader to quickly capture the maturity level of the respective research stream and to better understand the foundations of my theoretical conclusions.

2.3.1 Organisational Agility

Research on organisational agility aims at understanding how firms rapidly adapt to contingencies posed by the environment by reconfiguring its resources, processes, and strategies. In this way, YoungKi Park and colleagues define it as:

> "[…] an organisation's ability to quickly sense and respond to environmental changes in order to quickly seize market opportunities" (Park, El Sawy, & Fiss, 2017, p. 649).

Prior studies have suggested *few levels of hierarchy*, *sharing of decision-making power* (away from senior management), and a *symbiotic relationship* between formal and informal organisational structures as a key way to achieve organisational agility (Birkinshaw, 2018; Crocitto & Youssef, 2003; Eshlaghy et al., 2010; Sherehiy et al., 2007). In the same vein, Teece (2016) and Worley and Lawler (2010) propose adaptable designs through e.g. flexible sourcing arrangements, maintenance of organisational slack, and open innovation processes. To

further thrive a firm's responsiveness and flexibility, informational and interpersonal networks respectively open and informal communication offer critical linkages (Crocitto & Youssef, 2003; Sherehiy et al., 2007).

In addition, *organisational culture* has been identified as a major provider for organisational agility as it "[…] creates shared context, enables or inhibits knowledge exchange, and defines the boundaries of collaboration" (Nold & Michel, 2016, p. 345). Other scholars' research has been approached in a similar manner and revealed (1) a culture that shares agile values (Wendler, 2016), (2) a culture of change at every level in the organisation (Crocitto & Youssef, 2003; Sherehiy et al., 2007), (3) an organisational climate that enables innovative behaviour (Cai, Liu, Huang, & Liang, 2017; Ravichandran, 2017), and (4) team work based on trust, reciprocity, and transparency (Ali, 2016; Eshlaghy et al., 2010) as main contributors to a company's endeavour to become more agile according to the definition above. Since culture can either facilitate or hinder the exchange of knowledge, this finding becomes even more crucial considering a recent study by Cai et al. (2017), which shows that the knowledge management capability of a firm, i.e. mobilise and deploy knowledge, positively influences the ability to build organisational agility. Earlier research supports these findings by linking a robust process that ensures the proper use of acquired knowledge (Cegarra-Navarro, Soto-Acosta, & Wensley, 2016) and a company's *absorptive capacity* (Felipe et al., 2017) to its organisational agility. In this context, the latter is the most comprehensive concept as it encompasses the acquisition, assimilation, transformation, and exploitation of knowledge (Zahra & George, 2002). In other words, absorptive capacity is the measure of the rate at which an organisation can learn and use scientific, technological, or other knowledge that exists outside of the organisation itself.

Further empirical evidence has been collected that indicates that firms using the following *information and communication technologies* have a higher level of organisational agility than others: business intelligence technologies, advanced information and communication tools, enterprise resource planning, and extranet connection with networked companies (Bottani, 2010; Park et al., 2017). As one of the first scholars, Vallabh Sambamurthy and his colleagues conceptualised the

role of IT within the agility domain through the so-called *digital options*, described as "a set of IT-enabled capabilities in the form of digitised enterprise work processes and knowledge systems" (Sambamurthy et al., 2003, p. 247). Put differently, the authors consider IT as a generator of those digital options, which has inspired numerous researchers in the field. Today, this concept is widely used and 1) the necessity of a proper utilisation of IT-based resources (to e.g. support strategies and processes), 2) its global compatibility, 3) standardised interfaces, or 4) the joint use with other resources and capabilities are mentioned in most of the studies concerning organisational agility (Cai et al., 2017; Felipe et al., 2017; Ravichandran, 2017; Sarker & Sarker, 2009; Van Oosterhout et al., 2006; Wendler, 2016).

Guided by the dynamic capabilities framework (Teece et al., 1997), a firm's ability to detect, interpret and respond to discontinuous change has also been linked to its degree of organisational agility (Teece et al., 2016). Labelled as *strategic foresight* it is described as "the ability to anticipate discontinuities in the business environment, marketplace, or the information technology space, the threats and opportunities in the extended enterprise chain, and the impending disruptive moves by competitors" (Sambamurthy et al., 2003, p. 250). In other words, companies must be able to systematically scan the relevant environment, make sense of the observations, and conceptualise competitive action (Sarker & Sarker, 2009; Wendler, 2016).

Finally, research beyond the classical functions of private enterprises points out the importance of a *robust strategy* as well as early *approval from stakeholders* (Birkinshaw, 2018; Worley & Lawler, 2010). A robust strategy is characterised by its ability to give guidance and feasibility even when circumstances change. Considering interests and allaying the concerns of all stakeholders (like the works council representing the employees), shareholders, or the supervisory board will help to sell agile to these parties. This leads to the first conclusion:

Conclusion 1: *Main enablers for organisational agility can be clustered in (1) organisational structures and power distribution, (2) culture, (3) absorptive capacity, (4) information and communication technology, (5) strategic foresight, (6) robust strategy, and (7) stakeholder buy-in.*

An overview of the cited research is given in table 2.2 on the following pages. Due to my conceptual model of corporate agility (see figure 2.1) and the logic behind, I discussed not all of the mentioned agility enablers. Those, where a clear link is apparent to one of the five second-order capabilities (customer agility, partnering agility, manufacturing agility, development agility, and workforce agility), will be discussed in one of the next sub-sections.

Beside the main agility enablers and the origin of the data, table 2.2 shows also the type of research as indicator of the research stream's maturity. Here, a comparison is made between *inductive research*, i.e. from specific examples or phenomena to general principles, and *deductive research*, i.e. from general perceptions to specific truths. It can be seen that research on enabling organisational agility has first been conducted with an inductive logic before mainly deductive studies have been published. Nevertheless, even in the recent past some research has been done with an inductive approach. This leads to the recognition of a relatively high level of maturity, but allowing space for further research aimed at generating new theory.

In the following, the five second-order capabilities will be discussed. I will start with the customer agility dimension. In today's high-velocity markets customer preferences change constantly, thus firms need to respond quickly to maintain its competitive advantage.

Table 2.2: Research on organisational agility

Author(s), year	Type of research	Data	Main identified organisational agility enablers
Birkinshaw (2018)	Inductive, case study	In-person and phone interviews with 15 executives from ING in the Netherlands over an eight-month period	▪ Forge a structure around customer needs through small teams of up to nine people with end-to-end responsibility for a specific activity ▪ Ownership in the hands of those closest to the action, i.e. shift away of power from senior management; but keep top-level oversight ▪ Early buy-in from stakeholders and the works council ▪ Traditional way of mgmt. for finance, compliance, and legal functions ▪ Provide development and growth opportunities for employees
Cai et al. (2017)	Deductive, econometric	Surveys with 194 senior executives from Chinese companies in diverse industries	▪ IT capability: utilise IT resources to support strategies and processes ▪ Knowledge management capability: mobilise and deploy knowledge ▪ Innovative climate: shared perception of employees regarding the practices, processes, and behaviours that promote new ideas and change
Park et al. (2017)	Deductive, econometric	Surveys with 218 senior managers from Korean companies in diverse industries	▪ Business intelligence technologies, e.g. digital dashboards, data mining ▪ Communication technologies, e.g. collaboration systems, mobile apps ▪ Top management team energy, i.e. top managers' energy to steadfastly and energetically drive organisational changes to adapt to circumstances
Ravichandran (2017)	Deductive, econometric	Mail surveys with 129 senior information systems executives of large firms in the U.S.	▪ Digital platforms characterised by a flexible infrastructure in combination with the deployment of a range of enterprise software platforms ▪ Innovation capacity, i.e. possessing an organisational climate that enables innovative behaviour and at the same time leveraging the resources of the core organisation to tightly couple the new initiatives

Table 2.2 (continued)

Author(s), year	Type of research	Data	Main identified organisational agility enablers
Ali (2016)	Inductive, case study	146 semi-structured interviews with military personnel and a workshop with 26 participants	▪ Symbiotic relationship between formal and informal organisational structures (fostered by accountability, leadership and management, and responsible autonomy) ▪ Interactions that are based on trust, reciprocity, and transparency
Cegarra-Navarro (2016)	Deductive, econometric	Offline surveys in 110 Spanish companies using the Editran tool as communication platform	▪ Knowledge application: a process that ensures the proper use of the knowledge acquired; this implies a knowledge management process that requires being able to successfully transfer knowledge from one context to another
Felipe et al. (2016)	Deductive, econometric	Offline surveys with 172 senior managers from Spanish high and medium-high technology firms	▪ Information systems capabilities, i.e. the firm's ability to mobilise and deploy IT-based resources jointly with other resources and capabilities (mediated by the extent to which absorptive capacity can be generated) ▪ Absorptive capacity (negatively moderated by a hierarchy culture)
Nold and Michel (2016)	Deductive, econometric	Surveys in 50 companies from various industries around the globe	▪ Culture: creates shared context, enables or inhibits knowledge exchange, and defines the boundaries of collaboration ▪ Leadership: effective communication and interaction at all levels to foster a shared vision, collaboration, and positive relationships ▪ Systems: institutional framework with rules, routines, and tools that set the stage for rigorous and disciplined leadership

Table 2.2 (continued)

Author(s), year	Type of research	Data	Main identified organisational agility enablers
Teece et al. (2016)	Inductive, conceptual	Systematic literature review on organisational agility	▪ Sensing: generative sensing, sense making, scenario planning, and "purchase" of real options (e.g. through R&D investments) ▪ Seizing: flexible sourcing arrangements, maintenance of organisational slack, re-engineering rule-bound hierarchies, and open innovation ▪ Transforming: *build-measure-learn* methodology for new product development, i.e. build a minimum viable product, launch it, learn quickly, adjust accordingly, and improve
Wendler (2016)	Deductive, econometric	Online questionnaires with 437 decision-makers from the software and IT service industry mainly from Europe and North America	▪ Agility prerequisites: organisational culture that shares agile values and a technological basis that enables and supports the necessary communication and collaboration processes ▪ Agility of people: necessary capabilities of an organisation's employees (e.g. multi-skilled) and managements' capabilities to thrive change ▪ Structures enhancing agility: Close collaboration both internal and with customers, cooperation with partners, systematic information about/ strategic investment in appropriate technologies, and flexible structure
Bottani (2010)	Deductive, econometric	Surveys with 189 CEOs, logistics, and supply chain managers from European manufacturing SMEs	▪ Use of advanced information and communication tools ▪ Enterprise resource planning (ERP) systems ▪ Extranet connection with networked companies ▪ Quality Function Deployment (QFD) for integrated product/process design and development

Table 2.2 (continued)

Author(s), year	Type of research	Data	Main identified organisational agility enablers
Eshlaghy et al. (2010)	Deductive, econometric	Pre-workshop sessions and offline questionnaires with 141 managers from Iranian industrial firms	▪ Leadership (transactional/transformational, future/goal oriented) ▪ Organisational commitment ▪ Job satisfaction ▪ Empowerment and improvement (enrichment, accept job change) ▪ Planning and evaluating performance ▪ Organisation and structure-centrality ▪ Team working (efficiency, trust being group)
Worley and Lawler (2010)	Inductive, case study	Surveys and interviews with 161 managers from Acme Aerospace	▪ Robust strategy with an alternative economic logic, a strong future focus, and flexible intent; guided by their identity ▪ Adaptable designs: maximum surface area, transparent IT systems and decision-making processes, and nimble talent mgmt. and reward systems ▪ Shared leadership and an identity that favours change and learning
Sarker and Sarker (2009)	Inductive, case study	Interviews and informal meetings with IT-related personnel from a U.S.-based multinational high-tech firm (distributed information systems development context)	▪ Rapid ramp-up and down capability of development centre locations, team reconfigurability and distributed decision-making ▪ Comparable and compatible ICT infrastructure at each location ▪ Careful adoption of agile methodologies in distributed context ▪ Capability to transition work seamlessly across many time zones ▪ Systemic ability to scan and interpret the relevant environment ▪ Common and professional work culture across geographic locations ▪ Close collaboration among clients and distributed team members

Table 2.2 (continued)

Author(s), year	Type of research	Data	Main identified organisational agility enablers
Sherehiy et al. (2007)	Inductive, conceptual	Systematic literature review on agile manufacturing and an agile workforce	▪ Enriching the customer (through innovation) and customer satisfaction ▪ Internal and external cooperation; close relation to customers/suppliers ▪ Organisational learning and knowledge management; culture of change ▪ Organic organisation: few levels of hierarchy, changing lines of authority, open and informal communication, loose boundaries among functions and units, distributed decision-making, and fluid role definitions
Van Oosterhout et al. (2006)	Inductive, case study	Surveys and interviews with 21 companies from four sectors (considered to change rapidly) in the Netherlands	▪ Information technology: transparent and responsive IT organisation, simplified and standardised interfaces, reduced number of systems, integrated business and technology approach with centrally orchestrated structure, and bundled expertise in IT competency centres
Crocitto and Youssef (2003)	Inductive, conceptual	Systematic literature review on organisational agility	▪ Culture of change at every level in the organisation ▪ Marrying accepted agility practices with organisational and employee learning and rewards for agile employees ▪ Smash traditional hierarchies through e.g. power sharing and autonomy ▪ Informational and interpersonal networks
Sambamurthy et al. (2003)	Inductive, conceptual	Systematic literature review on agility and IT mgmt.	▪ Digital options: process reach/richness and knowledge reach/richness ▪ Entrepreneurial behaviour: strategic foresight and systemic insight
Hooper et al. (2001)	Inductive, case study	Interactive implementation of the concept in a SME	▪ Activity-based costing: comparison between value adding and non-value adding activities as well as internal and external activities; projection

2.3.2 Customer Agility

Within the research stream of customer agility, empirical evidence indicates that customer agility is characterised by the degree to which organisations are able to sense and respond to the preferences of its customers in a timely manner (Roberts & Grover, 2012 a). In other words:

> "[…] a firm's ability to sense and respond quickly to customer-based opportunities for innovation and competitive action" (Roberts & Grover, 2012 b, p. 579).

The definition above illustrates the two underlying mechanisms of the customer agility dimension, namely *sense* and *respond*. Scholars have conceptualised a company's customer-sensing capability at different levels of detail and in various industries. For instance, Kohli, Jaworski, and Kumar (1993) distinguish between market intelligence *generation* and market intelligence *dissemination*. While the first describes the collection and evaluation of customer needs as well as an investigation of the influences on those, the latter refers to the process and extent of market information exchange within the firm. Slater and Narver (2000) extent this approach in two ways: First, by linking market intelligence generation to the acquisition of information about customers' latent needs (not only the expressed ones), and second, by adding competitors' capabilities and strategies as an area of interest. Based on a further, more comprehensive study, Narver, Slater, and MacLachlan (2004) again point out the necessity to discover and to understand the latent demand of customers. Finally, also the analysis of customer-related information (beside the generation and dissemination) is included to operationalise customer-sensing capability (Jayachandran, Hewett, & Kaufman, 2004). In sum, customer-sensing activities comprise "investing in research activities, probing customer needs, understanding latent demand, and assessing likely supplier and competitor responses" (Roberts & Grover, 2012 b, p. 580).

On the other hand, customer-responding capability has first been researched at a more general level, i.e. how an organisation's ability to respond in rapidly changing environments contributes to firm success (Kohli et al., 1993; Zaheer & Zaheer, 1997). Key measurement criteria for responsiveness to customer needs were the action taken in general and the quickness of this reaction. Subsequent research revealed the importance of the effectiveness of the response and concep-

tualised customer-responding capability in two-sub-constructs: "*Customer response expertise* refers to the extent to which the responses of an organisation effectively meet customer needs, while *customer response speed* refers to the extent to which its responses to customer needs are rapid" (Jayachandran et al., 2004, p. 220). Roberts and Grover (2012 a) incorporate competitive activity as the ultimate outcome of customer-responding capability, i.e. how well firms respond to customer-based opportunities by for instance launching new products or services to improve profits and/or their competitive position.

Jayachandran et al. (2004) point out a third important aspect behind customer agility beyond the definition at the beginning of this sub-section. Resulting from a mixed-methods study with more than 200 managers they revealed a significant positive relationship between senior managements' risk propensity and customer-response capability. In other words, many decisions that are essential to satisfy customer needs may be delayed or not even implemented when a firm's senior management is risk averse. This and the insights before are summarised in a further conclusion:

Conclusion 2: *The main customer agility enablers comprise (1) a firm's customer-sensing capability, (2) its customer-responding capability, and (3) the risk propensity of senior management.*

The research stream on customer agility enablers appears to still need further inductive research. Over the past twenty years, the scope of underlying concepts has not been significantly enhanced, which indicates that only some specific phenomena were revealed (see also table 2.3). Therefore, further qualitative research is necessary to provide deep and unique insights into this area (Roberts & Grover, 2012 b). For instance, Jayachandran et al. (2004) conducted 31 in-depth interviews and shed light on the role of senior managements willingness to take risks. Thus, the maturity of the research stream can be classified as still being in the stage of theory development.

In the next sub-section, I will switch from the customer dimension to the perspective of an organisation's supply chain including its role in partnerships and/or joint ventures.

Table 2.3: Research on customer agility

Author(s), year	Type of research	Data	Main identified customer agility enablers
Roberts and Grover (2012 a)	Deductive, econometric	Surveys with 188 marketing managers from U.S.-based high-tech firms (computer manufacturing and pre-packaged software)	▪ Customer-sensing capability, which is significantly effected by a firm's web-based customer infrastructure; this relationship is positively moderated by analytical ability ▪ Customer-responding capability, which is significantly influenced by inter-functional coordination (the greater a firm's information systems integration) and channel coordination ▪ Alignment of customer-sensing and customer-responding capability
Roberts and Grover (2012 b)	Deductive, econometric	Surveys with 188 marketing managers from U.S.-based high-tech firms (computer manufacturing and pre-packaged software)	▪ Customer-sensing capability: investing in research activities, probing customer needs, understanding latent demand, and assessing likely supplier and competitor responses ▪ Customer-responding capability: addressing an opportunity for competitive action by mobilising the firm's existing processes or services
Jayachandran et al. (2004)	Deductive, econometric	Mail surveys with 227 managers from retailing organisations operating in different industries, followed up with 31 in-depth interviews	▪ Customer response expertise: the extend to which the responses of an organisation effectively meet customer needs ▪ Customer response speed: the extend to which responses to customer needs are rapid ▪ Customer knowledge process: activities within a firm focused on the generation, analysis, and dissemination of customer-related information ▪ Senior management risk propensity: willingness of the senior management to make relatively quick decisions even under uncertainty

Table 2.3 (continued)

Author(s), year	Type of research	Data	Main identified customer agility enablers
Narver, Slater, and MacLachlan (2004)	Deductive, econometric	Questionnaires with 120 sales or marketing managers from 25 companies operating in different industries	▪ Responsive market orientation: a business's attempt to understand and to satisfy the expressed needs of customers ▪ Proactive market orientation: a business's attempt to discover, to understand, and to satisfy the latent needs of customers
Slater and Narver (2000)	Deductive, econometric	Questionnaires with 66 presidents or general managers from the electronics industry	▪ Market-focused intelligence generation strategy, which focuses on acquiring information about customers' expressed and latent needs, and competitors' capabilities and strategies
Zaheer and Zaheer (1997)	Deductive, econometric	Data of trading operations from 4.088 banks on the Reuters dealing system within a 24 hour period	▪ Alertness: the extensiveness (number of other banks) of a bank's information network (its out-ties), the maintenance of multiple weak ties (frequency of contact between a focal bank and other banks), and the global scope of a bank's out-ties ▪ Responsiveness: the quickness of reaction to environmental signals
Kohli, Jaworski, and Kumar (1993)	Deductive, econometric	Survey with 230 marketing executives combined with a multi-informant approach	▪ Market intelligence generation: collection and assessment of both customer needs/preferences and the forces that influence the development and refinement of those needs ▪ Market intelligence dissemination: process and extent of market information exchange within the organisation ▪ Responsiveness: action taken in response to intelligence that is generated and disseminated

2.3.3 Partnering Agility

For a business to create a sustainable competitive advantage, i.e. when other firms are unable to duplicate the benefits of the strategy, organisational agility needs to be leveraged and maintained across a firm's ecosystem of external business partners. This endeavour is covered by the dimension of partnering agility and defined as:

> "[…] the ability to leverage assets, knowledge, and competencies of suppliers, distributors, contract manufacturers and logistics providers in the exploration and exploitation of innovation opportunities" (Sambamurthy et al., 2003, p. 246).

Put differently, in recent highly turbulent environments organisations need to change their focus from optimising individual functions within their supply chain towards coordination and cooperation with partners and even competitors (Samdantsoodol, Cang, Yu, Eardley, & Buyantsogt, 2017). Hereby, firms strive to respond as quickly as possible to external changes, which is expressed in the following definition:

> "Supply chain agility is the property of a supply chain that enables it to sense short-term, temporary changes in supply chain and market environment, and flexibly and rapidly respond to these changes" (Dubey et al., 2018, p. 132).

Regarding the supply chain, I will mainly consider a company's upstream activities as the downstream part is already captured in the customer agility dimension.

Extant research has identified several enablers of partnering agility using different theoretical perspectives. As a kind of foundation, *network integration* (also referred to as *supply chain integration* or *process integration*) has been regarded as one of the most important enablers (Lin, Chiu, & Chu, 2006; Van Hoek, Harrison, & Christopher, 2001). It is defined as "the formation of a network in which separate supply chain partners collaboratively manage intra- and inter-organisational processes to arrive at mutually acceptable outcomes" (Ngai, Chau, & Chan, 2011, p. 234). In this context, important contributions 1) emphasise coordinated processes across supply chain members (Feizabadi, Maloni, & Gligor, 2019), 2) point out the importance of a rigour execution of internal supply chain management processes (Blome, Schoenherr, & Rexhausen, 2013), and 3) recom-

mend strong regulatory frameworks and effective contract mechanisms to facilitate the partners' behaviour and actions towards the desired outcomes (Fayezi, Zutshi, & O'Loughlin, 2016). However, at its core, network integration is about building fluid clusters of network associates to leverage strengths and competencies with other companies with the final goal of providing maximal customer value (Christopher, 2000; Yusuf, Gunasekaran, Adeleye, & Sivayoganathan, 2004). Here, a close link exists to the idea of the *virtual enterprise* "as a temporary alliance to implement strategy that is not simultaneously being implemented by other potential competitors and thus sustains the competitive advantage" (Samdantsoodol et al., 2017, p. 69). The virtual enterprise, in turn, is strongly underpinned by the use of information technology, which brings me to the second main enabler of partnering agility hereafter.

As almost all of the research papers listed in table 2.4 refer to a proper use of *information and communication technology* (ICT), it seems to prevail broad consensus among scholars in this aspect. Some authors more generally underline a computer-based data integration with other companies to share and synchronise information (Fayezi, Zutshi, & O'Loughlin, 2015; Feizabadi et al., 2019; Kisperska-Moron & Swierczek, 2009; Singh Patel, Samuel, & Sharma, 2017; Yusuf et al., 2004) and refer to the virtual integration of other firms by means of leveraging information (Christopher, 2000; Lin et al., 2006; Ngai et al., 2011; Van Hoek et al., 2001). Dubey et al. (2018) and Kim and Chai (2017) provide a more precise contribution by separating between the technological capability that enables effective information sharing, information's quality and relevance, and the general willingness to share pertinent data. Samdantsoodol et al. (2017) even suggest four perspectives of adopting ICT: (1) an information system that integrates members to cooperate easily, (2) the effective utilisation of ICT to manage and share large amounts of data, (3) smart technology to ensure time and information accuracy, and (4) decision support systems to foster an effective enterprise collaboration and knowledge management flow.

Another finding is that a *collaborative relationship* between buyers and suppliers is an essential enabler of partnering agility. Singh Patel et al. (2017) identified the attributes of trust between partners, a shared vision, the willingness to com-

promise, and the mutual dependency between each other. Three previous studies revealed that in particular collaborative working and planning, jointly developing products, the use of common systems, and sharing of information play an important role (Agarwal, Shankar, & Tiwari, 2007; Christopher, 2000; Lin et al., 2006). In addition, Fayezi et al. (2016) and Fayezi et al. (2015) show the importance of commitment, communication, reward sharing, openness, and a forward thinking and opportunity seeking mindset.

In his seminal paper about the agile supply chain, Christopher (2000) names *market sensitivity* as one of the crucial characteristics to be truly agile. This reflects a supply chain's capability of reading and responding to real demands rather than relying on forecasts based on past data. Its enabling role on partnering agility has been tested in several subsequent studies, both inductive via structured interviews and case studies (Lin et al., 2006; Van Hoek et al., 2001) as well as deductive within large-scale electronic questionnaires in the Indian auto components industry (Dubey et al., 2018). Sing Patel et al. (2017) also include market sensitivity in their framework for supply chain agility, even though they emphasise the attributes of analysis of market trends, effective forecasting, production (e.g. minimising of non-value activities), and market survey. In turn, Gligor, Gligor, Holcomb, and Bozkurt (2019) and Mandal (2018) share this tendency towards scanning the business environment and generating knowledge about possible changes.

The fifth finding in this research stream is the significant impact of *flexibility* on partnering agility. Patricia M. Swafford and colleagues point out and define *supply chain flexibility* as those "abilities of reducing supply chain lead time, ensuring production capacity, and providing product variety while fulfilling customer expectations" (Swafford, Ghosh, & Murthy, 2008, p. 290). In their concept of supply chain agility, Gligor et al. (2019) understand flexibility as the ability to adjust tactics and operations and consider it to be among the key characteristics of agility. Ngai et al. (2011) as well identify supply chain flexibility and add *IT flexibility*. While the former is split into the strategic dimension (fast decision and commitment to respond) and its operational ability to implement the decision, IT flexibility refers to connectivity, compatibility, and modularity. The framework of Sing Patel et al. (2017) contains two further dimensions, namely *organisational*

and *operational flexibility*. Both reflect the ability to modify production, processes, and labour.

Research on partnering agility also found that the *role* and *vision of top management* are positively associated with supply chain agility (Ngai et al., 2011). Semi-structured interviews with top management representatives revealed that belief in the value of supply chain agility leads to an allocation of resources to support the related activities. Moreover, the interviewees reported that their confidence in agility resulted in an active participation of employees in obtaining the necessary competencies. Further insights provide Dubey et al. (2018) who proved the effectiveness of *top management commitment* on providing resources and utilising them to develop supply chain agility.

Eventually, Kim and Chai (2017) have been analysed more than 270 survey responses and indicate the enabling role of *supplier innovativeness*. They define it as "suppliers' ability to develop new processes and products in order to contribute to manufacturers' performance in cost, quality, delivery, flexibility, and product development respectively product technology" (Kim & Chai, 2017, p. 42). Together with the previous findings, another conclusion can be drawn:

Conclusion 3: *Main partnering agility enablers sum up to (1) network integration, (2) ICT integration, (3) collaborative relationship, (4) market sensitivity, (5) flexibility, (6) top management commitment, and (7) supplier innovativeness.*

Concerning the maturity of the research stream, table 2.4 on the following pages shows that after intense research in both an inductive and deductive manner the status of tested theory has been achieved. However, latest publications are of purely conceptual nature, which reflects further need for theory development. Feizabadi et al. (2019) for instance ask for qualitative work to reveal details about necessary processes for agility development in the supply chain.

Closely linked to activities in the supply chain is a firm's manufacturing organisation. To better understand its role in the corporate agility framework of this thesis, the following sub-section critically reviews the relevant literature with a focus on the enablers for manufacturing agility.

Table 2.4: Research on partnering agility

Author(s), year	Type of research	Data	Main identified partnering agility enablers
Feizabadi et al. (2019)	Inductive, conceptual	120 articles related to supply chain agility, adaptability, and alignment from a systematic literature review	▪ Flexibility to modify processes and outcomes ▪ Ability to quickly respond (speed) ▪ Alertness to detect changes, opportunities, and threats (visibility) ▪ Information integration/syncing information between firms ▪ Coordinated processes across supply chain members ▪ Product and service differentiation for continuous distinctiveness ▪ Supply management: supply chain cost minimisation, effective management of time to reduce inventory/capital waste, use of postponement
Gligor et al. (2019)	Inductive, conceptual	100 articles related to supply chain agility from a multidisciplinary systematic literature review	▪ Ability to quickly change direction (supply chain tactics and operations) ▪ Ability to speed/accelerate operations ▪ Ability to scan the environment/anticipate (market sensitive supply chain, i.e. capability of reading and responding to real demand) ▪ Ability to empower the customer/customise ▪ Ability to adjust tactics and operations (flexibility)
Dubey et al. (2018)	Deductive, econometric	Electronic questionnaires with 351 manages from the Indian auto components industry	▪ Supply chain connectivity: technological resource that enables effective information sharing ▪ Supply chain information sharing: information's quality and relevance ▪ Supply chain visibility: information flow that impacts on supply chain transparency (e.g. inventory and demand levels) ▪ Top management commitment in terms of e.g. resource allocation

Table 2.4 (continued)

Author(s), year	Type of research	Data	Main identified partnering agility enablers
Mandal (2018)	Deductive, econometric	Online surveys with 176 IT professionals from manufacturing, construction, retail, and textile sector	▪ Big data analytics (BDA) technology management: skills and orientation of employees towards learning new technologies and its implementation ▪ BDA business knowledge: extent to which a firm's employees are knowledgeable regarding the business environment changes ▪ BDA relational knowledge: ability of employees to handle joint projects, teaching others, and the capacity to maintain relationships
Kim and Chai (2017)	Deductive, econometric	Surveys with 272 supply and purchasing executives and managers in the Korean manufacturing industry	▪ Information sharing: connectivity (technological capability of connections in the supply chain) and willingness (level of openness to share relevant information in the supply chain) ▪ Strategic sourcing: process of supplier management and supply network design to constantly optimise value to the organisation ▪ Supplier innovativeness: suppliers' ability to develop and adopt new processes or new products
Samdantsoodol et al. (2017)	Deductive, econometric	Off- and online questionnaires with 205 managers from Mongolian logistics companies	▪ Virtual enterprise as a temporary alliance to implement strategy that is not simultaneously being implemented by other potential competitors and thus sustains the competitive advantage ▪ Adoption of information & communication technology (ICT): information system that integrates members, effective utilisation of ICT, smart technology, and decision support systems

Table 2.4 (continued)

Author(s), year	Type of research	Data	Main identified partnering agility enablers
Singh Patel et al. (2017)	Inductive, case study	Interviews with selected experts from an Indian manufacturing organisation	▪ Virtual enterprise in terms of partner selection, outsourcing, logistic and internal supply chain management, and organisational structure ▪ Collaborative relationship with the attributes of trust between each other, shared vision, compromise, and mutual dependency between partners ▪ Use of information technology with regard to investment in IT, its operational impact, and operationalising IT ▪ Market sensitivity concerning analysis of market trends, effective forecasting, production, and market survey ▪ Customer satisfaction: quality assurance and control, customer service ▪ Adaptability at supplier level, at production unit, and at distributor level ▪ Supply chain, organisational, and operational flexibility
Fayezi et al. (2016)	Inductive, conceptual	48 articles related to agility from a systematic literature review	▪ Careful management of external relationships: trust, information sharing, commitment, communication, and reward sharing ▪ Strong regulatory frameworks and effective contract mechanisms
Fayezi et al. (2015)	Inductive, case study	Semi-structured interviews with ten senior/middle managers from Australian manufacturing organisations	▪ Mindset: awareness and identification of change, preparedness, openness and willingness, forward thinking and opportunity seeking, vision ▪ Intelligence: information processing power and response capabilities; skills, know-how and experience, diligence, different work approaches ▪ Process: lean manufacturing, inventory management, learning systems and planning programs

Table 2.4 (continued)

Author(s), year	Type of research	Data	Main identified partnering agility enablers
Blome et al. (2013)	Deductive, econometric	Mail surveys with 136 high-level managers with supply chain responsibility from multinational manufacturing firms in Germany	▪ Supply side competence: firm's proficiency in managing its upstream (supply-related) activities; supply and production management ▪ Demand side competence: firm's ability to effectively manage down-stream (demand-related) aspects; demand and distribution management ▪ Process compliance: processes of supply, production, demand and dis-tribution management are executed and followed diligently by the firm
Gligor and Holcomb (2012)	Inductive, conceptual	88 articles related to supply chain agility and logistics capabilities from a systemat-ic literature review	▪ Logistics capabilities integrated at the supply chain level: demand-management capability, supply-management capability, integration ca-pability, measurement capability, and information exchange capabilities
Ngai et al. (2011)	Inductive, case study	Semi-structured interviews with three top management representatives from three fashion and textile manufac-turing companies in Hong Kong	▪ Supply chain (SC) integration: separate partners collaboratively manage intra- and inter-organisational processes to provide max. customer value ▪ SC flexibility: strategic (prompt decision and commitment to respond) and manufacturing flexibility (operational ability to implement decision) ▪ SC learning orientation: commitment, open-mindedness, shared vision ▪ IT integration: inter-organisational linkage of IT to create virtual SC ▪ IT flexibility: connectivity, compatibility, and modularity ▪ Role and vision of top management: active participation and approval ▪ Competence of employees: adequate knowledge, ability to communicate effectively, and ability to integrate a number of different supply chains

Table 2.4 (continued)

Author(s), year	Type of research	Data	Main identified partnering agility enablers
Kisperska-Moron and Swierczek (2009)	Inductive, econometric	Questionnaires with 96 companies operating in various industries in Poland	▪ Relations with customers, suppliers, and service providers ▪ Relations with competitors; collaborating to compete (*co-opetition*) ▪ Wide range and intensive use of information technology
Swafford et al. (2008)	Deductive, econometric	Online surveys with 131 Vice Presidents, Directors, and plant managers from U.S. manufacturing firms	▪ Supply chain flexibility: abilities of reducing supply chain lead time, ensuring production capacity, and providing product variety while fulfilling customer expectations
Agarwal et al. (2007)	Inductive, econometric	Questionnaires with 179 managers from OEMs and suppliers from the Indian automotive industry	▪ Use of IT tools to share data between buyers and suppliers ▪ Centralised and collaborative planning, synchronisation of partners ▪ Process integration: collaborative working between buyers and suppliers, joint product development, common systems, shared information
Lin et al. (2006)	Inductive, case study	Taiwan-based international IT products company	▪ Collaborative relationship (strategy): work collaboratively, jointly develop products, and share information ▪ Process integration (foundation): supply chain as confederation of partners linked into a network ▪ Information integration (infrastructure): use of IT to share data between buyers and suppliers and thus effectively creating a virtual supply chain ▪ Customer/marketing sensitivity (mechanism): read and respond to customer demands, master change and uncertainty

Table 2.4 (continued)

Author(s), year	Type of research	Data	Main identified partnering agility enablers
Yusuf et al. (2004)	Deductive, econometric	Questionnaires with 109 U.K.-based companies operating in various industries	▪ Computer-based data integration with other companies ▪ Alliances for design and manufacturing rather than marketing ▪ Cooperative alliances with competitors ▪ Leverage of core resources with other companies
Van Hoek et al. (2001)	Inductive, econometric	Questionnaires and structured telephone interviews with 35 managers from manufacturing companies in U.K. and the Benelux	▪ Customer sensitivity: market understanding and customer enrichment ▪ Virtual integration through leveraging of information: instantaneous demand capture, interpretation, and response ▪ Process integration: operator self-management to maximise autonomy and immediate response to master change across organisations ▪ Network integration: fluid clusters of network associates
Christopher (2000)	Inductive, conceptual	Systematic literature review on agility, underpinned with examples from industry	▪ Market sensitivity: capability of reading and responding to real demand ▪ Virtual supply chain: use of IT to share data between buyers and suppliers; information-based rather than inventory-based ▪ Process integration: collaborative working between buyers and suppliers, joint product development, common systems, shared information ▪ Network: ability to leverage strengths and competencies of partners

2.3.4 Manufacturing Agility

As described earlier in this chapter, agility originated in the context of manufacturing organisations as a joint initiative of the U.S. government, industry, and academics in 1991. In turn, the body of literature in this agility dimension is quite large since it reflects almost 30 years of intense research in this field. In a wider context, the concept of agile manufacturing can be seen as a management philosophy preceded by *mass customisation* and *lean manufacturing* (Gunasekaran et al., 2019). Thus, agile manufacturing can be defined as:

> "[…] a manufacturing paradigm which attempts to combine the efficiency of lean manufacturing with the operational flexibility of the flexible model while delivering customised solutions at the expense of mass production" (Routroy, Potdar, & Shankar, 2015, p. 2).

To operationalise the concept, the scientific community is used to bundle related practices in the term manufacturing agility. Mark Jacobs and his colleagues provide a comprehensive definition:

> "Firms manifesting manufacturing agility are characterised by responding quickly to customers in positive ways. Elements of this quick and effective response to demand changes include customer responsiveness, shorter manufacturing lead times than competitors, and rapid delivery of goods" (Jacobs, Droge, Vickery, & Calantone, 2011, p. 126).

The first major success factor for enabling manufacturing agility is *empowering the own workforce*. Based on several case studies, Potdar and Routroy (2018) and Routroy et al. (2015) refer to an organisation's ability to delegate authority to its members, in particular decision-making power. In a decentralised decision-making process, quick and independent decisions will flourish and lead to a reduction of delays across various dimensions. Extant deductive research has confirmed this finding and further identified everyone's involvement, team cooperation, mutual trust (Dubey & Gunasekaran, 2015), and intensive training (Vázquez-Bustelo, Avella, & Fernández, 2007) as important ingredients. Aravind Raj, Sudheer, Vinodh, and Anand (2013) point out the link of organisational structure and flat hierarchical arrangements to ensure the devolution of authority. Put differently, Zhang and Sharifi (2007) emphasise an informal management style together with the aspects of coaching and inspiring people as leading principles. Besides this, an earlier case study of a large, multinational organisation has shown

that the combination of proper trainings and incentives schemes (e.g. financial awards for good ideas) will result in an empowered workforce. In sum "employee empowerment has been proposed as the principle assets in making a plant truly flexible, notwithstanding loads of intelligence possessed by advanced manufacturing systems" (Gunasekaran et al., 2019, p. 5162).

Furthermore, also the *adaptability* and *flexibility* of a firm's manufacturing system have a crucial role in providing agility. While adaptability can be defined as "the capability of a system to respond to both predictable and unpredictable changes" (Potdar & Routroy, 2018, p. 4009), flexibility refers to several dimensions of the system and can be categorised in (1) *new product flexibility*, i.e. flexibility when technologies are evolving, (2) *mix flexibility* to manufacture a large number of products as quickly as possible, and (3) *volume flexibility* to operate under profitable conditions even when output varies (Dubey & Gunasekaran, 2015). Action research has revealed several practices to foster flexible manufacturing systems, e.g. buying in extra capacity or outsourcing production solely for the bottleneck activity to increase total capacity, daily meetings for buffer management, and standardising of components and assemblies (Ifandoudas & Chapman, 2009). In the context of *standardising*, Watanabe and Ane (2004) have investigated the case of Toyota Eco Cars and found that the capability of a manufacturing system to assemble a product based on modular architecture on a single flexible production line in small batches leads to an increase in manufacturing agility. Gunasekaran et al. (2019) extend this approach about the aspects of programmable systems to conduct a wide range of machining and assembly tasks without the efforts entailed in flexible systems. They name it *intelligent automation* with the core elements of cellular design, a wider range of automated processes, machine flexibility and intelligence, and plant mobility.

Closely linked with the degree of automation are various technologies that might be used to automate the different functions (Routroy et al., 2015). In a recent case study, Gunasekaran, Yusuf, Adeleye, and Papadopulus (2018) have explored the role of *big data* and *business analytics* within agile manufacturing. Two of the four invested companies were able to thrive manufacturing agility through applying the two concepts. Dubey and Gunasekaran (2015) have em-

ployed a large-scale approach by surveying more than 280 managers and revealed the importance of technologies enabling effective and efficient information sharing, the use of automated guided vehicle systems, and the use of robotic machines. In the same manner, Vázquez-Bustelo et al. (2007) were able to demonstrate the relevance of advanced design technologies, integrated customer/supplier information systems, and manufacturing information systems. A common information interface (e.g. electronic data interchange), an internal information network as well as an information management plan are further findings in this domain (Gunasekaran, 1998; Sharifi & Zhang, 2001). Ghobakhloo and Azar (2018) took up most of the subjects above and refer to *advanced manufacturing technologies* in terms of information acquisition and management, knowledge coding and sharing, group communications across time and space, data-based collaboration, visibility in general and of underlying data, and resource monitoring and control. They have proved their significance in order to achieve manufacturing agility.

The aspect of standardisation was already mentioned before in the context of the automation of manufacturing systems. *Modular product architectures* are an important prerequisite for a firm's ability to assemble individual modules into a product on a single production line, which in turn will increase manufacturing agility (Watanabe & Ane, 2004). This becomes even more significant when considering the study of Jacobs et al. (2011). They have conducted surveys with managers from first tier suppliers to large auto manufactures in North America and revealed the direct and positive effects of *product modularity* on manufacturing agility, process modularity, and growth performance. Here, product modularity is operationalised in modularity itself, i.e. interchangeable parts across products that allow the configuration into a wide variety of end products, and the use of standardised procedures, materials, and parts. To put it in a nutshell, "modularity will enable the organisation to meet the customer's specifications by modifying quickly parts of the product" (Yusuf et al., 1999, p. 40).

Another finding is that the *concurrent paradigm* (as opposed to sequential processing) helps in achieving agility (Yusuf et al., 1999). In other words, parallel information processing and concurrent execution of tasks within cross-functional teams instead of a step-wise approach. Various scholars have examined this by

using multiple research designs. In an early conceptual work, Gunasekaran (1998) revealed *concurrent engineering* as an answer to respond as quickly as possible to changing markets. That means all parties concerned in new product development deliver inputs already in the design phase, e.g. customers, field service, marketing, or manufacturing. Later, Vázquez-Bustelo et al. (2007) statistically validated most of these theoretical insights with a large-scale survey and further emphasised simultaneous process development, early involvement, and close collaboration. Zhang and Sharifi (2007) demonstrate the positive link between customer involvement in product development and manufacturing agility. In this light, case study research shows that Quality Function Deployment (QFD) is a practical tool to link the customer more to the company (Gunasekaran, Tirtiroglu, & Wolstencroft, 2002).

Research has also pointed out two successful practices related to *knowledge management* and *learning*. First, organisational systems to support experimentation, accessible databases that are applied and updated, and formal mechanisms to disseminate best practices (Vázquez-Bustelo et al., 2007). Second, an integrated learning process to avoid previous mistakes (Yusuf et al., 1999). This leads to the following conclusion:

Conclusion 4: *The main manufacturing agility enablers include 1) employee empowerment, 2) manufacturing system flexibility, 3) advanced manufacturing technologies, 4) product modularity, 5) concurrent paradigm, and 6) knowledge management and learning.*

From table 2.5 on the following pages can be seen that the maturity of research on enabling manufacturing agility on the one hand is well advanced due to pertinent works that show statistical significance of former developed hypothesis. On the other hand, research is still conducted by means of case studies or purely conceptual. Thus, it is necessary to confirm the agility enablers by further exploring their interactions through qualitative in-depth studies or surveys (Gunasekaran et al., 2019).

The next field of interest is the area of agility in new product development; this will be reviewed in the following sub-section.

Table 2.5: Research on manufacturing agility

Author(s), year	Type of research	Data	Main identified manufacturing agility enablers
Gunasekaran et al. (2019)	Inductive, conceptual	Systematic literature review on agile manufacturing	▪ Transparent customisation: accommodating to changing customer requirements through customer-led product solutions ▪ Agile supply chains: customer sensitivity, virtual integration, process integration, and network integration ▪ Employee empowerment: training, teaming, involvement, commitment ▪ Intelligent automation: cellular design, wide range of automated processes, machine flexibility, machine intelligence, and plant mobility ▪ Technology integration: adoption or synthesis of multiple technologies
Ghobakhloo and Azar (2018)	Deductive, econometric	Questionnaire-based survey with 189 Iranian automobile part manufacturers	▪ Advanced manufacturing technology in terms of information acquisition and management, knowledge coding and sharing functionality, group communications across time and space, data-based collaboration, visibility in general and of underlying data, resource monitoring and control
Gunasekaran et al. (2018)	Inductive, case study	Structured interviews with two CEOs and two senior managers from manufacturing companies in the U.K.	▪ Big data: volume (amount of data), velocity (rate of data generation), variety (different formats), veracity (reliable predictions), and value ▪ Business analytics: applying appropriate methods (regression modelling, decision trees, Bayesian statistics, neural networks, support vector machine, and nearest neighbour algorithms)
Potdar and Routroy (2018)	Inductive, case study	Expert interviews in an Indian electrical hardware manufacturing company	▪ Devolution of authority (delegate decision-making power), adaptability (respond to both predictable and unpredictable changes), information visibility and transparency, and supply chain integration

Table 2.5 (continued)

Author(s), year	Type of research	Data	Main identified manufacturing agility enablers
Dubey and Gunasekaran (2015)	Deductive, econometric	Electronic surveys with 286 (top) managers from Indian manufacturing firms operating in several industries	▪ Technologies: information sharing, dynamic sensing, and in production (in particular automated-guided vehicle systems and robotic machines) ▪ Workforce empowerment: delegation of authority, team cooperation, mutual trust, and everyone's involvement ▪ Customer focus: customer satisfaction, product reliability, service after sales, product quality, and voice of the customer ▪ Supplier relationships: informat. and risk sharing, collaborative planning ▪ Flexible manufacturing systems: new products, mix, and volumes ▪ Organisational culture: attention to detail, team and people orientation, innovation and risk taking, and stability
Routroy et al. (2015)	Inductive, case study	Interviews with five senior executives from an Indian manufacturing company	▪ Adaptability: adopt new methods of operating the manufacturing system ▪ Product and process automation through various technologies ▪ Supply chain integration of all partners to work towards a common goal ▪ Core competency: combination of capabilities that is unique and durable ▪ Supply chain key partners' alacrity: response to business environment ▪ Devolution of authority: delegating decision-making power ▪ Information visibly and transparency: availability of accurate informat. ▪ Manufacturing management as foundation for effective manufacturing ▪ Customer relationship management to enhance the relationship ▪ Supplier relationship management to understand and analyse suppliers ▪ Human resource management to engage, motivate, and retain employees

Table 2.5 (continued)

Author(s), year	Type of research	Data	Main identified manufacturing agility enablers
Aravind Raj et al. (2013)	Inductive, case study	Interviews in an Indian automotive component manufacturing company	▪ Management responsibility: hierarchical arrangement, devolution of authority, participation of management towards employee benefits ▪ Manufacturing mgmt. agility: customer response adoption, change in business and techn. processes, outsourcing, resource optimisation, agile customisation, flexible practices, knowledge mgmt., business support system, product variety, rapid manufacturing and inter-organis. system ▪ Workforce agility: employee status and involvement, team work, creativity, and fast production and delivery ▪ Technology agility: manufacturing set-ups, product life cycle, product service, design improvement, production methodology, manufacturing planning, automation type, IT integration, advances in design, concurrent processing, new product development, data management, and virtual enterprise ▪ Manufacturing strategy agility: status of quality and productivity, cost and time management, collaborative relationship, flexible volume production, seasonality, and flexible delivery time and locations
Inman et al. (2011)	Deductive, econometric	Surveys with 96 plant and operations managers of large U.S. manufacturers	▪ Just-in-time (JIT) purchasing as a set of techniques and concepts for eliminating waste and inefficiency in the purchasing process, e.g. daily delivery of small lot sizes from nearby vendors, shared information, supplier education, reduced inspection

Table 2.5 (continued)

Author(s), year	Type of research	Data	Main identified manufacturing agility enablers
Jacobs et al. (2011)	Deductive, econometric	Mail surveys with 57 managers from first tier suppliers to large auto manufacturers in North America	▪ Product modularity: modularity (the process of developing interchangeable parts across products that can be configured into a wide variety of end products) and standardisation (the use of standard procedures, materials, parts, and or processes for designing and manufacturing a product)
Ifandoudas and Chapman (2009)	Inductive, case study	Action research in a small Australian manufacturer of custom-built electrical components	▪ Flexible manuf. system: buying in extra capacity or outsourcing production solely for the bottleneck activity to increase total capacity, daily meetings for buffer mgmt., standardising of components and assemblies ▪ Replacement of cost-based accounting information with throughput accounting (use of constraint-based information) ▪ Resource-based strategy: identification of responsiveness and product innovation as key resources
Vázquez-Bustelo et al. (2007)	Deductive, econometric	Questionnaires with 283 plant/operations/manufacturing managers from manufacturing firms in Spain	▪ Highly trained, motivated, and empowered employees working in teams ▪ Use of advanced design and manufacturing technologies; integrated customer/supplier and manufacturing information systems ▪ Internal integration of operations, with suppliers and customers ▪ Concurrent engineering: simultaneous product and process development, multi-functional teams, early involvement, and close collaboration ▪ Knowledge management: organisational systems to support experimentation, accessible databases, working teams that access, apply, and update knowledge, formal mechanisms to disseminate best practices

Table 2.5 (continued)

Author(s), year	Type of research	Data	Main identified manufacturing agility enablers
Zhang and Sharifi (2007)	Deductive, econometric	Surveys with 58 managing, engineering, or operations Directors from U.K. businesses from three sectors (auto parts, aerospace, and electronics)	▪ Partnering is favoured; suppliers being audited, ranked, and informed ▪ Adoption of advanced manufacturing technologies ▪ Total integration (customers and suppliers) ▪ Informal management style, coaching, and inspiring people ▪ Customer involvement in product development ▪ Product development is based on information systems, which continuously track processes and changes in the environment
Watanabe and Ane (2004)	Inductive, case study	Case of Toyota Eco Cars (Prius, Estima, and Crown, which are designed from the same platform)	▪ Embodiment of modularity in product architecture to be able to assemble individual modules into a product on a single production line ▪ Capability of a manufacturing system to assemble a product based on modular architecture on a single flexible production line in small batches
Gunasekaran et al. (2002)	Inductive, case study	Standard questionnaires in a U.K.-based aerospace company	▪ Business process re-engineering to detect non-value adding activities ▪ Information technology and electronic commerce ▪ Quality Function Deployment to link the customer more to the company ▪ Training, education, and incentives schemes to empower people
Sharifi and Zhang (2001)	Inductive, case study	Interviews and questionnaires in two U.K.-based manufacturing companies	▪ Sensing, perceiving, and anticipating changes: strategic use of information systems, information interface with suppliers/customers, internal information network, empowerment of people, information mgmt. plan ▪ Immediate reaction to changes: computerised manuf. information system, concurrent team working, virtual organisation

Table 2.5 (continued)

Author(s), year	Type of research	Data	Main identified manufacturing agility enablers
Yusuf et al. (1999)	Inductive, conceptual	Systematic literature review on agile manufacturing	▪ Concurrent paradigm: parallel information processing and concurrent execution of functions/cross-functional teams ▪ Empowerment for frontline decision-making ▪ Modularity: quickly modifying parts of the product ▪ Integrated organisations with integrated learning processes (avoidance of previous mistakes)
Gunasekaran (1998)	Inductive, conceptual	Systematic literature review on agile manufacturing	▪ Virtual enterprise formation: temporary, across several partner-firms ▪ Physically distributed teams and manufacturing: temporary alliance of partner enterprises located all over the world ▪ Rapid partnership formation: aligning strategies and pooling of core competencies based on the competitive strategies of the firm ▪ Concurrent engineering: new products are designed with inputs from all concerned; i.e. customer, field service, quality, marketing, and manuf. ▪ Integrated product/production/business information system ▪ Rapid prototyping: early version of the product containing key features ▪ Electronic commerce, in particular electronic data interchange (EDI)

2.3.5 Product Development Agility

Agile development practices originally emerged in the context of software engineering. However, a recent trend shows the introduction of such methods as well in R&D departments of manufacturing companies (Riesener, Rebentisch, Doelle, Kuhn, & Brockmann, 2019) although the transformation from digital to hardware products requires suitable adaptions (Gerber, Goevert, Schweigert-Recksiek, & Lindemann, 2019). Most manufacturing firms follow traditional stage-gate processes due to the rigour and strategic benefits of this approach (Cooper & Sommer, 2016). As a consequence, almost all of the hardware case studies uncovered in industry so far revealed an application of agile methods only within some stages. New product development is usually done within sound project management structures, which results in a largely interchangeable use of the terms *agile product development* and *agile project management* in the literature. Hence, enabling aspects for agility in project management will be covered in this sub-section too.

Within this research stream I will focus on the development of physical products, where of course software can be integrated. Agility in the field of mechatronic system development is therefore understood as:

> "[…] the capability to discover and understand changing product requirements and being able to quickly consider these changes while making progress in developing the product" (Goevert, Heimicke, Lindemann, & Albers, 2019, p. 2288).

Academic research has shown that firms typically make use of *time-boxed development sprints* with frequent meetings and customer involvement when starting to experiment with the integration of agile development processes (Conforto & Amaral, 2016; Gerber et al., 2019; Goevert et al., 2019; Sommer, Hedegaard, Dukovska-Popovska, & Steger-Jensen, 2015). These studies revealed benefits in terms of (1) a higher level of responsiveness to changing customer needs, (2) integration of the customer's voice in a much more proactive and effective way, (3) improved coordination among project team members, and (4) a better overall productivity through e.g. reduced cycle times. The different stages of a development process (e.g. idea, concept, etc.) are composed of a series of sprints, each usually of the duration of two to four weeks. The development team plans every sprint at the beginning and commits to an amount of tasks to be accomplished,

resulting in some tangible result at the end of each sprint that the customer can respond to or management can see (Cooper & Sommer, 2018). During the sprint, daily stand-up meetings are held to ensure that work is on track according to the sprint-goal, to review the work of the past 24 hours and outline the tasks for the next 24 hours, and to discuss problems (Cooper & Sommer, 2016). These meetings are sometimes called *scrums*, stemming from an approach by Takeuchi and Nonaka (1986). The analogy is to manage new product development similar to a rugby team, which tries to go the distance in a unit (the scrum) while continuously deciding their next moves. An explorative survey with 19 manufacturing organisations has found that half of the firms even benefited from involving the customer already in the pre-sprint project-planning phase (Conforto, Salum, Amaral, Da Silva, & De Almeida, 2014).

The second contribution of those case studies is the application of *dynamic, visualised tools* for communication and knowledge sharing. Several static methods, such as Gantt-charts and project plans, have been pioneered by the traditional stage-gate process. When implementing agile processes, firms have replaced them with dynamic techniques (like the burn-down chart, the scrum board, and the product backlog) because the nature of the process demands for a continuous update of the information in the tools (Sommer et al., 2015). Conforto and Amaral (2016) have conducted observations and interviews over the course of four months to explore the implementation of agile project management in a technology-based company. Their findings confirm the use of visual boards to support face-to-face interaction of team members; simultaneously they point out the necessity to evaluate the option of digital solutions for such tools.

Another finding comes from focusing on the project members. According to a study, one of the key aspects is to keep the teams *small* and *co-located* and ensure that they are *fully dedicated to the project* (Conforto & Amaral, 2016). The latter aspect is also discussed by Cooper and Sommer (2018) who emphasise the difficulty for most companies to dedicate people with 100% of their time. However, case companies have largely found a practical solution by limiting maximum loads of team members, e.g. maximum one other project. In terms of team size, interviews in a German start-up company from the e-mobility sector revealed

groups of eight to twelve people (Schuh et al., 2018). Further, these teams were co-located through an office design containing a mixture of open-space areas, collaboration areas, and team offices. In this context, Conforto et al. (2014) refer to the experience level of the teams as well as the project manager. In both cases, an experience of more than two years has indicated an enabling role for achieving agility in new product development.

At the heart of the agile paradigm in development are small teams with *overall responsibilities* (Schuh et al., 2018). To empower the teams with some degree of autonomy to make decisions, two factors play an important role: On the one hand *less formalised processes* with the flexibility to tailor it to project needs (Conforto et al., 2014) and on the other hand an *agile mindset* of the people involved – up to the top management (Goevert et al., 2019). One of the key findings of an early study on agile product development was the necessity to modify management processes, e.g. to lock down requirements progressively instead of requesting a full specification before any design activities could begin, or to make piecewise commitments rather than binary choices (unreleased or released) (Thomke & Reinertsen, 1998). Based on an in-depth study of Cisco Systems, Chen, Ravichandar, and Proctor (2016) report on four new management practices to enable an agile development process, for instance the reduction of micromanaging. Cooper and Sommer (2018) recommend handling the project plan and cost estimation of a more tentative nature. Thus firms must learn to acknowledge change and accommodate more ambiguity in product definition, which might be outside the comfort zone. This acceptance of requirements-change throughout the process is an essential ingredient for an agile mindset (Sommer et al., 2015).

Another element that is being added is the adoption of *flexible design technologies* in combination with *rapid prototyping* (Thomke & Reinertsen, 1998). Technologies such as computer-aided design (CAD) help to create, modify, analyse, or optimise the design of new products. Prototyping techniques like three-dimensional printing compress time, increase flexibility, and reduce costs (Vinodh et al., 2010). Frequent prototyping is of primary importance in the context of iterative development as described earlier in this sub-section, because it "allows target-oriented development process being not specified and detailed in advance.

Moreover, it promotes the transparency of knowledge within the team and facilitates the speed of reaction or rather adaption" (Zink, Hostetter, Boehmer, Lindemann, & Knoll, 2017, p. 75). Prototyping activities should follow the concept of a minimum viable product (MVP), which is specified just above a viable level to yield reliable learning effects on the most crucial uncertainties in the current product version (Schuh et al., 2018).

Riesener et al. (2019) provide a further contribution by linking a firm's *involvement in product development networks* to its agile capabilities. Knowledge exchange in networks is particularly advantageous in knowledge-intensive sectors. Such collaborations can comprise industry clusters, research campuses, or strategic alliances. In the same context, Wilson and Doz (2011) have conducted interviews with managers from 30 global companies and revealed two important insights: First, different modes of access are necessary for different types of knowledge, and second, separate tools, processes, and mechanisms are needed to absorb this knowledge within the organisation. Applying both accordingly will boost the agility of a firm's innovation activities. From this and the findings before, the next conclusion can be drawn:

Conclusion 5: *The main product development agility enablers contain 1) time-boxed sprints with defined deliverables and customer involvement, 2) dynamic and visualised tools, 3) small, dedicated, and co-located teams, 4) less formalised processes that empower decision-making, 5) adoption of flexible design technologies together with rapid prototyping, and 6) collaboration in product development networks.*

Concerning the maturity of this research stream, it can be observed in table 2.6 that past research has been conducted almost exclusively by means of case studies. Further, there is little research on the applicability of agile methods for multi-team development projects of complex, physical product architectures. Taking this into account, the need for more qualitative research remains before this area will move toward theory development and subsequently theory testing.

The next sub-section deals with the last remaining agility dimension presented in my conceptual model of corporate agility: agile employees.

Table 2.6: Research on product development agility

Author(s), year	Type of research	Data	Main identified product development agility enablers
Gerber et al. (2019)	Inductive, case study	Survey with seven students collaborating in a project to develop a three-dimensional printed microtiter plate	▪ Division into pre-, iteration-, and final phase: research, interviews, and joint workshops on the topic before the actual development; iteration-phase in the sprint structure of scrum; final adaption of the product with closer consideration of risk and quality management
Goevert et al. (2019)	Inductive, econometric	Interview study with 18 participants from different industries and departments	▪ Development in sprints respectively modified forms of scrum ▪ Agile mindset of the people involved/living the agile culture ▪ Support of top management ▪ Understanding of the environment, e.g. customers or internal departments/functions
Riesener et al. (2019)	Inductive, conceptual	Systematic literature review on agile product developm.	▪ Collaboration in product development networks, e.g. industry clusters, research campuses, or strategic alliances
Cooper and Sommer (2018)	Inductive, case study	Interviews with development managers from six manufacturing companies in North America and Europe	▪ Hybrid agile stage-gate model, combining benefits of the two systems ▪ Project plan and cost estimation of a more tentative nature, change is acknowledged, and ambiguity accommodated ▪ Metrics to generate solid, measurable results (to get leadership buy-in) ▪ Limiting maximum loads of team members, e.g. maximum one other project ▪ Defining tangible sprint deliverables where customer can respond to and management can see, so-called *protocepts*

Table 2.6 (continued)

Author(s), year	Type of research	Data	Main identified product development agility enablers
Schuh et al. (2018)	Inductive, case study	Interviews in a German start-up company in the e-mobility sector	▪ Lead engineering groups (LEGs) with overall responsibility ▪ Transformation of user-stories into questions, clustering in minimum viable product (MVP) concepts and prototyping the MVP ▪ Weekly stand-up meetings between developers and LEG leaders ▪ Co-location offices: open-space and collaboration areas, team offices
Zink et al. (2017)	Inductive, case study	Surveys with 50 students collaborating in ten projects at a German university	▪ Iterative development by means of prototyping (to continuously support the learning process); no *one fits all* approach, nature of prototype must be unique to each product
Chen et al. (2016)	Inductive, case study	Interviews with various professionals playing different roles in the agile development process at Cisco	▪ Implementation of a dedicated team to assist business units and engineering teams: benefit assessment, readiness assessment, and multi-step efforts to help the transition (like training and coaching) ▪ Development of new management practices to support the agile process: leadership, planning and forecasting, coordinating tasks, and recruitment of collaborative customers
Conforto and Amaral (2016)	Inductive, case study	Questionnaires and interviews in a technology-based SME	▪ Development process as combination of stage-gate concepts (e.g. phase and criteria definitions, clear milestones) with iterative and fast development cycles with frequent informal meetings and feedback ▪ Visual boards to support face-to-face interactions of team members ▪ Software for project management and performance indicator system ▪ Small and co-located teams fully dedicated to the project

Table 2.6 (continued)

Author(s), year	Type of research	Data	Main identified product development agility enablers
Sommer et al. (2015)	Inductive, case study	Interviews, observations, and document review with professionals on all levels in seven manufacturing companies	▪ Retain stage-gate models for strategic mgmt. (e.g. steering committee) and use of scrum to structure execution within the development teams ▪ Replacement of static tools (Gantt-charts, project plans) with dynamic tools (burn-down chart, scrum board, product backlog) ▪ Visualisation techniques for communication and knowledge sharing ▪ Mindset: acceptance of requirements change throughout the process
Conforto et al. (2014)	Inductive, case study	Explorative survey with 48 professionals from project mgmt., R&D, and product development in 19 Brazilian companies	▪ Experienced and cross-functional teams, experienced project managers ▪ Less formalised processes, empowering the team with some degree of autonomy to make decisions ▪ Project-oriented and strong matrix organisational structure ▪ Customer/stakeholder involvement in the project planning
Wilson and Doz (2011)	Inductive, case study	Interviews with managers at 30 global companies from a wide range of sectors	▪ Different modes of access for different types of knowledge: attracting (explicit knowledge), foraying (embedded knowledge), and experiencing (existential knowledge) ▪ Different tools, processes, and mechanisms to absorb knowledge: internal specialists for explicit knowledge, scouts create mechanisms to transfer embedded knowledge back to home base, and cross-cultural relays create bridge between knowledge source (existential) and recipient (genuine business pull required)

Table 2.6 (continued)

Author(s), year	Type of research	Data	Main identified product development agility enablers
Vinodh et al. (2010)	Inductive, case study	Study in a small pump manufacturing company in India	▪ Computer-aided design (CAD) to create, modify, analyse, or optimise the design of new products ▪ Rapid prototyping technologies (e.g. fused deposition modelling) to compress time, increase flexibility, and reduce costs
Thomke and Reinertsen (1998)	Inductive, case study	Questionnaires to investigate 391 development projects in the integrated circuit design industry	▪ Adoption of flexible technologies, e.g. computer-aided design and engineering tools in combination with three-dimensional printing ▪ Modification of management processes: progressively locking down requirements, keeping multiple back-up approaches viable even after concept selection, providing decision support tools that facilitate rapid and correct decisions, measurement and improvement of reaction time, making piecewise commitments versus binary choices (unreleased or released), and structuring of design tasks (interdependence to boundaries) ▪ Leveraging design architectures: use of modular product structures, isolating volatility in the design, and reduction of coupling between modules

2.3.6 Workforce Agility

Corporate agility is not possible without agile employees. Muduli and Panya (2018) describe such a workforce with the following characteristics: 1) positive attitude towards learning and self-development, 2) good problem solving ability, 3) comfortableness with change and new ideas/technologies, 4) ability to generate innovative concepts, and 5) readiness to accept new responsibilities at any time. In this vein, workforce agility has been defined as:

> "[…] the ability of an employee to rapidly and appropriately respond to unexpected changes and leverage those changes as opportunities" (Pitafi, Liu, & Cai, 2018, p. 2159).

In my study, I follow this definition and consider workforce agility primarily as an observable agile performance or behaviours at work rather than the agile personality, predispositions, or attributes. For this research, the analysis of past literature provides six major insights.

First, it can be observed that several scholars point out the enabling role of *employee involvement*. Defined and understood as "the extend to which employees producing a product or offering a service have a sense of controlling their work […]" (Sumukadas & Sawhney, 2004, p. 1011), it covers a set of managerial tools. For instance *power sharing practices* include low-power practices (like suggestion systems) and high-power practices such as self-managed teams, job enrichment, and job enlargement (Sumukadas & Sawhney, 2004). The latter two, also referred to as *work redesign*, have been confirmed in a large-scale study with 344 participants (Muduli, 2016) as well as via intensive case study research conducted by Shafer, Dyer, Kilty, Amos, and Ericksen (2001) in a large healthcare organisation. In the context of self-managed teams, *independence* is a key factor, i.e. performing tasks with minimal guidance and a preference for responsibility (Doeze Jager-van Vliet, Born, & Van Der Molen, 2019). Sherehiy and Karowski (2014) describe this aspect as *job control/autonomy*, which has been the strongest predictor of workforce agility when investigating six U.S. manufacturing companies. Another essential practice is *empowerment* through decentralised decision-making, as it puts employees in charge and improves quickness and responsiveness (Qin & Nembhard, 2015). Alavi, Wahab, Muhamad, and Shirani (2014) were able to empirically link a decentralised decision-making process to greater auton-

omy and shared responsibilities at various levels in the organisation. As a result, the workforce gets motivated to proactively respond to changing circumstances instead of merely adapting. Similar findings were revealed by Breu, Hemingway, Strathern, and Bridger (2002) and Patil and Suresh (2019), both constitute the transfer of responsibility towards employees as a key enabling factor. Muduli and Pandya (2018) adopt a cognitive perspective to study the antecedents of workforce agility and confirm the enabling role of *psychological empowerment*, with meaningfulness, self-determination, and impact as the most dominant sub-factors.

Further, to foster workforce agility, intense research has been conducted on employees' working environment. Findings of Muduli (2016) confirm that workforce agility is facilitated in those organisations that promote suitable (1) internal and external team-working environment, (2) intra group team-working environment, and (3) cross-functional team-working environment. Therefore it is essential to develop cooperative relationships not only within an organisation but with customers and suppliers as well (Sherehiy & Karwowski, 2014). Put differently, cross-functional collaboration across organisational boundaries, which also includes the concept of virtual teams (Breu et al., 2002). This may help in creating a safer and more stable environment and in turn encourages working as a team. In one of the most cited conceptual studies on workforce agility, Hopp and Oyen (2004) identify *teamwork* itself as one of the three major cornerstones. Subtler concepts of teamwork comprise collaboration, authority, and communication. In addition, teamwork as a capability of an organisation's single member has also been identified as an agility enabler and is described as "the ability of an employee to work together with colleagues, share information, and stimulate group processes (Doeze Jager-van Vliet et al., 2019, p. 41). Combining the points above in the term *teamwork environment* leads to the requirement of an organisational structure that encourages autonomous action (Muduli, 2016). Such a structure should be made as flat as possible to avoid hierarchical referrals. In this way, interaction of members is encouraged and employees are motivated to share new ideas and opinions (Alavi et al., 2014).

Third, several forms of *organisational learning* and *training* have been mentioned in various pieces of research. Organisational learning can be understood as

"the method by which new knowledge is created and insights are gained through experiments of people in a firm" (Alavi et al., 2014, p. 6279). The authors cluster it in four dimensions, namely (1) commitment to learning, (2) shared vision, (3) open-mindedness, and (4) knowledge sharing. They further demonstrate that organisational learning creates a general atmosphere of knowledge, which results in facilitating the acquisition of knowledge and learning skills and, thereby, increasing strategic flexibility and the ability to adapt and to respond to changing environments. Developing an appropriate learning environment nurtures effective training, as employees tend to be more open and innovative in seeking new ideas (Muduli, 2016). Research highlights cross-training to built a broad competence set and obtain multi-skilled workers and ad-hoc/on-demand training in order to quickly recover employees' job performance (Qin & Nembhard, 2015). While the first is hardly to neglect these days and sometimes associated to job rotation (Nijssen & Paauwe, 2012), on-demand training activities gain particular importance when confronted with radical changes. Hopp and Oyen (2004) have also proved that employees' cross-training is a powerful strategy that can ensure workforce agility. Breu et al. (2002) add the finding to continuously align newly acquired skills with an evolving business direction and Shafer et al. (2001) emphasise the vigorous role of feedback when it comes to the identification of training needs. Finally, it is not only the organisation or management in charge of providing a suitable learning and training environment; employees have to be eager to learn because an active approach towards their personal development will significantly influence their agility level (Patil & Suresh, 2019).

It has also been argued that access to *consistent* and *accurate corporate information* is strongly associated with workforce agility, whereby customer information revealed the strongest correlation (Breu et al., 2002). This is supported by the findings in sub-section 3.2.1 on organisational agility that information and communication technology add value to enterprises when they make information widely and easily accessible. More recent studies make the role of enterprise social media (ESM) a subject of discussion. Pitafi et al. (2018) have surveyed more than 160 employees in Chinese organisations and shown that ESM enables knowledge share among employees, employee interaction, and contributes in es-

tablishing virtual communities within the organisation. ESM has also been proved in maximising work-related functions such as telecommunications, wikis, and knowledge maps. Thus, availability of information is enhanced and employees' abilities in handling their work will increase (Cai, Huang, Liu, & Wang, 2018).

Other studies investigate workforce agility from a behavioural driven perspective, where employee agility is understood to consist of two aspects: adaptive behaviour and proactive behaviour (Doeze Jager-van Vliet et al., 2019). Examples for proactive behaviour, such as independence or eagerness to learn, are already explained above. In terms of adaptive behaviour, strongest evidence is available in the literature for *resilience*. Resilient employees feel comfortable in handling ambiguity and have positive attitudes towards change and new ideas or technologies. Those people therefore can take calculated risks, react quickly when situations suddenly change, and deal with setbacks if things go wrong (Patil & Suresh, 2019).

Eventually, research has revealed the powerful role of *reward systems/incentive schemes*. Muduli (2016) suggests more performance-based pay such as skill-based pay systems, improvement-based incentives, or non-monetary rewards. This should be done in all varieties, i.e. individual-based, group-based, or in company-wide incentive programs. By the same token, Quin and Nembhard (2015) highlight the importance of incentives obtaining agility. Based on questionnaires with almost 60 plant managers, Sumukadas and Sawhny (2004) were able to demonstrate a direct positive relationship between team-based production incentives and workforce agility. An industry example shows how a manufacturing company was able to increase agility by paying workers according to the highest grade of task they did during a shift (Hopp & Oyen, 2004). In this way, training efficiency was increased that ended up in a multi-skilled workforce. Another case study points out the necessity of providing commensurate returns to those people exemplifying the organisation's agility attributes (Shafer et al., 2001). Especially non-monetary components like enriched assignments or enhanced opportunities for development served to reinforce employees' attitude towards contributing to the corporate strategy for agility. As a conclusion follows:

Conclusion 6: *Major workforce agility enablers constitute 1) employee involvement/empowerment, 2) teamwork environment, 3) organisational learning and training, 4) access to consistent and accurate corporate information, 5) resilience, and 6) reward systems/incentive schemes.*

The research stream itself is of a highly heterogeneous nature. Table 2.7 illustrates this phenomenon. After a period of more deductive research, recent studies have again approached the topic through an inductive lens. This reflects the perception that some concepts are somehow ill-defined and a holistic understanding of the enablers behind workforce agility is still in its infancy. As Sherehiy et al (2014) point out, little research has been done on workforce agility and even less is known about the organisation-characteristics that are conductive to the agile performance of employees.

In general can be concluded that corporate agility research is still driven by the aim to identify successful practices. To enhance the maturity of corporate agility and to move closer to theory development, a common framework with its constituting elements is needed. Such a framework can be an important step for developing testable constructs and hypothesis and thus can facilitate the transition to deductive research.

Table 2.7: Research on workforce agility

Author(s), year	Type of research	Data	Main identified workforce agility enablers
Doeze Jager-van Vliet et al. (2019)	Inductive, case study	Interviews with 42 employees working in different jobs in a Dutch non-profit service organisation	▪ Resilience: employees' ability to deal with setbacks ▪ Teamwork: ability to work together, share information, and stimulate group processes ▪ Coping with change: deal with and adapt to the implemented changes ▪ Decisiveness: willingness to find and exploit opportunities for change ▪ Eagerness to learn new skills and tasks ▪ Independence: performing tasks with minimal guidance, responsibility ▪ Courage: proactive approach towards possibilities and changes
Patil and Suresh (2019)	Inductive, econometric	Interview study with 25 employees engaged in internet of things projects in an Indian organisation	▪ Proactivity: behaviour to dynamically explore new opportunities ▪ Innovation: ability to continuously work towards gaining proficiency in multiple competency areas to deliver the forthcoming works ▪ Resilience: coming out comfortably from ambiguous situations quickly ▪ Self-motivation/ownership: need of different motivational factors like achievement, possibility of growth, recognition, and responsibility
Cai et al. (2018)	Deductive, econometric	Questionnaires with 167 employees in development, marketing, and administration in China	▪ Leverage enterprise social media (ESM) to help employees align their goals with their work experience to enhance their proactivity ▪ Building employees' confidence in their abilities by maximising work-related functions of ESM (such as telecommunication, wikis, and knowledge maps) and use of ESM to highlight specific strengths ▪ Encourage employees to use ESM for socialisation (e.g. chats and posts)

Table 2.7 (continued)

Author(s), year	Type of research	Data	Main identified workforce agility enablers
Muduli and Panya (2018)	Deductive, econometric	Questionnaires with 344 executives and non-executives from selected manufacturing and service sectors in India	▪ Psychological empowerment: increased intrinsic task motivation through impact (an individual's feeling that he or she can influence the strategic, administrative, or operating outcomes at work), self-determination (own behaviour initiated and regulated through choices rather than instigated/forced by the environment), and meaningfulness (fit between the requirement of a work goal/belief, values, and behaviour of employees)
Pitafi et al. (2018)	Deductive, econometric	Questionnaires with 161 employees in development, marketing, and administration in China	▪ Task conflict at a moderate level in order to encourage discussion and reasonable disputation on work-related tasks, which is beneficial for employees' flexible thinking and creative problem solving ▪ Enterprise social media for information exchange to enable knowledge sharing, employee interaction, and establishment of virtual communities
Muduli (2016)	Deductive, econometric	Questionnaires with 344 executives and non-executives from selected manufacturing and service sectors in India	▪ Team work environment: internal, external, intra group, and across-functional working environment with a suitable organisational structure ▪ Reward systems containing more performance-based pay ▪ Employee involvement in terms of power sharing practices (job enrichment, job enlargement, and self-managed teams) ▪ Organisational learning and training (environment, culture, and climate)
Qin and Nembhard (2015)	Inductive, conceptual	Systematic literature review on workforce agility and agility in general	▪ Staffing: selection based on attitude, motivation, personality and abilities ▪ Training (cross-/on-demand), collaboration, and related incentives ▪ Empowerment/involvement: decentralised decision-making

Table 2.7 (continued)

Author(s), year	Type of research	Data	Main identified workforce agility enablers
Alavi et al. (2014)	Deductive, econometric	Questionnaires with 161 mid-level managers from Iranian SMEs	▪ Decentralisation of decision-making as provider for greater autonomy and sharing of responsibilities at various levels of the organisation ▪ Flat structure to encourage interaction of the members due to decreased organisational hierarchy ▪ Organisational learning: shared vision, commitment to learning, open-mindedness, and knowledge sharing
Sherehiy and Karwowski (2014)	Deductive, econometric	Questionnaires with 176 employees of six small manufacturing companies based in the U.S.	▪ Job control/autonomy: the degree of freedom and independence an employee has in scheduling work and deciding how to perform it ▪ Developing cooperative relationships within an organisation, with customers, and suppliers to create a safer and more stable environment
Nijssen and Paauwe (2012)	Inductive, conceptual	Systematic literature review on organisational agility in the context of its workforce and dynamic capabilities	▪ Workforce alignment (fit): open (workforce) planning, creating a shared mindset, and employee participation ▪ Workforce fluidity (flexibility): building relations with suppliers of human resources, competence-based training, building a broad skill set (cross-training and job rotation), discretionary work design (relying on own initiative), and allowing organisational slack
Hopp and Oyen (2004)	Inductive, conceptual	Systematic literature review on an agile workforce applied to some industry examples	▪ Cross-training of employees: skill type, entity (output that the system produces), and resource (e.g. machine) ▪ Efficient worker coordination policy: switching and multi-tasking ▪ Team structure: collaboration, authority, communication, and incentives

Table 2.7 (continued)

Author(s), year	Type of research	Data	Main identified workforce agility enablers
Sumukadas and Sawhney (2004)	Deductive, econometric	Questionnaires with 58 plant managers across the manufacturing industry in Canada	▪ Power sharing: low-power practices (e.g. suggestion systems) and high-power practices such as job enrichment, job enlargement, and self-managed teams ▪ Team-based production incentives based on higher production output
Breu et al. (2002)	Deductive, econometric	Surveys with 515 senior-level managers from U.K.-based private and public sector organisations	▪ Collective environmental responsiveness: read and interpret external change, adjust objectives accordingly, and act speedily ▪ Continuous acquisition of skills and alignment with business direction ▪ Cross-functional collaboration across organisational boundaries ▪ Virtual teams within an organisation and across organisations ▪ Internal environment that capitalises on employee empowerment and rewards local decision-making ▪ Access to consistent and accurate corporate information resources, in particular customer information
Shafer et al. (2001)	Inductive, case study	Semi-structured interviews with 19 key informants at Albert Einstein Healthcare Network	▪ Achieving contextual clarity regarding the organisation's vision, its progress (or lack thereof) toward achieving the vision, and the links between individual and collective actions and enterprise performance ▪ Embedding core values trough communication, executive team building, breakthrough objectives, and revamped human resource policies ▪ Enriching work: flexible and blended assignments, redesign experiments ▪ Promoting personal growth: feedback, training, on the fly development ▪ Providing commensurate returns containing non-monetary components

2.4 Management Theories

As human beings, and in particular as scholars, theories influence all aspects of our everyday lives and help us to describe and understand what is going on around us. John McAuley, Joanne Duberly, and Phil Johnson define theories as:

> "[…] linguistic, conceptual devices that try to tell us things about the world by representing it in a causal manner" (McAuley, Duberley, & Johnson, 2007, p. 16).

The authors carry on that theories define, classify, or categorise aspects of the world, i.e. the *what* of scientific research. Further, they propose reasons in the form of cause-and-effect relationships – the *why* and the *how*. Eventually, theories provide guidance about the situation(s) or contexts *when* these causal relationships will or will not appear, thus setting the boundary conditions to *where* they are applicable. Put differently, such theoretical frames help guide and position the research. For this study, the underlying management theories are (1) the adaptive and flexible organisation, (2) organisational leanness, and (3) the dynamic view of organisations.

2.4.1 Adaptive and Flexible Organisation

The idea of *organisational adaptability* has emerged from the *contingency theory* of organisations, which is a subset of the contingency approach in science. The contingency approach says that the relationship between two variables is moderated by a third variable; thus the effect of X on Y depends upon Z. Applied to an organisational context, contingency theory states that there is not one best way of managing or organising a company, but that maximum organisational performance results from properly adapting to fit its contingency (Donaldson, 2001). A contingency is seen as:

> "[…] any variable that moderates the effect of an organisational characteristic on organisational performance" (Donaldson, 2001, p. 7).

The contingency theory has been guided by the primary assumption of Woodward (1958). In an early attempt in Britain to discover the correlation between management theory and business practice, a research group around her revealed that a firm's operations technologies in place have significant impact on its *organisational structure* and *human resource management*. With this insight they ques-

tioned the widely accepted assumption at that time that if given a prescribed goal, there is one best way to organise a firm. Their understanding of organisational structure is well described by John Child, who defines it as:

> "[…] the formal allocation of work roles and the administrative mechanisms to control and integrate work activities including those which cross formal organisational boundaries" (Child, 1972, p. 2).

This initial Woodward-work triggered a group of organisation theorists under the leadership of Derek S. Pugh during the 1970s, mainly based at the University of Aston, thus referred to as the *Aston Group* (McAuley et al., 2007). They pursued the objective to further explore the relationship between an organisation's structure and its context. The researchers defined *origin* and *history*, *ownership* and *control*, *size*, *charter*, *technology*, *location*, and *interdependence* as the contingency factors and concluded that "context is a determining factor – perhaps overall the determining factor – designing, shaping, and modifying the structure of any organisation" (Pugh, 1973, p. 28). Other scholars focused on the uncertain nature of external sources and considered only *environmental conditions* and *technology* as the main critical constraints upon the choice of effective organisational structure (Child, 1972; Pennings, 1975). In this light, some authors classify organisational adaptability as possessing a reactive character (Felipe et al., 2016).

While the contingency framework became more popular in the field of organisation theory, also some critical voices were raised to draw attention to the possible shortcomings of this approach. First it was Child (1972) and shortly afterwards Schreyögg (1980) who criticised (Child) and even rejected (Schreyögg) the contingency paradigm due to its economic determinism, i.e. the conceptualisation of organisations as fully dependent on contingency factors and not acting upon it. Both point to the fact that organisational decisions are not entirely determined by context and that the important role of decision-makers needs to be taken into account. They argue that also management influences an organisation by making strategic choices independent from environmental circumstances. However, today the contingency theory is one of the most prominent theoretical lenses used to view organisations whose applicability goes wide beyond the scope of the organi-

sation itself; e.g. contingency theories of leadership, human resource management, and strategic decision-making (processes) (Donaldson, 2001).

For research on corporate agility in this study, the contingency theory can be applied to investigate the relationship between contextual factors of the automotive supplier industry and the enablers for each of the six agility dimensions introduced in the section before. This leads to the following conclusion:

Conclusion 7: *The main identified agility enablers and their effectiveness depend on contextual factors.*

In the 1970s, the concept of *organisational flexibility* emerged as a more proactive approach how to cope with constantly changing environments and to generate variability in outputs (Baker, 1996; Felipe et al., 2016). At that time, firms in general developed a growing interest in flexibility because the growth of global markets also increased unpredictability, mass markets got more and more saturated, and customers gave greater emphasis on quality and customised products; altogether imposing a greater need of organisational capacity to respond to change and employees' ability to perform a variety of jobs (Reed & Blunsdon, 1998). Conceptually developed in the manufacturing research literature, early works focused on the antecedents, different types, and the key dimensions of flexibility (Bernardes & Hanna, 2009). In relation to its dimensions, Slack (1983) points out (1) a manufacturing system's *range* of feasible change, (2) the *cost* of adopting another state, and (3) the *time* necessary for change. The literature on flexibility reveals that the concept has continuously broadened its scope along the dimensions of an organisation. As one of the first scholars demonstrating a general understanding of flexibility, Zhang, Vonderembse & Lim (2003) consider *value chain flexibility* as an overarching construct, including product development flexibility, manufacturing flexibility, logistics flexibility, and spanning flexibility. The relevant definitions are summarised in table 2.8 on the next page:

Table 2.8: Types of flexibility and its definitions (Zhang et al., 2003, p. 175)

Flexibility	Definition
Value chain flexibility	It enables firms to introduce new products quickly, support rapid product customisation, shorten manufacturing lead times and costs for customised products, improve supplier performance, reduce inventory levels, and deliver products in a timely manner.
Product development flexibility	It enables firms to respond with product modifications and new product commercialisation. Such flexible design and development capabilities can increase manufacturability by simplifying product structure and standardising component parts.
Manufacturing flexibility	It enables firms to produce the needed quantity of high-quality products quickly and efficiently through set-up time reduction, cellular manufacturing layouts, preventive maintenance, quality improvement efforts, and dependable suppliers.
Logistics flexibility	It enables the smooth flow of materials, which facilitates the production and deliveries of high-quality, value-added products. Flexibility in physical supply, purchasing, physical distribution, and demand management are key components of logistics flexibility.
Spanning flexibility	It ensures that different departments or groups (inside and outside of the organisation) can coordinate product design, production, and delivery in ways that add value to customers.

Other definitions of flexibility are less differentiated and a comprehensive overview from the operations management literature can be found in the work of Bernardes and Hanna (2009, p. 34). On a more aggregated and enterprise level, Reed and Blunsdon (1998) consider the concept of flexibility in terms of *flexible organisations*. They define organisational flexibility as:

> "[…] the organisation's ability to adjust its internal structures and processes in response to changes in the environment" (Reed & Blunsdon, 1998, p. 457).

The most commonly used taxonomy of organisational flexibility distinguishes *numerical* and *functional* flexibility (Dastmalchian & Blyton, 1998). The former relates to reducing costs by adjusting the number of employees and working hours according to variations in demand and output (Kalleberg, 2001). "This type of flexibility is achieved by employing part-time, temporary, short-term contracts or by altering distribution of the working time" (Sherehiy et al., 2007, p. 447). Functional flexibility responds to the need of enhancing employees' ability, thus

providing them with skills and decision-making responsibility to undertake a wider range of tasks. In other words, replacing *Taylorist* or *Fordists* forms of production by a new paradigm of work organisation characterised by employee empowerment, teamwork, and commitment to the organisation (Kalleberg, 2001).

The reviewed research concerning flexibility suggests that the concept seems to be more an enabler for providing superior customer value instead of a realised ability, thus providing an *ex ante* capability to generate variety if the need arises. Put differently, the flexibility of an organisation may exist without being performed (Bernardes & Hanna, 2009). This concurs with Nigel Slack's seminal finding about flexibility as a measure of a system's potential behaviour, "it does not have to be demonstrated for it to be real" (Slack, 1983, p. 12).

In a nutshell, the approach of the flexible firm has been constantly refined and developed over the past 50 years and belongs to the oldest and most extensive underlying concepts of agility. Hence:

Conclusion 8: *A mutual exclusion between flexibility and agility is not possible given their intrinsic interconnections. For this research, flexibility is understood as a planned response to anticipated contingencies whereas agility involves reconfiguration to proactively capture emerging opportunities and to address unanticipated issues.*

2.4.2 Leanness

Most literature traces lean thinking back to the *Toyota Production System* in the 1950s (Ohno, 1988). The Japanese recognised the many buffers inherent to the mass production systems of the large American car manufacturers and set out to change the rules of the game. Toyota started employing teams of multi-skilled workers and used highly flexible, increasingly automated production equipment to banish waste (excess inventory or excess capacity), root out defects, and reduce lead times (Jayaram, Das, & Nicolae, 2010). Since manuals and subsequent literature were all written in Japanese in these early days of lean production, it took almost 40 years until the principles of this new manufacturing paradigm were revealed. The probably biggest contribution delivered a five-year study of the automotive industry from the Massachusetts Institute of Technology (MIT) that identi-

fied the lean approach as attribute to huge productivity differences between the United States and Japan (Womack, Jones, & Roos, 1990).

Although the concept of lean production initially suggests a maximum utilisation of resources in the production system, its basic principles for waste elimination can be applied to all levels of the organisation. Rachna Shah and Peter T. Ward capture the many facets of lean production in their definition:

> ”Lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimising supplier, customer, and internal variability“ (Shah & Ward, 2007, p. 791).

Also Shah and Ward (2007) apply lean production beyond the manufacturing division of a firm and provide an extensive proposal of the factors underlying lean production. They define ten operational constructs related to suppliers, customers, or internally to the firm as depicted in table 2.9:

Table 2.9: Dimensions of lean production (Shah & Ward, 2007, p. 799)

Dimension	Description
Supplier feedback	Provide regular feedback to suppliers about their performance
Just-in-time (JIT) delivery by suppliers	Ensures that suppliers deliver the right quantity at the right time in the right place
Supplier development	Develop suppliers so they can be more involved in the production process of the focal firm
Customer involvement	Focus on a firm’s customers and their needs
Pull	Facilitate JIT production including kanban cards, which serves as a signal to start or stop production
Continuous flow	Establish mechanisms that enable and ease the continuous flow of products
Set up time reduction	Reduce process downtime between product changeovers
Total productive/preventive maintenance	Address equipment downtime through total productive maintenance and thus achieve a high level of equipment availability
Statistical process control	Ensures that each process will supply defect-free units to subsequent process
Employee involvement	Employees’ role in problem solving and their cross-functional character

Other authors, like Warnecke and Hueser (1995) keep it more comprehensive and identify four dimensions: 1) product development, 2) supply chain, 3) shop floor management, and 4) after sales service.

Conboy (2009) extensively reviews the evolution of lean thinking and points to an important aspect of the concept, namely *value*. Until the mid-1990s, eliminating waste or rather reducing costs was seen as being equal to creating value. From then on, this view changed in the new perspective of lean thinking, which added *increasing customer value* as the main objective of the lean philosophy. From this value stream thinking, *order fulfilment* and *new business development* became the key business processes. This is reflected by the following definition of leanness:

> "[…] contribution to perceived customer value through economy, quality, and simplicity" (Conboy, 2009, p. 339).

To form a continuous value stream in the context of lean thinking, all parties involved have to equally apply lean techniques. Since the value chain is usually integrated vertically, also other companies are involved. If they all together strive for exploiting their competitive advantage through collectively committing to lean principles, the performance of the whole can be increased tremendously. This organisational model is coined as the *lean enterprise* (Womack & Jones, 1994). Put simply, lean thinking is mainly concerned with reducing waste, enhancing information sharing, and encourages standardisation of work and continuous improvement. In comparison and comprehensively summarised, the agility paradigm attempts to combine this efficiency of lean manufacturing with the operational flexibility of the flexible model (see sub-section 2.3.4), hence it positions itself between the totality of lean thinking and the flexible organisation with the intend to deliver customised solutions at the expense of mass production. In other words, the cornerstones of the lean enterprise need to be understood in order to develop and implement an efficient agility strategy. Thus, it can be concluded:

Conclusion 9: *For a firm to achieve its long-term agility strategies for matching market changes, it needs to be aware of the principles of the lean enterprise. Therefore, leanness can be considered as an antecedent to agility.*

2.4.3 Dynamic View of Organisations

The basic assumption of the dynamic view is that a major source for firms to obtain sustained competitive advantage is constantly adapting to their environment (Barney, 1991). David J. Teece extends this viewpoint: "They not only adapt to business ecosystems, but also shape them through innovation and through collaboration with other enterprises, entities, and institutions" (Teece, 2009, p. 4). Two underlying management theories build the major constituents of this perspective, the *resource-based view* and the *dynamic capabilities* framework.

2.4.3.1 Resource-Based View

From the *resource-based perspectiv*e, firms can be conceptualised as a broader set of resources; these (tangible or intangible) resources are heterogeneously distributed across firms and those differences persist over time (Barney, 1991; Wernerfelt, 1984). In this light, firm resources are defined as:

> "[…] those attributes of a firm's physical, human, and organisational capital that do enable a firm to conceive of and implement strategies that improve its efficiency and effectiveness" (Barney, 1991, p. 102).

All resources are path-dependent, insofar as the resources a firm possesses today depend upon the decision about resources made in the past (Wernerfelt, 1984). Certain (strategic) resources determine the ability of a company to achieve a *sustainable competitive advantage* by implementing a value creating strategy that cannot be easily duplicated by competitors. In order to classify a resource as a capability enabling a firm's sustained competitive advantage, it should fulfil four characteristics: (1) *valuable*, i.e. act as enabler to implement strategies that improve a firm's efficiency and effectiveness, (2) *rare*, thus not possessed by a large number of rivals, (3) *inimitable*, therefore not obtainable by firms that don't have it, and (4) *non-substitutable*, i.e. absence of a strategically equivalent valuable resource (Barney, 1991; Day, 1994; Eisenhardt & Martin, 2000). Examples for such resources are strategic planning, information processing systems, and positive reputations of firms amongst customers (Barney, 1991). However, it is not simply the possession of resources that will generate rents – it is the firm's knowledge-based resources that have to organise the other resources or a combination of them to create value (Teece et al., 1997).

The intellectual roots of the resource-based view can be found in Edith Penrose's seminal work about the nature of the firm. She was ahead of her time by defining an enterprise by its resources instead of its current products, thus implicitly avoiding market share as a measure for a firm's competitive position:

> "[…] a firm is essentially a pool of resources the utilisation of which is organised in an administrative framework. In a sense, the final products being produced by a firm at any given time merely represent one of several ways in which the firm could be using its resources, an incident in the development of its basic potentialities" (Penrose, 1959, p. 149 et seq.).

In other words, the resource-based view focuses on the internal organisation of firms, thus emphasising the entrepreneurial capabilities of management. Put simply, the limit to which an enterprise could grow is set by the capacity of management – not by obtaining the maximum output from economies of scale (Teece, 2007). To summarise, the resource-based theory of the firm complements the traditional perspective of determinants for competitive advantage, namely a firm's strategic positioning within its industry structure, and provides an effective framework for understanding how companies compete successfully against rivals and how that advantage might be sustained over time (Eisenhardt & Martin, 2000).

In this research, I have conceptualised corporate agility consisting of a first-order capability (organisational agility) with a set of second-order capabilities (customer agility, partnering agility, manufacturing agility, product development agility, and workforce agility). Corporate agility enables firms to sense environmental changes and respond quickly ahead of competitors. This would qualify corporate agility as being valuable. Further, due to the identified research needs and lack of best practices, the application of holistic agility approaches seems to be rare. The variety of enablers for each of the agility dimensions entails a careful examination for implementing them in different corporate contexts. Thus, it could be argued that corporate agility is inimitable to a certain extend. Finally, the criterion of non-substitutability is also supported by the scholarly and managerial debate in this field, which echoes missing alternatives to cope with discontinuous change. Hence:

Conclusion 10: *Corporate agility can be regarded as a strategic resource that determines the ability to achieve a sustainable competitive advantage.*

2.4.3.2 Dynamic Capabilities

Building in particular upon the theoretical foundations of the *theory of economic development* (Schumpeter, 1934), the *evolutionary theory of economic change* (Nelson & Winter, 1982), and the *knowledge-based view* (Kogut & Zander, 1992), Teece et al. (1997) argument that the mere possession of heterogeneous resources is not enough for a firm to survive and prosper in a competitive environment – rather, the success of the business enterprise lies in the development, configuration, and exploitation of those resources. Further, they point to the lack of the resource-based view to explain how to achieve a competitive advantage in dynamic markets, i.e. situations of rapid and unpredictable change. Based on this criticism they extend the resource-based view and provide the concept of *dynamic capabilities*, which they define as:

> "The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516).

Put differently, they point out the organisational and managerial competencies as an enabling device for both sensing and shaping the environment by adjusting or renewing a firm's business model to meat changing requirements, i.e. they define the concept in terms of *latent action* (Di Stefano, Peteraf, & Verona, 2014). Eisenhardt and Martin (2000) extend the understanding of dynamic capabilities by integrating organisational processes, routines, or patterns as a firm's means to reconfigure its resource base. With regard to the constituent elements of dynamic capabilities (Di Stefano et al., 2014), the concept is defined as:

> "The firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organisational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die" (Eisenhardt & Martin, 2000, p. 1107).

The authors of both definitions stress the importance of difficult-to-replicate enterprise capabilities, the combination or renewal of resources into new competencies, and its firm-specific development over time rather than its ready-for-use

availability in the market. Dynamic capabilities can be thought of falling into three categories: (1) the capacity to *sense* market and technological opportunities (and threats) by for instance investing in research and development (R&D) or understanding and interpreting latent customer demand, (2) mobilisation of resources to address favourable circumstances for innovation or competitive action, i.e. *seizing* the opportunity, and (3) the ability to continuously recombine and reconfigure the firm's intangible and tangible assets and organisational structures (Teece, 2007). The latter relates to the capacity to *transform* in order to maintain competiveness (Teece et al., 2016). Often, this cluster of sensing, seizing, and transforming is referred to as the *nature* of dynamic capabilities with the entrepreneurial function of the manager at its heart (Helfat et al., 2007; Teece, 2009). Managerial activity in dynamic markets requires "orchestrating complementary and co-specialised assets, inventing and implementing new business models, and making astute investment choices" (Teece, 2009, p. 74) and thus determines how the firm builds, shapes, and deploys capabilities.

For a better understanding of the dynamic capabilities framework, Winter (2003) points out the distinction between *dynamic* and *ordinary* (or operational) capabilities by arguing that the latter are extended, modified or created by dynamic capabilities. With that in mind, he defines ordinary capabilities as:

> "[…] those that permit a firm to make a living in the short term" (Winter, 2003, p. 991).

In other words, firms need ordinary capabilities to produce and sell a defined set of products; hence those capabilities are static in nature. Furthermore, it is not necessary to possess that kind of capabilities, rather it is an organisation's access what counts, for instance via outsourcing. In the end, they won't enable a firm to grow but have a crucial role to maintain the *technical fitness* of the business enterprise (Teece et al., 2016).

In the context of dynamic capabilities, the link to an organisation's *absorptive capacity* needs to be explained. In order to build dynamic capabilities, a firm must have absorptive capacity in place (Ashrafi et al., 2005). The concept of absorptive capacity was presented for the first time by Cohen and Levinthal (1990) and soon got the attention of the research community. The basic idea is that "prior related knowledge confers an ability to recognise the value of new information, assimi-

late it, and apply it to commercial ends" (Cohen & Levinthal, 1990, p. 128). Motivated by the multidimensionality of the absorptive capacity construct, Zahra and George (2002) conceptualised the various dimensions and linked it exclusively to the dynamic capabilities framework. They define absorptive capacity as:

> "[…] a set of organisational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organisational capability" (Zahra & George, 2002, p. 186).

The four dimensions in their definition are combined in two components comprising absorptive capacity: knowledge acquisition and assimilation are categorised as *potential capacity*, transformation and exploitation form the *realised capacity* (Zahra & George, 2002). Together they create "the maximum value of scientific or technological knowledge that a firm can incorporate into its business processes and as the ability of the firm to use this knowledge to exploit the technological and commercial potential of untapped knowledge in a particular domain" (Ashrafi et al., 2005, p. 3).

Returning to the two initial definitions of dynamic capabilities of Teece et al. (1997) and Eisenhardt and Martin (2000), a recent discussion among scholars points to the contradictions of the two portrayals with the "differences being starkest and most divergent in high-velocity environments" (Di Stefano et al., 2014, p. 317). While Teece et al. (2007) provide the dynamic capabilities framework in terms of learned organisational skills as lever to address highly dynamic markets, Kathleen M. Eisenhardt and Jeffrey A. Martin reject that view to some extend by arguing that "in high-velocity markets where industry structure is blurring, dynamic capabilities […] are simple, experimental, unstable processes that rely on quickly created new knowledge and iterative execution to produce adaptive, but unpredictable outcomes" (Eisenhardt & Martin, 2000, p. 1106). However, Ringov (2017) concludes in a recent empirical investigation that the conflicting claims mentioned above are contingent on key differences in factors internal to the firm (specifically on heterogeneity in firm's dynamism exposure and asset base complexity). His findings suggest and support that codified dynamic capabilities (according to David J. Teece and colleagues) can improve business performance even in markets characterised by discontinuous change. This scholarly

debate shows that the topic is still an active research area in the field of strategic management. Even David J. Teece as one of the founders of this concept recently provided a slightly adapted definition of dynamic capabilities:

> "Dynamic capabilities define the firm's capacity to innovate, adapt to change, and create change that is favourable to customers and unfavourable to competitors" (Teece et al., 2016).

Effective dynamic capabilities thus enable firms to achieve new and innovative business models to stay ahead of competitors and maintain a competitive advantage. Within this context, business models are understood as "the manner in which a business enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit" (Teece, 2009, p. 159).

At the heart of agility lies a firm's capacity to react quickly to rapidly changing circumstances. This takes place as a kind of resource configuration on different levels of an enterprise's value chain, or in other words, within each of the single agility dimensions. Hence, a final conclusion can be drawn:

Conclusion 11: *Corporate agility qualifies as a dynamic capability of an organisation to efficiently and effectively reconfigure its resources to value creating and value protecting activities.*

2.5 Summary of the Literature Review and Outlook

It is crucial for a developing research field to reach consensus on the core theoretical elements, such as definitions of terms and core relationships between variables. From past literature, a conceptual model and eleven major conclusions have been drawn (see table 2.10):

Table 2.10: Overview of theoretical conclusions from the literature review

Research stream	Theoretical conclusion for research on corporate agility
Agility dimension	*Main enablers*
Organisational agility (#1)	(1) organisational structures and power distribution, (2) culture, (3) absorptive capacity, (4) information and communication technology, (5) strategic foresight, (6) robust strategy, and (7) stakeholder buy-in
Customer agility (#2)	(1) customer-sensing capability, (2) customer-responding capability, and (3) the risk propensity of senior management

Table 2.10 (continued)

Research stream	Theoretical conclusion for research on corporate agility
Agility dimension	*Main enablers*
Partnering agility (#3)	(1) network integration, (2) ICT integration, (3) collaborative relationship, (4) market sensitivity, (5) flexibility, (6) top management commitment, and (7) supplier innovativeness
Manufacturing agility (#4)	(1) employee empowerment, 2) manufacturing system flexibility, 3) advanced manufacturing technologies, 4) product modularity, 5) concurrent paradigm, and 6) knowledge management and learning
Product development agility (#5)	(1) time-boxed sprints with defined deliverables and customer involvement, 2) dynamic and visualised tools, 3) small, dedicated, and co-located teams, 4) less formalised processes that empower decision-making, 5) adoption of flexible design technologies together with rapid prototyping, and 6) collaboration in product development networks
Workforce agility (#6)	(1) employee involvement/empowerment, 2) teamwork environment, 3) organisational learning and training, 4) access to consistent and accurate corporate information, 5) resilience, and 6) reward systems/incentive schemes
Management theories	
Contingency theory (#7)	The main identified agility enablers and their effectiveness depend on contextual factors.
Organisational flexibility (#8)	A mutual exclusion between flexibility and agility is not possible given their intrinsic interconnections. For this research, flexibility is understood as a planned response to anticipated contingencies whereas agility involves reconfiguration to proactively capture emerging opportunities and to address unanticipated issues.
Leanness (#9)	For a firm to achieve its long-term agility strategies for matching market changes, it needs to be aware of lean enterprise principles. Therefore, leanness can be considered as an antecedent to agility.
Resource-based view (#10)	Corporate agility can be regarded as a strategic resource that determines the ability to achieve a sustainable competitive advantage.
Dynamic capabilities (#11)	Corporate agility qualifies as a dynamic capability of an organisation to efficiently and effectively reconfigure its resources to value creating and value protecting activities.

These conclusions will be used to built upon the conceptual model and define a maturity model for corporate agility. The main motivation is a missing framework of agility in a corporate context that provides guidance for firms operating in the automotive supplier industry. The guiding role of such a framework becomes especially valuable when providing applicable sub-constructs, which give managers an indication about the current agility level and show necessary steps to increase this level. This study has the intention to close that gap.

The next chapter will present the methodological considerations to answer the research question presented in chapter one. A qualitative-subjective approach is taken to this research. Data has been generated with semi-structured in-depth interviews in a multinational corporation and triangulated with supporting documents. Depth and detail in this DBA thesis have been considered more important than generalisation of results.

CHAPTER THREE

Methodology

> In a field that seeks to understand the real world, it makes little sense to always put theory before facts. (Helfat, 2016, p. 185)

3.1 Introduction

The last chapter has outlined the literature pertinent to this study as well as underlying management theories. These will guide the researcher's perspective through which the phenomenon of corporate agility is explored. Chapter three is dedicated to the design of the study and establishes the base for my dominant research paradigm. It proposes suitable research methods to answer the research questions presented in chapter one:

RQ1: How is agility constituted in a corporate context?
RQ2: What are the main enablers for the key elements?
RQ3: What are the maturity levels within these enablers?

First, main scientific research paradigms are generically introduced and discussed. This gives the reader a broad overview of the philosophical landscape in science. Moreover, discussing these knowledge claims seems to be crucial in order to understand the variety of possible perspectives. The sub-section afterwards builds on this discourse and justifies a *pragmatist perspective* as the philosophical stance that has been adopted to carry out this research. Next, an appropriate research design is described by analysing the nature of the research questions in more depth and by outlining the research strategy pertinent to this study. The section afterwards highlights the research execution, which comprises clarifications of the (1) case selection and informants, (2) data collection instruments, (3) research sequence, and (4) data analysis procedure. Next, four major quality criteria are used to judge the quality of both the research design and its execution, fol-

lowed by the tactics employed in this research. The chapter ends with the ethical considerations specified by Sheffield Hallam University.

3.2 Research Paradigm

"It is important to realise, that any scientific endeavour is underpinned by philosophical assumptions about ontology and epistemology" (McAuley et al., 2007, p. 31). In other words, researchers position themselves about how the world is (ontological stance), how they can come to know it (epistemological stance), and how it can be investigated (methodological considerations). In order to make these assumptions, several *scientific paradigms* are available and provide guidance. Following the description of the American philosopher Thomas Kuhn, paradigms "[…] structure knowledge and practice by producing rules that put boundaries around what can be articulated" (McAuley et al., 2007, p. 284). He claimed that science guided by a certain paradigm would be incommensurable with science developed under a different one; in other words, that there is no common measure to assess the different scientific theories. His thesis gains particular relevance in social discourses where the researcher has to adopt a position whether human beings can be dealt with in the same way as natural scientists deal with the world of science, or that human beings are essentially different from natural objects as they give meaning and have consciousness.

It follows that social researchers agree not with all parts of one paradigm and also the wording for this kind of basic set of beliefs differs. Creswell (2009) refers to *worldviews* and discusses *postpositivism*, *constructivism*, *advocacy/ participatory*, and *pragmatism*. Johnson and Duberley (2000) adopt a perspective related to management research and propose *positivism*, *relativism*, *critical science*, and *pragmatic-critical realism*. McAuley et al. (2007) consider it in the context of organisation theory and outline five paradigms/theories, namely *modernism*, *neo-modernism*, *postmodernism*, *reflective organisation theory*, and *critical*, *psychoanalytic* and *feminist theories*.

Given its social nature, a certain dynamic in the paradigms itself could be reasonable. However, this discourse would exceed the scope of that study, although it is important to emphasise the mutability in philosophies in business and manage-

ment. Due to the link towards management research, I will stick to the main scientific paradigms according to Johnson and Duberley (2000), which will be reviewed in more detail on the following pages.

3.2.1 Positivist Social Science

Early positivist approaches can be found in the schools of thought of René Descartes (*rationalism*) and John Locke (*empiricism*) with the basic assumptions that there must exist an external world cognitively accessible to human thought and valid knowledge can only be generated by surviving the test of experience (Johnson & Duberley, 2000). More than 50 years later in mid of the nineteenth century, Auguste Compte coined the term *positivism* by expressing that "[…] science could only progress by ridding itself of (e.g. religious) dogma through the examination of the positively given: those empirical data or objectivist facts which were cognitively accessible through sensory perception" (Gill & Johnson, 2010, p. 193). A group of socialists based in Vienna during the 1920s and 1930s – dubbed the *Vienna Circle* – is often associated with *logical positivism*: the stance that any observer can stand back at a neutral point and observe the external world objectively (Johnson & Duberley, 2000). Later, one of the leading twentieth century philosophers of science, Karl Popper, criticised earlier positivist approaches and replaced inductive and verification principles with those of deduction and falsification (McAuley et al., 2007). Guided by the belief that we can never know anything for sure, he claimed that "science can in principle falsify any knowledge by confronting it with empirical data but it can never prove a knowledge claim" (Johnson & Duberley, 2000, p. 28).

The positivist vision in social research follows an epistemological stance that an external reality can be investigated without being influenced (by the observer) by *objectively* testing theory through gathering data (McAuley et al., 2007). Depending on the correspondence of the theoretical propositions with the researcher's observations, truthfulness is established; thus a *correspondence theory of truth* is applied (Gill & Johnson, 2010). Positivist approaches towards management research are generally associated with a *quantitative-deductive* methodological concept. Data is usually collected from large-scale studies and tested by means of statistical methods (Johnson & Duberley, 2000).

3.2.2 Relativism

As illustrated in the sub-section above, the different positions in positivism are united by the epistemological stance that warranted truth about the world emanates from the researcher's ability to objectively and directly access data. As one of the foundation figures of modern sociology, Max Weber criticised certain aspects of these positivism's epistemological commitments. Known as *interpretive social science*, he advocated an approach in which the sociologist tries to understand the reality that surrounds our lives (McAuley et al., 2007). In this sense, the researcher would consider the phenomenon of interest as a unique case due to the different meaning people give to it. Seeking to identify the causes of this uniqueness in turn is guided by the scientist's beliefs and feelings about the world and how it should be understood and studied (Gill & Johnson, 2010).

Another alternative to positivists' theory-neutral observational language is a *conventionalist* school of thought. It is characterised by "replacing positivism's passive conception of the scientist's apprehension of reality with that of the scientist as an active social agent conducting a value-laden enterprise in a particular historical context" (Johnson & Duberley, 2000, p. 62). Put differently, scientific statements are not considered as true or false descriptions of an external social and natural reality, but rather as the researcher's creations, which are taken to be true. In consequence, research remains a philosophically contested terrain, as reality is merely a variable human artefact (Gill & Johnson, 2010).

Related to the approaches above, *postmodernism* favours a variety of perspectives that emphasise ambivalence. "Postmodernists are interested in the constructed nature of people and reality, emphasise language as a system of distinctions that are central to the construction process, and argue against grand narratives and large-scale theoretical systems […]" (McAuley et al., 2007, p. 261). The term originally referred to a new architectural design in the late twentieth century rather than a school of thought. Characterised by randomness, anarchy, and fragmentation, it spread into art, film, literature, and philosophy (Johnson & Duberley, 2000). Thus, the postmodern researcher assumes that the reality we experience is itself created and determined by our acts of cognition (Gill & Johnson, 2010).

As reality is no longer neutrally accessible, truth is not determinable by comparison to indisputable facts (like in positivism). From a relativist's stance, truthfulness is attached to a set of *subjective* beliefs that were able to prevail in a certain social context. In other words, theory is proven to be true according its *consensus* to a socially established thinking between those who share a particular paradigm (Johnson & Duberley, 2000). Postmodernists sometimes even subordinate such a striving for agreement and prefer a relativistic totality. As a consequence, a *qualitative-inductive* methodology is applied where the researcher for instance spends longer periods in the field to collect data based on observation of everyday activities (Gill & Johnson, 2010).

3.2.3 Critical Social Science

The underlying school of thought of critical science is *critical theory*. Initiated by three leading theorists (Max Horkheimer, Theodor Adorno, and Herbert Marcuse) of the so-called *Frankfort School* and significantly influenced by the works of Juergen Habermas, the main critics of interpretative social science towards positivism are supported. "Critical theory focuses upon the inherent connection between politics, values and knowledge and, thereby, provokes a deeper consideration of the politics and values which underpin and legitimise the authority of scientific knowledge" (Johnson & Duberley, 2000, p. 115). Critical theorists question a value-free nature of science and point out that claims to truth are always discursively situated and implicated in relations of power (McAuley et al., 2007). On the other side, they attempt to avoid a too strong relativistic stance and argue that there are only view correct perspectives (Johnson & Duberley, 2000).

In this sense, critical theorists deploy a *consensus theory of truth* to legitimate knowledge about core aspects of society and organisations. Hereby it is the aim of critical theory to empower and emancipate disadvantaged people in organisations or the wider society (Gill & Johnson, 2010). Critical theorists usually undertake research of *qualitative* nature by e.g. applying *critical ethnography* where it is essential that both the researcher and the researched keep reflexively aware of their own presuppositions and values (Johnson & Duberley, 2000). Put simply, critical theory attempts to occupy some intellectual space between the foundational-absolute stance of positivism and the interpretative approach of relativism.

3.2.4 Pragmatic-Critical Realism

The worldview of pragmatic-critical realism comprises two schools of thought: *realism* and *pragmatism*. Realists are united by the belief that the structures of the world are independent of the structures of human investigators; put differently, they reject the notion that the world is created by the minds of human observers (Johnson & Duberley, 2000). There are multiple types of realism at a philosophical level. A central stance in organisational science is the one of *critical realism* (significantly developed by the works of Roy Bhaskar) as it emphasises the active role of the human agent in its interaction with an independent external reality in an organisational context (McAuley et al., 2007). Such independent entities may not be observable and thus, any social phenomena has to be critically evaluated because "[…] people may apprehend different (i.e. transitive) realities according to the varying paradigmatic, metaphorical or discursive conventions deployed through their human agency" (Johnson & Duberley, 2000, p. 154).

The other position in this domain, pragmatism, does not commit to any one system of philosophy and reality, and in consequence, pragmatists do not see the world as an absolute unity (Creswell, 2009). Influential writers included Charles Sanders Peirce, William James, Ferdinand Canning Scott Schiller, John Dewey, and more recently Andrew Sayer – jointly advocating the view that the ultimate goal of scientific inquiry may be a *transformed situation* rather than some correspondence with an inaccessible reality (Johnson & Duberley, 2000).

Pragmatic-critical realists evaluate the truthfulness of knowledge in the context of how successfully it may guide action towards the realisation of particular objects that express particular interests; in other words, what it does for, and to various groups of human actors (Gill & Johnson, 2010). They are not committed to methodological homogeneity, rather a mixed-methods approach of techniques and procedures is chosen, which best fits their needs and purposes (Creswell, 2009). A commonly used technique is *action research*, where data about an on-going system is collected and interpreted, fed-back into the system, and analysed further by e.g. altering another variables (Gill & Johnson, 2010). "In sum, this pragmatic-critical realist position asserts that there is a transcendental reality beyond our discursive productions. So while the truth may well be out there we may never

know it in an absolute sense because we lack the necessary cognitive and linguistic means of apprehending it“ (Johnson & Duberley, 2000, p. 162).

3.2.5 Paradigm Discussion

In order to comprehensively contrast the different philosophical approaches, the following figure summarises the discussion from the sub-sections before:

Figure 3.1: Research paradigms and methodological implications

Paradigm	School of thought	Epistemological stance	Theory of truth	Methodology
Positivist social science	Rationalism	Objectivist-realist	Correspondence	Quantitative-deductive
	Empiricism			
	Positivism			
	Logical positivism			
	Post-positivism			
Relativism	Interpretivism	Subjectivist-interpretative	Consensus	Qualitative-inductive
	Conventionalism			
	Postmodernism			
Critical social science	Critical theory			
Pragmatic-critical realism	Critical realism	Objectivist/subjectivist	Pragmatic	Multi-method
	Pragmatism			

This study takes place at three business units and corporate functions of a multinational corporation in Germany. The company was founded in 1908 and is amongst the largest 40 automotive suppliers worldwide. The turnover in the past fiscal year was approximately seven billion Euros. On the one hand, the environment can be characterised as *highly specialised* and *process-oriented* due to the high regulations and standards in this sector. On the other hand, the industry itself is subject to a highly turbulent market driven by the current mega trends and environmental impacts outlined in chapter one. To understand the results of the interviews, a *pragmatist perspective* has been adopted. This perspective is assumed essential for this study in order to understand human actions and interventions towards a directed goal, which is the successful application of a maturity model in the context of corporate agility.

It has been noted that pragmatists judge veracity within a specific context through reference to the efficacious practical realisation (Johnson & Duberley,

2000). Each of my research questions aims to stimulate debate about the socio-historical processes that have led to the knowledge claims of the interviewees. Here, particular attention is given to the practical use and success of the different agility enablers mentioned in the literature review. Therefore, the pragmatist position supposes an explicit recognition that social theory is interconnected with social practice (Gill & Johnson, 2010). In consequence, management knowledge is conceptualised "as a mutable cultural resource that influences, constrains, and legitimises particular social and organisational arrangements, relationships, and practices" (Johnson & Duberley, 2000, p. 171). Such management knowledge will be evaluated in terms of how effectively it explains and predicts phenomena of corporate agility in an automotive context, as opposed to how accurately it describes an objective reality. With this position in mind, pragmatists are passionate about how such theories are translatable into action and therefore often take an active part in the world being investigated (Gill & Johnson, 2010). This also supports my pre-understanding, as I am part of the research environment since more than ten years and also during the inquiry of this DBA study.

3.3 Research Design

The choice of research design is based on my philosophical assumptions above as well as the research problem of this study – expressed in the research questions. Therefore, I start with a more detailed look into the nature of these questions before proposing an appropriate research strategy.

3.3.1 Nature of the Research Questions

The research questions of this thesis begin with "how" and "what", which usually conveys an open and emerging design (Creswell, 2009). These questions are of a *qualitative* nature as they seek to explain a complex social or human problem and frequently require an extensive and in-depth investigation (Yin, 2018). In contrast, *quantitative* questions often ask for "why" and imply a researcher's aim to test objective theories by examining some type of cause-and-effect relationship among variables (Creswell, 2009). Furthermore, this study asks three open-ended questions, which indicates a strong explanatory direction (Yin, 2018). The questions

are broadly scoped due to the lack of plausible existing theory and empirical evidence, which gives the researcher more flexibility in investigating the phenomenon (Eisenhardt & Graebner, 2007). Research questions with such characteristics have the twin aims of revealing how extant theory operates in specific examples and theory building (as opposed to pure theory testing), and suggest a qualitative strategy of inquiry (Creswell, 2009; Yin, 2018). The next sub-section takes a closer look at this.

3.3.2 Research Strategy

The sorts of research questions I seek to answer can be characterised as those that prior research has not answered conclusively and/or as unexplained phenomena with different outcomes observed in different research environments. In order to explore such a new field where knowledge is limited, an exploratory strategy is recommended (Eisenhardt, 1989). Furthermore, corporate agility can be categorised as a *contemporary phenomenon*, meaning its occurrence in the recent past and the present (not just the present). Finally, agility can be observed in real-world conditions, i.e. private enterprises, where the researcher has little or no control over behavioural events and where contextual conditions are essential to understand the phenomenon. Taking these preconditions into account, *case study research* has been recommended to ensure a strong qualitative base upon which useful and robust theory is developed (Helfat, 2016). Robert K. Yin provides a comprehensive definition of this mode of inquiry in his seminal book about case study research and its applications:

> "A case study is an empirical method that investigates a contemporary phenomenon (the *case*) in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin, 2018, p. 15).

He continues:

> "A case study copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result benefits from the prior development of theoretical propositions to guide design, data collection, and analysis, and as another result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion" (Yin, 2018, p. 16).

In comparison, *experimental research* strives for deliberately separating the phenomenon from its context, *historical research* usually engages in non-contemporary events, and *survey research* comes to its limits when dealing with the entangled situation between phenomenon and context (questionnaires are most efficiently designed when limiting the number of questions to a few important items) (Yin, 2018).

Case studies include both *single-* and *multiple-case studies*. While the former contain opportunities in exploring a phenomenon under rare or extreme conditions (and maintaining the richness of the phenomenon in this special context), the latter are more grounded in varied empirical evidence and thus particularly powerful in yielding a more robust, generalisable, and testable theory (Eisenhardt & Graebner, 2007). For this study, a multiple-case study has been conducted because past research has already revealed insights about the single dimensions of agility as well as about semi-holistic approaches of agility in other branches than the automotive supplier industry. In order to shed light on corporate agility in an automotive context and develop theoretical implications, it was important to use different perspectives to capture the widest possible scope of aspects influencing the construct and its applicability.

"In theory building research, no matter how inductive the approach, we need to have a prior view of the general constructs or categories we intend to study, and their relationships" (Voss, Tsikriktsis, & Frohlich, 2002, p. 199). To follow this advice, the conceptual model of corporate agility (developed in chapter two) was taken as framework for the key factors and constructs to be studied. On the one hand, this sort of *a priori specification* will allow to measure/test already defined elements more precisely (Eisenhardt, 1989), and on the other hand it should help to focus and direct the research towards collecting all necessary data to answer the research questions (Yin, 2018). Before conducting the case study, I discussed my conceptual model with both supervisors (Munich Business School and Sheffield Business School) as well as five highly knowledgeable automotive experts to ensure that no major aspects were neglected. The review with the experts comprised three interview sessions and critically looked at the model from an overarching perspective (focus on dimensions, no in-depth discussion of the single enablers).

Eisenhardt (1989) and Voss et al. (2002) list several examples from peer-reviewed journals where case study research has been applied and thus demonstrate the increasing recognition of this mode of inquiry. Nevertheless, some traditional concerns remain. Yin (2018) points out the prejudices about missing rigour in applying this method. Furthermore, he mentions the mix-up with so-called *non-research* case studies, e.g. described cases from practical experience and taken for teaching reasons. This could also lead to confusion, as such case studies do not claim to follow any research methodology. A third common concern about case study research is the lack of generalisation of results. Indeed, conducting good case studies is difficult to do, but this chapter should demonstrate the reader that there is enough guidance available in the literature to create a *robust design*. Further, Kathleen M. Eisenhardt and Melissa E. Graebner emphasise the objectivity in theory building from cases because "its close adherence to the data keeps researchers honest" (Eisenhardt & Graebner, 2007, p. 25).

To summarise, by pursuing a pragmatist perspective I attempt to capture the different meanings organisational members give to corporate agility in terms of its efficacy in providing guidance in a fast changing market environment. By means of case study research I chose a multiple-case study design and collected data in a qualitative manner. I follow inductive research logic to develop a maturity model for corporate agility. All together, this reflects the underlying research strategy.

3.4 Research Execution

The previous section clarified when to use case study research and demonstrated the research design. Voss et al. (2002) recommend as next steps to discuss (1) how to select cases and informants, (2) how to conduct the data collection and (3) in which sequence, (4) how to analyse the data including documentation and coding, and (5) the rationales for hypothesis testing or theory development. This advice has been followed and each of the topics will be discussed in the following.

3.4.1 Case Selection and Informants

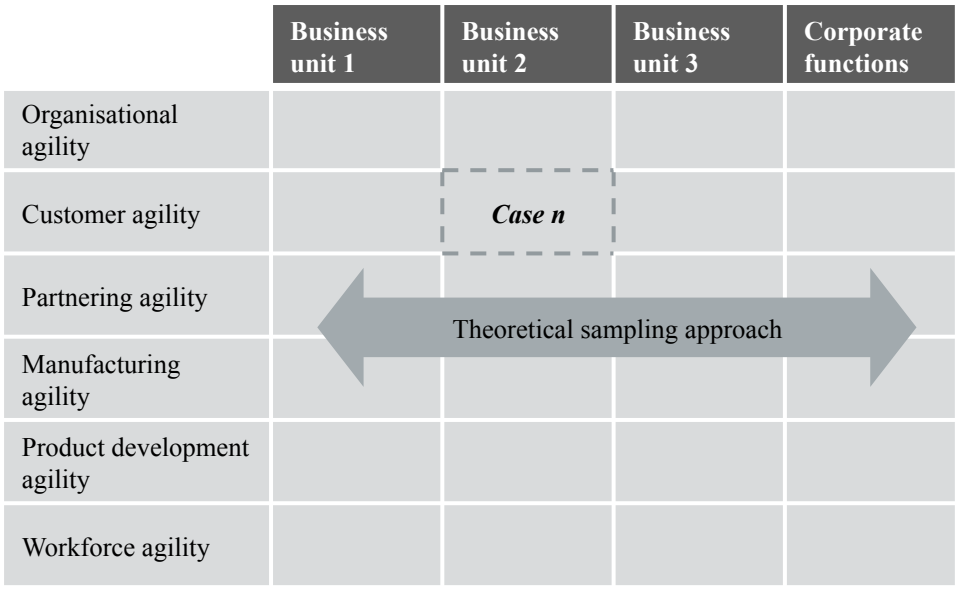
In order to design rigorous and methodologically sound case studies, cases should be selected purposively to uncover, confirm, or qualify the subjects of interest

(Voss et al., 2002). Speaking of *theoretical sampling*, Kathleen M. Eisenhardt and Melissa E. Graebner describe the procedure "[...] that cases are selected because they are particularly suitable for illuminating and extending relationships and logic among constructs" (Eisenhardt & Graebner, 2007, p. 27). Multiple-case studies follow a *replication design*. This replication logic can be compared to the method applied in multiple experiments, where some of the replications attempt to duplicate the exact conditions and others investigate the findings under altering parameters (Eisenhardt, 1989). Transferred to case study research, "each case must be carefully selected so that the individual case study either (1) predicts similar results (a *literal* replication) or (2) predict contrasting results but for anticipatable reasons (a *theoretical* replication)" (Yin, 2018, p. 61). Thus, cases are chosen to replicate, contrast, and extend the emerging theory – constantly considering the real-world context in which the phenomena occur (Eisenhardt & Graebner, 2007).

The description above points to another concern about case study research, namely the supposed huge effort to collect data. To keep the scope of this study at a manageable level and allow an in-depth investigation of corporate agility, the data collection took place at three business units and corporate functions of a multinational automotive supplier. The product portfolio in the single business units differs between its applications in the vehicle (e.g. chassis and powertrain), the level of vertical integration (e.g. components and systems), technologies (e.g. mechanical, electrical, or mechatronic), and degree of innovation (e.g. commodities and recently launched products). As a consequence, these business units rely on different supply chains, serve the OEM as customer as well as the tier-1 or tier-2 suppliers, and depend on different business drivers like market or technology. Such differences are important, because my aim is to develop a maturity model that can be applied to a wide range of firms in the automotive supplier industry.

Together with the corporate functions, four case study clusters were built (see figure 3.2). In these clusters, the identified phenomena (six dimensions of corporate agility) have been described and compared using replication and contrary replication logic. In this way, it was planned to conduct 24 interviews. However, two additional cases were necessary to deepen the dimensions of organisational and partnering agility, thus the multiple-case study sample comprised 26 cases.

Figure 3.2: Case study sample



For each of the cases, an individual with the appropriate knowledge was deliberately chosen. Here, "a key approach is using numerous and highly knowledgeable informants who view the focal phenomenon from diverse perspectives. These informants can include organisational actors from different hierarchical levels, functional areas, groups, and geographies" (Eisenhardt & Graebner, 2007, p. 28). Persons possessing these characteristics are known as *principle informants* (Voss et al., 2002). As a preparatory step, I chose one or two of those principle informants for each of the agility dimensions to be studied. This selection was mainly based on my own knowledge I had about these participants due to the long affiliation I had with the company. The primary selection criteria were their practical (and theoretical) experience in the respective agility dimension and their current involvement in activities that aimed to enhance the firm's agility. For instance, one of the interviewees was part of a steering committee within one of the R&D department's strategic initiatives to develop a new product with an agile approach. During the data collection, I collected further hints or recommendations for people who could serve the purpose of this study – always carefully considering the aspect of a *different* or *new perspective*. Thus, the final selection of informants was developed sequentially. In most of the agility dimensions, a kind of saturation point in terms of new insights was reached after the third interview. Hence, the forth case often has been used to discuss particular interesting findings in depth or

clarify some contradictions of the former interviews. Regarding the dimensions of organisational agility and partnering agility, even a fifth interview was conducted.

Yin (2018) recommends conducting a *pilot case study* in order to conceptually refine the research design and develop relevant lines of questions. In other words, this inquiry helps to clarify both substantive as well as methodological issues. I decided to approach a senior manager from a corporate function, the Head of Advanced Development. This had several reasons: First, he was my supervisor several years ago and we were in regular contact also after this period, thus good access to him was given. Second, he spent almost 20 years in the company and had more than 30 years automotive experience at that time. Finally, it has been the responsibility of his function to provide governance for agile development principles for the entire company and in his former positions he headed large R&D departments where also agility from an organisational perspective was relevant. Normally, such pilot reports should be explicitly used for lessons learned in terms of the aspects mentioned above (Yin, 2018). However, in my case this discussion fully confirmed the applied design (guided semi-structured interviews supported by templates) and revealed a lot of fruitful insights on my topic. This gave me great confidence for conducting the multiple-case study and I decided to include my pilot as a valid case into the scope of this research study.

Table 3.1 presents a more detailed view of the participants. From this overview can be noted, that the informants were from all hierarchical levels, i.e. either non-management members (27%) or members of middle management (23%; Managers and Directors), upper management (30%; Vice Presidents), and top management (20%; Senior and Executive Vice Presidents). The average age was around 47 years and the average time the participants spent in the company was roughly 14 years. The range comprised very new colleagues with almost no experience in the firm up to interview partners with a company affiliation of 30 years. Three of the interviewees were female participants and altogether the informants possessed more than 480 years experience in the automotive industry. This huge expertise and the broad range of the colleagues' age as well as their length of service with the company or with other organisations in the automotive sector served in particular the reason to collect a *large* and *diversified* knowledge base on my inquiry.

Table 3.1: Study participants

Interviewee	Gender	Position	Hierarchy	Age & years in the company	Years in automotive industry
1	Male	Head of Corporate Development	Senior VP	61/20	30
2	Male	Head of Business Unit	Executive VP	65/10	17
3	Male	Head of Corporate Human Resources	Executive VP	45/0,5	6
4	Male	Expert Development Methods	Employee	54/19	19
5	Male	Head of Production Plant	VP	50/25	25
6	Male	Head of Production Plant	VP	55/30	30
7	Male	Head of Human Resources	VP	56/16	16
8	Male	Head of Project Purchasing	Director	54/21	28
9	Male	Head of Advanced Development	Director	52/22	22
10	Male	Head of Human Resources	Director	34/3	3
11	Male	Head of Product Unit	Senior VP	53/27	27
12	Male	Head of Strategy	VP	43/7	19
13	Male	Head of Product Unit	Senior VP	56/24	24
14	Male	Expert Supply Chain Mgmt.	Employee	55/26	30

Table 3.1 (continued)

Interviewee	Gender	Position	Hierarchy	Age & years in the company	Years in automotive industry
15	Female	Head of Production Planning	VP	47/2	19
16	Male	Head of Business Development	VP	37/18	18
17	Male	Expert Personnel Development	Employee	50/13	34
18	Male	Project Manager Corporate Development	Employee	33/13	13
19	Male	Key Account Manager	VP	56/11	28
20	Male	Agile Coach	Employee	53/12	20
21	Female	Head of Sales Panning	Director	34/19	19
22	Male	Head of Innovation Mgmt.	Director	42/3	3
23	Male	Head of Innovation Team	Manager	33/8	8
24	Male	Expert Advanced Analytics	Employee	32/2	2
25	Female	Business Partner Human Resources	Employee	34/2	7
26	Male	Head of Production Technology	VP	34/14	14

The personal relationship between the researcher and most of the informants was considered as an essential aspect to gain *depth* and *detail* in research as outlined throughout this chapter. Furthermore, the participants included organisational actors from different hierarchical levels and functional areas to capture *diverse perspectives* on each of the agility dimensions. A third important fact was the experience of the participants in the company and the automotive (supplier) indus-

try. On the one hand, *high knowledge* and several *practical experiences* were required in order to discuss the topic in depth. On the other hand, the interview partners had to be *familiar* with the automotive environment as this is the context where the desired maturity model should be applicable.

3.4.2 Data Collection Instruments

In case study research, commonly applied sources to collect evidence comprise (1) documentation, (2) archival records, (3) interviews, (4) direct observations, (5) participant observation, and (6) physical artefacts (Yin, 2018). As none of these instruments has a complete advantage (rather they are complementary), a sound case study should allow the triangulation of data by multiple data collection methods (Eisenhardt, 1989). Put differently, the use and combination of different instruments to study the same phenomenon will increase the reliability of data (Voss et al., 2002) and thus provide stronger substantiation of constructs and hypothesis (Eisenhardt, 1989).

In order to study strategic phenomena, i.e. where informants have to reflect on their everyday practices, *interviews* are particularly useful to gather rich, empirical data (Eisenhardt & Graebner, 2007). Further, interviews can especially help in revealing the "how's" of key events by investigating participants' relativist beliefs and thus capturing distinctive perspectives (Yin, 2018). For these reasons, in-depth interviews were the primary data collection instrument in this DBA study. Robert K. Yin points out that "case study interviews will resemble guided conversations rather than structured queries" (Yin, 2018, p. 131). In that manner, the interviews were guided semi-structured and supported by templates, which were filled in together with the participants during the conversation. It has to be mentioned that obviously semi-structured interviews require extensive resources and are more time-consuming than strictly guided questionnaires or other interview techniques. However, as depth and detail have been considered most important, I decided for the semi-structured approach.

At the beginning of each interview, the three research questions (defined in chapter one), the conceptual model (derived from the literature in chapter two and further developed in chapter four), and the focus of each individual case study (i.e. one of the six agility dimensions) were outlined. Following Sheffield Busi-

ness School's research guidelines, the *participant information sheet* was explained and basis data of the informants were gathered. Afterwards, the real data collection procedure started by asking open questions regarding the overall comprehensiveness of the conceptual model. This discourse was taken to direct the focus to one of the six agility dimensions. Initially, the respective definition was presented and briefly discussed before a theoretical framework of the main enablers was introduced. At that point the interviews reached its core, as the completeness of the enablers and the maturity levels within these enablers (research questions two and three) are the most crucial part of this study. On the one hand, least empirical evidence is available compared to research question one, and on the other hand, the maturity levels are at the heart of the maturity model that will be developed over the course of this thesis. As mentioned earlier, particular attention was given to leave enough room to investigate relevant topics that emerged along the interviews. At the end, I summarised the main insights, asked for internal documents and further informants possessing particular knowledge, and finally gave a short outlook about upcoming steps. The interviews were either in English or German language, while in the end all of my notes have been translated into English for the transcripts. They lasted one to two hours and were documented by minutes of memory and by means of templates. As the COVID-19 pandemic reached one of its peaks in the time where the multiple-case study has been conducted, sometimes it took some extraordinary efforts to make a face-to-face interview happen. Taking this into account as well as the fact that I carried out this DBA project as a part-time researcher, the overall duration of this phase was roughly seven months. Only in two cases, the interviews took place virtually by making use of Microsoft Teams software.

The mentioned *templates* were used as a second data collection instrument to visualise and discuss the answers of the informants during the interviews. I created a set of standardised figures upfront and provided hard copies for each of the interviews according to the agility dimension that was subject of the investigation. The templates were deliberately not distributed upfront as I wanted to capture the thoughts and interpretations first hand. The first template was of general nature with the purpose to introduce the goals of my study and the research questions.

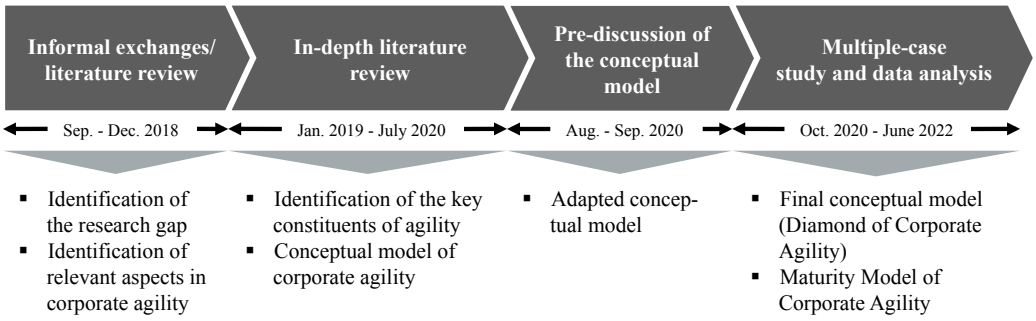
Basis for this template was mainly the content presented in chapter one. The second template was used to capture remarks of the informant on my conceptual model, which has been derived from the literature in chapter two and further developed based on a pre-discussion with five highly knowledgeable experts. Template three, four, and five were specific to the agility dimension, but followed an identical structure by 1) asking for remarks or comments on the definition, 2) introducing the main enablers from the literature, and 3) providing the framework to elaborate the maturity levels. The use of the templates made it possible to keep the answers of the informants continuously in mind and validate is impact during the interviews itself. In this way the risk of misinterpretation was decreased and the participants immediately could confirm main insights at the end of each interview. The interview templates can be found within the detailed version of the case study protocol in sections 6.2 and 6.3.

In some cases, the informants provided internal documents consisting mostly of working papers, presentations, or process descriptions. In one case, the informant even had some publications on the topic due to his hybrid role as employee and part-time researcher. This allowed me to reflect on several statements and descriptions afterwards in a non-interview situation and helped to increase the validity of the findings.

3.4.3 Research Sequence

This study can be divided into four steps. In the first phase, *informal exchanges* and a *first literature review* were used to explore the research gap and the need for agility from a practitioner's point of view. In the second phase, an *intense literature review* was conducted in order to define the key constituents of agility in a corporate context, ending in the conceptual model of corporate agility. The third phase was used to *pre-discuss* this theoretical model with five highly knowledgeable experts. All were working as consultants at this time and thus possessed the ability to judge the applicability of the model for practical discussions. The result was a slight adaption of the conceptual model. In the forth phase, the *multiple-case study* (including the pilot case study) was conducted and led to the final maturity model. Figure 3.3 shows the sequence that has been followed:

Figure 3.3: Research sequence



3.4.4 Data Analysis Procedure

As explained before, sound case study research is characterised by a *multiple data collection approach*. Thus, the gathered data are usually large and researchers need to structure and reduce it in order to derive focused conclusions. Yin (2018) proposes four general strategies to analyse case study evidence: (1) relying on theoretical propositions that led to the case study, (2) working the data from the ground up, i.e. inductively "playing" with the data and searching for emerging patterns, (3) developing case descriptions by organising the data according to some descriptive framework, and (4) examining rival explanations (which generally works in combination with all of the previous three). He emphasises the non-mutual exclusivity of these strategies and describes five analytic techniques, which can be used solely or in combination. One technique is *pattern matching*. Such logic compares patterns revealed from a case study with predicted ones. In explanatory research, these patterns may be related to e.g. the "how's" of the research questions. A second analytic technique is *explanation building*. Here, an iterative approach is applied through comparing case study data to initial but tentative theoretical statements and revising the earlier propositions accordingly. The goal is to analyse the data by building an explanation about the case. Third, *time-series analysis* could be the technique in favour if the objective is to examine the research questions about the relationship of events over time. Important is the aspiration of the researcher to analyse both causal inferences and time trends, as a non-case study strategy is probably more suitable for a pure investigation of time trends alone. The fourth technique uses *logic models* and "stipulates and operationalises a complex chain of occurrences or events over an extended period of time, trying to show how a complex activity, such as implementing a program,

takes place" (Yin, 2018, p. 204). These events are arranged in a repeated cause-effect order, why this technique is particular useful in studying theories of change or in evaluating the effectiveness of interventions. A fifth technique only applies to the analysis of multiple-case studies and aggregates findings across a series of individual studies. The goal of this *cross-case synthesis* is to retain the integrity of the whole case and then to compare within-case patterns along the cases (rather than a variable-based approach where cross-case data is aggregated towards key-variables by means of quantitative methods).

The multiple-case study of this DBA thesis is of explanatory nature and the pure transcripts alone run to more than 60 pages. To be able to handle and analyse this amount of data, the computer-based qualitative research tool NVivo 12 was used. This software allowed it to upload the transcripts and any kind of supporting data and further helped to organise it by information source and content. A fundamental principle of NVivo is the coding of emerging themes and ideas by attaching such codes to words, sentences, or other evidence collected by the researcher. Bazeley (2009) recommends the application of a category system for the descriptive level of coding to structure the data properly. In this study, the system of codes was created both deductively from the literature and inductively from the data collection (when new, interesting aspects arose). The final category system is given in table 3.2 on the next pages. It consists of eight categories and 50 codes.

Table 3.2: Category system and coding

Category	Code
Conceptual model	Conceptual model
Organisational agility (OA)	Definition OA
	Organisational structures and power distribution (OSPD)
	Culture (CLT)
	Absorptive capacity (AC)
	Information and communication technology (ICT)
	Strategic foresight (SF)
	Robust strategy (RS)
	Stakeholder buy-in (SBI)
Workforce Agility (WA)	Definition WA
	Employee involvement/empowerment (EIE)
	Teamwork environment (TE)
	Organisational learning and training (OLT)
	Access to consistent and accurate corporate information (ACAI)
	Resilience (RSL)
	Reward systems/incentive schemes (RSIS)
	Further enablers WA
Customer agility (CA)	Definition CA
	Customer-sensing capability (CSC)
	Customer-responding capability (CRC)
	Risk propensity of senior management (RPSM)
Partnering agility (PA)	Definition PA
	Network integration (NI)
	ICT integration (ICTI)
	Collaborative relationship (CR)
	Market sensitivity (MS)
	Flexibility (FLX)
	Top management commitment (TMC)
	Supplier innovativeness (SI)
	Further enablers PA

Table 3.2 (continued)

Category	Code
Manufacturing agility (MA)	Definition MA
	Employee empowerment (EE)
	Manufacturing system flexibility (MSF)
	Advanced manufacturing technologies (AMT)
	Product modularity (PM)
	Concurrent paradigm (CP)
	Knowledge management and learning (KML)
Product development agility (PDA)	Definition PDA
	Time-boxed sprints with defined deliverables (TBS)
	Dynamic, visualised tools (DVT)
	Small, dedicated, and co-located teams (SDCT)
	Less formalised processes (LFP)
	Flexible design technologies with rapid prototyping (FDRP)
	Collaboration in product development networks (CPDN)
	Further enablers PDA
Miscellaneous	Agility in general
	Automotive industry and norms
	KPIs, measurement, and system status
	Organisation and processes
	People

This study uses a theoretical proposition and aims to further develop it towards a maturity model for corporate agility. As described in the literature review, three underlying management theories are applied (the adaptive and flexible organisation, organisational leanness, and the dynamic view of organisations) and guide the proposition that companies can built certain capabilities in order to survive and succeed in a high-velocity and uncertain market environment. Corporate agility qualifies as such a capability and in order to implement or expand it within the firm, a guiding framework is necessary. To draw conclusions from the generated data out of the multiple-case study, I combined several of the techniques introduced before. During and after the single case studies, I compared the given statements to the available knowledge – particularly reflected by the conceptual model and its underlying definitions and described enablers. When new patterns

occurred, I built additional explanations to either revise earlier propositions or to extend the existing body of knowledge accordingly. Beyond this, the multiple cases allowed it to replicate or contrast the findings from earlier cases and thus to broaden the emerging theory.

3.5 Quality Criteria

As "qualitative research is highly descriptive, emphasises the social construction of reality, and focuses on revealing how extant theory operates in particular examples" (Eisenhardt & Graebner, 2007, p. 28), certain quality criteria need to be considered in order to judge the quality of both the research design and its execution. According to Voss et al. (2002), the first relevant test is *construct validity* and is related to the extent the researcher establishes correct operational measures for the concepts being studied. They recommend four tactics to increase construct validity: 1) observing if the upfront predictions about relationships between variables are confirmed, 2) use of multiple sources of evidence, 3) considering if a construct as measured can be differentiated from another, and 4) seeking triangulation (i.e. cross-comparison of multiple data sources). In this research, several informants and various data collection instruments were used. A category system and coding of the data were applied to clarify the phenomenon that was being observed. In addition, templates were used during the interviews to make the data as transparent as possible and to collect instant feedback on my interpretations by the principle informants. At the end of each interview, the main findings out of it were reviewed together with the respondents.

The second and the third test are related to *internal* and *external validity*. While internal validity seeks to establish a causal relationship (whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships), external validity shows whether a study's findings can be generalised beyond the immediate case study (Yin, 2018). In order to ensure internal validity, Yin (2018) suggests several analytic techniques (see sub-section 3.4.4). As described in the previous section, pattern matching in combination with explanation building and cross-case synthesis were applied in this study. The first tactic to enhance external validity and thus the generalisability of results is to chose a mul-

tiple-case study design in favour of a single-case study approach – which is the case for this research (see figure 3.2). As explained in sub-section 3.4.1, a theoretical sampling logic (Eisenhardt & Graebner, 2007) has been followed to observe all relevant phenomena and constructs. In addition, at least four cases for each of the six agility dimensions were selected and investigated by using replication and contrary replication logic. The cases usually differed in its product portfolio, the level of vertical integration, technologies, and the degree of innovation.

According to Yin (2018), the final test of *reliability* has the goal to make sure that a study's operations can be repeated with the same results. The author emphasises three tactics to ensure the reproduction of results in case study research: 1) the use of a case study protocol, i.e. a kind of guideline for the data collection, 2) the development of a case study database, and 3) maintaining a chain of evidence. Table 3.3 on the next page shows the overview of this research's case study protocol, which points out the general procedures that have been followed.

Having such a protocol in place is essential when dealing with a multiple-case study design (Yin, 2018). The detailed version, which was used within the interviews (see sections 6.2 and 6.3), contains precise descriptions of the main points like the purpose of this study or the agility dimensions. Thus, any later researcher who wants to conduct the same study could make use of this protocol and replicate the process. Furthermore, all interview data were transcribed, coded, and stored by means of a software tool. Such a database allows not only to store and sort interview data, but also to link it to any kind of supporting documents in a transparent manner. In order to maintain a chain of evidence, all data collection and analysis procedures were made as explicit as possible; and although in reality opportunities to repeat such a case study rarely occur, my ultimate goal of reliability was to minimise errors and biases of this study.

When judging the tactics employed in this study, some concerns remain in the reliability domain. On the one hand, opportunities for repeating a case study seldom occur in reality, and on the other hand the process itself highly relies on the interpretation of the collected data (Yin, 2018). The latter is particularly relevant for this study as I spent almost ten years in the company at the point in time when the interviews took place. Furthermore, I deliberately used my perspective and

experience to analyse and interpret the data and thus have to acknowledge some bias of myself. But as noted above, these doubts have been limited by a careful and comprehensive documentation of the procedure. The particular strengths of this study are the high construct validity due to carefully selected and highly knowledgeable informants in combination with various data sources, and the generalisability of the maturity model to a wide range of organisations operating in the automotive supplier industry (external validity).

Table 3.3: Overview of the case study protocol

Section A: Introduction and participant approval (ca. 15 min.)
1. Welcome, mission, and goals of the research study
2. Research questions and conceptual model
3. Scope of this single case study
4. Information sheet (according regulations of Sheffield Business School)
5. Basis data of informant a. Age and years in the company b. Years in automotive industry
Section B: Data collection procedure (ca. 60 min.)
1. Discussion on the comprehensiveness of the conceptual model
2. Presentation of definition of the relevant agility dimension and discussion
3. Introduction of the theoretical framework of main enablers and discussion
4. Discussion of the maturity levels within the enablers a. General classification between rudimentary and best practice b. Focus on rationales behind best practice examples
Section C: Summary and closing (ca. 15 min.)
1. Summary of the main insights
2. Request for further questions or clarifications
3. Availability of internal documents
4. Recommendation of informants to discuss the research questions
5. Outline of the research study's timeline
6. Tentative outlook for availability of results

3.6 Ethical Considerations and Summary

This research uses in-depth interview techniques and recognises the importance of protecting the participants of this study and the firm from any negative consequences resulting from their involvement. Therefore, this study follows the ethical guidelines outlined by Sheffield Hallam University and has been approved by its Ethics Committee (Ethic Review ID: ER5936845).

To sum up, chapter three lays the methodological foundation for collecting the data pertinent to this research. A brief reflection on the contents brings me to two aspects worth to mention: First, I made use of a pilot case study to test the robustness of the research design. This pilot ended in a decision of mine to include it as a valid case, as the participant had no major remarks how to refine the applied design. A possible explanation is the interview series with selected experts upfront to the multiple-case study. Here, the practicability of the conceptual model has been evaluated and adapted accordingly. As a major aim of this research is its later practical application, I spent significant efforts to make the data collection as precise and understandable for the practitioners to gain detailed insights instead of "wasting" time with explanations. The second topic I would like to emphasise (again) is the acknowledgement of my own bias throughout this study, as I was as well part of the research environment. Even if several tactics have been employed to ensure construct validity as well as internal and external validity, I am aware that my own experience and knowledge influenced the interview discussions to a certain extend. However, hereby I created an opportunity that the voices of my participants were really heard and I am convinced it helped to gather rich and valuable data.

CHAPTER FOUR

The Maturity Model of Corporate Agility

> The path to an agile organisation is a development process affecting all parts of an organisation from workforce through organisational structures and processes to technologies used and the overall organisational culture. (Wendler, 2014, p. 1197)

4.1 Introduction

Maturity models offer a simple but effective possibility to measure the quality of processes in a corporate context. The objective of those models is to outline the conditions when certain objects of interest reach the best state of their intended purpose; thus they describe a final state of maturity where (from the model's point of view) no further development is possible (Wendler, 2012). Maturity models usually contain several *maturity levels* of the desired outcome, indicating a progression on the improvement path (Henriques & Tanner, 2017). These levels should be of sequential nature and represent a hierarchical progression (Wendler, 2012). The considerations above are reflected in the following definitions:

> "A maturity model describes how a process can evolve (mature) over time" (Henriques & Tanner, 2017, p. 56).

> "A maturity model describes and determines the state of perfection or completeness of certain objects. The progress in maturity can be observed and managed by the definition of maturity stages or levels that measure the completeness of the analysed objects via sets of (multidimensional) criteria" (Wendler, 2014, p. 1198).

Thus, the application of maturity models provides useful benefits through (1) generating an awareness of the examined objects (e.g. requirements and complexity), (2) serving as reference frame to implement a systematic approach for improvement, and (3) assessing a firm's capabilities on a comparable basis (Wendler, 2012). A famous example is the *Capability Maturity Model Integrated*

(CMMI). As a widely adopted method in practice it has proven to be a successful framework for promoting *best practices* (tactics or methods that have been successful through real-life implementation) for developing products and services (Henriques & Tanner, 2017).

Attempts to create and apply maturity models in the context of agility reach back almost two decades. First, it was Meredith and Francis (2000) who had introduced the *Agile Wheel Reference Model* consisting of 16 elements and four subordinate dimensions. Intention of their framework was a focused organisational development of manufacturing firms. After, John Bessant showed his approach to the scientific community containing 16 key routines: "In its current form the reference model assumes that agility is a capability of the organisation which is expressed in terms of behavioural routines – the semi-automatic set of behaviour patterns which define the way we do things around here" (Bessant et al., 2002, p. 491).

More recently, Wendler (2014) has conducted an extensive literature analysis with the conclusion that available approaches suffer regarding their applicability due to 1) an insufficient reflection of the entire organisation, 2) the utilisation of complex algorithms limiting an intuitive and ad hoc usage, and 3) a lack in suggesting further actions for improvement or development. Attempting to close this gap, he developed the *Organisational Agility Maturity Model* in order to provide an assessment tool for firms operating in the software and IT service industry. The conclusion of his work asks for more case studies or action research to develop this research domain further.

To my knowledge, there is no maturity model or similar work about maturity models available considering agility from a corporate perspective in the automotive supplier industry. Practitioners in this area are curious for a guiding framework to manoeuvre in today's high clock speed environment. An investigation in this specific area of application is strongly supported by the contingency theory (conclusion 7 from the literature review), which emphasises the importance of the context in which the management practices are applied.

Accordingly, this chapter starts with outlining the *key elements of corporate agility* in order to build a foundation for the maturity model. Basis for this is the

pre-discussion of the conceptual model with five highly knowledgeable experts as well as the interview results of the multiple-case study conducted for this DBA thesis. Afterwards, a *logic for the maturity levels* is defined that can be applied to describe the different levels of proficiency for the underlying enablers. Consequently and by triangulating the case study data with theoretical insights from the literature, the *main enablers including the maturity levels* are depicted. Combining the former mentioned elaborations will finally allow establishing the *Maturity Model of Corporate Agility*.

Throughout the entire chapter I analyse my findings in terms if they agree or conflict with previous studies – or if they are even novel. A comparison in this way will help to pronounce the authenticity of my results, especially when similar procedures were used in other studies before. The ultimate goal is identifying evidence-based explanations for my findings in order give credibility to the Maturity Model of Corporate Agility. Therefore, this thesis is not structured in a separate results chapter and discussion chapter. Instead, the main discussion is incorporated in chapter four. Chapter five merely includes a final discussion to comprehensively reflect on the main discussed aspects and to lay the foundation for elaborating the limitations of this study and future research directions.

4.2 Key Elements of Corporate Agility

One of the main outputs of the literature review of this study is my conceptual model presented in chapter two (see figure 2.1). To include the practitioner's perspective to a certain extent upfront (before conducting the case study), this theoretical model has been discussed with five highly knowledgeable experts. All were working as consultants at this time and together possessed more than 40 years of experience in consulting the automotive (supplier) industry. Thus, they were capable to judge the applicability of the model for practical discussions.

4.2.1 Pre-Discussion

The discussions with the experts were focused on the six agility dimensions in terms of completeness and usage in industrial praxis. To get as much information as possible and related examples, it was important to hold the nature of these open

exchanges more loosely coupled rather than in a guided structure. Therefore I decided to not develop and apply any kind of interview guidelines.

In general, this *team of five* confirmed the comprehensiveness of the conceptual model, which is reflected in the following quotes:

> "The conceptual model is comprehensive, all relevant dimensions are covered; these dimensions are well distributed." (Expert 1)

> "Conceptual model of agility is comprehensive." (Expert 3)

Further, expert 2 explained that the model contains all aspects when agility is usually discussed in an industrial context. He emphasised the crucial role of top management in exemplifying agility (which was also confirmed by expert 4) and added that this is normally covered in the dimension of organisational agility. We also discussed the fact that typical corporate functions like strategy and finance are not included as a single dimension. An explanation in terms of strategy could be that the dimension of organisational agility already contains strategic foresight and a robust strategy as two main enablers. On the other hand with regards to finance, such departments usually have to strictly follow international financial reporting standards, why the degree of freedom to adapt in an agile manner is clearly limited.

Besides this, expert 3 confirmed the relevance of the topic itself by stating:

> "All of our customers are interested in agility and deal with the topic in the past months and years." (Expert 3)

Expert 2 gave this statement in a similar way and added that applying agility only in several departments can only work to a certain degree. He continued:

> "One of the main barriers of firms becoming agile is a punctual application instead of enterprise-wide." (Expert 2)

In this context, expert 1 described out of her experience that agility typically starts in product development and spreads from there into the organisation; whereby this rarely takes place in a structured way. A reason could be a missing framework to provide guidance, which is underlined by the following quote:

> "If companies want or need to become agile, i.e. adaptable to a constantly changing environment, they usually start with the question what is necessary on this path, how much agility is needed, and what resources are required." (Expert 1)

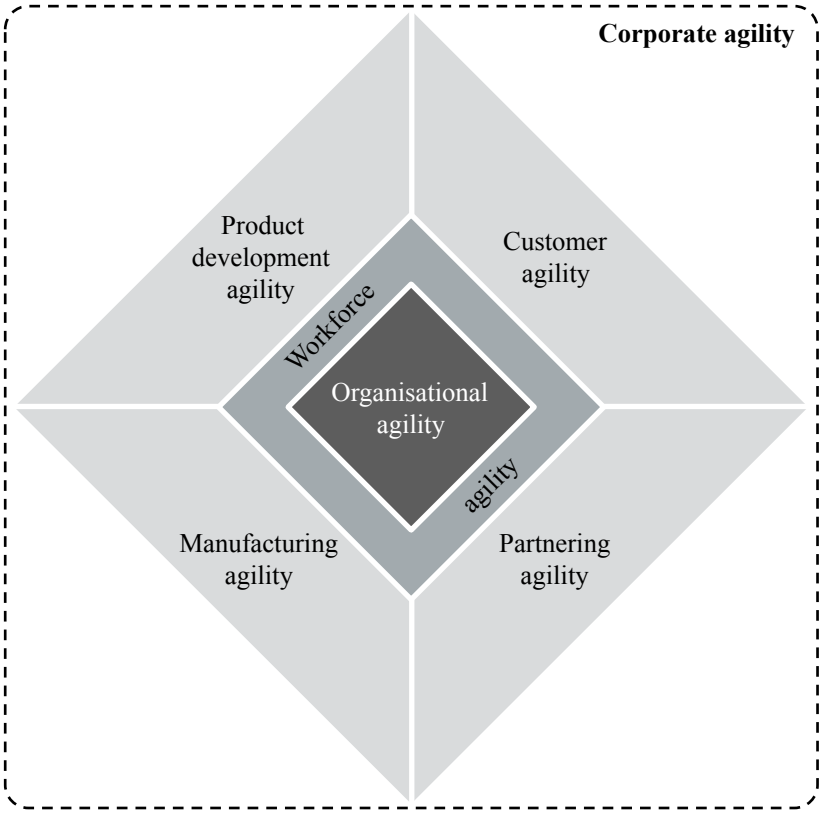
Furthermore, expert 3 explained his observation of the increasing relevance of the factor *employee* in the agility domain over the recent years and that even agile frameworks related to product development started to include this aspect as a single dimension. This is in line with the maturity evaluation of the literature behind workforce agility (see sub-section 2.3.6) where I figured out that this research stream began to gain importance in the scientific community in the early 2000s. In the same context, expert 2 described some concerns about the order of workforce agility. Consistent to the literature, he argued that the agile employee is at the heart of workforce agility – which in turn is subject to all the other second-order capabilities of customer agility, partnering agility, manufacturing agility, and product development agility. He underpinned this out of his experience where he and his colleagues recognised the crucial role of agile people in all the dimensions comprising an agile enterprise. For instance, he noted:

> "The order of workforce agility is somehow inconsistent with my experience from projects with practitioners, as it is a cross-function over all the other functions." (Expert 2)

> "The conceptual model should be adapted towards a more cross-functional order of workforce agility." (Expert 2)

Expert 1 as well emphasised this more central role of employees in firms striving for agility. She pointed to one of the most crucial success factors in the transition to an agile enterprise: the *willingness of people* to follow all these new approaches. Put differently, a prerequisite on the path to corporate agility is openness for agility of the involved employees – no matter if this affects the dimension of customers, the supply chain, or even the entire organisation. After revisiting the literature again, I can state that to the best of my knowledge there is no evidence or recommendation in place to not treat workforce agility as a first-order capability as well (beside the already identified first-order capability of organisational agility). Taking these arguments into account, I decided to slightly reframe the conceptual model of this study towards a more central position of workforce agility (see figure 4.1). It can be seen that the key elements of corporate agility stay unchanged; merely the order of workforce agility is new. Hence, the main enablers identified in the literature review remain valid as basis for the multiple-case study.

Figure 4.1: Adapted conceptual model of corporate agility (further developed from figure 2.1)



A final recognition out of this expert panel was a hint given by expert 5 while I was talking about the enablers. In his understanding, I was referring to methods. An example from the dimension of product development agility is the enabling role of time-boxed sprints. This made me aware about the necessity to explain the meaning of an enabler in general in more depth when conducting the case study.

4.2.2 Multiple-Case Study

The data collection procedure (see section B in the case study protocol, table 3.3) started with discussing the comprehensiveness of the adapted conceptual model (see figure 4.1 above). As an introduction, I explained the theoretical background together with the underlying management theories. Further, each of the six dimensions was described by pointing out the affected field/functions of the firm and outlining the main enablers. After, the interviewees were asked for remarks in the format of open questions like how this model is in line with their understanding of the phenomenon of corporate agility or if major concerns arose while the model has been introduced.

In total, almost 77% (20 out of the 26 key informants) stated very clear or to some extend that the model is 1) comprehensive, 2) in a logical order, and 3) that all relevant dimensions are covered. This does not mean that the remaining 23% are of minor importance, as in qualitative research every voice matters. However, I want to slightly highlight the relatively large consensus among the interviewed practitioners, which is reflected in the following statements:

> "The model is logical. It is good that the customer dimension is included with an own category." (Interviewee 4)

> "The model looks comprehensive; I do not miss anything crucial." (Interviewee 11)

> "In general, the cluster makes a lot of sense as you consider customers, suppliers, manufacturing, and development. By considering suppliers and manufacturing you also cover the idea of *make or buy*." (Interviewee 14)

> "It looks like the model includes all relevant dimensions, why I would say you covered everything." (Interviewee 21)

> "The model is comprehensive, plausible, and transparent." (Interviewee 25)

In the same manner, the central position of workforce agility was highly appreciated by some of the case study participants:

> "The model is comprehensive; I like in particular the central role of the workforce." (Interviewee 7)

> "I appreciate to see the dimensions of organisation and workforce at the core of the model. That is like to serve the other dimensions with organisational and workforce agility." (Interviewee 10)

> "I like the central role of organisational agility and the employees. Regarding employees, the ability to arrange with new working processes is very important." (Interviewee 11)

> "The separation of workforce is very essential from my point of view as the adaption to changing environmental conditions happens in particular in the human dimension." (Interviewee 14)

> "I like the model, in particular the fact that the workforce plays a central role. I am convinced that everything starts with people on the journey to an agile organisation." (Interviewee 23)

These statements were not surprising at least for interviewees 7 and 10 (both Heads of Human Resources, see table 3.1), but obviously also study participants from various other functions emphasised this aspect. Sub-section 2.3.6 demonstrates the essential role of employees from an academic perspective. After con-

ducting one of the first empirical studies on this topic with 515 senior-level managers, Breu et al. (2002) proclaimed workforce agility as the new employee strategy for managing uncertainty more proactively already 20 years ago. This debate went on until today and the pre-discussions with the experts further underlined this.

Another fruitful comment came from a Head of Advanced Development who confirmed the comprehensiveness of the model and further stated:

> "The main difference to agility in a software context […] is that we always need all functions on board. I.e. we always need the simulation department, production planning, etc. In software development, the necessary functions can be limited to a few essential ones." (Interviewee 9)

On the one hand, this supports conclusion 7 from sub-section 2.4.1 to apply the contingency theory as underlying management framework. On the other hand, it underpins my approach to capture all automotive supplier-relevant functions in the conceptual model.

Coming to the critical thoughts on the model, an Executive VP mentioned to include the strategic perspective as a main dimension by having in mind that a company must be able to permanently adapt its business model:

> "What about strategy? That means when the business model is subject to change, i.e. when money is made with service instead of hardware. The slogan is *shifting profit zones*." (Interviewee 2)

A similar discourse took place with expert 2 within the pre-discussion of the model. In the discussion with interviewee 2, I pointed out again that this is covered within the dimension of organisational agility. Hereupon, he emphasised the enormous relevance of this aspect and further supports the findings from previous research, where a robust strategy is clearly indicated as one of the most important ingredients towards agility in order to sustain above-average performance (Worley & Lawler, 2010).

Besides this, a pattern occurred regarding requests for including the functions of controlling and quality:

> "What about the functions controlling and quality (I am thinking along the product development process)? Where are they? I think especially all these people related to calculating the

> product costs etc. should be somehow included as well… while the same is valid for quality." (Interviewee 8)
>
> "Where can I find the controlling function? In particular product controlling? I think agility is also related to this function. Furthermore I am thinking of the annual planning of budgets, which is no longer up to date compared to the market we are in. This should take place in much shorter cycles with much more flexibility." (Interviewee 12)
>
> "I am missing quality, or where can I find this dimension. I think also the quality function has to be considered when becoming more agile." (Interviewee 14)

Starting with the controlling function, this aspect has been briefly examined with expert 2 in in the pre-discussion phase. As a reasonable explanation, the fact has been discussed that finance functions like controlling typically refer to strict calculation standards like the International Financial Reporting Standards (IFRS). In turn, degrees of freedom to adapt to more agile ways are somehow limited, why this dimension was obviously not in the centre of the academic discourse on corporate agility. The same applies for the quality functions, which typically follows the ISO 9001 from the International Organisation for Standardisation and in an automotive context additionally the IATF 16949 from the International Automotive Task Force. The harmonisation of agility-driven activities with overarching international standard-frameworks would go beyond the scope of this thesis and will be included in the section for future research directions in chapter five. The expectation towards my maturity model of corporate agility is clearly to be applicable within today's existing standards prevailing the automotive supplier industry.

Another remarks were given concerning an appropriate leadership style and an agile mindset:

> "I miss the aspect of leadership or supervision, as agility requires a different leadership style." (Interviewee 16)
>
> "[…] however, what I am missing is the premise of a common attitude towards agility, i.e. an agile mindset. Such an agile mindset has to emphasise that agility is strongly related to a high degree of tolerance." (Interviewee 17)

In terms of considering the phenomenon of agility from a psychological point of view (agile personality), this has been excluded from the scope of this thesis (see section 2.3.6). On the other side, the aspect of leadership is indeed one that is

not explicitly encompassed in my theoretical framework. However, most of the enablers behind workforce agility require significant involvement of supervisors when performed on a higher maturity level. Thus, the possible influence of the leadership team is also covered.

Furthermore, at least three of the interviewees pointed out some ambiguities in the wording for the dimension of partnering agility:

> "In general, the model is comprehensive. However, without an explanation the content behind partnering agility is not clear, in particular the fact that the customer is not included (but in a separate dimension). I would recommend thinking about the wording." (Interviewee 8)

> "My first impression is that the model is comprehensive. However, when talking about partnering agility I would think primarily about making relationships like joint ventures or the whole area of mergers and acquisitions (M&A). Instead of partnering agility I would recommend the wording *procurement agility*." (Interviewee 18)

> "Regarding partnering agility, it is not really clear what is behind. Partnering could mean several different aspects and leaves a lot of room for interpretation. After your explanations I would recommend to name it *supply chain agility*." (Interviewee 19)

By naming the dimension in this way I followed the approach of Sambamurthy et al. (2003) who apply a multi-theoretic lens to explain the role of information technology on firm performance via agility as an organisational capability. They emphasise the enabling role of modifying or adapting a company's existing network about assets, competencies, or knowledge currently not available. Providers for these missing aspects are suppliers, distributors, contract manufacturers, and logistic providers. In turn, those are typical constituents of a firm's supply chain and the identified main enablers widely refer to these parts. Revisiting the key papers on partnering agility (see table 2.4) shows that almost half of the research works use the term *supply chain agility* in the headline, which leads to the first adaption:

Adaption 1: *The main enablers for partnering agility refer to the primary parts of a firm's supply chain. Besides this, the wording of partnering agility poses some ambiguity, as partnerships could be wide-ranged in a business context. Thus, this dimension will be re-named into supply chain agility.*

A further fruitful discussion arose based on the following two comments:

> "In general I would have expected that the conceptual model is orientated towards an end-to-end process instead of single dimensions. This end-to-end process is structured in two levels: One level describes the core processes from order to delivery, and on the second level below there are a couple of central functions, which support this process. You could take our product development process as an example, why not describing agility along this process?" (Interviewee 12)

> "Considering the single dimensions of agility, it looks like that you chose an organisational perspective rather than a procedural (end-to-end) one; what was the reason for this? You should be aware that such an approach somehow compels to think in pigeonholes. A procedural one would avoid this." (Interviewee 24)

These two participants highlighted an interesting aspect, namely the possibility to build the conceptual model along a procedural order. However, such an end-to-end process in an organisational context would not only assume some clarity about the dimensions and determinants (see the first research question of this thesis) but also about the interdependencies and interfaces of the single dimensions (Wendler, 2014). This necessity became very clear in particular during the conversation with interviewee 24, who holds a PhD and was working as a part-time researcher during the phase of the interviews. Nevertheless, another statement provided food for thought that my conceptual model already includes a certain potential to depict some procedural order:

> "The four outer clusters are good. It would make sense to arrange them value stream oriented, i.e. starting with development agility in the upper right corner, then partnering agility, manufacturing agility, and customer agility." (Interviewee 16)

Put differently, by re-arranging the dimensions of the conceptual model according the row of activities that are performed to create value for the customer – the so-called *value chain* (Porter, 1985) – an end-to-end process can be included to a certain degree. As customer agility incorporates not only a firm's ability to respond but also to sense opportunities (Roberts & Grover, 2012 b), this dimension would be a good starting and end point. After successfully sensing customer needs, the R&D department has to start activities, which in turn automatically activates a company's supply chain. Ideally, the customer enquiry finally ends in a tangible product manufactured in mass production. Even if the interdependencies of the single dimensions are another limitation of this study, a logical ar-

rangement will in any case improve the clearness of the model and foster its understanding. This brings me to the second adaption:

Adaption 2: *In order to develop the conceptual model as close as possible to corporate procedures, the four second-order capabilities will be re-arranged according to the value chain, i.e. customer agility, product development agility, supply chain agility, and manufacturing agility.*

Some other critical remarks on the conceptual model were only of an isolated nature, for instance:

> "On the first impression the model looks a little abstractly." (Interviewee 13)

> "I like that you put organisational agility and workforce agility central to the model, but I think you cannot consider them separated from each other." (Interviewee 22)

> "I am wondering how you define the differentiation towards other well-known terms in academia like *enterprise agility*." (Interviewee 24)

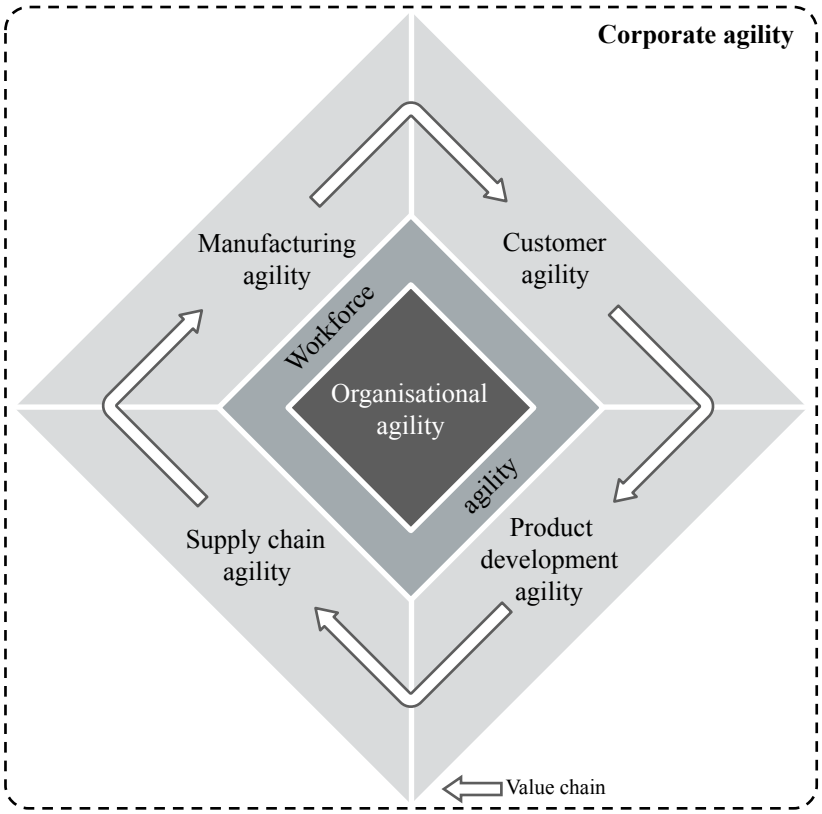
First, the concern about the delimitation between organisational agility and workforce agility could be solved quickly by explaining the underlying enablers. Second, by operating under the headline of corporate agility (vs. the academic term of enterprise agility) I want to point out my research interest in understanding the phenomenon of agility in private firms operating in the automotive supplier industry. Finally remains only the abstract impression of one of the participants, but the following adaptions (summarised in table 4.1) hopefully help to mitigate this feeling:

Table 4.1: Case study-based adaptions on the conceptual model

Adaption	Content
Re-wording of partnering agility (#1)	The main enablers for partnering agility refer to the primary parts of a firm's supply chain. Besides this, the wording of partnering agility poses some ambiguity, as partnerships could be wide-ranged in a business context. Thus, this dimension will be re-named into supply chain agility.
Re-arrangement of second-order capabilities (#2)	In order to develop the conceptual model as close as possible to corporate procedures, the four second-order capabilities will be re-arranged according to the value chain, i.e. customer agility, product development agility, supply chain agility, and manufacturing agility.

The two adaptions above eventually allow modifying the conceptual model again. To avoid any confusion with the models presented in chapter two and beginning of this chapter, this revised form is labelled as the *Diamond of Corporate Agility* and is depicted in figure 4.2:

Figure 4.2: The Diamond of Corporate Agility evolved from former conceptual models



Along with the discourse on the conceptual model, the definitions for the single dimensions have been presented and discussed as well. On the one hand, this was necessary to generate a fundamental understanding. On the other hand, I used this to collect data about the clearness of these terms from a practitioner's perspective. This will be further detailed in the next sub-section.

4.2.3 Revisiting the Definitions of the Agility Dimensions

As a quick reminder for the reader, table 4.2 on the next page summarises the relevant definitions of the agility dimensions from the literature review:

Table 4.2: Definitions of the agility dimensions

Agility dimension	Definition from literature review (chapter two)
Organisational agility	"[…] an organisation's ability to quickly sense and respond to environmental changes in order to quickly seize market opportunities" (Park et al., 2017, p. 649).
Workforce agility	"[…] the ability of an employee to rapidly and appropriately respond to unexpected changes and leverage those changes as opportunities" (Pitafi et al., 2018, p. 2159).
Customer agility	"[…] a firm's ability to sense and respond quickly to customer-based opportunities for innovation and competitive action" (Roberts & Grover, 2012 b, p. 579).
Product development agility	"[…] the capability to discover and understand changing product requirements and being able to quickly consider these changes while making progress in developing the product" (Goevert et al., 2019, p. 2288).
Supply chain agility	"[…] the property of a supply chain that enables it to sense short-term, temporary changes in supply chain and market environment, and flexibly and rapidly respond to these changes" (Dubey et al., 2018, p. 132).
Manufacturing agility	"Firms manifesting manufacturing agility are characterised by responding quickly to customers in positive ways. Elements of this quick and effective response to demand changes include customer responsiveness, shorter manufacturing lead times than competitors, and rapid delivery of goods" (Jacobs et al., 2011, p. 126).

The interview data out of my multiple-case study reveal that at least three of the definitions above fully reflect the understanding of the relevant participants. This contains the description of organisational, supply chain, and manufacturing agility. The statements below exemplify that critical remarks (1) were not repeated across the relevant cases, (2) merely comprised other wording proposals for single words, or (3) referred to very specific aspects beyond a general definition:

> "In general, the definition is fine. I would say *adapt* instead of *respond*." (Interviewee 12 referring to organisational agility)

> "In general, the definition is comprehensive. However, I would add two points. First, I would include the word *evaluate* after *sense*, i.e. […] quickly sense, evaluate, and respond […]. Se-

cond, I am missing the aspect of efficiency." (Interviewee 16 referring to organisational agility)

"I am missing the aspect of digitalisation. In particular because this was and is still a trend along the supply chain. Famous examples are all the supplier portals where documents like RFQs are made available and where quotes have to be submitted." (Interviewee 8 referring to supply chain agility)

"Typically in manufacturing we talk about lean, and everything that deviates is negative. However, if talking about agility as a compromise between lean and flexible (where I agree), then the word standardisation is missing in the definition. For instance, if we generate variance at the end of the production line, 95% of the whole process is designed according to lean principles." (Interviewee 6 referring to manufacturing agility)

Thus, these three definitions (organisational agility, supply chain agility, and manufacturing agility) from table 4.2 will be used to specify the relevant dimensions within the Diamond of Corporate Agility (see figure 4.2).

Coming to workforce agility as the first of the remaining three dimensions, interviewees liked the explicit link between behaviour of the workforce and change in their environment:

"The definition contains an important fact, namely to perceive change as an opportunity." (Interviewee 7)

"I like the definition; I would describe workforce agility very similar to this. In particular the aspect of unexpected change is at the core of workforce agility, but also at the core of agility in general." (Interviewee 25)

On the other hand, the definition was perceived more vague than precise; in particular concerning the abilities of employees:

"What is the exact meaning of the word *ability* in this definition? I am asking because ability takes place on several levels. First, there is a kind of intrinsic willingness (the opposite would be denial). Second, capability according to competence, i.e. the employee is willing but does not posses the necessary competencies. Third, freedom to act, i.e. the employee needs the permission and possibility to act accordingly." (Interviewee 10)

"What ability are you talking about? The description of the ability is missing. In my point of view, this definition is talking about a competence but not ability – as a competence always bundles a set of abilities. In consequence, competencies as a single entity cannot be developed, but the abilities (leading to this competence) can." (Interviewee 17)

As at the core of this dimension is the single employee and therefore a real human being, the interviewees expect a very precise description of such a tangible subject. Starting the analysis in the maturity of the research stream shows that indeed an accurate and solid definition of workforce agility could not be established so far (Muduli & Pandya, 2018). However, revisiting several of the key scientific papers reveals at least two definitions that point into the direction of a more detailed description of the necessary abilities of employees:

> "[…] people with a broad vision and capabilities to deal with marketplace turbulence by capturing the advantageous side of such dynamic conditions, such as occasional abrupt shifts in customer preferences and account structure" (Muduli, 2016, p. 1567).

> "The ability to adjust to new or different conditions caused by varying demands of technological and organisational changes by altering one's acts, behaviour, attitude, and mental state toward changes initiated internally (by the employee) or externally (e.g. organisation or technology)" (Doeze Jager-van Vliet et al., 2019, p. 40).

The latter provides a comprehensive picture and compared to the initially used definition (see table 4.2) only misses the aspects of a rapid response and unexpected change. As both conditions (fast response and sudden change) are core drivers for organisations to become agile, these elements should be included and lead to the following adaption:

Adaption 3: *Workforce agility is interpreted as the ability to rapidly adjust to new or different conditions caused by unexpected varying demands of technological and organisational changes by altering one's acts, behaviour, attitude, and mental state.*

Regarding customer agility, the interview participants highlighted the importance of a fast response time:

> "Maybe only speed is too less, I would even say extreme speed." (Interviewee 11)

> "In general, the definition is fine. Today the customer wants *A* and tomorrow *B*; so reacting quickly is very important. But this is nothing new." (Interviewee 21)

This is not surprising, as the time to market in the automotive supplier industry continuously decreases and thus reaction time gets more and more crucial. In this context, one of the interviewees expressed very clearly that sensing and respond-

ing quickly to market demands (Roberts & Grover, 2012 a) neglects another important aspect to a certain degree, namely the customer who is *indicating* change:

> "Our customers surprise us always with change, for instance one of my customers changes the schedule for product launches sometimes up to nine months – but in both directions, i.e. earlier and later. […] the aspect of customer-driven changes is somehow missing." (Interviewee 11)

Another participant confirmed this and continued:

> "Only responding is not enough. I miss two important adverbs: consequently and successfully. It could be that I recognised something and responded accordingly, but in the end it's all about if this response was successful." (Interviewee 13)

Including such efficiency-factors within a definition (like if the response was successful) is always difficult and somehow redundant. For instance, achieving a competitive advantage is already one of the fundamental goals underlying the concept of agility through the dynamic view of organisations (see sub-section 2.4.3). Nevertheless, the aspect of customer-driven change as one of the main drivers for more agility towards the customer is for sure one that helps no make the description of this dimension more precise.

Considering the sensing-perspective as the other most important component besides responding, another interviewee pointed out that sometimes it is even a pivotal success factor if a *proactive* sensing behaviour takes place:

> "I like that the ability of sensing is mentioned, this is crucial when talking about customer agility. What I miss is the aspect of proactivity. A proactive behaviour towards the customer is extremely important to get a time advantage, e.g. not waiting for the RFQ but trying to get all these data upfront." (Interviewee 19)

Based on the last two years of my professional career, during which I was responsible for several customer accounts, I would classify such proactivity even as the *conditio sine qua non* in order to be ahead of the competition and thus successful. Also Narver et al. (2004) highlight such a proactive market orientation and statistically demonstrate its positive, significant impact on new-product success. Hence, the following interpretation of customer agility will be applied:

Adaption 4: *Customer agility captures the ability of a firm to act proactively in front of the customer in order to sense and respond quickly to customer-driven changes or customer-based opportunities for innovation and competitive action.*

Concerning product development agility, the interviewees emphasised the central role of short-termed, iterative development sprints and the interdependencies of requirements – in particular when developing physical products, which is the background of this study:

> "The definition is somehow abstract and needs to be more precise. […] our journey towards agility started by using the scrum method. So we were in the situation that we knew only a few product requirements, decided to start a joint venture with […], and found in the scrum method an approach that helped to manage these two circumstances: partly defined requirements and two companies collaborating for this product." (Interviewee 20)

> "Two keywords are missing: *incremental* or *iterative* and *short-termed*. As the main benefit of agile development is to validate hypothesis in short loops while learning during this procedure." (Interviewee 4)

> "One important aspect is missing in the definition, which is the interdependency of product requirements. It is essential to clearly understand those interactions. In other words, changing product requirements mean a new specification. This new specification has to be described by considering all interdependencies. Only with this premise we are able to develop the product in an agile manner." (Interviewee 19)

In the context of manufacturing firms, agile product development is described as a "[…] time-boxed, iterative approach that emphasises rapid delivery of incremental components of a product and frequent communication among team members and with stakeholders" (Cooper & Sommer, 2018, p. 18) or as "an approach which prefers flexibility and improvement during a smaller process to linearly rigid planning and processing" (Gerber et al., 2019, p. 825). Hence, these explanations support the practical view of the interviewees. Regarding interdependencies of requirements, i.e. to fully understand the entire impact when e.g. the customer changes one requirement, an explicit scientific discourse did not start so far. However, as the aspired maturity model will be created in order to be applied by companies, such aspects help to sharpen the understanding. As I spent also more than three years in the R&D department of the company where the study took place, I can underline the crucial role of such interdependencies in the development of mechatronic systems from various examples. Hence, the definition of product development agility will be slightly adapted in order to emphasise the

applicability of the maturity model for developing mechatronic products and thus to be applied for the Diamond of Corporate Agility:

Adaption 5: *Product development agility is understood as the capability to discover and understand changing product requirements, considering interdependencies to other requirements or features, and delivering incremental components by means of a time-boxed, iterative approach.*

Now, as the conceptual model is finalised and the definitions of the single dimensions are slightly sharpened from a practitioner's point of view, another theoretical step is necessary to establish a base for judging the level of proficiency among the different agility dimensions. Such logic for the different maturity levels is content of the next section.

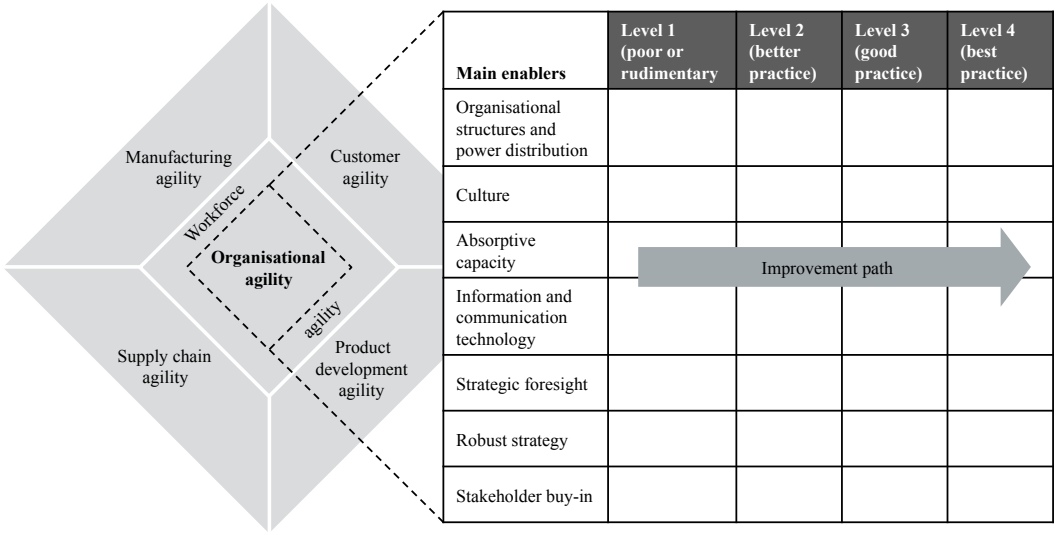
4.3 Levels of Maturity

In addition to establishing the key elements of corporate agility and the enablers behind, building a maturity model includes the definition of several maturity levels, indicating a progression on the improvement path. Kahn, Barczak, and Moss (2006) provide a comprehensive framework, which they applied in order to develop a best practice framework for new product development. They define six so-called *management dimensions* (which could be compared with the enablers in each of the agility dimensions of this study) and describe each dimension "[…] across four levels of sophistication, with each level corresponding to a particular set of characteristics describing poor or rudimentary practice (level one), better practice (level two), good practice (level three), and best practice (level four)" (Kahn et al., 2006, p. 108).

This logic was adapted to my research and included in the case study. The generated qualitative data will be used to describe the four maturity levels for each of the enablers for the respective agility dimension. Practitioners can then use this framework and rate their own proficiency within the enablers and draw conclusions about the level of agility they possess in each of the six dimensions, and finally in the entire company. In that way, also the improvement path is shown by

using the description of the next maturity level. Figure 4.3 illustrates this logic at the example of organisational agility:

Figure 4.3: Logic of maturity levels at the example of organisational agility



Main enablers	Level 1 (poor or rudimentary	Level 2 (better practice)	Level 3 (good practice)	Level 4 (best practice)
Organisational structures and power distribution				
Culture				
Absorptive capacity				
Information and communication technology				
Strategic foresight				
Robust strategy				
Stakeholder buy-in				

In the following six sub-sections, the different maturity levels for each of the main enablers are described and discussed while referring to the agility dimension they belong to.

4.3.1 Maturity Levels within Organisational Agility

The main enablers for organisational agility can be clustered in (1) organisational structures and power distribution, (2) culture, (3) absorptive capacity, (4) information and communication technology, (5) strategic foresight, (6) robust strategy, and (7) stakeholder buy-in (see sub-section 2.3.1).

4.3.1.1 Organisational Structures and Power Distribution

With regards to organisational structures and power distribution, an Executive VP emphasised the ultimate goal beyond every kind of organisation:

> "An organisation must be a solution for a problem; *structure follows strategy*. For instance, if the strategy is to increase an organisation's ability to quickly adapt and seize market opportunities, a structure according to competence centres is recommended (as this will push the development of the right products)." (Interviewee 2)

In respect to the hierarchical structure itself he continued:

> "To become quicker and give more freedom to the employees, I took out a complete hierarchy level. Hereby I reached a span of control of 1:12, which is so far best practice according to my experience. By taking out this level we had only three levels between the head of the division and the employees." (Interviewee 2)

Another Executive VP confirmed these few levels of hierarchy and pointed to a further crucial precondition that has to exist in parallel; the authority to make decisions:

> "Best practice from my point of view is a flat hierarchy combined with clear decision-making authority, i.e. a clear regulation who is allowed to decide what at which point in time." (Interviewee 3)

This combination fosters not only one of the core principles of agility, namely *shifting away power* from those at the top and put the ownership to those closest to the action (Birkinshaw, 2018), but helps also to focus on leadership and strategic work:

> "Best practice from my own experience is the definition of clear responsibilities. I remember when I took over the department from my predecessor who was always busy and had no time for topics like strategy etc. This was clearly because he didn't define clear responsibilities like e.g. mandates for purchasing volumes. In consequence, the employees permanently came to his desk to ask for allowance or he had to attend plenty of alignment meetings. I changed this and had two major effects. First, the motivation of the team increased, and second I was able to take care of e.g. developing a career path for strategic buyers. I simply had more time to focus on real leadership topics." (Interviewee 16)

Referring to the decision-making process, a VP responsible for one of the business unit's strategy even gave some insights about decision-making efficiency:

> "Best practice is also evaluating the optimum efficiency between delegation and bundling. In terms of delegation: Where it is important to have the big picture, decisions should be made preferably as high as possible; while where speed is the essential criteria, decisions should be made on the operational level as far as possible. In terms of bundling, there is always an optimum of tasks which can/should be comprised." (Interviewee 12)

However, that it is not all about the hierarchical structure and power distribution shows the following comment:

> "The pure organisational structure is not so important; important is that you have as much as synergies to the process organisation." (Interviewee 3)

Interviewee 3 was a member of the board with the overall responsibility for human resources. In his former roles he was also acting as Chief Operating Officer and General Manager at different other automotive companies. With this statement he pointed to the fact that the automotive supplier industry is typically a process-driven business. At the core is mostly a *product development process*, which sets as much as standards for all involved functions while leaving enough room for reacting to customer specific requirements. Put differently, the structural and the process organisation have to go hand in hand in order to be sustainably competitive. In the best case, such harmonisation of collaboration between functions along a common process is then reflected in the single organisational units, which will thrive the agility of the whole organisation:

> "Agility is strengthened by organisations that focus on *product creation*, i.e. where sales and engineering is combined to a certain extend. When we changed this at […], so that engineers went together with sales to the customer, we developed unbelievably much more new products. Another best practice example is today's customer team structure in […]." (Interviewee 2)

In the last sentence the participant referred to an established organisational structure in the company where the case study has been conducted. One of the commonness between the three business units are the so-called *customer teams*. These are organisational units within the organisation for sales and program management with a dedicative responsibility for one or more customers. Within those customer teams act the disciplines of sales, project management, and project engineering (technical project management). This happens as a kind of a "speedboat" in front of the customer, as several of the other necessary departments (e.g. quality, purchasing or technical functions) are orchestrated by the project manager and the project engineer through sticking to overall procedural frameworks like the product development process. Thus, an optimal symbiosis between the structural and the process organisation is achieved.

Ali (2016) demonstrates empirically that such a symbiotic relationship is also necessary between *formal* and *informal organisational structures* in order to compete in rapidly changing operational environments. Both can coexist, while informal networks have neither a defined structure nor a best way of operating. They emerge and permanently adjust to the demands of the environment. The

underpinning principles comprise trust, reciprocity, and transparency. In the same context (highly turbulent environments), Bohdana Sherehiy and her colleagues even state that entire organisations should adopt so-called *organic organisational forms*, characterised by "few levels of hierarchy, informal and changing lines of authority, open and informal communication, loose boundaries among function and units, distributed decision-making, and fluid role definitions" (Sherehiy et al., 2007, p. 448). One of the participants, possessing almost 20 years experience in the automotive industry, further underpinned this during the interviews:

> "There are three development stages an organisation can achieve: the first one is the classic structural organisation where leadership takes place in a hierarchical manner. The next level is a project-based organisation, which requires strong technical and functional leadership. The most agile organisation in my point of view is a network organisation, where everything is loosely coupled, work is done based on intrinsic motivation, and with lots of iterations." (Interviewee 12)

Finally, Teece et al. (2016) describe the efficient maintenance of organisational slack (excess resources and capacity) as "chief" among the architectural approaches to build agility within organisations. Keeping this kind of buffer is costly and somehow contrary to the origin objectives of managers to eliminate any kind of additional cost. However, like the military maintains reserve forces, that kind of overcapacity helps to manoeuvre through times where companies are hit by sudden changes from their environment. Anybody who has experience in managing a P&L can probably imagine the difficulties of making this part of one's agenda.

Taking the interview data above and the insights from the literature into account allows sketching the first scale of maturity levels:

Table 4.3: Maturity levels of organisational structures and power distribution

Enabler	Level 1	Level 2	Level 3	Level 4
Organisational structures and power distribution	Command and control organisational form where lots of hierarchy levels exist and decisions are mainly taken from the top	Project-based organisational structure primarily described by a symbiotic relationship between structural and process organisation	Organic organisational form characterised by few levels of hierarchy, wide span of control, distributed decision-making power with clear responsibilities, and existence of informal networks	Organic organisation where additionally organisational slack is maintained efficiently

At this stage of the thesis it is important to clarify that the maturity levels of the main enablers behind the six agility dimensions cannot be defined absolutely sharp and exclusively, as the journey towards a fully agile enterprise is highly context-dependent (see chapter two and the underlying contingency theory). Particularly they should indicate a kind of possible improvement path and outline a guiding framework applied in the automotive supplier industry. Put differently, the boundary between the single maturity levels is *loosely* and the aspects described within may partly also be valid for the level below or above.

4.3.1.2 Culture

The relevance of an *organisation's culture* became already visible during the discussion of the conceptual model:

> "The model is comprehensive regarding its single dimensions. However, what I am missing is the premise of a common attitude towards agility, i.e. an agile mindset. Such an agile mindset has to emphasise that agility is strongly related to a high degree of tolerance. Only with such a common mindset an organisation can enter the path towards agility by means of such a model." (Interviewee 17)

By performing an explanatory factor analysis and a cluster analysis, Wendler (2016) shows the importance of establishing a culture characterised by agile values. Such values comprise a proactive behaviour, responsiveness, trust, and sup-

porting employee proposals. The author even classifies these as *agility prerequisites*; meaning without such factors in place an organisation will not be able to successfully develop in other agility dimensions. A VP leading the department for human resources emphasised this at the example how he develops young talents towards more responsibility:

> "Best practice is in particular characterised by giving trust to employees (e.g. when nominating them into new positions), failure culture (i.e. acceptance that mistakes happen, e.g. when I gave significant decision power to my deputy), permanently giving support, and allowing growth." (Interviewee 7)

Hereby he pointed to another crucial aspect that was also highlighted by several other participants, namely the existence of a *failure culture*. For instance, interviewee 3 explained the link from generating entrepreneurial behaviour by giving responsibility to every single employee and thus creating an agile culture. In the same context he described the necessity of a failure culture for such entrepreneurship:

> "In my eyes, an agile culture has to be linked to entrepreneurship or entrepreneurial behaviour of every single employee. That means linking the motivation of the person to the mission of the company, so that every employee acts intrinsically for the company goals." (Interviewee 3)

> "Entrepreneurship needs failure culture. Hereby I mean not when someone makes a sloppy job; I mean for example when an employee has only a limited amount of information but has to take a decision. Then he or she takes this decision by assuming the best outcome for the company, but maybe the decision was wrong due to the limited amount of information. With a good failure culture in place, this employee doesn't get blamed; instead a lessons learned process would ensure to bring the take-away from this case into the organisation." (Interviewee 3)

Interviewee 16, who was acting as Head of Business Development and possessed 18 years of automotive experience in several leadership positions, even draw a span between poor and best practice:

> "Poor practice is a punishment culture or a culture based on fear. The more this culture develops towards a learning or failure culture, i.e. an environment that is characterised by trust and openness, the more it is best practice. Taking the example from before where I talked about the last department I took over, I changed people on purpose to get out this punishment culture and installed young managers who were used to lead with a strong learning culture in mind." (Interviewee 16)

Surprisingly, while a failure culture was a quite central component for several study participants, it was not explicitly mentioned in the body of literature I applied. In the context of culture, Crocitto and Youssef (2003) emphasise a learning organisation, but clearly link it to the acquisition of specific knowledge. In one of the most comprehensive reviews of enterprise agility, Sherehiy et al. (2007) list a learning culture below the main attributes of agility, but also with regards to employee training. However, the main issue where the interviewees pointed at, is the reaction of supervisors or the organisations in situations where fast decision-making was crucial but maybe not the most effective choice after carefully revisiting the case. While originally discussing the dimension of manufacturing agility with another informant, I came across this aspect as well in a brief talk after the original interview. The statement of this colleague was such comprehensive and thus provides a good summary:

> "In general, one of the most essential aspects to enable agility is an appropriate failure culture in the company. I think this is valid for all of your dimensions. We can only become agile in the broader sense, i.e. on a company level, if we develop a culture where failing fast is tolerated – if it is the consequence from courageous and fast decision-making where simply the information base was limited. Then, lessons learned must be conducted and implemented in the next iteration. This is the key for an enterprise to operate at the edge of a fast paced environment and to be always one step ahead of the competition." (Interviewee 26)

In their summary of concepts related to the main attributes of agility, Sherehiy et al. (2007) present a *culture of change* (where the above mentioned learning and employee training is incorporated). Hereby they describe an environment where people on all organisational levels have a positive and fearless attitude to changes and where changing responsibilities are fostered. This aspect was also central to one of the interviewees, who possessed huge industry experience and was acting in different CEO roles before:

> "Another enabler is the rotational system of an organisation. Two best practice examples: For very important projects, people were staffed from all divisions for the time of the project and then sent back into their original teams. Hereby, the following mindset was created: I'll make a career if I work for the entire organisation. Or, to become head of a division, a leadership position in the upper management abroad of three to four years was necessary. That means, creating an agile culture by means of rules for rotation." (Interviewee 2)

Or put differently by another participant:

> "As agility means always the ability to change, best practice in the enablers of culture is taking people the fear of change. Or in other words, making people believe that change is not related to something bad. This goes along with high transparency and honesty and much communication. People must not get the feeling of uncertainty, rather they should think in the direction *change is the new normal*." (Interviewee 12)

A final pattern regarding culture can be found in the interview data with respect to an organisational context that creates creative ideas and behaviours. Concerning leadership and the selection of employees, one of the interviewees explained how he usually staffs open position in a complementary way and hereby creates an innovative ground:

> "Agility can be pushed by creating a mindset that leaders will surround always the best people around oneself and hereby creating diversity of highly skilled employees in the teams." (Interviewee 3)

Another interesting example, which was classified as best practice, referred to the employees and in particular how to use individual values in order to push product innovation:

> "Leading through values as best practice; e.g. software developer are usually people who would like to work on the newest topics. As a consequence, every software developer who finished his work package or project was allowed to move on in another group to work on new topics." (Interviewee 2)

Here, the participant described a situation where on the one hand the intrinsic endeavour of the developers has been satisfied and thus these people were highly motivated. On the other hand, speed within the projects significantly increased after establishing such a procedure. Through a more theoretical lens, such examples fall in the category of an *innovative climate*, which is emphasised as "[…] the chief environmental factor encouraging employees to engage in knowledge exchange activities" (Cai et al., 2017, p. 4). The authors further explain "innovative climate reflects the shared perceptions of employees regarding the practices, procedures, and behaviours that promote the generation of new ideas, the experimentation with creative thoughts, and the acceptance of changes".

Particularly interesting was the discourse about the maturity levels when talking about culture as an enabler. Here, interviewee 2 gave a helpful impulse. He

explained out his more than 30 years experience in industrial companies that culture is a topic, which needs to be considered always as a whole. In other words, the full lever of culture becomes operative at an organisational level, but only partly on an individual one or within single teams. Thus, the taxonomy applied orients mainly along the fact how the practices mentioned above are established at every level in the organisation. The maturity levels are accordingly summarised in the following table:

Table 4.4: Maturity levels of culture

Enabler	Level 1	Level 2	Level 3	Level 4
Culture	Punishment culture or a culture based on fear	Culture of change (underpinned by employee learning, failure tolerance, and trust) as well as climate that enables innovative behaviour are partly available in the organisation	Culture of change (underpinned by employee learning, failure tolerance, and trust) as well as climate that enables innovative behaviour can be widely found in the organisation	Culture of change (underpinned by employee learning, failure tolerance, and trust) as well as climate that enables innovative behaviour are established at every level in the organisation

4.3.1.3 Absorptive Capacity

Before entering the discussion on the levels of maturity, I briefly want to outline the recognition in terms of the wording itself. Besides the fact that the concept of *absorptive capacity* is deeply founded and well known in the scientific community, it was hard for the practitioners to capture the content without receiving some further explanations. Even if this came out of the discussion with a comparable low number of participants (four), I consider this as a valuable insight also in terms of the applicability of the maturity model (of course also as in my qualitative-subjective approach every voice matters). One of the participants provided a fruitful comment how this issue could be overcome in the context of an example in the company:

> "I would name it *leverage external knowledge*. A very good example is the innovation management department in our purchasing organisation. This is a separate unit responsible for the assimilation of knowledge and ideas from our suppliers." (Interviewee 16)

To continue the debate, let's briefly revisit the definition of the concept. Wesley M. Cohen and Daniel A. Levinthal initially defined absorptive capacity as:

> "[…] an ability to recognise the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990, p. 128).

Zahra and George (2002) subsequently developed an extension and divided the construct into four capabilities, namely 1) *acquisition* (prior investments, prior knowledge, intensity, speed, and direction), 2) *assimilation* or understanding, 3) *transformation* (internalisation and conversion), and 4) *exploitation* (use and implementation).

All of the participants that have been interviewed on this enabler agreed on the descriptions above. They even described a kind of logical order of these capabilities when absorptive capacity is applied in their corporate setting. In other words, externally generated knowledge has to be identified and acquired in a proper way as a prerequisite for a sound assimilation, and so on. In general the more this order from acquisition towards exploitation is executed, the higher the maturity level. For instance, one of the informants emphasised this in the context of the benchmarking process for products in the company where the case study has been conducted:

> "A best practice example I know is the benchmark department of our business unit. Here they have a dedicated team (three to four people) responsible for this task. Further, they have rooms where people can come in to feel and experience the products. A sophisticated process is in place how the knowledge is spread into the organisation and how it is used for new product development. Furthermore, there is a database behind which is accessible on a global base." (Interviewee 12)

Subsequently, the maturity levels are drawn in table 4.5. Based on the comments regarding the understanding of the enabler itself, I additionally will use from now on a brief explanation:

Table 4.5: Maturity levels of absorptive capacity

Enabler	Level 1	Level 2	Level 3	Level 4
Absorptive capacity (leveraging external knowledge)	Acquisition (externally generated knowledge – critical to the firm's operations – is identified and acquired)	Acquisition and additionally assimilation (the firm possesses routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources)	Acquisition, assimilation, and additionally transformation (routines are developed and refined to facilitate the combination of existing knowledge and the newly acquired and assimilated knowledge)	Acquisition, assimilation, transformation, and additionally exploitation (routines are available that allow to refine, extend, and leverage existing competencies or create new ones by incorporating acquired and transformed knowledge into the firm's operations)

4.3.1.4 Information and Communication Technology

As already outlined in sub-section 2.3.1, the agility literature defines many different types of information technologies (IT) in a way that supports specific business parts. Wendler (2016) even categorises this aspect within the dimension of *agility prerequisites*, pointing to the availability of an appropriate technological basis that supports the necessary communication and collaboration processes. Other authors conceptualise it in the form of *digital platforms*, i.e. IT that enables firms to enhance the flexibility of their resources (Ravichandran, 2017), *capabilities* that provide technical support for agility by means of information acquisition, collaborative communication, and process adjustment (Cai et al., 2017), or as an *architecture* comprising different levels of the business network: hardware and systems software infrastructure, application software, management of an individual business, and dynamic control and governance of the business network (Van Oosterhout et al., 2006). Sambamurthy et al. (2003) apply real options theory and rede-

fine the role if IT as generator of so-called *digital options*, describing a set of IT-enabled capabilities in the form of digitised enterprise work processes and knowledge systems.

These examples shall demonstrate the wide span within research on the enabling role of information and communication technology on organisational agility. In order to describe the maturity levels in an applicable way, this work needs to narrow down the broad field towards a smaller corridor. As the context of this DBA thesis is the automotive supplier industry – a branch that is extremely regulated by different sets of norms – I posit that several examples mentioned by the authors above can be assumed as standards. Those standards comprise for instance the availability of an enterprise resource planning system, digitised supply chain management and warehousing processes, or internet-based CAD/CAE applications. On the other side, an aspect of IT that is described as a key element for enterprise agility and so far not widely available in firms is a proper sense and response capability (Van Oosterhout et al., 2006). Based on my on experience I can fully agree and also the interview data shows some evidence to underline this perspective. Pointing to the ability to proper respond in a timely manner, one of the participants highlighted the virtual collaboration of other companies in both directions within the firm and with all kind of business partners:

> "Best practice is a company like Google, which had for instance robust videoconference systems or home office models long before most of the companies in our industry. Technology must link us globally and enable us to cooperate without any incidents etc. Only then it is best practice." (Interviewee 16)

In the same vein, Park et al. (2017) set their focus on the role of IT regarding the core tasks of the sense-response process of organisations. They argue that *business intelligence* and *communication technologies* can best fit these tasks. While the former is defined as a set of functionalities that help to effectively build, manage, and access company-wide consistent data and extract patterns and insights from those complex data, the latter comprises all kind of tools and technologies that support interactive communication and collaboration. Table 4.6 summarises the key functionalities of both and provides some illustrative examples:

Table 4.6: Information technologies for sense-response tasks (Park et al., 2017, p. 655)

Type	Key functionalities	Examples
Business intelligence technologies	▪ Providing access to multiple data sources ▪ Rule-based exception handling ▪ Alerting managers about business events ▪ Accessing enterprise-wide consistent database ▪ Supporting what-if analysis ▪ Presenting data visually ▪ Extracting patterns from data	Digital dashboards, balanced scorecards, data warehouse, data mining, online analytical processing, web analytics
Communication technologies	▪ Disseminating relevant information to stakeholders in real time ▪ Information sharing and interaction within an organisation and with key partners ▪ Real-time virtual video/audio conference	Video/audio conferences, collaboration systems like Microsoft Teams, mobile apps, help desks, instant messaging, Web 2.0, blogs

This study does not argue that other types of information technologies like enterprise planning or supply chain management systems are able to support a proper sense and response capability as well. Nevertheless, I consider both business intelligence and communication technologies as particular important why the focus is set on their relationship with organisational agility. The enabling role of information and communication technology integration on supply chain agility will be discussed in depth in paragraph 4.3.5.2.

In order to span the different maturity levels, I will follow both the insights out of the case study as well as some theoretical recognition. Coming first to the recommendation of one of the interviewees:

> "From my point of view, the maturity level differs in terms of the scope how an organisation is able to digitalise its processes along all users/people (and thus locations) who are involved in such a process." (Interviewee 12)

Reflecting this statement with the literature, it falls into the category of *digitised process reach* and is defined as the "extend to which a firm deploys common, integrated, and connected IT-enabled processes. High reach is associated with processes that tie activity and information flows across departmental units, functional units, geographical regions, and value network partners" (Sambamurthy et

al., 2003, p. 248). Taking this into account leads to the following maturity levels of information and communication technology:

Table 4.7: Maturity levels of information and communication technology

Enabler	Level 1	Level 2	Level 3	Level 4
Information and communication technology	No availability or lack of business intelligence and communication technologies (as key types to support the sense-response process of organisations)	Low reach of business intelligence and communication technologies	Medium reach of business intelligence and communication technologies	High reach of business intelligence and communication technologies

4.3.1.5 Strategic Foresight

Following the sensing capability of a firm mentioned above, David Teece and his co-authors point out that "in environments characterised by deep uncertainty, companies must sense and/or generate options for growth before the market logics of those options become apparent to all" (Teece et al., 2016, p. 21). They define four sets of capabilities to achieve this outcome: *generative sensing*, *sense making*, use of *scenario planning*, and the purchase of *real options*. While generative sensing is about hypothesis building and learning (testing these hypothesis), sense making describes the actions undertaken to gain confidence in the tested hypothesis (e.g. identifying coherent patterns). Scenario planning can support generative sensing by methodologically creating numerous future scenarios and responses to be thought through. From this, real options – i.e. certain business activities – shall be analysed and executed. Such real options can be purchased e.g. through research and development investments.

Put differently, Sarker and Sarker (2009) also emphasise the sense making routines of firms to anticipate and recognise possible crises or competitive action. Such routines are underlined by continuously *scanning the environment*. Practices for environmental scanning comprise for instance trend research in the wider business context, competitor analysis, or generating a sound understanding of

customer desires (Zollo & Winter, 2002). In order to feed back such insights into organisational procedures, one of the study participants highlighted the dynamic character of the respective systems:

> "Best practice was a rolling forecast system, which was updated every three months instead of a rigour planning system (as modern organisations have to adapt quickly). Create a plan but be prepared for variety." (Interviewee 2)

During the discussions of such best practice examples another important aspect occurred, which is reflected in the following statement:

> "I do not know a best practice example. But a better practice is like we do it here: The overall process is very rigid and generic, and the responsible people are too far away from the business. They have too less interaction with the people who actually would apply the outcome of the foresight activities. When I think about, I would agree to the practices mentioned in the literature, but I would add the fact that the people responsible for doing all the foresight work have to be as close as possible to the real business in the business units. This means not in the same organisation but somehow closely aligned etc." (Interviewee 16)

While the reviewed literature mainly concentrates on the practices and processes, this participant pointed to the people behind. He referred to an in his opinion unsatisfying setup of the actors orchestrating several of the foresight activities, who are mainly located in the company's headquarter. An effect out of this could be that such foresight activities, even if carried out carefully and with proper methodologies, never reach the necessary depth to be executed by the respective managers acting in front of or close to the customer.

In the same context, another colleague underlined the close interlocking with the main processes installed to foster decision-making:

> "Most important is that strategic foresight activities are strictly linked to all major processes, which lead to mid-term or long-term decisions. These activities must not be decoupled." (Interviewee 12)

Combining the theoretical and practical findings above allows defining the respective maturity levels in the following table on the next page:

Table 4.8: Maturity levels of strategic foresight

Enabler	Level 1	Level 2	Level 3	Level 4
Strategic foresight	Activities lack a sound methodological base (generative sensing, sense making, scenario planning, and the purchase of real options), they are neither linked to decision-making nor orchestrated by people acting close to the business	Activities underlie a sound methodological base to a certain degree, they are partly linked to foster decision-making and sometimes orchestrated by people acting close to the business	Activities underlie mostly a sound methodological base, they are widely linked to foster decision-making, and are usually orchestrated by people acting close to the business	Activities underlie a sound methodological base, they are strictly linked to foster decision-making, and are orchestrated solely by people acting close to the business

4.3.1.6 Robust Strategy

Along with the topic of strategic foresight before comes the requirement for organisations to establish a *robust strategy*. A VP acting as Head of Strategy provided the following explanation:

> "A robust strategy is one that is precise at the beginning (e.g. in the first two to three years) and is able to manage the fuzziness, which automatically occurs after this timeframe. A possibility is for instance working with different and alternative scenarios instead of a rigid plan. The more this practice is implemented, the higher the maturity level." (Interviewee 12)

Also Worley and Lawler (2010) define the two aspects mentioned in the statement above as core elements of a robust strategy, namely a *strong future focus* and a *flexible intent*. Regarding the former, they refer to a firm's capability to play with the future, consider potential contingencies, and minimise surprises by external events. This is in particular facilitated by the creation of a variety of short- and long-term scenarios. With a flexible intent they describe a strategy characterised by breadth (alternatives in terms of products, services, and markets addressed), aggressiveness (varying amount of urgency, enthusiasm, and resources deployed), and differentiation (distinguished offerings compared to the competition). As a

third element the authors point to a fundamentally different *economic logic* compared to traditional strategies. The core idea is that "[…] short-term performance derives from the rent appropriated in a momentary advantage but that long-term performance derives from cumulating rents over a series of advantages" (Worley & Lawler, 2010, p. 194).

Similar to interviewee 12, another participant emphasised the accuracy of a strategy:

> "The strategy must be clear and precise, which is basically also mentioned in the practices from the literature. On the other side, a company must stick to its strategy. The term *robustness* is characterised by the fact that a company adheres to it. Only then it can become best practice." (Interviewee 16)

Here, a second important content is the reference to a firm's *adherence* to its strategy. Also from my own experience I know various examples where mid- or long-term objectives failed because the strategy to reach these has been numerously changed or neglected. A possibility to overcome this was discussed with interviewee 12 who recommended underpinning a strategy always with a bundle of smaller, dedicated projects. In doing so, the strategy gets a kind of foundation and deviations will become visible more faster as the tracking takes place in several single project-based activities:

> "It is important that a systematic mapping of internal projects towards its contribution to the corporate strategy is in place. On the one hand, you can ensure that every internal project exists for a specific reason, and on the other hand, you find the white spots of your implementation plan." (Interviewee 12)

Taking these insights into account will allow drawing the respective maturity levels as follows:

Table 4.9: Maturity levels of a robust strategy

Enabler	Level 1	Level 2	Level 3	Level 4
Robust strategy	Strategy is occasionally underpinned by dedicated project-based activities and neither characterised by an alternative economic logic nor a strong future focus or flexible intend	Strategy is partly underpinned by dedicated project-based activities and only sometimes characterised by an alternative economic logic, a strong future focus, and flexible intend	Strategy is largely underpinned by dedicated project-based activities and mostly characterised by an alternative economic logic, a strong future focus, and flexible intent	Strategy is fully underpinned by dedicated project-based activities and characterised by an alternative economic logic, a strong future focus, and flexible intent

4.3.1.7 Stakeholder Buy-In

Coming to the last enabler within the dimension of organisational agility, I would like to start with a participant's quote:

> "An important enabler is the buy-in of the shareholders. I believe that you can't make a firm more agile than the mindset of its shareholders." (Interviewee 10)

With this statement the interviewee pointed to a company's circle of shareholders as usually the most powerful steering body and thus essential to convince when adopting to agile practices. Based on a case study with ING Bank in the Netherlands, Birkinshaw (2018) confirms this necessity and outlines three success factors in persuading *shareholders* and the *executive board*: First, reporting from other companies where agile methods had demonstrably improved customer orientation and employee engagement. Second, demonstrating track records from small pilot activities in the own organisation; and third, sophisticated arguing the need of a new way of working to stay competitive in today's hypercompetitive environment.

Another participant, acting over almost ten years as the Executive VP of one of the business units, added a firm's *advisory board* as this is usually in very close contact and exchange to the shareholders and the executive board:

> "Beside the buy-in from shareholders, executive board, and works council, also the buy-in from a company's advisory board is very important or respectively the close collaboration with them." (Interviewee 02)

For instance in the company where the study took place, the advisory board seemed to have a strong influence on decisions that have been taken during the regular shareholder meetings. Thus, winning these people for one's standpoint upfront was often the decisive factor for getting the aspired agreements.

As a further important contribution to the discussion on stakeholder buy-in, interviewee 12 underlined the usual strong position of the *works council* here in Germany. Furthermore, he explained the dependency of the commitment of such stakeholders to the maturity level of the enabler itself:

> "Often and in particular here in Germany, the works council is a powerful institution that needs to be informed and convinced. […] The stronger such a commitment is (along all the different stakeholders), the higher is the maturity level." (Interviewee 12)

In the same vein, also interviewee 3 described the maturity levels in this category:

> "Buy-in of all the mentioned parties (shareholders, executive board, works council, external regulators) is very important, in particular the first three. The maturity levels can be assessed according to the degree these parties are involved and stay behind the path towards agility." (Interviewee 3)

To summarise, the reaction of stakeholders to major changes – like the transformation towards an agile organisation – needs to be assessed as early as possible and several concerns have to be allayed. Resulting from the discourse above, the maturity levels are accordingly depicted in the following table on the next page:

Table 4.10: Maturity levels of stakeholder buy-in

Enabler	Level 1	Level 2	Level 3	Level 4
Stakeholder buy-in	A company's shareholders, the advisory and executive board, and the works council have major concerns regarding an agile transformation	A company's shareholders, the advisory and executive board, and the works council support an agile transformation only partly	A company's shareholders, the advisory and executive board, and the works council largely support an agile transformation	A company's shareholders, the advisory and executive board, and the works council fully support an agile transformation

4.3.1.8 Summary of Maturity Levels within Organisational Agility

Finally, the maturity levels of the main enablers behind organisational agility are summarised in table 4.11 on the next pages. It is important to note that this table is a compact depiction of tables 4.3 - 4.10, thus no additional content added. Nevertheless, the comprehensiveness of having all the enablers and maturity levels together made it worth for me to include this overview here (as opposed in the appendix). The same logic will be applied in the next sub-sections.

Table 4.11: Maturity levels within organisational agility

Enabler	Level 1	Level 2	Level 3	Level 4
Organisational structures and power distribution	Command and control organisational form where lots of hierarchy levels exist and decisions are mainly taken from the top	Project-based organisational structure primarily described by a symbiotic relationship between structural and process organisation	Organic organisational form characterised by few levels of hierarchy, wide span of control, distributed decision-making power with clear responsibilities, and existence of informal networks	Organic organisation where additionally organisational slack is maintained efficiently
Culture	Punishment culture or a culture based on fear	Culture of change (underpinned by employee learning, failure tolerance, and trust) as well as climate that enables innovative behaviour are partly available in the organisation	Culture of change (underpinned by employee learning, failure tolerance, and trust) as well as climate that enables innovative behaviour can be widely found in the organisation	Culture of change (underpinned by employee learning, failure tolerance, and trust) as well as climate that enables innovative behaviour are established at every level in the organisation
Absorptive capacity (leveraging external knowledge)	Acquisition (externally generated knowledge – critical to the firm's operations – is identified and acquired)	Acquisition and additionally assimilation (the firm possesses routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources)	Acquisition, assimilation, and additionally transformation (routines are developed and refined to facilitate the combination of existing knowledge and the newly acquired and assimilated knowledge)	Acquisition, assimilation, transformation, and additionally exploitation (routines are available that allow to refine, extend, and leverage existing competencies or create new ones by incorporating acquired and transformed knowledge into the firm’s operations)

Table 4.11 (continued)

Enabler	Level 1	Level 2	Level 3	Level 4
Information and communication technology	No availability or lack of business intelligence and communication technologies (as key types to support the sense-response process of organisations)	Low reach of business intelligence and communication technologies	Medium reach of business intelligence and communication technologies	High reach of business intelligence and communication technologies
Strategic foresight	Activities lack a sound methodological base (generative sensing, sense making, scenario planning, and the purchase of real options), they are neither linked to decision-making nor orchestrated by people acting close to the business	Activities underlie a sound methodological base to a certain degree, they are partly linked to foster decision-making and sometimes orchestrated by people acting close to the business	Activities underlie mostly a sound methodological base, they are widely linked to foster decision-making, and are usually orchestrated by people acting close to the business	Activities underlie a sound methodological base, they are strictly linked to foster decision-making, and are orchestrated solely by people acting close to the business
Robust strategy	Strategy is occasionally underpinned by dedicated project-based activities and neither characterised by an alternative economic logic nor a strong future focus or flexible intend	Strategy is partly underpinned by dedicated project-based activities and only sometimes characterised by an alternative economic logic, a strong future focus, and flexible intend	Strategy is largely underpinned by dedicated project-based activities and mostly characterised by an alternative economic logic, a strong future focus, and flexible intent	Strategy is fully underpinned by dedicated project-based activities and characterised by an alternative economic logic, a strong future focus, and flexible intent
Stakeholder buy-in	A company's shareholders, the advisory and executive board, and the works council have major concerns regarding an agile transformation	A company's shareholders, the advisory and executive board, and the works council support an agile transformation only partly	A company's shareholders, the advisory and executive board, and the works council largely support an agile transformation	A company's shareholders, the advisory and executive board, and the works council fully support an agile transformation

4.3.2 Maturity Levels within Workforce Agility

"Surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets driven by customer-defined products and services requires an agile workforce" (Muduli, 2016, p. 1580). With reference to the Diamond of Corporate Agility (see figure 4.2), the dimension where the author above is referring to is labelled as workforce agility. The major enablers comprise 1) employee involvement/empowerment, 2) teamwork environment, 3) organisational learning and training, 4) access to consistent and accurate corporate information, 5) resilience, and 6) reward systems/incentive schemes (see sub-section 2.3.6).

4.3.2.1 Employee Involvement/Empowerment

First, it is necessary to briefly clarify some supposed ambiguity regarding a decentralised decision-making process with clear responsibilities. While I discussed this within the enabler of organisational structures and power distribution (in the dimension of organisational agility), some authors consider it as essential in order to empower people towards greater autonomy and thus assign it to the dimension of workforce agility (Alavi et al., 2014; Qin & Nembhard, 2015). I also came across this topic during one of my cases in the context of workforce agility, when talking to a Head of Human Resources (HR):

> "The more there is a clear commitment in place between the shareholders and the top management on decision-making authority, the more we are talking about best practice. Of course, these commitments have to be adhered to. Put differently, the rules have to be clear." (Interviewee 12)

However, as the dimension of organisational agility is central to the Diamond of Corporate Agility, it will indirectly influence the outer dimensions too. Consequently, also the underlying enablers and its practices could have validity for enablers in the outer dimensions. Thus, I will not repeat the discussion here and consider this aspect as already captured.

Nevertheless, Sumukadas and Sawhney (2004) develop and empirically test further power sharing practices aimed at moving important decisions into individuals and teams. On the one hand, they define *low power practices* containing quality circles (employee participation groups to improve work-related problems),

quality of work life committees, employee attitude surveys, and suggestions systems. On the other hand, within *high power practices* they cluster job enrichment (increased skill variety, autonomy, task significance, and performance feedback), job enlargement (adding up- or downstream tasks), and self-managed teams (work groups with the entire responsibility of a product or service). My interview data show evidence for all these practices, in particular the idea and effectiveness of self-managed teams was highlighted several times. Furthermore, establishing a high skill variety was extraordinary emphasised by two of the participants as foundation to empower employees in the form of self-managed individuals or teams:

> "On the other hand, the foundation of empowerment is a high variety of skills. The more sophisticated and institutionalised the methods are to get this variety of skills, the more we are coming towards best practice. I made very good experience with a continuous job rotation, in particular at the higher management levels." (Interviewee 17)

> "Employees get empowered by possessing a broad set of skills. This is the main enabler for responding to any unforeseeable change, as the change might be unexpected but not unknowing." (Interviewee 25)

At this point it is necessary to give a brief outlook, as another enabler in the dimension of workforce agility comprises organisational learning and training. There, I will discuss methodologies to systematically close knowledge gaps and thus enhance the skillset of individuals. Here, within the enabler of employee involvement/empowerment, I consider the obtainment of higher skill variability by getting more responsibility and thus learning to act in new situations with more freedom for decisions. As outlined above, practices include for instance job enrichment, enlargement, or rotation. Taking also the remaining aspects from the former discussion into account, the following maturity levels can be sketched:

Table 4.12: Maturity levels of employee involvement/empowerment

Enabler	Level 1	Level 2	Level 3	Level 4
Employee involvement/ empowerment	The organisation lacks low power practices (quality circles, quality of work life committees, employee attitude surveys, and suggestions systems) and high power practices (job enrichment, enlargement and rotation, and self-managed teams)	Low power practices and high power practices are partly available in the organisation	Low power practices and high power practices can be widely found in the organisation	Low power practices and high power practices are established at every level in the organisation

4.3.2.2 Teamwork Environment

Muduli (2016) conducted a study with more than 300 participants in selective Indian industries and found a positive and significant relation of *teamwork* with workforce agility. Among four other factors, teamwork has even the greatest influence. He considers teamwork as an organisational practice and to operationalise the concept he follows the approach of Breu et al. (2002) who differentiate between internal team-working environment, external team-working environment, intra group team-working environment, and cross-functional team-working environment. According to the literature, best practice is accomplished the more an organisation encourages the employees to work in teams respectively the more the different *team-working environments* mentioned above are promoted.

Considered through a more practical lens and with reference to my interview data, the relevant participants somehow distinguished between teamwork itself and the physical environment where the work takes place and how this can promote teamwork in return. As the study took place at an automotive supplier where the majority of the activities is organised in projects with respective members from al lot of different functions, it is not a surprise that encouraging this kind of

teamwork was seen as a kind of premise to make work successfully happen. A typical example is the product development process as a guideline how to bring an acquired project successfully into serial production. However, according to the interviewees the aspect of teamwork becomes in particular important for activities where such standard processes are hard to apply. For instance, when new opportunities arise that do not start as usual with a request for quotation (RFQ) from the customer, but instead with the request to enter in pre-development activities or a concept study. Then, the firm tends to set up new hierarchies or puts together an interdisciplinary team without giving the full power to work across organisational boundaries and thus violates one of the core principles of successful teamwork, namely *autonomous action*:

> "I would say that the highest maturity level is achieved when the organisation encourages teamwork for new projects or opportunities where people get mixed together to work towards a common goal without installing any additional hierarchy. All team members are somehow equal and get the full support to work also across the boundaries of the own organisation." (Interviewee 7)

In the same vein, another participant from the HR department, acting in the role of a Business Partner for several development teams, highlighted the selection of employees with complementary skills for such projects:

> "The encouragement of employees to work in teams is super important to enable workforce agility. As an example, when we started to work on the lean initiative or the micro mobility project, we immediately set up teams with complementary skills. However, to be really best practice, it has also to be considered that with each new team member a gap is created elsewhere in the organisation. Here, solutions must be included how to close these gaps." (Interviewee 25)

As outlined above, she further pointed to a very important aspect that can lead to massive issues if not considered carefully: the fact that creating a new team often implies a gap elsewhere in the organisation and thus a lack of competence or capacity. Taking this also into account and defining countermeasures was described as a best practice in this category.

On the other side, also the physical environment can have a significant role in fostering teamwork as an organisational practice. One of the interviewees referred to the so-called *working world* of the company:

> "The […] working world is already good practice from my point of view. Based on the flexible office concept, teams are able to sit together from day to day according to e.g. taskforce activities etc. When I remember the escalation on one of the […] projects, the responsible people from the different departments were able to sit ad hoc close to each other and work in a project team (despite the fact that all had a different disciplinary home base)." (Interviewee 10)

The philosophy of the company is that its development and administration employees require a functional workplace for their dynamic daily project business – whether in North America, China, or Germany. The main elements are consistent desk sharing, standardised hardware, access to all data via the globally networked communication systems, and technology that fosters home office work. According to internal studies and surveys, this practice boosts the international and interdisciplinary project teams' performance and efficiency. Also from my own experience, I have numerous examples where we were able to quickly and efficiently work in teams due to such a flexible infrastructure around us.

To define the maturity levels of this enabler, I will in particular take the findings from the interviews into account as the literature describes the enabling role of teamwork environment in a broad context without delivering detailed insights about best practice. The result is summarised in the following table:

Table 4.13: Maturity levels of teamwork environment

Enabler	Level 1	Level 2	Level 3	Level 4
Teamwork environment	Teamwork as organisational practice is hardly promoted by neither continuously forming project teams nor providing a flexible infrastructure (e.g. desk sharing and standardised hardware)	Teamwork as organisational practice is partly promoted by usually forming project teams and providing a flexible infrastructure in some parts of the company	Teamwork as organisational practice is widely promoted by mostly forming project teams and providing a flexible infrastructure in large parts of the company	Teamwork as organisational practice is fully promoted by continuously forming project teams and providing a flexible infrastructure throughout the entire company

4.3.2.3 Organisational Learning and Training

Starting with practices mentioned in the literature, a high maturity level is reached as soon as the organisation encourages and facilitates *learning* and *training* to enhance employees' adaptability and flexibility in a changing business environment (Muduli, 2016). Qin and Nembhard (2015) classify training into three types: First, *cross-training* in order to shift workers dynamically to where they are needed. By obtaining a multi-skilled workforce over a period of time, this practice is in particular beneficial when the conditions in the business environment are moderately varying. However, when companies are faced with highly unpredictable and radical changes, *on-demand training* should be the preferred choice. Here, a just-in-time delivery of the right skills is crucial to recover the workers' job performance. Third, training can also indirectly leverage workforce agility by e.g. teaching problem solving or reasoning. The authors describe this in the context of *training for indirect effects*. All these aspects have been widely confirmed during the interviews, especially the necessity to offer a portfolio of ad-hoc trainings for demands that occurred unplanned.

However, the case study revealed that besides the *pure facilitation* of trainings also the *availability of time* is of important weight. One of the most experienced interviewees, an Expert for Personnel Development, strongly outlined this aspect:

> "I agree to the practices mentioned in the literature, but two aspects are particularly important: on the one hand the time available for trainings and on the other hand the degree of freedom to choose the contents of the trainings. If you would ask our leadership team, most of them would tell you that there is no time for trainings. Making this time available is a crucial obligation that has to start at the top management in every company. Employee learning must be a top priority and every single employee in the organisation must know this. This is best practice." (Interviewee 17)

He explained many cases out of his over 30 years experience in the automotive industry where a lack of time was the largest barrier to establish a proper learning procedure. In particular here, the management of a company has to ensure free capacities for its workforce to fulfil their individual training requirements. In the same vein, another participant highlighted the precondition of available time as well as the role of supervisors:

> "Most of the enablers mentioned in the literature refer to common practices, at least in larger companies like we are. Appropriate training plans and IT-based cockpits look always good, but do employees have enough time to work carefully on their training needs? Thus, some important aspects are missing from my point of view: First, employees must have the necessary time for trainings. Second, supervisors must be a role model for such a learning culture. And third, closure of identified training needs has to be proactively demanded by the respective supervisors." (Interviewee 25)

Furthermore, she explained the *systematic identification* of training needs and hereby addressed a practice also well discussed in the scientific community (Muduli, 2016; Shafer et al., 2001). This can be done for instance by means of a 360 degree feedback process paired with a performance management system where competencies and desired results are transparently tracked (Shafer et al., 2001). The importance of feedback in general in the context of training became very clear when one of the interviewees reported a best practice example from his former employer where a new plant in India has been ramped up:

> "In a sequence of two weeks we had employees from India in Germany for training reasons. At each Monday after this two-week training period we arranged a session (60 min.) with the trainers and the trained employees of the past two weeks to give feedback to each other. In particular the feedback of the Indian colleagues to the trainers in Germany was very valuable to continuously improve the quality of the training concept." (Interviewee 10)

Here, the feedback in both directions had an extraordinary value as the trainings itself continuously improved over time. However, central to the usage of such managerial tools is an *organisational culture* that makes employee learning a top priority (Muduli, 2016). Again, an aspect also emphasised by the study participants. In order to establish such a culture, of course managers have to put learning and training for both themselves and their employees on their daily agenda and act as role models. To further encourage the workforce, a VP of HR illustrated the communication of positive examples:

> "In my eyes, training means also story-telling. What I mean is a kind of internal marketing of internal success stories. Tell people for instance about positive examples where change led to a big opportunity or progress for an employee. To foster agility, people have to be introduced to change as the new normal – and telling positive examples can do this. Also in this context, courage of employees has to be rewarded and this must be visible to all others by for instance bringing their stories to the remaining workforce." (Interviewee 7)

From my close collaboration to this interviewee, I knew quite well how he is living what he explained above. Examples comprised not only the intense communication but also small articles in the intranet or the company's mobile app. In the end, agile people need to be serious information seekers (Muduli & Pandya, 2018), which in turn needs encouragement by the firm. Thus, organisations have to provide the surrounding and fulfil the preconditions for their employees to awake the "[…] eagerness to get access to understand new aspects or technologies as well as learning through others experience or work" (Patil & Suresh, 2019, p. 160).

The combination of the theoretical and practical findings above leads to the respective maturity levels in the following table:

Table 4.14: Maturity levels of organisational learning and training

Enabler	Level 1	Level 2	Level 3	Level 4
Organisational learning and training	The organisation hardly encourages and facilitates learning and training, is sporadically laying out individuals' learning requirements, and its culture makes employee learning a low priority	The organisation partly encourages and facilitates learning and training, is laying out individuals' learning requirements to some extent, and its culture makes employee learning a medium priority	The organisation widely encourages and facilitates learning and training, usually provides the necessary time, is largely laying out individuals' learning requirements, and its culture makes employee learning a upper priority	The organisation fully encourages and facilitates learning and training, strictly provides the necessary time, is systematically laying out individuals' learning requirements, and its culture makes employee learning a top priority

4.3.2.4 Access to Consistent and Accurate Information

Considering the interview data, it looks like that the participants are used to a relatively high standard in terms of information sharing. There are no real concerns about the access of employees to information itself. Rather, the organisation should avoid an information overflow and spread it more purposefully instead:

> "In general, the more information people have, the higher the likelihood they may be less surprised by any unexpected change. Important is the kind of information the organisation shares and in this regard that not all information has the same influence to each employee. Thus, information flow must be target-oriented. This is an essential aspect to talk about best practice." (Interviewee 25)

In order to enlarge such an information flow towards an intensive knowledge-collaboration, enterprise social media (ESM) is an increasingly implemented platform for both internal communication and social interaction (Pitafi et al., 2018). ESM can be described as "web-based platforms that allow workers to communicate or broadcast messages, indicate or reveal particular co-workers as communication partners, post, edit, and sort text and files linked to themselves or others, and view the messages, connections, text, and files communicated, posted, edited and sorted by others" (Cai et al., 2018, p. 53). At the point in time when the case study took place, also this company was short in front of launching a new intranet. It was planned to have many elements of ESM as depicted in the definition above. One of the study participants, a business unit's Head of HR, was very close to this project and thus was able to describe his experiences and expectations. He explained the introduction of a company app a few years ago with the original intend to create in particular an information platform also for the blue-collar workers without access to a personal computer (as it could simply be downloaded on any mobile device). However, this app became more and more a communication tool, which allowed making comments or sharing of documents like shift schedules. Amongst other reasons, like an increased efficiency, also the good experience with this app finally led the company to the launch of a new intranet, accessible via both a personal computer and a mobile device. Having ESM in place was classified as best practice:

> "I see the usage of enterprise social media, or ESM, somehow at the end of the scale, i.e. best practice. A forerunner could be the use an employee app where also the features of ESM could be established to a certain degree." (Interviewee 7)

While talking about other practices from the literature and related maturity levels, he also pointed to another important aspect, namely the quality of the information itself:

> "Information must be tangible and understandable for every employee (not on an abstract and complex level). So I would agree to the practices mentioned in the literature, but I would add the quality of the information itself as well in terms of making differences between the maturity levels." (Interviewee 7)

When scrutinising the meaning of quality, he continued:

> "Corporate information is important, but in particular information about the objectives and the strategy of a company; the *why* is important." (Interviewee 7)

Behind this statement was the intention that people within every organisation need guidance and a purpose – *why* the things are done in which way (*how*) in order to achieve *what*. A proper information flow via selected channels can serve as a main contributor to spread this across the firm. Other crucial information comprise 1) a company's overall and the business unit's operating results, 2) new technologies that may affect employees, business plans/goals, and competitors' relative performance, and 3) lessons learned from history (Muduli, 2016).

Another interviewee provided a comprehensive summary at the end of his session that addresses the topics discussed above and from which the maturity levels can be derived in table 4.15:

> "In general, the more frequent information is shared, the more transparent and close this information is to the one the top management receives, and the more this procedure is institutionalised, the higher is the maturity level." (Interviewee 10)

Table 4.15: Maturity levels of access to consistent and accurate information

Enabler	Level 1	Level 2	Level 3	Level 4
Access to consistent and accurate information	Access to relevant and latest corporate information is hardly secured and additional information flow takes place occasionally	Access to relevant and latest corporate information is partly secured via IT technologies and additional information flow takes place	Access to relevant and latest corporate information is widely secured via state-of-the art IT technologies and additional information flow takes place target-oriented	Access to relevant and latest corporate information is permanently secured via modern platforms like ESM and additional information flow takes place target-oriented and frequently

4.3.2.5 Resilience

Based on former research within the field of workforce agility, Doeze Jager-van Vliet et al. (2019) conclude that employees' agility consists of two important aspects, namely *adaptive behaviour* and *proactive behaviour*. While the former is defined as an employee's ability to respond to on-going changes, the latter describes an employee's ability to create new opportunities. In this context, *resilience* is one of the main components underpinning an adaptive behaviour (besides teamwork and coping with change). Bohdana Sherehiy and her co-authors list it among the main attributes characterising an agile workforce and define it in the following way: "Resilience describes the ability to function efficiently under the stress and despite changing environment or when applied strategies have not succeeded. To this dimension belongs: 1) positive attitude to the changes, new ideas, and technology, 2) tolerance of uncertain and unexpected situations, differences in opinions and approaches, and 3) tolerance to stressful situations and coping with stress" (Sherehiy et al., 2007, p. 459). Other researchers define it in a similar way and Patil and Suresh (2019) conclude that the higher the resilience, the higher the tolerance to uncertain situations, and the better the ability of employees to cope with stress.

The discussion of the theoretical recognitions with the interview partners left no doubt of the enabling role of resilience itself. Rather, one of the main topics of interest was how to foster resilience. To shed light on this question, the following comments provide some insights:

> "I believe that main contributors are for instance the feeling to be part of a community (which is fostered e.g. by team events) or the support by our social office here at the location in […]. I think, in general being part of a team and having common successes and failures strengthens resilience." (Interviewee 7)

> "Resilience can be fostered by continuously running lessons learned sessions. For example in the case of a lost project, what were the reasons and what can be improved in the future? Such a lessons learned typically is on a team level, but should be enlarged on an individual level, i.e. individual lessons learned. In this respect it is also essential to question who did an extraordinary good job, as this awareness could help to apply such a particular good behaviour in another situation where things are fuzzy and unforeseen." (Interviewee 25)

The first statement points to a topic already discussed before, namely team work environment (see paragraph 4.3.2.2). Here, the defined maturity levels cover the extent to which teamwork as organisational practice is promoted. Along with this comes the other aspect mentioned by this interviewee, which points to the topic of *winning and loosing together*. In the case of failing, the other interviewee emphasised the sound conduction of lessons learned. Also this was already subject of intense discourse within paragraph 4.3.1.2, when discussing a proper failure culture. For that reason, I will not enter in this debate again. Instead, I will focus on figuring out the maturity levels behind resilience in a way to have some additional value, as it looks like there exists dependence on other enablers.

In the course of discussing the maturity levels, two aspects stood out: First, a *firm's recognition* that resilience gives comfort to handle ambiguity and thus enables the capability of workforce agility. Based on risk modelling, employees can take calculated risks and are able to bounce back quickly when situations suddenly change or setbacks arise. Second and in the context of change or high-velocity markets, the interviewees pointed to the necessity of a certain *degree of eagerness* and thus the availability of emotions. This is for instance reflected in the following statement:

> "I think that resilience is important, but only to a certain degree. The willingness to change has always to do with emotions towards something new and thus is somehow contradictory to a high degree of resilience where no emotion is available anymore. That means, best practice is a healthy dose of resilience, but not to the extend that there is no more room for passion towards change. The more this balance is met, the closer we are in the best practice range and only then it is an enabler for workforce agility." (Interviewee 17)

Accordingly, the maturity levels are depicted in the following table:

Table 4.16: Maturity levels of resilience

Enabler	Level 1	Level 2	Level 3	Level 4
Resilience	The organisation is neither or hardly aware of resilience as a key enabler for an agile workforce, nor pays attention to a healthy dose in order to keep emotions for change alive	The organisation is partly aware of resilience as a key enabler for an agile workforce and considers a healthy dose of resilience only to a certain degree	The organisation is widely aware of resilience as a key enabler for an agile workforce and takes care of a healthy dose in order to keep emotions for change alive	The organisation is fully aware of resilience as a key enabler for an agile workforce and strictly pays attention to a healthy dose in order to keep emotions for change alive

4.3.2.6 Reward Systems/Incentive Schemes

As determined by several empirical studies (Muduli, 2016; Sumukadas & Sawhney, 2004), *reward systems* are found strongly related with workforce agility. The main practices comprise that the organisation 1) has a reward system in place that encourages employees to acquire and demonstrate agility attributes and behaviours, 2) promotes skill-based pay systems, 3) encourages people through improvement-based incentives, and 4) adopts non-monetary rewards.

My case study interviews revealed that in particular *knowledge-* or *skill-based pay* and *incentives based on improvement* are associated with best practice. The first practice emphasises task variability (as employees are rewarded for the number and depth of skills), fosters rotation, and thus maximises workforce productivity by deploying people in a flexible manner:

> "Best practice is definitely payment according to skills. On the other end, payment schemes according to hierarchy are in my point of view poor practices, as these hinder the idea of rotation. For instance, a Sales VP has a higher salary range compared to a Head of HR, but it could have a significant positive impact having a person with so much experience in front of the customer in HR to e.g. push the recruitment of a strong sales force." (Interviewee 7)

> "I would even say that an organisation where everybody strives for *boxes* in the organisational chart (i.e. to become head of some department or team) is poor practice as it is completely contradictory to an agile organisation. In an agile organisation, the value of an employee (and therefore the salary) must be according to the competencies this employee possesses in combi-

nation with the responsibility for e.g. budgets – rather than to the box alone he is in, which is mostly linked only to the responsibility for e.g. budgets or P&L. With such an approach the flexibility of employees would increase significantly and most probably the agility of an organisation." (Interviewee 12)

The second practice – improvement-based incentives – fosters a culture of change as employees are motivated to hand in own ideas and continuously keep their eyes open for improvement potentials. A best practice example for rewarding this not purely monetary was described by a Head of HR from his former employer:

"A good or even best practice example of how to incentivise is to select among the suggestions for improvements with a significant impact to the company. My former company took this selection and the owner drew a lot within the yearly works council meeting. The winner could choose one of the company-wide overseas locations to spend two weeks for training and also some leisure time. This period was fully organised and financed by the company and the employee got the opportunity to learn about a new culture, expand his network, get trainings, have fun, etc. The entire initiative had a kind of event-character and was highly appreciated by the whole workforce." (Interviewee 10)

Regarding the recognition of employees' agility attributes as another practice, the feedback of the interviewees was more cautious. In order to incentivise agile behaviour, the company needs a very precise description of what constitutes such a behaviour and what not. Against the backdrop that in parts agility itself is still a fuzzy construct, the participants were carefully in recommending this aspect of a reward system. However, highly emphasised was performance-based pay that covers an *individual-based*, *group-based*, and a *company-wide* incentive program. While an individual reward system is normally widespread across the automotive industry and usually a firm's (senior) management is rewarded for entire company goals, group-based incentives are not so common. Having in mind other enablers like empowered teams, teamwork itself, or resilience, one of the interviewees highlighted the crucial role of such a model:

"In particular group-based incentives will support the idea of small and dedicated teams (which is a key element of agile working). Maybe also resilience is facilitated in this regard, as also individual setbacks are overcompensated by a good performance of the team. Having such group-based incentive programs in place would be best practice in the context of an agile enterprise." (Interviewee 25)

After interviewing more than 50 plant managers across the manufacturing industry in Canada, Sumukadas and Sawhney (2004) conclude that team-based incentives significantly motivate employees to acquire and exhibit agility. Taking the theoretical and practical insights into account will allow drawing the respective maturity levels as follows:

Table 4.17: Maturity levels of reward systems/incentive schemes

Enabler	Level 1	Level 2	Level 3	Level 4
Reward systems/incentive schemes	The organisation lacks a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance	In the organisation exists partly a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance	In the organisation exists widely a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance	At every level in the organisation exists a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance

4.3.2.7 Summary of Maturity Levels within Workforce Agility

Before summarising the maturity levels of the attributes mainly enabling workforce agility, I want to include one more quote from the case study. Here, the interviewee drew a very illustrative comparison in the entire context of workforce agility:

> "From my point of view, key to agility are people with so-called *T-profiles*. The vertical bar represents the depth of related skills and expertise in a single field, whereas the horizontal bar is the ability to collaborate across disciplines with experts in other areas; and of course also to apply this knowledge in areas of expertise other than one's own. A key element of agility is self-responsibility of the team; here depth of knowledge is necessary that these people are able to work self-sufficient. A second key element is the ability to adapt to a high-velocity environment. Here, the knowledge in other areas is essential to make this happen in a timely manner." (Interviewee 16)

I personally like this statement a lot, as it describes the phenomenon of workforce agility in a practical and comprehensive way. It can be used as a reminder

for the reader when applying the maturity model in the daily business or when explaining the idea to colleagues, respectively employees.

The respective summary of the maturity levels is depicted on the following pages:

Table 4.18: Maturity levels within workforce agility

Enabler	Level 1	Level 2	Level 3	Level 4
Employee involvement/empowerment	The organisation lacks low power practices (quality circles, quality of work life committees, employee attitude surveys, and suggestions systems) and high power practices (job enrichment, enlargement and rotation, and self-managed teams)	Low power practices and high power practices are partly available in the organisation	Low power practices and high power practices can be widely found in the organisation	Low power practices and high power practices are established at every level in the organisation
Teamwork environment	Teamwork as organisational practice is hardly promoted by neither continuously forming project teams nor providing a flexible infrastructure (e.g. desk sharing and standardised hardware)	Teamwork as organisational practice is partly promoted by usually forming project teams and providing a flexible infrastructure in some parts of the company	Teamwork as organisational practice is widely promoted by mostly forming project teams and providing a flexible infrastructure in large parts of the company	Teamwork as organisational practice is fully promoted by continuously forming project teams and providing a flexible infrastructure throughout the entire company
Organisational learning and training	The organisation hardly encourages and facilitates learning and training, is sporadically laying out individuals' learning requirements, and its culture makes employee learning a low priority	The organisation partly encourages and facilitates learning and training, is laying out individuals' learning requirements to some extent, and its culture makes employee learning a medium priority	The organisation widely encourages and facilitates learning and training, usually provides the necessary time, is largely laying out individuals' learning requirements, and its culture makes employee learning a upper priority	The organisation fully encourages and facilitates learning and training, strictly provides the necessary time, is systematically laying out individuals' learning requirements, and its culture makes employee learning a top priority

Table 4.18 (continued)

Enabler	Level 1	Level 2	Level 3	Level 4
Access to consistent and accurate information	Access to relevant and latest corporate information is hardly secured and additional information flow takes place occasionally	Access to relevant and latest corporate information is partly secured via IT technologies and additional information flow takes place	Access to relevant and latest corporate information is widely secured via state-of-the art IT technologies and additional information flow takes place target-oriented	Access to relevant and latest corporate information is permanently secured via modern platforms like ESM and additional information flow takes place target-oriented and frequently
Resilience	The organisation is neither or hardly aware of resilience as a key enabler for an agile workforce, nor pays attention to a healthy dose in order to keep emotions for change alive	The organisation is partly aware of resilience as a key enabler for an agile workforce and considers a healthy dose of resilience only to a certain degree	The organisation is widely aware of resilience as a key enabler for an agile workforce and takes care of a healthy dose in order to keep emotions for change alive	The organisation is fully aware of resilience as a key enabler for an agile workforce and strictly pays attention to a healthy dose in order to keep emotions for change alive
Reward systems/ incentive schemes	The organisation lacks a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance	In the organisation exists partly a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance	In the organisation exists widely a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance	At every level in the organisation exists a reward system that contains skill-based pay, improvement-based incentives, and covers both individual and group performance

4.3.3 Maturity Levels within Customer Agility

Coming to the outer dimensions of the Diamond of Corporate Agility, the first one is customer agility. As outlined in sub-section 2.3.2, the main enablers constitute (1) a firm's customer-sensing capability, (2) its customer-responding capability, and (3) the risk propensity of senior management. One of the interview partners, a Senior VP with almost 30 years experience in the company, put these enablers in a corporate context and thus demonstrated the practicability of the construct:

> "In general, the three enablers of sensing, responding, and risk propensity make sense. If I compare it to the typical process chain, at the beginning you have to sense customer needs. Then you need the willingness to serve these needs, where always some degree of risk propensity is necessary. Finally you have to execute, or in other words, respond." (Interviewee 11)

The single enablers will be discussed on the following pages.

4.3.3.1 Customer-Sensing Capability

To operationalise a firm's sensing capability, scholars apply the concept of *market orientation* (Kohli et al., 1993; Narver et al., 2004). This implies both "responsive market orientation, which addresses the expressed needs of customers, and proactive market orientation, which addresses the latent needs of customers – that is, opportunities for customer value of which the customer is unaware" (Narver et al., 2004, p. 334).

This differentiation was also highlighted by most of the interviewees, arguing that in the automotive supplier industry often car manufacturers specifically define the products. In order to sense such *expressed* needs, or put differently, sensitise sales, R&D, and other involved parties for solutions, the so-called *car clinic concept* was mentioned as a best practice example:

> "Best practice for sensing is for instance our car clinic concept, where a large amount of employees test several existing and new functions from our company and evaluate them afterwards." (Interviewee 11)

> "Take the example of our car clinic. This can help to understand and catch the current customer needs, but it will be hard to capture future customer needs. This is also something that needs to be considered: collecting improvements for current customer needs and collecting insights for future customer needs. Both are essential but require a different methodology." (Interviewee 13)

The car clinic is a daylong event taking place once a year at the company's headquarters in each of the three major regions Europe, China, and North America. The key point is to give the employees the chance to experience several of the existing and new products and receive feedback from them on different dimensions, e.g. the usability of the function, how much one is willing to pay for such a function, or potentials for improvement. The products are mounted into vehicles of different brands, what implies that the products already posses a high maturity level or are already in serial production. Experiences from the past show that the activity often ended in numerous incremental improvements of the existing product portfolio. However, as already outlined in the statements above, customers' *latent* needs are hard to detect in this way. Here, another perspective is necessary. The Head of a Product Unit within the business unit "Exterior" expressed the following:

> "A good approach is to consider the customer needs from a more abstract level; e.g. not how to open the vehicle door but rather how to enter the vehicle. I mean also questioning the way of access in this case." (Interviewee 11)

Taking up this comment in the discussion with the Manager of the Innovation Team led to the following insights:

> "The most important aspect is to put oneself in the position of the end-customer, the so-called *customer journey*. In our case, we observed people in entering and leaving the vehicle in order to very precisely understand this procedure. We then built up some prototypes with new product ideas and made this experience again and again. With this knowledge in place, we went to the customer and started the discussions." (Interviewee 23)

Having this in mind, I was in particular interested about the procedure how to address such a new idea in front of the customer. In order to shed light on this question, I discussed the topic with two highly experienced interviewees from the sales department. One of them, a Director responsible for many strategic topics, explained proper access to both the customer's purchasing department and R&D as the first important prerequisite to pitch such new ideas. By doing so, the likelihood to regularly participate in pre-development project rises and thus a kind of pole position as soon as the customer spreads the RFQ in the market. She continued:

> "Ideally, you have contact to the Customer Experience Managers (as these persons were called at one of my customers), as they elaborate the customer journey, describe product requirements, cluster them, and evaluate how the single commodities interact." (Interviewee 21)

In the same vein, also the Key Account Manager for one of the company's biggest customers (in terms of sales) reported a case out of almost 30 years automotive experience where contacting the right people made the difference:

> "I remember a best practice example where we did not as usually contact the purchasing and development departments at our customers, but where we showed a presentation of our product ideas to the marketing department. This ended in the creation of a demand where the customer was not aware of before. The marketing department is important, as they are defining the so-called *customer value* of a car and evaluate how much the customer is willing to pay for this. Thus, they also define target prices to a certain extend and draft the specification sheets. Since this experience, we always try to keep in close contact to the relevant people out of the marketing departments and ask for regular pitches of our ideas." (Interviewee 19)

In a nutshell, the more a firm is able to create ideas by putting oneself in the role of the end-customer and presenting these ideas to the decision-makers at the customer where the value for the end-customer is defined, the higher the likelihood to sense the latent needs.

To foster a critical internal evaluation of such ideas, one of the participants mentioned the inclusion of highly knowledgeable people who are able to challenge the product ideas:

> "[…]. We called it *the challenger days*, where we invited two challengers to a two-day workshop session and asked for a very critical feedback on our product visions. This gave us valuable insights on certain risks. On the other hand, the sessions were very constructive as everybody was aware that the objective of the whole meeting was to receive critical feedback. I think this made it a little easier for our engineers to cope with such a feedback, as these people are often emotionally connected to their ideas." (Interviewee 23)

This shows the importance of a sound methodology behind being successful in sensing customer needs and was also highlighted during the case study in the context of the maturity levels:

> "A clear strategy or methodology of how to collect and assess customer needs is a crucial characteristic between poor and best practice. But also the process how these insights are distributed and utilised within the organisation." (Interviewee 11)

In the literature, the process is often labelled *intelligence generation*, while a solid strategy comprises both traditional tools (e.g. scanning, focus groups, market surveys) and high touch techniques like working closely with lead customers, intense customer visits, and self-critical benchmarking (Slater & Narver, 2000). Roberts and Grover (2012 a) add the *extrapolation of key trends* to gain insights into what users in a current market will need in the future and the continuous attempt to develop new ways of looking at customers and their needs.

To summarise the insights above, first a firm's sensing capability implies both the expressed and the latent needs of its customers. Second and in order to classify best practices, the sensing-methodology for both needs must be different and sophisticated, and excellent access to decision-makers at the customer in an early product phase must be granted. This is reflected in the following table:

Table 4.19: Maturity levels of customer-sensing capability

Enabler	Level 1	Level 2	Level 3	Level 4
Customer-sensing capability	Lack of methodologies to sense and evaluate customers' expressed and latent needs, and no access to key decision-makers at the customer (in charge of defining the value for the end-customer)	Sound methodologies are partly defined and applied in order to sense and evaluate customers' expressed and latent needs, and access to key decision-makers at the customer exists to a certain degree	Sound methodologies are widely defined and applied in order to sense and evaluate customers' expressed and latent needs, and access is largely granted to key decision-makers at the customer	Sound methodologies are defined and applied in order to sense and evaluate customers' expressed and latent needs, and access is granted to key decision-makers at the customer

4.3.3.2 Customer-Responding Capability

The examination of the literature in sub-section 2.3.2 suggests that customer-responding capability is composed of *customer response expertise* and *customer response speed*. "Customer response expertise is important because a response that does not satisfy customer needs is unlikely to succeed. Customer response speed is necessary because a delay in response may result in an organisation fail-

ing to capitalise on a fast-moving market opportunity" (Jayachandran et al., 2004, p. 220).

The interviewees widely agreed in particular on the aspect of speed, respectively even emphasised it as *conditio sine qua non* in order to posses customer-response capability at all. Indications comprise for instance the promptness of implementation for planned activities towards customers or the time from identifying a customer need until the first response on it (Roberts & Grover, 2012 a). In the context of responding properly within a short timeframe, one of the participants drew a comparison to the working modus of a task force. Here, normally all involved people are carefully selected and fully dedicated to commonly solve a problem that is time-sensitive. In this manner, an excellent responding capability can be achieved. Another interviewee of the study, a younger woman acting already in different management positions within the sales department, had a similar intention when describing the following:

> "[...] in order to have an excellent customer-responding capability, the technical and commercial decision power must be combined at one person (instead of being separated). I know examples where it was not the case and customer areas only had a limited entrepreneurial scope, and this made the response slow or even unattractive for the customer. I would even say the more entrepreneurial scope is given to a team that is dedicated to a customer account, the more it is best practice. This is for instance reflected in a customer team structure where the head has the full P&L responsibility and where the project engineers are part of the customer team." (Interviewee 21)

According to these explanations, the topics of power distribution (paragraph 4.3.1.1) and self-managed teams (paragraph 4.3.2.1) seem to have a major influence on customer-responding capability. Thus, I will take the subject again in section 5.2 when discussing possible dependencies between the enablers.

Coming back to the actual debate of the maturity levels of customer-responding capability, the data collection revealed a major significance of creating *customer value*:

> "The central aspect for this enabler is the creation of customer value. Here, both have to be considered, customer value at the direct customer and at the end-customer. The more customer value is created, the higher the maturity level. In this context the aspect of a unique selling point (USP) is often discussed. It is important to differentiate between our USP and if this USP is also fully valid or recognised by the customer." (Interviewee 19)

This aspect gains even more importance in the context of this study, as the firm as an automotive supplier has usually no direct relationship with the end-customer. Hence, analysing and differentiating between value for the direct customer (car manufacturer) and for the people finally buying a car is essential when evaluating the customer-responding capability of any automotive supplier. This consideration becomes even more complex when the customer is another automotive supplier in the automobile manufacturer's upstream supply chain.

To further foster a company's responding capability, also the quick transfer of *satisfied customer needs* is essential. I.e. when a product or service served the need of one customer and the firm expects growth in market share out of it, the likelihood is high that the initial idea will satisfy other customer needs as well. This was expressed as follows:

> "Best practice is also the ability to *read across*. I.e. when we are successful with a new product or a feature of a product at one customer, this has to be placed at as much as other customers quickly. A good example is our […] where we have a market share of roughly 70% at the moment. Here we used this first mover position very good." (Interviewee 11)

Eventually, the maturity levels can be derived from these recognitions and are displayed in table 4.20. It is worth to mention that the theoretical findings on applicable constructs behind customer-responding capability are more superficial and lack tangible descriptions. However, I already emphasised the limited amount of concepts and the need for further inductive research during the literature review, why such a conclusion was somehow expected.

Table 4.20: Maturity levels of customer-responding capability

Enabler	Level 1	Level 2	Level 3	Level 4
Customer-responding capability	The organisation responds often too late with regard to customers, occasionally meets their expressed and latent needs, and rarely transfers the solutions for those needs to other customers	The organisation responds on time with regard to customers, partly meets their expressed and latent needs, and sometimes transfers the solutions for those needs to other customers	The organisation mostly responds rapidly with regard to customers, meets their expressed and latent needs, and transfers the solutions for those needs to other customers	The organisation responds rapidly with regard to customers, effectively meets their expressed and latent needs, and quickly transfers the solutions for those needs to other customers

4.3.3.3 Risk Propensity of Senior Management

Firms operate in complex environments, why it is often difficult for managers to decipher the signals emanating from them respectively to assess the outcomes resulting from their decisions. Consequently, such uncertainty can delay or constrain responses to constantly evolving customer needs (Jayachandran et al., 2004). In turn, the senior management's *willingness to tolerate risks* becomes an important determinant for a company's customer agility.

This aspect was also met with approval during the interview sessions several times. For instance, one of the participants explained a lack of risk propensity and serious consequences out of this behaviour:

> "If this is really the case, an agile behaviour towards the customer could be fostered. Besides this, the question is always *do we believe in our product*? The more we do so, the higher will be the risk propensity of our management. Thus, establishing such a strong belief needs also considered when we talk about maturity levels. The higher the belief in our product, the closer we are at best practice. I remember an example for an interior sensor for […]. Here we allocated the development costs only to this single product instead of creating a business case and allocating the costs to more projects. I think we did so because we did not truly believe in this product. With such an approach we were not able to offer the product at a competitive price level and in the end the competitor got the nomination. And I even get angry today when thinking about this topic." (Interviewee 19)

Another interviewee described that the management was more risk prone when the scope of responsibility was larger:

> "I think the ability of a senior manager to deal with uncertainty is the higher, the more functions he has under his responsibility. Here I have an example based on our old structure of the customer teams, which included also several functions. Any conflict could be brought for decision to the Head of the Customer Team and in most of the cases these decisions were expediently as in the end the whole team had the same objective by making the project a success. Unfortunately, I realise deterioration in this aspect as we e.g. split the customer teams into a sales team and project management, which brought in another level of hierarchy." (Interviewee 21)

This statement is not only very valuable for the current discussion, but supports the enablers of organisational structures and power distribution (paragraph 4.3.1.1) and self-managed teams (paragraph 4.3.2.1) as well.

In terms of the maturity levels, the interviewees outlined *continuity* as the crucial factor for the willingness of senior management to take risks in customer-related topics. Subsequently, the different levels are drawn in table 4.21:

Table 4.21: Maturity levels of risk propensity of senior management

Enabler	Level 1	Level 2	Level 3	Level 4
Risk propensity of senior management	The firm's senior management is averse to risks with regard to customers	The firm's senior management is sometimes willing to tolerate risks with regard to customers	The firm's senior management is usually willing to tolerate risks with regard to customers	The firm's senior management is continuously willing to tolerate risks with regard to customers

4.3.3.4 Summary of Maturity Levels within Customer Agility

Similar to the sub-sections before and for the purpose of comprehensiveness, the three enabling factors with its related maturity levels are summarised on the following page:

Table 4.22: Maturity levels within customer agility

Enabler	Level 1	Level 2	Level 3	Level 4
Customer-sensing capability	Lack of methodologies to sense and evaluate customers' expressed and latent needs, and no access to key decision-makers at the customer (in charge of defining the value for the end-customer)	Sound methodologies are partly defined and applied in order to sense and evaluate customers' expressed and latent needs, and access to key decision-makers at the customer exists to a certain degree	Sound methodologies are widely defined and applied in order to sense and evaluate customers' expressed and latent needs, and access is largely granted to key decision-makers at the customer	Sound methodologies are defined and applied in order to sense and evaluate customers' expressed and latent needs, and access is granted to key decision-makers at the customer
Customer-responding capability	The organisation responds often too late with regard to customers, occasionally meets their expressed and latent needs, and rarely transfers the solutions for those needs to other customers	The organisation responds on time with regard to customers, partly meets their expressed and latent needs, and sometimes transfers the solutions for those needs to other customers	The organisation mostly responds rapidly with regard to customers, meets their expressed and latent needs, and transfers the solutions for those needs to other customers	The organisation responds rapidly with regard to customers, effectively meets their expressed and latent needs, and quickly transfers the solutions for those needs to other customers
Risk propensity of senior management	The firm's senior management is averse to risks with regard to customers	The firm's senior management is sometimes willing to tolerate risks with regard to customers	The firm's senior management is usually willing to tolerate risks with regard to customers	The firm's senior management is continuously willing to tolerate risks with regard to customers

4.3.4 Maturity Levels within Product Development Agility

The cases in this category were characterised by very intense discussions, as from a higher viewpoint of course the question exist, what kind of product needs which scope of an agile development practice? As an example, what is the right extent of agility in developing another application of a product for a new customer, which is already in serial production at many other customers? At this point I want to emphasise, that this DBA study assumes that during the product development process the *likelihood for customer-driven changes is high* due to rapid technology change, increased innovation dynamic, or permanent cost pressure. Subsequently, traditional methods for new-product development are too linear and rigid.

Furthermore, the studied company itself is technology-driven and basically every product is based in mechanical or electrical engineering. As a consequence, the firm's product development process is at the heart of many employees' daily work. The interview partners itself on the one hand consisted of a very experienced selection (both in industry experience and time in the company), and were on the other hand all from different hierarchies. Each had at least 20 years automotive experience and the responsibilities ranged from Senior VP and Director level towards non-management-members, while these comprised an Expert for Development Methods and an Agile Coach. In sum a highly diversified mixture that allowed the discussion of many perspectives on the topic.

As shown in sub-section 2.3.5, the main product development agility enablers encompass 1) time-boxed sprints with defined deliverables and customer involvement, 2) dynamic and visualised tools, 3) small, dedicated, and co-located teams, 4) less formalised processes that empower decision-making, 5) adoption of flexible design technologies together with rapid prototyping, and 6) collaboration in product development networks.

4.3.4.1 Time-Boxed Sprints

In line with the literature there was no doubt between the interviewees that *time-boxed sprints* have to be an essential part of any agile development approach, like depicted in the following example:

> "This is definitely one of the most crucial enablers in the context of product development agility as we dismantle product requirements and allocate them in a timely and resource-available manner." (Interviewee 9)

Also regarding the criteria of duration, the participants had a similar standpoint and were in favour of two to three weeks. Important to note is that these recommendations resulted from different project-experiences:

> "Two weeks is a good timeframe where people can stay focused, it should not be longer. Together with defined deliverables at the end of this sprint this is best practice to me." (Interviewee 1)

> "Sprints should last two to three weeks, in no case more than four weeks." (Interviewee 4)

> "Best practice from my point of view is two to three weeks. I had a case with three weeks as a part of the project team was from France and travelled regularly to Germany. Therefore we had our daily meetings only from Tuesday to Thursday and decided to enlarge the sprints from typically two weeks to three weeks. Besides this, we were able to have new physical parts available within three weeks; two weeks would have been too short." (Interviewee 9)

> "[…] second, the sprint duration was three weeks with daily meetings." (Interviewee 20)

In this context, the interviewees highlighted the importance of *daily meetings* during the sprint phase as one key constituent for successful sprints. The second crucial factor is to have *defined deliverables* available, which will be presented and discussed at the end of the sprint:

> "[…] we defined deliverables towards our internal customers, who where the Business Owners (one from […], and one from […]). These deliverables contained simulation results, cost calculations, sometimes prototypes – in any case something that could be presented entirely after the sprint." (Interviewee 20)

Reinforcing the statement above, also the other participants pointed to the essential role of *continuous customer feedback*. In the case above, the described Business Owner (or Product Owner) is usually a member of the management and represents the product's stakeholders and the voice of the customer. This person is accountable for ensuring that the team delivers value to the business by fulfilling customers' requirements (Cooper & Sommer, 2018). Expanding this approach, Conforto et al. (2014) present evidence from an exploratory survey about the positive impact of direct customer involvement into such an agile product development methodology. This idea has also been discussed with the interview partners,

although some controversial outputs arose. On the one hand, there was a common understanding about the importance of frequent customer feedback. On the other hand, daily practice showed that involving the customer in such a regular base requires a very intense relationship – which is simply often not possible, as customers have to collaborate with several suppliers at the same time. However, the interviewees emphasised the more structured and organised such sprints are with corresponding valuable outputs, the higher the likelihood that customers are willing to regularly attend.

In general, the procedural rigour in terms of the right and continuous sprint duration, the execution of daily meetings, the definition of measurable and achievable deliverables, and regular (customer) feedback was seen as the main characteristic to classify the range from poor to best practice. This includes also so-called *retrospective meetings* at the end of each sprint, where the team meets to review its teamwork and discusses how to improve:

> "[…] after every sprint we conducted so-called *retrospectives*, where we discussed also basis topics like the sprint length at the beginning of the project." (Interviewee 20)

Combining the theoretical and practical insights allows defining the maturity levels for this enabler as follows:

Table 4.23: Maturity levels of time-boxed sprints

Enabler	Level 1	Level 2	Level 3	Level 4
Time-boxed sprints	The organisation rarely applies time-boxed sprints with defined deliverables, daily and retrospective meetings, and continuous customer feedback	The organisation partly applies time-boxed sprints of two to three weeks with defined deliverables, daily and retrospective meetings, and continuous customer feedback	The organisation widely applies time-boxed sprints of two to three weeks with defined deliverables, daily and retrospective meetings, and continuous customer feedback	The organisation strictly applies time-boxed sprints of two to three weeks with defined deliverables, daily and retrospective meetings, and continuous customer feedback

4.3.4.2 Dynamic and Visualised Tools

A further essential prerequisite to work in an agile process is the applied tool set: "In agile, static tools are replaced with *dynamic tools* (such as the burn-down chart, the scrum board, and the product backlog), and the process itself ensures continuous updating of the information in the tools, which in return increases trust in them" (Sommer et al., 2015, p. 41). With respect to the interview data, there was no overall debate about using dynamic tools. The participants preferred in particular the application of scrum boards and a schematic to classify the product backlog. The more intense discussion was in terms of the digitalisation level of such tools, as explained in the following quotes:

> "We started with relative simple scrum boards. These were manually and with hand-written cards. It was fine for the beginning as it made the work somehow transparent, but in the short term this was chaotic and inefficient. For instance we could not read the handwriting of all team members and the number of tasks increased significantly, why it took us a huge effort to cluster the cards. Thus, we changed to a self-made excel tool that had three categories: backlog, doing, and done. From there on we worked in this tool and saw it as essential having such a digital solution in place. As a take-away I would say the more digital such a visualised tool is, the more we are in the category of best practice." (Interviewee 20)

> "Application of all three methods (burn-down chart, scrum board, and product backlog) is important. The maturity levels for sure depend on the scope and the rigour how these methods are applied. However, I see a further differentiation to be best practice when applying digital tools that allow agile collaboration independently from the location." (Interviewee 4)

As collaboration in product development usually takes place between several locations (different competence centres) and across the globe to make use of the *follow the sun* concept, large boards for example within meeting rooms cannot fulfil those conditions. Thus, digital solutions of such dynamic tools have to be implemented. Here, it is crucial to ensure usability and creativity by for instance using large enough screens and/or digital flip charts. According to the interviewees, a stringent application of such dynamic tools determines the maturity levels of this enabler – of course also in the case when teamwork takes not only place in the same office:

> "Scrum boards are very pragmatic, but documentation is only possible via photos, which can get lost or the risk is given that the data gets lost respectively. On the other hand, also digital scrum boards have disadvantages, e.g. to keep the overview, large screens are necessary. In

general, the maturity level in this category depends on the one hand on the variety of tools and on the other hand on the depth they are adapted along the projects. A difference to best practice is for sure the sophisticated application of digital scrum boards." (Interviewee 1)

Accordingly, the maturity levels are summarised in the following table:

Table 4.24: Maturity levels of dynamic and visualised tools

Enabler	Level 1	Level 2	Level 3	Level 4
Dynamic and visualised tools	New-product development is hardly supported by dynamic and visualised tools	New-product development is partly supported by dynamic and visualised tools, which are sometimes digitalised	New-product development is widely supported by dynamic and visualised tools, which are largely digitalised as soon as required	New-product development is fully supported by dynamic and visualised tools, which are strictly digitalised as soon as required

4.3.4.3 Small, Dedicated, and Co-Located Teams

The topic has already been discussed in paragraph 4.3.2.1 (self-managed teams) to a certain extend. However, *dedication* gains in importance in the context of product development agility as emphasised during the interviews:

"The size is not so important, but the fact that these people are dedicated to a task. This will become especially visible when working in sprints of e.g. two weeks: It is impossible to focus on this sprint while being involved in four to five other projects. The maturity level depends on how dedicated the people can work." (Interviewee 1)

Another participant pointed to this fact in a similar way:

"Much more important is the 100% dedication to the project. For sure, not every team member can work through all his tasks on his own and has to coordinate with a certain back-office, but he has to do this fully dedicated to the project." (Interviewee 20)

At this point the question has to be raised, how realistic such a 100% dedication is in the daily development work of an automotive supplier? Discussing this critically with the interviewees revealed that there is some tolerance available. In many product development projects, lots of different and sometimes highly specialised competencies are needed. These people are leading experts in a respective field (e.g. magnet technology) and often have job descriptions accordingly like (Senior) Experts. Thus, it is essential for the company to involve such people in

several projects. For instance, one of the interviewees explained a 60% dedication as sufficient to work efficiently in time-boxed sprints, as long as the respective team member has not more than two other, smaller projects at the same time. Similar findings are reported in other case studies as well, e.g. "[…] among both case companies and workshop attendees, we've found that most manufacturers do make compromises like Tetra Pak's, not fully dedicating personnel but limiting maximum loads" (Cooper & Sommer, 2018, p. 23).

Regarding the *optimum team size*, the following contributions were collected:

> "The larger the teams are, the more formalistic it will become. The minimum team size should be ca. four people, but not more than nine. The closer the size comes to this four to nine spectrum, the higher the maturity level." (Interviewee 1)

> "As best practice, the team should comprise four to seven people. These people should be in the team from the beginning and should be hold together as long as possible. All team members who join the team during the project is like jumping on a driving train and thus the likelihood is high that these people are overstrained." (Interviewee 4)

> "Small teams are very important; in our case the core team comprised seven people." (Interviewee 20)

All three interviewees made similar good experiences with a core team comprising of four to seven people. However, all of them heavily emphasised that such a team can only fully work to a crucial agile principle – namely almost *autonomous* during the sprints – if the *right competencies* are in place without exception:

> "A criterion for best practice is the availability of necessary competencies in the team. The more this team is dependent on other functions, the less effective (in an agile manner). The team should be *quasi-autarchic*." (Interviewee 9)

In the same vein, a Senior VP explained a from his point of view absolutely outstanding example, where the right mixture of dedication and competencies even led to the successful launch of a new product:

> "For instance when we developed the […], we had four people with the right knowledge, dedicated to this new product, and co-located – who in the end were able to convince the customer. This was absolute best practice to me. Accordingly, the maturity levels can be assessed by the necessary competencies and experience in place." (Interviewee 1)

Furthermore, he pointed to the aspect of *co-location*. When discussing this further in detail, he continued:

> "Co-location is important, too. Virtual collaboration is possible as well, but not ideal. In particular in the project phases where it comes to a physical product, the aspect of co-location gains importance. E.g. that the core team is co-located and can feel and touch the product while some supporting functions are included e.g. via digital tools." (Interviewee 1)

An Expert for Development Methods confirmed this in the following way:

> "The team should be co-located; or if the digital landscape allows a virtual collaboration this could also be an option (virtual co-located)." (Interviewee 4)

Both made very clear, that a co-located core team is essential in order to achieve the necessary focus and pace in the development activities. However and as already outlined in the former paragraph, collaboration with other functions from different locations is somehow mandatory, why the importance of *digitalised tools* was also underlined in this context.

Resulting from this intense discourse, the maturity levels can be classified as follows:

Table 4.25: Maturity levels of small, dedicated, and co-located teams

Enabler	Level 1	Level 2	Level 3	Level 4
Small, dedicated, and co-located teams	The core team for new-product development exist occasionally of four to seven highly competent people, is less than 40% dedicated to the project, and rarely co-located	The core team for new-product development exist sometimes of four to seven highly competent people, is at least 40% dedicated to the project, and partly co-located	The core team for new-product development exist usually of four to seven highly competent people, is at least 50% dedicated to the project, and widely co-located	The core team for new-product development exist always of four to seven highly competent people, is at least 60% dedicated to the project, and strictly co-located

4.3.4.4 Less Formalised Processes that Empower Decision-Making

Within an exploratory survey in 19 medium- and large-sized companies from different industries, Conforto et al. (2014) found a tendency towards *less formalised processes* in order to empower the development teams with some degree of au-

tonomy. Practices to operationalise less process formalisation comprise for instance the use of partially standardised processes that can be tailored to project needs (Goevert et al., 2019), progressively locking down product requirements while the specification is gradually released (Thomke & Reinertsen, 1998), and in general the accommodation of ambiguity in product definitions (Cooper & Sommer, 2018).

During the multiple-case study of this thesis, the participants agreed to the practices mentioned above and highlighted in particular *autonomy* during the sprints:

> "Processes must allow that the team gets the full responsibility to accomplish a target at a given point in time. During this time, the team decides how to accomplish the sprint goals." (Interviewee 1)

> "During the sprint phase of two to three weeks, the team has the full decision power. This is best practice." (Interviewee 4)

> "Best practice in our case was the fact that we had the full decision power within the sprints. Thus, no kind of formalism in these periods." (Interviewee 20)

In this context, the interviewees pointed also to the *clear definitions of responsibilities*. While for example the Product Owner defines the deliverables after the sprint, the team has the full freedom to choose the way to come there. The essential role of defined responsibilities has also been intensively discussed in paragraph 4.3.1.1 (organisational structures and power distribution).

However, as the automotive industry can be classified as a branch with a high level of regulation, every *process-loosening* might be in conflict with subordinate process or quality standards. Overcoming this challenge has become an intense discourse in the scientific community in the last couple of years and resulted for instance in recommendations of *hybrid development frameworks* combining agile practices with the classic stage-gate model (Conforto & Amaral, 2016; Cooper & Sommer, 2018). The basic idea is to embed agile methods (time-boxed sprints, daily stand-up meetings, etc.) within some or all the stages of an existing stage-gate system in order to fulfil prescribed quality standards. Also the company where the interviews took place followed such an approach to balance stability with flexibility:

> "As the automotive industry is used to apply a lot of given standardised processes, the solution for agility in our branch can only be a hybrid model. On the one hand, to fulfil automotive requirements, and on the other hand to allow agile working by giving the team the full ownership during the sprints. Balancing these two aspects is for me best practice." (Interviewee 1)

Eventually, combining the theoretical and practical findings above will lead to the maturity levels depicted in table 4.26:

Table 4.26: Maturity levels of less formalised processes that empower decision-making

Enabler	Level 1	Level 2	Level 3	Level 4
Less formalised processes that empower decision-making	An agile stage-gate process is occasionally applied for new-product development and the development team is hardly authorised to tailor processes according to their needs during the sprints	An agile stage-gate process is sometimes applied for new-product development and the development team is partly authorised to tailor processes according to their needs during the sprints	An agile stage-gate process is usually applied for new-product development and the development team is widely authorised to tailor processes according to their needs during the sprints	An agile stage-gate process is always applied for new-product development and the development team is fully authorised to tailor processes according to their needs during the sprints

4.3.4.5 Flexible Design Technologies and Rapid Prototyping

In order to develop a physical product by making use of various iterations (via e.g. time-boxed sprints), *prototyping* is a central aspect to support the learning process (Zink et al., 2017). Moreover, also decision-making is fostered as important insights are provided about the solution space:

> "Rapid prototyping helps to get decisions. It is particular important to get insights about the dimensions and general operating principles of the product. But it has to go hand in hand with virtual rapid prototyping, e.g. to simulate a drive in a people mover by means of virtual reality." (Interviewee 1)

In his statement the participant pointed to an important fact, namely that prototyping should not be limited to the creation of touchable models. Rather, it has to be fast (*rapid* prototyping) and the entire range of physical and virtual prototypes

has to be considered. Another interviewee confirmed this perspective and illustrated its effectiveness:

> "In best practice examples, people made use of various methods; starting from handcrafting to rapid manufacturing technologies (like three-dimensional printing), and also simulation techniques like model-based engineering." (Interviewee 4)

He reported from a project where the team started to handcraft prototypes with simplest means and a minimum in resources. During the next iterations, three-dimensional prototyping was applied. All activities were underlined by simulation work, which helped the team to get a permanent feedback between practical and virtual insights.

Another colleague, working as an Agile Coach in the R&D department, highlighted the *minimum viable product* (MVP) concept when entering a new project:

> "We made very good experiences with the MVP approach. As I said before, this helped us to nail down the main requirements of the customers in an early stage and thus laid the foundation for the whole project." (Interviewee 20)

The mentioned concept is described in the following way: "The goal of MVPs is to prioritise development based on the most beneficial uncertainty reduction through feedback after every iteration. Ideal MVPs are product versions that are just above a viable level to yield reliable learning effects" (Schuh et al., 2018, p. 31). Put differently, the basic idea is crating a product version with just enough features to be usable by the team or the customer and receive a proper feedback.

For the sake of completeness I would like to mention that the enabler of flexible design technologies and rapid prototyping in general – in particular flexible design technologies like CAD – was somehow seen as state-of-the-art of a sound product development process. In other words, such methods are essential in today's new-product development, no matter if in an agile way or with a traditional approach. Therefore, I will focus on rapid prototyping practices together with a MVP approach when defining the respective maturity levels in the following table on the next page:

Table 4.27: Maturity levels of flexible design technologies and rapid prototyping

Enabler	Level 1	Level 2	Level 3	Level 4
Flexible design technologies and rapid prototyping	New-product development is hardly supported by rapid prototyping while a minimum viable product (MVP) concept is applied	New-product development is partly supported by rapid prototyping while a MVP concept is applied	New-product development is widely supported by rapid prototyping while a MVP concept is applied	New-product development is fully supported by rapid prototyping while a MVP concept is applied

4.3.4.6 Collaboration in Product Development Networks

Resulting from continuously shortening product lifecycles, growing product complexity, and changing demographics that drive a migration of brain-power to emerging economies, the need to collaborate with company-external organisations increases (Wilson & Doz, 2011). The basic idea of these so-called *product development networks* is intense knowledge exchange by for instance becoming part of industry clusters, research campuses, or entering in strategic alliances (Riesener et al., 2019).

Even if these activities are highly recommended in the literature, the data from my case study could not support this:

> "I made no experience that this helped in becoming more agile in product development. I can imagine that it can help a start-up company that has no own process landscape in place, but not a large enterprise like we are." (Interviewee 1)

> "I know no examples where this enabled us in becoming agile in product development." (Interviewee 4)

Here, the participants clearly stated that they had no kind of positive experience and were somehow convinced of sufficient competencies in the own company. In other cases of my study, the response was not that clear, although major concerns prevailed:

> "This could be an enabler, but not easy to achieve. Sometimes it is even complicated to work in an internal network, adding external partners would significantly complicate the situation. […] essential is the agile mindset or agile behaviour of the partner. This is clearly the success

> factor in this category, the agility-ability of the network partner. Imagine that your partner needs three months to come up with a solution but you would like to work in sprints of three weeks. This will never work. That means, product development networks will enable agility if the network partners are able to work in an agile way too. Otherwise it will slow the project down and I would not recommend this." (Interviewee 9)
>
> "For agile projects, partners have to be incorporated that are also able to work agile." (Interviewee 11)

Put simply, not only complementary competencies are necessary, but also the capability of a partner to work in an agile way seems to be equally essential. Both interviewees above described examples where this fact was in the end the pivotal criteria. In turn, the enabling role of product development networks is highly dependent on the agility-capabilities of its single partners. Due to this and missing positive experience and/or best practice examples from the interviewees, I will exclude this enabler in the dimension of product development agility.

4.3.4.7 Summary of Maturity Levels within Product Development Agility

Five out of the six originally identified enablers could be confirmed and verified with best practice examples during the case study. The final picture with the single maturity levels is depicted in table 4.28 on the following pages.

Table 4.28: Maturity levels within product development agility

Enabler	Level 1	Level 2	Level 3	Level 4
Time-boxed sprints	The organisation rarely applies time-boxed sprints with defined deliverables, daily and retrospective meetings, and continuous customer feedback	The organisation partly applies time-boxed sprints of two to three weeks with defined deliverables, daily and retrospective meetings, and continuous customer feedback	The organisation widely applies time-boxed sprints of two to three weeks with defined deliverables, daily and retrospective meetings, and continuous customer feedback	The organisation strictly applies time-boxed sprints of two to three weeks with defined deliverables, daily and retrospective meetings, and continuous customer feedback
Dynamic and visualised tools	New-product development is hardly supported by dynamic and visualised tools	New-product development is partly supported by dynamic and visualised tools, which are sometimes digitalised	New-product development is widely supported by dynamic and visualised tools, which are largely digitalised as soon as required	New-product development is fully supported by dynamic and visualised tools, which are strictly digitalised as soon as required
Small, dedicated, and co-located teams	The core team for new-product development exist occasionally of four to seven highly competent people, is less than 40% dedicated to the project, and rarely co-located	The core team for new-product development exist sometimes of four to seven highly competent people, is at least 40% dedicated to the project, and partly co-located	The core team for new-product development exist usually of four to seven highly competent people, is at least 50% dedicated to the project, and widely co-located	The core team for new-product development exist always of four to seven highly competent people, is at least 60% dedicated to the project, and strictly co-located

Table 4.28 (continued)

Enabler	Level 1	Level 2	Level 3	Level 4
Less formalised processes that empower decision-making	An agile stage-gate process is occasionally applied for new-product development and the development team is hardly authorised to tailor processes according to their needs during the sprints	An agile stage-gate process is sometimes applied for new-product development and the development team is partly authorised to tailor processes according to their needs during the sprints	An agile stage-gate process is usually applied for new-product development and the development team is widely authorised to tailor processes according to their needs during the sprints	An agile-stage-gate process is always applied for new-product development and the development team is fully authorised to tailor processes according to their needs during the sprints
Flexible design technologies and rapid prototyping	New-product development is hardly supported by rapid prototyping while a minimum viable product (MVP) concept is applied	New-product development is partly supported by rapid prototyping while a MVP concept is applied	New-product development is widely supported by rapid prototyping while a MVP concept is applied	New-product development is fully supported by rapid prototyping while a MVP concept is applied

4.3.5 Maturity Levels within Supply Chain Agility

The current COVID-19 pandemic has once more shown that a *responsive* supply chain is the most crucial factor for being able to fulfil customer demands even under such extreme volatile circumstances. This key role of a firm's supply chain was already emphasised 20 years ago: "Turbulent and volatile markets are becoming the norm as life cycles shorten and global economic and competitive forces create additional uncertainty. The risk attached to lengthy and slow-moving logistics pipelines has become unsustainable, forcing organisations to look again at how their supply chains are structured and managed" (Christopher, 2000, p. 37). Also recent literature points to the importance of a supply chain in the context of agility and highlights missing guidelines and examples of what actually constitutes the appropriate capabilities (Fayezi et al., 2016).

In order to contribute closing this gap, the maturity levels behind the enablers of supply chain agility will be discussed and defined in the next paragraphs. The respective enablers comprise (1) network integration, (2) ICT integration, (3) collaborative relationship, (4) market sensitivity, (5) flexibility, (6) top management commitment, and (7) supplier innovativeness (see sub-section 2.3.3).

4.3.5.1 Network Integration

Already in the earliest, highly profound pieces of research on an agile supply chain, *network integration* (or supply chain integration) has been regarded as one of the most important enablers (Van Hoek et al., 2001). Later, the construct has been applied for instance in order to develop an agility index (Lin et al., 2006) or to empirically demonstrate the positive impact of supply chain agility on firm performance (Ngai et al., 2011). For companies with an integrated supply chain, "[…] a high degree of operational visibility and inter-organisational cooperation is foreseen. When sudden changes occur in the market, the organisation can cooperate strategically with supply chain partners and respond to market changes in a cost-efficient manner" (Ngai et al., 2011, p. 234 f.).

Resulting from both the literature and my multiple-case study, a crucial prerequisite in this context is a *coordinated process* across the various supply chain members. Here, established rules, systems, procedures, and cross-functional relations make it more easy and effective for employees to share and access the nec-

essary information (Blome et al., 2013). In the same vein, Fayezi et al. (2016) emphasise the strong supporting role of regulatory frameworks and solid contracts. Beyond this and in order to foster process compliance, one of the interviewees recommended the deployment of so-called *resident engineers*:

> "A best practice example is the installation of a resident engineer, i.e. one of our employees is located at the supplier and coordinates and improves the processes there. In particular during the on-boarding of new suppliers, this practice significantly accelerates the procedure as we have someone on-site who is able to interfere into the process chain and makes the supplier aware about what is important for us." (Interviewee 14)

He pointed to this practice in particular in the context of new partners within a company's supply chain as knowledge transfer usually takes place significantly faster. Furthermore, he suggested negotiating the use of such a resident engineer already in the contract-phase with the new supplier in order to achieve also some commercial compensation for these resources. Regarding those contracts, a colleague from corporate development (with a very strong background in purchasing) stated the following:

> "To act commonly with the companies in our supply chain, we need for sure regulatory frameworks. Nevertheless, contracts with no ways of exception will automatically exclude a lot of partners from our supply chain. So I would say, best practice is related to the degree you are able to define strong frameworks but leaving some room for exception to have the right partners on board. In turn, very prescriptive contracts would be poor practice in my eyes." (Interviewee 18)

By explaining for example the application of endless checklists, he referred to some overly rigid processes that made the firm more constrained in the past when dealing with new partners. Also Blome et al. (2013) underline this issue in the context of a company's process infrastructure for supply chain management.

Further, the interview data showed a strong orientation towards efficiency when establishing such supplier networks. One of the participants for instance highlighted the selection of suppliers according to their system-competence:

> "I agree to all the practices mentioned in the literature. A best practice in this context is the structured integration of system suppliers. For instance, instead of sourcing single electronic components we source the whole electronic control unit (ECU) today. Put differently, we are looking for partners who have the competence of whole sub-systems of our products and/or

systems. As every supplier causes efforts like additional interfaces, administration, audits, or risk management evaluations, hereby we reduce these efforts and can be more efficient." (Interviewee 8)

Such efficiency can be even increased when entering into the commercial negotiations together with the mentioned system-supplier. Referring to the statement above, the approach would mean to commonly negotiate the electronic components necessary for the ECU with the respective sub-suppliers. Applying those components also in other products would further increase the economies of scale and thus strengthen the negotiating position:

"Another best practice is the so-called *supplier tiering*, which means we negotiate together with the supplier their sub-suppliers to e.g. reach further economies of scale. A further example is to define parts that our suppliers have to use for our products, while we negotiate these parts with the respective (sub-) suppliers. Hereby we achieve a highly integrated supply chain." (Interviewee 14)

From a theoretical perspective, sound network integration is in particular linked to the degree of solid processes and contracts and how well these processes are internally executed respectively the supply chain partners adhere to. Nevertheless, the interview data shows that specific practices can make the difference when talking about best practice. The resulting maturity levels are summarised in the following table:

Table 4.29: Maturity levels of network integration

Enabler	Level 1	Level 2	Level 3	Level 4
Network integration	Supply chain members are occasionally integrated while overly rigid frameworks constrain the collaboration	Supply chain members are integrated to a certain degree by means of coordinated processes and solid contracts while common collaboration towards sub-suppliers is partly executed	Supply chain members are integrated by means of coordinated processes and solid contracts while common collaboration towards sub-suppliers is executed	Supply chain members are highly integrated by means of coordinated processes, solid contracts, resident engineers, and common collaboration towards the sub-suppliers

4.3.5.2 Information and Communication Technology Integration

The enabling role of information and communication technology (ICT) on organisational agility has already been discussed in paragraph 4.3.1.4. There, the focus was of intra-organisational nature and described the extend to which a firm deploys common, integrated, and connected IT-enabled processes. Now, in the context of a company's supply chain, the enabling role is grounded in *virtually integrated information technology* to share data between supply chain members (Feizabadi et al., 2019). But proper information sharing is not only the foundation for virtual collaboration, it also "[…] significantly contributes to reduce supply chain costs, to improve partnerships, to increase material flow, to enable faster delivery and to improve order fulfilment rate, thus to contribute to increased customer satisfaction, enhanced channel coordination, and the achievement of competitive advantage" (Samdantsoodol et al., 2017, p. 63). These authors operationalise the integration of ICT by differentiating between the degree to which the members are able to cooperate easily, the effective utilisation to manage and share large amounts of data, smart technologies that keep time and information accuracy, and decision support systems to create an effective collaboration and knowledge management flow. Further, they empirically validate a positive leverage between ICT and agility in the supply chain. Similar to this study, Dubey et al. (2018) apply the resource-based view and investigate a firm's ability to gather and share information through the use of ICT as antecedent of agility. They label this capability as *supply chain connectivity* and measure the construct to the degree 1) current information systems satisfy supply chain communication requirements, 2) information applications are integrated within the firm and supply chain, and 3) adequate information systems linkages exist with suppliers and customers. Analyses based on 351 Indian auto components manufacturers support their hypothesised relationship.

Discussing the theoretical contributions above with the study participants showed on the one hand a strong consent of ICT's enabling role itself:

> "This is clearly a must-have. The maturity levels in this category of course depend on the wide and depth how the practices are implemented in a company." (Interviewee 8)

On the other hand and of course in the context of the current COVID-19 pandemic, *common communication platforms* were in particular emphasised:

> "Besides the examples from the literature I would add common communication platforms like Microsoft Teams. Having common software in place will make collaboration faster and easier." (Interviewee 14)

Another interviewee highlighted those joint communication tools as well as best practice and continued:

> "A common file system is also at the upper end of the maturity scale. We still believe that those systems jeopardise our IT security, which is wrong from my point of view. These systems help to share and synchronise all kind of information." (Interviewee 18)

As stated above, he somehow critically referred to the company's policy in terms of using common data storage systems. Of course, IT security needs to have a high importance in today's virtually connected business world, but starting this debate would go far behind the scope of this piece of work. Nevertheless and in particular with the COVID-19 issue in place, the new significance of commonly integrated information applications should at least give enough motivation for every firm to critically review its IT policies and for investing resources in investigating new technological possibilities to maximise data security at the same time.

The interviewee finally pointed to two crucial aspects when applying ICT together with suppliers: First, the *degree of automation* when for instance multiple data are collected across various suppliers. In this case, software applications must be available where the suppliers can fill in the necessary information and where our purchasing departments are able to analyse and compare the inputs in different ways. Second, such kind of standardised tools must allow some room for supplier's *individual contributions* or *proposals* to fulfil the product's specification maybe in a more efficient way than requested. He described it as follows:

> "In general, the more automated tools are available, the closer we are at best practice. Nevertheless, these automated tools must allow some flexibility. E.g. when asking for cost-breakdowns, only filling a standardised tool is too rigid. We must allow our suppliers to demonstrate the deviations they maybe have towards a standardised solution. This could mean a slight higher effort but helps to understand the supplier better." (Interviewee 18)

Combining the theoretical and practical findings above eventually leads to the respective maturity levels in this category:

Table 4.30: Maturity levels of information and communication technology integration

Enabler	Level 1	Level 2	Level 3	Level 4
Information and communication technology integration	Information systems and common automated tools are hardly integrated throughout the supply chain why an appropriate communication lacks	Information systems and common automated tools are partly integrated throughout the supply chain to enable appropriate communication	Information systems and common automated tools are widely integrated throughout the supply chain to enable proper communication	Information systems and common automated tools are highly integrated throughout the supply chain to enable frequent and regular communication

4.3.5.3 Collaborative Relationship

The importance of this enabler has been emphasised during the interviews by means of a currently very prominent example:

> "This is an important factor. In particular to make the supplier to go for the so-called *extra mile*, which is often important when talking about flexibly and rapidly responding to changes. Or for instance in a shortage situation where all other factors like volume share etc. are equal, a collaborative relationship can end up in a preferred treatment of our company. Hereby we can be more agile in coping with such a shortage situation, i.e. for instance in responding more quickly than our competitors. I would assess the maturity levels in terms of how strong the different practices are established." (Interviewee 8)

The participant, in this case a Head of Project Purchasing with almost 30 years experience in the automotive industry, pointed to a preferred treatment by suppliers where a strong partnership exists. He referred to the recent global shortage of semiconductors and outlined that secured supply forms a competitive advantage in such a crisis.

The foundations for a collaborative relationship can be clustered in trust, information sharing, commitment, communication, and risk and reward sharing (Fayezi et al., 2016); the authors label this bundle as *relationship factors*. Trust is understood as the binding force in most buyer-supplier transactions and in particu-

lar important when situational forces exist like uncertainty or asymmetric (product) information (Agarwal et al., 2007). Thus, and not merely because of this, it is essential to exchange relevant, accurate, complete, and confidential information – which includes also actively sharing intellectual property (Lin et al., 2006). In order to do so, two aspects are necessary: On the one hand, frequent and regular communication between both partners and a high willingness to share such information (Lin et al., 2006), and on the other hand a strong mutual obligation that should be characterised by committed responses of these partners (Singh Patel et al., 2017). Finally, Singh Patel et al. (2017) emphasise the willingness to compromise through e.g. sharing of risks or the joint handling of financial damages.

Additionally, one of the interviewees highlighted the balance of collaborating on eye level but keeping a certain competitive pressure at the same time. Without a doubt, such a balancing-act requires a lot of sensitivity and tactics why he mentioned this in also in the context of best practice:

> "In particular during the phase of building up a new supplier, a collaborative relationship is very important. However, this must be balanced with keeping always some competitive pressure. Otherwise it could end up in nepotism. Put differently, a collaborative relationship is important, but suppliers have to be challenged continuously too. Keeping this in balance as well as the suppliers' motivation is best practice." (Interviewee 14)

With reference to the topic of standardised tools that must allow some room for suppliers' individual contributions from the paragraph before, another interviewee mentioned its contribution in building trust:

> "Allowing some degrees of freedom in the contracts is also a sign of trust towards our suppliers. This sign is essential to foster a collaborative relationship and receive a preferred treatment by our suppliers." (Interviewee 18)

Generally and in order to establish an excellent buyer-supplier relationship, he explained a from his point of view outstanding procedure in the company:

> "A best practice example of how to develop an excellent relationship is our yearly event for the most innovative suppliers, the so-called *innovation days* in […]. Here we give our most innovative suppliers a platform in front of our top management, something they usually not get. I think that this event helps to get relevant information up to nine months earlier than our competitors and as a result we have this knowledge already available when entering in our development process. Apart from that, our Innovation Managers in the purchasing department per-

sonally rank the ideas in a first step, also by having individual discussions with the suppliers, instead of using a highly standardised ranking process. With this process we show a high degree of recognition to our suppliers and that is key in building up a trust-based relationship." (Interviewee 18)

Reflecting this example with the relationship factors from the literature shows that in particular the aspects of trust, information sharing, commitment, and communication are covered. What the participant did not explicitly mention but I know from my own experience, is the fact that our company supports promising ideas by mitigating the risks that possibly occur or making use of some innovation budget. Thus, also the reaming factor from the literature of risk and reward sharing is captured. This deep insight into the firm's operational procedures will be again picked up in paragraph 4.3.5.7, which deals with supplier innovativeness. To close the current discussion, the respective maturity levels of a collaborative relationship are depicted in table 4.31:

Table 4.31: Maturity levels of collaborative relationship

Enabler	Level 1	Level 2	Level 3	Level 4
Collaborative relationship	Buyer-supplier relationships are hardly characterised by trust, information sharing, commitment, communication, and risk and reward sharing while a certain competitive pressure exists occasionally	Buyer-supplier relationships are partly characterised by trust, information sharing, commitment, communication, and risk and reward sharing while a certain competitive pressure is sometimes maintained	Buyer-supplier relationships are widely characterised by trust, information sharing, commitment, communication, and risk and reward sharing while a certain competitive pressure is usually maintained	Buyer-supplier relationships are always characterised by trust, information sharing, commitment, communication, and risk and reward sharing while competitive pressure is maintained

4.3.5.4 Market Sensitivity

Christopher (2000) started the academic discussion on this topic by seminally recognising that agile supply chains must be *market sensitive*. With this criterion, he described the capability of reading and responding to real demand. Subsequent research took up this approach and slightly adapted the concept towards *customer*

sensitivity (Van Hoek et al., 2001), which includes market understanding, customer enrichment, customisation, and rapid response. Lin et al. (2006) extended the construct about the capability to master change and uncertainty and accordingly labelled it *customer/marketing sensitivity*. As one out of four major agility attributes, they firstly operationalised it in order to conduct a case study in a Taiwanese company. A new approach was developed by Sing Patel et al. (2017) that is based on a multi-grade fuzzy logic in order to determine an overall agility index of the supply chain. They differentiate between three levels, while the first level consists of agile supply chain enablers. In the second level, each enabler is divided into attributes, and finally each attribute is further divided into sub-attributes in the third level. These authors include market sensitivity as one enabler in their framework and operationalise it by referring to 1) the analysis of market trends, 2) effective forecasting, 3) multiple production-relevant sub-attributes like the accessibility and functioning of production equipment and workforce, and 4) a proper market survey procedure.

Considering the interpretations above shows that the customer dimension is already covered in sub-section 4.3.3 (maturity levels within customer agility) and also the topics of forecasting and market analysis have been discussed (see paragraph 4.3.1.5 on strategic foresight). As a brief outlook, all production-related aspects will be reviewed in sub-section 4.3.6.

With reference to the interview data, the participants indeed highlighted the visibility of inventory and demand levels through the supply chain, but pointed to the state-of-the-art procedure in the automotive industry:

> "The most important practice in this category is the visibility of demand levels across the supply chain, which is ensured in our EDI system. Without this, our business could not work. In other words, in the automotive industry, this is a standard procedure for a long time now. Of course, also the visibility of inventory levels within the company is essential to act quickly." (Interviewee 8)

Furthermore, one of the interviewees emphasised the consideration of the supply chain in a company's foresight process and in this context in particular the inclusion of the Supply Chain Managers:

> "In terms of market trends, dedicated teams should be installed to track and investigate e.g. the price development of raw materials. Furthermore, the foresight process of a company should

> also include the supply chain. The more these kind of activities are executed and relevant findings are fed back to the Supply Chain Managers, the closer we are at a best practice example." (Interviewee 18)

Such a close link of the foresight activities to the operational business was a central aspect in paragraph 4.3.1.5.

Beside the before mentioned statements, I was not able to collect significant data leading to further best practice examples or maturity levels respectively. The reason for this is on the one hand the comparatively high standard of market sensitivity-related instruments that the colleagues perceive in their daily business. On the other hand, practices with regards to the customer or a proper forecasting procedure have been already discussed before. Thus, I will not separately include the enabler of market sensitivity in the dimension of supply chain agility.

4.3.5.5 Flexibility

Before entering the debate on flexibility, I deem it for necessary to briefly remind the reader of sub-section 2.4.1. As part of the conclusion, a firm's flexibility can be seen as one of the major antecedents of its agility. Also Swafford et al. (2008) apply this perspective in their research on supply chain agility. They measure the flexibility of a company's upstream activities in terms of the ability 1) to change quantity of supplier's order, 2) to change delivery times of supplier's order, and 3) to alter delivery schedules to meet customer requirements. Using empirical data, they indicate the enabling role on supply chain agility and ultimately higher competitive business performance. Ngai at al. (2011) build on the approach of Patricia M. Swafford and her colleagues and find that two of the three companies in their multiple-case study place a high value on supply chain flexibility and believe that this flexibility allows them to respond fast to market changes. Another interesting viewpoint is presented by Gligor et al. (2019) who state that a firm's supply chain operates usually within a specific range and that its supply chain agility in turn is constrained by that range. Such a constraint can exist for example in the production capacity of a supplier who cannot quickly produce more items. However, the higher the ability to change tactics and operations in such a case (by e.g. ordering identical products from another supplier), the higher will be the agility in the end. This adjustment of tactics and operations is understood as flexibility.

Referring to the interviews on this topic shows that the participants widely agree to the insights provided in the literature. As the focus is the company's upstream activities, the interviewees were mainly selected out of the purchasing organisation. For example:

> "The different aspects of flexibility are well described in the overview from the literature; the more these abilities are available, the higher the maturity level. I think all of them are valid." (Interviewee 18)

The same colleague explained another practice in order to generate flexibility in terms of production capacities:

> "A best practice example is for instance the booking of over-capacities at our suppliers. This will cost some extra money, but gives us a high level of flexibility in terms of quantities and production mix." (Interviewee 18)

With this statement he referred to a procedure where a contractual agreement exists upfront for the case that additional capacity is needed. Even if the contractual framework normally includes some rate beyond or below the agreed volumes (usually 10-20%), sudden environmental changes can lead to an extraordinary demand. Suppliers can for instance react by applying additional shifts or making use of their own network to fulfil those demands. The right to participate on such unplanned capacity enlargements on supplier side is for sure desired, but it costs some extra money.

A second but the most mentioned practice in order to reach flexibility was a sound two-supplier strategy, or also called *dual sourcing*:

> "Best practice would be a rigour two-supplier strategy, i.e. having one part number in the system and always two suppliers behind. However, as we want also the best possible piece price, which is always related to volumes, we tend to give as much volumes as possible to one supplier." (Interviewee 8)

Here, a given component is released for the delivery from two suppliers and the flexibility increases when companies have to cope with unexpected events that could jeopardise capacity. In particular the years 2021 and 2022 were characterised by several shortages in the global supply chain (e.g. semiconductors or raw materials) and showed that it was essential to establish a second source for various critical materials. Of course, such an approach increases also the competition be-

tween suppliers and often provides the buyer with more negotiation power. Nevertheless, every additional supplier is related to additional resources for ramp-up and managing, means another interface into the supply chain, and thus creates extra efforts – or put differently: costs. Balancing the level between the additional flexibility needed and the related costs to an ideal level was also described as best practice. This in turn means a very careful and continuous analysis of the supply base and the necessary flexibility in order to successfully compete in the market. However and as emphasised by the interviewees, also this is sometimes theoretical thinking as for technically complex parts often only a few (or even only one) suppliers are available.

To draw a conclusion regarding the maturity levels, both dimensions (literature and interview data) have to be considered as the interviewees largely agreed to the mentioned practices. This is reflected in the following table:

Table 4.32: Maturity levels of flexibility

Enabler	Level 1	Level 2	Level 3	Level 4
Flexibility	The purchasing organisation is occasionally able to quickly adjust their supply chain tactics and operations, and rarely applies a dual or multiple supplier strategy where high flexibility is necessary	The purchasing organisation is sometimes able to quickly adjust their supply chain tactics and operations, and partly applies a dual or multiple supplier strategy where high flexibility is necessary	The purchasing organisation is usually able to quickly adjust their supply chain tactics and operations, and widely applies a dual or multiple supplier strategy where high flexibility is necessary	The purchasing organisation is always able to quickly adjust their supply chain tactics and operations, and strictly applies a dual or multiple supplier strategy where high flexibility is necessary

4.3.5.6 Top Management Commitment

Eric W.T. Ngai and his colleagues argue that "supply chain agility requires the organisation to identify market changes and commit recourses quickly to new course of action or reverse such resource commitments" (Ngai et al., 2011, p. 238). Thus, the *vision of top management* on supply chain agility plays an important role. Furthermore, this circle of people has to work proactively across

business units in order to foster collaboration in strategy formulation and planning. Dubey et al. (2018) demonstrate the moderating role of top management commitment on supply chain agility by gathering more than 350 responses from managers working in the Indian auto components industry. They also highlight the critical role of top management in terms of resource allocation and deployment decisions that are necessary for organisational change.

The attentive reader will already have noticed that a similar enabler has been discussed in paragraph 4.3.1.7 regarding organisational agility. There, the highest maturity level was identified when a company's shareholders, the advisory and executive board, and the works council fully support the agile transformation. As organisational agility is conceptualised as a first-order capability in this piece of research, the underlying enablers are also valid for the second-order capabilities; or at least to a certain extend. Since supply chain agility is one of those, there is initially no contradiction.

Nevertheless, a consideration of the interviewee data reveals that the practitioners usually classify top management commitment on a more overarching level; for instance:

> "It's a premise from my point of view. I am wondering why this is listed here in the dimension of partnering agility. I see it related to all the agility dimensions, or even on a higher level… that means that top management must support the willingness of a company to become more agile and then automatically all of the dimensions." (Interviewee 8)

Put differently, another interviewee made it very clear out of his 30 years experience in the automotive industry:

> "Of course, very important, but this should be essential for all the other agility dimensions as well. If top management is not convinced it will be hard to initiate any agility activities at all." (Interviewee 14)

Based on these statements and in order to keep the maturity model as clear and precise as possible, I consider the enabling role of top management already covered within the dimension of organisational agility – with validity for the underlying dimensions as well.

Finally, the question still remains why the literature emphasises this enabler particularly with regards to supply chain agility? An explanation could lie in the

wide span of supply chain activities. Dependent on the position of the own company in the value chain, there could be numerous of suppliers and sub-suppliers that need to be managed by means of agility principles. As original equipment manufacturers (OEMs) usually strive to a minimum of interfaces and thus give as much as system competence to their suppliers, products in turn tend to become more complex by the addition of e.g. electronics or control units. The more such an approach is applied downstream the supply chain, the higher becomes the complexity of the supply chain for most of the small and medium-sized enterprises (SMEs). These SMEs account for the majority of businesses worldwide and thus play a major role for the research community.

4.3.5.7 Supplier Innovativeness

Several studies show the positive link between *supplier innovativeness* and supply chain agility, while Kim and Chai (2017) even provide empirical evidence based on more than 270 survey responses from executives and managers in the manufacturing industry. They make use of the concept by operationalising it in the following way:

Table 4.33: Measurement items for supplier innovativeness (Kim & Chai, 2017, p. 47)

Construct	Measurement items
Supplier innovativeness	▪ In new product and service introductions, the supplier is often first-to-market ▪ The supplier has introduced more creative and useful products and services in the past five years than have its competitors ▪ The supplier aggressively markets its product innovativeness ▪ In new product and service introduction, the supplier is at the leading edge of technology ▪ The supplier is constantly improving its manufacturing processes ▪ The supplier changes production methods at a great speed in comparison with its competitors ▪ During the past five years, the supplier has developed many new management approaches (excluding manufacturing processes) ▪ When the supplier cannot solve a problem using conventional methods, it improvises with new methods

These characteristics of innovative suppliers were basically confirmed during the case study. One of the interviewees – the head of a small team within the purchasing organisation responsible for innovation management – explained:

> "As an example, we have suppliers that are technology leaders, like […] for laser welding. In terms of first to market, […] comes to my mind for plastic granulate. Another example for the category of manufacturing processes is […] for industry 4.0." (Interviewee 22)

With this statement he already referred to a comment provided by another participant, who highlighted the fact that innovation in this context must not reduced to the scope of components:

> "Innovativeness of suppliers must not only applied to products and/or components, but to everything what comes from outside into a company; e.g. new or innovative simulation methods, new barcode systems to improve logistics processes, etc." (Interviewee 8)

The other interviewee above even took an additional step by emphasising the search for the white spots in innovation:

> "What I miss is the category of somehow thinking outside the box. I mean also suppliers from other branches where we normally have no interfaces. An example is […]. I think they really do a great job, but here we have difficulties to get them on our radar. The same is valid for start-ups. They are often at the leading edge for technology and first to market but for sure often fraught with risk. What I want to say is that the process, which screens for innovative suppliers, must also include the white spots in the supplier landscape." (Interviewee 22)

In principal, a first interim conclusion is that innovative suppliers should not only be selected with regards to the product portfolio of the own company but also by considering the whole periphery around.

As the literature is comparatively weak on best practice examples in the category of supplier innovativeness, a clear focus has been set on this aspect during the interview sessions. A first pattern was identified regarding the *organisational setup*:

> "Best practice is having an own organisational unit within the purchasing department that is responsible for this." (Interviewee 8)

> "A very good example is the innovation management department in our purchasing organisation. This is a separate unit responsible for the assimilation of knowledge and ideas from our suppliers." (Interviewee 16)

> "I already mentioned the innovation management department within our purchasing organisation. Having such a dedicated organisational unit is for sure a best practice example in my opinion." (Interviewee 18)

Closely linked to the agile principle of *small and dedicated teams* (see paragraph 4.3.4.3), it looks like that the orchestration of all activities regarding supplier innovativeness is most appropriately done from a central organisational unit. For further synergies, this unit should be located in the purchasing organisation.

A second cluster regarding best practice examples can be built with respect to the *procedural perspective*. Here, a first important aspect is the early involvement of suppliers:

> "The earlier suppliers are involved in e.g. new product development, the higher is supplier innovativeness. In other words, early involvement of suppliers is essential. The more sophisticated the process is that ensures this early involvement, the higher is the maturity level. This process must also cover a structured evaluation of these ideas with some quality gates." (Interviewee 14)

He continued and pointed to the next essential criteria:

> "This process must also cover a structured evaluation of these ideas with some quality gates." (Interviewee 14)

In the same vein, another participant underlined:

> "[…], also a so-called *Inno-Gate* has to be established, which suppliers have to pass." (Interviewee 8)

Both referred to a kind of checkpoint, which evaluates the supplier's innovation capability and allows also some kind of comparison. Upon the enquiry, the interviewee explained:

> "Best practice is as well to rate the suppliers according to their innovation capability, i.e. giving additional points in the general evaluation if the innovation capability is high. Or having events related to this category, like a supplier innovation day, where the most innovative suppliers are invited to present their ideas and at the end the best idea among them is awarded." (Interviewee 8)

As an additional option in order to make such an evaluation, he pointed to the company's supplier innovation day – a practice already discussed in the context of a collaborative relationship in paragraph 4.3.5.3.

A third impulse was provided by the Head of the Innovation Management Team, to that the colleagues already referred above. As he was acting at the forefront of all these activities, the following insights were particularly valuable:

> "Of course, it is not only the identification of innovative suppliers, but also the successful inclusion. As an example, we identified the company […] as very innovative and even awarded them with our supplier innovation price. They invented a process to monitor welding seams in our seat division. However, after they presented the proof of concept, it took us nine months to negotiate a follow-up contract with them. We wanted to fix everything in the contract, but the technology was really new and needed a certain learning curve in the context of seat structures. Thus, also the fast and efficient on-boarding of new innovative suppliers is crucial for the enabling role of supplier innovativeness." (Interviewee 22)

He continued:

> "Another example is the company […]. Here it took us six months to find an alignment of the general terms and conditions that we wanted to have signed. These kind of contractual processes must be somehow agile, too. I mean, why not making contracts for a month and having a clever and fast process in place to be able to manoeuvre much more short-termed with these kind of companies." (Interviewee 22)

Put differently, best practice in leveraging supplier innovativeness is not finished when the innovation potential is identified and promisingly evaluated The respective suppliers have to be integrated fast and efficient in order to fully utilise the ideas.

Taking all these insights into account and reflecting on the literature, the respective maturity levels are summarised in the table on the next page:

Table 4.34: Maturity levels of supplier innovativeness

Enabler	Level 1	Level 2	Level 3	Level 4
Supplier innovativeness	The search for innovative suppliers hardly takes place along the firm's entire value stream and is loosely covered from identification over evaluation towards integration	The search for innovative suppliers partly takes place along the firm's entire value stream and is procedurally covered from identification over evaluation towards integration to a certain degree	The search for innovative suppliers widely takes place along the firm's entire value stream, is in the responsibility of a dedicated organisational unit, and is usually procedurally covered from identification over evaluation towards integration	The search for innovative suppliers takes place along the firm's entire value stream, is in the responsibility of a dedicated organisational unit, and is procedurally defined from identification over evaluation towards integration

4.3.5.8 Summary of Maturity Levels within Supply Chain Agility

Similar to the former category of product development agility, not all of the former identified enablers could be confirmed and verified with best practice examples during the case study. In terms of supply chain agility, five of the originally seven enablers have been proved to be appropriate for the final maturity model. The overview is comprehensively summarised in table 4.35.

Table 4.35: Maturity levels within supply chain agility

Enabler	Level 1	Level 2	Level 3	Level 4
Network integration	Supply chain members are occasionally integrated while overly rigid frameworks constrain the collaboration	Supply chain members are integrated to a certain degree by means of coordinated processes and solid contracts while common collaboration towards sub-suppliers is partly executed	Supply chain members are integrated by means of coordinated processes and solid contracts while common collaboration towards sub-suppliers is executed	Supply chain members are highly integrated by means of coordinated processes, solid contracts, resident engineers, and common collaboration towards the sub-suppliers
Information and communication technology integration	Information systems and common automated tools are hardly integrated throughout the supply chain why an appropriate communication lacks	Information systems and common automated tools are partly integrated throughout the supply chain to enable appropriate communication	Information systems and common automated tools are widely integrated throughout the supply chain to enable proper communication	Information systems and common automated tools are highly integrated throughout the supply chain to enable frequent and regular communication
Collaborative relationship	Buyer-supplier relationships are hardly characterised by trust, information sharing, commitment, communication, and risk and reward sharing while a certain competitive pressure exists occasionally	Buyer-supplier relationships are partly characterised by trust, information sharing, commitment, communication, and risk and reward sharing while a certain competitive pressure is sometimes maintained	Buyer-supplier relationships are widely characterised by trust, information sharing, commitment, communication, and risk and reward sharing while a certain competitive pressure is usually maintained	Buyer-supplier relationships are always characterised by trust, information sharing, commitment, communication, and risk and reward sharing while competitive pressure is maintained

Table 4.35 (continued)

Enabler	Level 1	Level 2	Level 3	Level 4
Flexibility	The purchasing organisation is occasionally able to quickly adjust their supply chain tactics and operations, and rarely applies a dual or multiple supplier strategy where high flexibility is necessary	The purchasing organisation is sometimes able to quickly adjust their supply chain tactics and operations, and partly applies a dual or multiple supplier strategy where high flexibility is necessary	The purchasing organisation is usually able to quickly adjust their supply chain tactics and operations, and widely applies a dual or multiple supplier strategy where high flexibility is necessary	The purchasing organisation is always able to quickly adjust their supply chain tactics and operations, and strictly applies a dual or multiple supplier strategy where high flexibility is necessary
Supplier innovativeness	The search for innovative suppliers hardly takes place along the firm's entire value stream and is loosely covered from identification over evaluation towards integration	The search for innovative suppliers partly takes place along the firm's entire value stream and is procedurally covered from identification over evaluation towards integration to a certain degree	The search for innovative suppliers widely takes place along the firm's entire value stream, is in the responsibility of a dedicated organisational unit, and is usually procedurally covered from identification over evaluation towards integration	The search for innovative suppliers takes place along the firm's entire value stream, is in the responsibility of a dedicated organisational unit, and is procedurally defined from identification over evaluation towards integration

4.3.6 Maturity Levels within Manufacturing Agility

Following the logic of the Diamond of Corporate Agility (see figure 4.2), the dimension of manufacturing agility remains for investigation in order to establish the maturity model. As outlined in section 2.2, the roots of agility can be traced back to the agile manufacturing enterprise in the 1990s. Thus, the dimension itself may have certain significance in the entire context of this thesis, as the subsequent debate will shed light on linking this dimension to the overall construct of corporate agility 30 years later.

Resulting from the literature review in sub-section 2.3.4, the main manufacturing agility enablers enclose 1) employee empowerment, 2) manufacturing system flexibility, 3) advanced manufacturing technologies, 4) product modularity, 5) concurrent paradigm, and 6) knowledge management and learning.

4.3.6.1 Employee Empowerment

In one of the most recent studies on agile manufacturing practices, Gunasekaran et al. (2019) identify five enabling competencies. Amongst them, *total employee empowerment* is discussed from three dimensions. First, *appropriate training* in order to equip workers with sufficient knowledge, skills, and tools necessary to operate intelligent machines and technologies. Second, a *team culture* that empowers employees individually and collectively by running most operations as mini-companies. And third, *employee involvement* in major decisions like stopping the production flow (in case of anomalies) or in the process for continuous improvement. The last aspect is as well emphasised by Srikanta Routroy and his co-authors who name it *devolution of authority* and describe it as "[…] the process of delegating authority to the members of the organisation. It also enhances independent decision-making which thereby translates to quick decision-making" (Routroy et al., 2015, p. 3). Besides this, earlier research has identified the practice of *job rotation* along with an environment where employees at each level are free to make suggestions (Dubey & Gunasekaran, 2015) and *flat hierarchical structures* that focus towards the individual personnel responsibility (Aravind Raj et al., 2013).

Looking at the practices above and reflecting on the former discourse in this chapter shows that every single factor is either included in the dimension of or-

ganisational agility or workforce agility. For instance, the enabler of organisational structures and power distribution (paragraph 4.3.1.1) covers the point of a few hierarchical levels, or job rotation is in depth discussed within low power practices and high power practices (paragraph 4.3.2.1). The explanation can be found in the overall perspective applied by most of the scholars above. They considered the companies of interest in a first line as manufacturing enterprises when conducting their studies on manufacturing agility. Put differently, they place the manufacturing domain as the central point of research with other areas, like the supply chain, around. In turn, the central aspects from the Diamond of Corporate Agility (organisational and workforce agility) were investigated with respect to agility in manufacturing. Nevertheless, as my conceptual model is grounded in a framework of capabilities that exist on different levels in an organisation, the enabling factors on organisational and workforce agility (first-order capabilities) will or can indirectly influence manufacturing agility (second-order capability) too. Hence, for redundancy reasons, employee empowerment will not be included in the dimension of manufacturing agility again.

For the sake of completeness, the interview responses on the one hand confirmed the mentioned practices:

> "We use skill matrices to ensure that all our employees can work on each production line; or at least this would be best practice. This has an effect on the peoples' salary – the more skills, the higher is the variable bonus." (Interviewee 6)

But pointed in a similar direction regarding the creation of redundancy:

> "It is interesting that this aspect is related to the dimension of manufacturing as I assume this affects the other agility dimensions as well. Or in other words, why is it not listed below organisational agility (e.g. hierarchical structures) or workforce agility (e.g. reward systems)." (Interviewee 6)

4.3.6.2 Manufacturing System Flexibility

In paragraph 4.3.5.5, flexibility has been discussed with respect to a firm's supply chain. In the context of the company's factories, the central subject is a *flexible manufacturing system*. Case study research of Ifandoudas and Chapman (2009) revealed for instance that a *T-plant manufacturing system* significantly increased flexibility while lead times went down. In such a system, products get manufac-

tured with common components as long as possible until the final assembly stage. Furthermore, the investigated company (an Australian SME manufacturing custom-built electrical components) installed some extra *sprint capacity* in its production schedule for products that were not planned in the initial schedule. This sprint capacity, which is basically not in favour of a true lean production system, was installed only for the bottleneck activities and thus resulted in a much more agile system for affordable costs. In order to proactively manage the buffers for the bottleneck components, the middle managers came together in a *daily meeting*.

From a more theoretical point of view, Gunasekaran et al. (2019) review the literature and revisit agile manufacturing enablers that can be deployed in today's increasingly fragmented markets characterised by rapid changes. In terms of flexibility in the product mix, they propose a *cellular layout* of machines based on related jobs or part families as a basic step. Here, a cell generally consists of one or more stand-alone computer numerical controlled (CNC) machines complemented by the necessary ancillary equipment (like robotic part handlers). This cellular design can then be automated selectively by additional machining and assembly tasks. Even if such a flexible automation has advantages in being adaptable and is able to perform a wider range of operations, valuable time has to be considered in case of retooling and change over.

The selected interviewees for this topic highlighted a cellular design as well. For instance, a head of several production plants in Europe explained out of his 25 years history in the company:

> "Good practice is characterised by a *plug-and-produce* concept, i.e. modular cells for single customers or customer projects. Best practice is characterised by modular cells for more customers and more customer projects." (Interviewee 5)

His description of best practice is of course desirable and closely linked to a standardised product architecture. However, the reality shows that even for the same product family customer requirements sometimes differ heavily from another and need to be considered in the manufacturing concept accordingly. Nevertheless, another colleague pointed to the usage of the *global production footprint* in such cases:

> "Customised production lines are not always avoidable. Of course, the strategy should be to have as less as possible individual lines and to produce the products for several customers with the same equipment. But when we need highly customised lines, these should be at least located in best-cost countries." (Interviewee 26)

He continued:

> "To come to best practice, the manufacturing system must consider the maturity of the product in terms of market penetration and our customer base as well as the footprint aspect regarding the potential to locate customised lines somewhere, where the labour costs are smaller than in high technology countries." (Interviewee 26)

These were valuable insights and should be part of the agenda when the concept for the industrialisation of a product gets finalised.

In order to achieve flexibility not only regarding the product mix in the single production plant but also in volumes and across several factories, the respondents emphasised the utilisation of *standardised production equipment*. In one of the cases, the participant explained the usage of standardised winding devices for the manufacturing of small electric motors. These devices can be installed at several production lines in different locations. Another colleague added:

> "If we have more machines for the same product, we always consider e.g. not making a release for each part number on each machine, as this also means additional efforts and thus costs. Often there is enough flexibility when each machine is released for a set of part numbers; maybe the high-runners of part numbers are released for more machines." (Interviewee 15)

Eventually, manufacturing system flexibility gains particular importance for the launch of new products in the automotive industry. The later aspired mass production usually starts with a smaller lead project at a single customer. During the journey from product development towards start of production a lot of insights will be generated, which in most cases will also impact the manufacturing concept. Here, flexibility usually pays off.

In summary, the respective maturity levels are depicted in the following table on the next page:

Table 4.36: Maturity levels of manufacturing system flexibility

Enabler	Level 1	Level 2	Level 3	Level 4
Manufacturing system flexibility	The firm's manufacturing system is hardly characterised by a cellular layout and standardised equipment, and thus allows rarely a customer-overarching production for same product families	The firm's manufacturing system is partly characterised by a cellular layout and standardised equipment that sometimes allows a customer-overarching production for same product families	The firm's manufacturing system is widely characterised by a cellular layout and standardised equipment that allows a customer-overarching production for same product families (at least to a certain degree)	The firm's manufacturing system is characterised by a cellular layout and standardised equipment that allows a customer-overarching production for same product families (at least to a certain degree)

4.3.6.3 Advanced Manufacturing Technologies

This enabler describes "the various technologies that might be used to automate the different functions that are routinely carried out by the manufacturing system. Adoption of such automation makes the system faster and thereby contributes to agile behaviour" (Routroy et al., 2015, p. 3). In a larger context, advanced manufacturing technologies can be clustered in three sub-dimensions and therefore form a multidimensional concept (Ghobakhloo & Azar, 2018). Within in the first category, namely *design and manufacturing-related technologies*, they figure out the highest adaption rate of the following practices: computerised maintenance management systems, computer-aided design/manufacturing (CAD/CAM), and automated inspection systems (vision/sensor, etc.). Within the second cluster of *process-related shop floor technologies* the highest usage was found regarding automated data collection (barcode, RFID, etc.) and automated guided vehicle systems. Below a third category, they bundle information and control (administrative) technologies. This aspect has already been covered in the present piece of research in paragraph 4.3.1.4 (information and communication technology) and will therefore not picked up again.

In another study, where Dubey and Gunasekaran (2015) collected almost 300 survey responses from (top) managers acting in Indian manufacturing firms, the most important technologies were the use of *automated-guided vehicle systems* and the use of *robotic machines*. The second aspect was as well emphasised during my data collection, as the following example demonstrates:

> "[…] is also characterised by highly flexible robots with independently traversing changer systems." (Interviewee 5)

When expanding this discussion to best practice examples, the participants explained the *combination of robots with sensing capabilities*:

> "Best practice is image-processing technology, e.g. when a robot is steered for the last 10 cm by a camera; this will give increased variability." (Interviewee 5)

> "Robots are always the most flexible equipment that is possible. In particular when these are equipped with cameras." (Interviewee 6)

> "Usually a robot is the most flexible technology. If you combine this with camera technology, more flexibility is hardly possible." (Interviewee 26)

These comments are also in line with the aspect of automated inspection systems mentioned in the study of Ghobakhloo and Azar (2018). Surprisingly, they figured out only an adaption rate of 14% of robots when investigating 189 Iranian automobile part manufacturers. However, again in line with the scholars' investigation, one of my participants highlighted the application of *automated mechanisms for maintenance*:

> "The flexibility of manufacturing systems can also be fostered by means of automated mechanisms for maintenance, e.g. vibration sensors or thermal imaging cameras. With this kind of early detection, maintenance work can be better scheduled and aligned with demand etc." (Interviewee 5)

Besides this, another participant pointed to *advanced analytics* as an emerging technology:

> "Advanced analytics will help to foster machine learning. E.g. when a screw is fixed with 4 Nm but the leakage test in the next workstation fails a few times in a row, the robot adjusts the screwing force to e.g. 6 Nm and the advanced analytics algorithm observes the effectiveness of this adjustment." (Interviewee 26)

In a scientific context, Gunasekaran et al. (2018) outline the benefits of *big data* and *business analytics* on agile manufacturing. They conceptualise the construct by the predictive power through using statistics to forecast future events based on what has occurred in the past. Necessary tools comprise for instance regression modelling, decision trees, Bayesian statistics, or neural networks. Their case study proves that successfully applying such tools will lead to an increased manufacturing agility and in turn to a better business performance.

With respect to the mentioned practices, a highly experienced Plant Manager of one of the company's lead plants described the following:

> "All the practices mentioned in the literature and discussed make sense and for sure contribute to manufacturing agility. I would rate them along their implementation in a global production network and that all shareholders of manufacturing are connected." (Interviewee 6)

Accordingly and taking as well the former discussion into account, the maturity levels can be depicted as follows:

Table 4.37: Maturity levels of advanced manufacturing technologies

Enabler	Level 1	Level 2	Level 3	Level 4
Advanced manufacturing technologies	The firm's production network lacks advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics	Advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics are implemented along the firm's production network to a certain extend	Advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics are widely implemented along the firm's production network	Advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics are entirely implemented along the firm's production network

4.3.6.4 Modular Product Architectures

Already in one of the earliest conceptual papers on agile manufacturing, Yusuf et al. (1999) identified *modularity* as a key attribute for agility as it will enable the

organisation to meet the customer's specification by modifying quickly parts of the product. A few years later, Watanabe and Ane (2004) provided sound empirical evidence from the automotive industry by demonstrating that the value of manufacturing agility increases in line with an increased utilisation of modules in the product and manufacturing process for the Toyota Eco Cars Prius, Estima, and Crown. Jacobs et al. (2011) figured out that even if little consensus has emerged on the definition of modularity, the common understanding of scholars is that product modularity incorporates building blocks, which can be combined to provide a comparatively large number of product configurations. In order to conduct their research, they define product modularity as "the use of standardised and interchangeable architectural elements that enable the configuration of a wide variety of products. The definition presupposes loose coupling, ease of disaggregation, heterogeneous outputs, and a one-to-one matching of function to module" (Jacobs et al., 2011, p. 125). To operationalise it for the sake of questionnaires, they used the following measurements:

Table 4.38: Measurement of product modularity (Jacobs et al., 2011, p. 129)

Measurement	Definition
Modularity	The process of developing interchangeable parts across products that can be configured into a wide variety of end products.
Standardisation	The use of standard procedures, materials, parts, and/or processes for designing and manufacturing a product.

The following statements from the cases selected to investigate this enabler show that the participants fully agree to the theoretical insights provided by the academics above:

> "Standardised components will allow producing in a global manufacturing network, which in turn increases the agility of the company." (Interviewee 5)

> "One of the most important enablers and the basis for a flexible manufacturing concept." (Interviewee 26)

It is worth to mention that the consensus even to the definitions and measurement criteria in the literature was surprisingly high. On the other hand, the fact that also the research of Jacobs et al. (2011) is based on surveys with first tier

suppliers to large auto manufacturers in North America gives an explanation. Considering the maturity levels, the practitioners recommended to evaluate it according to the degree of 1) modularity that exists along the firm's product portfolio and 2) implemented standardisation (in terms of procedures, materials, parts, and processes for manufacturing a product). Correspondingly, the maturity levels are drawn in table 4.39:

Table 4.39: Maturity levels of modular product architectures

Enabler	Level 1	Level 2	Level 3	Level 4
Modular product architectures	Products are occasionally designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products	Products are sometimes designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products	Products are usually designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products	Products are always designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products

A not negligible question remains regarding this enabler with respect to its listing below manufacturing agility and not within the dimension of product development agility. According to my own industrial experience but as well based on the debates in the scientific community, probably both agility dimensions benefit from modular product architectures. The benefit in product development might be due to the use of standardised materials or design processes, but developing such kinds of interchangeable architectural elements usually needs several design loops and intense alignment between development teams. In other words, the creation itself is often linked to increased efforts and a majority of the true agility effects is then perceived when it comes to manufacturing. Of course, besides also commercial benefits through e.g. higher volumes caused by standardised components.

4.3.6.5 Concurrent Paradigm

Upfront to the discussion of the maturity levels, I have to admit that the wording of this enabler turned out to be not clearly understandable within the interviews. The informants caught the idea, but in most of the cases only after additional explanations. For instance, a Head of Production Technology for one of the business units stated:

> "As I said in the beginning, product and process must not be separated. I am wondering about the wording: *simultaneous engineering* is the more common wording in our industry." (Interviewee 26)

Other proposals comprised also simultaneous engineering or *concurrent engineering*. Revisiting the literature indeed shows that latter wording is used by several well-known scholars in this field (Gunasekaran, 1998; Gunasekaran et al., 2002; Vázquez-Bustelo et al., 2007; Yusuf et al., 1999). For the sake of clarity and applicability, I will as well stick to concurrent engineering and accordingly adapt the wording in the final maturity model for corporate agility.

Coming to the theoretical foundations, early research recognised that "in an agile environment, there is a need for a quick responsive manufacturing system. Concurrent engineering is the answer to the need for shorter product development cycles and hence to respond quickly as possible to changing markets" (Gunasekaran, 1998, p. 1230). The gains in speed can be particularly achieved through *parallel information processing* and *concurrent execution of functions* (Yusuf et al., 1999). Practices comprise for instance 1) the formation of cross-functional product development teams, 2) concurrent design of products and processes, 3) multidisciplinary team work environment, 4) customer and supplier integrated multidisciplinary teams, or 5) early involvement of different agents in the product development process and concurrent execution of functions/activities (Vázquez-Bustelo et al., 2007).

When I made this topic part of the case study discussion, I realised quite quickly that the practitioners linked in particular the *early involvement of manufacturing functions* to a higher degree of manufacturing agility. A VP within the corporate function for production planning explained:

> "Theoretically it is defined in our product development process (PDP). This process strongly supports the concurrent paradigm. However, as the practical world is always different to theory, I would say the maturity level correlates to the stringency how our people stick to the PDP." (Interviewee 15)

She pointed to two important aspects: First, the basic idea of early involvement of the manufacturing colleagues into process and product development is already defined in the firm's product development process (PDP). Second, it looks like that this theoretical guideline is not strictly followed why she connected the maturity to the *stringency* of involved people. Another colleague described it slightly more precise:

> "Best practice from my point of view is the integration of a production planner in the project core team from the beginning. That means even in the acquisition phase of a project. Then, of course, product and process design must be happen simultaneously. If this is ensured widely in all projects via some kind of process or within the rules for product development, I would classify this as the highest maturity level." (Interviewee 6)

Deepening this discourse further revealed that the company's PDP defines a project core team, which is formed at an early stage (i.e. sometimes even before an RFQ is received). Within this team, a role is specified for production planning. This team member is the responsible interface on the one hand into the corporate functions for manufacturing technologies and on the other hand into possible production plants in order to align needed capacities for manufacturing or storage. Within his/her own function, topics like an overall business case for similar products have to be aligned. In this way, the manufacturing aspect is considered from the very beginning of each project activity or development phase.

Combining these practical insights with the former discussed theoretical perspectives leads to the following maturity levels:

Table 4.40: Maturity levels of concurrent engineering

Enabler	Level 1	Level 2	Level 3	Level 4
Concurrent engineering	The firm lacks a procedure that clearly defines the early involvement of manufacturing into process and product development	The firm has a procedure in place that partly defines the early involvement of manufacturing into process and product development and is followed by concerned employees to a certain degree	The firm has a procedure in place that widely defines the early involvement of manufacturing into process and product development and is largely followed by concerned employees	The firm has a procedure in place that clearly defines the early involvement of manufacturing into process and product development and is strictly followed by concerned employees

4.3.6.6 Knowledge Management and Learning

Taking the *knowledge-driven enterprise* into consideration as one of the core concepts of agile manufacturing, Yusuf et al. (1999) note that *knowledge is power*. With this statement they refer to the necessity that "organisations which intend to become agile should include the development of a well trained and motivated workforce, with the right set of skills, expertise and knowledge, as an essential element of their strategies" (Yusuf et al., 1999, p. 39). Specific practices comprise for instance an easy and global access to databases and information, knowledge management systems, organisational structures that promote training and education, a firm-wide integration of learning, and/or core competence management (Vázquez-Bustelo et al., 2007).

With reference to my interview data, the participants generally agreed with the practices mentioned in the literature. One informant pointed out:

> "Best practice means that knowledge must be visible and accessible. These are the premises that knowledge can be applied. A best practice example from my own experience is the *working out loud* approach, which means not only making his own work but also letting other people know about it. This will allow other people to participate and learn. " (Interviewee 15)

She continued:

> "Even if all the practices mentioned in the literature make sense, the most essential criteria to be best practice is the degree how knowledge is applied." (Interviewee 15)

With respect to the manufacturing context of this topic, another colleague emphasised the urgent necessity when a project enters the ramp-up phase, i.e. when serial tools are finished, final samples are built, and serial production shortly starts:

> "In terms of best practice, the employees have to be multi-skilled on the one hand and on the other hand a process and knowledge management share point for instance has to be filled after every ramp-up (and considered before any future ramp-up). Most important is that those systems must be widely accepted and practised. Accordingly, the maturity levels can be distributed along the criteria if those systems are in place and if they are integrated in the daily work." (Interviewee 5)

In general, a pattern occurred regarding the *applicability of knowledge*. However, this was not surprising according to the interviewees' operational roles within the organisation.

In the larger context of this DBA study, practices concerning *organisational learning and training* have been discussed in paragraph 4.3.2.3 within the dimension of workforce agility. The maturity levels were identified according to the degree an organisation 1) encourages and facilitates learning and training, 2) provides the necessary time, 3) is systematically laying out individuals' learning requirements, and 4) how its culture makes employee learning a top priority. These aspects are widely in line with the practices discussed before regarding knowledge management and learning. Only the point that knowledge must be accessible has been more dedicatedly argued within the cases on manufacturing agility. An explanation could be that employees on the shop floor have in general less access to the company's informative infrastructure via e.g. personal computers. Thus, visibility and accessibility of knowledge have to be considered as important prerequisites.

Finally, as workforce agility is conceptualised as a first-order capability, the underlying enablers are also valid for manufacturing agility as a second-order capability. Taking the prerequisites mentioned before into account, I consider the enabler of knowledge management and training as covered and will not define further maturity levels for the manufacturing domain.

4.3.6.7 Summary of Maturity Levels within Manufacturing Agility

The discourse before shows that basically all of the identified enablers have been constructively discussed with the participants and were classified as suitable for the maturity model of corporate agility. However, two of the six enablers are already part of the other dimensions' debates: employee empowerment is covered within the dimensions of organisational agility and workforce agility, and knowledge management and learning as well within workforce agility. Hence, the remaining four enablers will be considered for the final maturity model and are entirely depicted on the next pages:

Table 4.41: Maturity levels within manufacturing agility

Enabler	Level 1	Level 2	Level 3	Level 4
Manufacturing system flexibility	The firm's manufacturing system is hardly characterised by a cellular layout and standardised equipment, and thus allows rarely a customer-overarching production for same product families	The firm's manufacturing system is partly characterised by a cellular layout and standardised equipment that sometimes allows a customer-overarching production for same product families	The firm's manufacturing system is widely characterised by a cellular layout and standardised equipment that allows a customer-overarching production for same product families (at least to a certain degree)	The firm's manufacturing system is characterised by a cellular layout and standardised equipment that allows a customer-overarching production for same product families (at least to a certain degree)
Advanced manufacturing technologies	The firm's production network lacks advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics	Advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics are implemented along the firm's production network to a certain extend	Advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics are widely implemented along the firm's production network	Advanced manufacturing-related technologies, process-related shop floor technologies, and big data in combination with business analytics are entirely implemented along the firm's production network

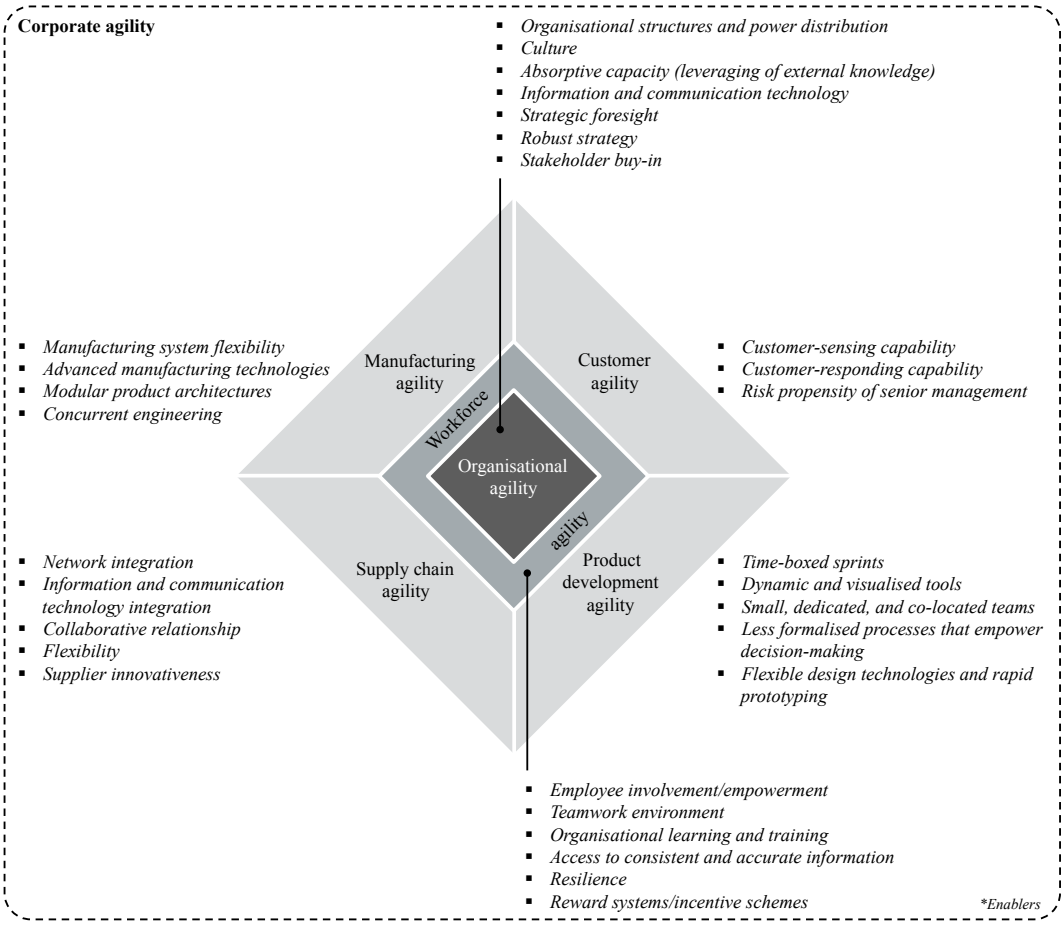
Table 4.41 (continued)

Enabler	Level 1	Level 2	Level 3	Level 4
Modular product architectures	Products are occasionally designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products	Products are sometimes designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products	Products are usually designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products	Products are always designed by means of interchangeable architectural elements within and across them and by use of standardised procedures, materials, and processes for manufacturing these products
Concurrent engineering	The firm lacks a procedure that clearly defines the early involvement of manufacturing into process and product development	The firm has a procedure in place that partly defines the early involvement of manufacturing into process and product development and is followed by concerned employees to a certain degree	The firm has a procedure in place that widely defines the early involvement of manufacturing into process and product development and is largely followed by concerned employees	The firm has a procedure in place that clearly defines the early involvement of manufacturing into process and product development and is strictly followed by concerned employees

4.4 Establishing the Maturity Model of Corporate Agility

To finally build the entire maturity model, the Diamond of Corporate Agility (see figure 4.2) needs to be synthesised with the enablers that have been categorised as applicable by the case study participants. Accordingly, the six agility dimensions and the related enablers are merged as the *Maturity Model of Corporate Agility*:

Figure 4.4: Maturity Model of Corporate Agility established by Markus Holzberger



Each of the 30 enablers has been defined from poor or rudimentary practice (level 1) until best practice (level 4) in the sections before. The definitions are mainly based on the insights from the interviews regarding tactics or methods that have been successful through real-life implementation. Accordingly, in some cases the collected data allowed to sketch the maturity levels along varying aspects within the single maturity levels (see for example the enabler of organisational structures and power distribution, table 4.3), in other cases the maturity levels have been drawn along a higher sophistication level of the same factors (see for

example the enabler of strategic foresight, table 4.8). Similarity was not the primary goal at this point, rather I made use of the most valuable insights from the practitioners. Thus, I am well aware of these variations, which however again underline the model's practical use. Consequently, the different levels automatically describe the *improvement path* in order to enter the next stage. With this logic in place, firms can use the maturity model to evaluate its current level of corporate agility and define a target state. It is important to understand that not all companies should aim at attaining the maximum in each enabler of each agility dimension. In doing so, the resource demand would be probably much too high and the risk occurs of slowing down other crucial processes in the company. The aim should rather be to strive towards an *optimum level given a certain context*.

In order to identify the optimal target state, managers should first consider their own *firm size*. Multiple respondents pointed out that the larger the company, the higher should be the aspired maturity level. The logic is that sluggish organisational structures often correlate with a high company size. Another crucial contextual factors are the *industry clock speed* and the *complexity of the environment* itself. While the first is characterised for instance by the rate of new products or processes, complexity can be described by the number of interdependencies in the market that need to be monitored and taken into account. Taking the automotive (supplier) industry as example, the government plays a decisive role regarding several ecological criteria such as the level of nitrogen oxide emissions or the noise level of vehicles. On the other hand, large associations try to advocate the interests of this industry and thus sometimes create additional tension. Not least of the strong public visibility of this branch, also labour unions strive to ensure proper working conditions. In a nutshell, the higher these factors, the higher is the recommended maturity level for corporate agility as the likelihood for unexpected changes rises.

Once the context of the company is carefully considered, the single agility dimensions need to be analysed regarding an aspired target state. Here, the logic of the maturity model should be followed; meaning to start with the two first-order capabilities (organisational and workforce agility) before analysing the remaining four agility dimensions regarding the customer, product development, the supply

chain, and manufacturing. The underlying enablers with their maturity levels help in each case to describe an overall target level of the respective dimension. In the same logic, the result of these classifications indicates a holistic target state of corporate agility.

Rating the firm's status quo for each of the enablers and comparing it with the former defined target maturity levels will finally show the respective improvement path. Based on this, dedicated activities can be initialised and progress can be tracked anytime by referring to the Maturity Model of Corporate Agility. In the company where the case study took place, it is already planned to run a pilot project with the proposed maturity model. The model will be applied to one of the three business units in order to test its practicability and to further optimise the usage. In a first workshop session with the business unit's Executive VP and his direct reports (the management team), an optimal target state of the two first-order capabilities will be elaborated as the aspects of organisation and people affect the entire business unit. For both dimensions, organisational and workforce agility, an extended working group will be defined. Furthermore, for each of the remaining four agility dimensions a kind of "owner" will be named. With each of these persons I will determine a target state for those dimensions and select a working group too. After, the management team will come together again in order to commonly review the single target states and reflect on the resulting overall agility level. If this level is considered appropriate, the second workshop sessions can be started with the former selected people. Here, the firm's status quo for each of the enablers will be worked out and depicted in comparison to the former defined target maturity levels. Now, a gap analysis can be conducted that results in ranking the enablers from the highest deviation towards maybe already achieving or even over-achieving the required maturity level. At this point in time, the decision must be taken where to allocate resources to close the identified gaps. Therefore, these intermediate results for each of the six agility dimensions will be presented to the management team again together with recommended measures and necessary resources. In case of approval, dedicated activities can be initialised that will be tracked from now on within regular reviews. As soon as the target state of each agility dimension is achieved, I will discuss the maturity model's application in

depth with the management team and decide on next steps. It is estimated to need around six months to reach this point.

In order to close chapter four, two aspects are worth to emphasise: First, the necessity of the established Maturity Model of Corporate Agility. As outlined at the beginning of this chapter, there is no maturity model available that considers agility from a corporate perspective in the automotive supplier industry. Most recently it was Wendler (2014) who concludes that available models suffer regarding their applicability due to 1) an insufficient reflection of the entire organisation, 2) the utilisation of complex algorithms limiting an intuitive and ad hoc usage, and 3) a lack in suggesting further actions for improvement. Attempting to close this gap, he introduces the Organisational Agility Maturity Model as a new approach to assess organisational agility in the software and IT service industry. This maturity model is structured into three dimensions (agility prerequisites, agility of people, and structures enhancing agility), each with two sub-dimensions. Even if it may serve as a reference frame to implement a systematic and well-directed approach for improvements and continuous assessment of action taken, it is not fully suitable to be applicable in the automotive supplier industry. Firms operating in this sector typically orchestrate a bundle of distinct functions, e.g. product development, sales, and manufacturing. Each of these functions underlies different factors enabling agility. Consequently, a respective maturity model must consider this variability of enablers. The data out of my multiple-case study clearly echoed the request of managers that an appropriate maturity model must reflect the different dimensions of the firm's value chain. Thus, I conclude that the Organisational Agility Maturity Model of Wendler (2014) and the Maturity Model of Corporate Agility might have some parallels regarding the two dimensions of organisational agility and workforce agility, but the essential contribution of my model is its extension towards customer agility, product development agility, supply chain agility, and manufacturing agility. Without considering those dimensions it would be hardly possible for an automotive supplier to apply such a framework.

Second and finally, the evolution of the Maturity Model of Corporate Agility is characterised by slight and medium modifications instead of bold changes, for

instance the transformation from the conceptual model into the Diamond of Corporate Agility. On the one hand, I was myself a little bit surprised of the participants' relatively high consensus with the conceptual model and also that later adaptions followed often on a very detailed level like a more practical wording or re-defining some of the agility dimensions. On the other hand, this study considered agility from the beginning through a practical lens: Within the literature review I was intensively searching for in-depth data for the enabling aspects of agility, a pre-discussion (upfront to the multiple-case study) with five highly knowledgeable experts took place, and overall a pragmatist philosophical position was selected for conducting the research. Eventually, my own experience of more than ten years in the automotive industry helped to narrow down the discussions to the essential aspects when it comes to applying such a maturity model to a real business context. In this way, I was able to enter the main data collection with a robust and practically oriented theoretical base and could fully use the collected inputs to verify and refine the conceptual model towards the Maturity Model of Corporate Agility.

CHAPTER FIVE

Final Discussion and Conclusion

> The field of organisation theory has, I believe, paid dearly for the obsession with rigour in the choice of methodology. Too many of the results have been significant only in the statistical sense of the world. (Mintzberg, 1979, p. 583)

5.1 Introduction

This study aims to understand how agility is *constituted* in a corporate context, what are the *main enablers* behind, and in particular what are the *maturity levels* within these enablers. Building upon the theoretical foundations of the *resource-based view* and the concept of *dynamic capabilities*, the literature review highlighted six different agility dimensions split into first- and second- capabilities. The worldview of *pragmatism* has been characterised to be appropriate for conducting the research, as the primary goal was to translate the collected management knowledge into *efficacious practical realisation*.

A series of *in-depth interviews* with five highly knowledgeable experts has been carried out in order to ensure the practicability of the conceptual model for a *multiple-case study*. Afterwards, the relevant cases were selected across three business units and the corporate functions of a *multinational automotive supplier*. At that point in time, I spent almost ten years in this company and thus had explicit access to the employees – up to high-level managers even including members of the board. The case study itself was carried out by means of semi-structured interviews. Additionally, templates were used as a second data collection instrument to visualise and discuss the answers of the informants.

The research concludes with the *Maturity Model of Corporate Agility*, which builds on a pragmatic understanding of the phenomenon of agility amongst the participants of this study. That is, agility in a corporate context is characterised by six key elements: two first-order capabilities and four second-order capabilities.

These are grounded in a set of enablers, in total 30. Each of them has been defined from poor or rudimentary practice to *best practice* while the different levels automatically indicate the *progression on the improvement path*. Practitioners can apply this framework in order to rate the proficiency of their own company and define an aspired target state.

This chapter comprehensively discusses the results outlined in the previous chapter with relevance to the existing body of literature and regarding the role of the researcher. Furthermore, managerial and theoretical contributions are presented before I come to the limitations of this study and future research directions. The thesis closes with some personal final thoughts of mine.

5.2 Final Discussion

In the following two sub-sections, the Maturity Model of Corporate Agility as well as my own role within this study is finally reviewed. The main intend is to comprehensively reflect the procedure and the findings.

5.2.1 The Maturity Model of Corporate Agility

After an intense literature review, the journey started somehow with the first conceptual model (see figure 2.1) with its six agility dimension and 35 underlying enablers. The first significant adaption was the transformation into the Diamond of Corporate agility (see figure 4.2) where in particular a more practical wording and a reconfiguration of the agility dimensions took place. Within the second main iteration step towards the Maturity Model of Corporate Agility (see figure 4.4), the underlying enablers have been reduced and clustered into the single maturity levels. This reduction is mainly driven by missing evidence out of the case study interviews or the logic that the two first-order capabilities have certain interdependencies to the four second-order capabilities, as they are “simply” on a higher level. In turn, also the underlying enablers of organisational and workforce agility may affect some of the crucial aspects discussed within the dimensions of customer agility, product development agility, supply chain agility, and manufacturing agility. For instance, the enabling role of *organisational structures and power distribution* can be found in the literature in both dimensions of organisa-

tional and workforce agility. I decided to link this enabler to organisational agility, as at the heart is a flat hierarchy with a decentralised decision-making process and organisational agility itself is anyhow central to the maturity model. Besides this, the interviewees linked a distributed decision-making power also to a proper customer-responding capability – one of the major enablers within customer agility. Another example is *employee empowerment*, which scholars discuss in the context of workforce and manufacturing agility. As I linked it already to workforce agility as a first-order capability, it is also valid for the domain of manufacturing.

These examples clearly demonstrate some of the interdependencies between the enablers of the single agility dimensions. This is not surprising, as the phenomenon of agility (linked to organisation theory) is rooted in the manufacturing domain and has been investigated from various perspectives over the past 30 years. Hence, the more it was important to avoid any kind of redundancy between the single enablers in order to ensure a managerial feasibility of the model. Nothing is a greater barrier for practitioners as being lost in understanding the basic descriptions of a maturity model instead of focusing on the application to a real-world context. Applying a capability perspective on different levels (first- and second-order) in combination with incorporating some interdependencies seemed a promising approach and had already a good resonance during the case study.

Besides this, the chosen inductive research logic by means of a qualitative data collection via a multiple-case study allowed an extensive and in-depth investigation of the research questions. This gained particular importance in those cases where the literature was comparatively weak or the interviewees explained a completely new/different perspective. Taking the enabling role of *supplier innovativeness* as an example, several studies indeed deliver evidence about its positive correlation on supply chain agility, but lack of detailed practices. To overcome such shortcomings, I carefully selected colleagues for the interviews where I was confident that they could contribute with special knowledge – in this case I chose a Director leading the innovation management team within the purchasing department. This kind of discussions in particular helped to establish the respective maturity classifications along the four levels. A second noticeable example

comprises the discussion around the existence of a *proper failure culture* within the enabler of *culture* itself. This aspect was not mentioned in the reviewed literature and first brought up by an Executive VP in the context that agility needs entrepreneurship, which in turn requires failure culture. Including the insights from this debate into the next interview with a Head of HR for one of the business units revealed a more detailed picture of what characterises a healthy failure culture. Again deepening this discussion with a Head of Business Development and focusing on the differences between poor and best practices led to a first sketch of the different maturity levels. Discussing this further with another participant and collecting other best practice examples finally delivered enough evidence for embedding the aspect of failure culture into the maturity levels of culture. In sum, it is an illustrative example of how the case study methodology was used to replicate findings from former cases by constantly considering the real-world context in which the phenomenon occurs – for sure one of the cornerstones when pursuing a pragmatist research perspective.

Overall, the Maturity Model of Corporate Agility is designed to be applicable in a corporate context. To be more precise, "at least" in the automotive supplier industry, as it has been developed in this environment. Accordingly, throughout the study the practical feasibility of the model has been equally considered as the scientific rigour. In the end, it should be beneficial for practitioners by giving guidance towards a more agile enterprise and for scholars to sharpen the understanding of agility, the underlying enablers, and the related practices. To summarise this research, the research questions can be answered as follows:

RQ1: How is agility constituted in a corporate context?

Answer: *Adopting a capability perspective, agility in a corporate context is constituted of six agility dimensions and 30 underlying enablers. While organisational agility and workforce agility are defined as first-order capabilities, the remaining four dimensions of customer agility, product development agility, supply chain agility, and manufacturing agility are specified as second-order capabilities. Agility in general needs to be considered as a context-dependent phenomenon, why the enablers' effectiveness depends on contextual factors.*

RQ2: What are the main enablers for the key elements?

Answer: *The enabling factors for each of the six agility dimensions are described in the Maturity Model of Corporate Agility (see figure 4.4). Hereby, organisational agility possesses seven underlying enablers, workforce agility is characterised by six underlying enablers, customer agility by three underlying enablers, product development agility and supply chain agility in each case by five underlying enablers, and manufacturing agility finally possesses four underlying enablers.*

RQ3: What are the maturity levels within these enablers?

Answer: *Each of the 30 enablers has been precisely defined from poor or rudimentary practice (level 1) until best practice (level 4) in section 4.3. The different levels automatically describe the improvement path in order to enter the next stage. Firms can use this logic to evaluate its current level of corporate agility and define a target state.*

5.2.2 The Role of the Researcher

A second aspect worth to discuss is of course my own role within this DBA thesis, as the study has been carried out in a firm where I was employed before and during the entire period of the research. Since my start in that company in 2012, I worked in six different roles at four locations – three German ones and a stay abroad in China. This helped me a lot to develop a wide network within the organisation across all hierarchy levels. The resulting personal relationships allowed an exclusive access to deep knowledge and experiences of a broad set of people. These colleagues were the "essential ingredients" in the applied method of case study research and made it possible to fully utilise the outstanding strengths of such a methodology: 1) The phenomenon can be studied in its *natural setting* and meaningful theory can be generated from the understanding gained through *observing actual practice*, 2) the research questions can be answered with a *relatively full understanding* of the nature and complexity of the complete phenomenon, and 3) the case method lends itself to *early*, *exploratory investigations* where the variables are still unknown (Voss et al., 2002).

A general experience throughout the whole study was an extraordinary interest of the participants to discuss about agility. For instance, some interviewees recommended other people which whom I could follow-up some of the discussed topics or offered a second session if further questions arise. Other participants regularly asked for the progress in the study or to receive intermediate results. One interviewee outlined the importance of such a study with regards to the created attention:

> "Agility means mindset first. To become truly agile, people must be confident in the meaning of agility and the methods behind. If they do not possess this knowledge, they are shocked and anxious. Hence, agility is a massive tool if you have the right mindset in your organisation." (Interviewee 18)

This showed me the high relevance of the topic itself and of course kept the motivation level up. Furthermore, from one interview session to the next I felt like coming more and more into a kind of "research flow". While the first interviews for each of the agility dimensions were usually of a data collection nature, the following ones were characterised by intense debates as former statements have been challenged or completely new perspectives came up. Naturally, the more knowledge I gained, the more I was able to specify my questions in order to replicate, contrast, or extend the previous insights. Due to this, I also experienced the increasing importance of a proper preparation and a sound time management within the interviews. In almost each of the six agility dimensions, I realised a first saturation level after the third case. However, considering the in-depth literature review and the pre-discussion with the experts, this amount of interviews in order to reach a first saturation point underlines the complexity of the phenomenon and the necessity for depth and detail.

In retrospect, slipping into the role of a part-time researcher within the own organisation might be a challenging task – but was in any case extremely insightful. Having this kind of access to such a high number of principal informants allows an exceptional data collection. Put differently and as emphasised by Kock (2004), an organisation can be more deeply understood *if the researcher is part of it*.

5.3 Managerial Contributions

I began this research with the hypothesis that we lack a clearly defined framework for explaining agility from an enterprise-wide perspective (see section 1.2). Without such a holistic understanding it is almost impossible for practitioners to put this topic on their strategic agenda in order to deal with unpredictable, dynamic, and constantly changing environments. The reasons are two-fold: On the one hand, corporate agility as a managerial concept has many facets and can be found on different levels in organisations. In turn, the major elements must be known to be aware of the scope and bring the right people together as starting point for the discussion. On the other hand and broadly speaking, you can hardly manage what you cannot measure.

A main part of this study is the synthesis of the literature with practitioners' contributions to figure out how agility is constituted in a corporate context. This ended in characterising agility by *six key elements*: two first-order capabilities (organisational agility and workforce agility) and four second-order capabilities (customer agility, product development agility, supply chain agility, and manufacturing agility). As the first-order capabilities contain aspects that might be also of relevance for the second-order capabilities, it is recommended to start the discussion within these two dimensions. As soon as those basic ideas for the entire organisation and its workforce are understood, it makes sense to enter into grasping the remaining four dimensions. With this understanding in mind, the journey towards an (more) agile enterprise can be started and the first contribution can be outlined:

Contribution 1: *Providing a practical understanding of the main constituents of agility relevant for its application in a corporate context.*

The fact that the topic itself generated so much interest from the interviewees during the data collection seems to indicate that there are still missing pieces in the jigsaw puzzle of managing hypercompetitive markets. Even if the key elements of corporate agility are known and understood (see contribution 1 above), these concepts "have to be brought to life". In order to do so, managers like to have a framework at hand that is 1) clear in its underlying terms, concepts, and structures, 2) simple and traceable in its practical application, and 3) fruitful in

suggesting further actions for improvement or development. For this purpose, academics like Hopp and Oyen (2004) and Henriques and Tanner (2017) provide the idea of maturity models as catalysts for promoting good practices. As those models have proven to be successful in various contexts (see section 4.1), the *Maturity Model of Corporate Agility* has been developed over the course of this DBA study and finally introduced in section 4.4. During its design I paid special attention to compensating the lacks of available approaches and to come up with a new model fulfilling in particular the requirements of an application in the automotive supplier industry. These comprise an applicable logic for instance to 1) a branch usually regulated by different sets of norms, 2) SMEs as well as large enterprises operating on a global base, or 3) the design and manufacturing of mechatronic systems. As the automotive industry is undergoing revolutionary change that poses an existential threat for suppliers, exactly these suppliers need simple but powerful tools to guide their actions. This is summarised as follows:

Contribution 2: *Providing a new maturity model that allows benchmarking and planning the improvement of corporate agility practices in the automotive supplier industry.*

The cross-cases comparison within the multiple-case study helped to figure out *best practices* (tactics or methods that have been successful through real-life implementation) or put differently, a final state of maturity from where no further development is possible. The benefits are obvious: First of all, managers have something at hand that proved to be efficient elsewhere in a firm. This is in particular important in turbulent times when resources and time are anyway scarce or decisions have to be fast. Second, sharing and discussing these best practices nurtures a learning culture within the organisation and can help to generate further creative and innovative ideas. A solid point of departure is always more fruitful than starting from scratch. And third, transferring (and maybe tailoring) those best practices into the own company helps to strengthen its knowledge base. Know-how has become one of the most important assets for firms and should be managed properly. In general, the insights provided in the literature were often the starting point for discussing these best practices. By means of replication and contrary replication logic, those aspects have been critically discussed and enriched

with the practitioners' narratives from various contexts. Thus, each of the described maturity levels reflects a deep discussion from different perspectives and prevents an isolated view on the enablers' proficiency. This procedure was an essential part in securing the applicability of the maturity model to real-world problems. Furthermore, it significantly helped to figure out appropriate maturity levels (including best practices) for enablers where the theoretical base was comparatively weak. This was for instance the case regarding the enabling role of supplier innovativeness or culture (see sub-section 5.2.1). In a nutshell:

Contribution 3: *Describing best practices in their application context, allowing managers to learn from practically proven examples for initialising agility activities according to their contingency factors.*

With the maturity model and the best practice recommendations at hand, it is my intend that this research will contribute to the enhancement of management practices and the creation of more agile and robust organisations. The extremely engaged debates during the pre-discussion of the conceptual model and throughout the multiple-case study showed the interest and relevance for corporate agility. Even if 20% of the interviewees already comprised Senior and Executive Vice Presidents, it has yet to be seen whether the maturity model will lead to an increased interest of top management in building agility capabilities.

5.4 Theoretical Contributions

In the literature review I discussed the main enablers for each of the six relevant agility dimensions: organisational agility, workforce agility, customer agility, product development agility, supply chain agility, and manufacturing agility. Only the dimension regarding the organisation could be characterised as a research stream with a relatively high level of maturity, all others lacked qualitative research to provide deep and unique insights regarding its enablers. During my interviews I carefully discussed each of these enablers in order to decide its suitability for the maturity model. Hereby, the collected data revealed a lot of details in terms of the enablers' usability in a practical context and their interactions with organisational processes – but also a *holistic understanding of the totality of ena-*

blers underlying each of the six agility dimensions. Thus, the call for further qualitative research by several scholars (Feizabadi et al., 2019; Gunasekaran et al., 2019; Roberts & Grover, 2012 b; Sherehiy & Karwowski, 2014) could be echoed and is reflected in the following contribution:

Contribution 4: *Extension of knowledge regarding the main enablers underlying corporate agility by providing unique qualitative in-depth data.*

Following the advice of Hopp and Oyen (2004) that frameworks like maturity models should break new ground in carefully defining the terms, concepts, and structures, I put high emphasis on this point during the interviews. The ambiguity and substantial confusion are one of the major shortcomings of the agility concept (Sherehiy et al., 2007). Nevertheless, several descriptions from the literature already reflected the understanding of the participants and thus were incorporated in my maturity model. To sharpen the definitions and elements, and thus the practitioners' perception, *five major adaptions* were necessary. These comprise the 1) re-wording of partnering agility, 2) re-arrangement of second-order capabilities, 3) re-definition of workforce agility, 4) re-definition of customer agility, and 5) re-definition of product development agility (see sub-sections 4.2.2 and 4.2.3). From this, a further contribution can be derived:

Contribution 5: *Sharpening the understanding of the terms, concepts, and structures underlying agility from an enterprise-wide perspective.*

Furthermore, the literature review clearly identified some major shortfalls of existing approaches to determine enterprise agility. In general, the assessment of agility implies that the components of an agile organisation are known and precisely described. To shed light on this topic, Wendler (2013) identified and systematically compared 28 frameworks of agility. These covered the domains of agile manufacturing, agile software development, agile organisation, and agile workforce. His conclusion is as follows: "However, to date there is no empirical study that delivered a comprehensive picture of agility in an explanatory way. So it remains unclear, which concepts of the framework are prevalent in practice and how the factors behind agility are composed" (Wendler, 2013, p. 1182). In turn, scholars are claiming 1) the lack of comprehensive metrics able to embrace all

aspects of agility and specifically to jointly examine elements and enablers to come to an overall assessment of agility (Bottani, 2009b), 2) an indication for firms to know when they have it (Lin, Chiu, & Tseng, 2006), and 3) insufficient qualitative in-depth analysis for instance by case studies or action research (Wendler, 2014). Following the research methodology of this study and conducting a cross-case analysis, I was able to outline the dimensions and determinants of agility from an enterprise-wide perspective. In addition, each of the underlying 30 enablers has been defined from poor or rudimentary practice to best practice. By combining agility dimensions and agility levels, it was possible to build a novel *comprehensive maturity model* for corporate agility and foster the understanding of corporate agility as an organisational ability. Hence, the contribution is:

Contribution 6: *Extending the understanding of agility from an enterprise-holistic perspective by identifying six agility dimensions and combining them with 30 underlying enablers in a novel comprehensive maturity model.*

As not unusual for a young research stream, corporate agility lacked an established basis of management theories that can be found in more mature research areas. Thus, particular emphasis was given on analysing the *suitability of theoretical foundations* in the literature review. As a result, the applicability of the contingency theory, the concepts of organisational flexibility and leanness, the resource-based view, and the dynamic capabilities framework could be confirmed. This hopefully provides fruitful ground for other scholars to ground their research on a similar base and come up with results that complement each other. Therefore, a final contribution can be drawn:

Contribution 7: *Extension of the theoretical foundation of corporate agility research by proposing contingency theory, organisational flexibility and leanness, resource-based view, and dynamic capabilities as guiding frameworks.*

5.5 Limitations and Future Research Directions

In the section before, the shortcomings of previous research have been shown and how this study contributes to the existing body of knowledge. Nevertheless and by its very nature, research, no matter how well-designed and well-executed, will

always carry limitations regarding its interpretation and the generalisability of results. Thus, the following pages are dedicated to highlight the study's major limitations in order to suggest future research directions.

A primary – and from my perspective most important – limitation is that data has been generated more or less from one source: one multinational corporation. Size-wise, the company is among the largest 40 automotive suppliers worldwide. However, it cannot be classified as a huge group with multi-billions in turnover. Even if 1) a pre-discussion with highly knowledgeable experts took place, 2) 26 case studies within three business units and corporate functions have been conducted, and 3) data has been triangulated with supporting documents, a certain risk for a *single-informant bias* remains. Consequently, the developed maturity model might be limited in its applicability to other industries beyond automotive. As automotive suppliers are subject to a relatively high number of standards and norms, they usually follow similar processes and operate in comparable set-ups. Furthermore, several of the interviewees spend significant time at other automotive companies before they joint the firm where I am employed. In turn, I have a high degree of confidence that the Maturity Model of Corporate Agility will be beneficial for a large number of automotive suppliers. Also for car manufacturers (as the OEM) the maturity model should be applicable to a certain extend, even if it is expected that some of the agility dimensions have a different importance. For instance the dimension of customer agility might have a higher relevance to a typical automotive supplier as for the OEM where the distribution takes place via a network of contractual partners. However, the qualitative research design chosen for this study does not aim at making universal generalisations. Rather, my objective was to go for depth and detail to unravel the main elements and aspects enabling corporate agility in the automotive supplier industry. Accordingly, I recommend for future research:

Recommendation 1 for Future Research: *Investigate the applicability of the Maturity Model of Corporate Agility for other sectors underlying a similar turbulent environment like the automotive supplier industry.*

Another limitation is that all of the agility dimensions (organisational agility, workforce agility, customer agility, product development agility, supply chain

agility, and manufacturing agility) are treated equally important regarding the overall agility of the enterprise. The main reason was the missing clarity concerning the key elements of corporate agility. Including also the aspect of a *different weighting* would have brought another unknown variable into the already fuzzy defined agility construct. Although some of the study participants pointed to this fact, I decided not to additionally investigate possible weighting factors of the single dimensions. Furthermore, a quantitative research design by means of statistical methods would be probably more suitable for this kind of inquiry. Therefore, I hope that other scholars will use the Maturity Model of Corporate Agility as starting point to shed light on possible differences in the agility dimensions' contribution to the overall agility level. Hence, a second recommendation is:

Recommendation 2 for Future Research: *Use the Maturity Model of Corporate Agility as conceptual base and apply a quantitative research design in order to investigate differences in how each of the agility dimension contributes to the firm's overall agility level.*

A third limitation may arise from the discussion around a company's *optimum agility level*, which arises in my model from the target maturity levels of the single enablers. In section 4.4, I highlighted the own firm size, the industry's clock speed, and the complexity of the environment as the main indicators. These factors should be taken into account by managers when identifying an optimal target state for corporate agility. However, such a determination is still subjective and in the own discretion of the respective people involved. In other words, my study does not propose specific agility levels to be reached according to different contingency factors. Rather it gives an orientation to practitioners about the aspects that need to be considered. For follow-up research, I would therefore recommend to deepen the understanding about the context elements that influence the enablers' target maturity levels. Such an investigation could be carried out in a qualitative manner by for instance action research. The researcher could conduct workshop sessions with a selected group of managers – e.g. from an entire firm or one of its business units – and develop a kind of *design guide* in order to define an overall maturity level for corporate agility. This design guide can then be used in follow-up sessions with other practitioners from other automotive suppliers to

replicate or contrast the former insights. In a second step, this should of course be expanded to other industries (as proposed in recommendation 1 before). In a nutshell, such a design recommendation would perfectly complement the Maturity Model of Corporate Agility and is therefore highly recommended:

Recommendation 3 for Future Research: *Develop a design guide for a company's optimum level of corporate agility in an automotive context and expand the applicability to other industries.*

A final – and from my point of view also very important – limitation is that this research was conducted in a multiple-case study design at a certain time. This design has been chosen because the sorts of research questions I sought to answer required an explanatory approach in order to investigate a contemporary phenomenon in depth within its real-world context. The generated insights mainly arose through comparing the single cases and thus replicating, contrasting, and extending the emerging theory. However, the downside of such a cross-case design at a certain time point is that it makes it not possible to study dynamic developments over time. In particular, the question "does corporate agility contribute to a firm's ability to survive in hypercompetitive markets?" is difficult to answer with a cross-case design. To come closer to an answer, a *longitudinal research design* would be more appropriate. By studying a company at various points in time, it would be possible to first judge its level of corporate agility and in subsequent points in time its ability to retain its competitive position when the environment changes towards strong doses of dynamism, complexity, and uncertainty. For this study, it was decided that advancing the research field requires first a sound clarification about the constituents of agility in a corporate and enterprise-wide context. Nevertheless, conducting a research project of longitudinal nature pledges another promising direction:

Recommendation 4 for Future Research: *Use a longitudinal design to answer the question if corporate agility positively influences a firm's ability to retain its competitive position in hypercompetitive markets.*

5.6 Final Thoughts from the Researcher

The overall outcome of this research appears to leave a positive notion on agility as a managerial tool to manoeuvre in markets where boundaries are blurred, business models are underlying constant change, and its players are ambiguous and shifting. My decision to enter the research field of how organisations can successfully deal with such an environment was carefully taken. Already after my diploma studies I was impressed about the power of science and thought about continuing with a PhD program. However, influenced by several internships in large industrial firms, I felt a strong intrinsic motivation to dedicate my research on a topic with high relevance to a business context (which I still had to find). Consequently and fascinated by the automotive industry, I decided to join this sector and started my career at a global automotive supplier. After a few years I realised that this industry is underlying dramatic change and practitioners were intensively seeking for guidelines and tools to cope with it. At this point in time I saw the opportunity to develop a scientifically grounded framework to compete in those high-velocity markets. Or put differently: to connect the academic world with managerial practice. In turn and for the last six years, I engaged in the role of a part-time researcher within a DBA program to follow this profession.

However, I also came across several challenges during this journey, which in turn fostered my personal and professional learning. Already at the very beginning I realised the complexity in narrowing down the research gap in order to fulfil both contributing to theory and solving a problem in a business context. I remember a point in time where I was fully convinced that the area of interest is the field of strategic foresight in order to cope with such high-velocity markets. Only after reading intensively through the literature and discussing the purpose of my research with some scholars I realised that I was coping with a subdomain of a much more relevant field, namely the one of enterprise agility. I should have started my investigation from a broader context and iteratively narrowing down instead of digging into a specific area from the beginning. This motivated me further to conduct the upcoming literature review in a more structured way. For instance, I created an excel-based overview where I wrote a short summary (purpose, methodology, findings, originality) about every source I used including

some additional facts like key words or the Chartered Association of Business Schools' journal ranking. This helped a lot to get not lost in the huge body of literature and to classify the single research papers in its broader context. Besides this, a major learning arose around the entire process of collecting my data. Due to the COVID-19 pandemic, sometimes it took extraordinary efforts to make a face-to-face interview happen. However, afterwards I can say it was absolutely worth it because I clearly realised a difference compared to the two cases where the interviews took place virtually. Even if the output and/or insights were on a comparative level, the way to come there was much smoother in the cases when I sat physically together with the participants. I recognised a more interactive behaviour when we worked creatively with the templates on the table compared to doing this IT-based on our screens. Put differently, giving the interviewees the ability to visually illustrate their ideas on a piece of paper was very helpful to faster understand their thoughts. Furthermore, the face-to-face meetings allowed me to interpret micro-behaviours such as facial expressions and gestures that helped gauging how interested the participants were in the conversation and thus provided insights into how they might be feel. In turn, I could use these nonverbal cues to better guide my responses and the conversation. Finally, I again experienced the power of small talk. In some cases, additionally valuable insights came up after the real data collection when people felt free of the original interview situation. These examples strongly encourage me to prefer a physical setup in case I will do such a study again or when running the pilot project with the proposed maturity model (see section 4.4).

Nevertheless, the main personal lesson of this study is still that conducting research in parallel to a full-time job as a manager requires extraordinary self-management, discipline, and a never-ending willingness to contribute to solving a real-world problem from an academic perspective. Fortunately, in every single case study I felt extreme interest of the participants and even gratefulness that I am dealing with this topic. Not least of the large number of requests on the progress of my research, my motivation level was kept up until the submission of this thesis. Gratefully I can conclude that I did not only develop my research skills and significantly improved my English writing and communication, but the DBA was

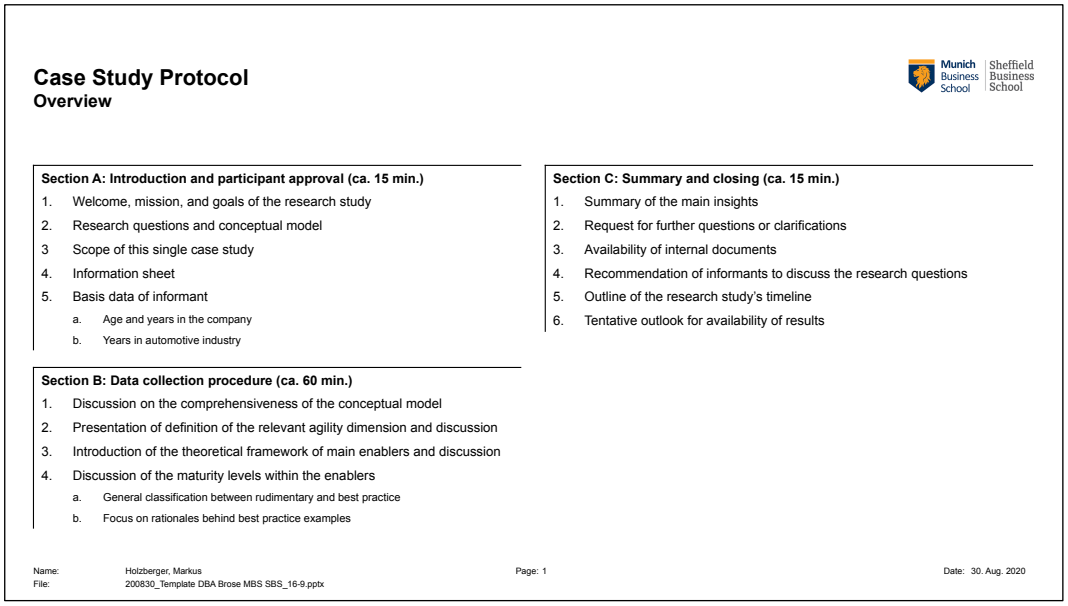
an excellent exercise in project management, critical thinking, and collaboration. Finishing this dissertation required me to design a project, make a realistic timeline, overcome setbacks, and manage stakeholders. Through managing long-term activities in parallel to a lot of short-term goals I was able to improve my organisational skills. Furthermore, I had to approach problems systematically, see the links between ideas, evaluate arguments, and analyse information to come up with my own conclusions. Doing this procedure again and again sharpened my ability to thing critically, which I meanwhile apply more often to my daily work in industry. Eventually, even if a DBA is a solo project, on a day-to-day basis I worked with a lot of different people on my maturity model. Doing these tasks successfully required knowing how to divide up a task, get along with others, communicate effectively, and sometimes also resolve conflicts. Overall, I learned to collaborate between the frontiers of academia and the practical world in order to combine the strengths of both into a strong piece of research.

It is my hope that my contributions will help to advance the research field of corporate agility and that practitioners will apply the developed maturity model. Over the course of my research I have become convinced that agility is an important ability for any firm. We cannot change the environment where we are in or what our business is currently facing, but with the right tools we can establish a certain confidence level of how to manage it and consider unpredictability and uncertainty as a chance rather than a risk.

CHAPTER SIX

Appendix

6.1 Case Study Protocol: Overview



Case Study Protocol
Overview

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Section A: Introduction and participant approval (ca. 15 min.)

1. Welcome, mission, and goals of the research study
2. Research questions and conceptual model
3. Scope of this single case study
4. Information sheet
5. Basis data of informant
   a. Age and years in the company
   b. Years in automotive industry

Section B: Data collection procedure (ca. 60 min.)

1. Discussion on the comprehensiveness of the conceptual model
2. Presentation of definition of the relevant agility dimension and discussion
3. Introduction of the theoretical framework of main enablers and discussion
4. Discussion of the maturity levels within the enablers
   a. General classification between rudimentary and best practice
   b. Focus on rationales behind best practice examples

Section C: Summary and closing (ca. 15 min.)

1. Summary of the main insights
2. Request for further questions or clarifications
3. Availability of internal documents
4. Recommendation of informants to discuss the research questions
5. Outline of the research study's timeline
6. Tentative outlook for availability of results

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6.2 Case Study Protocol: Introduction (Section A)

Case Study Protocol
Section A: Overview of Agility

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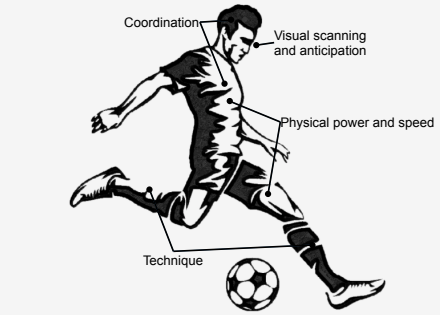
Systemic approach of agility



Corporate agility

- Has its origins in management research and explains how to successfully navigate in turbulent environments
- Pursues the target to increase speed and flexibility to be as adaptable and resilient as possible while maintaining efficiency and reliability at the same time
- Is an organisational capability of continually sensing market change and responding appropriately in a timely manner
- Helps firms to continually develop new competitive actions and gain sustainable competitive advantage
- Can be defined as "the ability of firms to sense environmental change and respond readily" (Overby et al., 2006)

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Case Study Protocol
Section A: Purpose of the Research Study

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	Today	Objectives of the study
Academia	▪ Existing literature mainly focus on specific domains, e.g. manufacturing, product development, or workforce ▪ No consensus about what constitutes an agile enterprise ▪ No clearly defined framework for explaining the enablers of agility comprehensively in a corporate context	▪ Explanation of the relevant dimensions of agility in a corporate context that cover the entire enterprise ▪ Rigorous definition of the enablers for the key elements ▪ Comprehensive theoretical framework grounded in sound management theories
	Doing agile	**Being agile**
Practice	▪ Available approaches suffer regarding their applicability due to 1) an insufficient reflection of the entire organisation, 2) the utilization of complex algorithms limiting an intuitive and ad hoc usage, and 3) a lack in suggesting further actions for improvement or development ▪ Existing frameworks do not deal with the context of the automotive (supplier) industry	▪ Maturity model of corporate agility that gives managers an indication about the current agility level and show necessary steps to increase this level ▪ Agility framework that provides guidance for firms operating in the automotive (supplier) industry

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6 Appendix

Case Study Protocol
Section A: Research Questions and Conceptual Model

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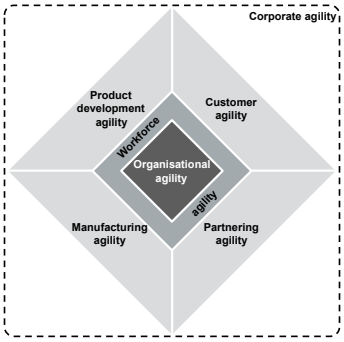
Research questions

RQ1: How is agility *constituted* in a corporate context?

RQ2: What are the *main enablers* for the key elements?

RQ3: What are the *maturity levels* within these enablers?

Conceptual model of corporate agility



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Case Study Protocol
Section A: Information Sheet

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1. **Title of research study:** Corporate Agility: A Framework to compete in high-velocity Markets

2. **Legal basis for research for studies:** The University undertakes research as part of its function for the community under its legal status. Data protection allows us to use personal data for research with appropriate safeguards in place under the legal basis of public tasks that are in the public interest. A full statement of your rights can be found at https://www.shu.ac.uk/about-this-website/privacy-policy/privacy-notices/privacy-notice-for-research. However, all University research is reviewed to ensure that participants are treated appropriately and their rights respected. This study was approved by UREC with Converis number ER5936845. Further information at https://www.shu.ac.uk/research/ethics-integrity-and-practice

3. **Study participants:** Participants were chosen as they are highly knowledgeable informants who view the focal phenomenon from diverse perspectives. It is up to you to decide if you want to take part. A copy of the information provided here is yours to keep, along with the consent form if you do decide to take part. You can still decide to withdraw at any time without giving a reason, or you can decide not to answer a particular question. By taking part, it is required to talk and reflect on your everyday practices regarding the several dimensions of corporate agility. It is not planned to have any follow-up interviews. However, the researcher would be glad to come back if questions arise and maybe to deepen any topic. You can contact the researcher any time to discuss your participation.

4. **Risks, disadvantages, and possible benefits:** To the best knowledge of the researcher, there are no risks or disadvantages. Rather, by participating in this study valuable insights about corporate agility will be revealed and can be applied in your company to achieve a competitive advantage.

5. **Confidentiality of information and data management:** All kind of information is treated anonymously to protect the identity of the participant. Any physical material will be stored securely, including any physical consent forms. Data protection is ensured by keeping identifying details separate from the data. This is achieved by storing anonymised coded data on the University's research store and keeping the key (with peoples names and the code used to identify their data) as an encrypted file on my own device. There is no final date defined until raw data will be kept. Raw data will not be passed to other people or used in other studies.

6. **Usage of information:** All data will be mainly used to conduct this research project, which will end in a final report. Publications may follow in parallel or afterwards, always following the statement of confidentiality mention above. After the study is finished, you will receive a personal copy of the final report.

7. **Further contacts:** You should contact the Data Protection Officer (DPO@shu.ac.uk) if (1) you have a query about how your data is used by the University, (2) you would like to report a data security breach (e.g. if you think your personal data has been lost or disclosed inappropriately), or (3) you would like to complain about how the University has used your personal data.
You should contact the Head of Research Ethics (Professor Ann Macaskill, a.macaskill@shu.ac.uk) if you have concerns with how the research was undertaken or how you were treated.
Postal address: Sheffield Hallam University, Howard Street, Sheffield S1 1WBT Telephone: 0114 225 5555

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6.3 Case Study Protocol: Data Collection (Section B)

Case Study Protocol
Section B: Comprehensiveness of the Conceptual Model

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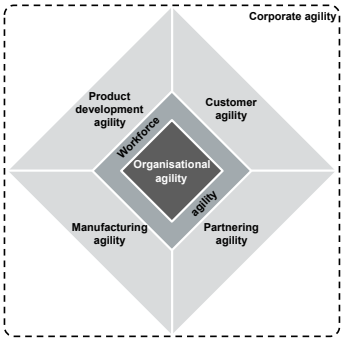
Conceptual model of corporate agility



Remarks of the informant

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Following interview templates exemplify the investigation of organisational agility; the same logic has been applied for the remaining five agility dimensions.

Case Study Protocol
Section B: Definition of Organisational Agility

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"[…] an organisation's ability to quickly sense and respond to environmental changes in order to quickly seize market opportunities"
(Park, El Sawy, & Fiss, 2017, p. 649)

Remarks of the informant

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6 Appendix

Case Study Protocol
Section B: Main Enablers of Organisational Agility from Literature

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Main Enablers	Practices mentioned in the literature
Organisational structures and power distribution (OSPD)	- few levels of hierarchy/wide span of control - power/ownership is shifted away from the top towards those closest to the action - symbiotic relationship between formal and informal organisational structures - building organisational slack - informational and interpersonal networks - open and informal communication
Culture (CLT)	- establishing a culture following agile values such as proactivity, responsiveness, trust, support of employee proposals - culture of change (continuous improvement, learning, change of responsibilities) at every level in the organisation - organisational climate that enables innovative behaviour - team work based on trust, reciprocity, and transparency
Absorptive capacity (AC)	- externally generated knowledge (critical to the firm's operations) is identified and acquired - the firm possesses routines and processes that allow it to analyse, process, interpret, and understand the information obtained from external sources (assimilation) - routines are developed and refined to facilitate the combination of existing knowledge and the newly acquired and assimilated knowledge (transformation) - routines are available that allow to refine, extend, and leverage existing competencies or create new ones by incorporating acquired and transformed knowledge into a firm's operations (exploitation)
Information and communication technology (ICT)	- process reach: processes that tie activity and information flows across departmental units, functional units, geographical regions, and value network partners (e.g. enterprise resource planning systems, product data management) - process richness: high quality of information collected about transactions in the process, transparency of that information to other processes and systems that are linked to it - business intelligence technologies (functionalities that help to effectively build, manage, and access enterprise-wide consistent data and extract patterns from complex data, e.g. dashboard for volumes, balanced scorecard) - advanced information and communication tools (information/knowledge sharing and interaction in real time via virtual video/audio conference)
Strategic foresight (SF)	- systematically scan the relevant environment to anticipate discontinuities in the marketplace or the information technology space, the threats and opportunities in the extended enterprise chain, and the impending disruptive moves by competitors - make sense of the observations (interpretation) - conceptualise and implement competitive action
Robust strategy (RS)	- strategy characterised by its ability to generate results under varying environmental conditions (change leads to effectiveness through momentary advantages) - strategy has a strong focus on the future while creating a variety of short- and long-term scenarios (future can not be predicted but played with via alternative futures) - strategy has a flexible intent, i.e. strategic intend operationalizes the current resource deployment required to monetise momentary advantage
Stakeholder buy-in (SBI)	- shareholders - executive board - works council - external regulators

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Case Study Protocol
Section B: Main Enablers of Organisational Agility – Discussion

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Main Enablers	Level 1 (poor or rudimentary)	Level 2 (better practice)	Level 3 (good practice)	Level 4 (best practice)
Organisational structures and power distribution				
Culture				
Absorptive capacity				
Information and communication technology				
Strategic foresight				
Robust strategy				
Stakeholder buy-in				

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