Exploring Digital Transformation: Implications of Digitalization on the Firm and Employee Level

—

A Traversal from Corporate Strategy Development to Implementation

Inauguraldissertation
zur Erlangung des akademischen Grades eines Doktors
der Wirtschaftswissenschaften des Fachbereichs Wirtschaftswissenschaften
der Universität Osnabrück

vorgelegt
von

Tobias D. Herbst

Osnabrück, April 2022

Dekan:
Prof. Frank Westermann, Ph.D.

Referenten:
apl. Prof. Dr. J. Piet Hausberg
Prof. Dr. Frank Teuteberg

Tag der Disputation:
29.04.2022

Isn't it funny how day by day nothing changes, but when you look back, everything is different. - CS Lewis.

Preface

This cumulative dissertation was prepared between February 2019 and October 2021 during my time as a Ph.D. candidate at the Department of Technology and Innovation Management of the School of Business Administration and Economics Osnabrück University.

The dissertation was mentored by my doctoral supervisor, Adj. Prof. J. Piet Hausberg, who I would like to thank especially. He continuously challenged and encouraged me during my dissertation project. Our various conversations and discussions and his thought-provoking ideas allowed me to adopt new perspectives within my research. Especially as a co-author of several contributions, our close collaboration allowed me to strengthen my academic capabilities and interest in the research subjects.

I would also like to thank Prof. Dr. Teuteberg, who agreed to be my dissertation's co-advisor.

I would also like to thank my family for their patience and especially my parents, Thomas and Manuela Herbst, for their constant support in every possible way in my life so far. Finally, I want to express sincere gratitude to my wife, Andrea, for her moral support and relentless encouragement. She also tolerated the consequences associated with the dissertation with understanding and forbearance. Significantly, her understanding, motivation, and assistance helped me to follow my dreams.

Brunswick, October 2021 Tobias D. Herbst

Notes on the Structure of the Document

This cumulative dissertation is composed of two main parts. Part A offers a general introduction to the research topics leading to the main contributions of the research. The introduction includes the motivation, research problem, and research questions. The underlying research design is explained, followed by a summary of the main contributions. Next, the main theoretical and managerial implications, limitations, and future research directions are provided. Lastly, Part A closes with a conclusion and references section.

The results of the individual contributions have already been published, presented, or are under review and are explicitly listed in Part B. Thus, in Part B, the results and discussions of the research contributions, which are published and under review in high-profile journals, can be viewed in their entirety. The given layout for the publication was used.

Table of Contents

Part A—Introductory Overview

List of Figures

List of Tables

List of Abbreviations

AC	Absorptive Capacity
CMV	Common Method Variance
EO	Entrepreneurial Orientation
GQ	Guiding Question
IS	Information Systems
IT	Information Technology
KBV	Knowledge-Based View
KM	Knowledge Management
KMSs	Knowledge Management Systems
OEM	Original Equipment Manufacturer
OI	Open Innovation
OSF	Open Science Framework Platform
MTurk	Amazon Mechanical Turk
RBV	Resource-Based View
RQ	Research Question
VHB	Verband der Hochschullehrer für Betriebswirtschaftslehre, translation: German Academic Association for Business Research

1 Introduction

1.1 Motivation and Background

The corporate environment today is subject to fierce competitiveness and dynamism with no sign of slowing down (Ireland and Webb, 2007; Smith and Lewis, 2011; Gordon and Martin, 2019). Firms need to leverage knowledge (internal and external), ways to market, and actively engage in various innovation activities (Schumpeter, 1934; Chesbrough, 2003a; Chesbrough, 2003b). Research by Barney (1991) and Grant (1996) on the effect of knowledge on enabling competitive advantage facilitated the development of the resource-based view (RBV) and the knowledge-based view (KBV). More specifically, the RBV highlights firms' strategic assets (e.g., resources and capabilities) as key to capturing sustained competitive advantage (Conner and Prahalad, 1996; Grant, 1996). The KBV evolved from the RBV and focuses on how knowledge management (KM) and knowledge-based resources leverage those resources despite existing limitations (Gassmann and Keupp, 2007; Gardner, Gino, and Staats, 2012). Notably, the KBV underlines the relevance of knowledge to gain sustainable competitive advantages (Kogut and Zander, 1992; Amit and Schoemaker, 1993; Spender, 1996).

Multiple studies have identified the link between knowledge and innovation (building on the KBV), emphasizing that innovative firms successfully build and manage knowledge within and beyond their boundaries (Díaz-Díaz, Aguiar-Díaz, and De Saá-Pérez, 2008; Martín-de Castro et al., 2013; Tamayo-Torres et al., 2016; Gomes and Wojahn, 2017). Others have elucidated the importance of effective resource and asset orchestration (Sirmon et al., 2011; Pagani, 2013) and effectively leveraged information

technology (IT; Kearns and Lederer, 2004) in the pursuit of sustainable competitive advantage.

Particularly during the last decade, developments in IT have rapidly changed the economy and, more specifically, our work and personal lives (Hirt and Willmott, 2014). In light of this progression, firms seek to apply IT to foster operational efficiency and further adapt their existing and new business models to the digital era, supported especially by digital technologies (e.g., components generating digital output, like sensors; Bharadwaj et al., 2013). In this context, scholars coined the term digitalization, defined as using digital technology to enable business model innovation (BMI) and contribute to a firm's value proposition via digitalized product information (Gobble, 2018; Parida, Sjödin, and Reim, 2019).

Prominent firms, such as Uber and Apple, have already taken advantage of digital technologies to implement new products and business models (Keen and Williams, 2013). Since business models map firms' general business logic, this implies a transformation across all business areas, divisional layers, and processes (Teece, 2010). Thus, digitalization may be a valuable source for developing sustainable competitive advantage by differentiating firms' product and service offerings (Kowalkowski and Brehmer, 2008).

At the same time, this implies a significant impact on existing firms and their established business models (e.g., Nokia; Aspara et al., 2013), with born-digital firms being exempt (Tumbas, Berente, and Vom Brocke, 2018). Hence, firms may consider digitalization as an opportunity or risk. On the one hand, digitalization can be seen as an enabler by leveraging digital technologies to drive new revenue streams (e.g., Bharadwaj et al., 2013; Hess et al., 2016; Yoo et al., 2010) through differentiation. On the other hand, it can also be seen as a risk in multiple domains (e.g., Singh and Hess, 2017; Svahn et al.,

2017), increasing competition (Hirt and Willmott, 2014). For example, high investments are required, digital capabilities have to be developed, and new technology-driven competitors may enter with digital business models disrupting established industry verticals (Christensen and Overdorf, 2000). Given digitalization's impact, firms are investing extensively in digital technologies to transform their pre-digital status quo (Ross et al., 2016). Globally, firms are expected to spend approximately 6.8 trillion USD from 2020–2023 on digital transformation to foster digital products, services, and business development (Fitzgerald et al., 2021). Consequently, the top investment priorities for CEOs after the COVID-19 pandemic are IT and innovation (Deloitte and Fortune, 2020). Although digitalization appears to be a key priority, Ulrich et al.'s (2020) survey highlighted that 64% of the non-digital leading firms, do not have a defined strategy for digitalization.

In this context, firms gradually introduce digital technologies into products or related services (Bharadwaj et al., 2013) not only to thrive but to survive in the digital era. As products become increasingly digital, product data can be leveraged to exploit advanced data analytics to provide novel services and solutions, such as tracking real-time product health and customers' process optimization, which are called advanced services (Baines and Lightfoot, 2014; Loebbecke and Picot, 2015). Consequently, digitalization impacts and may transform firms' stakeholder interfaces and relationships, their way of value generation, and, thus, ensure sustained competitive advantage (Bharadwaj et al., 2013; Pagani, 2013; Pagani and Pardo, 2017). Accordingly, it is becoming of ever greater importance to adopt an ecosystem perspective that includes all stakeholders affected by innovations in a network-oriented approach (Adner and Kapoor, 2010). Specifically, to enable digital product and service innovation, firms may increasingly rely on external knowledge sources (e.g., competitors, customers) to

complement their internal knowledge by integrating external stakeholders into their ecosystem (Bharadwaj et al., 2013).

Firms are, therefore, increasingly concerned with leveraging knowledge from internal and external sources to foster innovative performance and increase competitiveness (Penrose, 1959; Hult, Hurley, and Knight, 2004). This is with the consideration that knowledge is the first step towards innovation and enables the differentiation of firms' offerings (Anderson, Potočnik, and Zhou, 2014). To achieve sustainable competitive advantage, firms are increasingly opening up their innovation processes and using intentional inflows and outflows of knowledge, called open innovation (OI), greatly popularized by Chesbrough (2003a, 2003b, 2006).

Particularly driven by digitalization, OI enables an efficient exchange of knowledge with external stakeholders (Sambamurthy, Bharadwaj, and Grover, 2003). Using digitalization as an enabler, a global study among 1001 technology executives highlighted that 64% of firms are shifting away from developing (digital) knowledge in-house (Ulrich et al., 2020). However, firms need to pay close attention to managing the process of organizing and leveraging their knowledge, which is defined as KM (Spender, 1996). Consequently, IT has facilitated the enhancement of knowledge management systems (KMSs) to acquire, store, generate, apply, and share knowledge within and across a firm's boundaries (Alavi and Leidner, 2001).

However, while acknowledging the benefits of KMSs for business performance (Petter, DeLone, and McLean, 2008) and the competitiveness (Cao, Thompson, and Triche, 2013) of firms, it is the use of the system itself that leads to success (DeLone and McLean, 1992). Thus, investment and provisioning alone are not sufficient for the success of KMSs as scholars refer to the necessity of linking human resources, processes, and the technology itself (Poston and Speier, 2005; Wu and Wang, 2006; Petter, DeLone, and

McLean, 2008). Otherwise, the risk is that extensive investments in IT will not lead to superior financial performance (Melville, Kraemer, and Gurbaxani, 2004). Therefore, it is essential to understand the underlying drivers that lead to the individual adoption of KMS practices.

Given the urgency and need to ensure digitalization, firms are launching digital transformation initiatives to address the formulation of digital business strategies as one of their first steps (Vial, 2019). To enable the success of these initiatives, scholars highlight the importance of merging IT and business strategy (Bharadwaj et al., 2013). In this context, firms define a digital strategy where they formulate how to leverage digital technologies to change the value creation and later how to execute the strategy (Bharadwaj et al., 2013). This, in turn, has a significant impact on the organization and, consequently, its structure, culture, leadership roles, and collaboration behavior. However, in approaching organizational-change initiatives, firms suffer a failure rate of 70 percent (Hughes, 2011). Among the key challenges are the lack of skills and talent, operating models, and strategies (Ulrich et al., 2020). This may be due to the complexity of digital transformation initiatives, which describe how the digital strategy may be developed and then executed. Further, digitalization can fundamentally impact products, services, processes, business models, and operations (Yoo et al., 2012; Hess et al., 2016). Conversely, firms have to consider and address various dimensions in the transformation process (Nwaiwu, 2018; Vial, 2019). Therefore, firms need to understand the digitalization phenomena in their business environment to develop and effectively implement digital strategies. Additionally, firms need to examine the anticipated advantages of these strategic initiatives to formulate a tailored strategy at the firm level and enable the necessary adjustments to be made to the organizational collaboration model, its capabilities, and corresponding implementation on the employee level.

1.2 Research Problem and Questions

Indeed, multiple previous studies have examined and elaborated on the phenomena of digital transformation (see Nwaiwu (2018) and Vial (2019) for a broad overview) and digital strategy (Bharadwaj et al., 2013; Grover and Kohli, 2013; Pagani, 2013; Matt, Hess, and Benlian, 2015; Cenamor, Rönnberg Sjödin, and Parida, 2017). However, there appears to be a lack of empirical research concerning the (mostly) conceptual digital transformation frameworks and concrete digitalization strategies that can be used as a framework to leverage digital technologies. This may also be due to the missing generalizability of business model innovation between industries and the applications per se. As highlighted by Vial (2019), previous research has often focused on specific digitalization issues involving pervasive strategies, innovation strategies, organizational structures, or processes. However, no specific frameworks have addressed detailed industry- and firm-specific factors (e.g., stages of value creation in specific industries) and the interconnection of multiple concepts. It is against this backdrop that this dissertation develops, firstly, a framework for linking concepts and appreciating firm contexts and market settings which may enable firms to take an efficient approach (e.g., resource allocation) to strategically evolving their current positioning and value creation, thereby contributing to the creation of competitive development advantages in different market settings.

To further adapt the strategic framework, firms need to open their innovation activities to external stakeholders and, more importantly, foster external knowledge. Concerning OI and its impact on innovation performance, firms may benefit from individual factors, for instance, capabilities, capacities, organizational design, and practices (West and Bogers, 2014; Saebi and Foss, 2015; Hosseini et al., 2017). However, there appears to be a lack of research concerning important contingencies that may affect

OI to support innovation performance (West and Bogers, 2014). Hosseini et al. (2017) found IT capabilities, which refer to a firm's ability to merge its resources with IT-related resources (Bharadwaj, 2000), to be of high importance concerning the strategic alignment perspective. Additionally, entrepreneurial orientation (EO), which involves methods, processes, and decision-making styles that determine a firm's entrepreneurial activities (Lumpkin and Dess, 1996), maybe a critical contingency (Zhou, Yim, and Tse, 2005; Anderson, Potočnik, and Zhou, 2014). However, scholars found mixed EO results on business performance (Matsuno, Mentzer, and Özsomer, 2002; Wiklund and Shepherd, 2005; Zhou, Yim, and Tse, 2005; Hughes and Morgan, 2007; Rauch et al., 2009; Cheng and Huizingh, 2014). Therefore, this dissertation's second goal is to better understand IT capability and EO effects on the relationship between OI and firms' innovation performance.

To share knowledge within the firm, organizations are increasingly turning to KMSs to boost their employees' creative performance (Anderson, Potočnik, and Zhou, 2014). Ultimately, it is the individual's creativity that enables the firm's increased innovative performance (Mumford, 2000). Consequently, prior studies stated that it is pivotal to understand employee motivation (Amabile, 1993; Madjar, Oldham, and Pratt, 2002) and individual absorptive capacity (AC; Seo, Chae, and Lee, 2015; Kang and Lee, 2017) alongside the processes resulting in creative outcomes (Zhang and Bartol, 2010). Categorized into intrinsic and extrinsic motivation, where intrinsically motivated employees perform a task out of pure interest or enjoyment of the task, extrinsically motivated employees perform a task if they can obtain a personal benefit from it (e.g., reward; Amabile, 1993; Vallerand, 2000). Prior research revealed the positive impact of intrinsic motivation on innovation and creativity (Anderson, Potočnik, and Zhou, 2014). Regarding extrinsic motivation, the results of past studies are ambiguous, with some

studies indicating a positive influence and others indicating a negative impact (Shalley, Zhou, and Oldham, 2004; Anderson, Potočnik, and Zhou, 2014). Examining process orientation, previous studies identified creative process engagement, describing how employees engage in the creative process as a vital enabler of employee creativity (Zhou and Shalley, 2003). However, there appears to be a lack of research elaborating on the impact of employee motivation (Shalley, Zhou, and Oldham, 2004; Anderson, Potočnik, and Zhou, 2014) and engagement in creative processes (Zhang and Bartol, 2010). Therefore, as a third goal, this dissertation seeks to enhance the understanding of KMS usage impact on employee creative performance, employee motivation, and creative process engagement.

Last, concerning the individual AC, Enkel et al. (2016, p.1) identify:

> three dimensions: individuals' ability to identify valuable knowledge external to the existing firm environment, individuals' ability to assimilate the external knowledge to existing organizational identity, and individuals' ability to advocate for the utilization of the external knowledge within an organization.

There is a lack of research on individual AC, specifically concerning KMS usage, intrinsic and extrinsic motivation, and creative employee performance. Accordingly, as a fourth goal, this dissertation aims to highlight the impact of KMS usage on creative employee performance and the direct and moderating effect of individual AC and intrinsic and extrinsic motivation.

The preceding discussion demonstrates the broad scope of the research problems addressed in this dissertation. A mixed-methods approach (Creswell, 2003; Tashakkori and Creswell, 2007; Venkatesh, Brown, and Sullivan, 2016) is adopted to answer the following overarching guiding question (GQ) and research questions (RQs):

- **GQ**: How does the ability to leverage digitalization affect firms' strategy and organizational dimensions?

- **RQ1**: How can component suppliers in a multi-tier supply chain use digitalization to develop new positioning opportunities and enable sustainable competitive advantage?
- **RQ2**: How does OI affect a firm's innovation performance, and what are the impacts of IT capabilities and EO?
- **RQ3**: How does the use of KMSs influence employees' creative performance, and what role do creative process engagement and employee motivation play?
- **RQ4**: How does the use of KMSs influence employees' creative performance, and what role do individual AC and employee motivation play?

This dissertation serves as a guide for firms facing digitalization challenges that are willing to understand the phenomenon itself, develop strategically, and want to successfully drive digital transformation. The dissertation is further motivated by highlighting relevant fields of action derived from the strategy and firm dimension enabled by digitalization and its impact on the firm and employee level. However, it does not offer the exact strategic steps to be employed within the framework or how firms should adopt them. Instead, it offers a framework for how firms can conduct successful strategic reorientation considering digitalization. It also points out relevant concepts that enable, facilitate, or enhance the strategic change process and how they can be moderated.

1.3 Structure of the Dissertation

The remainder of Part A of this dissertation is structured as follows: Section 2 presents the scholarly approach, outlines the contributions to the research by answering the RQs, and places the research results into perspective. Section 2 commences with the research design, including the publication history of contributions of this dissertation, the

research setting, the spectrum of methods and theories, and the framework of this dissertation. Section 3 summarizes each specific research contribution to illustrate the research approach and main findings. Section 4 presents the results, theoretical and managerial implications, limitations, and future research opportunities to outline the practitioner and academic ramifications. The final section of Part A is the conclusion, which frames the research objectives by answering the GQ and RQs and describes the study's contributions.

2 Research Design

2.1 Publication History

During this dissertation, four research contributions were developed. All contributions have been previously published, presented, or submitted to high-quality journals, conferences, and an international academic publisher that performed a rigorous double-blind peer-review process to ensure a superior scientific standard. Table 1 provides an overview of the contributions, including their bibliographic information, respective qualitative classification by the German Academic Association for Business Research (VHB; JOURQUAL3, VHB 2015)—where applicable—and the publication status. The author of this dissertation formulated the main scientific contribution in each of the contributions listed. More specifically, the respective contributions of the author of this dissertation and Adj. Prof. Dr. J. Piet Hausberg as a co-author of some contributions, are provided in the commentary section of Table 1.

In the remainder of Part A, the author will refer to and discuss the research of contributions I, II, III, and IV, excluding the conference contributions as they constitute preliminary results of the submitted long papers.

Table 1: Overview of the Research Contributions of this cumulative dissertation. VHB=Verband der Hochschullehrer für Betriebswirtschaftslehre e.V. (Translation: German Academic Association for Business Research) — Journal Quality Index 3 (VHB 2015).

#	Title	Authors	Publication Outlets	Ranking	Status
I	Component suppliers in the commodity battle: Can digital technology in multi-tier supply chains help to transform liabilities into opportunities?	Herbst, T. D.	International Journal of Business Science and Applied Management	VHB: C	Published
II	A Contingency Model of the Open Innovation-Innovation Performance Relationship: The Role of Entrepreneurial Orientation and IT Capability	Herbst, T. D.; Hausberg, J. P.	EURAM 2021 Conference	Acceptance rate: 86%	Presented 17.06.202
			In Proceedings of the AOM 2021 Conference (best papers)	Acceptance rate: 63% (conference), 3% (best papers)	Published and presented 29.07.-04.08.2021
			International Journal of Business Science and Applied Management	VHB: C	Under review since 22.11.2022
III	Linking the use of knowledge management systems and employee creative performance: The influence of creative process engagement and motivation	Herbst, T. D.; Hausberg, J. P.	ISPIM Innovation Conference 2021 (top 14 best papers)	Acceptance rate: 71%	Presented 22.06.2021
			R&D Management Conference 2021	Acceptance rate: 73%	Presented 08.07.2021
			International Journal of Innovation Management	VHB: B	Published
IV	Knowledge Management System Usage and Creative Performance: Moderating Role of Absorptive Capacity and Motivation	Herbst, T. D.; Hausberg, J. P.	International Studies of Management & Organization	VHB: C	Under review since 17.07.2022

Comments on the Authors Contributions

The order of authors describes the authors' contributions to the research. Hence, the author of this dissertation made the major research contribution.

Contribution II:
- The author of this dissertation performed the majority of the research. In the process, the author developed and conducted the literature search, jointly developed the research design, derived the hypotheses, pre-registered the research proposal including a priori calculations to the open science framework, developed and conducted the survey, and wrote the abstract, introduction, theoretical background and hypotheses, methodology, discussion, and conclusion section of the manuscript.
- Adj. Prof. Dr. J. Piet Hausberg made notable contributions to the manuscript. Particularly, he critically reflected and added to the research design, conducted the survey's data evaluation, and wrote the manuscript's results section. He also provided a critical review of the introduction of the submitted version of the manuscript.

Contribution III:
- The author of this dissertation performed the majority of the research. In the process, the author developed and conducted the literature search, jointly developed the research design, derived the hypotheses, pre-registered the research proposal including a priori calculations to the open science framework, developed and conducted the survey, and wrote the abstract, introduction, theoretical background and hypotheses, methodology, the discussion, and conclusion section of the manuscript.
- Adj. Prof. Dr. J. Piet Hausberg made notable contributions to the manuscript. Particularly, he critically reflected and added to the research design, conducted the survey's data evaluation, and wrote the manuscript's results section.

Contribution IV:
- The author of this dissertation performed the majority of the research. In the process, the author developed and conducted the literature search, developed the research design, derived the hypotheses, developed and conducted the survey, and wrote the abstract, introduction, background, hypotheses and conceptual model, methodology, added to the results section by discussing the results, solutions and recommendations, future research directions, conclusion, additional reading, and key terms and definitions section of the manuscript.
- Adj. Prof. Dr. J. Piet Hausberg made notable contributions to the manuscript. In particular, he conducted the survey's data evaluation and wrote a major part of the results section in the paper.

2.2 Research Setting

The research settings and application levels of the studies are manifold. Contribution I is within the capital goods industry. For example, in areas such as transportation or power generation, firms, such as Siemens or ABB, act as solution providers (product and extended services), thus achieving sustainable competitive advantage (Gann and Salter, 2000). The framework focuses on capital- and knowledge-intensive, slow-moving (in terms of technological innovation) industries that exhibit long product life cycles and the highest safety requirements. The study adopts a multilateral

approach, incorporating a multi-tier perspective on innovations (i.e., original equipment manufacturer [OEM], module supplier [tier-1], and component suppliers [tier-2] perspectives). The railway industry may be seen as a vital representative where the framework is applied in an exemplary manner. As detailed previously, digitalization leads to the need for explicit capabilities to realize eventual innovations, such as data-driven business models or network-oriented orchestrating roles. Due to the decade-long multi-tier approach in such industries as railways, digitalization enables a reorganization or a partial dilution of the long-standing structures. Besides, component suppliers are being pushed by increasing competition - particularly from Asian countries - to uncover new strategic development opportunities to escape or counteract their product and service portfolio commoditization. Finally, the derived strategic framework, and thus, the development options are drawn from the view of a component supplier and provided at the firm level. Contribution II also relates to the firm level but due to the more generalized excluding industry or multilevel reference approach. However, the authors limited the research setting to Germany as scholars point to regional disparities in innovation networks. Contributions III and IV, however, find their application at the individual (employee) level. Thus, the authors attempted to ensure a high diversity of study participants to reflect firms' increasingly diverse employees (Singh and Point, 2004). Likewise, this study is without a specific industrial or multilevel approach.

2.3 The Spectrum of Methods and Theories

The research methodology describes the theory and analysis of a study undertaken and the strategy for answering specific RQs (Saunders, Lewis, and Thornhill, 2012). It also substantiates the framework employed and incorporates the adaptation of the methods to the specific research context (Tracy, 2013). That said, the RQs and objectives should guide the research methods and design (Tracy, 2013). This dissertation aims to

develop a strategic framework for effective management considering digitalization and offers empirical evidence on how to adapt to firm and employee levels. Thereby, the dissertation builds on qualitative, quantitative, and conceptual research methods collectively in one research project, thus utilizing the mixed-method approach (Creswell, 2003; Tashakkori and Creswell, 2007). By applying a mixed-method approach, this dissertation aligns with the viewpoint of scholars regarding the possible positive effects of the mixed-method approach, which may improve data accuracy, offering an overarching picture by joining approaches, and avoiding biases compared to single methods (i.e., qualitative, quantitative, or conceptual; Denscombe, 2008). As stated by Tracy (2013), some of the most robust research projects in the past were based on approaches that employed a multiple method approach (Floyd, Pauley, and Hesse, 2010). Table 2 summarizes the research methods and main theories employed in this dissertation for each contribution. Next, the methods of individual contributions are briefly discussed. For a comprehensive explanation, please refer to the corresponding references. Last, to avoid redundant information in this dissertation, the author refers to the respective contributions, especially to the corresponding references (see Table 2).

Contribution I is a study based on qualitative and conceptual methods. The main focus was to create a compelling and operational strategic framework used by firms' decision-makers, especially in strategic development. McMeekin et al. (2020) stated that many approaches exist on framework development (ranging from a literature review and expert experience to interviews and case studies). While the research process draws on Eisenhardt (1989) and McMeekin et al. (2020) to derive a framework, not all of the proposed steps are performed in this research study. Further validation through case studies or empirical analysis of the framework constitutes future research potential.

Nevertheless, conceptual frameworks and theory building may be founded on a combination of prior literature, common sense, and experience (Eisenhardt, 1989).

Table 2: Overview of the applied spectrum of methods and theories

		Research Methods	Key Theories, Framweorks, & Models	Contributions				References
				I	II	III	IV	
Methods	Qualitative	Literature review		x	x	x	x	Bernard (2017), Tracy (2013)
	Quantitative	(Online) survey (incl. data analysis and hypothesis testing)			x	x	x	Bernard (2017), Groves et al. (2011), Kothari (2008)
	Conceptional	Framework development		x				Gimpel (2018), McMeekin (2020), Nylén and Holmström (2015)
Theories			Resource-based view	x	x	x		Barney (1991), Eisenhardt and Schoonhoven (1996), Grant (1996), Conner and Prahalad (1996)
			Knowledge-based view	x	x	x		Amit and Schoemaker (1993), Gardner et al. (2012), Gassmann and Keupp (2007), Kapoor and Adner (2012), Kogut and Zander (1992)
			Business model concept	x				Foss and Saebi (2017), Osterwalder et al. (2005)
			Theory of (interdependence and) modularity	x				Baldwin and Clark (1994, 2000), Cabigiosu and Camuffo (2011), Frandsen (2017), Sanchez and Mahoney (1996), Ulrich (1995)
			Motivation–Opportunity–Ability			x	x	MacInnis and Jaworski (1989)

Past research has successfully used similar approaches (i.e., without using a dedicated process, including multiple methods; McMeekin et al. 2020) to develop relevant strategic (managerial) frameworks, especially building on a literature review and experience (e.g., Nylén and Holmström, 2015). Accordingly, a literature review was utilized for this purpose to consider current research and its results and limitations (Bernard, 2017). This allowed the review of critical conceptual foundations related to the scope of the study.

Relevant theories and phenomena and their interrelationships were studied, building the basis for developing the strategic framework. The study was based on the author's broad five-year experience in the strategic management of a component supplier facing the same challenges described in the first study. This insider knowledge (e.g., various customer meetings, market and competitive analyses, business figures) would not have been accessible to external researchers. This access to the essential data allowed a comprehensive understanding of the study's diverse phenomena and enabled research work with high managerial relevance that assisted in developing the strategic framework. The strategic framework was also applied to a higher-level case study in the rail industry to underline the managerial importance.

Contributions II, III, and IV are of quantitative nature. Building on a literature review, the critical element, however, is a survey approach. Groves et al. (2011) define a survey as a systematic method for gathering information from various entities to construct quantitative descriptors of the larger population's attributes. Hence, survey research allows, by considering a population sample, for the characteristics to be determined and then by inference applying those same characteristics to the larger population (Kothari, 2008). The survey approach is vital to gain crucial insights by collecting data on experts' views or opinions (Bernard, 2017). This dissertation implemented an online survey approach for contributions II, III, and IV to measure variables and test related hypotheses in the given structural models. Importantly, further methodological rigor was applied for contributions II and III by submitting a non-modifiable pre-registration of the research to the open science framework (OSF.io) platform (Foster and Deardorff, 2017; Sullivan, DeHaven, and Mellor, 2019), which is automatically released to the public after an embargo period of two years. This avoids the suspicion of cherry-picking results and the file drawer effect (Rosenthal, 1979; Franco, Malhotra, and Simonovits, 2014). This

approach avoids making only strong results of the research accessible and making research accessible detached from the research results (Franco, Malhotra, and Simonovits, 2014; Sullivan, DeHaven, and Mellor, 2019). In contribution II, the research conducted is at the firm level, where one respondent represents one firm. In contributions III and IV, however, the research is on the individual (employee) level, and employees from a variety of firms were among the respondents.

2.4 The Framework of the Research Contributions

Prior research explored key dimensions of digital transformation strategy (e.g., Matt, Hess, and Benlian, 2015; Nwaiwu, 2018; Vial, 2019). Although these studies highlight different dimensions, approaches, processes, and priorities, they share the view that technology itself is only one critical component contributing to successful development within the digital age (Vial, 2019). In this context, Matt, Hess, and Benlian (2015) developed a digital transformation framework that forms this dissertation's research framework—balancing four transformational dimensions: use of technologies, changes in value creation, structural changes, and financial aspects (see Figure 1).

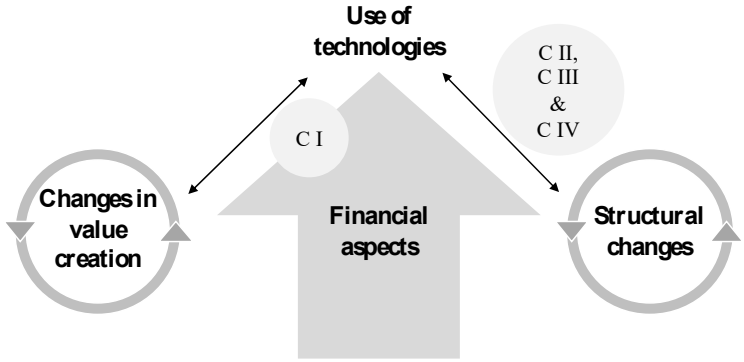


Figure 1: Digital transformation framework according to Matt, Hess, and Benlian (2015, p. 341), including the classifications of the dissertation's contributions (C I, C II, C III, C IV)

When initiating digital transformation within a firm, it is essential to address all four dimensions and guide concepts from conceptualization to implementation within the

firm (Nwaiwu, 2018). Exploring the digital transformation framework, the first dimension, the use of technologies, demonstrates the firm's degree of commitment and the ability to use new technologies (Matt, Hess, and Benlian, 2015). Thereby, Matt, Hess, and Benlian (2015) emphasized that a firm has to decide on the strategic role of IT and whether it intends to be a technology leader (to gain competitive advantage) or to rely on established technologies and develop new ideas from them; implying a different level of competitive advantage. The introduction of new technologies can lead to a change in value creation at the firm level, thus directly impacting a firm's corporate strategy, product, service offerings, and business scope (Matt, Hess, and Benlian, 2015). In the dimension of structural change, Matt, Hess, and Benlian (2015) refer to organizational aspects that need to be addressed in the context of digital transformation enabling an "adequate basis for the new operations" (Matt, Hess, and Benlian, 2015, p. 341). As an example, they mention a firm's organizational setup of new digital business activities. Due to the close relationship between technology use and operationalization within a firm, the dissertation's framework also identifies the required capabilities (on firm and employee levels) within structural changes. The fourth dimension, financial aspects, includes the firm's financial pressure to act (e.g., reduced inventory business or lower profitability) to undertake digital transformation and the ability to implement the digital transformation with monetary resources (Matt, Hess, and Benlian, 2015). It can be understood as the primary driver of pursuing digital transformation (Nwaiwu, 2018).

This dissertation's contributions are framed according to Matt, Hess, and Benlian's (2015) framework to provide further insight into the phenomenon of digital transformation (see Figure 1). Taking a comprehensive view of the four dimensions provides firms with a more systematic understanding (e.g., impact factors) and approach to exploring the transformation driven by digitalization. All four contributions are

motivated by the financial aspects dimension. Contribution I shows the financial pressure to act driven by the market environment and firm-specific situation (e.g., commoditization) and strategic options enabled by digital technologies that facilitate improved financial performance. Contributions II, III, and IV are motivated by the challenging market position and potential benefits regarding (innovation) performance. Nevertheless, the contributions of this research dissertation are distinct and were addressed by implementing independent research projects.

By developing a strategic framework considering digitalization driven by an extremely competitive setting, the first contribution addresses three dimensions. Namely, the change in value creation, use of technologies, and financial aspects at the firm level. Within the strategic framework and its development stages presented in contribution I, component suppliers must leverage digital technologies to gain and use (external) knowledge beyond their boundaries to realize the strategic options. To further capitalize on the IT-enabled transformation, firms must open their innovation process. This strategic framework is rather new and requires changes to the firms' organizational operations and capabilities. A growing share of firms are launching digital transformation projects, yet more than 70% of these initiatives fail (Hughes, 2011). Accordingly, it is highly relevant to analyze which dimensions positively influence the strategic options presented in contribution I to increase the success rate of digital transformation projects.

Contributions II, III, and IV, however, concern the use of technologies and structural change dimensions, notably, by elaborating on OI and its impact on innovation performance, and IT and EO's interrelation. Contribution II addresses structural changes that must be considered at a firm level. It analyzes the opening of the innovation process (OI) and the improved innovation performance possible as a result. Increased innovation performance can enable the relevant development steps from contribution I, as new and

useable products and services need to be developed and applied, positively impacting the firms' financial performance. Besides influencing factors, IT capabilities and EO were examined. Consequently, the purpose was to answer the following RQ: "How does OI affect a firm's innovation performance, and what is the impact of IT capabilities and EO?" The question of which dimensions and levels must be considered to enable such strategic positioning remains.

Consequently, contributions III and IV address vital elements of the use of technologies and structural changes at the (individual) employee level as they deal with the effect of creative process engagement, individual AC, motivation, and the influence of KMSs on creative employee performance.

3 Summary of the Research Contributions

The following sections present and summarize the central aspects of the four research contributions. As shown in Table 1, the contributions are at different stages of publication. Detailed descriptions can be found in this dissertation's individual contributions listed in Part B (appendix).

3.1 Contribution I—Component suppliers in the commodity battle: Can digital technology in multi-tier supply chains help to transform liabilities into opportunities?

Given the increased competition and dynamic environments, component suppliers face multiple challenges to sustaining competitive advantage (Tate et al., 2014). Adding to the pressure, dedicated positions within a multi-tier supply chain, including standardized processes and product interfaces, allow for increased product standardization (Cabigiosu, Zirpoli, and Camuffo, 2012). Preceding stages of the multi-tier supply chain act as knowledge filters, leveraging information and knowledge, leading

to an information asymmetry, which prevents component suppliers from delivering renewed value. Consequently, component suppliers have increasingly less of a chance to differentiate their portfolio through innovations, which leads to a homogenous offering. Combined with high industry stability, low switching costs and high price sensitivity—scholars coined the concept commoditization—component suppliers not only struggle to stay competitive but to survive (Reimann, Schilke, and Thomas, 2010; Uehara et al., 2018). Consequently, component suppliers need to somehow enrich their offerings on product and service levels. The critical question is how? In this context, scholars widely discuss the possible benefits of digitalization (Yoo et al., 2012; Bharadwaj et al., 2013; Baines and Lightfoot, 2014), primarily to enrich non-digital components to foster new and valuable options to develop products and services (Bharadwaj et al., 2013; Hess et al., 2016; Wiesböck and Hess, 2020). However, digitalization may also be leveraged to enable entirely new value creation methods (Pagani, 2013; Pagani and Pardo, 2017). Thus, component suppliers may use digitalization to their advantage. The question remains how they can use digitalization to their advantage and what strategic options are emerging to achieve sustainable competitive advantages.

This research attempts to contribute to current research and managerial challenges by answering the RQ: "How can component suppliers in a multi-tier supply chain use digitalization to develop new positioning opportunities and enable sustainable competitive advantage?" This research focuses on relevant elements of component suppliers' strategic positioning options within a multi-tier supply chain in the light of digitalization. It incorporates different concepts (e.g., commoditization, modularity), finds key linkages, and focuses on a dedicated value chain stage to make a relevant research contribution. Specifically, the identified research gaps have revealed that past studies have dealt with the overarching opportunities of digitalization at the firm level

(e.g., innovation strategies and processes; Vial, 2019). There is a lack of frameworks that consider the specific situation (e.g., competitive environment) of different value creation stages, link the related concepts, and identify strategic development options. To address this challenge, this research develops a strategic framework for component suppliers, considering digitalization as an opportunity and deriving strategic options to enable competitive advantage.

In this research, five steps were applied to answer the RQ. A literature review—on innovation capabilities, modularity, commoditization, digitalization, and advanced services—was conducted in the first step. This helped determine the state of research on the relevant concepts and related domain knowledge, to illustrate the interrelationships of concepts, and to confirm the research gap (lack of a strategic framework for component suppliers). In the second step, critical enablers of digitalization were analyzed to explain how digital technologies can be used to support a new and direct flow of information to component suppliers. In the third step, the important assessment of the status quo was further enriched and aligned with experience gained from customer interviews, records, and expert discussions. Based on this upfront research phase, a strategic framework was developed in the fourth step, and significant development options for component suppliers were presented (see Figure 2). In the fifth step, the framework was applied to demonstrate managerial relevance using the rail industry as a sample exemplary case. This served as a first step to validating the usability of the derived framework.

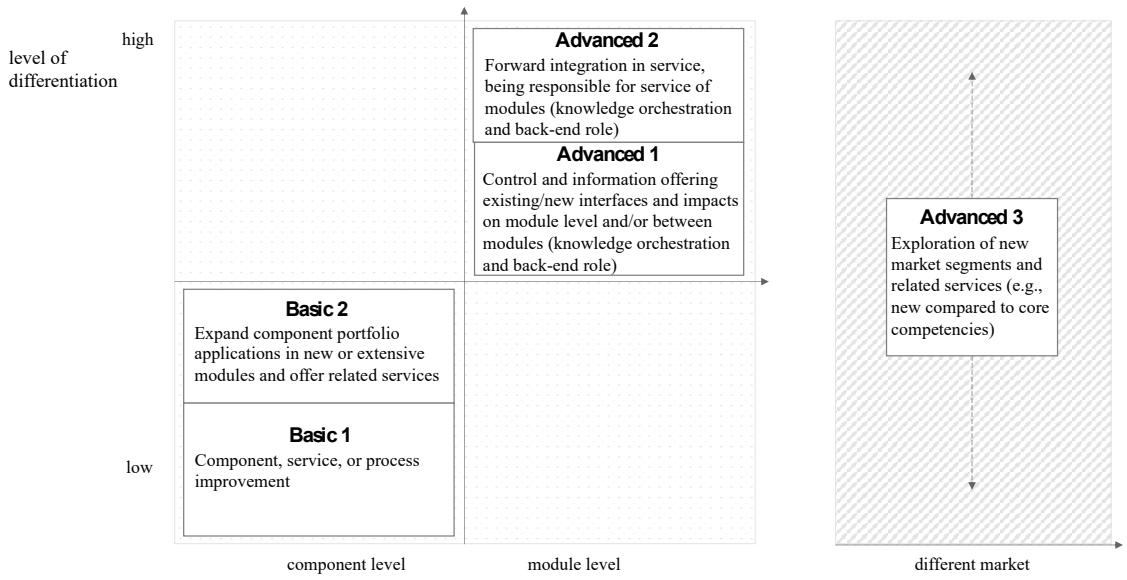


Figure 2: Strategic implications for component suppliers (Herbst, 2021)

In summary, this conceptual study presents a structure to leverage digitalization via a strategic framework on how component suppliers can escape the commodity battle, thus offering component suppliers important strategic opportunities. It is shown that the precarious situation of component suppliers is caused, among other things, by the lack of innovations driven by an information asymmetry within the multi-tier supply chain, as innovations can offer the opportunity for differentiation. Specifically, this study revealed that with the advent of digitalization, component suppliers could leverage their position, which was previously perceived as a downside (driven by commoditization and modularization). Enabled by digitalization, the framework offers strategic options classified into various development stages (component or module level) within its market or in a different market. It also demonstrates the various differentiation characteristics offered by each strategic option. In the various development stages, the aim is to use innovations (especially advanced services) to exploit this differentiation potential for positioning. Thus, component suppliers may target different stages in the value chain by leveraging an orchestration position. Last, component suppliers must increasingly assume responsibility for other components and modules in a network-like structure to be able to

deliver better end-customer value. They should focus on vertical and horizontal partnerships and especially information sharing to enable essential innovations.

Aligning with the research framework, this study's results facilitated a sound basis for a possible strategic repositioning with a new approach to generate value. Accordingly, structured planning of the subsequent research process could commence.

3.2 Contribution II—A Contingency Model of the Open Innovation-Innovation Performance Relationship: The Role of Entrepreneurial Orientation and IT Capability

To remain competitive in challenging market environments and achieve sustainable competitive advantage, firms need to open up their innovation process and benefit from external knowledge (Chesbrough, 2003b). In this context, scholars refer to OI (Chesbrough, 2003a) as a valuable opportunity to increase firms' (innovation) performance (Laursen and Salter, 2006; West and Bogers, 2014; Hosseini et al., 2017). However, OI's positive effect may also have limitations, suggesting a curvilinear effect on innovation performance (Laursen and Salter, 2006). Consequently, researchers have explored factors that might positively impact OI use, including capabilities, organizational design, and practices (West and Bogers, 2014; Saebi and Foss, 2015; Hosseini et al., 2017). A positive contingency factor may be firms' ability to combine their internal resources with IT-related resources (IT capability; Bharadwaj, 2000). Nevertheless, another critical contingency may be a firm's EO. EO represents methods, processes, and decision-making styles that determine entrepreneurial action. However, there is a lack of empirical research analyzing contingencies and their combined effect on OI and innovation performance.

This research aims to contribute to current research by answering the following RQ: "How does OI affect a firm's innovation performance, and what is the impact of IT

capabilities and EO?" The study focuses on inbound OI (i.e., external knowledge search) and distinguishes between search breadth and depth (Laursen and Salter, 2006). The following steps were taken for this purpose: First, a literature review was executed. This served to provide insight into the current state of research and identify research gaps. It also enabled the interrelationships and possible influences of the individual factors to be examined in greater detail. Second, based on this initial effort, the corresponding hypotheses were derived, and a structural model was created that was to be empirically tested (see Figure 3). Third, to avoid cherry-picking results and counter the file drawer effect, the research project was non-modifiable and pre-registered on the open science framework platform, OSF.io, with an automatic release embargo period of two years. Most importantly, this included the hypothesis, methodology section, and approach to the analysis. Fourth, the cross-sectional survey was developed and pre-tested with individuals who reflected the target group and experts from the research community with years of experience using LimeSurvey. Fifth, the (online) survey was conducted using experts selected from publicly traded German firms on social media platforms. Achieving 146 useable responses (response rate of 23%) may be considered sufficient (Sheehan, 2001) for our analysis. Last, the data was analyzed, and the derived hypothesis was checked.

In summation, the findings provided only partial evidence of the curvilinear (inverted u-shape) effect of external search strategy breadth and depth on innovation performance. This contrasts with prior research (e.g., Laursen and Salter, 2006; Cheng and Huizingh, 2014) and our hypotheses. This may be due to the study's focus on interactions between members of a single or multiple firms, thus, a different operationalization of external search strategy. Conversely, we have considerably fewer observations than Laursen and Salter (2006); 146 versus ~2700. Additionally, the study

provides no support for the hypothesis that IT capability positively affects external search strategy and innovation performance. Specifically, the results provide a negative impact.

Hence, the results suggest that the general business value of IT capability and investments could be questioned. This is contrary to most existing research, which shows the positive effect of IT investments and the establishment of IT capabilities (e.g., Bharadwaj, 2000; Chen et al., 2015). Over-sharing of knowledge with external stakeholders may risk knowledge spillover to an unreasonable level (Foss, Husted, and Michailova, 2010) and, thus, impede the ability to leverage the knowledge. Additionally, innovation may be hindered by groupthink and encouraged by enhanced knowledge exchange (Lu and Ramamurthy, 2011). Herein may lie an explanation for the negative, direct, and moderating impact of IT capability. In terms of EO, the results positively affect innovation performance and only positively moderate the effect of external knowledge search depth, which only partially aligns with our hypotheses. In this respect, EO may reinforce the over-search effect, and firms may no longer prioritize relevant innovations (Laursen and Salter, 2006). However, firms may also prioritize existing partnerships and, thus, not invest in the broader deployment of new partnerships (e.g., resources).

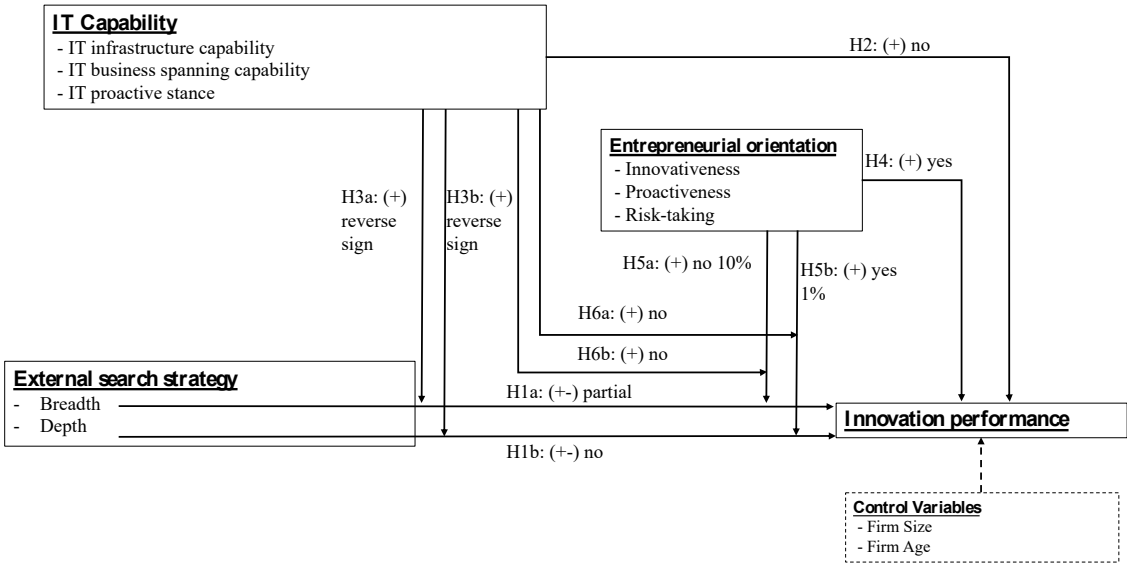


Figure 3: Initial hypothesis (in brackets) and overview of findings in the structural model

3.3 Contribution III—Linking the use of knowledge management systems and employee creative performance: The influence of creative process engagement and motivation

To successfully operate in the current highly competitive and dynamic environment (Gopalakrishnan and Damanpour, 1997; Smith, Collins, and Clark, 2005), firms need to leverage knowledge to foster innovation and, thus, enable sustainable competitive advantage (Schumpeter, 1934; Penrose, 1959; Hult, Hurley, and Knight, 2004; Jiménez-Jiménez and Sanz-Valle, 2011). Importantly, as knowledge is the first step towards innovation (Anderson, Potočnik, and Zhou, 2014), and creative output is performed on the individual (employee) level (Mumford, 2000), firms need to find proper ways to manage and leverage internal and external knowledge within and across their boundaries (KM; Spender, 1996). Through IT advancements, firms can implement KMSs to acquire, store, generate, apply, and share knowledge (Alavi and Leidner, 2001). However, it is essential not only to implement the KMSs per se, but also to link human resources, processes, and technology (Petter, DeLone, and McLean, 2008). Without an

effective linkage of success factors, over 70 percent of initiatives fail (Wu and Wang, 2006; Petter, DeLone, and McLean, 2008). In this respect, past research has focused on the firm level to analyze other effects, missing the employee level (Petter, DeLone, and McLean, 2008). Nevertheless, systems use defines success itself (Reiter-Palmon, Mumford, and Threlfall, 1998). In this context, scholars refer to motivation (Amabile, 1993; Amabile and Pratt, 2016) and employee engagement in creative processes (Zhang and Bartol, 2010; Cheng and Yang, 2019) as being critical to driving employee creativity. However, prior research underlines the importance of analyzing the process itself, leading to creative performance (Zhang and Bartol, 2010).

This study wanted to contribute to the current research and managerial challenges by answering the RQ, "How does the use of KMSs influence employees' creative performance, and what role do creative process engagement and employee motivation play?" To answer the RQ, the following steps were conducted: First, a literature review was conducted to gain insights into the current state of research and the research gaps and to reveal worthy research directions. Second, based on understanding the different factors and their interdependencies, the hypotheses were derived, and a structural model was developed (see Figure 4). Third, to overcome existing research pitfalls, such as cherry-picking results and the file drawer effect, the research project (e.g., procedure, hypotheses, analysis) was registered on an open science platform (OSF.io) in an unmodified form. Fourth, the survey was previously tested for comprehension and ease of implementation with researchers and individuals familiar with the research topics. The utilized platform for this (online) survey was LimeSurvey. Fifth, the survey was hosted on Amazon Mechanical Turk (MTurk). MTurk is a crowdsourcing website where businesses and individuals can hire "crowdworkers" remotely to perform discrete on-demand tasks. Previous research had already revealed that MTurk crowdsourcing yields

similar results to that of other online sources. Last, the 646 responses were analyzed, and the hypotheses were tested.

In summary, the findings confirmed the hypothesized direct effects but not the moderating effects. More specifically, the positive hypothesized impact of the use of KMSs on employee creative performance was confirmed. This implies that the increased use of KMSs leads to increased creative output from employees, which confirms the positive impact of KMSs (Elmorshidy, 2018). Concerning the effect of motivation, it was shown that intrinsic and extrinsic motivation positively impact creative employee performance. Notwithstanding, the two hypotheses that extrinsic and intrinsic motivation positively affect the impact of KMSs on creative employee performance were not confirmed. However, this might be because, in a work environment, employees (need to) perform the tasks regardless of their motivation. Thus, creative performance is primarily defined by using KMSs. Consequently, the use of KMSs is more likely to lead to better task performance in terms of quality and time (Aldholay et al., 2018). Concerning creative process engagement, the results provided a positive direct impact on employee creative performance, confirming prior research (Zhang and Bartol, 2010; Cheng and Yang, 2019). However, we found no support of our hypotheses of a positive moderating effect of employee creative process engagement affecting the impact of the use of KMSs on employee creative performance. This may be because KMS usage is mainly defined by employee satisfaction concerning the system and its potential benefits (Stefanovic et al., 2016; Al-Kofahi, Hassan, and Mohamad, 2020), not creative process engagement. Thus, employees may increase KMS usage driven by the idea of faster and increased task completion. The study provides no support for the hypothesis arguing the positive relationship between the combined effect of KMSs, employee creative process engagement, and intrinsic and extrinsic motivation on employee creative performance.

This may be explained due to the lack of AC. Missing the ability to recognize the value of knowledge and innovation potential (Cohen and Levinthal, 1990) may reduce employees' creative performance (Gong, Zhou, and Chang, 2013; Schweisfurth and Raasch, 2018).

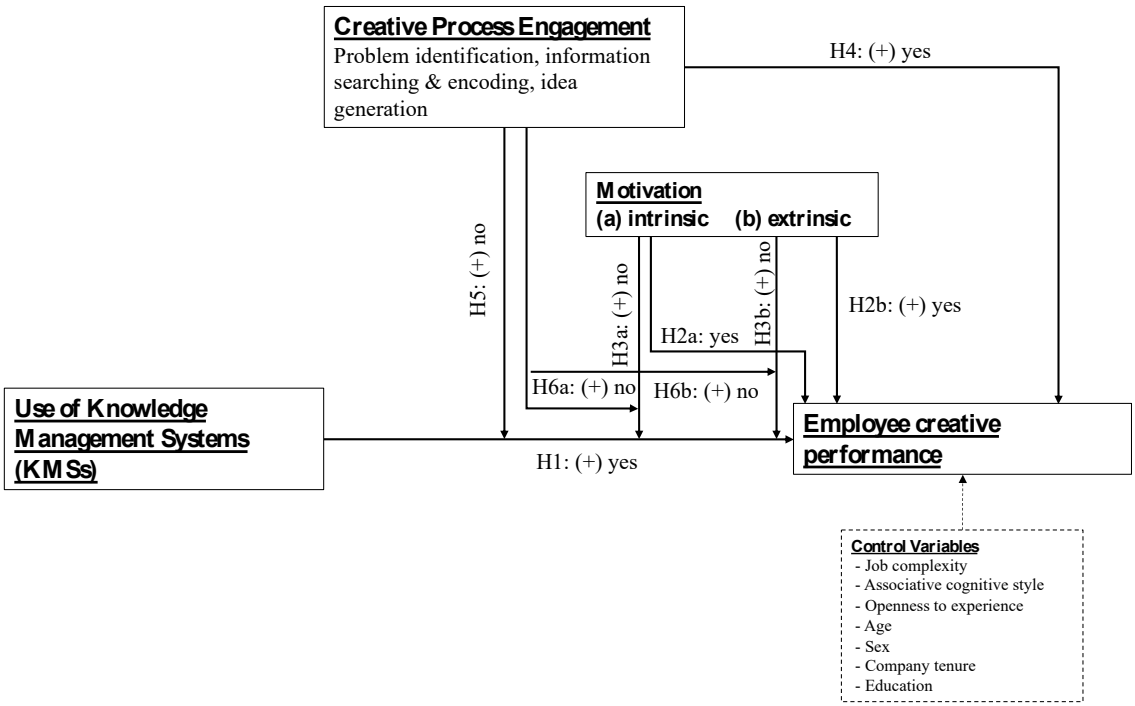


Figure 4: Initial hypotheses (in brackets) and overview of findings in the structural model

3.4 Contribution IV—Investigating knowledge management system usage and employee creative performance: The moderating role of absorptive capacity and motivation

Surviving and striving and strive in the current competitive and dynamic environment requires firms in many industry verticals to innovate. Prior studies devoted much attention to drivers fostering innovation outcomes and highlighted employee creativity as the first pivotal step. This is because employee creativity adds to success at the firm level and is defined as developing novel and beneficial ideas related to products, services, procedures, and practices (Amabile, 1988; Oldham and Cummings, 1996). Owing to this relevance, scholars revealed multiple contextual factors and personal

drivers enhancing employee creativity (Oldham and Cummings, 1996; Shalley, Zhou, and Oldham, 2004), highlighting knowledge as one of them (Weisberg, 1999; Mumford and Hunter, 2005; Collins and Smith, 2006). Thus, using IT as an enabler, firms increasingly apply KMSs to acquire, store, generate, apply, and share knowledge within and across their boundaries (Alavi and Leidner, 2001). The COVID-19 pandemic strongly reinforced this tendency, as employees were required to work from home, and firms had to successfully implement remote working (Lee et al., 2020), further linking employees and firms to enable knowledge exchange.

As approximately 70% of such initiatives, including information systems (IS), fail as a result of failing to link human resources, processes, and technology (Petter, DeLone, and McLean, 2008), it is of utmost importance to study the contingency factors of KMS usage. Surprisingly, however, given the current and future importance, this research field received scant research attention. Against these backdrops, the authors analyzed the effect of KMS usage on employee creative performance and further analyzed the direct and moderation effects of individual AC (i.e., identification, assimilation, and utilization of knowledge by employees; Enkel et al., 2016) and extrinsic and intrinsic motivation. Specifically, the authors wanted to contribute to the literature by answering the following RQ: “How does the use of KMSs influence employees' creative performance, and what role do individual AC and employee motivation play?”

The following steps were conducted to answer the RQ: In the first step, the authors conducted literature research using multiple databases and search mechanisms. Subsequently, the literature was screened and analyzed. Last, the authors derived the hypotheses. Prior to the questionnaire being disseminated, the authors conducted a pre-test to check for clarity, comprehension, and completion time with a test group comprising experienced researchers and professionals reflecting the target group (i.e.,

manager and specialists in the research field). In step number two, to empirically test our hypotheses, the authors used a survey design. The authors adopted MTurk to obtain a high feedback rate and thoroughly answered questionnaires. As a crowdsourcing platform, MTurk can be used for surveys and delivers reliable results if the given specifications are followed (Cheung et al., 2017). Overall, the authors received 569 questionnaires. After excluding those with substantial missing data, the authors also checked for plausibility in several ways, which led to a final sample size of 414 cases. Last, the completed questionnaires were analyzed, and the hypotheses tested.

In summation, the prior derived direct hypotheses were supported in that KMS usage, individual AC, and intrinsic and extrinsic motivation positively impact employee creative performance. While these views mostly support the results of prior studies (e.g., Kang and Lee, 2017; Khalifa et al., 2008; Liu et al., 2016), the authors shed light on the understanding of extrinsic motivation's effect on creative performance. While prior studies found mixed results (Shalley, Zhou, and Oldham, 2004), this study revealed that extrinsic motivation helps to develop novel and beneficial results. The moderating effects, however, were not supported, indicating that individual AC and intrinsic and extrinsic motivation do not increase the positive impact of KMS usage on employee creative performance. In addition to the given explanations in section 3.3. concerning intrinsic and extrinsic motivation, the non-supported moderating effect of individual AC maybe because increasing employees' creative performance depends on specific knowledge capabilities related to dedicated fields of expertise (Liao, Fei, and Chen, 2007) or fields of work (e.g., engineering work; Deng et al., 2008). Employee characteristics (e.g., ambition) may further help to increase employees' ability to identify potentially beneficial knowledge from internal or external sources (Enkel et al., 2016).

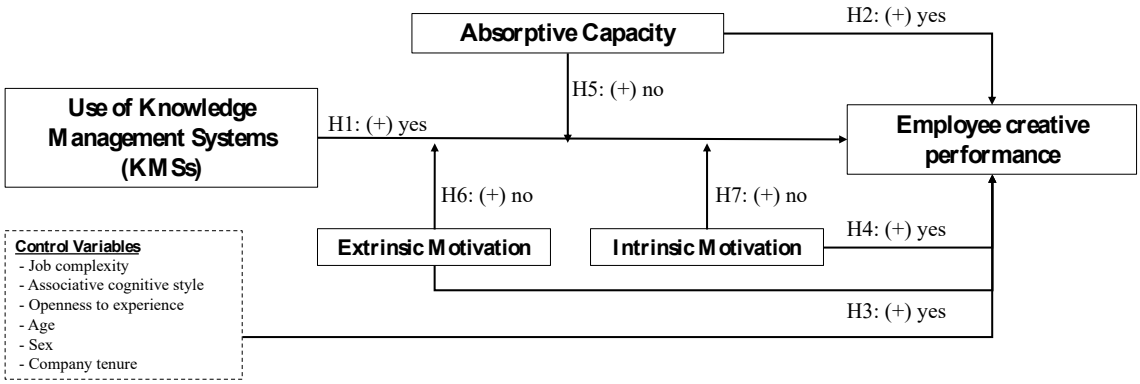


Figure 5: Initial hypotheses (in brackets) and overview of findings in the structural model

4 Discussion of the Results

Based on the applicative research in this dissertation with a particular focus on digitalization, multiple research gaps were identified, and theoretical and managerial implications were deduced. The overarching aim was to provide firms with a comprehensive development framework for digital transformation. This included the strategic component and, conversely, specific dimensions at the firm and employee level for the potential implementation of the strategic options. Specifically, we responded to the call to specify certain dimensions and elements of the digital transformation framework (Matt, Hess, and Benlian, 2015; Nwaiwu, 2018). In addition, the research contributions of this dissertation were able to demonstrate the relevance of Matt, Hess, and Benlian's (2015) digital transformation framework and, thus, its usability for understanding digitalization beyond the conceptual level. The individual research, managerial implications, limitations, and future research were summarized for each research project in the following section.

4.1 Theoretical Implications

Contribution I of this dissertation revealed that specific strategic frameworks for component suppliers regarding development potentials through digital technologies did

not exist. In this context, an essential part of this research project was to demonstrate that digital technologies enable new value-creation paths (Bharadwaj et al., 2013; Pagani and Pardo, 2017) beyond information and knowledge exchange (Bressanelli et al., 2018). This contributes to understanding the success of digital technologies, namely, aligning organizational and IS strategies (Bharadwaj et al., 2013). This contribution integrates multiple concepts, including commoditization, modularity, and servitization. Thus, it adds to competition literature by highlighting the potential benefits of being a commodity supplier in contrast to the current literature's opposing viewpoint (Gopposingn, 2004; Lager and Blanco, 2010). Rather, it shows a way to escape the commodity trap (Lager and Blanco, 2010) and pursue profitable servitization (Gebauer, Fleisch, and Friedli, 2005; Benedettini, Neely, and Swink, 2014).

Although prior studies have focused on firms' ability to innovate and create competitive advantage by leveraging digital technologies (e.g., Pagani, 2013), they presented overarching frameworks and focused on unilateral relationships, neglecting the impact of a position within a multi-tier supply chain. Thus, this study's novelty is the presentation of a multilateral approach, encompassing a multi-tier perspective on innovations. It is also the first study in the management literature to explicitly elaborate on the strategic implications of digital technologies for component suppliers in a multi-tier supply chain. Hence, it addresses the manifold calls to develop frameworks joining organizational behavior, strategy research, and digital innovation (Sosa, Eppinger, and Rowles, 2003; Zirpoli and Becker, 2011; Martín-de Castro et al., 2013; Un and Asakawa, 2015; Loebbecke, van Fenema, and Powell, 2016; Razmerita, Kirchner, and Nielsen, 2016; Cenamor, Rönnberg Sjödin, and Parida, 2017; Bressanelli et al., 2018; Le and Lei, 2018).

Contribution II, thus, adds to current research on OI by testing a construct elaborating on the possible effects of IT capability and EO on OI's impact on innovation performance. In this context, analyzing the impact of EO in the given research construct adds to the current research on firm-level contingencies affecting OI's impact on innovation performance. Additionally, having used IT capability as a contingency contributes to the current research on IS and its impact on firm performance (Bharadwaj et al., 2013; Cheng and Huizingh, 2014). However, this contribution offers a distinct view on IT capability (Chen et al., 2015; Nwankpa and Roumani, 2016; Zhang, Zhao, and Kumar, 2016), adding to the limited available literature suggesting the potential adverse effects of IT capability (Lu and Ramamurthy, 2011; Tallon and Pinsonneault, 2011; Queiroz et al., 2018).

Contribution III extends the scope of the Motivation–Opportunity–Ability framework by empirically testing and confirming KMS usage, employee creative process engagement, and the impact of intrinsic and extrinsic motivation on creative performance on an individual- rather than firm-level. Confirming the positive impact of KMS usage on creative employee performance adds to the current research elaborating on the positive impact of IS (Nguyen, Nguyen, and Cao, 2015; Aldholay et al., 2018) and especially KMSs (Elmorshidy, 2018). The simultaneous empirical examination of intrinsic and extrinsic motivation contributes to the established research on motivation (Shalley, Zhou, and Oldham, 2004). The focus on employees' creative performance also allowed the study to empirically confirm the benefits of intrinsic motivation (Cerasoli, Nicklin, and Ford, 2014; Liu et al., 2016) and demonstrate extrinsic motivation in more complex tasks. The benefits of extrinsic motivation in more complex tasks are ambiguous and lack evidence in the existing literature. Last, this contribution adds to the processual understanding of

creativity by empirically proving the positive impact of employees' creative process engagement on creative performance (Zhang and Bartol, 2010).

Finally, contribution IV supports the positive view of IS in various fields (e.g., Nguyen et al., 2015). It specifically adds to the scarce literature on KMS usage at the individual level (Khalifa, Yan, and Ning, 2008), highlighting the positive effect of KMS usage on creative performance. By investigating intrinsic and extrinsic motivation, the study sheds additional light on the understanding of extrinsic motivation, as the positive impact of extrinsic motivation is an ongoing subject of debate (Shalley, Zhou, and Oldham, 2004), especially with increasing task complexity (e.g., Kuvaas et al., 2016; Montag et al., 2012). In this way, the authors responded to the call of Cerasoli et al. (2014) to further investigate the impact of extrinsic motivation. The authors also added to the limited literature on AC at the individual level (Deng et al., 2008; Enkel et al., 2016; Minbaeva et al., 2007) by empirically investigating and revealing its positive effect on creative employee performance. Lastly, the study contributes to the understanding of which technologies may help to foster remote collaboration (Baker, Avery, and Crawford, 2006; Wang et al., 2021).

4.2 Managerial Implications

Based on the research in contribution I, a strategic framework that includes multiple strategic options was derived. This strategic framework offers component supplier managers a strategic roadmap focusing on transforming the value-creation and capture processes (Pagani, 2013; Vial, 2019), (re-) gaining competitive advantage by leveraging digital technologies. Offering multiple strategic options, which are also distinguished by the risk (e.g., monetary investment, module risk assumption) each firm needs to take, this framework offers strategic flexibility for a firm's development. From leveraging digital technologies to reduce information asymmetry (e.g., for new product

development) to leveraging newly gained information to develop into different markets. However, the use of the framework is not without risk. Among others, firms must be able to position themselves appropriately within the multi-tier supply chain. For this purpose, in most instances, various capabilities on the firm level (e.g., IT capabilities) and employee level (e.g., knowledge development) need to be enhanced to enable customer added value. Specifically, the individual resistance to digital technologies may be a problem not to be overlooked (Wiesböck and Hess, 2020).

Contribution II provided multiple implications, particularly for innovation and IT managers. On the one hand, opening the innovation process enables improved innovation performance. On the other hand, however, increased investment in IT capabilities does not strengthen this relationship at the same rate. Accordingly, innovation and IT decision-makers must analyze more closely when IT investments are useful. More does not equal better. The same is true for EO, which does not necessarily lead to improved innovation performance. In both cases, it can be concluded from the contribution that a step-by-step approach to IT capabilities and EO should be followed in conjunction with OI. This allows a continuous alignment of investments, organizational alignment, and added value and may avoid over-investment.

Contribution III demonstrates the relevance of KMSs concerning employee creativity. Primarily, the use of KMSs drives employee creative performance and not the studied contingencies (i.e., motivation and creative process engagement). Thus, a manager needs to focus on the great experiences and benefits of KMSs (e.g., quality of the system, useability, employees' added value) to motivate everyone to use the KMSs when creative tasks are performed. Further, managers should prioritize KMSs and use monetary resources to establish and increasingly expand KMSs.

Last, contribution IV supports managers with the important understanding that KMSs and their usage are key to creative employee performance. Hence, decision-makers may foster the attractiveness and usability of such systems. Last, managers may foster KMS initiatives and consider KMS as a valuable contribution to innovation at the firm level.

4.3 Limitations and Future Research

Various limitations in the different contributions must be considered. One person undertook the literature review and, thus, the selection of the literature for all four contributions. Even though a keyword search, forward search, and backward search were utilized for this purpose, bias in selecting and evaluating the sources could be present. In contributions III and IV, the online survey approach was deployed. Even though various preventative remedies to avoid common method variance (CMV; Spector et al., 2019) were taken ex-ante, not all measures could be followed due to the research projects' structure. For example, the surveys were conducted once and at a fixed time. Researchers suggest that CMV can be avoided by conducting the same survey with the same individuals at different times or using multiple survey approaches (Podsakoff, MacKenzie, and Podsakoff, 2012). Further, post-hoc techniques (e.g., Harman's single factor test; Harman, 1967) were applied to demonstrate the effectiveness of the ex-ante measures.

In contribution I, the strategic framework was not empirically tested and focused on specific industry settings. Therefore, its empirical relevance and generalizability need to be evaluated in future studies. Additionally, only selected digital technologies were included in the considerations; other advanced technologies (e.g., additive manufacturing) may have different impacts or offer other strategic options. Ultimately, not only the positive aspects of the framework should be considered, but also the risks.

The different strategic options could lead to different risks, which should be considered in future studies. Hence, future research may elaborate on the comparison of opportunities and risks and the long-term effects of pursuing the outlined strategic options within the framework.

Contribution II's regional focus limits the research. Future research may test the developed construct in various countries. The abridged version of Laursen and Salter's (2006) measure of external search openness requires further empirical testing and comparison with the established items (including increased sample sizes). Importantly, future research needs to be established to evaluate the circumstances in which firms may benefit from IT capability investment.

Contribution III related to data retrieved from an online survey using MTurk. On the one hand, users are mainly from North America and India (Cheung et al., 2017). Thus, it may be worth testing the construct in other regions, as technology usage varies among cultures (Oliveira and Martins, 2012). On the other hand, even though scholars refer to the possible benefits of using MTurk for research purposes (Smith et al., 2016; Kees et al., 2017), there might be a critical point in using the platform. Users are paid after the completion of the survey, and there is a possibility that users depend on additional income. Thus, it may be that the participants do not consider the task itself but target many finished projects. Even though various measures were applied ex-ante in the study to discard these cases from the analysis, it is not beyond the possibility that this may negatively impact the validity of the results. Last, self-rated items were used in the survey, which allows participants to rate their creative performance or motivation levels. It would be fruitful to conduct the given construct with employee-supervisor pairs. This could show potential deviations in the evaluations and employees' own perceptions.

Finally, contribution IV was performed during the COVID-19 pandemic. Prior studies highlighted multiple factors influencing employees' perceived (creative) performance, for instance, workplace changes or lack of privacy (Van Der Voordt, 2004). Accordingly, the study could be reproduced in a more settled economic environment or involve employees' work environment (e.g., home office status or hybrid working), leading to different results. Given that MTurk users are mainly from North America and India (Cheung et al., 2017), it may be fruitful to implement varying operationalizations as technology usage differs between countries (Oliveira and Martins, 2012).

5 Conclusion

This dissertation explores the impact of digitalization and the related business opportunities (e.g., strategic options, enhancing innovation performance) at the firm and employee level. It highlights how firms leverage digitalization at a strategy and organizational dimension. Thereby, it sheds light on four critical dimensions of digital transformation (Matt, Hess, and Benlian, 2015) and on future research opportunities. In part A of this dissertation, multiple steps were realized directed by the presented framework in section 2.4. To analyze the GQ and RQs, a mixed-methods approach was employed, i.e., qualitative, quantitative, and a combination of both methods (see section 2.3).

In contribution I, a strategic framework was developed using digitalization as an enabler to develop new positioning opportunities for component suppliers in a multi-tier supply chain and enable sustainable competitive advantage (RQ1). Contribution II drew on key elements from the first contribution and demonstrated how digital technologies could be leveraged at the firm level to enable strategic options. Expressly, it confirmed OI's positive impact on innovation performance, demonstrated the positive direct effect of EO on innovation performance, and revealed the possible negative direct and

moderating effect of IT capability on innovation performance (RQ2). In contribution III, initial evidence of the positive impact of digital technologies at the employee level was shown. Among other results, the positive impact of the use of KMSs, creative process engagement, and intrinsic and extrinsic motivation on creative employee performance was highlighted (RQ3). Last, in contribution IV, the positive direct impact of KMS usage, individual AC, and intrinsic and extrinsic motivation on employee creative performance was revealed (RQ4). All contributions have been published or submitted and accepted in reputable journals and will be presented at relevant professional conferences.

In summary, this dissertation, and specifically the included contributions, highlight digitalization's potential impact on the firm and employee level. However, it also explores the relevant changes firms need to address in pursuing new value creation strategies and in implementing and using digital technologies effectively on multiple levels. In this context, the dissertation adds to the body of literature concerning digitalization at a theoretical and managerial level. Four essential dimensions of digital transformation were considered: the use of technologies, changes in value creation, structural changes, and financial aspects (Matt, Hess, and Benlian, 2015). The wide variety of frameworks with different dimensions illustrate the research field's complexity (Nwaiwu, 2018). Likewise, the conceptual frameworks need to be empirically tested in the future to further explore the relevant dimensions. Therefore, this dissertation does not claim to offer a processual description of firms' digital transformation in its entirety. However, regarding managerial implications, its contributions serve to provide firms with a way to efficiently implement digital transformation's relevant dimensions by considering strategic, organizational, and employee perspectives. In terms of theoretical implications, it provides further empirical insights on digitalization and the relevant dimensions of digital transformation.

References

Adner, R., and R. Kapoor. 2010. Value Creation in Innovation Ecosystems: How the Structure of Technological Interdependence Affects Firm Perfomance in New Technology Generations. *Strategic management journal* 31(3): 306–33.

Al-Kofahi, M. K., H. Hassan, and R. Mohamad. 2020. Information systems success model: A review of literature. *International Journal of Innovation, Creativity and Change* 12(10): 104–28.

Alavi, M., and D. E. Leidner. 2001. Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *MIS Quarterly* 25(1): 107–36.

Aldholay, A. H., O. Isaac, Z. Abdullah, and T. Ramayah. 2018. The role of transformational leadership as a mediating variable in DeLone and McLean information system success model: The context of online learning usage in Yemen. *Telematics and Informatics* 35(5): 1421–37.

Amabile, T. M. 1988. A Model of Creativity and Innovation in Organizations. *Research in Organizational Behavior* 10: 123–67.

Amabile, T. M. 1993. Motivational synergy: Toward new conceptualizations of intrinsic and extrinsic motivation in the workplace. *Human Resource Management Review* 3(3): 185–201.

Amabile, T. M., and M. G. Pratt. 2016. The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior* 36: 157–83.

Amit, R., and P. J. H. Schoemaker. 1993. Strategic assets and organizational rent. *Strategic Management Journal* 14(1): 33–46.

Anderson, N., K. Potočnik, and J. Zhou. 2014. Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. *Journal of Management* 40(5): 1297–333.

Aspara, J., J. A. Lamberg, A. Laukia, and H. Tikkanen. 2013. Corporate business model transformation and inter-organizational cognition: The case of nokia. *Long Range Planning* 46(6): 459–74.

Baines, T. S., and H. W. Lightfoot. 2014. Servitization of the manufacturing firm: Exploring the operations practices and technologies that deliver advanced services. *International Journal of Operations & Production Management* 34(1): 2–35.

Baker, E., G. C. Avery, and J. Crawford. 2006. Home Alone: The Role of Technology in Telecommuting. *Information Resources Management Journal* 19(4): 1–22.

Barney, J. 1991. Firm Reources ad Sustained Competitive Advantege. *Journal of Management* 17(1): 99–120.

Benedettini, O., A. Neely, and M. Swink. 2014. Why do servitized firms fail? A risk-based explanation. *International Journal of Operations & Production Management* 35(6): 946–79.

Bernard, H. R. 2017. *Research methods in anthropology: Qualitative and quantitative*

approaches. Rowman & Littlefield.

Bharadwaj, A., O. A. El Sawy, P. A. Pavlou, and N. Venkatraman. 2013. Digital business strategy: Toward a next generation of insights. *MIS Quarterly* 37(2): 471–82.

Bharadwaj, A. S. 2000. A resource-based perspective on information technology capability and firm. *MIS Quarterly* 24(1): 169–96.

Bressanelli, G., F. Adrodegari, M. Perona, and N. Saccani. 2018. Exploring how usage-focused business models enable circular economy through digital technologies. *Sustainability* 10(3): 1–21.

Cabigiosu, A., F. Zirpoli, and A. Camuffo. 2012. Modularity, interfaces definition and the integration of external sources of innovation in the automotive industry. *Research Policy* 42(3): 662–75.

Cao, Q., M. A. Thompson, and J. Triche. 2013. Investigating the role of business processes and knowledge management systems on performance: A multi-case study approach. *International Journal of Production Research* 51(18): 5565–75.

Cenamor, J., D. Rönnberg Sjödin, and V. Parida. 2017. Adopting a platform approach in servitization: Leveraging the value of digitalization. *International Journal of Production Economics* 192: 54–65.

Cerasoli, C. P., J. M. Nicklin, and M. T. Ford. 2014. Intrinsic motivation and extrinsic incentives jointly predict performance: A 40-year meta-analysis. *Psychological Bulletin* 140(4): 980–1008.

Chen, Y., Y. Wang, S. Nevo, J. Benitez-Amado, and G. Kou. 2015. IT capabilities and product innovation performance: The roles of corporate entrepreneurship and competitive intensity. *Information and Management* 52(6): 643–57.

Cheng, C., and M. Yang. 2019. Creative process engagement and new product performance: The role of new product development speed and leadership encouragement of creativity. *Journal of Business Research* 99: 215–25.

Cheng, C. C. J., and E. K. R. E. Huizingh. 2014. When is open innovation beneficial? The role of strategic orientation. *Journal of Product Innovation Management* 31(6): 1235–53.

Chesbrough, H. 2003a. *Open Innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.

Chesbrough, H. 2003b. The logic of open innovation: Managing intellectual property. *California Management Review* 45(3): 33–58.

Chesbrough, H., Vanhaverbeke, W., and J. West. 2006. *Open innovation: Researching a new paradigm*. Oxford University Press on Demand.

Cheung, J. H., D. K. Burns, R. R. Sinclair, and M. Sliter. 2017. Amazon Mechanical Turk in Organizational Psychology: An Evaluation and Practical Recommendations. *Journal of Business and Psychology* 32(4): 347–61.

Christensen, C. M., and M. Overdorf. 2000. Meeting the Challenge of Disruptive Change. *Harvard Business Review* 78(2): 66–76.

Cohen, W. M., and D. A. Levinthal. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly* 35(1): 128–52.

Collins, C. J., and K. G. Smith. 2006. Knowledge exchange and combination: The role of human resource practices in the performance of high-technology firms. *Academy of Management Journal* 49(3): 544–60.

Conner, K. R., and C. K. Prahalad. 1996. A Resource-Based Theory of the Firm: Knowledge versus Opportunism. *Organization Science* 77(5): 477–501.

Creswell, J. W. 2003. *Research design: Qualitative, quantitative, and mixed methods approaches*. 2nd ed. Sage.

Deloitte and Fortune. 2020. Fortune&Deloitte CEO Survey October 2020. https://www2.deloitte.com/us/en/pages/chief-executive-officer/articles/ceo-survey-gauging-priorities.html. Accessed 28 August 2021.

DeLone, W. H., and E. R. McLean. 1992. Information systems success: the quest for the dependent variable. *Information Systems Research* 3(1): 60–95.

Deng, X., W. J. Doll, and M. Cao. 2008. Exploring the absorptive capacity to innovation / productivity link for individual engineers engaged in IT enabled work. *Innovation & Management* 45(2): 75–87.

Denscombe, M. 2008. Communities of practice. *Journal of Mixed Methods Research* 2(3): 270–83.

Díaz-Díaz, N. L., I. Aguiar-Díaz, and P. De Saá-Pérez. 2008. The effect of technological knowledge assets on performance: The innovative choice in Spanish firms. *Research Policy* 37(9): 1515–29.

Eisenhardt, K. M. 1989. Building Theories from Case Study Research. *The Academy of Management Review* 14(4): 532–50.

Elmorshidy, A. 2018. The impact of knowledge management systems on innovation: An empirical investigation in Kuwait. *VINE Journal of Information and Knowledge Management Systems* 48(3): 388–403.

Enkel, E., S. Heil, M. Hengstler, and H. Wirth. 2017. Exploratory and exploitative innovation: To what extent do the dimensions of individual level absorptive capacity contribute? *Technovation* 60: 29–38.

Fitzgerald, S., D.-Z. Jimenez, S. Findling, Y. Yorifuji, M. Kumar, L. Wu, G. Carosella, S. Ng, R. Parker, P. Carter, and M. Whalen. 2021. Worldwide Digital Transformation 2021 Predictions. *International Data Corporation*. https://www.idc.com/getdoc.jsp?containerId=prUS46967420. Accessed 28 August 2021.

Floyd, K., P. M. Pauley, and C. Hesse. 2010. State and trait affectionate communication buffer adults' stress reactions. *Communication Monographs* 77(4): 618–36.

Foss, N. J., K. Husted, and S. Michailova. 2010. Governing knowledge sharing in organizations: Levels of analysis, governance mechanisms, and research directions. *Journal of Management Studies* 47(3): 455–82.

Foster, E. D., and A. Deardorff. 2017. Open science framework (OSF). *Journal of the Medical Library Association* 105(2): 203–6.

Franco, A., N. Malhotra, and G. Simonovits. 2014. Publication bias in the social sciences: Unlocking the file drawer. *Science* 345(6203): 1502–5.

Gann, D. M., and A. J. Salter. 2000. Innovation in project-based, service-enhanced firms: the construction of complex products and systems. *Research Policy*

29(2000): 955–72.

Gardner, H. K., F. Gino, and B. R. Staats. 2012. Dynamically integrating knowledge in teams: Transforming resources into performance. *Academy of Management Journal* 55(4): 998–1022.

Gassmann, O., and M. M. Keupp. 2007. The competitive advantage of early and rapidly internationalising SMEs in the biotechnology industry: A knowledge-based view. *Journal of World Business* 42(3): 350–66.

Gebauer, H., E. Fleisch, and T. Friedli. 2005. Overcoming the service paradox in manufacturing companies. *European Management Journal* 23(1): 14–26.

Gobble, M. A. M. 2018. Digitalization, Digitization, and Innovation. *Research Technology Management* 61(4): 56–9.

Gomes, G., and R. M. Wojahn. 2017. Organizational learning capability, innovation and performance: study in small and medium-sized enterprises (SMES). *Revista de Administração (São Paulo)* 52: 163–75.

Gong, Y., J. Zhou, and S. Chang. 2013. Core Knowledge Employee Creativity and Firm Performance: The Moderating Role of Riskiness Orientation, Firm Size, and Realized Absorptive Capacity. *Personnel Psychology* 66(2): 443–82.

Gopalakrishnan, S., and F. Damanpour. 1997. A review of innovation research in economics, sociology and technology management. *Omega* 25(1): 15–28.

Gordon, V., and D. Martin. 2019. The 21st-Century CEO: Intrinsic attributes, worldview, and communication capabilities. *Journal of Leadership & Organizational Studies* 26(2): 141–9.

Grant, R. M. 1996. Toward a knowledge-based theory of the firm. *Strategic Management Journal* 17(S2): 109–22.

Greenstein, S. 2004. The paradox of commodities. *IEEE Micro* 24(2): 73–5.

Grover, V., and R. Kohli. 2013. Revealing Your Hand: Caveats in Implementing Digital Business Strategy. *MIS Quarterly* 37(2): 655–62.

Groves, R. M., F. J. Fowler, M. P. Couper, J. M. Lepkowski, E. Singer, and R. Tourangeau. 2011. *Survey mehodology* (Vol. 561). John Wiley & Sons.

Harman, H. H. 1967. Modern Factor Analysis. 2nd ed. *University of Chicago Press*.

Herbst, T. D. 2021. Component suppliers in the commodity battle: Can digital technology in multi-tier supply chains help to transform liabilities into opportunities ? *International Journal of Business Science and Applied Management* 16(2): 22-45.

Hess, T., A. Benlian, C. Matt, and F. Wiesböck. 2016. Options for formulating a digital transformation strategy. *MIS Quarterly Executive* 15(2): 123–39.

Hirt, M., and P. Willmott. 2014. Strategic principles for competing in the digital age. http://www.inseit.nl/ziw/wp-content/uploads/2014/ 12/20143012-McK-Strategic-principles-for-competing-in-the- digital-age.pdf. Accessed 20 August 2021.

Hosseini, S., A. Kees, J. Manderscheid, M. Röglinger, and M. Rosemann. 2017. What does it take to implement open innovation? Towards an integrated capability framework. *Business Process Management Journal* 23(1): 87–107.

Hughes, M. 2011. Do 70 Per Cent of All Organizational Change Initiatives Really Fail?

Journal of Change Management 11(4): 451–64.

Hughes, M., and R. E. Morgan. 2007. Deconstructing the relationship between entrepreneurial orientation and business performance at the embryonic stage of firm growth. *Industrial Marketing Management* 36(5): 651–61.

Hult, G. T. M., R. F. Hurley, and G. A. Knight. 2004. Innovativeness: Its antecedents and impact on business performance. *Industrial Marketing Management* 33(5): 429–38.

Ireland, R. D., and J. W. Webb. 2007. Strategic entrepreneurship: Creating competitive advantage through streams of innovation. *Business horizons* 50(1): 49–59.

Jiménez-Jiménez, D., and R. Sanz-Valle. 2011. Innovation, organizational learning, and performance. *Journal of Business Research* 64(4): 408–17.

Kang, M., and M. J. Lee. 2017. Absorptive capacity, knowledge sharing, and innovative behaviour of R&D employees. *Technology Analysis and Strategic Management* 29(2): 219–32.

Kearns, G. S., and A. L. Lederer. 2004. The impact of industry contextual factors on IT focus and the use of IT for competitive advantage. *Information and Management* 41(7): 899–919.

Keen, P., and R. Williams. 2013. Value Architectures for Digital Business: Beyond the Business Model. *Journal of Chemical Information and Modeling* 37(2): 643–7.

Kees, J., C. Berry, S. Burton, and K. Sheehan. 2017. An Analysis of Data Quality: Professional Panels, Student Subject Pools, and Amazon's Mechanical Turk. *Journal of Advertising* 46(1): 141–55.

Khalifa, M., A. Y. Yan, and K. S. Ning. 2008. Knowledge management systems success: A contingency perspective. *Journal of Knowledge Management* 12(1): 119–32.

Kogut, B., and U. Zander. 1992. Knowledge of the firm, Combinative capabilities, and the replication of technology. *Organization Science* 3(3): 383–97.

Kothari, C. R. 2008. *Research Methodology Methods and Techniques*. New Age International.

Kowalkowski, C., and P. O. Brehmer. 2008. Technology as a driver for changing customer-provider interfaces: Evidence from industrial service production. *Management Research News* 31(10): 746–57.

Kuvaas, B., R. Buch, M. Gagné, A. Dysvik, and J. Forest. 2016. Do you get what you pay for? Sales incentives and implications for motivation and changes in turnover intention and work effort. *Motivation and Emotion* 40(5): 667–80.

Lager, T., and S. Blanco. 2010. The Commodity Battle: A product-market perspective on innovation resource allocation in the Process Industries. *International Journal of Technology Intelligence and Planning* 6(2): 128–50.

Laursen, K., and A. Salter. 2006. Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal* 27(2): 131–50.

Le, P. B., and H. Lei. 2018. The effects of innovation speed and quality on differentiation and low-cost competitive advantage: The case of Chinese firms. *Chinese Management Studies* 12(2): 305–22.

Lee, Y., W. Tao, J. Y. Q. Li, and R. Sun. 2020. Enhancing employees' knowledge sharing through diversity-oriented leadership and strategic internal communication during the COVID-19 outbreak. *Journal of Knowledge Management*.

Liao, S. H., W. C. Fei, and C. C. Chen. 2007. Knowledge sharing, absorptive capacity, and innovation capability: An empirical study of Taiwan's knowledge-intensive industries. *Journal of Information Science* 33(3): 340–59.

Liu, D., K. Jiang, C. E. Shalley, S. Keem, and J. Zhou. 2016. Motivational mechanisms of employee creativity: A meta-analytic examination and theoretical extension of the creativity literature. *Organizational Behavior and Human Decision Processes* 137: 236–63.

Loebbecke, C., and A. Picot. 2015. Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *Journal of Strategic Information Systems* 24(3): 149–57.

Loebbecke, C., P. C. van Fenema, and P. Powell. 2016. Managing inter-organizational knowledge sharing. *Journal of Strategic Information Systems* 25(1): 4–14.

Lu, Y., and K. Ramamurthy. 2011. Understanding the link between information technology capability and organizational agility: An empirical examination. *Management Information Systems Research Center* 35(4): 931–54.

Lumpkin, G. T., and G. G. Dess. 1996. Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review* 21(1): 135–72.

Madjar, N., G. R. Oldham, and M. G. Pratt. 2002. There's no place like home? The contributions of work and nonwork creativity support to employees' creative performance. *Academy of Management Journal* 45(4): 757–67.

Martín-de Castro, G., M. Delgado-Verde, J. E. Navas-López, and J. Cruz-González. 2013. The moderating role of innovation culture in the relationship between knowledge assets and product innovation. *Technological Forecasting and Social Change* 80(2): 351–63.

Matsuno, K., J. T. Mentzer, and A. Özsomer. 2002. The effects of entrepreneurial orientation and market orientation on business performance. *Journal of Marketing* 66: 18–32.

Matt, C., T. Hess, and A. Benlian. 2015. Digital Transformation Strategies. *Business and Information Systems Engineering* 57(5): 339–43.

McMeekin, N., O. Wu, E. Germeni, and A. Briggs. 2020. How methodological frameworks are being developed: Evidence from a scoping review. *BMC Medical Research Methodology* 20(1): 1–9.

Melville, N., K. Kraemer, and V. Gurbaxani. 2004. Review: Information Technology and Organizational Performance: An Integrative Model of IT Business Value. *MIS Quarterly* 28(2): 283–322.

Minbaeva, D. B., K. Makela, and L. Rabbiosi. 2007. Individual Absorptive Capacity and Knowledge Transfer. *unpublished paper, Copenhagen Business School.*: 1–39.

Montag, T., C. P. Maertz, and M. Baer. 2012. A Critical Analysis of the Workplace Creativity Criterion Space. *Journal of Management* 38(4): 1362–86.

Mumford, M. D. 2000. Managing Creative People: Strategies and Tactics for

Innovation. *Human Resource Management Review* 10(3): 313–51.

Mumford, M. D., and S. T. Hunter. 2005. Innovation in Organizations: A Multi-Level Perspective on Creativity. In *Multi-level issues in strategy and methods* Emerald Group Publishing Limited.

Nguyen, T. D., T. M. Nguyen, and T. H. Cao. 2015. Information Systems Success: A Literature Review. In *International Conference on Future Data and Security Engineering:* 242–56. Springer, Cham.

Nwaiwu, F. 2018. Review and Comparison of Conceptual Frameworks on Digital Business Transformation. *Journal of Competitiveness* 10(3): 86–100.

Nwankpa, J. K., and Y. Roumani. 2016. IT capability and digital transformation: A firm performance perspective. *2016 International Conference on Information Systems, ICIS 2016*: 1–16.

Nylén, D., and J. Holmström. 2015. Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation. *Business Horizons* 58(1): 57–67.

Oldham, G. R., and A. Cummings. 1996. Employee creativity: Personal and contextual factors at work. *Academy of Management Journal* 39(3): 607–34.

Oliveira, T., and M. Martins. 2012. Literature Review of Information Technology Adoption Models at Firm Level. *Australasian Journal of Construction Economics and Building* 14(1): 110–21.

Pagani, M. 2013. Management Information Systems Research Center, University of Minnesota. *MIS Quarterly* 37(2): 617.

Pagani, M., and C. Pardo. 2017. The impact of digital technology on relationships in a business network. *Industrial Marketing Management* 67: 185–92.

Parida, V., D. Sjödin, and W. Reim. 2019. Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. *Sustainability* 11(2): 1-1.

Penrose, E. 1959. *The Theory of the Growth of the Firm*. Oxford University Press.

Petter, S., W. DeLone, and E. McLean. 2008. Measuring information systems success: Models, dimensions, measures, and interrelationships. *European Journal of Information Systems* 17(3): 236–63.

Podsakoff, P. M., S. B. MacKenzie, and N. P. Podsakoff. 2012. Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology* 63: 539–69.

Poston, R. S., and C. Speier. 2005. Effective use of knowledge management systems: A process model of content ratings and credibility indicators. *MIS Quarterly: Management Information Systems* 29(2): 221–44.

Queiroz, M., P. P. Tallon, R. Sharma, and T. Coltman. 2018. The role of IT application orchestration capability in improving agility and performance. *Journal of Strategic Information Systems* 27(1): 4–21.

Rauch, A., J. Wiklund, G. T. Lumpkin, and M. Frese. 2009. Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future. *Entrepreneurship: Theory and Practice* 33(3): 761–87.

Razmerita, L., K. Kirchner, and P. Nielsen. 2016. What factors influence knowledge sharing in organizations? A social dilemma perspective of social media communication. *Journal of Knowledge Management* 20(6): 1225–46.

Reimann, M., O. Schilke, and J. S. Thomas. 2010. Toward an understanding of industry commoditization: Its nature and role in evolving marketing competition. *International Journal of Research in Marketing* 27(2): 188–97.

Reiter-Palmon, R., M. D. Mumford, and K. V. Threlfall. 1998. Solving Everyday Problems Creatively: The Role of Problem Construction and Personality Type. *Creativity Research Journal* 11(3): 187–97.

Rosenthal, R. 1979. The file drawer problem and tolerance for null results. *Psychological Bulletin* 86(3): 638–41.

Ross, J. W., I. M. Sebastian, C. Beath, M. Mocker, K. G. Moloney, and N. O. Fonstad. 2016. Designing and executing digital strategies. *2016 International Conference on Information Systems, ICIS 2016*: 1–17.

Saebi, T., and N. J. Foss. 2015. Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions. *European Management Journal* 33(3): 201–13.

Sambamurthy, V., A. Bharadwaj, and V. Grover. 2003. Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly* 27(2): 237–63.

Saunders, M., P. Lewis, and A. Thornhill. 2012. *Research methods for business students*. Pearson Education Limited.

Schumpeter, J. 1934. *The theory of economic development*. Transaction Publishers.

Schweisfurth, T. G., and C. Raasch. 2018. Absorptive capacity for need knowledge: Antecedents and effects for employee innovativeness. *Research Policy* 47(4): 687–99.

Seo, Y. W., S. W. Chae, and K. C. Lee. 2015. The impact of absorptive capacity, exploration, and exploitation on individual creativity: Moderating effect of subjective well-being. *Computers in Human Behavior* 42: 68–82.

Shalley, C. E., J. Zhou, and G. R. Oldham. 2004. The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management* 30(6): 933–58.

Sheehan, K. B. 2001. E-mail survey response rates: A review. *Journal of Computer-Mediated Communication* 6(2): JCM 621.

Singh, A., and T. Hess. 2017. How chief digital officers promote the digital transformation of their companies. *MIS Quarterly Executive* 16(1): 1–17.

Singh, V., and S. Point. 2004. Strategic responses by European companies to the diversity challenge: An online comparison. *Long Range Planning* 37(4): 295–318.

Sirmon, D. G., M. A. Hitt, R. D. Ireland, and B. A. Gilbert. 2011. Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. *Journal of Management* 37(5): 1390–412.

Smith, K. G., C. J. Collins, and K. D. Clark. 2005. Existing knowledge, knowledge creation capability, and the rate of new product introduction in high-technology firms. *Academy of Management Journal* 48(2): 346–57.

Smith, W. K.., and M. W. Lewis. 2011. Toward a theory of paradox: A dynamic equilibrium model of organizing. *Academy of Management Review* 36(2): 381-403.

Smith, S. M., C. A. Roster, L. L. Golden, and G. S. Albaum. 2016. A multi-group analysis of online survey respondent data quality: Comparing a regular USA consumer panel to MTurk samples. *Journal of Business Research* 69(8): 3139–48.

Sosa, M. E., S. D. Eppinger, and C. M. Rowles. 2003. Identifying modular and integrative systems and their impact on design team interactions. *Journal of Mechanical Design* 125(2): 240–52.

Spector, P. E., C. C. Rosen, H. A. Richardson, L. J. Williams, and R. E. Johnson. 2019. A New Perspective on Method Variance: A Measure-Centric Approach. *Journal of Management* 45(3): 855–80.

Spender, J.-C. 1996. Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal* 17(S2): 45–62.

Stefanovic, D., U. Marjanovic, M. Delić, D. Culibrk, and B. Lalic. 2016. Assessing the success of e-government systems: An employee perspective. *Information and Management* 53(6): 717–26.

Sullivan, I., A. DeHaven, and D. Mellor. 2019. Open and reproducible research on open science framework. *Current Protocols in Essential Laboratory Techniques* 18(1): 1–24.

Svahn, F., L. Mathiassen, R. Lindgren, and G. C. Kane. 2017. Mastering the digital innovation challenge. *MIT Sloan Management Review* 58(3): 14–6.

Tallon, P. P., and A. Pinsonneault. 2011. Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly: Management Information Systems* 35(2): 463–86.

Tamayo-Torres, I., L. J. Gutiérrez-Gutiérrez, F. J. Llorens-Montes, and F. J. Martínez-Loopez. 2016. Industrial Management & Data Systems Article information : *Industrial Management & Data Systems* 116(8).

Tashakkori, A., and J. W. Creswell. 2007. Editorial: The New Era of Mixed Methods. *Journal of Mixed Methods Research* 1(1): 3–7.

Tate, W. L., L. M. Ellram, T. Schoenherr, and K. J. Petersen. 2014. Global competitive conditions driving the manufacturing location decision. *Business Horizons* 57(3): 381–90.

Teece, D. J. 2010. Business models, business strategy and innovation. *Long Range Planning* 43(2–3): 172–94.

Tracy, S. J. 2013. *Qualitative Research Methods: Collecting Evidence, Crafting Analysis, Communicating Impact*. John Wiley & Sons.

Tumbas, S., N. Berente, and J. Vom Brocke. 2018. Born Digital: Growth Trajectories of Entrepreneurial Organizations Spanning Institutional Fields. *ICIS 2017: Transforming Society with Digital Innovation*: 1–20.

Uehara, H., A. Kobayashi, K. Uenishi, J. Ikeda, H. Nagano, and S. Ishida. 2018. Considerations for avoiding commoditisation in the automotive industry – analysis of factors that enhance customisation. *International Journal of Business and Systems Research* 12(1): 85–105.

Ulrich, P., S. Prabhakaran, F. Exley, G. Engler, T. Qui, and L. McGarrity. 2020. Learn eight key actions to help improve your digital strategy and realize a return on digital investments. https://www.ey.com/en_gl/strategy/will-your-digital-investment-strategy-go-from-virtual-to-reality. Accessed 28 August 2021.

Un, C. A., and K. Asakawa. 2015. Types of R&D collaborations and process innovation: The benefit of collaborating upstream in the knowledge chain. *Journal of Product Innovation Management* 32(1): 138–53.

Vallerand, R. J. 2000. Deci and Ryan's self-determination theory: A view from the hierarchiacal model of intrinsic and extrinsic motivation. *Psychological Inquiry* 11(1): 312–8.

Venkatesh, V., S. A. Brown, and Y. W. Sullivan. 2016. Guidelines for conducting mixed-methods research: An extension and illustration. *Journal of the Association for Information Systems* 17(7): 435–95.

Vial, G. 2019. Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems* 28(2): 118–44.

Van Der Voordt, T. J. m. 2004. Productivity and employee satisfaction in flexible workplaces. *Journal of Corporate Real Estate* 6(2): 133–48.

Wang, B., Y. Liu, J. Qian, and S. K. Parker. 2021. Achieving Effective Remote Working During the COVID-19 Pandemic: A Work Design Perspective. *Applied Psychology* 70(1): 16–59.

Weisberg, R. W. 1999. *Creativity and Knowledge: A Challenge to Theories*. In *R. J. Sternberg (Ed.), Handbook of creativity*: 226–50. Cambridge University Press.

West, J., and M. Bogers. 2014. Leveraging external sources of innovation: A review of research on open innovation. *Journal of Product Innovation Management* 31(4): 814–31.

Wiesböck, F., and T. Hess. 2020. Digital innovations. *Electronic Markets* 30(1). Electronic Markets: 75–86.

Wiklund, J., and D. Shepherd. 2005. Entrepreneurial orientation and small business performance: A configurational approach. *Journal of Business Venturing* 20(1): 71–91.

Wu, J. H., and Y. M. Wang. 2006. Measuring KMS success: A respecification of the DeLone and McLean's model. *Information and Management* 43(6): 728–39.

Yoo, Y., O. Henfridsson, and K. Lyytinen. 2010. Research Commentary: The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. *Information Systems Research* 21(4): 724–35.

Yoo, Y., R. J. Boland, K. Lyytinen, and A. Majchrzak. 2012. Organizing for innovation in the digitized world. *Organization Science* 23(5): 1398–408.

Zhang, P., K. Zhao, and R. L. Kumar. 2016. Impact of IT governance and IT capability on firm performance. *Information Systems Management* 33(4): 357–73.

Zhang, X., and K. M. Bartol. 2010. The influence of creative process engagement on employee creative performance and overall job performance: A curvilinear assessment. *Journal of Applied Psychology* 95(5): 862–73.

Zhou, J., and C. E. Shalley. 2003. Research on Employee Creativity: a Critical Review and Directions for Future Research. *Research in Personnel and Human Resources*

Management 22: 165–217.

Zhou, K. Z., C. K. Yim, and D. K. Tse. 2005. The effects of strategic orientations on technology- and market-based breakthrough innovations. *Journal of Marketing* 69(2): 42–60.

Zirpoli, F., and M. C. Becker. 2011. The limits of design and engineering outsourcing: Performance integration and the unfulfilled promises of modularity. *R&D Management* 41(1): 21–43.

Part B—Research Contributions

Contribution I

Table 3: Overview Contribution I

Title	**Component suppliers in the commodity battle: Can digital technology in multi-tier supply chains help to transform liabilities into opportunities?**
Author	Herbst, Tobias D.
Year	2021
Outlet	International Journal of Business Science and Applied Management
Ranking	VHB: C
Status	Published
Online	https://www.business-and-management.org/paper.php?id=146
Bibliographical Information	Herbst, T.D., 2021. Component suppliers in the commodity battle: Can digital technology in multi-tier supply chains help to transform liabilities into opportunities? International Journal of Business Science & Applied Management 16.
Abstract	This conceptual study analyzes how digital technologies can create opportunities for component suppliers in multi-tier supply chains facing the issue of commoditization, and it develops a strategic framework based on prior studies. This study finds that modularity facilitates the understanding of the dynamics of commoditization and knowledge sharing. Furthermore, modularization drives the asymmetric distribution of information in a multi-tier supply chain. Finally, digital technologies can offer strategic opportunities for targeting different stages of the value chain. Component suppliers should evaluate the criticality of products in new business models and advanced services to reduce the complexity of the landscape of strategic options and, thus, reduce wrong decisions. Managers should encourage general information sharing and open data exchange in a multi-tier supply chain. They should focus on vertical and horizontal partnerships and collaborations to foster the benefits of digital technologies. Conclusively, component suppliers should cooperate to build a counterweight to original equipment manufacturers in the vertical partnership. This study is the first to integrate the benefits of commodities and digital technologies in a strategic framework. It contributes to the literature on competition in the background of commoditization by outlining the concept of information asymmetry within a multi-tier supply chain driven by modularity. Thus, it advances the literature on digital technology and commoditization.
Keywords	multi-tier supply chain, strategy, modularity, servitization, commoditization, digitalization, knowledge-based view

Contribution II

Table 4: Overview Contribution II

Title	**A Contingency Model of the Open Innovation—Innovation Performance Relationship: The Role of Entrepreneurial Orientation and IT Capability**
Author	Herbst, Tobias D.; Hausberg, J. Piet
Year	2022
Outlet	International Journal of Business Science and Applied Management
Ranking	VHB: C
Status	Under review since 22.11.2022
Online	-
Bibliographical Information	-
Abstract	Open innovation (OI) describes how firms share innovation processes to interact and exploit external knowledge. Related studies show that firms yield varying results in adapting OI. They suggest an optimum OI level using the external search breadth and depth concept, whose antecedents have been inadequately examined, especially regarding their relationship with innovation performance. This study sheds light on the antecedents moderating OI's effectiveness and its impact on innovation performance. It explores how information technology (IT) capability and entrepreneurial orientation (EO) influence firms' external search strategies and their direct and moderating impact on innovation performance. A survey of listed German firms (n=146) found no support for a curvilinear relationship between open external search strategies and innovation performance. Moreover, the assumption that IT capability positively affects the relationship between external search strategy openness and innovation performance was unsupported, suggesting a negative moderating impact of IT capability. Hence, the general business value of IT capability is questionable. Thus, the study proposes differential moderating and direct EO effects on external search strategy effectiveness and its collective impact on innovation performance. This study contributes insight to external search strategies, information systems research, and antecedents moderating the effectiveness of external search strategies' impact on innovation performance.
Keywords	Open Innovation, External Search Strategies, Innovation, IT capability, Entrepreneurial Orientation

A Contingency Model of the Open Innovation-Innovation Performance Relationship: The Role of Entrepreneurial Orientation and IT Capability

Abstract

Open innovation (OI) describes how firms share innovation processes to interact and exploit external knowledge. Related studies show that firms yield varying results in adapting OI. They suggest an optimum OI level using the external search breadth and depth concept, whose antecedents have been inadequately examined, especially regarding their relationship with innovation performance. This study sheds light on the antecedents moderating OI's effectiveness and its impact on innovation performance. It explores how information technology (IT) capability and entrepreneurial orientation (EO) influence firms' external search strategies and their direct and moderating impact on innovation performance. A survey of listed German firms (n=146) found no support for a curvilinear relationship between open external search strategies and innovation performance. Moreover, the assumption that IT capability positively affects the relationship between external search strategy openness and innovation performance was unsupported, suggesting a negative moderating impact of IT capability. Hence, the general business value of IT capability is questionable. Thus, the study proposes differential moderating and direct EO effects on external search strategy effectiveness and its collective impact on innovation performance. This study contributes insight to external search strategies, information systems research, and antecedents moderating the effectiveness of external search strategies' impact on innovation performance.

Keywords: Open Innovation, External Search Strategies, Innovation, IT capability, Entrepreneurial Orientation

Introduction

Firms must leverage external knowledge and marketing techniques to successfully operate in today's highly competitive and dynamic environment; they must employ open innovation (OI) actively (Chesbrough, 2003a; 2003b). Prior research elaborated on the benefits, potential limitations, and negative impacts of OI on (innovation) performance (Laursen and Salter, 2006; West and Bogers, 2014; Hosseini et al., 2017). However, OI may not always be beneficial in all circumstances at all levels. Context matters. For example, prior studies suggest that OI may have a curvilinear effect on innovation performance (Laursen and Salter, 2006; Leiponen and Helfat, 2010; West and Bogers, 2014). Furthermore, empirical studies indicate that the successful use of OI depends on various factors, such as capabilities, organizational design, and practices (West and Bogers, 2014; Saebi and Foss, 2015; Hosseini et al., 2017). This study contributes to a better understanding of two examples of such contingencies.

First, research considering the moderating role of capabilities on the relationship between OI and innovation performance is lacking. West and Bogers (2014) highlighted the need for research focusing on internal capabilities affecting OI to support innovation performance. Similarly, Hosseini et al. (2017) underline the lack of research on the strategic alignment perspective between the implementation of OI and business strategies. Their study identified several relevant capabilities from the strategic alignment perspective, including information technology (IT) capabilities. IT capability is a firms' ability to combine its resources with IT-related resources (Bharadwaj, 2000). Hosseini et al. (2017) addressed the call to investigate its effect on the relationship between OI and innovation performance (Hosseini et al., 2017) as only a few scholars elaborated on the relationship between a firm's IT capability and OI strategy. Cui et al. (2015), Dong and Netten (2017), and Joshi et al. (2010) are examples.

Firms face the decision to invest in IT capabilities regarding technological and human resources (Joshi et al., 2010; Cui et al., 2015; Savino, Messeni Petruzzelli, and Albino, 2017). Current research fails to present the influence of IT capabilities on OI and how OI may or may not benefit from IT capabilities (e.g., Cui et al., 2015; Hosseini et al., 2017; Joshi et al., 2010; West and Bogers, 2014). Therefore, this study bridges the gap by empirically investigating IT capabilities' effect on the relationship between OI and innovation performance.

Second, entrepreneurial orientation (EO) is another potentially important contingency (Lumpkin and Dess, 1996a; Zhou, Yim, and Tse, 2005; Anderson, Potočnik, and Zhou, 2014; Cheng and Huizingh, 2014). Following Miller (1983), Lumpkin and Dess (1996a) define EO as methods, processes, and decision-making styles that determine entrepreneurial activities. Extant research notes the importance of entrepreneurial risk-taking to benefit from OI (Hung and Chiang, 2010; Cheng and Huizingh, 2014). Using Miller's (1983) three-dimension framework, multiple studies have examined EO's influence on various business performance factors (Hughes and Morgan, 2007; Covin and Lumpkin, 2011). However, the findings were very mixed, with some reporting a positive and others, a negative, EO effect on business performance (Matsuno, Mentzer, and Özsomer, 2002; Wiklund and Shepherd, 2005; Zhou, Yim, and Tse, 2005; Hughes and Morgan, 2007; Rauch et al., 2009; Cheng and Huizingh, 2014). Thus, the exact nature of the relationship remains elusive. This study contributes insight into EO by empirically investigating its effect on the relationship between OI and innovation performance.

Accordingly, this study develops and empirically tests a model that links OI, IT capabilities, and EO to innovation performance. It focuses on inbound OI (i.e., external knowledge search) and distinguishes between its breadth and depth per prior research (Laursen and Salter, 2006). Ultimately, it answers the following research question to contribute to relevant debates in various research fields: Do IT capability and EO positively moderate the effect of external search strategy openness on innovation performance?

First, by focusing on OI aspects that rely on relationships and interactions between members of the same or different organizations, this study develops and validates a more comprehensive scale for external search strategies. This inclusive approach helps understand the key drivers of Laursen and Salter's (2006) definition of the external search strategy. However, this study may not support the view that external search breadth and depth have an inverse u-shaped relationship with innovation performance. Second, this study systematically investigates the relationship between external search breadth and depth and IT capability and evaluates their combined and direct effect on innovation

performance. It shows that IT capability could negatively impact external search breadth and depth. This study offers further transparency on OI effectiveness driven by capabilities. Further, empirically studying IT capability impact sheds light on its business value and antecedents of external search breadth and depth. Third, this study contributes to essential insights on the impact of EO on external search strategies (breadth and depth). It suggests that EO may not positively moderate external search strategies. Nevertheless, EO directly and positively influences innovation performance. Finally, empirically testing the framework in Germany contributes insight to the cultural differences in external search openness strategies impacting innovation performance (Hosseini et al., 2017).

Theoretical background and hypotheses

The effect of external search breadth and depth on innovation performance

OI has long been an essential innovation concept and has received increased scholarly attention (e.g., Chesbrough, 2012, 2003; Dahlander and Gann, 2010; Enkel et al., 2011; Gassmann and Enkel, 2004). Since the introduction of the term by Chesbrough (2003), scholars have discussed the advantages and disadvantages of the OI model. OI enables a firm to leverage external knowledge to improve internal innovations or expand its external market positions. Even so, empirical research refers to negating the positive effects through increased costs and risks (Laursen and Salter, 2006; Lichtenthaler, 2010). However, empirical evidence strongly indicates the positive effects of OI (e.g., Enkel et al., 2009; Lichtenthaler and Lichtenthaler, 2009; Lim et al., 2010; Vanhaverbeke et al., 2008) and highlights how it may foster new product development (Fang, Palmatier, and Evans, 2008).

Scholars have discussed which factors make OI strategies effective. For instance, Tomlinson (2010) elaborated on the benefits of vertical cooperation on innovation performance. Laursen and Salter (2006) underlined the importance of the openness of external search strategies (breadth and depth) by capitalizing on external knowledge. Whereas the breadth of external search refers to the amount and diversity of external knowledge sources, the depth of external search reflects the degree or intensity to which firms rely on external knowledge (Lumpkin and Dess, 1996b; Laursen and Salter, 2006). Thus, different OI strategies (i.e., degrees of external search openness) may lead to disparities in innovation performance (Laursen and Salter, 2006; Dittrich and Duysters, 2007; Saebi and Foss, 2015). Drawing on OI aspects, Laursen and Salter (2006) highlighted a curvilinear (inverted u-shape) relationship between the openness of external search strategies and innovation performance. Thus, they noted a point where too much OI harms innovation performance.

Accordingly, we may conclude a curvilinear relationship between the openness of external search strategies (measured by external search breadth and depth) and innovation performance. Hence, this study proposes the following hypothesis:

H1: *External search (a) breadth and (b) depth have an inverse u-shaped relationship with innovation performance.*

The role of IT capability

As indicated by prior research, IT is a valuable source for technological innovations (Liang, You, and Liu, 2010) and may foster innovative ideas (Brynjolfsson et al., 2008; Chou, Chuang, and Shao, 2014). Furthermore, IT can enhance product and service innovations (Arvanitis, Loukis, and Diamantopoulou, 2013). IT capability is the ability to combine firms' resources with IT-related resources (Bharadwaj, 2000). Empirical evidence support how IT capability is crucial in innovation performance (Bharadwaj, 2000; Chen et al., 2015; Nwankpa and Roumani, 2016; Zhang, Zhao, and Kumar, 2016). Moreover, as Nwankpa and Roumani (2016) stated, prior research underlines the importance of IT capability to differentiate product offerings (Tan and Teo, 2000). However, exactly how IT capability contributes to innovation performance remains largely unknown. Some studies even challenge the notion of the direct impact of IT capability on innovation performance (e.g., Cheng and Huizingh, 2014).

Lu and Ramamurthy (2011) described and measured three IT capability dimensions: IT infrastructure capability, IT business spanning capability, and IT proactive stance. IT infrastructure capability is the firm's ability to manage and share multiple applications and services in data management services and architectures, platforms, network communication services, and

communication technology (Broadbent, Weill, and Neo, 1999; Bharadwaj, 2000; Weill, Subramani, and Broadbent, 2002). IT business spanning capability is "the ability of a firm's management to envision and exploit IT resources to support and enhance business objectives" (Lu and Ramamurthy, 2011). It encompasses a clear IT strategic vision that offers a combined IT and business strategy to enhance management's willingness to sponsor IT investments given a clear understanding of its added value to business success (Bharadwaj, 2000; Lu and Ramamurthy, 2011). IT proactive stance is a firm's ability to capitalize on new or already existing IT resources and foster IT innovations proactively by, for instance, continually scanning markets for new IT technologies or taking business risks in early-stage IT implementation (Weill, Subramani, and Broadbent, 2002; Lu and Ramamurthy, 2011).

The three IT capability dimensions may help support an inbound OI strategy and positively impact external knowledge search breadth and depth. Understanding IT capability's moderating effect provides essential insights into information systems (IS) research, as previous studies fail to investigate IT capability as a contingency factor. Hence, this study responds to the call for further empirical studies on IT capability (Cheng and Huizingh, 2014) and proposes the following hypothesis :

H2*: IT capability has a positive direct effect on innovation performance.*

IT capability and external search breadth

Excellent IT infrastructure enables firms to integrate data, processes, and communication technologies and share the information across a firm's boundary by operating a global platform approach (Lu and Ramamurthy, 2011; Ceccagnoli et al., 2012). IT infrastructure forms the basis for interactions within and beyond a firm, enabling information exchange between multiple external sources and channels. The utilization of superior IT infrastructure enables the standardization of interfaces and processes (Rai and Tang, 2010; Venkatesh and Bala, 2012). Firms with outward-oriented innovation activities benefit from the ability to scan data and sense market information, thus making quick and precise multiple search channel analysis for innovative activities (Overby, Bharadwaj, and Sambamurthy, 2006; Tallon and Pinsonneault, 2011). This analysis enables firms to probe several channels for suitable partnerships and select the most appropriate ones.

Additionally, the ability to scan data efficiently and in real-time allows firms to increase search efficiency and external sources for innovative activities (Laursen and Salter, 2006; Tallon and Pinsonneault, 2011). A robust IT infrastructure enables modularized and automated business processes and fast and flexible interfaces for data exchange, increasing the number of potential cooperation partners (Sambamurthy, Bharadwaj, and Grover, 2003). Search openness requires an extensive internal capacity to allow the effective processing of multiple external knowledge channels (Laursen and Salter, 2006). The opportunity to store, share, and reuse data automatically facilitates innovative activities with numerous external knowledge sources. It facilitates a quicker understanding of standards and routines of the various knowledge channels if these have already been applied or analyzed (Laursen and Salter, 2006; Lu and Ramamurthy, 2011; Levallet and Chan, 2018). A globally integrated infrastructure enables firms to react quickly to unpredictable changes and adapt their innovation process (Lu and Ramamurthy, 2011), allowing them to quickly change and adapt to external sources. Further, building on existing code and external knowledge sources permits firms to generate innovative offerings and engage in new markets, thus, generating new innovative activities with external sources (Chiang and Hung, 2010; Tallon and Pinsonneault, 2011).

A firm with a strong IT business spanning capability is characterized by the ability to address its business and IT strategy via a robust, cooperative alignment of IT and business plans (Chan and Reich, 2007; Bharadwaj et al., 2013). Hence, firms with a superior IT business alignment may benefit from cross-unit alignment effects and improved operationalization, enabled by effective decisions, strategic applications, and greater buy-in (Tanriverdi, 2005; Aral and Weill, 2007). Strong alignment could emphasize the benefit of external knowledge sources and lead to more significant support for innovative activities with external partners. Moreover, working with multiple external sources increases organizational efforts and may generate poor experiences (Laursen and Salter, 2006). Superior IT business spanning may help tailor innovation activities, including external sources, to the business strategy needs. It promotes being more success-oriented, leading to a faster decision-making process driven by the trust between the actors (Vance, Elie-dit-cosaque, and Straub, 2008).

A firm with a proactive IT stance is characterized by constant and ongoing efforts to uncover new business potentials enabled by IT. Such firms can better decide when to implement new IT innovations and quickly analyze their overall benefits (Lu and Ramamurthy, 2011). Thus, these firms can decide more quickly where they focus their capacities and possibly engage in new external innovation activities (Swanson and Ramiller, 2004; Roberts et al., 2012). Further, a solid understanding of IT technologies and future development enables firms to focus and capitalize on new opportunities with external partners at an early stage before entering into partnerships with other firms (Aral and Weill, 2007). A proactive IT stance supports constant learning and renewal of knowledge through continuous information exchange (Lu and Ramamurthy, 2011). This stance allows a firm to broaden its external search horizon (e.g., new applications) to engage in innovation activities with external sources. A firm can also cautiously weigh the added value and future viability of a new IT innovation to avoid a lock-in effect and maintain flexibility in the choice of interfaces and external sources (Swanson and Ramiller, 2004; Lu and Ramamurthy, 2011).

Scholars nonetheless refer to a curvilinear relationship between external search breadth and innovation performance, which may imply negative effects between the mechanisms (Laursen and Salter, 2006). The mechanisms of IT capability may reinforce these negative aspects. Firms with many external sources may "over-search" the external environment, which can harm innovation performance (Katila and Ahuja, 2002; Laursen and Salter, 2006). A globally integrated IT infrastructure enables more extensive access to external information sources and external channels and could lead to an overload of information (Lu and Ramamurthy, 2011). The increased level of information access could hinder decision-makers and emphasize incorrect information channel selection, prolonging decision-making time (Langley, 1995; Bakker and Shepherd, 2017). Hence, an integrated IT infrastructure could intensify the "over-search" effect. An increased information density may generate multiple new ideas and present more challenges to selecting, analyzing, and implementing the most promising idea (Helfat and Peteraf, 2015; Laursen and Salter, 2006).

Further, increased knowledge sharing may foster knowledge homogeneity (Kane and Alavi, 2007), potentially making it challenging for firms to select relevant innovations that differentiate them from the competition. A globally integrated infrastructure may reduce firms' ability to change internal processes and interfaces due to rigid technology and may lose the ability to cooperate with new external sources (Lu and Ramamurthy, 2011; Queiroz et al., 2018). An overemphasis of IT business synergy may reduce information and knowledge heterogeneity within a firm's decision stages. Furthermore, it may be easier to create a supportive environment for group thinking (Lu and Ramamurthy, 2011). Hence, these aspects can lead to fewer external sources and channels for innovation activities being identified, analyzed, and considered.

A proactive IT stance may lead to increased prioritization of external innovation activities and could lead to the attention problem (Laursen and Salter, 2006). Firms may approach too many external innovation activities without adequate internal resources. Instead of being mindful of each activity, the firm may have multiple open external activities and cannot focus on strategic projects to turn opportunities into profit (Laursen and Salter, 2006; Brynjolfsson et al., 2008; Lu and Ramamurthy, 2011).

Therefore, a positive moderating impact is expected of the three IT capability dimensions on external knowledge search breadth and innovation performance. Hence, this study proposes the following hypothesis:

***H3a**: IT capability positively moderates the relationship between external search breadth and innovation performance.*

IT capability and external search depth

A superior IT infrastructure enables firms to utilize platforms and the resulting standardization to integrate external sources in their innovation process more deeply (Lu and Ramamurthy, 2011; Ceccagnoli et al., 2012). In particular, standardization, global real-time information, and data integration allows firms to increasingly use and draw deeply from external sources and search channels. The real-time information enables more decisions and processes (e.g., innovation process, research, and development [R&D]) to be supported by external data and, thus, increasingly integrate external sources into firms' value creation process. The more straightforward implementation could enhance this effect

and application of data in processes since the storage and reusability of data reduce general transaction costs and is used more deeply (Levallet and Chan, 2018). The modularity of systems, data storability, and automation of interfaces may also facilitate the conversion of previously complex interfaces (e.g., incomprehensible communication) into efficient collaboration by utilizing successful IT applications. Moreover, excellent IT infrastructure may enable firms to use modular, reusable code that enables suitable IT products to be utilized efficiently within several business divisions, which increases the level firms draw from external sources (Overby, Bharadwaj, and Sambamurthy, 2006). Previous studies underlined the benefits of integrated IT, leading to improved innovation performance (volume and radicalness; Cui et al., 2015).

A firm with strong IT business spanning capability may benefit from a more substantial buy-in of decision-makers (Tanriverdi, 2005; Aral and Weill, 2007) and, thus, use external sources and search channels to a greater extent. Greater substantial internal management support firms may extend and sustain more in-depth knowledge exchange and collaboration between IT and business managers and external knowledge sources (Aral and Weill, 2007; Vance, Elie-dit-cosaque, and Straub, 2008). Moreover, a superior IT business alignment may contribute to a better strategic understanding of IT cooperation's contribution to business success and support in-depth IT cooperation within the internal value creation process (Lu and Ramamurthy, 2011).

A proactive IT stance is characterized by a continuous search for ways to utilize existing IT resources or new IT innovations (Lu and Ramamurthy, 2011). Hence, firms may find more applications and external sources to make deeper integrations into internal innovation efforts. Firms with a proactive IT stance more willingly engage in data exchange and collaborations with external sources and use existing or new technologies (Swanson and Ramiller, 2004). Moreover, they can analyze whether new technologies offer added value compared to existing technologies. This analysis approach avoids a lock-in effect (Swanson and Ramiller, 2004), and firms can mindfully decide which technology is appropriate to use (e.g., existing vs. emerging) to capitalize on external sources and channels consistently. A proactive IT stance may enable firms to reconfigure processes, adapt applications in response to changes, and continuously learn, which may help keep external partnerships over time as external sources may change technological interfaces or innovation focus (Laursen and Salter, 2006; Lu and Ramamurthy, 2011).

However, the three IT capability dimensions may also present adverse moderating effects on the external search depth and innovation performance. Laursen and Salter (2006) referred to the fact that a deep dependence on external sources negatively impacts innovation performance. This effect may be enforced by IT capability. For example, synergies between the three dimensions may broadly and deeply integrate external sources with firms' innovation and decision-making (Tanriverdi, 2005; Aral and Weill, 2007; Chiang and Hung, 2010; Tallon and Pinsonneault, 2011). Thus, the easy and fast access to information and the reduction of firms' decision-making ability could lead to excessive dependency on innovation's external interfaces (Langley, 1995; Bakker and Shepherd, 2017). Thus, the deep link with external sources may limit firms' capacities for additional external innovation activities (Laursen and Salter, 2006).

Based on the prior discussion on balance, we expect a positive moderating impact of the three IT capability dimensions on external knowledge search depth and innovation performance. Hence, this study proposes the following hypothesis:

H3b*: IT capability positively moderates the relationship between external search depth and innovation performance.*

The role of entrepreneurial orientation

EO highlights a firm's willingness to engage in new market fields and new operations (Miller, 1983). Prior research on the conceptualization of EO offers three dimensions: innovativeness, risk-taking, and proactiveness (Miller, 1983). Scholars have widely discussed the intercorrelation of the three dimensions and either conceptualize EO as a joint dimension or three separate dimensions (Lumpkin and Dess, 2001; Rauch et al., 2009). Due to high intercorrelations of these dimensions (Bhuian, Menguc, and Bell, 2005; Rauch et al., 2009), extensive research follows the merging of the three EO dimensions into one construct (e.g., Lee et al., 2001; Rauch et al., 2009; Walter et al., 2006; Wiklund and Shepherd, 2003) to analyze the moderating effect. Cheng and Huizingh (2014) highlight

key elements of EO. Importantly, firm leaders demonstrate a strong willingness to take risks to explore new market opportunities with products or services with a high degree of novelty and unclear market performance. Hence, this study proposes the following hypothesis:

H4*: EO has a positive direct effect on innovation performance.*

Entrepreneurial orientation and external search breadth

Firms must transform externally acquired knowledge into innovations and bring new products or services to the market to capitalize on OI (Chesbrough, 2003a). A higher EO may lead to faster improvement and recognition of innovation potential on the market with external sources (Lumpkin and Dess, 1996b; Wiklund and Shepherd, 2005). EO may nurture proactive behavior, thus fostering elevated participation in emerging industries, increasing the search for market opportunities, and striving for first-mover advantages (Venkatraman, 1989; Pérez-Luño, Wiklund, and Cabrera, 2011). Hence, high EO firms should constantly scan for external sources, search channels for innovative activities (Sciascia, Naldi, and Hunter, 2006), and proactively engage in innovation (Covin, Green, and Slevin, 2006). Addressing external sources require firms to cope with uncertainty (Laursen and Salter, 2006) and risk during innovation (Zhou, 2006). EO may allow firms to cope accordingly to foster the willingness to engage in innovative external activities.

Further, to find the right cooperation partner during the process, firms must encounter the proper external source and knowledge exchange approach (Laursen and Salter, 2006). Firms with a high EO may better deal with setbacks and new beginnings in the search and knowledge exchange process. More so, coping with many external sources and search channels requires extensive effort and time (Laursen and Salter, 2006). Firms with high EO could be more willing to provide resources for external cooperation and innovation efforts. A firm with a lower EO is less likely to address new market or customer segments proactively, resulting from their resistance to taking risks or closed-mindedness toward innovative ideas (Keh, Nguyen, and Ng, 2007; Zhang et al., 2016). However, this weakness could be driven by unfavorable market proximity and lack of information to identify innovation potential (Lumpkin and Dess, 1996b; Covin and Miles, 1999). Contrarily, firms with a sound EO tend to exploit external knowledge and sources in greater breadth, fostering innovation performance (Keh, Nguyen, and Ng, 2007).

However, EO may also enforce adverse effects of external search breadth on innovation performance. The positive and open attitude toward innovative opportunities (Wiklund and Shepherd, 2005) could increase the over-search effect, which harms innovation performance (Laursen and Salter, 2006). Firms with a superior EO might engage in more external innovative activities that may exceed management capacities regarding the number and quality of processing (Laursen and Salter, 2006), thereby reducing innovation performance. Hence, this study proposes the following hypothesis:

H5a*: EO positively moderates the relationship between external search breadth and innovation performance.*

Entrepreneurial orientation and external search depth

Laursen and Salter (2006) referred to a positive connection between external search depth and innovation performance by integrating relevant external sources into internal innovation efforts. Firms that exhibit greater EO could understand this effect through an open attitude toward risks, and management leaders could advocate a deeper integration of external sources in internal innovation activities (Wiklund and Shepherd, 2005). Moreover, firms with high EO may proactively interact with existing and new external sources and further support the in-depth exchange of knowledge and sustain collaborations over time (Lumpkin and Dess, 1996b; Laursen and Salter, 2006).

Nevertheless, EO may also show adverse moderating effects on external search depth and innovation performance. The proactiveness of firms exhibiting outstanding EO may establish many deep connections with external sources, which may exceed the internal resources for conscious management of these interfaces (Laursen and Salter, 2006; Lu and Ramamurthy, 2011). Moreover, firms' willingness to take risks may introduce external sources too profoundly in their innovation activities. A technology change could produce inflexible firms because they are overly dependent on

external sources to drive innovation (Swanson and Ramiller, 2004; Laursen and Salter, 2006). Thus, this study proposes the following hypothesis:

***H5b**: EO positively moderates the relationship between external search depth and innovation performance.*

The relationship between the joint effect of external search strategy, IT capability, and entrepreneurial orientation on innovation performance

A superb IT capability enables timely and accurate information exchange via an integrated platform (Bharadwaj, 2000; Broadbent et al., 1999; Weill et al., 2002). Access to real-time data and global information (Tallon and Pinsonneault, 2011) could reinforce the proactive attitude with high EO and lead to more significant external innovation activities. A global platform enables a standardized and, therefore, efficient exchange of information (Ceccagnoli et al., 2012). Combining this factor with a positive attitude toward risk, firms with a potent EO can implement multiple, IT-enabled global activities simultaneously for external knowledge management. This implementation enables faster integration of new external innovation activities and positively influences innovation performance (Lu and Ramamurthy, 2011; Levallet and Chan, 2018). A superior IT capability makes it possible to react fast to external changes and adapt internal processes. Accordingly, IT-enabled products and services can be implemented quickly (Chiang and Hung, 2010; Tallon and Pinsonneault, 2011). This implementation can support proactive orientation since firms with a high EO have a future-oriented perspective and actively seek new opportunities to participate (Hughes and Morgan, 2007). A positive alignment and use of synergies between IT and business managers lead to greater buy-in and better implementation of IT technologies (Tanriverdi, 2005; Aral and Weill, 2007). Adding increased trust over time positively influences new IT activities (Vance, Elie-dit-cosaque, and Straub, 2008). This increased trust positively impacts corporate EO and risk appetite, as there is a greater understanding of the potential risks of external innovation activities. Moreover, IT and business alignment support improvised decision-making (Lu and Ramamurthy, 2011), which, combined with EO firms' proactive attitude, enables faster capitalization on external innovation opportunities (Brown and Eisenhardt, 1997). A further synergy effect between IT capability and EO is made possible by the proactive IT stance. Accordingly, firms continuously use IT and capitalize on business opportunities enabled by IT applications (Weill, Subramani, and Broadbent, 2002; Aral and Weill, 2007) to foster proactivity and risk-taking with high EO and engage in more external innovation activities.

An excellent IT capability enables firms to draw on global platforms, standardized interfaces, modular technologies, and reusable code via superior IT infrastructure (Overby, Bharadwaj, and Sambamurthy, 2006; Rai and Tang, 2010; Venkatesh and Bala, 2012). EO's success may be affected by the positively corresponding in-depth networking opportunities (Walter, Auer, and Ritter, 2006), enabling deep external innovation activities over time. Moreover, the easy-to-use and reliable opportunity to exchange data with key sources may foster proactive behavior to deeply integrate external sources with internal innovation processes (Laursen and Salter, 2006) and sustain those collaborations in uncertain environments (e.g., radical technological changes). Accordingly, this study highlights the synergy of the effects of IT capability and EO and, thus, the mutual influence and amplification. Therefore, two contingencies must be considered in one construct since the effects cannot be generated unilaterally by IT capability or EO. Accordingly, this study proposes the following hypothesis:

***H6**: IT capability positively moderates the combined effect of external search (a) breadth and (b) depth and EO on innovation performance.*

Insert Figure 1 about here

Methodology

Operationalization

The study design and the multi-item scales mostly follow prior studies, except for measuring external search breadth and depth. Respondents answered the questions via corresponding scales following studies without adaptions. It allows for comparability of the derived mechanism effects, even if it is a subjective assessment of the respondents.

External search strategy. This study employed two dimensions, external search breadth and depth, to measure external search strategy openness. It focuses on aspects of external search strategies that rely on relationships and interactions between members of the same or different organizations. Hence, we adapted Laursen and Salter's (2006) approach using eight instead of 16 items. However, we only incorporated organizational sources, not documentation and points of contact, to focus on OI aspects that rely on relationships and interactions between different organizations.

Innovation performance. We measured innovation performance using Hausberg and Leeflang's (2019) scale based on Laursen and Salter (2006). As Hausberg and Leeflang (2019) addressed, innovation performance conceptualizes instruments used in the marketing and management literature (Atuahene-Gima, Slater, and Olson, 2005; De Luca and Atuahene-Gima, 2007). Hence, innovation performance was measured via respondent ratings of their firm and competitor's achievements in innovation projects.

IT capability. The study followed the Lu and Ramamurthy (2011) approach, built on prior studies (Mata, Fuerst, and Barney, 1995; Ross, Beath, and Goodhue, 1996; Bharadwaj, Sambamurthy, and Zmud, 1999; Weill, Subramani, and Broadbent, 2002; Fichman, 2004), to measure IT capability via three dimensions and 12 items by which participants rate their firm's performance.

Entrepreneurial orientation. EO was adapted from George and Marino (2011) following Miller (1983) via three dimensions (innovativeness, proactiveness, and risk-taking). It was measured as a unidimensional construct (George and Marino, 2011) using nine items by which respondents rate their firm's performance.

Controls. Two control variables control for external effects. First, we measured firm size as the logarithm of the number of full-time equivalent employees. For analysis purposes, we applied the logarithmic transformation (Hausberg and Leeflang, 2019). Prior studies suggest a positive correlation between firm size and innovation (Wagner and Hansen, 2005; Cassiman and Veugelers, 2006; Laforet, 2008; Cohen, 2010). Second, we analyzed firm age by calculating the number of years since its foundation (Sinkula, 1994).

Sampling and data collection

Further, to empirically test the hypotheses, this study employed a cross-sectional survey design, for which we searched online social-media platforms for expert managers who work for German publicly traded firms. We also incorporated departments in the search for reliable survey answers (e.g., IT, innovation management, R&D, business development, digitalization). Previous studies achieved valid and insightful results from surveys based on samples of publicly traded firms (George, Zahra, and Wood, 2002; Aghion et al., 2004; Przychodzen and Przychodzen, 2014). We found managers from 430 firms. We then created a research project on the open science framework (OSF) platform (Foster and Deardorff, 2017; Sullivan et al., 2019) before sending out the online survey to the managers to follow the best practice and create full transparency regarding the ex-ante hypotheses and avoid suspicions of cherry-picking results. We pre-registered the project, highlighting the hypotheses and research design (https://osf.io/dyjs8/?view_o). Moreover, to counter the "file drawer" problem (Rosenthal, 1979; Franco, Malhotra, and Simonovits, 2014), where only results with significant effects get published (Franco, Malhotra, and Simonovits, 2014), creating a bias, for example, in later meta-studies, we made the project public with an embargo time of two years. The publication of the pre-registered project after the embargo period allows for the research's discoverability (Sullivan, DeHaven, and Mellor, 2019).

The online survey was designed to be efficient to avoid any interruptions to the survey for a good response rate. The average survey duration was approximately 15 minutes. Moreover, the online survey was hosted on a dedicated server via the official university domain and a secure connection. The survey

was conducted anonymously; we did not track participant data assigned to the respective surveys (conformity GDPR, German DSGVO). In the contact e-mail, we emphasized the survey's anonymity and incentivized the feedback by offering comprehensive research data. We used Daniel Soper's a-priori sample size calculators (Soper, 2021) to determine a necessary minimum sample size of 145 for the confirmatory factor analysis (CFA) of the structural equation modeling (Westland, 2010) and 113 for the multiple regression (Cohen et al., 2003) However, to detect smaller effect sizes, we targeted a bigger sample size (170+).

We developed an English and a German version of the online questionnaire to accommodate managers whose mother tongue is not German. Further, to avoid artifacts due to item sequence, all items of item batteries, where appropriate, were presented randomly. Before the questionnaire was sent out, we did run a pre-test to check for clarity, comprehension, and completion time with a test group comprising experienced researchers and professionals reflecting the target group (i.e., manager and specialists to the research field). The results of the pilot survey showed that the participants adequately understood all items and scales. Based on the feedback, we refined and created the final questionnaire.

One expert per firm was contacted and invited to fill out the online questionnaire. Nevertheless, in the situation the first contact for a specific firm opt out of the survey explicitly, we employed the contingency of identifying and contacting a substitute expert from the same firm. In total, we sent 646 inquiries and received overall 227 responses, of which 146 were useably complete, which corresponds to a response rate of 23%. Considering the increasing survey fatigue among managers (Sheehan, 2001), this response rate can be considered good and usual for surveying managers online (e.g., Hausberg and Leeflang, 2019; Verhoef and Leeflang, 2009).

Results

Data quality

We checked the data manually for plausibility. Some respondents entered the foundation date (e.g., 1997) instead of the firm's age, which was easily corrected. We also evaluated the impact of missing values since missing data can lead to important biases (Schafer and Graham, 2002; Byrne, 2010). Several participants answered only the first variable. A few did not respond on an entire variable. Some cases had more than 10 missing values, which we dropped. Other cases missed a few values, mostly in the control variables. Overall, we have 146 complete cases and an additional 19 cases, for which only a few data points are missing, making 165 cases for the analysis. The remaining missing values seem to be randomly distributed on the first visual inspection. However, we also run Little's "missing completely at random" test (Little, 1988), resulting in a Chi-square of 382.5 (with 394 df), and thus a significance level of 0.652. Thus, we cannot reject the hypothesis that the missing values are completely random. Hence, it is reasonable to impute the Likert-scale items by column mean.

Exploratory factor analysis and confirmatory factor analysis

In an initial exploratory factor analysis, we first checked whether the items loaded on the higher-order factors and inspected for mono method bias via Harman's single factor test (Harman, 1967). No factor explained more than 50% of the variance. However, this test is questionable today; thus, we employed a common latent factor (CLF) during the CFA in AMOS. We ran the unconstrained model and the same model with a CLF and performed a Chi-square difference test on the two model results. The test indicated a significant difference. Therefore, we leave the CLF in the model for the calculation of the item bundles. Figure 2 illustrates the overall CFA-model.

Insert Figure 2 about here

We created such bundles using regression-based data imputation. We calculated the composite reliability (CR), average variance extracted (AVE), and mean shared variance (MSV) to assess the construct reliability and validity. Thus, we deleted some items (IP4-7) due to issues with discriminant validity and one item (IP1) due to reliability. However, we attained good degrees of reliability and validity for all variables (Table 2).

Insert Table 2 about here

However, deleted one item (IKC2) due to significant skew. Other variables exhibited significant kurtosis such that multivariate normality was not reached. However, this may also be due to the sample size, and whether the model can be considered a good fit was checked by bootstrapping. We inspected the Bollen-Stine-bootstrap corrected p-value to assess the model fit (Byrne, 2010). The model fit better in 853, equally well in 0, and failed to fit in 147 bootstrap samples. Testing the null hypothesis that the model is correct based on the Bollen-Stine bootstraps results in a p-value of 0.148. Thus, we cannot reject the hypothesis that the model fits well. Moreover, all other relevant indicators for good fit achieved acceptable values (Byrne, 2010). The Tucker-Lewis-index and the comparative fit index resulted both over the common threshold of 0.9 with values of 0.98 and 0.983, respectively. The root mean square error of approximation achieved 0.045 (with a 90% CI of 0.029 to 0.059). Thus, it was below the acceptable value of 0.1.

Multivariate regression

We used Daniel Soper's online post hoc power calculator to determine the power. The models achieved a 0.96–0.999 statistical power range. An initial regression helped identify potential outliers and collinearity issues. There was no collinearity indication. However, there was an outlier beyond 3 standard deviations, which proved to be a response (1 on the seven-point Likert scale) to 24 items in a row. Therefore, we deleted that case (ID 154).

We then compared a linear and a curvilinear model as predicted for the focal effects between breadth and depth of openness and innovation performance. There was no support for a curvilinear relationship, not for the slope's negative part (the downside of the curve), which may be due to several effects. First, we apply an innovation performance operationalization slightly different than Laursen and Salter (2006). Second, Laursen and Salter (2006) find the negative part of the slope to be equally significant but with a much smaller effect size. Despite a relatively high statistical power, it is not comparable to the approximately 2,700 Community Innovation Survey observations, likely leading to significant results even for small effects. This study shows that the slope's positive part is significant. Thus, we continue the moderation analysis to test for a positive, linear relation between openness and innovation performance. Table 3 provides an overview of the results from the multivariate regression models.

Insert Table 3 about here

After running the first regression only with the two control variables, in Model 1, we incorporated the direct effects for our main variables. Of these, only search breadth (*OI_breadth*) and EO (*EO*) were significant at the 5% level, with p-values of 0.036 and 0.035, respectively. Here, EO had a larger effect size, 0.236 compared to 0.192 of search breadth. Thus, we can confirm H1a and H4 and reject H1b and H2.

In Model 2, we included the interaction effects of search depth with IT capability (*ITC*) and *EO* variables; we included the interaction effects of search breadth with the same variables in Model 4. The *EO* interaction with search depth was highly significant; it interacted with search breadth at the 10% level. The interactions of *ITC* were significant in both cases but not in the anticipated direction. Hence, we can confirm only H5b and may have a borderline case for H5a. However, we must reject H3a and H3b.

We tested for the three-way-interactions in Models 3 and 5. While all significant effects from the previous models remained significant, we could not find anything close to an effect for the hypothesized three-way-interactions. We cannot confirm the three-way-interaction, but we find support for some of the hypothesized moderation effects. We employed Hayes SPSS-macro PROCESS v3.5 to visualize the

effect slope changes in Figure 3 and Figure 4. Table 4 and Figure 5 present a quick overview of our findings.

Insert Figures 3, 4, and 5
and Table 4 about here

Discussion

This study aims to determine the relationship between external search strategies and innovation performance. Moreover, it investigates the mediating role of IT capability and EO. Hence, the study examined whether external search breadth and depth, IT capability, and EO directly affect innovation performance. Moreover, it investigates whether IT capability and EO interact positively to influence innovation performance.

Apart from replicating existing results that prove the curvilinear (inverted u-shape) effect of external search strategies on innovation performance (Laursen and Salter, 2006; Leiponen and Helfat, 2010; Laursen and Salter, 2014), we argued that IT capability and EO positively moderate the effect of external search strategy (breadth and depth) on innovation performance. Prior related studies failed to investigate IT capability as a contingency factor (Cheng and Huizingh, 2014). However, it is essential since firms increasingly invest to achieve a superb IT capability and foster multiple firm performance indicators (Bharadwaj, 2000; Bharadwaj et al., 2013), particularly innovation performance (Chen, Jiao, and Zhao, 2016). Further, to investigate resources that facilitate innovation, we argued for a positive direct and moderating EO effect as an essential firm factor. It is crucial as it sheds further light on proper resource allocation between capabilities to foster innovation performance (Zhang et al., 2016).

Unlike prior studies (Laursen and Salter, 2006; Leiponen and Helfat, 2010; Cheng and Huizingh, 2014; Laursen and Salter, 2014), we found no support for a curvilinear relationship between external search strategies on innovation performance (i.e., search breadth and depth). However, this may be due to several effects. Our study focused on OI aspects that rely on relationships and interactions between members of the same or different organizations. Hence, we apply a different operationalization of innovation performance than Laursen and Salter (2006), which may support a more linear relationship between open search strategies and innovation performance. Second, Laursen and Salter (2006) find the slope's negative part equally significant but with a much smaller effect size. Although we have relatively high power, it is not comparable to the approximately 2,700 observations employed, which may make even tiny effects appear significant. Our results show that at least the upward part of the slope is significant. Another reason might be that firms use their capacities and energy for ideas that do not promise success. Laursen and Salter (2006) provided a possible rationale they term as the attention problem because firms have too many ideas that cannot be handled with sufficient capacities. Even a deepening and strengthening of external activities would not lead to an improvement of the ideas themselves. This effect could be reinforced by realizing too many ideas and lacking resources to process them. Another reason may be that firms become dependent on external resources and lose skills needed in other projects (Laursen and Salter, 2006).

Moreover, we found a strong significant effect regarding IT capability and open search strategies on innovation performance. This contrasts with prior studies that show how IT skills positively affect innovation performance (e.g., Bharadwaj, 2000; Chen et al., 2015; Nwankpa and Roumani, 2016; Zhang, Zhao, et al., 2016). Perhaps, over-sharing of knowledge with external partners (e.g., competitors) increases knowledge spillovers' risk to an unreasonable level (Foss, Husted, and Michailova, 2010). Both supporting and preventing roles of knowledge spillover or transfer in organizational innovation capacity were confirmed (Nieto and Quevedo, 2005). Superb IT capabilities enable easier knowledge exchange by aligning interfaces (Lu and Ramamurthy, 2011). However, increased collaboration and alignment to facilitate knowledge exchange encourages unintentional knowledge spillover (Emden, Calantone, and Droge, 2006). A more homogenous available knowledge reduces firms' innovation capability as it strongly depends on its organizational and intellectual knowledge (Martín-de Castro et al., 2013). Hence, the situation could also explain why there was no direct positive effect between IT capabilities and innovation performance, as firms must deploy capabilities (Martín-de Castro et al., 2013).

A second explanation could be that increased knowledge sharing leads to group thinking, which hinders innovation performance (Foss, Husted, and Michailova, 2010). Lu and Ramamurthy (2011) note that firms with a high IT business synergy have an increased group thinking attitude and tend to ignore innovation opportunities. Likewise, IT and business' strong coupling can lead to an increased routine (Lu and Ramamurthy, 2011) and reduce innovation speed and quality (Le and Lei, 2018). Thus, a strong IT business dependency may prevent the perception of innovation opportunities that require quick action to enable differentiation (Loebbecke, van Fenema, and Powell, 2016). Furthermore, the effect of group thinking through IT capabilities and external search strategies can lead to an attention deficit dilemma (Laursen and Salter, 2006), which might cause decision-makers to overlook opportunities that can lead to innovations. A third explanation could be that firms with a proactive IT stance may have an impaired resource orientation. Using too many internal resources in the IT-sphere to, for instance, strengthen or expand external partnerships, firms could overcommit external resources. Hence, missing the inward-looking resource orientation may reduce the ability to successfully manage internal resource bases to enable innovation (Cheng and Huizingh, 2014).

EO directly and positively affects innovation performance, which accords with prior research results (Lumpkin and Dess, 1996a; Pérez-Luño, Wiklund, and Cabrera, 2011; Cheng and Huizingh, 2014). However, EO only positively moderates the effect with external search depth. EO probably increases the over-search effect. Therefore, firms cannot prioritize their capacities on influential innovation opportunities (Laursen and Salter, 2006). Perhaps, firms also increasingly invest in existing partnerships and limit the broader external search to focus internal resources. This finding is relevant as it further contributes to the view that firms should not focus explicitly on EO (Tang et al., 2008; Wang, 2008), which leads to another interesting question. What is the EO optimal focus in conjunction with external search strategies beyond moderating effects? The question regards whether an inverse-u relationship exists therein.

Further, IT capability had no positive effect on the relationship between EO and external search depth and breadth on innovation performance. Perhaps, the lack of inward-looking resource orientation, which, combined with extensive investment in IT capabilities, may reduce firms' ability to invest in critical business areas (Cheng and Huizingh, 2014).

Conclusion

This study makes several contributions to the literature. It extends prior research on OI by empirically testing an abridged OI measurement scale. Evidently, no empirically tested construct exists in the literature regarding IT capability and EO's moderating effects on the broad range of external search strategies. Laursen and Salter (2006) proposed an inverted u-shaped relationship between external search strategies and innovation performance. This study extends their approach by considering firms' IT capabilities to support the internal ability for external search breadth and depth further. Moreover, prior studies failed to investigate IT capability as a contingency factor in IS research (Cheng and Huizingh, 2014).

EO as a construct extends the literature on firm-level contingencies of OI on innovation performance. Hence, we analyze the moderating effect of a firm's capability. We examine the influence of multiple constructs on innovation performance simultaneously by combining it with firms' EO. The situation underlines the importance of aligning firms' internal and external orientation with their capabilities to affect OI's influence on innovation performance positively.

Such insights allow for a different view on IT capabilities as important moderating constructs that influence the relationship between external search strategy openness and innovation performance. They represent a distinction from current research in the field of technological capabilities on firm performance (e.g., Bharadwaj, 2000; Zhang, Zhao, et al., 2016) and innovation performance (e.g., Héroux and Fortin, 2018; Liao et al., 2020; Wu et al., 2009). Thus, firms must consider supporting resource allocation in this setting.

From a managerial perspective, our findings provide innovation and IT decision-makers with several results. When firms consider to expand their knowledge using external knowledge sources, they must scrutinize their IT capabilities investment. Importantly, this study helps to foresee potential downsides of IT capabilities, which contrasts with the current notion providing a complementary view on linking technological capabilities, open innovation, and innovation performance (e.g., Héroux &

Fortin, 2018; Liao et al., 2020). In particular, we recommend a gradual alignment of the added value to avoid over-investment in EO and IT.

Even so, the study's limitations must be considered against the scope for further research on an empirical and conceptual level. First, this study is limited by the regional focus on listed German firms. Thus, further work could extend the national focus to generalize the results. Second, the measure of external search openness (i.e., depth and breadth) was adapted from Laursen and Salter (2006) by focusing on parts of OI that rely on relationships and interactions between members of the same or different organizations. Future research is needed to clarify whether the shortened item list is suitable for such research constructs. Third, further research is needed to understand better the complex interactions between IT capability, external search strategies, and innovation performance. Another possible area of future research would be to investigate why EO has different mediating effects on external search breadth and depth. Therefore, further research can analyze the effect of firms' absorptive capacity in our research setting to investigate its ability to apply gained external knowledge. Fourth, we collected the data in a short period, influenced by an economic downturn, thereby affecting the feedback quality. This study may also be repeated in a rationalized economic environment. Finally, an additional limitation is our small sample size. More research is needed to develop a deeper understanding of the correlation between the sample size and the relationship between external search strategies and innovation performance.

References

Aghion, P., S. Bond, A. Klemm, and I. Marinescu. 2004. Technology and financial structure: Are innovative firms different? *Journal of the European Economic Association* 2(2–3): 277–88.

Anderson, N., K. Potočnik, and J. Zhou. 2014. Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. *Journal of Management* 40(5): 1297–333.

Aral, S., and P. Weill. 2007. IT assets, organizational capabilities, and firm performance: How resource allocations and organizational differences explain performance variation. *Organization Science* 18(5): 763–80.

Arvanitis, S., E. Loukis, and V. Diamantopoulou. 2013. The effect of soft ICT capital on innovation performance of Greek firms. *Journal of Enterprise Information Management* 26(6): 679–701.

Atuahene-Gima, K., S. F. Slater, and E. M. Olson. 2005. The contingent value of responsive and proactive market orientations for new product program performance. *Journal of Product Innovation Management* 22(6): 464–82.

Bakker, R. M., and D. A. Shepherd. 2017. Pull the plug or take the plunge: Multiple opportunities and the speed of venturing decisions in the Australian mining industry. *Academy of Management Journal* 60(1): 130–55.

Bharadwaj, A., V. Sambamurthy, and R. W. Zmud. 1999. IT capabilities: Theoretical perspectives and empirical operationalization. *Management Science* Charlotte,(January): 378–85.

Bharadwaj, A., O. A. El Sawy, P. A. Pavlou, and N. Venkatraman. 2013. Digital business strategy: Toward a next generation of insights. *MIS Quarterly* 37(2): 471–82.

Bharadwaj, A. S. 2000. A resource-based perspective on information technology capability and firm. *MIS Quarterly* 24(1): 169–96.

Bhuian, S. N., B. Menguc, and S. J. Bell. 2005. Just entrepreneurial enough: The moderating effect of entrepreneurship on the relationship between market orientation and performance. *Journal of Business Research* 58(1 SPEC.ISS): 9–17.

Broadbent, M., P. Weill, and B. S. Neo. 1999. Strategic context and patterns of IT infrastructure capability. *Journal of Strategic Information Systems* 8(December 1996): 157–87.

Brown, S., and K. M. Eisenhardt. 1997. The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly* 42(1): 1–34.

Brynjolfsson, E., A. McAfee, M. Sorell, and F. Zhu. 2008. Scale without mass: Business process replication and industry dynamics. *SSRN Electronic Journal* 1(213): 1–46.

Byrne, B. M. 2010. *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. 2nd ed. New York: Routledge.

Cassiman, B., and R. Veugelers. 2006. In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science* 52(1): 68–82.

Ceccagnoli, M., C. Forman, P. Huang, and D. J. Wu. 2012. Cocreation of value in a platform ecosystem! The case of enterprise software. *MIS Quarterly* 36(1): 263–90.

Chan, Y. E., and B. H. Reich. 2007. IT alignment: What have we learned? *Journal of Information Technology* 22(4): 297–315.

Chen, J., H. Jiao, and X. Zhao. 2016. A knowledge-based theory of the firm: managing innovation in biotechnology. *Chinese Management Studies* 10(1): 41–58.

Chen, Y., Y. Wang, S. Nevo, J. Benitez-Amado, and G. Kou. 2015. IT capabilities and product innovation performance: The roles of corporate entrepreneurship and competitive intensity. *Information and Management* 52(6): 643–57.

Cheng, C. C. J., and E. K. R. E. Huizingh. 2014. When is open innovation beneficial? The role of strategic orientation. *Journal of Product Innovation Management* 31(6): 1235–53.

Chesbrough, H. 2003a. *Open Innovation*. Vol. 3. Cambridge, MA: Harvard University Press.

Chesbrough, H. 2003b. The logic of open innovation: Managing intellectual property. *California Management Review* 45(3): 33–58.

Chesbrough, H. 2012. Open innovation: Where we've been and where we're going. *Research Technology Management* 55(4): 20–7.

Chiang, Y. H., and K. P. Hung. 2010. Exploring open search strategies and perceived innovation performance from the perspective of inter-organizational knowledge flows. *R&D Management* 40(3): 292–9.
Chou, Y. C., H. H. C. Chuang, and B. B. M. Shao. 2014. The impacts of information technology on total factor productivity: A look at externalities and innovations. *International Journal of Production Economics* 158: 290–9.
Cohen, J., P. Cohen, S. G. West, and L. S. Aiken. 2003. *Applied multiple regression/correlation analysis for the behavioral sciences*. Routledge.
Cohen, W. M. 2010. Fifty years of empirical studies of innovative activity and performance. In *Handbook of the Economics of Innovation* (Vol. 1), ed. H. H. Bronwyn and R. Nathan, 129–213. Elsevier B.V.
Covin, J. G., and G. T. Lumpkin. 2011. Entrepreneurial orientation theory and research: Reflections on a needed construct. *Entrepreneurship: Theory and Practice* 35(5): 855–72.
Covin, J. G., and M. P. Miles. 1999. Corporate entrepreneurship and the pursuit of competitive advantage. *Entrepreneurship Theory and Practice* 23(3): 47–63.
Covin, J. G., K. M. Green, and D. P. Slevin. 2006. Strategic process effects on the entrepreneurial orientation—Sales growth rate relationship. *Entrepreneurship Theory and Practice* 30(1): 57–81.
Cui, T., H. Ye, H. H. Teo, and J. Li. 2015. Information technology and open innovation: A strategic alignment perspective. *Information and Management* 52(3): 348-58.
Dahlander, L., and D. M. Gann. 2010. How open is innovation? *Research Policy* 39(6): 699–709.
Dittrich, K., and G. Duysters. 2007. Networking as a means to strategy change: The case of open innovation in mobile telephony. *Journal of Product Innovation Management* 24(6): 510–21.
Dong, J. Q., and J. Netten. 2017. Information technology and external search in the open innovation age: New findings from Germany. *Technological Forecasting and Social Change* 120: 223–31.
Emden, Z., R. J. Calantone, and C. Droge. 2006. Collaborating for new product development: Selecting the partner with maximum potential to create value. *Journal of Product Innovation Management* 23(4): 330–41.
Enkel, E., O. Gassmann, and H. Chesbrough. 2009. Open R&D and open innovation: Exploring the phenomenon. *R&D Management* 39(4): 311–6.
Enkel, E., J. Bell, and H. Hogenkamp. 2011. Open innovation maturity framework. *International Journal of Innovation Management* 15(6): 1161–89.
Fang, E., R. W. Palmatier, and K. R. Evans. 2008. Influence of customer participation on creating and sharing of new product value. *Journal of the Academy of Marketing Science* 36(3): 322–36.
Fichman, R. G. 2004. Real options and IT platform adoption: Implications for theory and practice. *Information Systems Research* 15(2): 132–54.
Foss, N. J., K. Husted, and S. Michailova. 2010. Governing knowledge sharing in organizations: Levels of analysis, governance mechanisms, and research directions. *Journal of Management Studies* 47(3): 455–82.
Foster, E. D., and A. Deardorff. 2017. Open science framework (OSF). *Journal of the Medical Library Association* 105(2): 203–6.
Franco, A., N. Malhotra, and G. Simonovits. 2014. Publication bias in the social sciences: Unlocking the file drawer. *Science* 345(6203): 1502–5.
Gassmann, O., and E. Enkel. 2004. Towards a theory of open innovation: Three core process archetypes. In *R&D Management Conference (RADMA)*. Lisbon, Portugal.
George, B. A., and L. Marino. 2011. The epistemology of entrepreneurial orientation: Conceptual formation, modeling, and operationalization. *Entrepreneurship: Theory and Practice* 35(5): 989–1024.
George, G., S. A. Zahra, and D. R. Wood. 2002. The effects of business-university alliances on innovative output and financial performance: A study of publicly traded biotechnology companies. *Journal of Business Venturing* 17(6): 577–609.
Harman, H. H. 1967. *Modern Factor Analysis*. 2nd ed. Chicago: University of Chicago Press.
Hausberg, J. P., and P. S. H. Leeflang. 2019. Absorbing integration: Empirical evidence on the mediating role of absorptive capacity between functional-/cross-functional integration and innovation performance. *International Journal of Innovation Management* 23(6): 1950056.

Helfat, C. E., and M. A. Peteraf. 2015. Managerial cognitive capabilities and the microfoundations of dynamic capabilities. *Strategic Management Journal* 36: 831–50.
Héroux, S., and A. Fortin. 2018. The moderating role of IT-business alignment in the relationship between IT governance, IT competence, and innovation. *Information Systems Management* 35(2): 98–123.
Hosseini, S., A. Kees, J. Manderscheid, M. Röglinger, and M. Rosemann. 2017. What does it take to implement open innovation? Towards an integrated capability framework. *Business Process Management Journal* 23(1): 87–107.
Hughes, M., and R. E. Morgan. 2007. Deconstructing the relationship between entrepreneurial orientation and business performance at the embryonic stage of firm growth. *Industrial Marketing Management* 36(5): 651–61.
Hung, K. P., and Y. H. Chiang. 2010. Open innovation proclivity, entrepreneurial orientation, and perceived firm performance. *International Journal of Technology Management* 52(3–4): 257–74.
Joshi, K. D., L. Chi, A. Datta, and S. Han. 2010. Changing the competitive landscape: Continuous innovation through IT-enabled knowledge capabilities. *Information Systems Research* 21(3): 472–95.
Kane, G. C., and M. Alavi. 2007. Information technology and organizational learning: An investigation of exploration and exploitation processes. *Organization Science* 18(5): 796–812.
Katila, R., and G. Ahuja. 2002. Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal* 45(6): 1183–94.
Keh, H. T., T. T. M. Nguyen, and H. P. Ng. 2007. The effects of entrepreneurial orientation and marketing information on the performance of SMEs. *Journal of Business Venturing* 22(4): 592–611.
Laforet, S. 2008. Size, strategic, and market orientation affects on innovation. *Journal of Business Research* 61(7): 753–64.
Langley, A. 1995. Between "Paralysis by Analysis" and "Extinction by Instinct." *Sloan Management Review* 36(3): 63–76.
Laursen, K., and A. Salter. 2006. Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal* 27(2): 131–50.
Laursen, K., and A. J. Salter. 2014. The paradox of openness: Appropriability, external search and collaboration. *Research Policy* 43(5): 867–78.
Le, P. B., and H. Lei. 2018. The effects of innovation speed and quality on differentiation and low-cost competitive advantage: The case of Chinese firms. *Chinese Management Studies* 12(2): 305–22.
Lee, C., K. Lee, and J. M. Pennings. 2001. Internal capabilities, external networks, and performance: A study on technology-based ventures. *Strategic Management Journal* 22(6–7): 615–40.
Leiponen, A., and C. E. Helfat. 2010. Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal* 31(2): 224–336.
Levallet, N., and Y. E. Chan. 2018. Role of digital capabilities in unleashing the power of managerial improvisation. *MIS Quarterly Executive* 17(1): 4–21.
Liang, T. P., J. J. You, and C. C. Liu. 2010. A resource-based perspective on information technology and firm performance: A meta analysis. *Industrial Management and Data Systems* 110(8): 1138–58.
Liao, S., L. Fu, and Z. Liu. 2020. Investigating open innovation strategies and firm performance: the moderating role of technological capability and market information management capability. *Journal of Business and Industrial Marketing* 35(1): 23–39.
Lichtenthaler, U. 2010. Open innovation: potential risks and managerial countermeasures. *Proceedings of the R&D Management Conference*: 1–11.
Lichtenthaler, U., and E. Lichtenthaler. 2009. A capability-based framework for open innovation: Complementing absorptive capacity. *Journal of Management Studies* 46(8): 1315–38.
Lim, K., H. Chesbrough, and Y. Ruan. 2010. Open innovation and patterns of R&D competition. *International Journal of Technology Management* 52(3/4): 295–321.
Little, R. J. A. 1988. A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association* 83(404): 1198–202.

Loebbecke, C., P. C. van Fenema, and P. Powell. 2016. Managing inter-organizational knowledge sharing. *Journal of Strategic Information Systems* 25(1): 4–14.
Lu, Y., and K. Ramamurthy. 2011. Understanding the link between information technology capability and organizational agility: An empirical examination. *Management Information Systems Research Center* 35(4): 931–54.
De Luca, L. M., and K. Atuahene-Gima. 2007. Market knowledge dimensions and cross-functional collaboration: Examining the different routes to product innovation performance. *Journal of Marketing* 71(1): 95–112.
Lumpkin, G. T., and G. Dess. 2001. Linking two dimensions of entrepreneurial orientation to firm performance: the moderating role of environment and industry life cycle. *Journal of Business Venturing* 16(5): 429–51.
Lumpkin, G. T., and G. G. Dess. 1996a. Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review* 21(1): 135–72.
Lumpkin, G. T., and G. G. Dess. 1996b. The entrepreneurial clarifying It construct and linking orientation. *Academy of Management Review* 21(1): 135–72.
Martín-de Castro, G., M. Delgado-Verde, J. E. Navas-López, and J. Cruz-González. 2013. The moderating role of innovation culture in the relationship between knowledge assets and product innovation. *Technological Forecasting and Social Change* 80(2): 351–63.
Mata, F. J., W. L. Fuerst, and J. B. Barney. 1995. Information technology and sustained competitive advantage: A resource-based analysis. *MIS Quarterly: Management Information Systems* 19(4): 487–504.
Matsuno, K., J. T. Mentzer, and A. Özsomer. 2002. The effects of entrepreneurial orientation and market orientation on business performance. *Journal of Marketing* 66: 18–32.
Miller, D. 1983. The correlates of entrepreneurship in three types of firms. *Management Science* 29(7): 770–91.
Nieto, M., and P. Quevedo. 2005. Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort. *Technovation* 25(10): 1141–57.
Nwankpa, J. K., and Y. Roumani. 2016. IT capability and digital transformation: A firm performance perspective. *2016 International Conference on Information Systems, ICIS 2016*: 1–16.
Overby, E., A. Bharadwaj, and V. Sambamurthy. 2006. Enterprise agility and the enabling role of information technology. *European Journal of Information Systems* 15(2): 120–31.
Pérez-Luño, A., J. Wiklund, and R. V. Cabrera. 2011. The dual nature of innovative activity: How entrepreneurial orientation influences innovation generation and adoption. *Journal of Business Venturing* 26(5): 555–71.
Przychodzen, J., and W. Przychodzen. 2014. Relationships between eco-innovation and financial performance—Evidence from publicly traded companies in Poland and Hungary. *Journal of Cleaner Production* 90: 253–63.
Queiroz, M., P. P. Tallon, R. Sharma, and T. Coltman. 2018. The role of IT application orchestration capability in improving agility and performance. *Journal of Strategic Information Systems* 27(1): 4–21.
Rai, A., and X. Tang. 2010. Leveraging IT capabilities and competitive process capabilities for the management of interorganizational relationship portfolios. *Information Systems Research* 21(3): 516–42.
Rauch, A., J. Wiklund, G. T. Lumpkin, and M. Frese. 2009. Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future. *Entrepreneurship: Theory and Practice* 33(3): 761–87.
Roberts, N., P. S. Galluch, M. Dinger, and V. Grover. 2012. Absorptive capacity and information systems research: Review, synthesis, and directions for future research. *MIS Quarterly* 36(2): 625–48.
Rosenthal, R. 1979. The file drawer problem and tolerance for null results. *Psychological Bulletin* 86(3): 638–41.
Ross, J. W., C. M. Beath, and D. L. Goodhue. 1996. Develop long-term competitiveness through IT assets. *IEEE Engineering Management Review* 26(2): 31–42.
Saebi, T., and N. J. Foss. 2015. Business models for open innovation: Matching heterogeneous open innovation strategies with business model dimensions. *European Management Journal* 33(3):

201–13.
Sambamurthy, V., A. Bharadwaj, and V. Grover. 2003. Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly* 27(2): 237–63.
Savino, T., A. Messeni Petruzzelli, and V. Albino. 2017. Search and recombination process to innovate: A review of the empirical evidence and a research agenda. *International Journal of Management Reviews* 19(1): 54–75.
Schafer, J. L., and J. W. Graham. 2002. Missing data: Our view of the state of the art. *Psychological Methods* 7(2): 147–77.
Sciascia, S., L. Naldi, and E. Hunter. 2006. Market orientation as determinant of entrepreneurship: An empirical investigation on SMEs. *International Entrepreneurship and Management Journal* 2(1): 21–38.
Sheehan, K. B. 2001. E-mail survey response rates: A review. *Journal of Computer-Mediated Communication* 6(2).
Sinkula, J. M. 1994. Market information processing and organizational learning. *Journal of Marketing* 58(1): 35.
Soper, D. S. 2021. A-priori sample size calculator for structural equation models and for multiple regression.
Sullivan, I., A. DeHaven, and D. Mellor. 2019. Open and reproducible research on open science framework. *Current Protocols in Essential Laboratory Techniques* 18(1): 1–24.
Swanson, E. B., and N. C. Ramiller. 2004. Innovating mindfully with information technology. *MIS Quarterly* 28(4): 553–83.
Tallon, P. P., and A. Pinsonneault. 2011. Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly: Management Information Systems* 35(2): 463–86.
Tan, M., and T. S. H. Teo. 2000. Factors influencing the adoption of internet banking In kenya. *IOSR Journal of Business and Management* 1(5): 1–43.
Tang, J., Z. Tang, L. D. Marino, Y. Zhang, and Q. Li. 2008. Exploring an inverted u-shape relationship between entrepreneurial orientation and performance in Chinese ventures. *Entrepreneurship Theory and Practice*: 219–39.
Tanriverdi, H. 2005. Information technology relatedness, knowledge management capability, and performance of multibusiness firms. *MIS Quarterly* 29(2): 311–34.
Tomlinson, P. R. 2010. Co-operative ties and innovation: Some new evidence for UK manufacturing. *Research Policy* 39(6): 762–75.
Vance, A., C. Elie-dit-cosaque, and D. W. Straub. 2008. Examining trust in information technology artifacts: The effects of system quality and culture. *Journal of Management Information Systems* 24(4): 73–100.
Vanhaverbeke, W., V. Van de Vrande, and H. Chesbrough. 2008. Understanding the advantages of open innovation practices in corporate venturing in terms of real options. *Creativity and Innovation Management* 17(4): 251–8.
Venkatesh, V., and H. Bala. 2012. Adoption and impacts of interorganizational business process standards: Role of partnering synergy. *Information Systems Research* 23(4): 1131–57.
Venkatraman, N. 1989. The concept of fit in strategy research: Toward verbal and statistical correspondence. *The Academy of Management Review* 14(3): 423.
Verhoef, P. C., and P. S. H. Leeflang. 2009. Understanding the marketing department's influence within the firm. *Journal of Marketing* 73(2): 14–37.
Wagner, E. R., and E. N. Hansen. 2005. Innovation in large versus small companies: Insights from the US wood products industry. *Management Decision* 43(6): 837–50.
Walter, A., M. Auer, and T. Ritter. 2006. The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Journal of Business Venturing* 21(4): 541–67.
Wang, C. L. 2008. Entrepreneurial orientation, learning orientation, and firm performance. *Entrepreneurship Theory and Practice*: 635–57.
Weill, P., M. Subramani, and M. Broadbent. 2002. Building IT infrastructure for: Strategic agility. *MIT Sloan Management Review* 44(1): 57–65.
West, J., and M. Bogers. 2014. Leveraging external sources of innovation: A review of research on

open innovation. *Journal of Product Innovation Management* 31(4): 814–31.
Westland, C. J. 2010. Lower bounds on sample size in structural equation modeling. *Electronic Commerce Research and Applications* 9(6): 476–87.
Wiklund, J., and D. Shepherd. 2003. Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses. *Strategic Management Journal* 24(13): 1307–14.
Wiklund, J., and D. Shepherd. 2005. Entrepreneurial orientation and small business performance: A configurational approach. *Journal of Business Venturing* 20(1): 71–91.
Wu, S., J. Jin, J. Chen, and W. Vanhaverbeke. 2009. Open innovation strategy in the process of technological capability development: Conceptual framework aspect. *IE and EM 2009 - Proceedings 2009 IEEE 16th International Conference on Industrial Engineering and Engineering Management*: 657–60.
Zhang, J. A., F. Edgar, A. Geare, and C. O'Kane. 2016. The interactive effects of entrepreneurial orientation and capability-based HRM on firm performance: The mediating role of innovation ambidexterity. *Industrial Marketing Management* 59: 131–43.
Zhang, P., K. Zhao, and R. L. Kumar. 2016. Impact of IT governance and IT capability on firm performance. *Information Systems Management* 33(4): 357–73.
Zhou, K. Z. 2006. Innovation, imitation, and new product performance: The case of China. *Industrial Marketing Management* 35(3): 394–402.
Zhou, K. Z., C. K. Yim, and D. K. Tse. 2005. The effects of strategic orientations on technology- and market-based breakthrough innovations. *Journal of Marketing* 69(2): 42–60.

Table 1. Core items adjusted according to the literature

Items	Item based on	Measurement
External search breadth and depth		
To what degree does your company use the following external knowledge sources? (1) Suppliers of equipment, materials, components, or software (2) Clients or customers (3) Competitors (4) Consultants (5) Commercial laboratories/R&D enterprises (6) Universities or other higher education institutes (7) Private research institutes (8) Government research institutes	Laursen and Salter (2006)	(0) to almost no degree ... (3) to a rather high degree

Table 2. Reliability and validity analysis results

	CR	AVE	MSV	MaxR(H)	ITC	EO	IP
ITC	0,961	0,891	0,498	0,962	**0,944**		
EO	0,918	0,790	0,498	0,989	0,706	**0,889**	
IP	0,712	0,553	0,127	0,989	0,257	0,356	**0,744**

Table 3. Results of multivariate regression models

	Controls		Model 1		Model 2		Model 3		Model 4		Model 5	
	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p
(Constant)		0,852		0,788		0,766		0,733		0,861		0,860
Firm Age	-0,043	0,620	-0,060	0,493	-0,033	0,696	-0,033	0,699	-0,038	0,665	-0,038	0,666
Firm Size	0,114	0,188	0,019	0,843	0,023	0,803	0,025	0,784	0,009	0,922	0,009	0,921
Open Innovation (OI) breadth (OIB)			**0,192**	**0,036**	**0,190**	**0,032**	**0,190**	**0,032**	**0,210**	**0,022**	**0,210**	**0,022**
OI depth (OID)			0,133	0,104	0,068	0,398	0,025	0,802	0,119	0,144	0,116	0,245
IT Capability (ITC)			-0,155	0,170	0,010	0,934	0,000	0,998	-0,146	0,194	-0,148	0,199
Entrepre-neurial Orientation (EO)			**0,236**	**0,035**	0,141	0,201	0,137	0,215	**0,246**	**0,033**	**0,246**	**0,033**
OIDxITC					**-0,431**	**0,000**	**-0,447**	**0,000**				
OIDxEO					**0,293**	**0,007**	**0,298**	**0,006**				
OIDxEOx ITC							0,071	0,456				
OIBxITC									**-0,246**	**0,036**	**-0,247**	**0,036**
OIBxEO									0,206	0,088	0,206	0,089
OIBxEOx ITC											0,006	0,951
R^2 / adj. R^2	0,011	-0,002	0,122	0,088	0,199	0,158	0,202	0,155	0,146	0,102	0,146	0,097
F-Test / sig.	0,877	0,418	3,62	0,002	4,814	0	4,329	0	3,325	0,002	2,937	0,003
Power				0,960		0,999		0,998		0,977		0,971

Table 4. Overview of findings

H1a/b	External search (a) breadth and (b) depth have an inverse u-shaped relationship with innovation performance.	(a) Only upward-part (b) No
H2	IT capability has a positive direct effect on innovation performance.	No
H3a	IT capability positively moderates the relationship between external search breadth and innovation performance.	Reverse sign (5%-level)
H3b	IT capability positively moderates the relationship between external search depth and innovation performance.	Reverse sign (0.1%-level)
H4	Entrepreneurial orientation has a positive direct effect on innovation performance.	Yes (5%-level)
H5a	Entrepreneurial orientation positively moderates the relationship between external search breadth and innovation performance.	Borderline (10%-level)
H5b	Entrepreneurial orientation positively moderates the relationship between external search depth and innovation performance.	Yes (1%-level)
H6a/b	IT capability positively moderates the combined effect of external search (a) breadth and (b) depth and entrepreneurial orientation on innovation performance.	(a) No (b) No

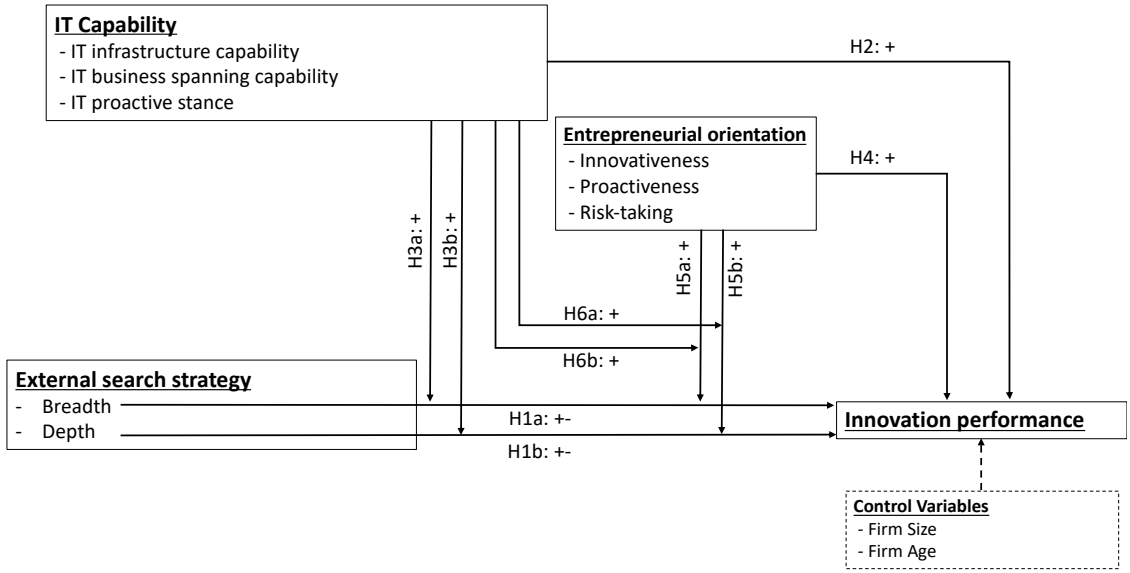


Figure 1. Hypotheses in the structural model

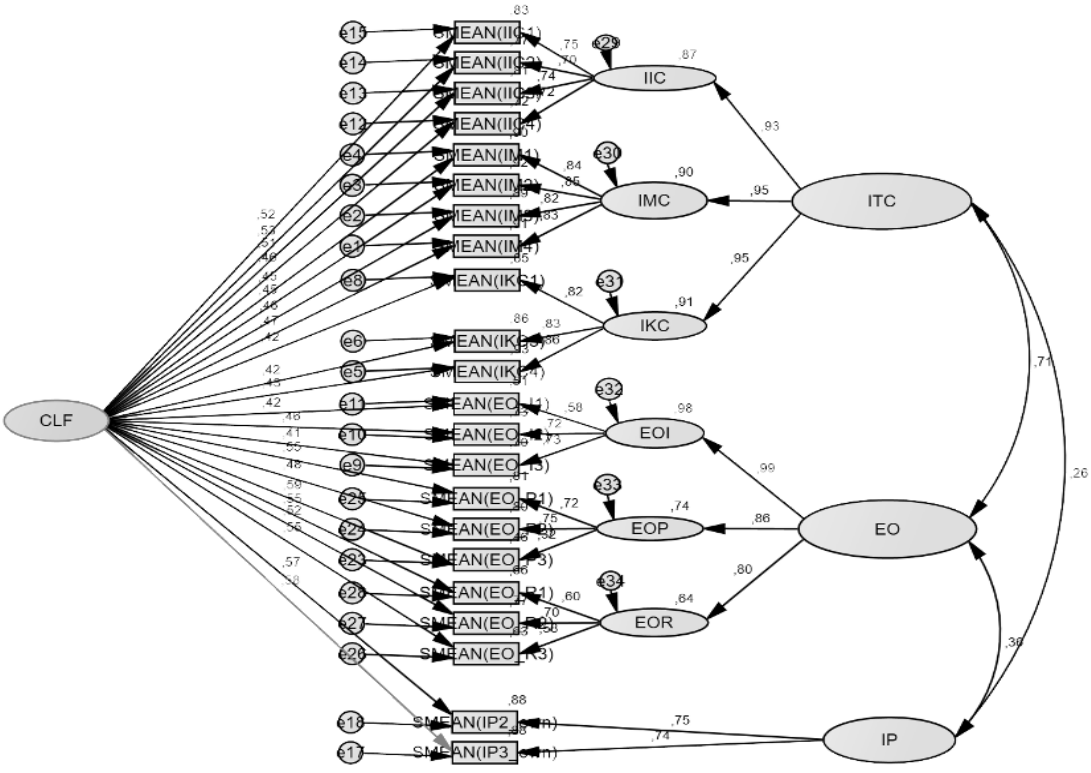


Figure 2. Final Confirmatory Factor Analysis (CFA)-model structure; common latent factor (CLF), IT Capability (ITC), IT infrastructure capability (IIC), IT business spanning capability (IMC), IT proactive stance (IKC); Entrepreneurial Orientation (EO); Innovativeness (EOI), Proactiveness (EOP), Risk-taking (EOR); and Innovation Performance (IP)

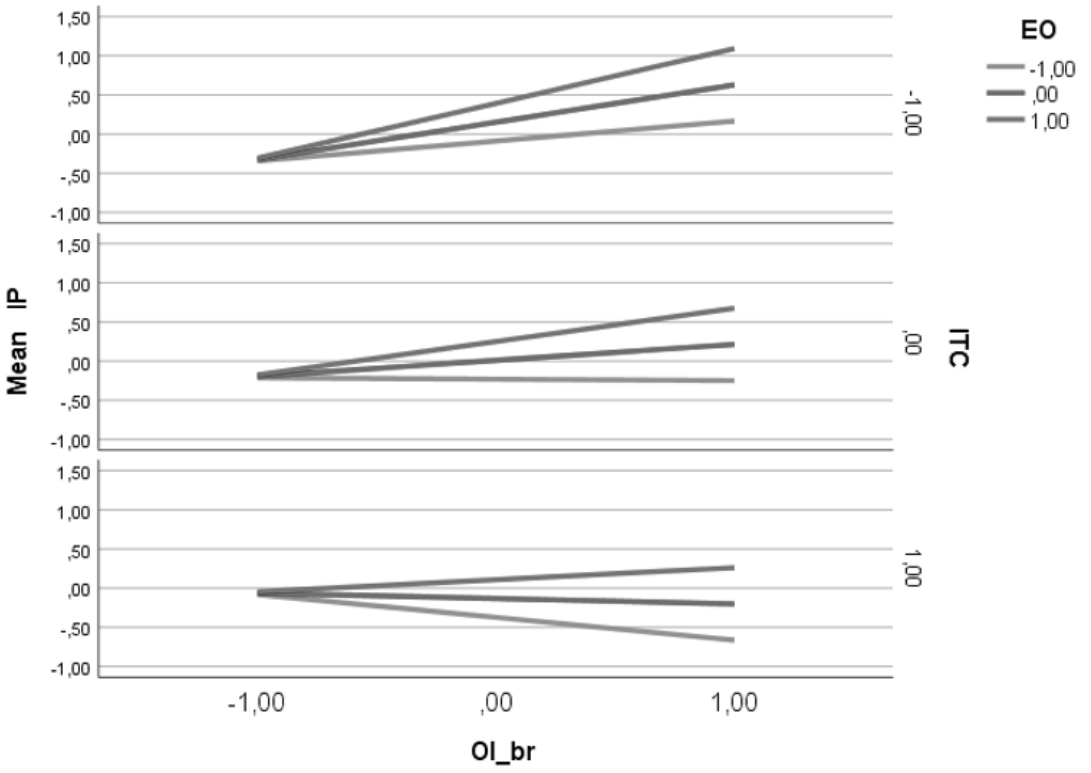


Figure 3. Illustration of the interaction effect between Entrepreneurial Orientation (EO), IT Capability (ITC), and Open Innovation (OI)-breadth

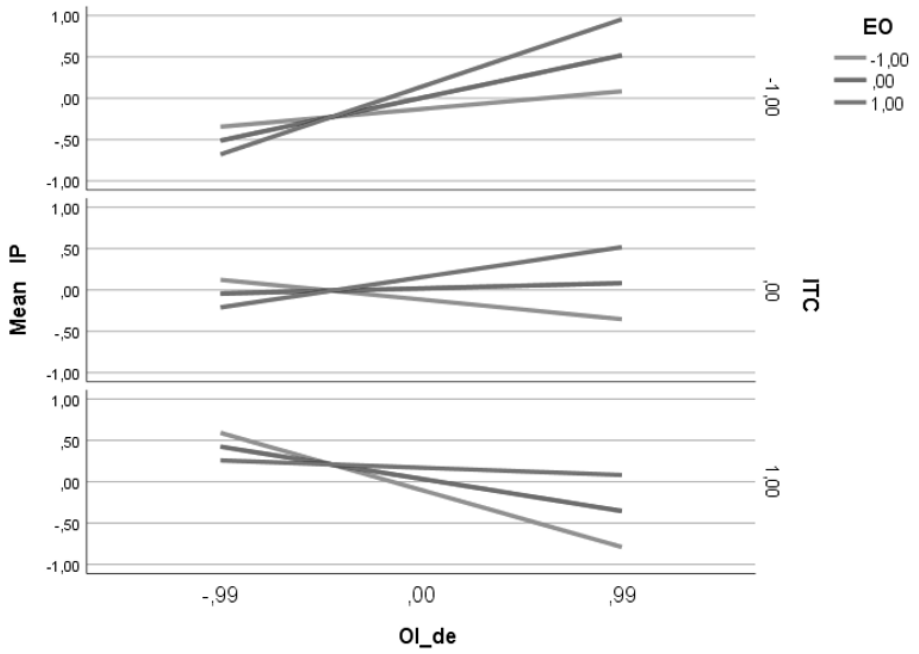


Figure 4. Illustration of the interaction effect between Entrepreneurial Orientation (EO), IT Capability (ITC), and Open Innovation (OI)-depth

L

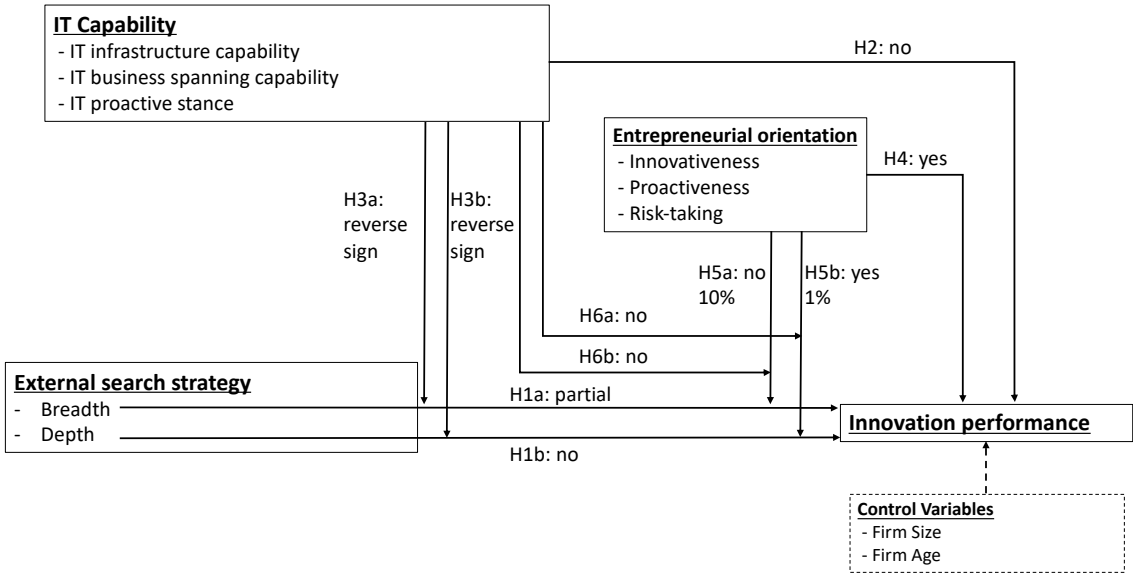


Figure 5. Overview of findings in the structural model

Contribution III

Table 5: Overview Contribution III

Title	**Linking the use of knowledge management systems and employee creative performance: The influence of creative process engagement and motivation**
Author	Herbst, Tobias D.; Hausberg, J. Piet
Year	2021
Outlet	International Journal of Innovation Management
Ranking	VHB: B
Status	Published
Online	https://www.worldscientific.com/doi/abs/10.1142/S1363919622500475
Biblio-graphical Information	-
Abstract	Although prior studies have examined the positive direct effect of using knowledge management systems (KMSs) on firm performance, scholars have devoted scant attention to their impact on creative performance at the employee level even though individuals primarily provide creative outputs. To investigate the impact of using KMSs on employee creative performance and help clarify the relevant contingencies that positively affect this relationship, we develop a theoretical model that links KMS usage with intrinsic and extrinsic motivation and creative process engagement and explore their contribution to employee creative performance. Using data from an online survey of 528 employees, the empirical results show that KMS usage raises employee creative performance. Moreover, intrinsic and extrinsic motivation and creative process engagement increase employee creative performance. However, we find no positive moderating impact of intrinsic and extrinsic motivation or creative process engagement on the KMS usage–employee creative performance relationship.
Keywords	Knowledge Management, Knowledge Management Systems, Creativity, Motivation, Creative Process Engagement

Contribution IV

Table 6: Overview Contribution IV

Title	**Knowledge Management System Usage and Creative Performance: Moderating Role of Absorptive Capacity and Motivation**
Author	Herbst, Tobias D.; Hausberg J. Piet
Year	2022
Outlet	International Studies of Management & Organization
Ranking	VHB: C
Status	Under review since 17.07.2022
Online	-
Bibliographical Information	-
Abstract	The COVID-19 pandemic has disrupted firms' prior working modes. As more employees are required to work from home, firms need to successfully implement remote working and distance learning conditions. In this context, knowledge management systems (KMSs) are helpful in sharing knowledge and enhancing employee creativity, regardless of their place of work. This study elucidates the antecedents that moderate the impact of KMS usage on employees' creative performance. It explores how absorptive capacity (AC), as well as extrinsic and intrinsic motivation, directly influences employees' creative performance and their moderating effects. Results from an online survey of 415 employees indicate that KMS usage increases employees' creative performance. Moreover, AC as well as extrinsic and intrinsic motivation have a positive direct effect on employees' creative performance. However, the authors find no positive moderating effect of AC or extrinsic and intrinsic motivation on the relationship between KMS usage and employees' creative performance.
Keywords	Remote Working, Remote Collaboration, Information Technology, Distance Learning, Home Office, COVID-19, Employees, Innovation, Competitiveness, Performance, Networks, Ability

Knowledge Management System Usage and Creative Performance: The Moderating Role of Absorptive Capacity and Motivation

Abstract

The COVID-19 pandemic has disrupted firms' prior working modes. As more employees are required to work from home, firms need to successfully implement remote working and distance learning conditions. In this context, knowledge management systems (KMSs) are helpful in sharing knowledge and enhancing employee creativity, regardless of their place of work. This study elucidates the antecedents that moderate the impact of KMS usage on employees' creative performance. It explores how absorptive capacity (AC), as well as extrinsic and intrinsic motivation, directly influences employees' creative performance and their moderating effects. Results from an online survey of 415 employees indicate that KMS usage increases employees' creative performance. Moreover, AC as well as extrinsic and intrinsic motivation have a positive direct effect on employees' creative performance. However, the authors find no positive moderating effect of AC or extrinsic and intrinsic motivation on the relationship between KMS usage and employees' creative performance.

Keywords: Remote Working, Remote Collaboration, Information Technology, Distance Learning, Home Office, COVID-19, Employees, Innovation, Competitiveness, Performance, Networks, Ability

Acknowledgements: The authors are grateful to the editors and anonymous reviewers for their valuable feedback.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Introduction

In today's competitive and dynamic environments, firms need to find ways to operate successfully, and thus achieve competitive advantage. In most sectors, to sustain competitive advantage and survive in the long run, firms also need to innovate continuously, at least to some degree. Extant research highlights the importance of knowledge as a resource that enables innovation, and thus, sustainable competitive advantage. However, the mere existence of knowledge in a portion of a firm is not sufficient. To develop new products and services, knowledge must be transferred within and across firm boundaries. In the past, remote work was viewed mainly as a change in the spatiality of work; for example, it improved the lives of long-distance commuters (Hardill & Green, 2003). However, the COVID-19 pandemic has revealed both the challenges as well as the vital importance of effective, continued remote collaboration (Wang et al., 2021). Some studies show ways to improve knowledge sharing under such peculiar circumstances (Lee et al., 2020). However, knowledge sharing by itself is not sufficient to generate creative outputs. Firms need to facilitate the creative usage of available knowledge.

Therefore, how to manage internal and external knowledge effectively is highly relevant for strategic innovation management, particularly with the increasing diffusion of remote and smart work practices. Due to advancements in information technology (IT), knowledge management systems (KMSs) are effective and used extensively in corporate settings. Prior studies highlight the positive direct effect of KMS usage on firm performance, which helps to create knowledge by linking individuals and organizations. Specifically, employees provide the creative output. Up to 70 percent of initiatives fail because they do not integrate and link human resources, processes, and technology (Petter et al., 2008). Hence, investing in KMSs alone is not sufficient. Despite their relevance and the evident difficulty in implementing them effectively, the contingency factors that render KMS usage effective have been scarcely studied. Therefore, the authors investigate the effect of KMS usage on employees' creative performance and help clarify relevant contingencies that positively affect this relationship.

The authors noted a lack of research on the moderating role of intrinsic and extrinsic motivation, as well as absorptive capacity (AC), on the relationship between KMS usage and employees' creative performance. Despite employee creativity being an essential factor in firm innovation performance, research examining the effects of AC, KMS usage, and motivation on creative performance at the employee level is scarce. In rare exceptions, employees' motivation and ability are investigated jointly to understand the effect of AC on some form of innovative output; however, this does not consider KMS usage and returns to firm-level of analysis in the dependent variable (Liao et al., 2007).

Against these backdrops, the authors endeavor to contribute to the understanding of KMS usage and the impact on creative performance, at the individual (employee) level. Further, the authors analyze the direct and moderating effects of employee motivation and AC that affect the impact of KMS usage on employee creative performance. The specific research question is as follows: How does KMS usage influence employees' creative performance, and what roles do AC and motivation play? Based on the research question, a theoretical model that links KMS usage at the individual (employee) level to creative performance and incorporates relevant contingencies, namely motivation and AC, will be developed.

This study makes several contributions. First, it provides an interdisciplinary model connecting the research on knowledge management, motivation, and creativity. Second, the authors intend to demonstrate that KMS usage supports employees' creative performance and motivation, and that AC supports this effect. Finally, the study aims to elucidate the direct effects of intrinsic and extrinsic motivation, as well as AC on employees' creative performance.

Background

Scholars have explored many vital factors that may positively influence innovation capability. In particular, knowledge is viewed as an essential resource for driving innovation and gaining competitive advantages (Grant, 1996; Penrose, 1959). Moreover, knowledge is pivotal in fostering employees' creative performance, defined as generating novel and useful ideas at the individual level. This creative output by employees is the first step toward innovation (Anderson et al., 2014). Prior exploratory (Cao et al., 2013) and empirical (Wu & Wang, 2006) studies highlight the crucial impact of KMS usage on facilitating competitive advantage. However, they focus on the firm level, while disregarding the employee level, which drives a system's success. Building on the Motivation-Opportunity-Ability framework (MacInnis & Jaworski, 1989), the authors suggest a similar concept, but on an individual level. Further, behavioral output, in terms of creative performance, depends on more than just the opportunities available, such as the presence of KMSs. Instead, motivation and ability must reach a certain threshold to allow for the effective generation of creative outputs.

First, motivation is pivotal in increasing employee creativity (Amabile & Pratt, 2016). Most relevant studies distinguish between intrinsic and extrinsic motivation (Deci et al., 1982). Intrinsically motivated employees perform tasks based on pure interest or pleasure. Extrinsically motivated employees are driven and engaged by personal benefit (e.g., material or social rewards; Amabile, 1993; Vallerand, 2000). Of these two, prior research mainly focuses on the positive influence of intrinsic motivation on innovation and creativity (Anderson et al., 2014). The influence of extrinsic motivation on creativity is debatable (Anderson et al., 2014). After investigating the positive effect of extrinsic motivation on more complex (creative) tasks, researchers find added value in tasks that are easy to perform and measure (Bareket-Bojmel et al., 2017).

Second, if knowledge is key for creativity and innovation, the ability to absorb knowledge should be among the most important abilities in this context. AC was first defined as the ability to "identify, assimilate, and exploit knowledge from the environment" (Cohen & Levinthal, 1989, p. 589). Existing studies highlight the link between AC and firm learning, innovation, and performance (Volberda et al., 2010) and, ultimately, firms' competitive advantage (Lane et al., 2006). However, recent studies have investigated AC on more profound analysis levels, such as departmental (Hausberg & Leeflang, 2019) and individual (Beck et al., 2020) levels. In fact, individual-level AC has been found to affect—jointly with knowledge sharing—the innovative behavior of R&D employees (Kang & Lee, 2017).

Knowledge Management Systems

Knowledge is generated when an individual processes information(Alavi & Leidner, 2001). In this context, firms should identify and exploit their knowledge, defined as knowledge management (von Krogh, 1998, 2009), as knowledge enables innovation (Collins & Smith, 2006; Penrose, 1959). Firms increasingly leverage IT to manage internal and external knowledge (Lin & Huang, 2008). More specifically, they use knowledge management techniques based on IT, defined as KMSs, to manage their corporate knowledge across their boundaries (Alavi & Leidner, 2001).

Furthermore, according to Alavi and Leidner, (2001), firms may benefit from corporate knowledge directories, knowledge networks, and coding and sharing best practices. Prior studies (e.g., Cao et al., 2013; Wu & Wang, 2006), highlight the crucial impact of KMSs' usage on facilitating competitive advantage. However, they focus on the firm level, while disregarding the employee level, which drives a system's success. Cao et al., (2013) analyze the role of KMSs on individual and business performance. They find that KMS utilization positively influences business performance and, more importantly, leads to improved firm and individual (employee) performance. One of the scarce empirical studies on KMSs, at the individual level, analyzes the effect of KMSs on innovation (Elmorshidy, 2018). The study finds that KMS usage improves multiple aspects of employees' work, for instance, facilitates new ideas to solve problems and accomplish complex tasks faster (Elmorshidy, 2018). Thus, in contrast to the existing research on

KMSs at a firm level and its impact on (innovation) performance (Petter et al., 2008), the authors attempt to elucidate the effects of KMS usage at the individual level.

Employee Creative Performance

Employees' creative performance refers to the development of novel and useful ideas that address the firm level and are related to products (including services), procedures, and practices (Amabile, 1988; Oldham & Cummings, 1996; Shalley et al., 2004). Novel ideas contribute to the firm's existing ideas (Oldham & Cummings, 1996). Ideas are useful when (directly or indirectly) they contribute to a firm's success (Shalley et al., 2004). Further Anderson et al. (2014) and Shalley et al. (2004) highlight employee creativity as the first step toward innovation and as vital for firms' competitiveness (Oldham & Cummings, 1996).

The importance of employee creativity in terms of innovation is widely recognized (e.g., Madjar et al., 2002; Oldham & Cummings, 1996; Shalley et al., 2004). Thus, prior research has found extensive contextual factors and personal drivers fostering employee creativity (Anderson et al., 2014; Oldham & Cummings, 1996; Shalley et al., 2004). Importantly, in their study, Mumford and Hunter (2005) found that knowledge supports new and useful ideas.

Absorptive Capacity

In their seminal work, Cohen and Levinthal (1990) built the AC concept, based on three dimensions: identification (recognize the value of, and acquire, new knowledge), assimilation (processing of new knowledge), and utilization (effective use of new knowledge). Furthermore, Jansen et al. (2005) highlight AC as being resident at both firm and unit levels (Cohen & Levinthal, 1990). AC has been studied extensively (Lane et al., 2006; Zahra & George, 2002) on both firm and unit levels (e.g., Hausberg & Leeflang, 2018; Hotho et al., 2012; Jansen et al., 2005; Kostopoulos et al., 2011; Liao et al., 2007).

Although firms AC depends on their employees' AC (Cohen & Levinthal, 1990), AC has been scarcely studied at the individual level (Enkel et al., 2016). In line with Cohen & Levinthal's (1990) definition, Enkel et al. (2016) refer to individual AC, comprising "three dimensions: individuals' ability to identify valuable knowledge external to the existing firm environment, individuals' ability to assimilate the external knowledge to existing organizational identity, and individuals' ability to advocate for the utilization of the external knowledge within an organization" (Enkel et al., 2016, p. 1). Davis and Da Silva (2011) investigate AC in academia at the individual level and demonstrate the positive effect of AC on creativity and innovation. Some rare studies investigate AC and IT (Deng et al., 2008) or information systems link (IS) (Wang et al., 2014). Deng et al. (2008) highlight the positive effect of AC on IT enabled engineer work and further highlight its impact on task innovation. Wang et al. (2014) emphasize that individual AC positively mediates the relationship between innovations and IS usage. Based on these findings, this study aims to investigate the direct and moderating effect of individual AC on employee creative performance.

Motivation

According to the self-determination theory (Deci & Ryan, 1987) (employees') behavior may be intrinsically or extrinsically motivated. Further, Amabile (1993) split motivation, as a multidimensional construct, into intrinsic and extrinsic motivation. Intrinsic motivation stems from the task itself; hence, employees process tasks out of enjoyment or interest in the topic (Amabile, 1993; Deci & Ryan, 1987). In contrast, extrinsically motivated employees are driven by personal benefits, such as external incentives (e.g., material rewards; Amabile (1993)). Prior research highlights motivation as a key factor fostering IT acceptance (Davis et al., 1992; Teo et al., 1999; Venkatesh et al., 2003) and the greater effectiveness of intrinsic motivation (Cho & Perry, 2012).

Hypotheses and conceptual model

Direct effects

The use of knowledge management systems

Proper KMSs, accompanied by advanced IT infrastructure (e.g., platforms, communication technology), support the effective sharing of internal and external knowledge (Chen et al., 2017; Soto-Acosta & Cegarra-Navarro, 2016). Further, IT infrastructure may help employees to communicate and share internal and external information within knowledge networks (Alavi & Leidner, 2001; Lu & Ramamurthy, 2011) and thus develop new knowledge for novel ideas. In addition, KMSs help in setting up a well-diverse and transparent information sharing structure that is available throughout the firm, thus help in acquiring new information (Alavi & Leidner, 2001). Therefore, the authors hypothesize the following:

Hypothesis One: The higher the knowledge management system (KMS) usage, the higher the employee creativity (MCRE).

Individual level absorptive capacity

Some studies have revealed a positive effect of individual AC on individual creativity (Seo et al., 2015), innovative behavior (Kang & Lee, 2017), and innovation capability (Liao et al., 2007). Moreover, prior studies highlight that AC causes more willingness to share knowledge (Ko et al., 2005) and thus may increase the use of new knowledge for innovative ideas. Following this reasoning, the authors hypothesize the following:

Hypothesis Two: The higher the employee absorptive capacity (AC), the higher the employee creativity (MCRE).

Extrinsic and intrinsic motivation

Montag et al. (2012) demonstrated that extrinsic motivation raises creativity when creative performance is part of the job requirements. As such, the authors expect the same results and hypothesize the following:

Hypothesis Three: The higher the extrinsic motivation (EXMO), the higher the employee creativity (MCRE).

Ryan and Deci (2020) found that intrinsic motivation fosters individual engagement. Moreover, existing studies highlight the positive impact of intrinsic motivation on creative performance (Cerasoli et al., 2014; Liu et al., 2016). Hence, the authors hypothesize the following:

Hypothesis Four: The higher the intrinsic motivation (INMO), the higher the employee creativity (MCRE).

Moderating effects

The moderating role of individual level absorptive capacity

Minbaeva et al. (2003) revealed that, in prior research, the combined effect of motivation and AC at a firm level is not examined; the same is true for the individual level. At the individual level, Yildiz et al. (2019) reveal that employees' intrinsic motivation is an important antecedent of AC, while their extrinsic motivation fails to perform as a predictor. Further, the authors follow Liao et al.'s (2007) argument that only motivated employees are willing to share their knowledge, and through motivation, employees are willing to learn. In addition, the authors conclude that Minbaeva et al.'s (2003) findings, at a firm level, that motivation is a key dimension for firms' AC, may also be true at the individual level. Moreover, the greater the AC, the more employees use IT to solve problems, resulting in an improved task innovation performance (Deng et al., 2008). Further, Wang et al. (2014) found this positive correlation tin the IS environment by showing the moderating effect of AC on innovation with IT usage. Based on the previous discussion, the authors conclude that AC leads to greater IT usage and improved creative performance. Combining these aspects, the authors may assume:

Hypothesis Five: The higher the employee absorptive capacity (AC), the higher the effect of knowledge management system (KMS) usage on employee creativity (MCRE).

The moderating roles of extrinsic and intrinsic motivation

Hansen & Levin (2016) highlight a strong effect of employees' extrinsic motivation on their intention to use (social media) technology for work tasks. More specifically, extrinsic motivation incentivizes employees to use and contribute to KMSs, which may positively influence the generation of new ideas (Eisenberger & Shanock, 2003; Montag et al., 2012). Hence, the authors hypothesize the following:

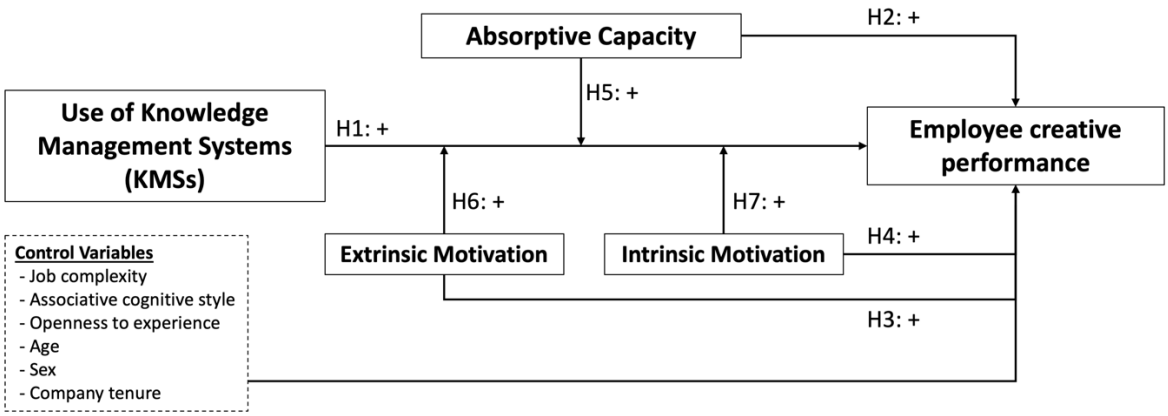
Hypothesis Six: The higher the extrinsic motivation (EXMO), the higher the effect of knowledge management systems (KMS) usage on employee creativity (MCRE).

Motivation drives IT acceptance (Teo et al., 1999; Venkatesh et al., 2003) and intrinsic motivation is a prerequisite for great achievements (Meyer et al., 2004). Kuvaas & Dysvik (2009) demonstrate that intrinsically motivated employees exhibit great creative performance and are self-motivated to use KMSs while facing new tasks. Therefore, the authors hypothesize the following:

Hypothesis Seven: The higher the intrinsic motivation (INMO), the higher the effect of the use of knowledge management systems (KMS) on employee creativity (MCRE).

Figure 1 shows the research model used and summarizes the hypotheses formulated in this study.

Figure 1. Overview of results in the structural model



Methodology

Operationalization

The multi-items scales employed in this study are mainly based on existing studies. Respondents answered questions based on adapted items and scales to fit this study's individual research level (self-rated items).

The use of Knowledge Management Systems: This study adapted eight items from Lin & Huang (2008) that measure KMS usage and support. As this study explores KMS usage at the individual (employee) level, the authors adjusted the items accordingly. For instance, a statement read, "I use the KMSs of our organization to collaborate with other persons inside the organization." Participants rated the eight items based on a five-point scale, ranging from "never" (0) to "very frequently" (4).

Employee creative performance: The authors adapted three items from Shalley et al. (2009) that are based on Oldham & Cummings (1996). The participants rated their creative performance individually, based on a seven-point Likert-type scale, ranging from "disagree very strongly" (3) to "agree very strongly" (+3) and with a midpoint labeled "neither agree nor disagree" (0).

Absorptive Capacity: The researchers adapted Enkel et al.'s (2017) operationalization at the individual level, based on three dimensions (identification, assimilation, and utilization of knowledge). A statement read, "I systematically analyze advantages and weaknesses of existing

products and services on the market." Participants were required to answer an overall of 23 items based on a seven-point Likert-type scale, ranging from "disagree very strongly" (3) to "agree very strongly" (+3) and with a midpoint labeled "neither agree nor disagree" (0).

Extrinsic motivation: The authors adapted four items from Zhu et al. (2016) that are based on Manolopoulos (2006). Participants rated the four items based on seven-point Likert scales, ranging from "disagree very strongly" (-3) to "agree very strongly" (+3) and with a midpoint labeled "neither agree nor disagree" (0).

Intrinsic motivation: This study adapted four items from Wilkesmann et al. (2009). Participants rated the four items based on seven-point Likert scales, ranging from "disagree very strongly" (-3) to "agree very strongly" (+3) and with a midpoint labeled "neither agree nor disagree" (0).

Control variables: Multiple control variables control effects that may significantly influence employees' creativity (X. Zhang & Bartol, 2010; Xiaomeng Zhang & Bartol, 2010). This study controls for age, sex (female, male, diverse), and company tenure (Gong et al., 2012; X. Zhang & Bartol, 2010; Xiaomeng Zhang & Bartol, 2010). In addition, the authors control for job complexity, adapted from Zacher and Frese (2011) and based on Semmer (1982), using four items that participants need to rate, which are based on a five-point scale ranging from "never" (0) to "very frequently" (4). Moreover, the study controls for associative cognitive style, adapted from Shalley et al. (2009) and, based on Jabri (1991), using three items. Participants rated the three items based on seven-point Likert scales ranging from "disagree very strongly" (-3) to "agree very strongly" (+3) and with a midpoint labeled "neither agree nor disagree" (0). Finally, the authors control for openness to experience, adapted from Schweisfurth & Raasch (2018) and based on Rammstedt and John (2007), using two items that participants need to answer, which are based on seven-point Likert-type scales ranging from "disagree very strongly" (-3) to "agree very strongly" (+3) and with a midpoint labeled "neither agree nor disagree" (0).

Satisfaction (marker variable): For quality purposes, the authors included a theoretically distinct marker variable (Simmering et al., 2015). They adapted three items from Seiders et al. (2005) to measure the participants' satisfaction with Amazon MTurk, based on Voss et al. (1998). A statement read, "I am pleased with the overall service at MTurk." Participants rated the three items based on a scale varying from "disagree very strongly" (-3) to "agree very strongly" (+3), with a midpoint labeled "neither agree nor disagree" (0).

Sample and Data

The authors used an (online) survey design to empirically test the study's hypotheses. To achieve a high and useable feedback rate, the authors used Amazon Mechanical Turk (MTurk) as a crowdsourcing platform. Prior research highlights that MTurk provides reliable and construct validity, compared to conventional online research approaches (Kees et al., 2017; Smith et al., 2016), if certain specifications are complied with (Cheung et al., 2017). This study implemented various quality checks suggested by Cheung et al. (2017). First, the authors employed two filter requirements, which possible participants were required to meet before taking the survey. (1) MTurk users were required to have a full-time job (at least 35 hours per week) to avoid potential interference with mediating constructs (e.g., motivation or job complexity). (2) MTurk users were required to have a prior task approval rate of at least 96%. Second, the authors set various conditions for participation, which were required for the MTurk user's task to be accepted. These conditions included a maximum survey duration of 25 minutes to ensure a concentrated process without interruptions and sufficient understanding of items, by providing definitions and examples upfront and during the survey. The authors also highlighted rigorous quality checks (e.g., checking the same answers). If the quality checks were not met, participants could only repeat the survey once. To track non-repeated participation, the authors used the participants' MTurk worker IDs.

The survey was hosted on a private and secure university server, using an official university domain. The authors designed the survey as user-friendly and efficient to avoid interference and increase the response rate. Moreover, to ensure anonymous execution of the survey, the authors did not track any participants' data. The questionnaire was made available in English and German, and all items were presented randomly. A pre-test was conducted to check

for clarity and average duration of completion, and the authors assumed good construct validity as all items and scales were well understood.

Results

Data Screening and Sample Size

Thereafter, the survey was released for completion on MTurk. Overall, the authors received 515 complete questionnaires. First, the data were checked for plausibility, after which two cases had to be dropped because of invalid data. After controlling for the correct responses to the authors' filter variable, 444 cases remained. In 30 cases, age had to be recoded, because the year of birth had been entered. Next, data were inspected for unusual fast responses, while deleting cases in which the entire questionnaire had been completed in less than two minutes; overall, 415 cases remained, which is an acceptable sample size.

Factor analysis and item bundling

First, Harman's single factor test was performed, showing that 37% of variance could be explained by a single factor, which is well below the 50% threshold. Hence, this test did not provide any indication of an issue with common method bias. Next, inter-item correlations were checked and a principal component analysis was performed, which clearly showed the predicted number of latent variables. However, some items were dropped due to low factor loadings. The final items were bundled by dividing the sum of all latent variable items by the number of items. Table 1 shows the correlations of the thus created item-bundles.

Table 1. Pearson correlations with two-tailed significance levels; abbreviations used in this table: use of knowledge management systems (KMSs), absorptive capacity (AC), extrinsic motivation (EXMO), intrinsic motivation (INMO), employee creativity (MCRE), job complexity (JCX), associative cognitive style (ACS), and openness to experience (OTE)

		AC	EXMO	INMO	MCRE	JCX	ACS	OTE
KMS	Correlation	,585**	,382**	0,069	,481**	,449**	,264**	,303**
	p-value	0,000	0,000	0,158	0,000	0,000	0,000	0,000
AC	Correlation	1	,444**	,341**	,591**	,482**	,400**	,454**
	p-value		0,000	0,000	0,000	0,000	0,000	0,000
EXMO	Correlation	,444**	1	,147**	,406**	,297**	,311**	,303**
	p-value	0,000		0,003	0,000	0,000	0,000	0,000
INMO	Correlation	,341**	,147**	1	,298**	,197**	,298**	,211**
	p-value	0,000	0,003		0,000	0,000	0,000	0,000
MCRE	Correlation	,591**	,406**	,298**	1	,481**	,294**	,424**
	p-value	0,000	0,000	0,000		0,000	0,000	0,000
JCX	Correlation	,482**	,297**	,197**	,481**	1	,238**	,265**
	p-value	0,000	0,000	0,000	0,000		0,000	0,000
ACS	Correlation	,400**	,311**	,298**	,294**	,238**	1	,269**
	p-value	0,000	0,000	0,000	0,000	0,000		0,000

Regression Model

The variables were included stepwise in a sequence of multivariate ordinary least squares (OLS) regression models. The results of all six models are presented in Table 2. All models exhibited significant F-values and an adjusted R2 of up to 0.448. Given the sample size of 415 cases and 10 predictors, a statistical power of 0.8 was achieved for effects as small as 0.2. Given

that the correlations between independent variables were high, particular care was taken to identify potential multicollinearity. However, all variance inflation factors (VIF) in models 1 to 5 were below 2.5, the highest being that of AC with 2.222. Only the interaction terms exhibited VIFs of 8.5, 12.1, and 7.8, which is, however, a necessary side effect of interaction terms. Finally, the residuals were also normally distributed.

Table 2. Multivariate OLS regression results of models 1 to 6; abbreviations used in this table: see Table 1.

N = 415	**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**	
	Beta	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**	**Beta**	**Sig.**
(Constant)		0.042		0.000		0.011		0.008		0.001		0.007
AGE	-0.053	0.261	-0.001	0.978	-0.003	0.941	0.018	0.682	-0.006	0.899	-0.005	0.910
SEX	0.013	0.748	0.027	0.488	0.021	0.577	0.019	0.614	0.029	0.433	0.029	0.428
TENURE	0.017	0.712	0.011	0.805	-0.008	0.856	-0.007	0.877	-0.009	0.833	-0.007	0.864
JCX	0.370	0.000	0.279	0.000	0.214	0.000	0.208	0.000	0.198	0.000	0.205	0.000
ACS	0.126	0.003	0.096	0.021	0.035	0.393	0.019	0.645	-0.003	0.937	-0.006	0.895
OTE	0.292	0.000	0.247	0.000	0.172	0.000	0.159	0.000	0.153	0.000	0.150	0.000
KMS			0.259	0.000	0.140	0.004	0.127	0.009	0.149	0.002	0.171	0.089
AC					0.314	0.000	0.287	0.000	0.248	0.000	0.190	0.021
EXMO							0.119	0.007	0.115	0.008	0.226	0.016
INMO									0.121	0.004	0.143	0.091
ACxKMS											0.091	0.393
KMSxINMO											-0.043	0.737
KMSxEXMO											-0.136	0.183
Adj. R^2	0.333		0.380		0.428		0.437		0.448		0.446	
Change in F	35.456	0.000	31.807	0.000	35.510	0.000	7.478	0.000	8.474	0.783	0.654	0.391

In model 1, only control variables were included. Model 1 results indicate that four of the six control variables are significant predictors of employee creative performance. As predicted, higher openness to experience, associated cognitive style, and job complexity all lead to higher employee creative performance. Furthermore, as predicted, employee creative performance decreases with increasing age. In contrast, sex and tenure do not significantly influence employee creative performance.

In models 2 and 3, KMS and AC were also included, respectively. The inclusion of AC in model 3 did not affect the significance of KMS in model 2. Both KMS and AC exhibited highly significant effects on MCRE, with standardized regression coefficients of 0.259 and 0.314, respectively. However, the coefficient for KMS dropped to 0.140 once AC was included. Hence, KMS usage and individual AC both raise employee creative performance. Therefore, hypotheses One and Two were confirmed.

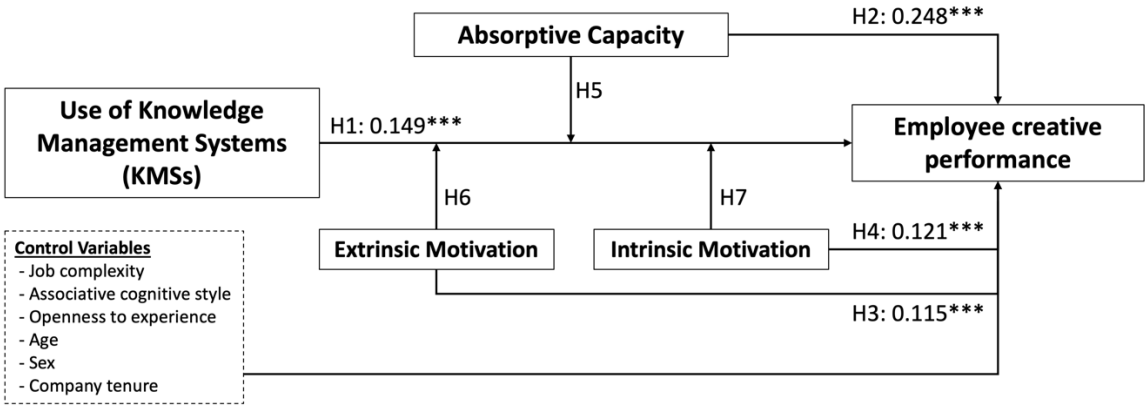
In models 4 and 5, the two types of motivations (EXMO and INMO) were included, which did not affect the significance of the previous two predictors. Both, EXMO and INMO, were highly significant, with standardized regression coefficients of 0.119 and 0.121, respectively. Thus, models 4 and 5 results indicate that extrinsic and intrinsic motivation significantly relate to employee creative performance. Hence, hypotheses Three and Four were confirmed, as well.

Finally, in model 6, the interaction terms of AC, INMO and EXMO with KMS were included into the model. However, in these cases, neither the interaction terms nor the changes in the two models' F-values were significant. The results did not change when the terms were included one by one. Thus, higher extrinsic motivation, intrinsic motivation, and, individual AC do not raise the effect of KMSs on employee creativity. Therefore, Hypotheses Five to Seven were rejected. This could mean that in the work environment the knowledge on how to perform

a task was enough to utilize and exploit the available KMSs and its information. Thus, the employees may be aware that using KMSs would help them to perform tasks more efficiently themselves and ultimately cause their engagement.

Figure 2 gives an overview of the findings of this study.

Figure 2. Overview of results in the structural model



Solutions and Recommendations

Based on the existing literature on KMS usage and employee creative performance, the authors developed a research model to investigate the effect of using KMSs on employee creative performance. Moreover, this study investigates the direct and moderating effect of individual AC, extrinsic motivation, and intrinsic motivation. Specifically, the research question was: Do individual AC and extrinsic and intrinsic motivations positively moderate the effect of KMS usage on employee creative performance?

Based on prior research, which states that the actual use of a system positively affects firm performance (Petter et al., 2008; Wu & Wang, 2006), the authors argued that KMS usage increases employees' creative performance; thereby, the authors contribute to the scarce research on KMS usage at the individual level (e.g., Khalifa et al., 2008). This study's results support the view that employee creative performance increases with higher KMS usage, which is in line with prior research that highlights the positive effect of information systems (e.g., Aldholay et al., 2018; Nguyen et al., 2015; Xinli, 2015).

The authors further revealed that both extrinsic and intrinsic motivations positively and directly affect employees' creative performance. For intrinsic motivation, this is in line with the existing research on creative performance (Cerasoli et al., 2014; Liu et al., 2016) and qualitative tasks (Zhu et al., 2016). For extrinsic motivation, however, prior studies found mixed results (Shalley et al., 2004), meaning, extrinsic motivation has positive and negative correlations, depending on the level of task complexity (e.g., Gagné & Deci, 2005; Kuvaas et al., 2016; Montag et al., 2012; Zhu et al., 2016).Following the call by Cerasoli et al. (2014), the authors explicitly contribute to the literature on extrinsic motivation, revealing its positive impact on employee creative performance. In contrast to the developed hypotheses, the authors could not find any evidence supporting the positive moderating effect of intrinsic and extrinsic motivation. This may be because employees execute creative tasks while valuing the benefit of KMS usage nevertheless. In other words, employees know that the task needs to be done anyway and perform it, while utilizing KMSs, hoping for quicker and better quality results (Aldholay et al., 2018).

Moreover, the authors analyzed the direct and moderating effects of individual AC on employees' creative performance, which further contributes to the understanding of AC at the individual level (Minbaeva et al., 2007). This study found a significant direct effect of individual AC, which is in line with prior studies that highlight the positive effect of individual AC on several innovation-relevant dimensions (e.g., individual creativity, innovative behavior, innovation capability; Kang & Lee, 2017; Liao et al., 2007; Seo et al., 2015). Thus, this study suggests that a higher individual AC leads to higher employee creative performance. However, the study

findings did not support the hypothesis that individual AC positively moderates the effect of KMS usage on employee creative performance. This may be because, absorbed knowledge that is transformed into innovative ideas using KMSs needs to be processed by employees that have relevant knowledge capabilities (Liao et al., 2007). This could also be explained by the fact that AC is only significant in certain fields of work (e.g., engineering work), where it has a stronger effect on the use of KMSs and a stronger impact on employee creative performance (Deng et al., 2008). Therefore, the creative engagement of employees may define the effect of the individual AC. Thus, individual AC may have a more significant impact on the effect of KMS usage on employee creativity, in the case of little creative engagement. Moreover, as Enkel et al., (2017) suggest, at an employee level, employee characteristics (e.g., independent thinking, alertness to new opportunities, ambition) may lead to the ability to further identify internal and external knowledge in the work environment. Ultimately, the findings suggest that companies should aim to increase KMS usage in general to improve employees' creative performance. Hence, firms may focus on the efficient and easy use of KMSs (Aldholay et al., 2018), leading to general satisfaction with the KMSs (Al-Kofahi et al., 2020; Stefanovic et al., 2016).

Future Research Directions

During the COVID-19 pandemic, studies are increasingly focusing on remote working as an increasing number of companies need their employees to work from home, to keep up the daily operation and innovation tasks for future products and services. For remote working and distance learning, multiple factors exist, which may influence employees' perceived (creative) performance. For instance, Van Der Voordt (2004) revealed that frequent changes in the work environment (e.g., constant changes of workplace) and lack of privacy reduce perceived productivity. Professionals working from home may not have a dedicated room for work or may need to alternate shifts, when both partners are working. Moreover, when working in a noisy and busy open room, employees ability to solve and work on complex (creative) tasks may reduce, as these tasks require more privacy (Van Der Voordt, 2004). Hence, the benefits of remote working may alter and, instead, working from home may have a varying impact on multiple performance related dimensions (e.g., knowledge sharing, innovation; Allen et al. (2015)). Furthermore, although remote working may increase work efficiency (Allen et al., 2015), the increasing use of technology while working remotely may also reduce employees' wellbeing (Molino et al., 2020). Thus, remote working can be perceived as a double-sided sword, and future studies need to examine the advantages or disadvantages in conjunction with the enabling factors (e.g., technologies).

In this context, the authors analyzed an important factor that enables remote working, that is, KMSs, and its impact on employee creative performance. However, there are several limitations of this study to be considered. First, it may be beneficial to empirically test this study's model after the COVID-19 pandemic and in a more settled work environment. However, using a more structured workweek (e.g., hybrid working in the work office and from home) may lead to different results. Second, it may be interesting to test the model in different countries, as technology usage varies between countries (Oliveira & Martins, 2012). In this context, it may be useful to use a variation in the methodology, as MTurk users are mainly from North America and India (Cheung et al., 2017). Third, while different KMSs (e.g., platforms, person to person) may have varying effects on creative performance, different antecedents may influence this effect. Finally, future studies may apply this study's model in different industries (e.g., automotive, railway, energy) and compare large firms and small and medium enterprises.

Conclusion

The authors make several theoretical contributions based on this study's results. They apply the Motivation–Opportunity–Ability framework to the individual (employee) level and reveal that employees' creative performance depends on KMS usage and, more importantly, motivation and ability to exhibit a certain correlation level. The study empirically demonstrates the importance of utilizing KMSs in corporate innovation settings and at the individual (employee) level to foster creative performance. Furthermore, the authors highlight the relevance of exploring the

contingency perspective of KMSs to specify further on what drives KMSs' success. The study contributes to the motivation literature through the analysis of extrinsic and intrinsic motivation in the research model. Moreover, by empirically exploring extrinsic motivation, the study contributes to the broader understanding of extrinsic motivation. Thus, the authors answer the call by Cerasoli et al. (2014) to investigate the impact of extrinsic motivation further. Furthermore, by empirically analyzing the direct and moderating effects of AC, this study adds to the understanding of AC at the employee level (e.g., Deng et al., 2008; Enkel et al., 2017; Minbaeva et al., 2007). Finally, the authors contribute to the understanding of which technologies are required for, and drive, efficient remote collaboration (e.g., Baker et al., 2006; Wang et al., 2021).

From a managerial perspective, this study provides various significant implications for decision-makers. It underlines the significance of KMSs and, specifically, their usage for employees' creative performance. Further, the authors provide practitioners with a better understanding on how to improve employee creative performance, and thus they intend to demonstrate the relevance of KMSs in corporate settings, by analyzing contingencies.

In conclusion, the increased focus, especially on remote work due to the COVID-19 pandemic, reveals that enabling effective, continued remote collaboration (B. Wang et al., 2021) is greatly important. Thus, for firms to not only remain competitive but also survive, they essentially rely on innovation, whether through, for example, offering new products or services. Enabling the transfer of internal and external knowledge within and across firms' boundaries is key, not only to facilitate commuters work, but also to enable the remote work of innovation-oriented tasks. KMSs may be a key driver to enable and foster innovation in a remote work environment.

References

Al-Kofahi, M. K., Hassan, H., & Mohamad, R. (2020). Information systems success model: A review of literature. *International Journal of Innovation, Creativity and Change*, *12*(10), 104–128.

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, *25*(1), 107–136.

Aldholay, A. H., Isaac, O., Abdullah, Z., & Ramayah, T. (2018). The role of transformational leadership as a mediating variable in DeLone and McLean information system success model: The context of online learning usage in Yemen. *Telematics and Informatics*, *35*(5), 1421–1437.

Allen, T. D., Golden, T. D., & Shockley, K. M. (2015). How effective is telecommuting? Assessing the status of our scientific findings. *Psychological Science in the Public Interest*, *16*(2), 40–68.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in Organizational Behavior*, *10*, 123–167.

Amabile, T. M. (1993). Motivational synergy: Toward new conceptualizations of intrinsic and extrinsic motivation in the workplace. *Human Resource Management Review*, *3*(3), 185–201.

Amabile, T. M., & Pratt, M. G. (2016). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior*, *36*(2016), 157–183.

Anderson, N., Potočnik, K., & Zhou, J. (2014). Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. *Journal of Management*, *40*(5), 1297–1333.

Baker, E., Avery, G. C., & Crawford, J. (2006). Home alone: The role of technology in telecommuting. *Information Resources Management Journal*, *19*(4), 1–22.

Bareket-Bojmel, L., Hochman, G., & Ariely, D. (2017). It's (not) all about the Jacksons: Testing different types of short-term bonuses in the field. *Journal of Management*, *43*(2), 534–554.

Beck, S., Bergenholtz, C., Bogers, M., Brasseur, T.M., Conradsen, M.L., Di Marco, D., Distel, A.P., Dobusch, L., Dörler, D., Effert, A., Fecher, B., Filiou, D., Frederiksen, L., Gillier, T., Grimpe, C., Gruber, M., Haeussler, C., Heigl, F., Hoisl, K., Hyslop, K., Kokshagina, O., LaFlamme, M., Lawson, C., Lifshitz-Assaf, H., Lukas, W., Nordberg, M., Norn, M.T., Poetz, M., Ponti, M., Pruschak, G., Pujol Priego, L., Radziwon, A., Rafner, J., Romanova, G., Ruser, A., Sauermann, H., Shah, S.K., Sherson, J.F., Suess-Reyes, J., Tucci, C.L., Tuertscher, P., Vedel, J.B., Velden, T., Verganti, R., Wareham, J., Wiggins, A., & Xu, S.M (2020). The open innovation in science research field: A collaborative conceptualisation approach. *Industry and Innovation*, 1–50.

Cao, Q., Thompson, M. A., & Triche, J. (2013). Investigating the role of business processes and knowledge management systems on performance: A multi-case study approach. *International Journal of Production Research*, *51*(18), 5565–5575.

Cerasoli, C. P., Nicklin, J. M., & Ford, M. T. (2014). Intrinsic motivation and extrinsic incentives jointly predict performance: A 40-year meta-analysis. *Psychological Bulletin*, *140*(4), 980–1008.

Chen, L., Zhao, X., Tang, O., Price, L., Zhang, S., & Zhu, W. (2017). Supply chain collaboration for sustainability: A literature review and future research agenda. *International Journal of Production Economics*, *194*(April), 73–87.

Cheung, J. H., Burns, D. K., Sinclair, R. R., & Sliter, M. (2017). Amazon Mechanical Turk in organizational psychology: An evaluation and practical recommendations. *Journal of Business and Psychology*, *32*(4), 347–361.

Cho, Y. J., & Perry, J. L. (2012). Intrinsic motivation and employee attitudes: Role of managerial trustworthiness, goal directedness, and extrinsic reward expectancy. *Review of Public Personnel Administration*, *32*(4), 382–406.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: The two faces of R&D. *Economic Journal*, *99*(397), 569–596.
Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128.
Collins, C. J., & Smith, K. G. (2006). Knowledge exchange and combination: The role of human resource practices in the performance of high-technology firms. *Academy of Management Journal*, *49*(3), 544–560.
Da Silva, N., & Davis, A. R. (2011). Absorptive capacity at the individual level: Linking creativity to innovation in academia. *The Review of Higher Education*, *34*(3), 355–379.
Davis, A. R., & Da Silva, N. (2011). Absorptive capacity at the individual level: Linking creativity to innovation in academia. *Review of Higher Education*, *34*(3), 355–379.
Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology*, *22*(14), 1111–1132.
Deci, E. L., & Ryan, R. M. (1987). The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*, *53*(6), 1024–1037.
Deci, E. L., Spiegel, N. H., Ryan, R. M., Koestner, R., & Kauffman, M. (1982). Effects of performance standards on teaching styles: Behavior of controlling teachers. *Journal of Education Psychology*, *74*(6), 852–859.
Deng, X., Doll, W. J., & Cao, M. (2008). Exploring the absorptive capacity to innovation / productivity link for individual engineers engaged in IT enabled work. *Information & Management, 45*(2), 75–87.
Eisenberger, R., & Shanock, L. (2003). Rewards, intrinsic motivation, and creativity: A case study of conceptual and methodological isolation. *Creativity Research Journal*, *15*(2 & 3), 121–130.
Elmorshidy, A. (2018). The impact of knowledge management systems on innovation: An empirical investigation in Kuwait. *VINE Journal of Information and Knowledge Management Systems*, *48*(3), 388–403.
Enkel, E., Heil, S., Hengstler, M., & Wirth, H. (2017). Exploratory and exploitative innovation: To what extent do the dimensions of individual level absorptive capacity contribute? *Technovation*, *60–61*(August), 29–38.
Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. *Journal of Organizational Behavior*, *26*(4), 331–362.
Gong, Y., Cheung, S. Y., Wang, M., & Huang, J. C. (2012). Unfolding the proactive process for creativity: Integration of the employee proactivity, information exchange, and psychological safety perspectives. *Journal of Management*, *38*(5), 1611–1633.
Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic management journal*, *17*(S2), 109–122.
Hansen, J. M., & Levin, M. A. (2016). The effect of apathetic motivation on employees' intentions to use social media for businesses. *Journal of Business Research*, *69*(12), 6058–6066.
Hardill, I., & Green, A. (2003). Remote working – Altering the spatial contours of work and home in the new economy. *New Technology, Work and Employment*, *18(3)*, 212–222.
Hausberg, J. P., & Leeflang, P. S. H. (2019). Absorbing integration: Empirical evidence on the mediating role of absorptive capacity between functional-/cross-functional integration and innovation performance. *International Journal of Innovation Management*, *23*(6), 1–37.
Hotho, J. J., Becker-Ritterspach, F., & Saka-Helmhout, A. (2012). Enriching absorptive capacity through social interaction. *British Journal of Management*, *23*(3), 383–401.
Jabri, M. M. (1991). The development of conceptually independent subscales in the measurement of modes of problem solving. *Educational and Psychological Measurement*, *51*, 975–983.
Jansen, J. J. P., Van Den Bosch, F. A. J., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: How do organizational antecedents matter? *Academy of Management Journal*, *48*(6), 999–1015.
Kang, M., & Lee, M. J. (2017). Absorptive capacity, knowledge sharing, and innovative behaviour of R&D employees. *Technology Analysis and Strategic Management*, *29*(2),

219–232.
Kees, J., Berry, C., Burton, S., & Sheehan, K. (2017). An analysis of data quality: Professional panels, student subject pools, and Amazon's Mechanical Turk. *Journal of Advertising*, *46*(1), 141–155.
Khalifa, M., Yan, A. Y., & Ning, K. S. (2008). Knowledge management systems success: A contingency perspective. *Journal of Knowledge Management*, *12*(1), 119–132.
Ko, D. G., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations. *MIS Quarterly: Management Information Systems*, *29*(1), 59–85.
Kostopoulos, K., Papalexandris, A., Papachroni, M., & Ioannou, G. (2011). Absorptive capacity, innovation, and financial performance. *Journal of Business Research*, *64*(12), 1335–1343.
Kuvaas, B., Buch, R., Gagné, M., Dysvik, A., & Forest, J. (2016). Do you get what you pay for? Sales incentives and implications for motivation and changes in turnover intention and work effort. *Motivation and Emotion*, *40*(5), 667–680.
Kuvaas, B., & Dysvik, A. (2009). Perceived investment in employee development, intrinsic motivation and work performance. *Human Resource Management Journal*, *19*(3), 217–236.
Lane, P. J., Koka, B. R., & Pathak, S. (2006). The reification of absorptive capacity: A critical review and rejuvenation of the construct. *Academy of Management Review*, *31*(4), 833–863.
Lee, Y., Tao, W., Li, J. Y .Q., & Sun, R. (2020). Enhancing employees' knowledge sharing through diversity-oriented leadership and strategic internal communication during the COVID-19 outbreak. *Journal of Knowledge Management*.
Liao, S. H., Fei, W. C., & Chen, C. C. (2007). Knowledge sharing, absorptive capacity, and innovation capability: An empirical study of Taiwan's knowledge-intensive industries. *Journal of Information Science*, *33*(3), 340–359.
Lin, T. C., & Huang, C. C. (2008). Understanding knowledge management system usage antecedents: An integration of social cognitive theory and task technology fit. *Information and Management*, *45*(6), 410–417.
Liu, D., Jiang, K., Shalley, C. E., Keem, S., & Zhou, J. (2016). Motivational mechanisms of employee creativity: A meta-analytic examination and theoretical extension of the creativity literature. *Organizational Behavior and Human Decision Processes*, *137*, 236–263.
Lu, Y., & Ramamurthy, K. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *Management Information Systems Research Center*, *35*(4), 931–954.
MacInnis, D. J., & Jaworski, B. J. (1989). Information processing from advertisements: Toward an integrative framework. *Journal of Marketing*, *53*(4), 1–23.
Madjar, N., Oldham, G. R., & Pratt, M. G. (2002). There's no place like home? The contributions of work and nonwork creativity support to employees' creative performance. *Academy of Management Journal*, *45*(4), 757–767.
Manolopoulos, D. (2006). What motivates R&D professionals? Evidence from decentralized laboratories in Greece. *International Journal of Human Resource Management*, *17*(4), 616–647.
Meyer, J. P., Becker, T. E., & Vandenberghe, C. (2004). Employee commitment and motivation: A conceptual analysis and integrative model. *Journal of Applied Psychology*, *89*(6), 991–1007.
Minbaeva, D. B., Makela, K., & Rabbiosi, L. (2007). Individual absorptive capacity and knowledge transfer. *Unpublished Paper, Copenhagen Business School.*, 1–39.
Minbaeva, D. B., Pedersen, T., Björkman, I., Fey, C. F., & Park, H. J. (2003). MNC knowledge transfer, subsidiary absorptive capacity, and HRM. *Journal of International Business Studies*, *34*(6), 586–599.
Molino, M., Ingusci, E., Signore, F., Manuti, A., Giancaspro, M. L., Russo, V., Zito, M., & Cortese, C. G. (2020). Wellbeing costs of technology use during Covid-19 remote

working: An investigation using the Italian translation of the technostress creators scale. *Sustainability (Switzerland)*, *12*(15), 1–20.
Montag, T., Maertz, C. P., & Baer, M. (2012). A critical analysis of the workplace creativity criterion space. *Journal of Management*, *38*(4), 1362–1386.
Mumford, M. D., & Hunter, S. T. (2005). Innovation in organizations: A multi-level perspective on creativity. *Research in Multi-Level Issues*, *4*(05), 9–73.
Nguyen, T. D., Nguyen, T. M., & Cao, T. H. (2015). Information systems success: A literature review. *Springer International Publishing Switzerland*, *9446*, 242–256.
Oldham, G. R., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. *Academy of Management Journal*, *39*(3), 607–634.
Oliveira, T., & Martins, M. (2012). Literature review of information technology adoption models at firm level. *Australasian Journal of Construction Economics and Building*, *14*(1), 110–121.
Penrose, E. (1959). *The Theory of the Growth of the Firm*. Oxford University Press.
Petter, S., DeLone, W., & McLean, E. (2008). Measuring information systems success: Models, dimensions, measures, and interrelationships. *European Journal of Information Systems*, *17*(3), 236–263.
Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203–212.
Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*.
Schweisfurth, T. G., & Raasch, C. (2018). Absorptive capacity for need knowledge: Antecedents and effects for employee innovativeness. *Research Policy*, *47*(4), 687–699.
Seiders, K., Voss, G. B., Grewal, D., & Godfrey, A. L. (2005). Do satisfied customers buy more? Examining moderating influences in a retailing context. *Journal of Marketing*, *69*(4), 26–43.
Semmer, N. K. (1982). Stress at work, stress in private life and psychological well-being. In *W. Bachmann, & I. Udris (Eds.), Mental load and stress in activity: European approaches* (pp. 42–55). Elsevier.
Seo, Y. W., Chae, S. W., & Lee, K. C. (2015). The impact of absorptive capacity, exploration, and exploitation on individual creativity: Moderating effect of subjective well-being. *Computers in Human Behavior*, *42*, 68–82.
Shalley, C. E., Zhou, J., & Oldham, G. R. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management*, *30*(6), 933–958.
Shalley, C., Gilson, L., & Blum, T. (2009). Interactive effects of growth need strength, work context, and job complexity on self-reported creative performance. *Academy of Management Journal*, *52*(3), 489–505.
Simmering, M. J., Fuller, C. M., Richardson, H. A., Ocal, Y., & Atinc, G. M. (2015). Marker variable choice, reporting, and interpretation in the detection of common method variance: A review and demonstration. *Organizational Research Methods*, *18*(3), 473–511.
Smith, S. M., Roster, C. A., Golden, L. L., & Albaum, G. S. (2016). A multi-group analysis of online survey respondent data quality: Comparing a regular USA consumer panel to MTurk samples. *Journal of Business Research*, *69*(8), 3139–3148.
Soto-Acosta, P., & Cegarra-Navarro, J. G. (2016). New ICTs for knowledge management in organizations. *Journal of Knowledge Management*, *20*(3), 417–422.
Stefanovic, D., Marjanovic, U., Delić, M., Culibrk, D., & Lalic, B. (2016). Assessing the success of e-government systems: An employee perspective. *Information and Management*, *53*(6), 717–726.
Teo, T. S. H., Lim, V. K. G., & Lai, R. Y. C. (1999). Intrinsic and extrinsic motivation in Internet usage. *Omega*, *27*(1), 25–37.
Vallerand, R. J. (2000). Deci and Ryan's self-determination theory: A view from the hierarchical model of intrinsic and extrinsic motivation. *Psychological Inquiry*, *11*(4),

312–318.
Van Der Voordt, T. J. m. (2004). Productivity and employee satisfaction in flexible workplaces. *Journal of Corporate Real Estate*, *6*(2), 133–148.
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478.
Volberda, H. W., Foss, N. J., & Lyles, M. A. (2010). Absorbing the concept of absorptive capacity: How to realize its potential in the organization field. *Organization Science*, *21*(4), 931–951.
von Krogh, G. (1998). Care in knowledge creation. *California Management Review*, *3*, 133–153.
von Krogh, G. (2009). Individualist and collectivist perspectives on knowledge in organizations: Implications for information systems research. *Journal of Strategic Information Systems*, *18*(3), 119–129.
Voss, G. B., Parasuraman, A., & Grewal, D. (1998). The roles of price, performance, and expectations in determining satisfaction in service exchanges. *Journal of Marketing*, *62*(4), 46–61.
Wang, B., Liu, Y., Qian, J., & Parker, S. K. (2021). Achieving Effective Remote Working During the COVID-19 Pandemic: A Work Design Perspective. *Applied Psychology*, *70*(1), 16–59.
Wang, W., Liu, L., Feng, Y., & Wang, T. (2014). Innovation with IS usage: Individual absorptive capacity as a mediator. *Industrial Management and Data Systems*, *114*(8), 1110–1130.
Wilkesmann, U., Wilkesmann, M., & Virgillito, A. (2009). The absence of cooperation is not necessarily defection: Structural and motivational constraints of knowledge transfer in a social dilemma situation. *Organization Studies*, *30*(10), 1141–1164.
Wu, J. H., & Wang, Y. M. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model. *Information and Management*, *43*(6), 728–739.
Xinli, H. (2015). Effectiveness of information technology in reducing corruption in China A validation of the DeLone and McLean information systems success model. *Electronic Library*, *33*(1), 52–64.
Yildiz, H. E., Murtic, A., Zander, U., & Richtnér, A. (2019). What fosters individual-level absorptive capacity in MNCs? An extended motivation–ability–opportunity framework. In *Management International Review* (Vol. 59, Issue 1). Springer Berlin Heidelberg.
Zacher, H., & Frese, M. (2011). Maintaining a focus on opportunities at work: The interplay between age, job complexity, and the use of selection, optimization, and compensation strategies. *Journal of Organizational Behavior*, *32*, 291–318.
Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185–203.
Zhang, X., & Bartol, K. M. (2010). Linking empowering leadership and employee creativity: The influence of psychological empowerment, intrinsic motivation, and creative process engagement. *Development and Learning in Organizations: An International Journal*, *24*(5), 4–9.
Zhang, Xiaomeng, & Bartol, K. M. (2010). The influence of creative process engagement on employee creative performance and overall job performance: A curvilinear assessment. *Journal of Applied Psychology*, *95*(5), 862–873.
Zhu, Y. Q., Gardner, D. G., & Chen, H. G. (2016). Relationships between work team climate, individual motivation, and creativity. *Journal of Management, 44(5)*, 2094–2115.