The Importance of Artificial Intelligence and Technological Entrepreneurship on Firm Level

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This publication-based dissertation analyzes the importance of artificial intelligence (AI) and technological entrepreneurship on firm level over six chapters. The essence of this dissertation consists of four independent research papers developed for publication in academic journals whose peer review process is double-blinded. The first chapter offers a general introduction to the subject matter and provides a summary of the four research papers in this dissertation. The second chapter is a systematic literature review that focuses on the importance of AI in stra-tegic management. This analysis merges the existing knowledge concerning the impact of AI on the field of stra-tegic management in an integrative framework. The third chapter is a research paper that examines the signifi-cance of technology-driven entrepreneurship activities and provides crucial lessons from small and medium-sized enterprises (SMEs) operating in the manufacturing industry. In order to provide an understanding of how tech-nological entrepreneurship activities transform the business of SMEs, this empirical paper considers the flexible pattern matching approach and iteratively compares preceding theoretical patterns from extant research to em-pirically collected data from corporate executives in SMEs operating in the manufacturing industry. The fourth chapter is a research paper that empirically examines how top management can encourage and facilitate AI-ena-bled business model innovation. In this context, the required core competencies and roles of top management are summarized in a comprehensive framework. The fifth chapter comprises a teaching case study and provides an understanding of how to implement an AI-based analytical tool for decision-making in a firm. This case study uses a real-world example of a mid-sized firm and identifies the crucial managerial resources and capabilities required for the implementation of analytics-based decision-making processes in a firm. The sixth chapter outlines the main findings and contributions of this dissertation to academia and for practitioners. It also summarizes the dissertation's limitations and suggests potential directions for future research.

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List of abbreviations

ABDC	Australian Business Deans Council
AI	Artificial Intelligence
APA	American Psychological Association
AQ	Assignment Question
B2B	Business-to-Business
BM(I)	Business Model (Innovation)
BU	Business Unit
CDO	Chief Digital Officer
CEO	Chief Executive Officer
ChatGPT	Chat Generative Pre-trained Transformer
COVID-19	Corona Virus Disease 2019
CRM	Customer Relationship Management
DC	Dynamic Capabilities
DL	Deep Learning
DOI	Digital Object Identifier
EaaS	Equipment as a Service
EBSCO	Elton B. Stephens Company
Ed(s).	Editor(s)
e.g.	exempli gratia (English: for example)
et al.	et alii (English: and others)
etc.	et cetera
FPMA	Flexible Pattern Matching Approach
GIM	Group Information Management
HHL	HHL Leipzig Graduate School of Management
HR	Human Resources
IABE	International Academy of Business and Economics
i.e.	id est (English: that is)
IEEE	Institute of Electrical and Electronics Engineers
ID	Identification
IP	Interview Partner
ISSN	International Standard Serial Number
IT	Information Technology

LM	Lower Management
LO	Learning Objectives
M&A	Mergers and Acquisitions
MBA	Master of Business Administration
Min	Minutes
ML	Machine Learning
MM	Middle Management
NLP	Natural Language Processing
No.	Number
OEM	Original equipment manufacturer
p. / pp.	Page / pages
PSO	Particle Swarm Optimization
RBV	Resource-Based View
R&D	Research & Development
RPA	Robotic Process Automation
SE	Societas Europaea
Sec	Seconds
SJR	Scimago Journal Rankings
SLR	Systematic Literature Review
SM	Strategic Management
SME(s)	Small and Medium Sized Enterprise(s)
TE	Technological Entrepreneurship
TEM	Transaction on Engineering Management
TM	Top Management
USA	United States of America
VHB	Verband der Hochschullehrer der Betriebswirtschaft (English: German Academic Association of Business Research)
Vol.	Volume
VP	Vice President

1 Introduction

1.1 Motivation and research gap

Acknowledgement of the importance of technological development and utilization of emerging technologies is gaining momentum in academic research. More and more studies in management literature highlight the potential of and opportunities provided by new technologies (Taeihagh et al., 2021; Yunus et al., 2019; Majdouline et al., 2022; Spanaki et al., 2022; Atanasovski & Tocev, 2022; Hang et al., 2011; Berman & Dalzell-Payne, 2018). As a result, new models and frameworks are constantly developing in current research and existing theories need to be rethought and adapted appropriately. In the same way, the significance of innovative technologies, notably Artificial Intelligence (AI), is also increasing in real-life business (Helfat et al., 2023; Wu et al., 2023; Meister & Chandrasekhar, 2021; Lam et al., 2020). The competitiveness of established firms depends on how successfully these new technologies are implemented to optimize internal processes or innovate entire business models (Ransbotham et al., 2017; Gudigantala et al., 2023). This phenomenon, which is becoming increasingly representative and influential, serves as the main motivation for this dissertation.

In order to understand this development in more detail, from the academic as well as the practical perspective, this thesis focuses on the role of Technological Entrepreneurship (TE) activities, and the importance of AI technologies in particular, on firm level. So far, both topics have been studied from various perspectives in academic research. The research trend concerning the importance of TE and AI for the strategic management of firms started falteringly at the beginning of the 1980s (Tomkins, 1980; Holloway, 1983; Geisler, 1986; Orsini, 1986; Daneke, 1989), but the number of publications addressing TE has increased

substantially in recent decades (Majdouline et al., 2022). Hence, TE has become an indispensable field of entrepreneurship. Likewise, research in the area of AI technologies and its firm-level utilization possibilities has recently intensified enormously (Berman & Dalzell-Payne, 2018; Davenport & Mahidhar, 2018). The historical development of both TE and AI will be defined and explained in more detail below.

Overall, there is no uniform definition of TE in management literature. For instance, Petti (2009) describes TE as a process that links the development of technology with business creation. The outcome of this process results from technological activities by different individuals and groups within an environment that is appropriate for entrepreneurial activities (Petti, 2009). Similarly, Bailetti (2012) defines TE as an investment in a project in order to create and capture value for a firm by uniting particular individuals and different assets. Furthermore, Majdouline et al. (2022) add that the entrepreneurial utilization of technology-driven activities enables firms to reduce transaction costs and determine state-of-the-art solutions suited to market needs. In addition, Kekkonen et al. (2023) emphasize that sustainability and TE are closely linked. According to them, new products, services, and processes are developed with the help of technology and innovation that meet external challenges and certain demands (Kekkonen et al. 2023).

With regards to the historical development of TE, Majdouline et al. (2022) identified the following three main phases of the TE research evolution: initiation (~1985-2008), development (~2009-2016), and consolidation (~2016-today). During the initiation stage, academic research on TE was at a very early stage and the number of scientific publications was small. It is crucial to note that what are now the most frequently cited research papers were first published during the initiation stage. The development stage was characterized by the fact that

during this time the number of academic publications on TE varied considerably. Towards the end of the development stage, the number of academic publications on TE even decreased. Finally, during the consolidation stage, the number of publications on TE significantly increased (Majdouline et al., 2022). This can be explained mainly by the fact that emerging technologies, such as AI, became more and more the focus of firms and thus the interest in this field of research increased (Taeihagh et al., 2021; Spanaki et al., 2022; Atanasovski & Tocev, 2022; Davenport & Mahidhar, 2018).

When it comes to the definition of AI, it can be stated that AI enables systems to understand external data in an appropriate way, to learn and gather crucial insights from this data, and ultimately to utilize corresponding learnings for achieving certain targets (Haenlein & Kaplan, 2019). This dissertation mainly refers to Haenlein and Kaplan's (2019) definition of AI, which is widely accepted in the academic literature. In the business context, Martínez-López and Casillas (2013) argue that intelligent systems that are based on AI primarily concentrate on the creation of valuable and automated solutions linked to particular business challenges.

AI had its academic origins in the 1940s and 1950s in the research fields of information technology and engineering. Today, AI has an essential role in management literature, real-life business cases, and societal contexts, as data volumes are rapidly increasing and computing capabilities are continuously improving (Haenlein & Kaplan, 2019; Tarafdar et al., 2019; Fares et al. 2022). Current progress in AI technologies, such as generative AI (e.g., ChatGPT), has made the need for research in this area paramount and accelerated innovation in products, services, and business models (Brem et al. 2023; Burger et al. 2023; Dwivedi et al. 2023; Sharma et al. 2022). Therefore, it is important to analyze AI's development path in more detail.

Haenlein and Kaplan (2019) divide the historical development of AI into the following phases: AI spring (~1940-1959), AI summer and winter (~1960-1989), and AI fall, the harvest period (~1990-today). During the AI spring phase, Isaac Asimov's short story *Runaround* encouraged numerous scientists focusing on the research areas of robotics, AI and computer science, such as the co-founder of the MIT AI Laboratory, Marvin Minsky. In particular, ideas about collaboration between humans and AI—something still discussed intensively today—was addressed and explored in 1943 on the basis of Asimov's *Three Laws of Robotics* (Asimov, 1942; Haenlein & Kaplan, 2019). 13 years later, Minsky and McCarthy conducted the Dartmouth Summer Research Project on Artificial Intelligence in Hampshire in 1956 (McCarthy et al., 2006). Many participants in this workshop played a significant role in the further development of AI. Shortly thereafter, the term AI was officially established (Haenlein & Kaplan, 2019).

Over the AI summer and winter, the Dartmouth workshop was followed by additional AI-related success stories. The rapid development and implementation of initial AI-based technologies, such as natural language processing tools facilitating communication between humans and computers or programs that were able to solve simple problems automatically, led to controversies and discussions among leading researchers in the field of AI (Weizenbaum, 1966; Newell et al. 1959; Newell, 1963; Haenlein & Kaplan, 2019). These discussions primarily related to the potential further development paths of AI. While some researchers assumed that AI-based machines with the intelligence of an average human would be developed within a few years, other researchers and governmental institutions criticized the high investments in AI research (Lighthill, 1973). Consequently, the pessimistic view prevailed, and no significant progress was made in AI research as many governments and academic institutions pulled out (Haenlein & Kaplan, 2019).

Likewise, no significant developments were recorded in AI research at the beginning of the AI fall phase and harvest period. The reason was that at their core, AI systems work by relying on so-called expert systems, which are mainly sets of rules (a variety of if-then relations) created by humans (Kaplan and Haenlein, 2019). Thus, for a very long time, AI technologies were not able to recognize more complex patterns from data that go beyond if-then relations (Hutson, 2018; Haenlein & Kaplan, 2019). It was not until the development of deep learning technology that AI was able to achieve further significant milestones during the 2010s. This development trend continues today, so that deep learning increasingly represents the fundamental technology of current AI applications (Haenlein & Kaplan, 2019). The significant increase in the number of publications in recent years underlines that the harvest period has arrived (Haenlein & Kaplan, 2019; Wu et al., 2023).

As explained in the previous sections, the importance of TE and AI is increasingly visible in management literature. However, some research gaps remain to be addressed by academic contributions. So far, there is little management literature that consolidates and theoretically frames existing knowledge about TE and AI. Additionally, the effect of TE activities on specific types of firms, such as German SMEs operating in the manufacturing industry, remains mostly unexplored. Present research concerning the importance of TE for companies is rather generic and only partially transferable to specific types of companies. Another research gap relates to the limited availability of academic contributions on how firms' top management can facilitate and encourage AI-based business model innovation (BMI). Furthermore, there is also a need for the expansion of the finite knowledge available concerning the implementation of AI tools in firms; this expansion must be based on academically rooted frameworks and roadmaps.

As shown in the following chapters, this publication-based dissertation contributes to these conversations and research gaps using a variety of different research methods (see Figure 1). The first research paper is a systematic literature review based on the approach used by Tranfield et al. (2003). In this study, the current state of research regarding the importance of AI in Strategic Management (SM) is analyzed and the main findings are summarized in a structured framework. The results of this first research paper are presented in Chapter 2 of this dissertation. The second research paper empirically analyzed to what extent SMEs operating in the manufacturing industry are dealing with emerging technologies and implementing TE activities. Using the flexible pattern matching approach (FPMA) (Bouncken et al., 2021a; Bouncken et al., 2021b), the most crucial theoretically and empirically determined components were summarized in the TE process framework. The results of this empirical research paper are shown in Chapter 3 of this dissertation. The findings of the first two research papers highlighted that there is a discrepancy between the high potential of implementing TE initiatives, including the utilization of AI (which is mainly mentioned in the theory, i.e., the state of current research), and the extent of specific types of firms' practical implementation, which is comparatively low. Among other things, it was noted that for the entrepreneurial implementation of emerging technologies such as AI, the competencies and roles of top management (TM) are crucial and need to be further examined. Therefore, based on the grounded theory methodology (Gioia et al., 2013), the third research paper empirically analyzed how TM can encourage and facilitate AI-enabled BMI. The main findings of this empirical research paper are presented in Chapter 4. The fourth research paper provides important insights for practitioners about how to implement analytical methods in decision-making based on AI technology. Using the case study of a real mid-sized firm, this teaching case study educates students and its users on the core managerial resources and capabilities needed for the implementation of analytics-based decision-making processes in a digitally transforming firm. The teaching case study (research paper four) is shown

in Chapter 5. Finally, Chapter 6 summarizes the contributions of this dissertation to academia and for practitioners; provides an overview of the dissertation's limitations; and suggests potential avenues for future research.

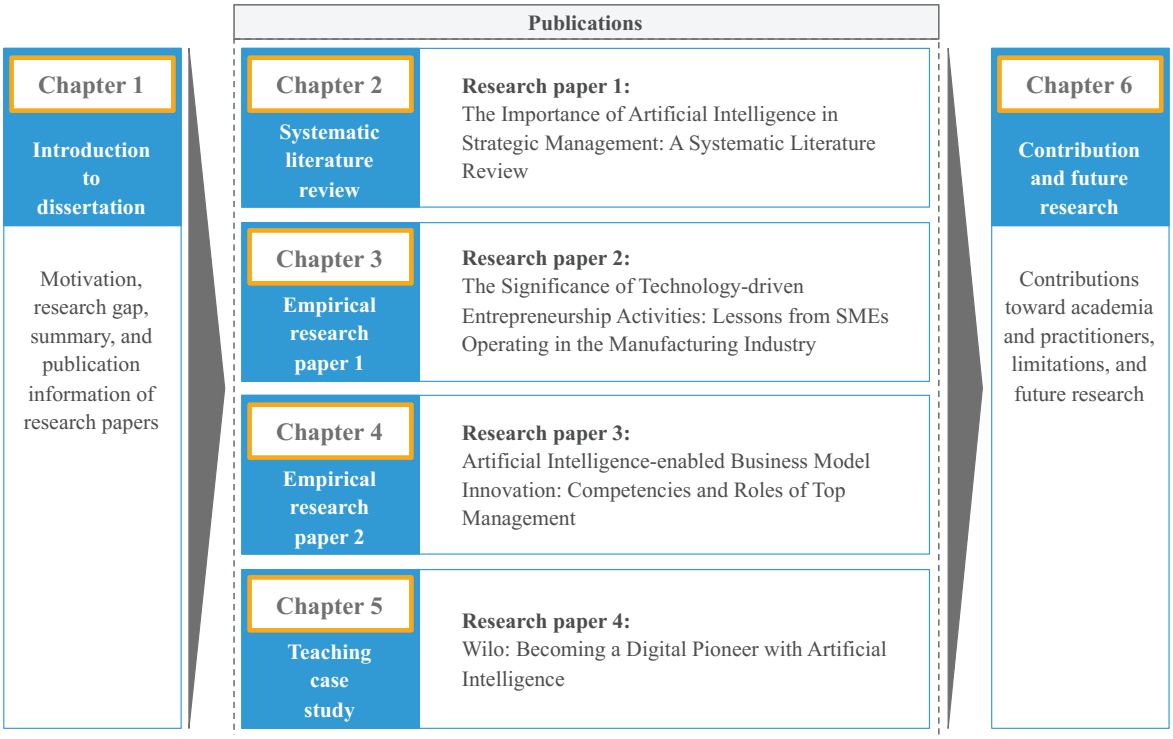

Figure 1 Overview of publication-based dissertation
Source: Own illustration

1.2 Summary of research papers

This publication-based dissertation comprises four research papers. All papers are contextually independent from each other and are designed for publication in peer-reviewed academic journals. Each study has its own research focus and is based on different methodologies.

The first research paper is a systematic literature review and is presented in Chapter 0. Research papers two and three are empirical examinations and are offered in Chapters 3 and 4. Chapter 5 encompasses a teaching case study. The following sections introduce each of these papers.

1.2.1 Research paper I (Chapter 2): Systematic literature review

The first research paper is entitled “The Importance of Artificial Intelligence in Strategic Management: A Systematic Literature Review”. It is a systematic literature review (SLR) and analyzes the impact of AI technologies on the field of SM.

The importance of AI in SM was recognized early in management literature. In the 1980s, initial academic studies examined the implications of AI for SM (Holloway, 1983; Geisler, 1986; Orsini, 1986). This research continued in the following decades, with a significant increase in published research papers on this topic from 2015 to 2022. Nevertheless, no previous academic study has yet summarized the findings on the importance of AI in SM using an integrative framework that includes the dimensions of SM and AI technologies. For this reason, an SLR was performed in the first research paper, adopting the structured approach of Tranfield et al. (2003). In total, the sample of selected management literature consists of 50 papers that were published between 1980 and 2020. First, these studies were analyzed and categorized according to the widely agreed steps of the SM process (Porter, 1980; Andrews, 1987; Wit & Meyer, 2005; Kvint, 2009; Hungenberg 2014), which encompasses the three main stages of ‘Strategic Analysis’, ‘Strategy Formulation & Selection’, and ‘Strategy Implementation’. Second, the sample studies were analyzed and categorized according to the different types of AI technologies that are most suited to providing possible utility within the different fields of SM. Hence, AI technologies such as Machine Learning, Deep Learning, Natural Language Processing, and Robotic Process Automation were considered in this research paper.

The SLR of this dissertation provides essential findings in four major aspects. First, nearly 70% of the selected studies from the sample were published in the period 2015-2021, highlighting the emerging significance of this topic. Second,

only 30% of the studies in the sample are based on empirical data, emphasizing the increasing need for more empirical studies. Third, an evolution within academic research regarding the importance of AI in SM has become apparent. The analysis of the underlying theoretical concepts from the sample studies show that AI is considered more and more when developing new (or innovating within existing) business models, rather than limiting it to the pure optimization or simplification of firm-specific processes. Four, most papers were assigned to the 'Strategy Formulation & Selection' stage of the SM process. In addition, the analysis and categorization of the sample studies highlighted that machine learning is the most widespread AI technology enabling recent opportunities within SM.

This research paper was co-authored with Dominik Kanbach and was submitted for publication in the *International Journal of Strategic Management*. It was accepted for publication in March 2021 and is retrievable at: http://dx.doi.org/10.18374/IJSM-21-1.1. The *International Journal of Strategic Management* is a journal using a double-blind peer review process and is rated C on the VHB-JOURQUAL 3 ranking. Additionally, this paper was presented at the International Academy of Business and Economics (IABE) 2021 Orlando Winter Conference in March 2021.

1.2.2 Research paper II (Chapter 3): Empirical paper 1

The second research paper is entitled "The Significance of Technology-driven Entrepreneurship Activities: Lessons from SMEs Operating in the Manufacturing Industry". It empirically examines the TE process, with a particular focus on German SMEs in the manufacturing industry.

Previous research on TE has dealt with the topic and associated process components in very general terms (Petti, 2009; Bailetti, 2012; Habtay, 2012; Chaston, 2017; Majdouline et al., 2022; Maysami et al., 2019; Siyanbola et al., 2011).

Although the number of publications on this topic has increased significantly in the last 10 years and TE offers firms enormous growth potential, there are a very limited number of research contributions regarding the TE process in SMEs (Majdouline et al., 2022; Prodan, 2011; Bailetti, 2012; Petti, 2009; Hitt et al., 2001; Passiante & Romano, 2016; Cavallo et al., 2021; Guerrero & Link, 2022). Furthermore, extant research on TE has mainly focused on TE initiatives in firms operating in the North American manufacturing industry. Only limited research exists that specifically examines additional geographic regions (Liu et al., 2022). Numerous academic papers emphasize the significance of SMEs for the German economy and underline their outstanding position because of their technology- and innovation-driven attitudes (Berlemann et al., 2022; Pahnke & Welter, 2019; Röhl & Engels, 2021). However, almost no studies address TE activities in German SMEs. This research paper delves into the current research gap and focuses on the research question of how technology-driven entrepreneurship processes transform the business of SMEs operating in the German manufacturing industry.

Based on the flexible pattern matching approach (FPMA), this paper (Research paper II: Empirical paper 1) iteratively compared preceding theoretical patterns from extant research with data empirically collected from 17 interviews with the managers of SMEs operating in the German manufacturing industry (Bouncken et al., 2021a; Bouncken et al., 2021b). The main results of this study are summarized in a TE process framework explicitly developed for SMEs. This framework consists of the four main dimensions of TE drivers, TE input components, TE process components, and TE output components. Depending on the type and form of their presence, the TE drivers can have a decisive positive or negative impact on the input components. The input components are the foundation of the main TE process. Depending upon the combination in which these input components are present in SMEs, the TE process can be accelerated or

obstructed. Consequently, the following four different outputs can be generated based on the TE process performed: (1) corporate-function-related outputs, (2) business-model-related outputs, (3) competitiveness-related outputs, and (4) customer-related outputs.

This paper contributes to technology-driven innovation theory and broadens the scope of TE research in SMEs. On the one hand, it affirms the validity of existing TE theories for SMEs; on the other, it provides a new, empirically grounded TE process framework comprising the core process components tailored to SMEs operating in the German manufacturing industry.

This research paper was co-authored with Dominik Kanbach and was submitted for publication in *Cogent Business & Management* in August 2022. It was accepted for publication in February 2023 and is retrievable at https://doi.org/10.1080/23311975.2023.2185069. The *Cogent Business & Management* is a journal whose peer review process is double-blinded and is ranked Q2 in SJR.

1.2.3 Research paper III (Chapter 4): Empirical paper 2

The third research paper is entitled "Artificial Intelligence-enabled Business Model Innovation: Competencies and Roles of Top Management". It is an empirical study that analyses how top management can encourage and facilitate AI-enabled BMI.

Research in the field of BMI is increasingly focused on the role of emerging technologies in innovating and transforming businesses (Arsenyan and Piepenbrink 2023; Di Vaio et al. 2020; Caputo et al. 2021; Burström et al. 2021; Coskun-Setirek and Tanrikulu 2021; Chen et al. 2021; Wirtz et. al 2016). Previous studies have already underlined that technologies such as AI can transform and

optimize processes in companies, leading to higher efficiencies (Kinkel et al. 2022; Valter et al. 2018). In this context, the existence of both the appropriate competencies and roles of TM plays an important role in understanding how innovation can create and sustain value when considering emerging technologies such as AI (Paschen et al. 2020; Barham et al. 2020). Although developments in the utilization of AI technologies in business processes already significantly concern the TM, current academic discussions deal insufficiently (and only exceptionally on the basis of primary data) with the phenomenon of AI-enabled BMI and its importance for TM (Sjödin et al. 2021). Ongoing conversations about AI-enabled BMI refer to existing theories such as the resource-based view (Barney, J., 1991) or dynamic capabilities view (Teece et al., 1997). However, these theories can only partially explain the phenomenon of AI-enabled BMI in combination with TM.

Based on grounded theory, this research paper developed a theoretical framework that makes an important contribution to the current research gaps in the literature related to AI-enabled BMI and TM. In addition, this study supplemented the theoretical aspects of the dynamic capabilities view (sensing, seizing, and transforming) by conducting further research on the areas that are crucial in the context of AI-enabled BMI and TM. Likewise, this paper has important management implications and supports firms in achieving a successful AI-enabled BMI by ensuring the availability of relevant competencies and roles in TM teams, as well as by taking into account the interests of the firm and its stakeholders.

Inductive research was adopted in this paper based on the approach of Gioia et al. (2013). The empirical findings, which were derived from 47 semi-structured interviews, were summarized in a framework that covers the main roles and competencies of TM required for AI-enabled BMI. In total, the framework

consists of five TM competencies and eight TM roles, with a multidimensional interrelationship between the competencies and roles. Hence, the TM roles arise from the combination of different competencies.

This research paper was co-authored with Philip Jorzik, Dominik Kanbach, Sascha Kraus, and Marina Dabić. It was submitted for publication in *IEEE Transaction on Engineering Management (TEM)* in December 2022 and was accepted for publication in May 2023. This research paper is retrievable at http://dx.doi.org/10.1109/TEM.2023.3275643. The *IEEE TEM* is a journal whose peer review process is double-blinded. It is rated B in the VHB-JOURQUAL 3 ranking and its SJR ranking is Q1.

1.2.4 Research paper IV (Chapter 5): Teaching case study

The fourth research paper is a teaching case study entitled "Wilo: Becoming a Digital Pioneer with Artificial Intelligence". Wilo is a leading provider of premium pump systems and the teaching case study uses the real-life example of Wilo's adoption of an AI-based tool in the sales function for preventing customer churn. This case study provides students with the opportunity to learn about the core factors as well as the managerial resources and capabilities necessary in the context of transitioning to analytics-based decision-making processes using AI.

In addition to the teaching case study, in which the particular situation at Wilo and important background information about the company and case are conveyed, the fourth research paper also consists of comprehensive teaching notes (i.e., an instructor's manual). The instructor's manual guides the instructor through the case study, provides a detailed overview of the openly posed case questions, and serves as a guide for potential responses.

The teaching case study is aimed at graduate and executive education courses and includes several learning objectives. In the case study, students address the five learning objectives described below. First, they gain an understanding of the advantages and disadvantages of analytics-based decision-making. Second, students have the opportunity to comprehend the leading factors relevant to digital transformation in a firm. Third, they identify the core resources and capabilities needed to implement AI tools in the corporate sales function. Fourth, class participants determine best practices and challenges in the context of digital transformation. Finally, students design a strategy for actively managing digital transformation in firms.

This teaching case study was co-authored with Philipp Korherr and Dominik Kanbach. The initial double-blinded peer review is completed and the manuscript is currently prepared for re-submission in Case Research Journal (ISSN 2328-5095).

1.3 Publication information of research papers

At the time of writing this publication-based dissertation, the publication status of the four research papers is shown in Table 1.

No.	**Title**	**Publication Status**

I	The Importance of Artificial Intelligence in Strategic Management: A Systematic Literature Review	• Published in *International Journal of Strategic Management* (ISSN 1555-2411)
		  ○ VHB: C
		  ○ Double-blinded peer reviewed
		• Published in Volume 21, Issue 1, p.5-40, June 2021
		• http://dx.doi.org/10.18374/IJSM-21-1.1
		
		• Presented at the *International Academy of Business and Economics (IABE)* 2021 Orlando Winter Conference (March 13-14, 2021)

II	The Significance of Technology-driven Entrepreneurship Activities: Lessons from SMEs Operating in the Manufacturing Industry	• Published in *Cogent Business & Management* (ISSN 2331-1975)
		  ○ SJR: Q2
		  ○ Double-blinded peer reviewed
		• Published in Volume 10, Issue 1, March 2023
		• https://doi.org/10.1080/23311975.2023.2185069

III	Artificial Intelligence-enabled Business Model Innovation: Competencies and Roles of Top Management	• Accepted for publication in *IEEE Transaction on Engineering Management* (ISSN 0018-9391) in May 2023
		  ○ SJR: Q1
		  ○ VHB: B
		  ○ Double-blinded peer reviewed
		• http://dx.doi.org/10.1109/TEM.2023.3275643

IV	Wilo: Becoming a Digital Pioneer with Artificial Intelligence	• Preparation of revised manuscript for re-submission in *Case Research Journal* (ISSN 2328-5095) • Initial double-blinded peer review completed

Table 1 Publication status of the research papers
Source: Own illustration

1.4 References (for Chapter 1)

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2 The importance of artificial intelligence in strategic management: A systematic literature review

Research paper I: Systematic literature review[1]

Authors: Anil Yigit and Dominik Kanbach

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Abstract

The management literature has seen a surge of publications that focus on the utilisation opportunities of Artificial Intelligence (AI) technologies. This paper conducts a Systematic Literature Review (SLR) to create an in-depth understanding of this development by analysing the latest academic contributions on the impact of AI on the field of Strategic Management (SM). In so doing, it aims to provide an integrative framework that merges the current understanding in this area into suitable categories according to the two dimensions of SM and AI. The analysis revealed that: (1) almost 70% of these were published within the last six years, underlining the growing importance of this topic; (2) only 30% of the selected papers were based on empirical data; (3) the majority of the papers were categorised in the 'Strategy Formulation & Selection' stage of the SM process; and (4) machine learning is far and away the most common AI technology providing new opportunities for SM. Finally, we present further ideas and directions to advance this field of academic research.

Keywords: Artificial intelligence, Strategic management, Systematic literature review

[1] This paper is written in British English according to the language requirements of the corresponding paper submission process

3 The significance of technology-driven entrepreneurship activities: Lessons from SMEs operating in the manufacturing industry

Research paper II: Empirical research paper 1

Authors: Anil Yigit and Dominik K. Kanbach

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Abstract

Innovation in small and medium enterprises (SMEs) is often the result of technology-driven or market-pull entrepreneurship activities. So far, although its importance in practice, as well as in academia continues to grow, extant research exhibits little theory about the process of technology-driven entrepreneurship in SMEs. The study aims to better understand how technology-driven entrepreneurship processes transform business in SMEs in the manufacturing industry. Therefore, we developed a technological entrepreneurship (TE) process framework by utilizing the flexible pattern matching approach (FPMA). We iteratively compared a priori patterns from existing theoretical knowledge to empirical findings that emerged from in-depth interviews with corporate executives in the manufacturing industry. The framework highlights the TE process in SMEs leading to four output components: (1) corporate-function-related, (2) business-model-related, (3) competitiveness-related, and (4) customer-related. This study makes a unique contribution to academia by being the first that develops a TE process framework tailored to SMEs from the manufacturing industry. We point out that sustainable growth and competitiveness of SMEs depends on appropriate TE process management, and we underline the strategic importance of TE-driven transformation for SME managers. Our study expands the scope

of TE and SME research and provides empirically grounded insights into technology-driven innovation.

Keywords: Technology-Driven Entrepreneurship, Technological Entrepreneurship, Small and Medium Enterprises, Flexible Pattern Matching Approach, Innovation

4 Artificial intelligence-enabled business model innovation: Competencies and roles of top management

Research paper III: Empirical research paper 2

Authors: Anil Yigit, Philip Jorzik, Dominik K. Kanbach, Sascha Kraus, and Marina Dabić

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Abstract
Research in artificial intelligence and business model innovation is flourishing. Nevertheless, the current discussion lacks an overarching understanding of, and thus has not sufficiently addressed, the interface between artificial intelligence-enabled business model innovation and the critical role of top management. Although a paradigm shift affecting top management is already occurring, extant management literature is limited, especially in terms of primary research. Accordingly, this study explores how top management can encourage and facilitate artificial intelligence-enabled business model innovation. We utilized an inductive approach and conducted semi-structured interviews with 47 practitioners to develop a grounded theory. The developed framework consists of five top management competencies and eight top management roles. Overall, our study contributes to research in business model innovation theory, revealing that top management requires a specific skill set to carry out their roles and fulfill expectations.

Managerial Relevance Statement
When implementing artificial intelligence-enabled business model innovation, the roles and competencies of top management are anticipated to evolve and adapt. This paper presents a framework that comprises the top management

roles and competencies that have a positive effect on organizations in the context of artificial intelligence-enabled business model innovation. Furthermore, this study emphasizes that top management must be conscious of the potential of artificial intelligence to disrupt business models and create new values by suitably considering strategic, environmental, and behavioral challenges. Artificial intelligence technologies are advancing and playing an increasing role in businesses, and top management is compelled to closely scrutinize development in this area.

Keywords: Business Model Innovation, Artificial Intelligence, Top Management

5 Wilo: Becoming a digital pioneer with artificial intelligence

Research paper IV: Teaching case study

Authors: Anil Yigit, Philipp Korherr, and Dominik K. Kanbach

Abstract
The use of analytical tools and disruptive technologies is a strategic imperative for companies to operate successfully in global markets. Wilo, a leading premium provider of pumps and pump systems, tasked Holger Jentsch, the Vice President (VP) of the Group Sales Excellence department, with piloting initial technological transformation projects in certain sales processes. As a lighthouse project, Jentsch aimed to use an artificial intelligence (AI) tool in order to prevent customer churn. Therefore, the case outlines critical success factors for the implementation of data-based decision-making which are elementary for Jentsch's digital transformation project.

Keywords: Artificial Intelligence, Analytics-Based Decision-Making, Digital Transformation

5.1 Teaching case study

5.1.1 Becoming a digital pioneer

In 2015, the Executive Board of Wilo, one of the world's leading premium providers of pumps and pump systems for building services, water management, and the industrial sector, set a far-reaching digitalization strategy for the entire group (Wilo 2015). The project aimed to further digitalize manufacturing processes and product components as well as equip the company for the future in a globally competitive market. The entire digitalization project was divided into smaller sub-projects, including one dedicated to the use of analytics solutions in decision-making processes. By enriching large volumes of internal corporate data with external information, Wilo intended to optimize and accelerate the decision-making processes of middle and top managers using algorithms and statistical models.

As the Vice President (VP) of the Group Sales Excellence department at the Wilo headquarters, Holger Jentsch was responsible for the optimization of global sales processes. In close collaboration with the sales subsidiaries, which aimed to generate higher revenues and secure Wilo's leading position in the market, Jentsch desired to increase the maturity level and efficiency of local sales organizations by relying on analytics solutions for decision-making. With his broad experience with digitalization, Jentsch knew that he would face various difficulties during the implementation of the digital transformational process in the local sales subsidiaries. However, the immature digital infrastructure in certain subsidiaries prevented them from meeting those ambitious goals prior digitalization strategy roll-out.

The analysis of an exemplary sales subsidiary revealed that the number of customers had remained relatively stable over the past few years. Based on those

findings and aiming to transform Wilo into a data-driven company, Jentsch initiated a well-founded analysis in close collaboration with the management of the local sales subsidiary, which exposed a high customer churn. On his flight back from a business trip, he read an interesting study by Yigit and Kanbach (2021), which highlighted the great potential of artificial intelligence (AI) technologies for gathering significant insights during decision-making processes. Consequently, he decided to use an AI-based analytics tool to assess Wilo's customers and investigate their churn probability. An AI algorithm should facilitate the process of identifying customers with a high likelihood of churn. Jentsch wished to use this tool as an early-warning mechanism, allowing him and managers in general to make timely decisions to avoid potential customer churn.

In line with the encompassing strategic project Ambition 2025, the management board authorized Jentsch's lighthouse project to implement an analytical tool for the Sales Excellence department. For this endeavor, he chose a sales subsidiary in Central Europe, as its organizational and sales structure and IT infrastructure fitted well. The chosen sales subsidiary was also known for best-practice approaches to sales processes within Wilo. However, Jentsch was aware of the challenges that might arise throughout the transformation. To be well prepared for the kickoff, and knowing the crucial importance of the project to the management board, he collected data regarding all relevant aspects that might determine the transformational process.

The following sections present all the information collected by Jentsch in preparation for the project planning and subsequent managerial tasks for which he was responsible. The subsequent material is based on the experience reports of some of his colleagues and best-practice approaches from previous digitalization projects conducted within the Wilo Group.

5.1.2 Current situation

The Wilo SE company originally emerged from the Copper and Brassware Factory Louis Opländer, which was founded in 1872 in Dortmund by Caspar Ludwig "Louis" Opländer (Wilo 2022d). In its founding years, the company produced distillery equipment for the beverage industry. Industrialization and increasing prosperity in the 19th century positively influenced the growth of the Copper and Brassware Factory Louis Opländer. The firm developed into one of the leading companies in central heating construction, mainly driven by their invention and further development of steam and water heaters. The current company name, Wilo, was derived from the name of one of the family successors, Wilhelm Opländer, who led the company into further growth (Wilo 2022a).

Over four generations, Wilo evolved into an international technology group. In 1967, the company initiated the globalization process by opening its first foreign subsidiary in Belgium. Further internationalization activities followed in the mid-1980s in France, England, and Italy. Wilo entered the Asian market in 2000 by establishing a subsidiary in Korea. The expansion into additional markets such as India (2005) and the United Kingdom (2006) represented additional milestones in Wilo's growth (see Figure 2) (Wilo 2022d).

Wilo SE was a European stock corporation, and the Wilo Foundation was its majority shareholder (holding 90 percent of its shares). Furthermore, Wilo SE was the parent company of the Wilo Group and executed the central management activities for the whole group and its own operations. For the fiscal year ending December 2021, the Wilo Group generated approximately 1.7 billion euros in sales and employed 8,200 people across 80 production and sales subsidiaries in over 50 countries. The pumps and pump systems were manufactured at 15 production sites located in Europe, Asia, and the Americas (see Figure 2) (Wilo 2021). In 2022, the group looked back on a history of 150 years. As one

of the worldwide leading premium providers of pumps and pump systems for heating, ventilation and air-conditioning, water supply, and wastewater disposal, the firm successfully developed from a hidden into a visible champion (Wilo 2022b). Throughout its history, Wilo continuously focused on innovation, calling itself "the digital pioneer of the pump industry." The principles consistency and adaptability helped it to overcome various challenges in the different phases of its development. Based on its brand promise, "Pioneering for You," Wilo offered its customers high-quality products, system solutions, and services that are user-friendly, energy efficient, as well as powerful (Wilo 2022d).

In 2018, Wilo designed the Ambition 2025 strategic project, which incorporated the corporate objectives, development, and strategic growth path until 2025 and beyond and consisted of two key components (see Figure 3) (Wilo 2018). The first component included six strategic pillars:

1) Striving for maximum customer satisfaction.
2) Engaging and empowering employees.
3) Setting new standards as an innovation leader.
4) Intending to establish itself as the digital pioneer of the pump industry.
5) Standing for business excellence.
6) Remaining an independent and responsible company

The second component contained five different market segments through which Wilo managed its worldwide businesses (Wilo 2021):

a) Building services residential
b) Building services commercial
c) OEM (Original equipment manufacturer)
d) Water management
e) Industry (Pumps and pump systems developed and manufactured for industrial applications in various industries)

The content and objectives of the strategic pillars were transferred to each of the five market segments to ensure the consistent implementation of Ambition 2025 across all market segments (Wilo 2021).

The purpose of Ambition 2025 was to realign the long-term orientation with the rapidly changing economic environment resulting mainly from intense competition and technological advancements related to digital transformation (Wilo 2018; Wilo 2021). Wilo had to compete with new players in a globally competitive market. In recent years, small companies with digital business models, digitized products, and in-depth digital integration capabilities in business-to-business (B2B) had been entering the market. Digital expertise and increasing know-how in the engineering sector were progressively leveling out Wilo's advantage as the market leader. Megatrends such as increasing digitalization and product sustainability, as well as sustainable manufacturing, played a decisive role. In this context, digitalization was a main competitive driver to make products even more customer-friendly, further strengthen internal decision-making processes, and leverage synergies using digital solutions.

In 2018, Wilo launched the world's first smart pump, Stratos MAXO. Thanks to these smart devices and the product's connectivity function with other devices, Wilo started to collect valuable data about their customer's usage behaviors and used it to adapt product features accordingly. As a technology leader, Wilo aimed to set industry standards to meet its own demands but also keep competitors at a distance. Meanwhile, manufacturing companies from Asia were increasingly entering the market and convinced customers with digital products and lean, digitalized business processes. These new market entrants offered customers a lower sales price through automated, analytics-supported processes and the use of smart products. In addition, smart goods provided important

information over their entire life cycle, which could be used to further develop products and form the basis for decision-making.

However, Wilo still benefited from its engineering work and the trust it had built over many years among its numerous customers. The organization decided to apply analytical tools to improve decision-making processes in order to stay competitive in the global market. Hence, a holistic understanding of customer expectations, in line with key indicators that provide valuable information about customer behavior, was determined as a key competitive differentiator. Therefore, the successful utilization of an AI-based churn-prediction tool was a crucial pilot project for Jentsch and his team to further drive the change towards analytics-based decision-making within the Wilo Group. To ensure the favorable implementation of this project, an upstream in-depth analysis of all the factors that might influence the smooth utilization of analytics was essential.

5.1.3 Digitalization initiative

The digital transformation was an all-encompassing project and required the collaboration of employees from all market segments, business units, and departments. The Wilo management board defined a distinct course of action and aimed to maintain the existing competitive advantage that resulted from an excellent engineering performance. Simultaneously, the entire industry went through a digital transformation driven by suppliers, competitors, and buyers. Therefore, the management board of Wilo presented the digital transformation as a fundamental pillar of Ambition 2025. The company significantly invested in its digital infrastructure and drove the digital transformation based on three dimensions: products and solutions, processes, and business models (Wilo 2018).

With the processes dimension, Wilo desired to shift the organization to analytics-based decision-making whenever possible. Already in the initial stages of the digital transformation, Wilo recognized that decision quality heavily relies on a solid and mature database and a harmonized IT infrastructure (Wilo 2015). Wilo's IT infrastructure was comprised of internal software-based systems that collect data and software that processes data for the decision-making process. The overall goal was to establish an end-to-end data life cycle for all operating segments and subsidiaries so as to cover each step and action of the process.

The implementation of a completely new customer relationship management system (CRM) was one of Wilo's pivotal projects to address the upcoming challenges of increased customer demands, a highly global and competitive market, and the requirements of commercial customers. The enhanced interface enriched the customer experience and enabled Wilo to collect all relevant information about its customers and markets (Wilo 2015). A holistic data ecosystem structured around the customer was a crucial differentiator and helped to increase the maturity of data acquisition and handling by the employees (Comuzzi and Patel 2016).

When initiating the CRM project, a heterogeneous IT infrastructure and system landscape with different maturity levels across subsidiaries posed a challenge to the parties involved. Wilo's top management tasked the Group Information Management (GIM) department, which consisted of experienced line managers, IT consultants, and data scientists, with stepwise harmonizing the system landscape and enhancing the corresponding data ecosystem. To fulfill the top management's requirements, the GIM managers set ambitious goals and assigned clear responsibilities to each team member, who took full ownership of their tasks.

Additionally, Wilo established a central analytics hub located at the headquarters. By creating dynamic and interactive business intelligence dashboards, the new hub was responsible for making data from systems usable for decision-makers. These dashboards were primarily required to ensure a good user experience and motivate managers to consider using front-end tools in their decision-making processes.

The CRM project represented just one of the many digital transformation initiatives at Wilo and showed that the company was starting to become data driven. In retrospect, Jentsch acknowledged the complexity of this endeavor with regard to creating a harmonized IT infrastructure, compiling a suitable team of data specialists, and using data appropriately for the AI tool.

5.1.4 Organization

The existence of a suitable organizational structure was one of the key success criteria for the digital transformation at Wilo. The change to analytics-based decision-making processes forced the company to realign its organizational and management structure. With Ambition 2025, Wilo adjusted its internal organizational and management structure to be able to steer sales and transformation activities more concretely towards market needs (Wilo 2019). Thus, Wilo aimed to establish and ensure the efficient and easy processing of data, with corresponding data exchange between departments and across various subsidiaries. As of 2020, the group's top-level organizational and management units consisted of three sales regions and two strategic business units. The sales regions were restructured into Mature Markets, North America, and Emerging Markets. Each included different sales areas and countries in which the subsidiaries carried out business operations. The two strategic business units, OEM and Water Treatment, were not split by region and therefore had a global focus. The Executive Board regarded the sales regions and strategic business units as the

primary control level of the company (see Figure 4). Each region and unit in the primary control level was led by experienced managers with direct reporting lines to the Executive Board. Similar to the structure of Ambition 2025, Wilo's five market segments represented the secondary control level (Wilo 2022e). The sales region managers collaborated closely with each market segment leader to promote 'silo' thinking and guarantee a conjoint collaboration on transformational projects (Wilo 2022e). The availability of a fitting organizational structure was an important change driver and provided a crucial basis for ensuring the replicability of implemented projects. For instance, in 2019, the firm opened its ultra-modern production complex in Dortmund, the Wilo Factory. Based on digital technologies and solutions, Wilo redefined all processes related to production, including the integrated planning and control of customer orders, dynamic linking of production and logistics processes, and close connections to the suppliers (Wilo 2019; Wilo 2022c). Thanks to its well-designed global organizational and management structure, the company was able to successfully implement the digital transformation at the headquarters' production site and other locations such as Laval in France. This production site received the "Industry of the Future" award from the French organization "Alliance Industrie du Futur" in 2020 (Wilo 2020). By relying on a smooth organizational setup, Wilo established a proper transfer of best practices for project management.

Another crucial adaptation was the establishment of a central analytics hub. Wilo was able to strengthen and further develop an agile, state-of-the-art organizational structure in combination with an optimized IT infrastructure. Numerous projects associated with system harmonization and data quality improvement were successfully conducted based on an interdisciplinary setup of team members from the consolidated central analytics hub, the GIM department, and experts from various corporate functions.

However, those achievements were only possible with holistic and encompassing corporate governance. Therefore, Wilo's top management created individual strategic development plans for each region and strategic business unit, including clear activities linked to Ambition 2025 and, consequently, to the digital transformation strategy. Those coherent responsibilities ensured the effective bundling of transformational needs and measures. In particular, comprehensive projects like the establishment of a holistic data ecosystem or utilization of analytics-based decision-making processes required a distinct line of communication and reporting to implement the change and ensure the long-term and sustainable success of the project. An additional criterion for sustainable success was standardized and consistent data governance. Such governance ensured the consistency of the process across all departments and organizations. Furthermore, it clarified the scope of action for employees and ensured a precise framework for the handling of data. Thus, it also served as a means to anchor the strategic considerations of senior executives throughout the organization in a consistent manner.

Even though Wilo, with more than 8,200 employees, possessed a wide range of skills and abilities, digitalization projects for enhancing analytics-based decision-making processes often posed a major challenge to manufacturing companies in particular, as such engineering-driven organizations lack the necessary knowledge and experience. Collaboration with external know-how providers such as consulting companies or university research centers enabled Wilo to implement several projects and build up related expertise, aiming to be a pioneer in the digital age.

5.1.5 Human resources and development

The digital transformation of Wilo into a data-driven company also required changes related to human resources (HR) management. Consequently, in some

cases, the requirements for employees and open vacancies evolved in keeping with the digitalization of tools and decision-making processes.

Previous digital transformation projects enabled Wilo to identify highly talented employees at headquarters or subsidiaries around the world whose knowledge met the requirements. The firm could directly involve employees with suitable skills in appropriate digitalization projects. A great balance of educational background, geographical and organizational affiliation, and gender enhanced team productivity and supported the exchange of ideas. Heterogeneous teams and new forms of collaboration increased the speed of implementation of new systems and created visibility for and trust in new technologies, tools, and processes within the group.

Whenever possible, Wilo aimed to prioritize the further development of internal employees. In close collaboration with the managers of potential candidates from the talent pool, this development was planned by the HR department, considering the capabilities and development path of each employee. This approach highly motivated the internal employees to get new perspectives on the job and develop professionally. Strengthening its employees with the skills required for the digital transformation was also highly valuable for Wilo, as these employees already had significant experience with the firm's product portfolio, customer characteristics, and market behavior.

Experience has shown that executives should be trained first, especially regarding digital topics, which have an all-encompassing influence on the value chain. Key employees and specialists should then be trained as a second step. Managers are frequently the first point of contact for employees to address relevant issues, and with the appropriate expertise, a fruitful discussion can ensue. Nonetheless, a certain limitation presented itself. Employees who were designated for

internal development initiatives had to go through a learning phase. Therefore, the firm had to take into account a reasonable period of additional learning.

However, in some circumstances, Wilo had to extend the staffing of projects to external solutions, which led to adaptations in the recruitment process. On the one hand, departing employees needed to be replaced; on the other hand, new technologies and systems demanded skills and capabilities that would be too complex and expensive to develop internally. An update of job profiles and advertisements enabled Wilo to identify development needs with respect to employee capabilities, set up trainings and continue education programs, and find appropriate candidates for new jobs. Hiring new candidates therefore enriched the firm's capabilities and also introduced a new perspective on the status quo and current issues.

Based on Jentsch's experience and academic evidence, top managers were identified as key success factors of the digital transformation (Shamim et al. 2020). Furthermore, Jentsch was aware that many managers continue to struggle to transform their organization into a data-driven company and apply analytics in various fields of the organization to improve decision-making processes (Korherr et al. 2022).

5.1.6 The role of management

The top management represented a very important link throughout the global organization, and its role was crucial when Wilo aimed to start the digital transformation projects. Since the beginning of the far-reaching digitalization strategy, the top management acted as an indispensable driver of change and pushed the company's global strategy across all regional and central management functions. Whenever possible, they showed trust in analytical methods and their

utilization in decision-making, innovative technologies, and data. This significantly influenced the corporate culture to make Wilo into a digital pioneer.

Already at the very beginning of the transformation, great emphasis was placed by Wilo's top management on implementing a sustainable compensation model with correlating objectives. Previous digitalization initiatives showed that short-term goals could be quickly discarded, especially in the event of personnel changes in management. Therefore, the content of the objectives and compensation model was aligned with the long-term global digitalization strategy anchored in Ambition 2025.

Since numerous stakeholders were involved in this transformation project, the holistic acceptance of the new mindset and attitude had to be ensured by setting up the strategic direction. This required a very transparent communication of the corporate strategy to all stakeholders. Defining the global digital transformation strategy in Ambition 2025 provided precise guidelines for breaking down long-term goals into subordinated smaller tasks, which were then assigned to different corporate functions and departments. This provided a coherent orientation for employees concerning the execution of their tasks.

To ensure that line managers enhanced their personality characteristics and contributed appropriately to the digital transformation process, coaching and managerial trainings were conducted. Line managers subordinated to the top management participated in global trainings that helped them to reconsider their management behavior and apply it properly during the implementation of digitalization processes. As a decisive aspect of the digital transformation process, a main focal point of these trainings was the enhancement of line managers' personality characteristics, such as acting as an empathic role model, being

open to changing existing processes, and showing a willingness to engage with new methods and tools.

One of the primary aims of Wilo's digitalization projects was to improve the decision-making processes across all organizational and managerial levels by relying on analytics-based approaches. To achieve the desired improvement of decision-making processes, it was crucial that line managers act as role models. Therefore, leaders had to utilize new technologies and approaches in their own decision-making processes at a very early stage. This particularly emphasized the serosity of the targeted shift to data-driven decision-making. Managers needed to explain to their employees the advantages and functionalities of analytics-based decision-making techniques for increasing transparency and comprehensibility as well as expanding confidence in decisions and the methods underlying them. In this context, the role of managers in decision-making was critical since employees would hardly be willing to use new decision-making methods if their managers did not.

An annual employee survey revealed that appropriate leadership behavior was another essential factor in favorable outcomes in digitalization projects. Employees expected their line managers to build trust in the strengths, knowledge, and skills of each team member. Furthermore, the survey results showed that the employees desired a leadership style where managers provided them with adequate time to go through the transformation and familiarize themselves with new approaches. The employees additionally stated that the creation of a high level of trust and transparency was a required leadership behavior for all involved team members to gradually leave their comfort zone.

Based on key takeaways from digital transformation projects implemented successfully in other areas within Wilo, Jentsch understood that managerial factors

such as personality characteristics, leadership skills, and decision-making approaches were crucial components for appropriately performing change management in a digitalization project.

5.1.7 Analytics tool for churn prediction

Wilo's top management selected Jentsch's project to implement an analytics-based tool to prevent customer churn as one of the lighthouse projects of the Ambition 2025 strategic realignment. Jentsch chose a sales subsidiary in Central Europe to implement an AI tool to foster the customer relationship and ultimately reduce customer churn. In preparation for a project with such impact, Jentsch formulated the following questions and tasks to base his decisions on a solid foundation.

First, Jentsch wanted to create a common understanding of analytics and decision-making to establish a solid foundation for change management. Hence, we need to clarify the difference between intuitive and data-driven decision-making exemplified by Wilo. Furthermore, what are some advantages and disadvantages of intuitive decision-making and, in contrast, what benefits and drawbacks result from data-driven decision-making?

As a major preparation for his task, Jentsch considered project management–related aspects. Thus, which topics require special attention to facilitate the shift from intuitive to analytics-based decision-making? A clustering of the results into logical dimensions facilitates subsequent utilization. Considering the scope of the project and with the support of the management board, Jentsch wishes to involve all executives related to sales at Wilo in the transformation process. What skills and capabilities of the top management and normal line managers are needed to increase acceptance of an analytics-based decision-making tool in this case? Finally, to complete project management preparations, set up a

potential roadmap for Jentsch to foster the digital transformation of Wilo. What are the five major steps for Wilo to become a digital pioneer?

5.1.8 Exhibits (teaching case study)

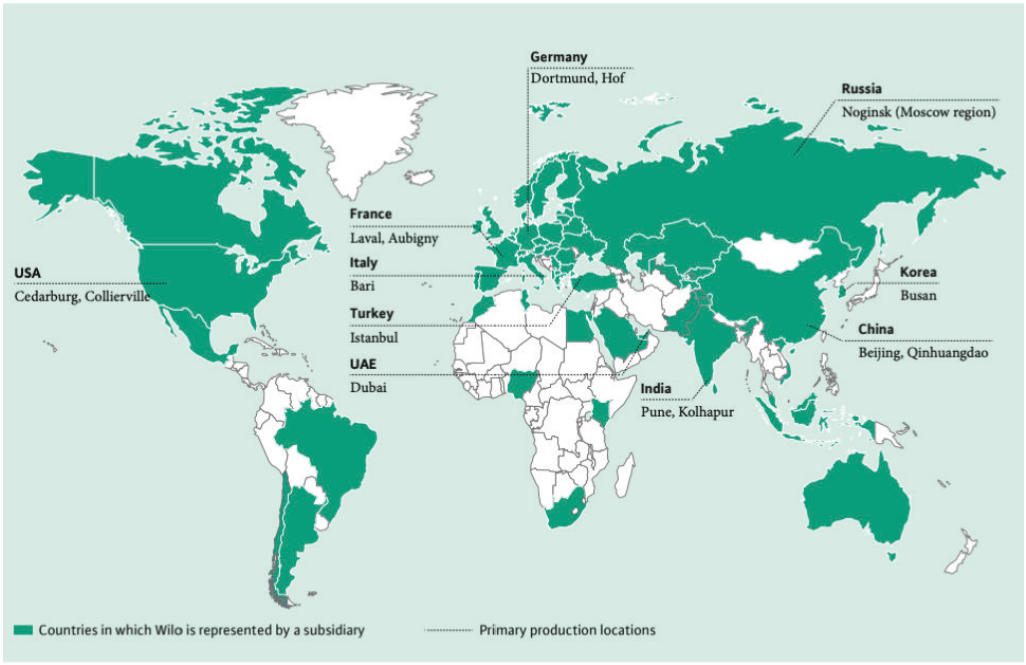

Figure 2 Wilo Group locations
Source: Wilo (2021), p. 47

Figure 3 Wilo's Ambition 2025
Source: Own illustration, following Wilo (2021), p. 52

Figure 4 Organzation and management structure of Wilo Group
Source: Wilo (2021), p. 49

5.1.9 References (for Chapter 5.1)

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Shamim, S., Zeng, J., Khan, Z., & Zia, N. U. (2020). Big data analytics capability and decision making performance in emerging market firms: The role of contractual and relational governance mechanisms. *Technological Forecasting and Social Change, 161.*

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5.2 Instructor's manual

5.2.1 Case synopsis

Change is a major challenge not only for us as people but also for the companies in which we work on a daily basis. Digital transformation using analytical models and methods is one of the main reasons why companies are changing in the 21st century. In this context, the use of analytics in the decision-making processes of executives has long ceased to be an option and is now a strategic imperative for organizations operating globally. As part of the Ambition 2025 strategy project, the Vice President (VP) of the Group Sales Excellence department of Wilo, Holger Jentsch, was commissioned in 2021 to make analytics usable by his department. Jentsch is now evaluating possible challenges for applying artificial intelligence (AI) as part of analytics to predict customer churn.

Students will examine the key success factors of Wilo's transformation into a data-driven company, understand the value added of such analytical endeavors, and reflect on the benefits and drawbacks of analytics-based decision-making.

5.2.2 Intended courses and levels

This case can be used in strategic management or IT management courses/modules at the graduate, MBA, or executive course level. Operational experience can be helpful to fully exploit the potential of findings and the subsequent transfer in an economic context.

5.2.3 Learning objectives

This case concerns analytics-based decision-making. Particularly, it examines the corresponding organizational shift that is required. The context is artificial intelligence for decision-making, which has important applications for various

industries. After working through the case and assignment questions (AQ), students will be able to accomplish the following objectives:

LO-1: Understand the advantages and disadvantages of analytics-based decision-making.

LO-2: Develop an understanding of factors relevant to the transition to analytics-based decision-making in a corporate context.

LO-3: Determine the key aspects and elements required for implementing analytics.

LO-4: Identify skills and capabilities of the top management and normal line managers are needed to increase the acceptance of analytics-based decision-making.

LO-5 Outline a strategy to actively manage digital change in a corporate context.

5.2.4 Research methods

This case is based on original, primary research conducted by the authors through field visits and interviews with the case protagonist. During the period referred to in the case, one of the authors worked at the company Wilo, which provided direct access to first-hand information. The case protagonist, Holger Jentsch, was also the author's direct supervisor. Actual names were used in the teaching case study. Likewise, secondary research on the industry and market situation was conducted. The authors certify that the case protagonist, Holger Jentsch, reviewed the case for content and presentation and has authorized them to submit the case for publication. Following data is included:

- In total, 180-minutes interview with Holger Jentsch, Vice President Sales at Wilo SE
- Verbal exchange and communication via email with corresponding managing director and sales representatives from Wilo SE subsidiary
- Publicly available sources of the company (e.g., homepage, annual reports, communications, newsletters, social media posts, and newspaper articles)

5.2.5 Theoretical linkages

In the following, the Learning Objectives (LO) 1,2,3,4, and 5 (explained in section 3) are linked to corresponding underlying theories.

In order to create a general understanding of decision-making and the benefits of considering analytical models, LO-1 and LO-2 are based on elementary publications (Plessner et al. 2007; Sinclair and Ashkanasy 2005; Agrawal 2014; Davenport 2013; McAfee and Brynjolfsson 2012). The theoretical focus is especially on change management, digital transformation, and human-related aspects that are relevant for the implementation of analytics.

The six factor framework by Korherr et al. (2022a) calls for an assessment of the firm´s managerial aspects that influence the transformation from intuitive to analytics-based decision making (LO-3). Thereby, leadership, top management, infrastructure, organization, human resources processes, and aspects of culture need to be evaluated in order to have a holistic picture of change related elements. Fostering the utilization of analytics is not just about the management of technology, it is rather focused on humans and their interaction in an organizational context (Tabrizi et al. 2019).

To support the identification of appropriate skills and capabilities, the top management and normal line managers need to increase the acceptance of analytics-based decision-making (LO-4). Therefore, a framework of prevalent managerial archetypes is used (Korherr et al. 2022b). Clustering various management types along the dimensions characteristics, capabilities, and their contribution to the application of analytics in the decision-making process helps to understand Jentsch´s challenge within Wilo.

The delineation of a transformational strategy builds on profound literature that specifically deals with the implementation and management of artificial intelligence projects in a business context (Maisel et al. 2022; Ahmed and Pathan 2018; Weber and Stanek 2018). Grounding on those fundamental theoretical concepts of change management in the context of applied analytics is a useful way to design a proper and successful roadmap for Jentsch and Wilo (LO-5).

5.2.6 Suggested teaching approaches (teaching plan)

It is recommended to teach this case in a 90-minute class according to the time-allocation proposal below.

Points for discussion	**Time (Minutes)**
Introduction	**5**
Difference between intuitive and data-driven decision-making	**15**
Advantages and disadvantages of both methods	**15**
Success factors relevant to change to analytics-based decision-making	**15**
Differentiation between line managers and top management	**20**
Roadmap for change	**15**
Conclusion and wrap-up	**5**

Table 2 Teaching plan
Source: Own illustration

5.2.6.1 Online Teaching Strategies

The COVID-19 pandemic, which started in 2020, accelerated the use of online teaching strategies, methods, and tools to depict the transfer of knowledge in research remotely and correspondingly guarantee proper education. To meet the requirements of a changing teaching environment, this case study includes appropriate online teaching strategies. In the following, the options for instructors are detailed for each question to allow them to prepare. The teaching strategies aim at avoiding unnecessary media breaks to lose as little time as possible by switching between different technologies. Therefore, the present case is confined to the standard functionalities of online video conferencing systems such as Microsoft Teams, Zoom, or Cisco Webex.

The instructor should adopt the role of moderator or host in the online meeting, thus making all possible functionalities available and leading the case, notably by presenting the screen or creating breakout rooms.

To handle all five assignment questions properly, the instructor should be able to use breakout rooms and the whiteboard function. If the online video conferencing system does not allow breakout sessions, the instructor should set up additional, separate meetings, to which the participants can switch while working in groups. If the online video conferencing system does not offer the whiteboard function, the instructor should prepare a PowerPoint presentation with the templates provided in the appendix and share their screen to gather the information and make it visible for all participants.

The following online teaching strategies can be applied while working on the case.

Assignment question 1

Group work: Split the participants into groups of equal size with breakout rooms to discuss the question.

Gathering results: Use the whiteboard function to collect the data. If preferred, use the template in the exhibit (see Figure 5) as a structuring element.

Assignment question 2

Group work: Split the participants into two groups of equal size with breakout rooms to prepare arguments for the discussion of the question. Each group should focus on one aspect (intuitive or data-driven decision-making). If possible, shuffle the groups with regard to group work 1.

Gathering results: Use the whiteboard function to collect the data. If preferred, use the template in the exhibit (see Figure 6) as a structuring element.

Assignment question 3

Group work: Split the participants into groups of equal size with breakout rooms to discuss the question. If possible, shuffle the groups with regard to group work 1.

Gathering results: Use the whiteboard function to collect the data. If preferred, use the template in the exhibit (see Figure 7) as a structuring element.

Assignment question 4

Group work: To differentiate between didactical elements, use the chat function of the online video conferencing system. All participants should take a moment to think about the question and then post one of their answers in the chat.

Gathering results: Go through the chat point for point and let each participant explain their point. Gather the data with the whiteboard function.

Assignment question 5

Display the graphic of the exhibit (see Figure 9) to provide structural guidance to the participants. Then, collect the information. Each participant should use the 'raise hand' function, which will allow the instructor to chronologically call up the participants and collect the answers using the whiteboard function and corresponding template.

5.2.6.2 Relevant readings

The following reading suggestions might help answer questions 1 and 2 of the case study. Depending on the level of the students, the instructor might decide whether they are necessary and provide the material before the course.

Thomas H. Davenport, "Keep up with your quants," Harvard Business Review 91 (2013): 7–8.

Philipp Korherr and Dominik K. Kanbach, "Human-Related Capabilities in Big Data Analytics: A Taxonomy of Human Factors with Impact on Firm Performance," Review of Managerial Science (November 2021): 1–28, https://doi.org/10.1007/s11846-021-00506-4.

Kurt Matzler, Franz Bailom, and Todd A Mooradian, "Intuitive Decision Making," MIT Sloan Management Review (2007), https://doi.org/10.4135/9781452276090.n139.

Henning Plessner, Cornelia Betsch, and Tilmann Betsch, "From Intuition to Analysis: Making Decisions with Your Head, Your Heart, or by the Book," in Intuition in Judgment and Decision Making, 1st ed. (Psychology Press, 2007), 211–228, https://doi.org/10.4324/9780203838099.

Behnam Tabrizi, Ed Lam, Kirk Girard, and Vernon Irvin, “Digital Transformation Is Not About Technology,” Harvard Business Review (2019): 2–7, https://hbr.org/2019/03/digital-transformation-is-not-about-technology.

Before the case study, the instructor might send two videos as preparation, which can be watched voluntarily. These videos might help to deepen the understanding of today’s managerial challenges in implementing analytics in established companies:

1. “Stop Managing, Start Leading | Hamza Khan | TEDx RyersonU” August 24, 2016, YouTube video, 18:12, https://www.youtube.com/watch?v=d_HHnEROy_w.

2. “Digital Leadership vs Digital Transformation | Nelson Phillips | TEDxHessle”, October 05, 2018, YouTube video, 14:25, https://www.youtube.com/watch?v=_lvgdF8OQwI.

5.2.7 Assignment questions

Assignment Question 1: What is the difference between intuitive and data-driven decision-making exemplified by Wilo? (LO-1)

Assignment Question 2: What are the advantages and disadvantages of intuitive decision-making and, in contrast, what benefits and drawbacks result from data-driven decision-making? (LO-2)

Assignment Question 3: Which topics need special consideration by Jentsch to facilitate the shift from intuitive to analytics-based decision-making? Please cluster the results into logical categories. (LO-3)

Assignment Question 4: What skills and capabilities of the top management and normal line managers are required to increase the acceptance of analytics-based decision-making tools? (LO-4) Please take the example of using an AI-based churn-prediction tool in the sales function.

Assignment Question 5: Set up a potential roadmap for Jentsch to foster the digital transformation of Wilo. What are the five major steps for Wilo to become a digital pioneer? (LO-5)

5.2.8 Analysis and responses to assignment questions

5.2.8.1 Assignment Question 1: What is the difference between intuitive and data-driven decision-making exemplified by Wilo? (LO-1)

The discussion for this first question can be structured in two parts: first, the students' general understanding of the topic, and second, their understanding with regard to the case of Wilo. This provides valuable takeaways and creates a common understanding of analytical methods. For classes held online, please refer to the TEACHING PLAN for further details on the online teaching strategies.

The first part of the question can be led by the basic examination of the students' knowledge about decision-making. The instructor can ask questions about their experience with analytics. In particular, sharing valuable insights at this point helps to break the ice and also provides other students with first-hand accounts of best practices. Subsequently, the instructor could lead the discussion from experience reports to the interpretation of intuitive and data-driven decisions. In an in-class setting, the instructor could use the template of Figure 5 as a blueprint for structuring the answers on the whiteboard. Having all students in the

classroom offers the opportunity to call them one by one and directly discuss their answers in the plenum.

Based on the information gathered from the recommended readings, potential answers could be as follows.

Intuitive decision-making

- Intuitive decision-making is the process of unconsciously accessing information gained as a result of associated learning and stored in long-term memory to develop the basis for a judgment or decision.
- Intuitive decision-making is a non-sequential mode of information processing.
- It is a subconscious decision in favor of one option between two or more options based on personal knowledge.
- Intuitive decision-making is a process led by experience and acquired capabilities.
- Emotions and cognition influence judgment.

Analytics-based decision-making

- Analytics-based decision-making is a process based on a recommendation resulting from the analysis of large amounts of data.
- Decisions are made based on structured and unstructured information, which was analyzed to derive a recommendation.
- Davenport detailed a six-key approach:
  1. *Recognize the problem or question:* Frame the decision or business problem and identify possible alternatives to the framing.
  2. *Review previous findings:* Identify people who have tried to solve this problem or similar ones and the approaches they used.

3. *Model the solution and select the variables:* Formulate a detailed hypothesis regarding how particular variables affect the outcome.
4. *Collect the data:* Gather primary and secondary data about the hypothesized variables.
5. *Analyze the data:* Run a statistical model, assess its appropriateness for the data, and repeat the process until a good fit is found.
6. *Present and act on the results:* Use the data to tell a story to decision-makers and stakeholders so that they may take action.

Given that all participants have a common understanding of intuitive and data-driven decision-making, the instructor should now move on to the second part of the question and connect these points to the case of Wilo. The instructor can mention that findings regarding intuitive decision-making could be drawn from the reading material in combination with information on Wilo, whereas those about analytics-based decision-making can be gathered from the insights provided by the case. A potential answer regarding the two dimensions of decision-making is outlined below.

Intuitive decision-making at Wilo

- Given the company's long history and organic growth, Wilo's established structure, processes, and organization result in a high ratio of intuitive decisions.
- The broad industry experience and know-how of executives combined with the company's background as an industry leader foster trust in relying heavily on the opinion of sophisticated top managers.
- Wilo's company size, with various departments and subsidiaries and the geographic spread, demands strong corporate governance and, thus, business cases for important decisions.

Analytics-based decision-making at Wilo

- The importance of analytics is understood and becomes increasingly important as the use of data and relevant applications is a major objective of Ambition 2025.
- The general need to apply analytics in order to stay competitive. Megatrends such as the digitalization of manufacturing processes, the development of smart products, and the entry of new Asian competitors into the market incite Wilo's management board to define a precise course of action to maintain the company's existing competitive advantage, which has so far been based on high engineering performance.
- Analytics and the use of big data are a prerequisite for organizations to understand customers and industries and thereby remain competitive in the global market. Therefore, in line with the aforementioned megatrends, the management board considered that a holistic understanding of customer expectations and information are key competitive differentiators.

5.2.8.2 Assignment Question 2: What are the advantages and disadvantages of intuitive decision-making and, in contrast, what benefits and drawbacks result from data-driven decision-making? (LO-2)

At this point, the instructor should allow some time for the students to brainstorm about the second assignment question. The in-class setting offers a valuable opportunity to start an open discussion regarding the advantages and disadvantages of intuitive decision-making. Because the case exemplifies several benefits and drawbacks of analytics-based decision-making processes, the instructor should ensure that the students first limit themselves to the pros and cons of intuitive decision-making. This will allow them to gain a holistic understanding of the topic.

Optionally, the participants can be split into two groups and tasked with examining the benefits or drawbacks individually. Subsequently, both groups should present their results in class and discuss the findings.

Figure 6 provides the instructor with a template for collecting ideas in class. This can be done digitally or, if preferred, the template can be printed and distributed to all participants in the class so that they may take notes.

For classes held online, please refer to the TEACHING PLAN for further details regarding online teaching strategies.

The potential benefits and drawbacks of applying analytics are as follows.

Advantages of intuitive decision-making

- As the leading premium provider of pumps and pump systems for the building services, water management, and industrial sectors, employees at Wilo possess broad industry experience, which is a valuable resource for organizations as it helps to make fast and well-founded decisions.
- The application of best practices gathered from various departments and companies of Wilo Group made the latter a pioneer within the industry and allows it to compile easily applicable approaches, processes, and structures.
- Because of Wilo's diverse client structure, high flexibility in the decision-making process enables salesmen to make fast customer-oriented decisions.

Disadvantages of intuitive decision-making

- The application of established best practices within the organization can hamper innovative and visionary approaches that might be out-of-the-box and unconventional.
- Decisions purely based on experience and intuition might be difficult to implement, especially given Wilo's multilayered international structure, which is affected by different cultures from various countries.
- Intuition is closely connected to emotions and feelings, which can be influenced differently by various triggers, especially in turbulent times (e.g., the COVID-19 pandemic, raw material shortages, wars, etc.).

The instructor might point out that the advantages and disadvantages identified may vary according to the individual situation of the organization and may have limited generalizability. However, it is important to understand the benefits and drawbacks of data-driven decision-making.

Advantages of analytics-based decision-making

- Analytics requires the use of internal and external data and, therefore, allows a holistic view of the potential options and decisions to be made.
- The broad database and structured decision-making process in a given structure ensure a high level of consistency and standardization for all relevant stakeholders.
- Analytical tools offer the possibility to easily apply different analyses and studies, which may foster new creative approaches and insights.

Disadvantages of analytics-based decision-making

- A high level of maturity in the area of data quality and availability, which, if absent, prevents the full exploitation of the potential of analytics.

- Heterogeneous system landscapes in different subsidiaries and departments may complicate the provision of data and increase the corresponding costs related to data quality and availability.
- The application of analytics requires more stakeholders (e.g., data scientists), which hampers fast and lean decision-making.

Thereupon, the instructor might explain that there is no black or white regarding which decision methodology is better. It is important to mention that analytics-based decisions still require a human being to make the final decision and interpret the solution suggested by the algorithm.

5.2.8.3 Assignment Question 3: Which topics need special consideration by Jentsch to facilitate the shift from intuitive to analytics-based decision-making? Please cluster the results into logical categories. (LO-3)

At this point, the instructor might point out that Wilo, and especially Jentsch, is facing various challenges and the digital transformation has not been easy. For in-class and online work on the case, the instructor should guide students by providing the structure of Figure 7. For classes held online, please see the TEACHING PLAN, which comprises further details on the online teaching strategies.

Based on the information presented throughout the case, the students should mention the following six topics to master the topic of the change to a data-driven company. The order of the results determines the structure of the case; however, the solution presented by the students can vary.

1. **Organizational factors**
   a. Establish an organizational structure to ensure the necessary exchange of data for analytics.
   b. Provide necessary governance for data handling to ensure the high quality of the data obtained across divisions, departments, and geographical spread.
   c. Collaborate with external specialists, such as data scientists, consulting companies, or universities, to rapidly obtain data know-how in Wilo.

2. **Centralization of analytics know-how and infrastructure**
   a. Arrange a common and capable IT infrastructure for all teams, departments, and divisions.
   b. Establish an end-to-end data life cycle with a holistic data ecosystem including all subsidiaries and permeating all processes and entities.
   c. Centralize Wilo's analytics knowledge of initiatives and skilled employees in a central hub.

3. **HR processes and development**
   a. Establish cross-functional teams from various departments and functions to obtain diverse perspectives on projects and challenges while implementing analytical tools and methods.
   b. Provide training and development possibilities to existing staff to create awareness and foundational knowledge of data analytics.
   c. Adapt recruitment processes and define skill profiles for vacancies with requirements to apply analytics.

4. Leadership behavior of executives

a. Use personalities and advocates like Jentsch for the endeavor and create awareness.
b. Point out that executives are role models and their attitude towards analytics-based decision-making is essential because subordinates, driven by intrinsic and extrinsic values, imitate their behavior.
c. Emphasize that leadership behavior and the management of employees play a significant role.

5. Top management as a driver of change

Unlike normal changes within organizations, digital transformation for the use of analytical models in decision-making should be driven by the top management team.

a. Utilize the top management team as the key driver of change for the digital transformation because if they do not use analytical tools for decision-making, there is no reason to expect their employees to do so.
b. Tie objectives and compensation models to the application of analytics and their decision-making behavior; the specifications depend on the organization.
c. Align the overall strategy and strategy process with this overarching goal in terms of vision and mission, as becoming a data-driven organization is a holistic endeavor.

6. Culture

Culture is the last element that Jentsch should keep in mind regarding the digital transformation. However, this aspect should be understood as interdependent and mutually enforcing factor.

For Wilo, the cultural aspect is critical as its values, mission, and vision are based on the fairness, respect, and responsibility of every single employee. Furthermore, what sets Wilo apart is the facilitation of free working styles to empower everyone in the group. Furthermore, becoming a digital pioneer, Wilo aims to set standards for the pump industry by respecting and valuing diversity, ways of life, background, and qualities – a fundamental pillar of culture and an essential cornerstone of the digital transformation.

Students must understand that digital transformation always encompasses the corporate culture of an organization and that this factor permeates all departments and divisions as a multilayered, complex concept. Culture should be understood as invisible glue connecting all the aforementioned factors.

Figure 8 gives an overview of the factors and can be provided by the instructor to the students after they have answered the question. If some time remains and students have not identified all the factors, a general discussion can be opened about all aspects of the framework. Thereby, the instructor may encourage the students to think of potential extensions of the given factors and support their arguments with practical examples.

5.2.8.4 Assignment Question 4: What skills and capabilities of the top management and normal line managers are required to increase the acceptance of analytics-based decision-making tools? (LO-4) Please take the example of using an AI-based churn-prediction tool in the sales function.

Based on the information provided in the case, the instructor should expect students to structure the task as illustrated below.

Required skills and capabilities of…

1) … the **top management** for increasing the acceptance of **analytics-based tools in general**.

2) … **line managers** for increasing the acceptance of **analytics-based tools in general**.

A potential answer regarding the required skills and capabilities of top management and line managers is presented in the following passages.

Regarding **1) top management**:

- Acting as an indispensable **driver of chan**ge and pushing the company's global strategy across all regional and central management functions.
- Implementing a sustainable **compensation model with correlating objectives** related to the global digitalization strategy, including the breakdown of long-term goals into subordinated smaller tasks, which are assigned to different corporate functions and departments.
- Defining a global **corporate strategy** with regard to digital transformation and the shift to analytics-based decision-making, including transparent communication with all stakeholders.

Regarding **2) normal line managers**:

- Focusing on and enhancing **personality** characteristics such as empathy, the tendency to engage in teamwork, and openness since they are decisive for the success of the digital transformation process.
- Applying analytics in their own **decision-making** processes at a very early stage and acting as role models for employees.
- Displaying suitable **leadership** behavior by appropriately assessing the skills, knowledge, and strengths of team members as well as providing

adequate time to undergo the transformation and become familiar with new approaches.

The instructor might point out that the information collected about the skills and capabilities of the top management and normal line managers may vary depending on the individual setup of the organization and may have limited generalizability.

In the third step, the students should determine which management skills and capabilities are required to increase the acceptance of **AI-based sales tools** in particular. A potential answer is:

- Convincing salespeople of the benefits of the AI tool (e.g., efficiency enhancement, sales/ business impact) and highlighting their positive contribution to the achievement of personal, department, and overarching corporate sales targets.
- Presenting best practices and success stories from other sales subsidiaries at the earliest possible stage of the project (especially to long-standing, entrenched sales employees).
- Offering professional trainings by reputable institutes to enlighten salespeople on the correct usage of AI-based sales tools.

For online classes, please refer to the TEACHING PLAN, which provides further details about the online teaching strategies.

5.2.8.5 Assignment Question 5: Set up a potential roadmap for Jentsch to foster the digital transformation of Wilo. What are the five major steps for Wilo to become a digital pioneer? (LO-5)

To close the case, students must be able to transfer their knowledge and the best-practice example of Wilo to a practical application within a digital transformation project. Depending on the educational level of the students, the instructor can provide more or less guidance for this question. It must also be mentioned that there is no wrong answer to this question and the roadmap for the digital transformation project. The following statements are based on Wilo's experience, scientific findings, and academic collaborations with universities conducting research in this field and the German Association for Information Technology, Telecommunications, and New Media. Importantly, the instructor must be aware that the example for this question consists of a highly simplified framework. The listed aspects represent the path that Wilo followed in terms of project management to implement an AI solution in the sales organization.

For Jentsch, the endeavor to implement an AI solution within the sales function is one of the most important projects. Therefore, proper project management comprising all the elements identified in the previous questions is indispensable.

First, the instructor could ask whether the students have clarifying questions about the task. Second, the instructor could start the brainstorming phase. The instructor might also show Figure 9 on a screen or hand out a printed version.

As Wilo already identified its use case, the step from the original roadmap 'Identification of Use Case' is not required here. This point may be mentioned by the instructor.

1. Requirements Engineering & Change Management

As a first step, Jentsch should discuss the requirements of the sales employees and other departments who act as stakeholders on the topic of customer-churn prediction. To design a state-of-the-art analytics tool, all requirements must be considered and addressed to the software and data engineers. Second, Jentsch should start with some change-management measures to inform all relevant stakeholders and create awareness of the issue as well as acceptance by shedding light on a topic that is a black box for many people.

At this point of the class discussion, students might directly proceed to the elaboration of the tool and its programming. In this case, the instructor might mention the organizational aspect of Wilo and that problems may occur with the common database required for a holistic and fruitful application of analytics in Wilo's sales subsidiaries.

2. Database & IT Infrastructure Prerequisites

After gathering all the requirements and establishing general conditions, Jentsch had to create a common database and a capable IT infrastructure to apply analytics properly. Because Wilo has various databases, a global network of subsidiaries, and a heterogenous digital infrastructure, Jentsch had to set prerequisites for such a digital transformation. A so-called readiness assessment compares the requirements of the first phase with the existing IT infrastructure and identifies possible gaps that must be closed in the course of the project.

3. Solution Definition & Tool Evaluation

Wilo started from scratch for the definition of its analytical solutions. This allowed a complete detachment from already existing tools and their functionalities and enabled the company to completely configure the software solution in accordance with the requirements defined in the first phase. In parallel, suitable

and possible tools are selected, and their feasibility is checked with regard to the requirements. Whether the potential tool can be integrated into Wilo's existing IT infrastructure is also examined.

The instructor might guide the discussion and answer the plenum's clarifying questions to include all students and convey the content in a way that is appropriate for the audience.

4. Implementation & Integration

The fourth step was the implementation of the analytical tool in a sales subsidiary. Major challenges were the integration of the tool into the existing IT infrastructure and the training of the employees. With this lighthouse project, Wilo aimed to prevent minor defects and so-called teething problems at the very beginning, before the global rollout. As part of the concept of change, this project also provided an opportunity to test the communication regarding new content and adjust the trainings based on the employees' needs in order to guarantee a smooth rollout across all sales areas and reduce resource-intensive ramp-up time for employees.

Depending on the time left, the instructor might start a discussion on the advantages and drawbacks of a lighthouse project such as the one conducted by Wilo.

5. Rollout & Optimization

Finally, Jentsch started to plan the rollout of the AI-based customer-churn prediction tool in other sales subsidiaries across the world. This final step enabled Wilo to leverage the entire power of the analytical solution. Furthermore, clear responsibilities were assigned to employees. With a steep learning curve, it was

possible to further optimize the solution and ensure satisfactory data quality across the subsidiaries implementing the tool.

At this point, the instructor might ask the students if they see further actions that need to be taken for Wilo to become a data-driven company. Finally, the instructor can show Figure 10 with the solution.

To summarize the case, the instructor might ask the students in the plenum to reflect on the case, state what surprised them most and share their impression of how Wilo implemented the use of analytics in the sales department.

5.2.9 What happened (epilogue)

Wilo continued its digital transformation by successfully implementing the AI-based churn-prediction tool with Jentsch as the project manager in 2022. In co-operation with the pilot sales subsidiary and based on the insights generated by the AI tool, the decision-making process for identifying customers with a high likelihood of churn was facilitated. This tool was used as an early-warning mechanism, allowing managers to make timely decisions to avoid potential customer churn by taking appropriate countermeasures. Following the success of the pilot project, Jentsch took it upon himself to roll out this tool in other sales subsidiaries step by step.

5.2.10 Exhibits (instructor's manual)

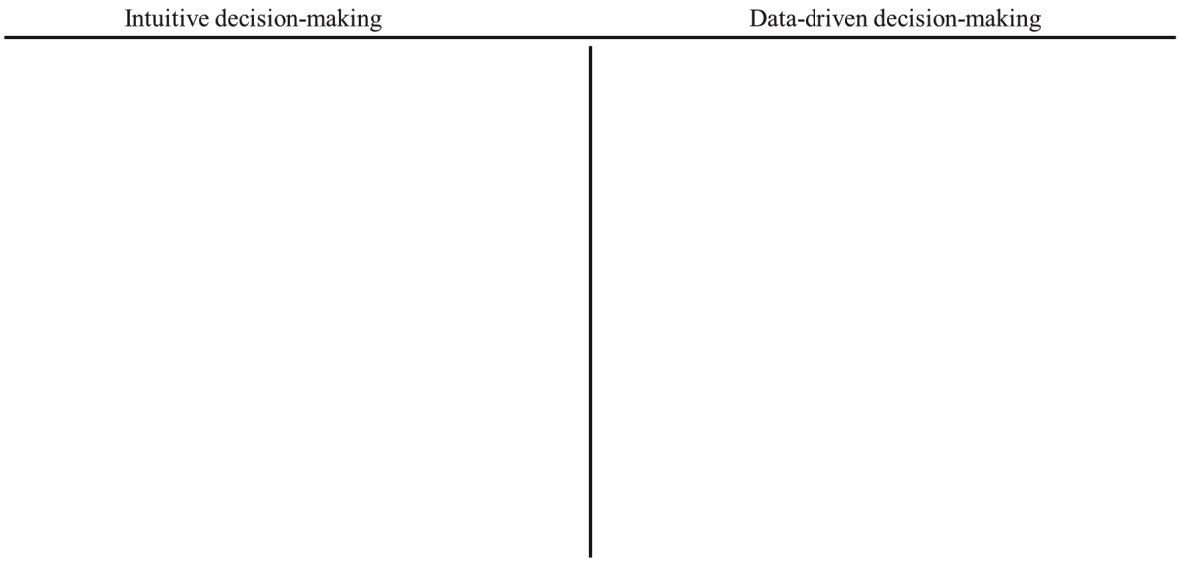

Figure 5 Template AQ1 – Differences between intuitive and data-driven decision-making
Source: Own illustration

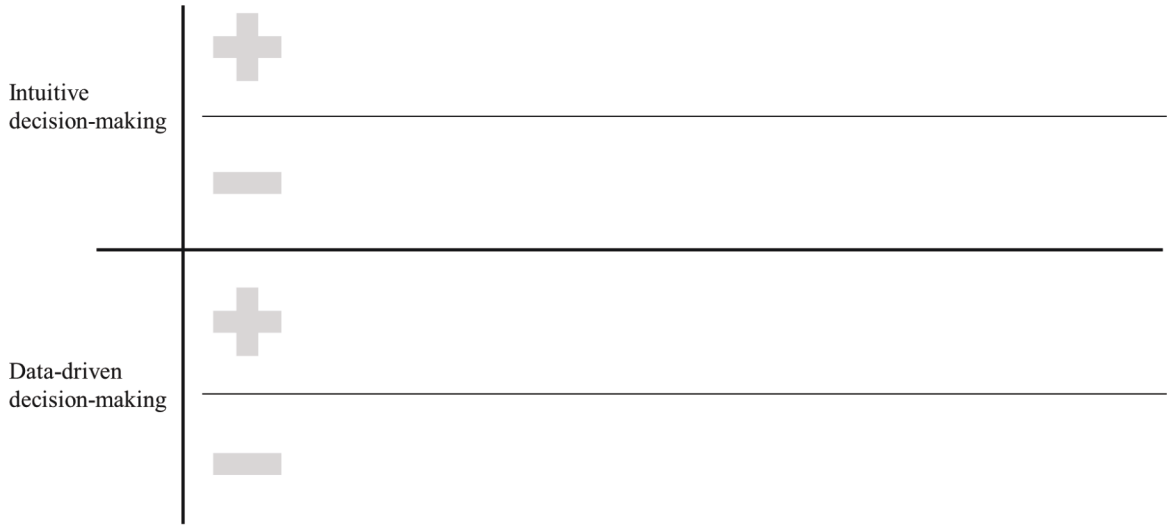

Figure 6 Template AQ2 – Pros and cons of intuitive and data-driven decision-making
Source: Own illustration

Figure 7 Template AQ3 – Structure of the factors influencing the shift to data-driven decision-making
Source: Own illustration, following Korherr et al. (2022a)

Figure 8 Factors relevant to the shift to analytics-based decision-making
Source: Owin illustration, following Korherr et al. (2022a)

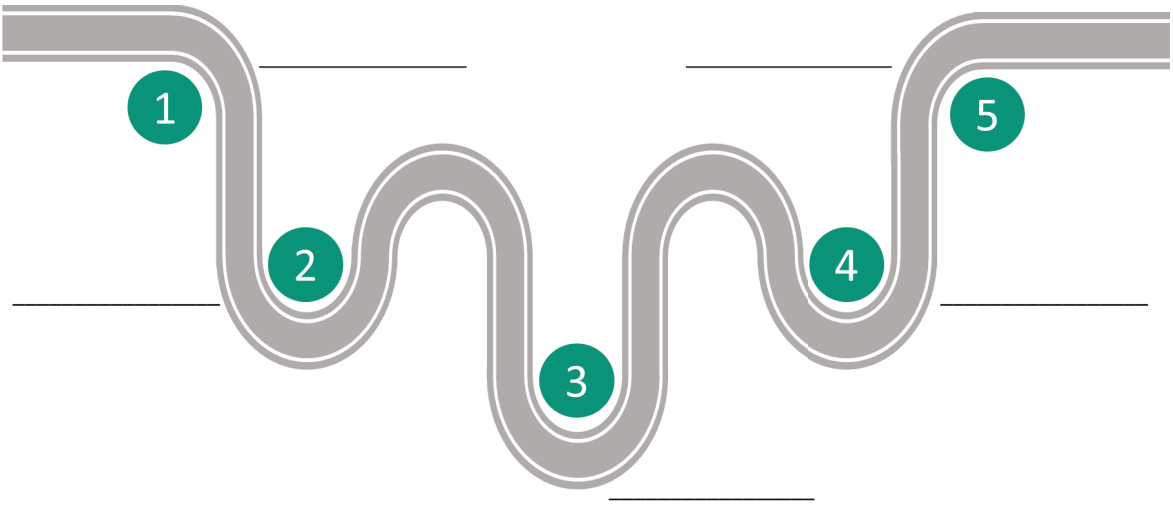

Figure 9 Template AQ5 – Roadmap for the digital transformation
Source: Own illustration

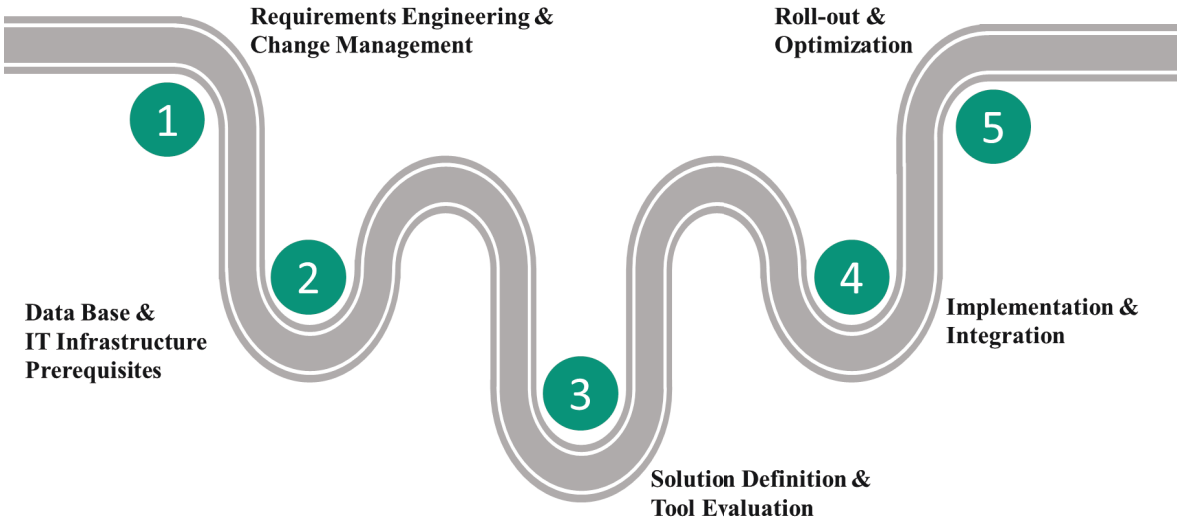

Figure 10 Solution AQ5 – Roadmap for the digital transformation
Source: Own illustration

5.2.11 References (for Chapter 5.2)

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6 Contributions and future research

The research papers of this publication-based dissertation analyze the importance of AI and TE, make crucial contributions to academia, and address the prevailing research gaps (see Chapter 6.1). The research findings also serve practitioners by applying their relevance to real-life business examples (see Chapter 6.2). The main contributions of each research paper to academia and for practitioners are summarized in Figure 11. In addition to the important findings and contributions, this dissertation also acknowledges existing limitations and determines potential directions for future research (see Chapter 6.3).

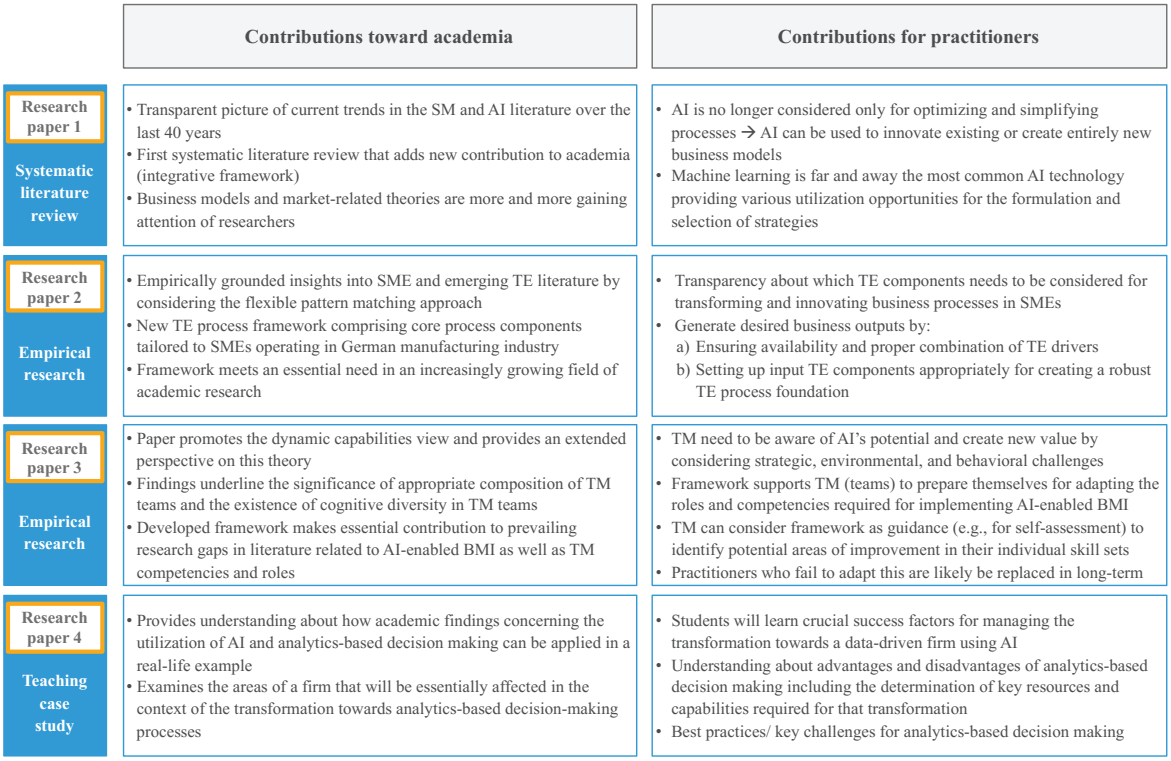

Figure 11 Contributions of research papers to academia and for practitioners
Source: Own illustration

6.1 Contributions to academia

This publication-based dissertation's research papers have made various contributions to academia and are explained in the following sections.

First, this dissertation provides a transparent picture of trends in the SM and AI literature over the last 40 years. In this context, the first research paper provides a first systematic literature review, which adds a new contribution to academia by capturing in an integrative framework the existing knowledge concerning the importance of AI in SM. Furthermore, this dissertation identifies that in the academic field of SM and AI, business model and market-related theories are increasingly gaining researchers' attention (Holloway, 1983; Geisler, 1986; Orsini, 1986; Agrawal et al., 2018; Iansiti & Lakhani, 2020).

Second, this dissertation contributes empirically grounded insights into the SME and emerging TE literature by both confirming prior findings on TE theory and augmenting new observations in that research field. The first empirical paper introduces a state-of-the-art framework precisely tailored to SMEs operating in the manufacturing industry and encompasses relevant TE process core components. Previous research dealt with TE process only in a general context without focusing on specific company characteristics, such as on SMEs from a particular industry (Petti, 2009; Bailetti, 2012; Habtay, 2012; Chaston, 2017; Majdouline et al., 2022; Maysami et al., 2019; Siyanbola et al., 2011). In addition, previous research on TE focused on companies operating mainly in North America (Liu et al., 2022). In this context, this study examined the extent to which previous findings on TE activities in the manufacturing industry can be applied to other, less researched geographic regions. The developed TE framework specifically tailored to SMEs operating in the German manufacturing industry meets an essential need in an increasingly growing field of academic research.

The third contribution to academia is the promotion of the dynamic capabilities (DC) view (Teece et al., 1997). The second empirical paper provides an extended perspective on the DC theory by considering a new framework comprising the TM competencies and roles that are required for AI-enabled BMI (e.g., widening the view on theoretical aspects of the DC view such as sensing, seizing, and transforming). The developed framework makes an essential contribution to research gaps in literature related to AI-enabled BMI as well as TM competencies and roles. Furthermore, the findings of the second empirical paper enhance the theory of TM teams and underline the significance of both TM teams' appropriate composition and the existence of cognitive diversity within them.

Ultimately, the teaching case study contributes to academia by providing an understanding of how academic findings concerning the utilization of AI and analytics-based decision making can be applied in a real-life example. Based on existing theoretical concepts and models, the case study examines the areas of a firm that are affected when transitioning to analytics-based decision-making processes.

6.2 Contributions for practitioners

The research papers of this publication-based dissertation offer numerous contributions for practitioners, which are shown in the following sections.

The first contribution of this dissertation for practitioners is the demonstration that AI is no longer considered something only to be used for optimizing and simplifying processes. Instead, AI is increasingly seen as a way to innovate within existing business models or create entirely new ones. Furthermore, machine learning is far and away the most common AI technology, providing numerous utilization opportunities for the formulation and selection of strategies concerning the strategic management of firms.

Second, this dissertation assists practitioners by illustrating how corporate managers need to consider relevant TE components in order to transform and innovate business processes in SMEs as well as achieve sustainable competitiveness and a targeted customer focus. Managers are required to contribute actively to the development and management of the TE process, especially if a firm is intending to create, deliver, and provide value to its customers through TE-driven initiatives (Bailetti, 2012; Prodan, 2011). The first empirical research paper shows that at each stage of the TE process, practitioners are required to deal with various factors of TE components in order to generate a desired business output. For this purpose, it must be ensured by managers that the required TE drivers are available and properly combined with each other. The TE input components must also be set up appropriately to create a robust TE process foundation and achieving desired outcomes.

The third contribution for practitioners is that TM need to be aware of AI's potential and create new value by considering strategic, environmental, and behavioral challenges. TM must appropriately accommodate relevant roles and competencies in order to successfully implement AI-enabled BMI. The new framework introduced in the second research paper supports TM (teams) as they prepare themselves for adapting the roles and competencies required for AI-enabled BMI. In this context, TM can also consider the framework as guidance for conducting self-assessments and identifying potential areas of improvement in their individual skillsets. Further, this dissertation indicates that managers who do not understand how to appropriately encourage and facilitate the use of AI for BMI are likely to be replaced in the long term.

Finally, the teaching case study helps students and practitioners to learn the crucial success factors for managing the transition to data-driven firms and represents the last contribution of this dissertation for practice. This case creates

an understanding of the advantages and disadvantages of analytics-based decision making, including the determination of key resources and capabilities required for that transformation. It identifies and delivers crucial best practices and key challenges on the path toward analytics-based decision making.

In conclusion, this dissertation contributes to both academia and practice. It makes a significant theoretical contribution to research in the field of AI and TE, which also serves as a useful basis for further research. In the same way, this dissertation's empirical findings also equip practitioners with knowledge of essential managerial implications and applicable frameworks concerning the comprehension of the most current developments in the field of AI and TE.

6.3 Limitations and future research

Despite the important contributions to academia and practitioners illustrated above, the research conducted in this publication-based dissertation demonstrates some limitations which can, however, suggest avenues for further research. The limitations and potential avenues for further research are presented in this section.

First, the management literature concerning AI and TE is currently in a significant growth phase. As shown in the systematic literature review in the first research paper, the number of management studies has increased greatly in recent years. It can confidently be assumed that the management literature will continue to be enriched with new insights in the years to come. Therefore, future research could extend the findings of this dissertation with additional reasonable insights that might emerge with further development in the research fields of AI and TE. Due to the fact that the research fields in the area of emerging technologies are constantly evolving (Spanaki et al., 2022; Yunus et al., 2019),

continuously adapting and expanding the existing frameworks and theories is highly recommended.

Second, the empirical studies conducted for this dissertation, such as the second and third research papers (see Chapter 3 and 4), are based on qualitative methods. These methodologies are ideally suited to generating new theories in research areas that focus on new technological developments and innovations (Mulisa, 2022, Gioia et al., 2013; Bouncken et al., 2021). Further validating the presented qualitative findings of this dissertation and conducting complementary research by using quantitative research methods may generate new insights. Furthermore, the consideration of quantitative methods with larger sample sizes in future research might be also facilitate the generalizability of research results (Mulisa, 2022). In this context, important findings could be transferred to other research areas.

Third, this dissertation focuses on various research development paths, such as the importance of AI in SM (research paper 1), significance of TE in SMEs operating in the manufacturing industry (research paper 2), competencies and roles of TM for AI-enabled BMI (research paper 3), and a best practice case focusing on implementing analytics-based decision-making processes in a firm by relying on AI (research paper 4). Moreover, the data collected in the empirical studies were largely collected in Central Europe with a strong focus on Germany. Future research could expand the theories and frameworks developed in the various research papers by focusing on other particular industries and regions. This third limitation relates to the aforementioned second limitation, as extending the focus to other industries and regions would reinforce the generalizability of the empirical observations.

Regardless of these limitations, this dissertation enriches the research on AI- and TE-related activities on firm level. It enhances the understanding of the concrete role and importance of AI in SM and firms; it illuminates the research area of TE from the perspective of SMEs operating in the manufacturing industry; it improves theoretical and practical understanding regarding the competencies and roles of TM required for AI-enabled BMI; and, finally, this dissertation's key academic findings contribute to classroom discussions on the basis of the teaching case study.

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