Changes in Value Creation Paths in the Digital Transformation of Established Companies: A Multi-level Perspective

Am Fachbereich Rechts- und Wirtschaftswissenschaften
der Technischen Universität Darmstadt

genehmigte

Dissertation

vorgelegt von

Jonas Younes Toutaoui

geboren am 21.02.1992 in Berlin

zur Erlangung des akademischen Grades
Doctor rerum politicarum (Dr. rer. pol.)

Erstgutachter: Prof. Dr. Alexander Benlian
Zweitgutachter: Prof. Dr. Alexander Kock

Darmstadt 2023

Jonas Toutaoui: Changes in Value Creation Paths in the Digital Transformation of Established Companies: A Multi-level Perspective
Darmstadt, Technische Universität Darmstadt
Jahr der Veröffentlichung der Dissertation auf TUprints: 2023
Tag der mündlichen Prüfung: 31.05.2023

Acknowledgement

This thesis would not have been possible without the support of many. First, I would like to thank my supervisor Prof. Dr. Alexander Benlian for his support over the years and for giving me the opportunity to learn a lot about research and to earn my doctorate at his chair. He has always provided me with the fruitful balance of academic guidance and feedback on the one hand, and freedom of action and the opportunity to find and follow my own path on the other. I thank you very much for helping me greatly in achieving my Ph.D. project.

I would also like to thank Prof. Dr. Alexander Kock for assuming the position of the second assessor. Furthermore, I would like to thank Prof. Dr. Thomas Hess and Prof. Dr. Oliver Hinz, who supported my academic journey with joint research projects.

Moreover, I would like to thank the many co-authors with whom I had the pleasure to work with along different projects: Martin Adam, Nicolas Pfeuffer, Lea Müller, Adeline Frenzel-Piasentin, Karoline Glaser, Gregor Albrecht and Konstantin Röthke (with whom I had the additional joy of sharing an office and a lot of non-science related topics). Thank you for the many hours of interesting and sometimes heated discussions. I would also like to thank all the other colleagues at the department for Information Systems & E-Services for making my Ph.D. a very enjoyable time.

Finally, I would like to thank my family for always supporting and motivating me during the ups and downs of this journey.

Munich, January 2023

Jonas Toutaoui

Abstract

Digital technologies, such as mobile technologies, analytics, and cloud computing are ubiquitous in our daily lives and affect individuals, companies, and societies at large. Especially established companies find themselves confronted with changing customer demands and new competitors (e.g., start-ups), thus starting concentrated efforts of undergoing so-called digital transformations (DT). Such DT not only enhance existing value creation but may massively change existing or create completely new value creation paths for the established companies. These alterations form the affordances of novel digital technologies, i.e., their action potentials, and can usually be classified in one of three categories: value proposition and value networks, agility and ambidexterity, and digital channels. Previous research has predominantly examined how established companies initiate their efforts with DT strategies and what elements compose a DT. A few studies started to investigate outcomes of the DT of established companies and primarily focused on longer-term outcomes on an organizational level (e.g., improved financial performance), while the success rate of DT remains low. Research on outcomes specific to DT's changes to value creation paths, also on levels other than the organizational level, is scarce. Latest research started to identify such outcomes and indicated that they may hinder DT success (e.g., self-depletion of agile developers, privacy concerns of customers). However, we require more insights to gain a more comprehensive picture of DT, to address hindrances once they are known, and to finally increase DT success rate. Hence, this thesis aims to unveil unknown outcomes of DT of established companies on an organizational and individual level (with individuals being customers or employees of established companies). Against this backdrop, four articles are part of this thesis, organized along changes in value creation paths during the DT.

The first article uncovers novel outcomes on an organizational level of actualized changes in value propositions and value networks. Established companies often create additional platform-based digital business models during their DT, concurrent to their established business models. The change towards concurrent business models, with one being platform-based, create outcomes in terms of important synergy potential and both business models can fuel each other.

In the second article, outcomes of changes in agility and ambidexterity are examined. Within the IT function, DT often leads to ambidextrous bi-modal IT functions, consisting of one “agile IT” and one “traditional IT”. Establishing this bi-modal IT (in the sense of actualizing the affordance of increased agility and ambidexterity) creates tensions and paradoxes on an organizational (e.g., resource conflicts) and individual level (e.g., emotional tensions). Additionally, the article shows how intertwined paradoxes, tensions, and management approaches are across levels, highlighting the complexity of DT and its outcomes.

In the third article, I investigate outcomes on an individual level of digital channels in a customer context. Robo-advisors as a novel digital technology can allow for automated and digital wealth management for new customer segments. The article shows that, as opposed to analogue channels, digital properties of robo-advisors enable dynamic recommendations (similarly to well-known dynamic pricing in e-commerce). These recommendations can improve the economic decision-making of individual customers and are also to the benefit of the financial provider. Moreover, anthropomorphism (i.e., human-like representation of the robo-advisor) allow a social atmosphere which further increases the effects on customers.

The last article studies outcomes on an individual level of digital channels, specifically chatbots, in an employee context. With chatbots being used more and more within companies (e.g., for IT helpdesk self-services), effectiveness of the interactions remains questionable and outcomes for employees unclear. In an experiment focusing on the attribution of gender-typical design cues to a chatbot, which we often see in today’s applications, users applied stereotypical prejudices to chatbots, even though they were thoroughly briefed on how the artificial intelligence was trained and that it didn’t have a gender. These prejudices then affected trust levels towards the chatbot, influencing the effectiveness of the interaction.

Overall, this thesis provides new perspectives on the outcomes of changes in value creation paths during the DT of established companies. Going beyond mostly organizational-level longer-term outcomes, the studies comprised in this thesis offer a more detailed and nuanced understanding of the outcomes of DT, on an individual and organizational level, along the main changes in value creation in DT. By uncovering rather negative outcomes, the studies also help understanding why DT potentially fail.

Finally, the results contribute to different theories in IS by extending (e.g., social presence theory) or challenging them (e.g., structural ambidexterity). Apart from these research contributions, this thesis also offers important insights for practitioners managing the DT of their companies.

Zusammenfassung

Digitale Technologien wie mobile Technologien, Analytik und Cloud Computing sind in unserem täglichen Leben allgegenwärtig und wirken sich auf Einzelpersonen, Unternehmen und die Gesellschaft insgesamt aus. Vor allem etablierte Unternehmen sehen sich mit veränderten Kundenanforderungen und neuen Wettbewerbern (z. B. Start-ups) konfrontiert, so dass sie konzentrierte Anstrengungen unternehmen, um sogenannte digitale Transformationen (DT) zu vollziehen. Solche DT verbessern nicht nur die bestehende Wertschöpfung, sondern können bestehende Wertschöpfungspfade massiv verändern oder völlig neue Wertschöpfungspfade für die etablierten Unternehmen schaffen. Diese Veränderungen bilden die Affordanzen neuartiger digitaler Technologien, d.h. deren Aktionspotenziale, und lassen sich in der Regel in eine der drei Kategorien Wertangebote und Wertnetzwerke, Agilität und Ambidexterität sowie digitale Kanäle einordnen. Die bisherige Forschung hat überwiegend untersucht, wie etablierte Unternehmen ihre Bemühungen um DT-Strategien einleiten und welche Elemente ein DT ausmachen. Einige wenige Studien haben begonnen, die Ergebnisse der digitalen Transformation etablierter Unternehmen zu untersuchen, wobei sie sich in erster Linie auf die längerfristigen Ergebnisse auf organisatorischer Ebene (z. B. verbesserte finanzielle Leistung) konzentrierten, während die Erfolgsquote der digitalen Transformation nach wie vor gering ist. Es gibt nur wenige Forschungsarbeiten zu den Ergebnissen, die sich speziell auf die Veränderungen der Wertschöpfungspfade durch DT beziehen, auch auf anderen Ebenen als der organisatorischen. Jüngste Forschungen haben begonnen, solche Ergebnisse zu identifizieren und darauf hingewiesen, dass sie den Erfolg von DT behindern können (z. B. Selbstverarmung von agilen Entwicklern, Datenschutzbedenken von Kunden). Wir benötigen jedoch weitere Erkenntnisse, um ein umfassenderes Bild von DT zu erhalten, um Hindernisse zu beseitigen, sobald sie bekannt sind, und um schließlich die DT-Erfolgsquote zu erhöhen. Daher zielt diese Arbeit darauf ab, unbekannte Ergebnisse der DT etablierter Unternehmen auf organisatorischer und individueller Ebene aufzudecken (wobei Individuen Kunden oder Mitarbeiter etablierter Unternehmen sind). Vor diesem Hintergrund sind vier Artikel Teil dieser Arbeit, die entlang der Veränderung der Wertschöpfungspfade während der DT angeordnet sind.

Der erste Artikel deckt neuartige Ergebnisse auf organisatorischer Ebene auf, die sich aus aktualisierten Veränderungen von Wertangeboten und Wertnetzwerken ergeben. Etablierte Unternehmen schaffen während ihrer DT häufig zusätzliche plattformbasierte digitale Geschäftsmodelle, die parallel zu ihren etablierten Geschäftsmodellen laufen. Der Wandel hin zu konkurrierenden Geschäftsmodellen, von denen eines plattformbasiert ist, führt zu wichtigen Synergiepotenzialen und beide Geschäftsmodelle können sich gegenseitig beflügeln.

Im zweiten Artikel werden die Ergebnisse von Veränderungen in der Agilität und Ambidexterität untersucht. Innerhalb der IT-Funktion führt DT oft zu bimodalen IT-Funktionen, die aus einer "agilen IT" und einer "traditionellen IT" bestehen. Die Etablierung dieser bimodalen IT (im Sinne der Verwirklichung der Möglichkeiten von erhöhter Agilität und Ambidexterität) führt zu Spannungen und Paradoxien auf organisatorischer (z.B. Ressourcenkonflikte) und individueller Ebene (z.B. emotionale Spannungen). Darüber hinaus zeigt der Artikel, wie Paradoxien, Spannungen und Managementansätze über die verschiedenen Ebenen hinweg miteinander verwoben sind, was die Komplexität von DT und ihrer Ergebnisse verdeutlicht.

Im dritten Artikel untersuche ich die Ergebnisse auf individueller Ebene von digitalen Kanälen im Kundenkontext. Robo-Advisors als neue digitale Technologie können eine automatisierte und digitale Vermögensverwaltung für neue Kundensegmente ermöglichen. Der Artikel zeigt, dass die digitalen Eigenschaften von Robo-Advisors im Gegensatz zu analogen Kanälen dynamische Empfehlungen ermöglichen (ähnlich wie die bekannte dynamische Preisgestaltung im E-Commerce). Diese Empfehlungen können die wirtschaftliche Entscheidungsfindung des einzelnen Kunden verbessern und sind auch für den Finanzdienstleister von Vorteil. Darüber hinaus ermöglicht der Anthropomorphismus (d. h. die menschenähnliche Darstellung des Robo-Advisors) eine soziale Atmosphäre, die die Wirkung auf den Kunden noch verstärkt.

Der letzte Artikel untersucht die Ergebnisse auf individueller Ebene von digitalen Kanälen, insbesondere Chatbots, im Mitarbeiterkontext. Da Chatbots in Unternehmen immer häufiger eingesetzt werden (z. B. für IT-Helpdesk-Self-Services), bleibt die Wirksamkeit der Interaktionen fraglich und die Ergebnisse für die Mitarbeiter unklar. In einem Experiment, in dem es um die Zuordnung von geschlechtstypischen Designmerkmalen zu einem Chatbot ging, die wir in heutigen Anwendungen häufig

sehen, wendeten Nutzer stereotype Vorurteile auf Chatbots an, obwohl sie gründlich darüber informiert waren, wie die künstliche Intelligenz trainiert wurde und dass sie kein Geschlecht hatte. Diese Vorurteile wirkten sich dann auf das Vertrauensniveau gegenüber dem Chatbot aus und beeinflussten die Effektivität der Interaktion.

Insgesamt bietet diese Arbeit neue Perspektiven auf die Ergebnisse von Veränderungen der Wertschöpfungspfade während der DT etablierter Unternehmen. Die in dieser Arbeit zusammengefassten Studien gehen über die längerfristigen Ergebnisse auf Unternehmensebene hinaus und bieten ein detaillierteres und differenzierteres Verständnis der Ergebnisse von DT auf individueller und organisatorischer Ebene entlang der wichtigsten Veränderungen in der Wertschöpfung bei DT. Durch die Aufdeckung eher negativer Ergebnisse tragen die Studien auch zum Verständnis der Gründe für ein mögliches Scheitern von DT bei. Schließlich tragen die Ergebnisse zu verschiedenen Theorien im Bereich der Informationsgesellschaft bei, indem sie diese erweitern (z. B. die Theorie der sozialen Präsenz) oder in Frage stellen (z. B. strukturelle Ambidextrie). Abgesehen von diesen Forschungsbeiträgen bietet diese Arbeit auch wichtige Erkenntnisse für Praktiker, die die DT ihrer Unternehmen managen.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

AI	Artificial Intelligence
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
BM	Business Model
CA	Conversational Agent
CDO	Chief Digital Officer
CEO	Chief Executive Officer
CIO	Chief Information Officer
DT	Digital Transformation
HCI	Human-Computer Interaction
HTMT	Heterotrait-Monotrait ratio of correlations
IS	Information Systems
IT	Information Technology
LLCI	Lower Limit of Confidence Interval
NLP	Natural Language Processing
OEM	Original Equipment Manufacturer
SRMR	Standardized Root Mean Residual
StD	Standard Deviation
ULCI	Upper Limit of Confidence Interval
VIF	Variance Inflation Factor

1 Introduction

1.1 Motivation and Research Questions

Digital transformation (DT) affects modern societies on multiples levels and often on a day-to-day basis (Legner et al. 2017). For instance, individuals now use digital technologies to fulfil basic needs (e.g., mobile technologies for online shopping), start-ups attack traditional industries with novel digital technologies (e.g., FinTechs offering wealth management), the public sector serves new demands from citizens (e.g., online registration for unemployment), and societies as a whole experience new forms of communication and participation (e.g., news through social media) (Urbach and Röglinger 2018; Wendt et al. 2022). Such a multi-level transformation, on a global scale, has also attracted a vast research interest in recent years. Indeed, the number of publications dealing with DT has increased exponentially.

DT has become a top priority across various sectors for established companies – defined as companies that have a stable (and profitable) business model (Berlin 2022). In 2021, established companies have spent about 1.5 trillion USD on DT and the number is expected to rise in the next years (Sava 2022). DT refers to leveraging digital technology in (re)defining an organization's value proposition which may lead to a new organizational identity (Wessel et al. 2021). As such, it differs from the well-known concept of IT-enabled organizational transformation which refers to leveraging digital technology to support the value proposition and to enhance an existing organizational identity (ibid).

Most research on DT so far focused on the answer of established companies to the appearance of new digital technologies, namely the formulation of a digital business or digital transformation strategy (e.g., Bharadwaj et al. 2013; Matt et al. 2015). Recent research uncovered how DT is implemented in companies (e.g., Sia et al. 2016; Svahn et al. 2017), often based on qualitative, case-study based research which indicates the timeliness of the research topic (Ridder 2017). Few studies have shed light on longer-term effects of DT, focusing on overall firm performance such as increased innovativeness (Svahn et al. 2017), efficiency (Vithayathil 2018), and customer focus (Ross et al. 2016). However, 45% of DT initiatives still fall short of these goals and do not create the expected value (de la Boutetière et al. 2018; McKinsey 2019a). To increase

the success rate, it is necessary to further unpack DT and to understand how DT's outcomes unfold in detail.

In a comprehensive literature review on DT, Vial (2019) identified three main areas of value creation in which establish companies experience important changes using digital technologies: *value proposition & value networks* (new business models based on services in eco-systems such as platforms), *agility & ambidexterity* (companies rapidly adapting to market changes and combining exploration of digital innovation with exploitation of existing resources), and *digital channels* (new customer-facing interactions and company-internal algorithmic decision making). It is important to note that, following the affordance theory in Information Systems (IS) research, digital technologies do not have a universal value and unequivocal outcome. Rather, their potential depends on the actor and its goals using the digital technologies, forming the technology affordance. For instance, a modern cloud-based IT architecture (the digital technology) has no value in its own. An IT function with the goal of reducing time-to-market of new digital products might see the potential of faster deployments while a controlling function might see direct cost reduction potential (affordances of the same technology to different actors). Subsequently, the affordance is actualized (e.g., cloud is implemented) which generates outcomes that should support the actors' goals. Combining affordance theory and DT research, the changes in value creation paths during DT form the affordance of novel digital technologies.

To better understand DT success and failure regarding actors' goals, research needs to shed light on the outcomes of the main changes in value creation paths as they may hinder the longer-term DT success. Research on these paths is scarce and often focused on positive outcomes (Majchrzak et al. 2016). Some negative outcomes are known and go hand in hand with a change actualization such as data privacy and security concerns (Newell and Marabelli 2015). These outcomes may overlay positive ones and hinder the success of DT. Hence, a more detailed and nuanced understanding of the value creation paths and the outcomes of affordance actualization is needed, as numerous researchers have already called for (e.g., Hanelt et al. 2020; Majchrzak et al. 2016; Vial 2019). To contribute to this research field, this thesis aims to answer the following question:

> *RQ1: What are outcomes on an organizational level of actualized changes in value creation paths during the digital transformation of established companies?*

Besides established companies, digital technologies also affect individuals. Indeed, digitalization in the private life of individuals, e.g., through the wide-spread usage of mobile technology, has gained a lot of attention in IS research and multiple facets of technology affordances were uncovered, e.g., fatigue (Benlian 2020) or changed behavior (Benlian et al. 2020; Gerlach and Cenfetelli 2020). Next to their private life, DT affects individuals two-fold, as employees and customers of established companies. Especially *agility & ambidexterity* and *digital channels* affect employees' ways of working. Consideration of the outcomes of changes in value creation paths on individual employees or customers, however, is lacking in research and practice. Barthel (2021) identified 20 different DT goals of established companies based on a literature review (e.g., number of digital products and services, relative importance of digital business revenue, brand index score). Aside "employee satisfaction", all these DT goals were on an organizational level, underlining the focus of practitioners to implement DT to reach organizational outcomes. Similar to practitioners, researchers have moved outcomes on individuals into the background. Thereby, individual level and humanistic outcomes (e.g., well-being) have been neglected even though they are an integral part of IS research's socio-technical perspective (Sarker et al. 2019). First studies already indicate mixed outcomes of changes in value creation paths on an individual level (e.g., self-depletion in agility, Mueller and Benlian 2023). This individual level is all the more important as individual-level actions and outcomes are often linked to organizational-level actions and outcomes (Felin et al. 2015). Thus, understanding changes in value creation paths and their outcomes at the individual level might be a necessary element to better understand the DT phenomenon overall. Hence, this thesis also examines the following research question:

> *RQ2: What are outcomes on an individual level of actualized changes in value creation paths during the digital transformation of established companies?*

While DT affects multiple actors, the focus of this thesis lies on established companies; from an organizational-level perspective and an individual-level perspective (with individuals as employees or customers of established companies) and several studies of qualitative and quantitative nature were conducted to answer these research questions. Thereby, this thesis contributes in several important ways to the existing IS research. By unravelling prior unknown outcomes on organizational and individual levels (e.g.,

behavioural changes of customers, emotional tensions within the information technology (IT) function, synergy potential between business models), this thesis extends the understanding of DT and adds new facets to the discourse on DT. Findings on an individual level (e.g., stereotyping of chatbots by users) and uncovered dynamics between individual and organizational levels additionally highlight the importance of perspectives not solely tuned to the organizational level to better understand the phenomenon of DT. I therefore plead for a consensus shift in DT research, switching from a dominant organizational-level perspective towards multi-level perspectives that incorporate dynamics between the levels. Besides theoretical contributions, this thesis offers a multitude of practical contributions such as pointing managers to potential tensions and paradoxes in their IT function during the digital transformation, potential for synergies when establishing a platform-based digital business model or showing financial companies dynamic recommendation strategies to increase investment volumes of costumers.

In the following, I first introduce conceptual and theoretical foundations of DT and affordance theory before discussing how this thesis fits into the current discourse. Afterwards, the structure of the thesis including its main articles is presented and the main articles are summarized before shown in full length.

1.2 Theoretical Foundations

In the next sub-section, the foundations of DT are presented, especially how DT forms a process with three new value creation paths as central element, enabled by new digital technologies and generating outcomes. These paths are further detailed in the subsequent sub-section, explaining the theoretical foundation of each path. In the last sub-section, the affordance theory is introduced as explanation of how new value creation paths and associated digital technologies may generate outcomes.

1.2.1 Digital Transformation of established companies as a process

Research on DT in IS primarily started with Bharadwaj et al. (2013) being the first to recognize and formulate that companies adapt to novel digital technologies by creating digital business strategies, also called digital transformation strategies. These are different from traditional IT strategies as they are not subordinate to the business strategy but reflect a fusion between IT and business strategy and finally guide the DT of a company. As Matt et al. (2015) showed, DT strategies encompass, independent from the sectors, four elements: use of technology, changes in value creation, structural changes, and financial aspects. Especially the changes in value creation are important for this thesis and refer to the extent of change with which an established company renews its value chain (i.e., how far the new value proposition deviates from the classical business model). The extent can vary a lot from company to company, even within the same sector as Hess et al. (2016) demonstrated for the media sector. Further cases of DT implementation in practice were analyzed by researchers (e.g., Dremel et al. 2017; Hansen and Sia 2015; Sia et al. 2016) and multiple perspectives and definitions of DT appeared, all highlighting the importance of changes in value creation (compared to previous IT transformations) (Porter and Heppelmann 2015). With an increasing number of DT studies published, more and more authors represented DT as a process (e.g., with a DT strategy that is constantly changing (Chanias et al. 2018)). Recently, Vial (2019, p. 118) synthesized existing definitions into the following one:

"[DT is] a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies".

Additionally, Vial (2019) developed a model of the DT process as shown in the next figure and described afterwards.

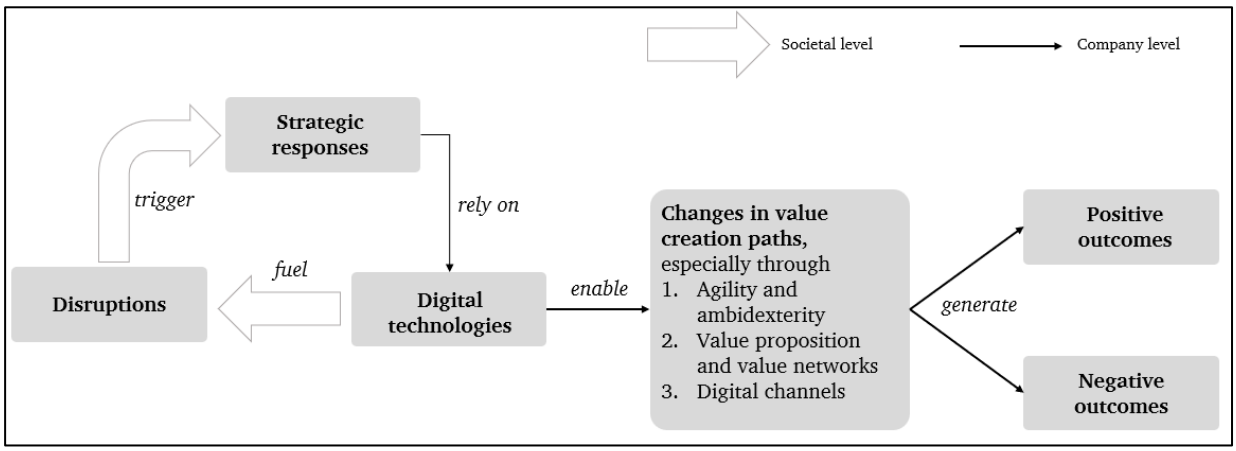

Figure 1-1 Simplified process model of Digital Transformation based on Vial (2019)

On a societal level, novel digital technologies, so-called SMACIT technologies (Social, Mobile, Analytics, Cloud computing, Internet of Things) (Legner et al. 2017), fuel disruptions such as changing consumer behavior and expectations (e.g., expecting seamless mobile banking) which then trigger strategic responses by individual companies. It is important to note that not necessarily a single digital technology leads to a specific disruption but usually the combination of several novel digital technologies fuels disruptions.

On an organizational level, companies then respond with DT strategies. Researchers (in IS) focused mostly on these strategies so far and uncovered different types (e.g., customer engagement strategy, digitized solutions strategy) (Hess et al. 2016; Matt et al. 2015; Ross 2017; Ross et al. 2016; Sebastian et al. 2017). Across these studies researchers created consensus on the breadth of DT strategies, going beyond the IT function and IT strategy and affecting functions, organizational setups, and even business models across the companies (Hanelt et al. 2020; Nadkarni and Prügl 2020).

DT strategies do not only respond to novel digital technologies but also rely on them. However, digital technology itself does not transform a company. Following the socio-technical perspective of IS research, the transformation happens through the interaction between technical artifacts and individuals/collectives that develop and use the artifacts in their social (e.g., psychological, cultural, and economic) contexts (Sarker et al. 2019). As such, individuals are key to DT, however, past research has neglected such interactions and profound effects on individuals and shoved them into the background (Wessel et al. 2021). With organizational actors employing these digital technologies,

DT is enabled and the ways in which companies create, deliver and capture value are changing (Osterwalder and Pigneur 2010). These changes are then the core of DT. More specifically, three categories of change in value creation paths can be observed: *agility and ambidexterity, value proposition and value networks,* and *digital channels.*
While Vial's (2019) definition and model are not without critique and certainly do not represent the final consensus of research on DT, they have effectively guided most recent research (Markus and Rowe 2021): Wessel et al. (2021), for instance, move away from the focus on change process and emphasize, that DT (re)defines the value proposition and value creation of an established organization – which underlines the importance of changes in value creation paths as focus of this thesis and detailed below.

1.2.2 Changes in value creation paths

To answer the research questions, it is necessary to further investigate the changes in value creation and their relation to a level of analysis. On an organizational level, the changes of *agility & ambidexterity* and *value proposition & value networks* are especially important, as they fundamentally affect the value proposition an established company offers and the way it is created. *Digital channels*, on the other hand, have significant effects in how individuals interact with each other (and with an established company) and thus, primarily affect the individual level. The three named categories of change are detailed in the following.

Agility and ambidexterity

Agility refers to the organizational ability of quickly 1) identifying market changes and 2) reacting to them, which often leads to increased firm performance (Lu and Ramamurthy 2011; Singh et al. 2013; Tallon and Pinsonneault 2011). Agility has experienced a tremendous focus by research and practitioners in recent years (Diegmann et al. 2018) due to the Agile Manifesto. Originally published with five core values and twelve principles to increase agility in software development projects (Fowler and Highsmith 2001), the Agile Manifesto has been refined to describe a multitude of agile practices that shall increase agility (e.g., daily stand-up) (Schwaber and Sutherland 2011). These agile practices were first introduced in the IT functions of established companies to reduce the time-to-market of new software products and thus better react

to changing customer expectations and new technologies (Lee and Xia 2010). Recently, companies started agile transformations as part of their DT, introducing agile practices to other functions, to further increase organizational agility (Gerster et al. 2018; Saunders et al. 2020).

Consonant with agility is ambidexterity, which is defined in an organizational context as the challenge for companies to allocate limited resources between the "exploration of new possibilities" and the "exploitation of old certainties" (March 1991). Companies able to manage this challenge have a higher financial performance than organizations focusing on only one of these two aspects (He and Wong 2004; Jansen et al. 2006). Companies have always explored new possibilities. As these are now mostly based on new digital technologies, responsibility for exploration is often shifted toward the IT function which experiences important changes in its role, now enabling value creation instead of reducing costs and "keeping the lights on" (Urbach et al. 2018; Urbach et al. 2017). For instance, in their study of ongoing DTs of 25 companies, Sebastian et al. (2017) showed how companies and especially the IT function build and maintain both an "operational backbone" as well as a "digital services platform" to foster ambidexterity, with the "digital services platform" heavily relying on agile practices. Since the simultaneous pursuit of exploration and exploitation is contradictory yet necessary for DT (Andriopoulos and Lewis 2009), ambidexterity aligns well with Smith and Lewis' (2011, p. 382) definition of a paradox, as it consists of *"contradictory yet interrelated elements that exist simultaneously and persist over time."* Organizational paradoxes are known for complex and conflicting outcomes (Putnam et al. 2016), thus, they play an important role in understanding outcomes of agility and ambidexterity for DT.

Changes in agility and ambidexterity often go hand in hand with DT as companies try to increase both to increase financial performance in the longer-term. As these changes may create multiple outcomes (e.g., paradoxes as mentioned), it is of particular importance to study them to better understand DT outcomes (on an organizational level). Additionally, established companies often experience significant changes in their value propositions and value networks during DT and agility and ambidexterity become key to create and manage new and redefined value propositions.

Value proposition and value networks

Changes in value proposition and value networks are primarily related to digital platforms. From an economics perspective, digital platforms are two-sided markets where different parties are brought together to match supply and demand, facilitated on a common platform (Schreieck et al. 2016). Marketplaces like eBay or Etsy are examples of such two-sided markets. While two-sided markets are not new to research and practice, digital technologies allow creation and growth of many more platforms as it has become easier to match supply and demand, thanks to real-time possibilities or global reach. Indeed, the most valuable companies in the world as of today are based on digital platforms (e.g., Alphabet, Amazon). Thus, companies are facing in their DT the question of how to engage with or on such digital platforms (Cennamo and Santalo 2013; McIntyre and Srinivasan 2017; McKinsey 2019b). Digital platforms include three different parties. The platform owner provides the platform and controls the environment in which any activity takes place. Platform users can be differentiated by those consuming and those complementing. Consumers buy or use what is offered on the platform terms of products, services, or information. Complementors provide the platform with these products, services, or information.

Following Tiwana (2014), interactions between these three parties considerably change companies' value proposition and value network. Being active as a complementor on a third-party platform means to consider other complementors and recombine offerings with them. It also means losing the direct interaction with customers as every interaction is mediated and monitored by the platform owner. Starting a new platform and acting as platform owner means for established companies to move away from traditional value chains where one product is handed to one customer in the end, to a position where two interrelated value propositions have to constantly be fulfilled towards two very distinct parties: complementors and customers. Such a start of a new digital platform as new business model also highlights one important difference to past (IT-enabled) transformations: DT not only includes the transformation of existing business models and internal processes but often leads to the creation of completely new business models (Remane et al. 2017a; Wessel et al. 2020), which have been an important pillar of IS research (Veit et al. 2014). While platforms themselves have been analyzed in the past, DT entails that new platform-based business models concur with existing (non-digital) business models in established companies. Such a simultaneity potentially influences the

affordance and outcomes of digital platforms in established companies' DT as they might, for instance, benefit from shared goals and resources, or bear reduced potential actualization from conflicting goals and non-complementary resources.

To understand DT outcomes (on an organizational level) it is therefore necessary to further investigate changes in value propositions and value networks.

While changes in agility, ambidexterity, value propositions, and value networks predominantly affect the organizational level, they also have outcomes for the individuals participating in DT. Changes in digital channels, though, have further outcomes especially on the individual level as they change the way individuals communicate with each other and with established companies.

Digital channels

Digital channels refer to how companies change their value delivery in the course of the DT. Thanks to advancements in artificial intelligence (AI) and notably natural language processing (NLP), digitalization of channels (e.g., in customer service, company-internal communication) are one of the most common initiatives within a DT, moving from an analogue channel (e.g., telephone) to an automated digital channel (Maedche et al. 2019; Srinivasan et al. 2018). New digital channels however might not only replace existing channels but complement them as it is the case for many brick-and-mortar stores following an omnichannel strategy (e.g., with click-and-collect offers) (Hansen and Sia 2015). Further possibilities of digital channels include the use of social media channels by companies (e.g., for social commerce Wang and Zhang 2012) or automated decision-making within companies thanks to automated sensory data collection and analysis as in the Internet of Things (Bilgeri et al. 2019).

Especially conversational agents (CA) appear as dominant way of digitalizing the interaction with customers and employees (Adam et al. 2022). Voice-based CAs like Amazon Alexa or text-based CAs like so-called chatbots are prime examples. They allow companies to reduce channel costs by taking over routine tasks while increasing the availability of the channel. As conversational interaction via natural language is probably the most natural way for humans to interact, CAs are inherently anthropomorphic (Pfeuffer et al. 2019). Anthropomorphism can be defined as a deeply ingrained human

innate tendency which leads humans to attribute human-like physical or non-physical traits, characteristics and emotions to non-human agents (Epley and Gilovich 2006; Pfeuffer et al. 2019). When humans interact with unknown human or non-human agents, they subconsciously apply anthropomorphism to better connect with the other agent. Novel digital technology such as improved NLP or "deep-fakes" further increase anthropomorphism in digital channels.

With digital channels and CAs becoming increasingly prevalent, it is of particular importance to understand the effects of anthropomorphism and the outcomes of anthropomorphic digital channels as a building block of DT outcomes.

1.2.3 Affordance theory and outcomes

The theory of affordance was pioneered in ecology by Gibson (1977) and later introduced to IS research, where it has gained a lot of attention (Fromm et al. 2020). Affordance can be defined, based on Hutchby (2001), as "the perceived and actual properties of a digital technology, that determine just how the digital technology could possibly be used". Put simply, affordances can be seen as possibilities for action. It is important to note that affordances are not inherent to a digital technology. They rather emerge from the relationships between actors and digital technologies, reflecting the possibilities of action related to the goals and capacities of actors (Wang et al. 2018). With different goals and actors, the same digital technologies can present multiple affordances. This relational perspective holds a promising ground between often employed technological determinism and pure social constructivism (Robey et al. 2013; Volkoff and Strong 2013).

Once an affordance is perceived by the actors, they engage in its actualization by taking actions in support of longer-term goals. The actualization results in outcomes which may support but also hinder the longer-term goals, again, depending on the actors, their goals, and the digital technology (Wang et al. 2018). The following figure summarizes the theory and its core concepts.

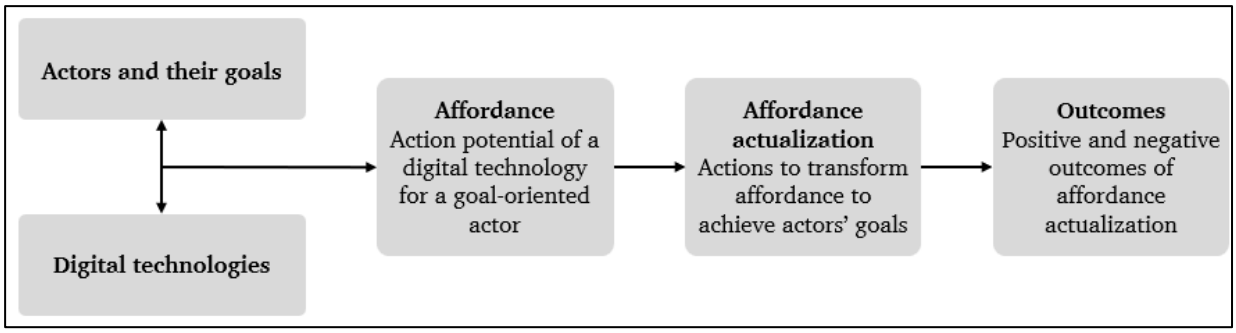

Figure 1-2 Simplified model of affordance theory based on Wang et al. (2018)

In the context of this thesis, established companies are the actors who use digital technologies with different but closely related longer-term goals such as increased performance, efficiency, or innovativeness. The relation between the digital technologies and the goal-oriented established companies creates affordances: changes in value creation paths. As they start to actualize the affordance (i.e., implementing changes) outcomes emerge, which can support or hinder the longer-term success of DT.

1.3 Thesis Positioning

This thesis is positioned along the lines of the critique mentioned beforehand and contributes to research studying outcomes of the DT of established companies. Especially outcomes of changes in value creation paths on an organizational and individual level are studied in this thesis. Therefore, this thesis should be seen as a step toward building a more comprehensive picture of DT and simultaneously not as final step as it aims by no means to create a complete picture of all potential outcomes of DT. Drawing on Vial's (2019) process model of DT and affordance theory, outcomes are studied in the different articles of this thesis. In order to provide an overview of the relationships between these articles, Figure 1-4 illustrates how the articles fit to the research questions, based on an excerpt of Vial's (2019) process model and the model of the technology affordance theory.

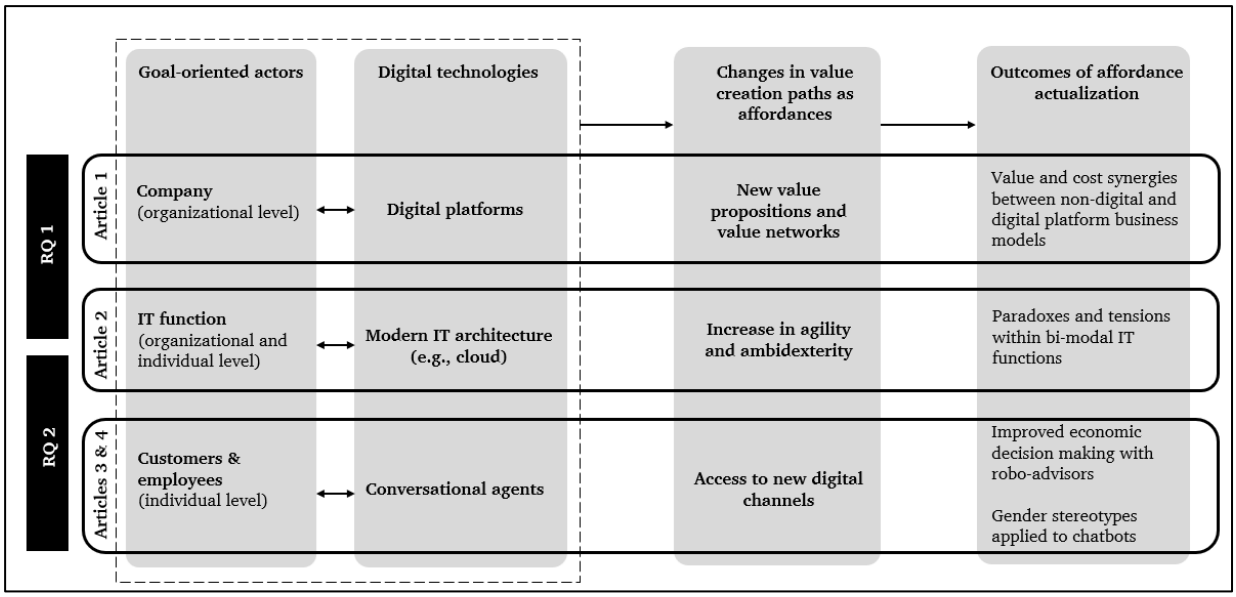

Figure 1-3 Positioning of the research articles

In summary, the first article addresses RQ1 and investigates on an organizational level the outcomes of digital platforms for established companies, namely of the actualization of changes in value propositions and networks. Uncovered outcomes focus on synergies between digital platform-based business models and established business models within companies that enable them to accelerate the development and growth of their digital platform and to foster innovation of the established business model. Article 2 examines DT on an organizational and individual level, thus addressing RQ1 and RQ2. IT functions of established companies see the potential of novel digital technologies in IT architecture (e.g., cloud) to increase their agility and ambidexterity. The IT functions then go through important transformations to have an "agile IT" mode beside their "traditional IT" mode and to become ambidextrous. The actualized affordance leads to immediate paradoxes and tensions on an organizational and individual level in the bi-modal IT functions of companies. Article 3 addresses RQ2 and unveils actualized affordance of conversational agents for customers. It sheds light on robo-advisors, a new way of financial service companies to provide automated wealth management to prior unserved customers (e.g., for non-high-net-worth individuals). Possibilities of nudging and personalized real-time calculation are demonstrated to overcome the hyperbolic discounting bias of individuals which tend to not invest enough money for the future (and retirement). Finally, the last article – also addressing RQ2 and investigating outcomes of digital channels – examines chatbots as assistants for employees. The article demonstrates how users apply gender stereotypes to chatbots. Even though participants were informed that the chatbot was an

AI and had learned how the AI was trained, their trusting intentions varied depending on whether the chatbot was equipped with a female or male avatar, showing unexpected outcomes that may hinder the success of DT.

1.4 Thesis Structure and Synopses

The thesis contains eight chapters. In the introduction (Chapter 1), the motivation of the thesis, the overarching research questions and the theoretical foundations are presented. In chapters two to five, four distinct research articles are presented. All of them contribute to answering the overarching research questions and have already been published in IS outlets with a double-blinded peer-review process. To ensure a consistent layout in this thesis, the originally published versions of the four articles were slightly revised. The articles included in this thesis and their respective publication outlets and dates are presented in the following Table 1-1. Finally, in the last chapter, theoretical and practical contributions together with limitations of this thesis are discussed and avenues for future research are depicted.

Chapter 2 (Article 1)	**Outcomes of Changes in Value Proposition and Value Networks** **Toutaoui, J.; Benlian, A. (2020)** *"The Whole is Greater than the Sum of its Parts – Synergies between Non-Digital and Digital Business Models within Companies"* In: 53rd Hawaii International Conference on System Sciences (HICSS), Maui, USA. **VHB: C**
Chapter 3 (Article 2)	**Outcomes of Changes in Agility and Ambidexterity** **Toutaoui, J.; Benlian, A.; Hess, T. (2022)** "*Managing paradoxes in bi-modal information technology functions: A multi-case study"* In: Information Systems Journal **VHB: A**
Chapter 4 (Article 3)	**Outcomes of Changes in Digital Channels in a Customer Context** **Adam, M.; Toutaoui, J.; Pfeuffer, N.; Hinz, O. (2019)** "*Investment Decisions with Robo-Advisors: The Role of Anthropomorphism and Personalized Anchors in Recommendations"* In: 27th European Conference on Information Systems (ECIS), Stockholm-Uppsala, Sweden. **VHB: B**
Chapter 5 (Article 4)	**Outcomes of Changes in Digital Channels in an Employee Context** **Pfeuffer, N.; Adam, M.; Toutaoui, J.; Hinz, O.; Benlian, A. (2019)** "*Mr. and Mrs. Conversational Agent – Gender Stereotyping in Judge-Advisor Systems and the Role of Egocentric Bias"* In: 40th International Conference on Information Systems (ICIS), Munich, Germany. **VHB: A**

Table 1-1 Overview of the included research articles

Subsequently, each of the four articles is briefly summarized (i.e., Chapters 2 to 5, see Table 1-1 Overview of the included research articles

) regarding its procedure and main contribution regarding DT. The articles will use the first-person plural (i.e., 'we'), as multiple authors were involved in their creation.

Article 1 – Chapter 2: Outcomes of Changes in Value Proposition and Value Networks

Article 1 (Chapter 2) unveils outcomes of changes in the value proposition and value networks of established companies thanks to newly created digital platform-based business models. Across industries DTs often have in common the development of new business models (BMs), based on emerging digital technologies. Such additional, new

digital BMs do not replace the established non-digital BMs; established companies see the affordance of additional source of economic value.
We conducted a qualitative, interpretive multi-case study based on a retrospective data collection to uncover what synergies exist between a new additional digital business model and the established non-digital business model within the same company. We present how growth of digital BMs within established companies can be spurred, namely by using the brand, channels, customer relationships, and key resources (e.g., industry knowledge) from the established BMs. Moreover, we show how established BMs are accelerated by digital platform-based BMs within the same company once they are connected to the platform, forming a platform ecosystem within the same company.

Article 2 – Chapter 3: Outcomes of Changes in Ambidexterity and Agility

Article 2 (Chapter 3) investigates outcomes of the DT within the IT function. We examine the phenomenon of bi-modal IT, a 'traditional IT' mode focusing on the stability and exploitation of existing IT resources and an 'agile IT' mode focusing on exploring new digital technologies. This phenomenon was solely analyzed on an organizational level by previous research, treating it as an aggregated entity.
We take individual-level and organizational level perspectives using multiple cases from different industries and different company sizes. We identify tensions and paradoxes on different levels and how practitioners address them. Additionally, we unveil that such paradoxes on an individual level might spur paradoxes on an organizational level (vice-versa), demonstrating how intricate outcomes of DT on different levels can be.

Article 3 – Chapter 4: Outcomes of Changes in Digital Channels in a Customer Context

Article 3 (Chapter 4) addresses outcomes that come with the digitalization of financial advisory services, originally provided in person and now available online to a wider audience through automated forms and chats, so-called robo-advisory. One challenge that financial service companies face is the design of adequate digital channels that are accepted by potential investors. Yet, little is known on how the design and mechanics of robo-advisory can improve economic decision making too often influenced by heuristics. In a randomized online experiment with a fictitious robo-advisor, we showed that real-time calculated personalized recommendations, now possible in the online context compared to offline contexts previously, increase investment volumes and thus enhance

investors' finances by countering hyperbolic discounting bias. Additionally, the results demonstrate that anthropomorphism (i.e., applying human-like traits to an avatar) allows to increase social presence in this context of digital channels which further increases investment volumes.

Article 4 – Chapter 5: Outcomes of Changes in Digital Channels in an Employee Context

In Article 4 (Chapter 5) we investigate outcomes of changes in digital channels, namely text-based conversational agents (CAs), also called chatbots, in an employee context. CAs are tremendously permeating and shaping work lives. Gartner (2019), for example, expects that 25% of all digital workers (i.e., people who use IT to increase workplace efficiency) utilize a virtual workplace assistant in 2021. Similarly, 56% of CIOs and CTOs surveyed by Accenture revealed that CAs are driving disruption in their industry (Srinivasan et al. 2018). Despite the soar in importance and permeation of CAs, the experience of early adopters revealed that such digital channels encounter new challenges and concerns regarding biases.

In a randomized online experiment with an own-developed and trained CA using NLP we let participants interact with CAs in a cooperative context. Participants faced gendered CAs (i.e., male or female avatar) and used them as aid in mathematical or financial topics. We observed that participants applied gender stereotypes and showed egocentric biases based on the CA's design and participants' subjective knowledge. The female CA was rated more competent than the male CA even though participants were informed that the CA is only an algorithm (and not a human). As such, digital channels potentially influence the interaction with employees as they trigger biases.

Additional Articles (not included in the thesis):

In addition to the publications listed above, the following eight articles were also published or submitted for publication during my time as a Ph.D. candidate. These articles are, however, not part of the thesis.

Published:

Müller, L., Albrecht, G., Toutaoui, J., Benlian, A. 2021. „Role Identity Tensions of IT Project Managers in Agile ISD Team Settings."
In: *Forty-Second International Conference on Information Systems*. Austin, Texas, USA, December 12-15 (VHB: A)

Müller, L., and Toutaoui, J. 2020. "Who Am I and What Am I Doing Here? - IT Project Manager Identity in Agile ISD Team Settings"
In: *Forty-First International Conference on Information Systems*. A virtual AIS conference. (VHB: A)

Albrecht, G., Toutaoui, J., Röthke, K. 2022. „The Intricate Effects of Complexity and Personalization on Investment Intention in Robo-Advisory."
In: *55th Hawaii International Conference on System Sciences (HICSS)*. A Virtual Conference, January 3-7, 2022 (VHB: C)

Frenzel-Piasentin, A., Glaser, K., Toutaoui, J., Veit, D. 2022. „'No Matter I'll Be Selected; in the Next Challenge I Will Be Better!' – Understanding Non-Technical Skill Development in the Gig Economy."
In: *55th Hawaii International Conference on System Sciences (HICSS)*. A Virtual Conference, January 3-7, 2022 (VHB: C)

Toutaoui, J. 2019. "When 1+1 Is Greater Than 2: Concurrence of Additional Digital and Established Business Models within Companies"
In: *14. Internationale Tagung Wirtschaftsinformatik*. Siegen, Germany. (VHB: C)

Toutaoui, J., Müller, L., Benlian, A. 2021 "Synergien zwischen nicht-digitalen und digitalen Geschäftsmodellen in Unternehmen: Möglichkeiten und Handlungsempfehlungen"
In: *HMD Praxis der Wirtschaftsinformatik*, DOI: 10.1365/s40702-020-00703-x. (VHB: D)

Frenzel, A., Glaser, K., Toutaoui, J. 2019 "The Nerd Becomes the Softie: Non-Technical Skill Development Through Agile Practices and Crowdwork"
In: *8th CNoW pre-ICIS 2019 workshop*. Munich, Germany. (VHB: n.a.)

Submitted:

Müller, L., Albrecht, G., Toutaoui, J., Benlian, A., Cram A. "Navigating Role Identity Tensions — IT Project Managers' Identity Work in Agile Information Systems Development"
Submitted to: *European Journal of Information Systems* (after rejection in the 3rd round at Information Systems Journal) (VHB: A)

2 Outcomes of Changes in Value Proposition and Value Networks

Title:	The Whole is Greater than the Sum of its Parts – Synergies between Non-Digital and Digital Business Models within Companies
Authors:	Jonas Toutaoui, Technische Universität Darmstadt, Germany Alexander Benlian, Technische Universität Darmstadt, Germany
Published in:	Proceedings of the 53rd Hawaii International Conference on System Sciences (2020)

Abstract

Digital transformation is increasingly becoming a major concern for established companies. Part of the digital transformation is often the creation of new business models based on digital technologies, which do not replace the established business model but act as additional source of revenue. Two concurrent business models within one company creates the opportunity of synergies between these business models. However, knowledge on interactions between two business models, specifically digital and non-digital, remains in an embryonic stage. This multi-case study, based on companies from various industries and size, addresses this shortcoming. Following the business model canvas and the theories of resource relatedness and complementarity, we show how both business models can propel each other thanks to value and cost synergies between them. Finally, we offer rich insights for practitioners on what type of synergies they can benefit from and present guidelines they can use to identify and unlock these synergies.

2.1 Introduction

At a time of digital disruption throughout the global economy, many established companies face digitalization challenges and develop diverse digital transformation strategies as responses (Hess et al. 2016; Sebastian et al. 2017). These digital transformations often have in common the development of new business models (BMs), based on emerging technologies. Such additional, new digital BMs do not replace the established non-digital BMs but act as additional source to create economic value. For instance, the automotive company Daimler AG built car2go, a digital car-sharing BM for which all interactions with the customers happen through a smartphone application (Daimler AG 2018). This new digital BM does not herald the end of the established BM of Daimler AG (development, manufacturing, and sales of vehicles). Rather Daimler AG, like many other pre-digital companies, now has two concurrent BMs, one being non-digital and one being digital. Furthermore, several companies have not yet started their digital transformation, meaning that even more concurrence between digital and non-digital BMs is expected for the near future (Remane et al. 2017b).

Related research in the past focused mainly on BM definitions and frameworks or studied single BMs (Wirtz et al. 2016). Few studies shed little light on the synergies and conflicts between a BM based on premium products and a BM based on low-cost products for the same market and within the same company (e.g., Smith et al. 2010). However, the possibilities of differentiation between digital and non-digital BMs are far greater and this realm of synergies remains largely unexplored (Osterwalder and Pigneur 2013). Synergies, defined as "the combined power of a group of things when they are working together that is greater than the total power achieved by each working separately" (Peters 2013), mark an important topic for research and practice for decades (e.g., Hill and Hoskisson 1987). The emergence of digital technologies and business models now fuels the search for novel synergies. Thus, we pose the following research question:

What synergies exist between a new additional digital business model and the established non-digital business model within the same company?

We conducted a qualitative, interpretive multi-case study to answer this research question. Each case company had built up a new additional digital BM in the past, thus enabling a retrospective data collection. To collect and analyze the data we employed the prevalent business model canvas and the theories of complementarity and resource relatedness (Milgrom and Roberts 1995; Osterwalder and Pigneur 2010; Robins and

Wiersema 1995; Tanriverdi and Venkatraman 2005). We interviewed 16 managers and C-level executives from eight different case companies of various industries and size. In addition, we examined archival public and internal secondary data of the case companies.

We reveal synergies in each case, with many synergy types repeating across cases. While the new digital BMs primarily thrive thanks to cost synergies via shared customer relationships and channels with the established BMs, the same established BMs benefit from value synergies through increased capabilities and strengthened value propositions. Our study contributes to the IS research stream on digital BMs, following the call of Veit et al. (2014), by offering new insights on the synergies between multiple BMs within a company in the context of digital transformation. We also present theoretical contributions to the concept of synergy, the theory of relatedness, and the theory of complementarity by defining synergies on a BM level.

Finally, we derive practical insights for managers and executives responsible for new digital BMs or established BMs. We offer an overview of synergies they might unlock to spur the development of their own BMs. Our practical guidelines also give impulses on how to identify and unravel BM synergies in the digital transformation.

2.2 Conceptual background

2.2.1 Digital transformation leads to new digital BMs in established companies

Across all sectors, established companies currently face a wave of digitalization, the adoption and use of emergent digital technologies in an individual, organizational, and societal context (Legner et al. 2017). As a reaction to this wave, pre-digital companies start digital transformations which Vial (2019, p. 118) describes as "*a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies*". The importance of this topic is also reflected by the increasing number of publications in premier IS journals (Vial 2019). One aspect of the digital transformation is in many cases the development of new BMs through the combination of the evoked technologies. Indeed, pre-digital companies regard these digital technologies as potential revenue sources (Porter and Heppelmann 2015).

The build-up of new organizational units, such as digital innovation units or internal start-ups, goes hand in hand with new additional digital BMs and digital transformation

as these emerging units often take the responsibility for the development (and operation) of the additional BM (Fuchs et al. 2019). Thus, the new BM is frequently physically separated from the established BM (Markides and Charitou 2004).

2.2.2 Business models and the difference between digital and non-digital BMs

Business models are an important topic for practitioners and researchers alike since the mid-1990s, also exposed by the important number of publications in practitioner-related journals (Zott et al. 2011). While many definitions and frameworks exist for BMs (Wirtz et al. 2016), we adopt the widespread definition and business model canvas framework from (Osterwalder and Pigneur 2010) to guide our research. Hence, we define a BM as "the rationale of how an organization creates, delivers, and captures value" (Osterwalder and Pigneur 2010).

The business model canvas is not tailored to a specific context or industry (e.g., e-commerce) like other BM frameworks. Hence, it suits our research endeavor very well. Figure 2-1 below depicts the business model canvas that will be used later in this paper and in Table 2-1 we describe each of the nine business model components.

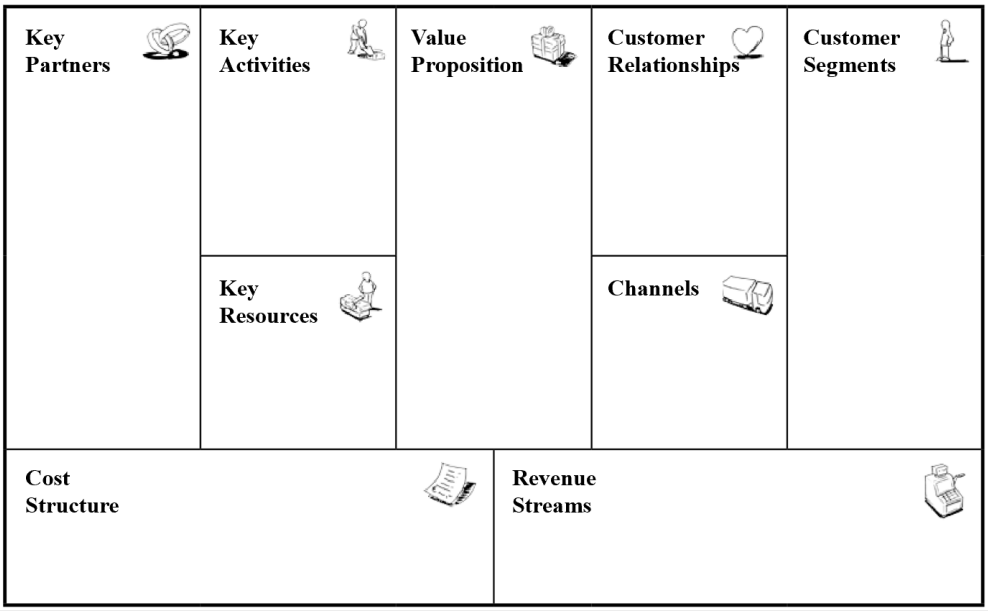

Figure 2-1 The business model canvas (Osterwalder and Pigneur 2010)

Key Partners	The network of suppliers and partners that make the business model work.
Key Activities	The most important activities a company must do to make its business model work (e.g., supply chain management).

Key Resources	The most important assets required to make a business model work.
Cost Structure	The most important costs incurred while operating under a particular business model.
Value Proposition	The bundle of products and services that create value for a specific customer segment.
Customer Relationships	Types of relationships a company establishes with specific customer segments.
Channels	Channels describe how a company communicates with and reaches its customer segments to deliver a value proposition.
Customer Segments	Different groups of people or organizations a company aims to reach and serve.
Revenue Streams	Represents the cash a company generates from each customer segment.

Table 2-1 Description of the business model components (Osterwalder and Pigneur 2010).

To answer our research question, it is necessary to differentiate between digital and non-digital business models. According to Veit et al. (2014) a BM is digital "if changes in digital technologies trigger fundamental changes in the way business is carried out and revenues are generated" . Furthermore, digital business models are characterized by an increased complexity, mutability, and pace due to the increased number of key partners compared to non-digital business models. Simultaneously, digital business models benefit from an improved cost-revenues-ratio thanks to better flow of information (resulting in lower communication and transaction costs) and thanks to practically zero marginal cost when reproducing digital products or services (Steininger et al. 2012).

2.2.3 Concurrent business models and the two types of synergy

In the past decades, many established companies had built up additional business models as an instrument for strategic positioning in one market (Porter 1980). These concurrent BMs enabled companies to offer a low-price version and a premium version of a product within the same market. Examples of companies which adopted such concurrent BMs are Toyota with its premium brand Lexus, SMH with its lower-price Swatch brand, or

Nestlé with its Nespresso subsidiary offering premium coffee (Markides and Charitou 2004). These concurrent business models notably differed in their cost structure (Porter 1980). Researchers, especially in management and strategy disciplines, studied integration mechanisms between such BMs and tensions that arise within the company (e.g., Markides and Charitou 2004; Smith et al. 2010). Afterwards, Wiener et al. (2018) and Hoßbach (2015) laid ground for further IS research by identifying synergies and tensions in omni-channel businesses (e.g., newspaper industry).

While these studies provide valuable insights for research and practice, digital BMs tend to be more differentiated to established BMs than only in their cost structures or channels, hence offer additional synergy potential (Toutaoui 2019).

To identify and analyze potential synergies we adopt the theory of resource relatedness and the theory of complementarity. Originally developed in the strategy and economics research, they explain most of the synergy concept and have also been applied in IS research many times (Radszuwill and Fridgen 2017; Tanriverdi 2006; Tanriverdi and Venkatraman 2005). The theory of resource relatedness states that the use of common resources across units creates so-called sub-additive cost synergies, meaning that the units benefit from reduced joint costs (Robins and Wiersema 1995). Similarly, the economic theory of complementarity affirms that distinct resources can be interdependent. A set of resources is then complementary, when the returns to a resource vary depending on the levels of other resources or as Milgrom (Milgrom and Roberts 1995) originally declares: “Doing more of one thing increases the returns to do more of another” (Milgrom and Roberts 1995). Complementary resources create super-additive value synergy as their joint value is greater than the sum of their individual values (Tanriverdi 2006).

Similar to Radszuwill and Fridgen (2017) we adapt the definitions of the two types of synergies (super-additive value synergy and sub-additive cost synergy) to our BM context with (A) and (B) being two BMs:

- Two BMs benefit from *super-additive BM value synergy* if the value created, delivered or captured is higher compared to conducting the BMs individually: $Value(A+B) > Value(A) + Value(B)$.
- Two BMs benefit from *sub-additive BM cost synergy* if the costs incurred when developing or operating the BMs is lower compared to the costs of development or

operations of the BMs individually, thanks to sharing of BM components: $Costs(A+B) < Costs(A)+Costs(B)$.

2.3 Research methodology

We follow the established research practice and philosophy of social constructivism and opt for an interpretive multi-case study approach. Knowledge on the interaction, namely synergies, between concurrent digital and established BMs is scarce and an interpretive approach is especially suited to generate findings for new areas of research (Yin 2003). Moreover, we aim to study concurrent BMs within companies, which is challenging to simulate in an experimental setting. Our approach covering multiple cases allows us to study synergy potentials for different industries and size and for different established and additional digital business models to find patterns across cases (Yin 2003). In the design and conduct of our research we adhere to the principles of Klein and Myers (1999).

2.3.1 Data collection

To restrain companies as potential cases we applied several criteria: (1) The company had to be a well-established in its market to demonstrate the seriousness of the established non-digital BM. This criterion excluded "pure-play" digital companies (e.g., Amazon). (2) The new digital BM had to show an important level of maturity which we defined by success with first customers, to sufficiently inform the research. Furthermore, companies were selected from various industries and size to increase validity and reliability.

Interview partners were selected based on the key informant method and we focused on senior managers of which we assumed being knowledgeable about both concurrent BMs in their company (based on their position and experience in the company) (Benlian and Hess 2011). In each case, we employed our interview guideline and did two semi-structured interviews to counter biases of the interview partners and (Benlian and Haffke 2016; Keutel et al. 2014).

For each case, we obtained internal documentation or public information as additional data, to triangulate our findings and further increase their validity.

Once 16 interviews out of eight cases were concluded, we recognized that we had reached theoretical saturation as the coded transcripts of the last case had revealed no new findings. Following Beattie et al. (2004) we terminated our collection of case companies, resulting in eight cases which fits to Eisenhardt's (1989) recommendation of four to ten cases for qualitative IS research. Table 2-2 below summarizes our cases.

ID	Industry	Revenue (bn EUR)	Employees	Interview partners
1	High-tech	~ 6	10,000 – 50,000	Head of digital innovation unit
				Project manager within IT
2	Pharma-ceutical	~ 20	>50,000	Management team member of digital innovation unit
				Team leader within IT
3	Retail	~ 6	<10,000	Chief Customer Officer
				Chief Information Officer
4	Mobility	~ 0.8	<10,000	Chief Digital Officer
				Chief Information Officer
5	Auto-motive	> 100	> 100,000	Management team member of digital innovation unit
				Team leader within IT
6	Utilities	~ 20	10,000 – 50,000	Management team member of digital innovation unit
				Team leader within IT
7	Logistics	~ 1.5	<10,000	Management team member of digital innovation unit
				Chief Information Officer
8	Automotive	~ 15	>50,000	Head of digital innovation unit
				Team leader within IT

Table 2-2 Case companies and interview partners

2.3.2 Data analysis

We followed established recommendations for our qualitative data analysis and proceeded in two steps (Miles and Huberman 1994). Firstly, a within-case analysis led to the craft of two business model canvases per case, one for the established BM and one for the new digital BM. Secondary data was also helpful in creating these canvases. In detail, we employed a selective coding technique, identifying transcript sections that mapped to one of the nine business model components (which therefore acted as seed

codes). These business model canvases served as unit of analysis further on. Secondly, we identified synergies based on within-case and across-case analyses. Using open and axial coding techniques we identified parts of the qualitative data referring to one of the two synergy types and coupled these synergies to the respective BM components (e.g., “We presented the prototype of our digital BM to customers to get feedback: our colleagues presented the newest instruments in the front, we were at the same booth in the back” to code “cost synergy in sales and marketing / channels”).
Coding was done by several researchers who showed a high level of agreement for randomly selected sets of qualitative data.

2.4 Results

Our study reveals three key findings and guidelines for practitioners. Firstly, digital platforms play a crucial role among the types of additional digital BMs established companies build up, tapping into the same or completely new customer segments. Secondly, established BMs can vastly benefit from an additional digital BM as it allows to extend their established value proposition, connecting existing physical products to a new digital platform. It also allows to raise new key resources in terms of capabilities. Thirdly, growth of new digital BMs is accelerated by the sharing of industry knowledge, channels, and customer relationship resources. Regarding guidelines, we emphasize the importance of acceptance of the additional digital BM via enforced internal communication, formal and informal alignment, and the re-use of what exists instead of re-inventing the wheel.

2.4.1 Finding 1: The prevalence of digital platforms as additional digital business models

The cases reveal that established companies focus on digital platforms as new digital BMs. Case 6, a large utility company, is the only company in our sample that does not develop a digital platform (so far) but develops new Software-as-a-Service products for business customers (e.g., smart energy and facility management solutions) besides its established BM of producing and selling energy to private and business customers. All other new digital BMs, for business-to-business (B2B) and business-to-consumer (B2C) companies alike, rely on platform BMs based on cloud technology. Platform BMs are

notably characterized by providing a set of stable (software) product elements that supports variety and evolvability by constraining the linkages among the product elements delivered by complementors (Benlian et al. 2018; Schreieck et al. 2016).

The main difference between the digital platform BMs of the case companies in our sample is whether the companies target new or existing customer segments.

A regional retailer for example (case 3) built an online platform for the existing customer segment to shop everywhere and at any time, integrating its fashion stores for click-and-collect functions and to allow personal shoppers in the stores to order online in case of articles being sold out in store (to be delivered to the store or directly to the customer). On its digital platform, the retailer also adds fashion bloggers and influencers which directly exchange with online shoppers. Similarly, a global company from a different industry, namely an automotive original equipment manufacturer (OEM), set up a digital platform mainly to serve their existing customers with new services (case 8). Apart from the established BM of developing, manufacturing and selling cars, the digital platform BM allows the same customers to connect with parking garages to use digital payment methods for parking fees and avoid paper-based parking tickets.

While the previous examples from B2C companies across various industries show that digital platform BMs allow to serve the same customer segments, some B2B companies employ a new digital BM to target new customer segments. Case company 7 construes such a case. The global service provider for logistics companies (e.g., freight forwarders) extends its customer segments with its digital platform. This new digital BM relies on connecting the freight sender and receiver and offer them real-time positioning information thanks to a device being attached to the freight, leaving out the freight forwarders.

Summarizing, we observe B2C companies focusing their digital (platform) BMs on existing customer segments and some B2B companies adopting digital platforms to open their business to new customer segments. Nonetheless, no case was observed in which a B2B or B2C company switched its focus and built a digital BM purely for private or business customers respectively.

2.4.2 Finding 2: Established business models mostly benefit from increased value

In different cases we discovered value synergies between the concurrent BMs. Synergies between additional digital BM and established BM allow an innovation of the established BM, especially regarding its value proposition and key resources.

Existing mechanical products (e.g., medical technology in case 1), which are at the core of the established non-digital BM, are now directly integrated to the digital platform BM, thereby offering new features. As this integration is done per default within existing production processes, efforts are limited. Hence, the digital BM significantly increases the *value proposition* of the established BM without important additional efforts. In that sense, the established BM acts as complementor to the digital platform BM and we observe a platform ecosystem within a company. In case 1, a global manufacturer of instruments for medical imagery decided to build a new digital BM based only on cloud technology with no physical product. The pay-per-use platform that was built offers different image processing techniques, optimized for the medical context (e.g., count of cells, marking of specific cells). The platform is independent of the instrument with which the image was taken and allows the integration of instruments of many manufacturers and of image processing applications of other parties. Instruments of the case company are now shipped with the integration to the digital platform by default: with one additional button on the instruments, images are directly sent to the platform. Thus, customers now experience a seamless imagery process in laboratories or hospitals. This new generation of instruments but also existing instruments now offer additional value to the customers by offering image processing techniques without an important cost increase for the established BM. The digital platform BM also benefits as a complementor, the own company, is included from the very first day of the platform.

Another example of a value synergy marks case 8. The global automotive OEM started a digital fleet management platform, connecting various freight forwarders with OEMs to offer them real-time positioning information about the vehicles and predictive maintenance services. The platform is also open to vehicles of other OEMs but requires freight forwarders to install a tracker device on their vehicles. Within the established BM (development, manufacturing, and sales of vehicles) new produced vehicles are now equipped and sold by default with the tracker device. Thus, these vehicles offer the

additional platform features (without great effort from neither the established BM nor the customers) and show an increased *value proposition:*

> *"Equipping our vehicles with our device is a first important step closer to our vision of a fully networked transport and logistics value chain. At the same time, it is a prerequisite for giving our customers access to digital value-added services."* – CEO case 8 (publicly available interview)

New digital BMs may not only increase the value proposition of the established BM but also increase the value of its *key resources*: the co-workers' capabilities. In all examined cases the development of new digital BMs was based on agile, cloud-based, software development methods – methods that were prior unknown to the case companies according to the interview partners. Through knowledge exchange on these new methods, co-workers focusing on the established BM were trained on new competencies and especially, as managers and C-level executives explained, became more customer centric as these new methods usually insist on regular customer interaction (e.g., regular customer feedback):

> *"We did training days, did agile coaching etc. In each project we involve people [working within the established BM] which work with us and by our methods"* – Head of digital innovation unit (case 1)

Therefore, the capabilities and value of the co-workers driving the established BM increase, without important costs for the BM.

Finally, some interview partners report that with the presence of a successful new digital BM, the co-workers (as key resource for both business models) experience a higher level of satisfaction and identification with the employer. One manager describes it as follows:

> *"Sales, for example, likes to talk about us [the digital BM]. Co-workers are proud, and you hear things like: Awesome, CaseCompany as a family business knows how to use digitalization for itself."* – Management team member of digital innovation unit (case 7)

2.4.3 Finding 3: Cost synergies accelerate the success of new digital business models

"*Why is CaseCompany a really good owner for this digital platform? That's because we have an amazing distribution network where we have a good relationship with 50 percent of all targeted doctors*" - Management team member of digital innovation unit (case 2)

Across all cases, the most important synergy we observed between digital and established BM concerns *channels* and *customer relationships*.

Even though the digital BM is based on a digital product or platform radically different than previous physical products of the case companies, existing customer relationships and established channels were used to spur the success (in terms of sales) of the digital BM. Especially for digital platform BMs, where a critical user mass is necessary to overcome the chicken-and-egg-problem (Tiwana 2014), this acceleration is deemed crucial by interview partners to quickly reach an important number of users as the quote above shows. In detail, the existing sales force is used to promote the new digital BM based on its relationship with known customers of the established BM. Other channels were also activated for the new digital BM such as industry fairs where the digital BM was promoted to customers which originally might have visited the company's booth for the established BM. Replicating these customer relationships (i.e., building up a new sales team) would have been very expensive and time-consuming for the digital BM, which hence experienced important cost synergies thanks to the established BM. This synergy is still existent if the digital BM targets new customer segments. Indeed, several interview partners declare that the new digital BM builds upon the strong brand of the established BM to gain credibility and convince customers much faster than creating and building a brand reputation on its own:

"If you try to get an appointment with an OEM plant manager, you will have a hard time as a start-up. But when you call and say "we are from CaseCompany", you get an appointment. That's pretty valuable." – Management team member of digital innovation unit (case 7)

Furthermore, several interview partners express that the development of the digital BM takes less erroneous paths (and was therefore faster and less expensive) as a *key resource* of the established BM is used: the large body of industry experience. Although knowledge on digital topics may be scarce within the case company, knowledge on the specific industry's customers is broad which allows to quickly identify customer pain points. The following quote succinctly points it out:

"We build [our digital BM] on our competence in medical technology. We know our customers." – Head of digital innovation unit (case 1)

In total, digital BMs benefit from *key resources*, *channels*, and existing *customer relationships* of the established BMs, leading to reduced marketing and sales costs and

a reduced cost structure overall. Surprisingly, no cost synergies in terms of IT costs are found. Our interview partners affirm that they had built up a new bi-modal IT architecture to conform to the requirements of the digital BM, leaving no room for IT cost synergies.

The Figure 2-2 below summarizes the previous two findings.

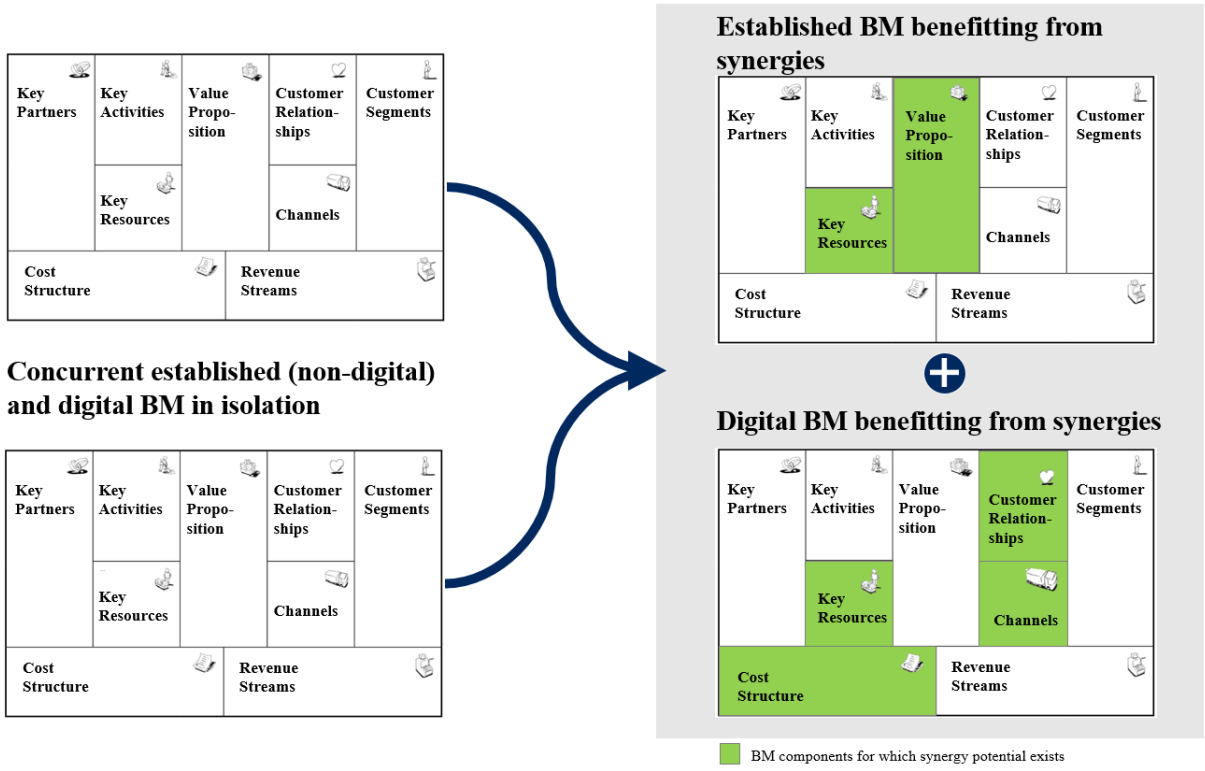

Figure 2-2 Synergies between established and digital BMs

2.4.4 Practical guidelines to identify and unlock business model synergies

Once an additional digital BM is crafted, practitioners can follow the requirements below to power the success of the digital BM and innovate their established BM:

1. First, create acceptance of the additional digital BM within your company. A new BM might create a detrimental feeling of competition among co-workers focusing on the concurrent BMs and related conflicts might surface soon. A company's top-management must quickly resolve such conflicts by clarifying the role each BM is playing for the future of the company and by clearly communicating that a new BM does not herald the end of the established BM but rather builds on and extends the established BM. On a lower hierarchy, internal communication can also be enforced. Especially communication about the

methods used for the new BM and its progress (e.g., first revenue captured) can spur the interest of other co-workers and prove the seriousness of the digital BM.

2. Second, establish continuous knowledge exchange between BMs. Potential for synergies will only be identified by co-workers if they truly understand both BMs. Both BMs are usually developed and operated in different organizational units that even are in physically different locations. Therefore, create informal alignment and knowledge exchange opportunities like round tables, common workshops, or mutual workplace visits. Also, add formal alignment and knowledge exchange elements like job rotations between both BMs or "liaison officers": people from one BM working within the team of the concurrent BM, dedicated to gather and transfer knowledge.
3. Third, don't reinvent the wheel. Your digital BM might be on a growth path and cost reductions not in focus. Simultaneously, an increase of the value proposition of your established BM might not have an important priority. However, concurrent BMs enable both without important efforts. Analyze what resources of the established BM can be re-used rather than built up from the ground up for the new digital BM. Simultaneously, evaluate how to link your concurrent BMs to each other as complementary offer to your customers instead of developing completely new features for both BMs independently.

2.5 Discussion

Many pre-digital companies that have embarked on a digital transformation now operate two concurrent BMs, one established non-digital and one additional being a digital BM. This study uncovers synergies between BMs in such companies and reveals that both BMs can benefit from each other. Consistent with the perspective that digital business models construe a topic inherent to IS research, we offer insights into the area of interactions between digital and non-digital BMs which is in an embryonic stage but gains importance with digital transformation. We extend previous research which focused on interactions between premium vs. low-cost or online vs. offline BMs, and demonstrate that even radically different BMs, that may even target different customer segments, allow for synergies. Thereby, we also present how growth of digital BMs within established companies can be spurred, namely by using the brand, channels, customer relationships,

and key resources (e.g., industry knowledge) from the established BMs. Moreover, we add a new perspective on BM innovation by revealing how established BMs are innovated by connecting them to a digital platform BM, forming a platform ecosystem within the same company. In regard to the theories of complementarity and resource relatedness, we take a novel perspective and define the concepts of sub-additive cost synergy and super-additive value synergy on a BM level.

In addition to our theoretical contributions, our study offers important insights and guidance for practitioners managing concurrent BMs. First, we show managers of established or additional digital BMs on what BM components they have to pay attention to further increase their value proposition or avoid costs. Managers may also want to use our practical guidelines as a blueprint to design and implement interventions to continuously identify and unlock synergies.

Despite these contributions, this study is not without some limitations. First and foremost, we acknowledge that the sample of cases is limited in size. Additionally, even if we reached a theoretical saturation, all case companies are multi-nationals headquartered in Germany. Companies from other regions with different culture might approach the digital transformation, digital BMs, and synergies differently. Finally, we based our study on a retrospective data collection, similar to previous IS studies (e.g., Ngai et al. 2011), whereas a longitudinal study might have provided more data.

We also set a foundation on which future research can build. Researchers might further study synergies between non-digital and digital BMs and eventually derive (based on single case studies or econometric analyses), the economic impact of such synergies. Also, additional types of interaction between established non-digital and digital BMs such as conflicts might be of interest for researchers (e.g., competition between BMs on organizational level or overload of co-workers who have to comprehend different BMs on an individual level).

2.6 Conclusion

Digital BMs are increasingly prevalent in the global economy, not only through start-ups but also through established companies undergoing a digital transformation. Yet, previous research has mostly studied BMs in isolation, neglecting possible synergies with the established non-digital BM. Using the business model canvas and the theories of

resource relatedness and complementarity we extend existing research and uncover multiple synergy possibilities from which not only the additional digital BM but also the established non-digital BM benefits. While synergies notably regarding shared channels and customer relationship allow the digital BM to jump-start its growth, the established BM profits from an increasing value proposition with little additional effort. We also derive major guidelines for practitioners. These guidelines equip managers with initiatives to actually get in the required stance to identify and unlock synergies afterwards.

3 Outcomes of Changes in Agility and Ambidexterity

Title: Managing paradoxes in bi-modal information technology functions: A multi-case study

Authors: Jonas Toutaoui, Technische Universität Darmstadt, Germany
Alexander Benlian, Technische Universität Darmstadt, Germany
Thomas Hess, Technische Universität München, Germany

Published in: Information Systems Journal (2022)

Abstract

Leveraging digital technologies is a major concern for companies and has significant implications for their information technology (IT) functions. In many cases, a bi-modal IT function is established: a 'traditional IT' mode focusing on the stability and exploitation of existing IT resources and an 'agile IT' mode focusing on exploring new technologies. Whereas previous research has predominantly taken an organisational-level view of bi-modal IT by treating it as a single, aggregated entity, we provide a micro-foundations perspective on the intricate and paradoxical interrelationships between the two IT modes. Based on a multi-case study with companies from different industries and of varying sizes, we uncover nine core tensions between traditional IT and agile IT as manifestations of five underlying paradoxes. We also identify corresponding management practices to address these tensions and paradoxes. Our study contributes to Information Systems research by *disaggregating* bi-modal IT and capturing the tensions and their underlying paradoxes at the organisational *and* individual levels that bi-modal IT entails. By highlighting the intricate interdependencies between the traditional and agile IT modes, we show that bi-modal IT can be messier and more contested than previously anticipated. For practitioners, our study offers an overview of paradoxes and tensions that may arise in bi-modal IT settings and provides suggestions on how to manage them.

Keywords: Bi-modal IT, Paradox, Tension, Agile IT, IT Ambidexterity, Case Study

3.1 Introduction

Across all sectors, companies are increasingly offering products and services that are embodied in digital technologies or enabled by them, often leading to fundamental shifts in value creation and value capture (Legner et al. 2017; Matt et al. 2015; Wessel et al. 2021). The information technology (IT) function has become the core driver of such transformational shifts due to its focus on technology, which has become indispensable for any business or innovation activity (Urbach et al. 2017). Expectations toward the IT function have increased, as it is still considered a cost center focused on "keeping the lights on," while additionally assuming the task of driving activities to digitize products, processes, or even business models (Benlian and Haffke 2016; Haffke et al. 2017a). To meet these expectations, many companies have adopted the concept of bi-modal IT consisting of two different IT modes within one company: a "traditional IT" mode (Mode 1), which optimizes for safe and steady operations, and an "agile IT" mode (Mode 2), which strives for fast innovation (Horlach et al. 2016). Gartner (2015) showed that in 2014, 45% of Chief Information Officers (CIOs) affirmed that their organizations' IT functions had a "second, fast mode of operation," and that the percentage was expected to rise. Similarly, McKinsey & Company affirmed "two-speed IT" as a requirement for companies to fully harness the business opportunities of digital technologies (Bossert et al. 2014). This was confirmed by Sebastian et al. (2017), who showed that for all 25 companies they studied, bi-modal IT was a prerequisite to exploit the potentials of novel digital technologies. With bi-modal IT driving complexity and change in organizations, paradoxes—contradictory yet interrelated elements—have emerged, and researchers have observed tensions as manifestations of such paradoxes (Schad et al. 2016; Wimelius et al. 2020). Indeed, 80% of the senior information systems (IS) managers surveyed by Teubner and Ehnes (2018) agreed that both IT modes would co-exist in the future and that the interrelationships between them were and would be challenging. With the IT function being the core engine of IT-enabled business transformations (Wessel et al. 2021), however, tensions between the traditional and agile IT modes may cause this engine to stall and for transformation processes to come to a complete standstill. Against this background, it is of critical importance for research and practice to understand such tensions and their underlying paradoxes, as well as the practices that help manage them.

Previous research on bi-modal IT has primarily focused on describing different archetypes of bi-modal IT and the ways in which they are set up, while only anecdotally pointing to potential tensions arising from splitting the IT function into two modes (e.g., Haffke et al. 2017a; Horlach et al. 2017; Joehnk et al. 2017). However, while providing valuable insights for further studies, research still largely treats bi-modal IT as an aggregate concept without looking into the interactions and tensions within bi-modal IT—namely, between the traditional and agile IT modes—thus taking a purely organizational-level view of the phenomenon. This comes as a surprise, given that bi-modal IT is, per definition, based on two very different IT modes. Joehnk et al. (2019) echoed this shortcoming, as they uncovered governance paradoxes, tensions, and practices on an organizational level, while calling for more nuanced research into lower-level bi-modal IT paradoxes.

With our study, we want to address this and related calls for a deeper analysis on how to manage paradoxes in bi-modal IT—a form of ambidextrous IT (Gregory et al. 2015; Montealegre et al. 2019). We therefore follow the emergent micro-foundations research movement, which aims to unpack collective concepts by understanding how individual-level factors, and interactions between individual- and organizational-level variables, impact organizations (Felin et al. 2015). In doing so, we aim to zoom in on bi-modal IT by (1) identifying emergent tensions, (2) shedding light on underlying *individual- and organizational-level* paradoxes, and (3) uncovering adequate practices to manage them. Thus, we ask the following research questions:

RQ1: What tensions emerge due to bi-modal IT, and how are they related to underlying individual- and organizational-level paradoxes?

RQ2: How do IS practitioners manage these tensions and paradoxes?

To provide answers to our research questions, we drew on a paradox theoretical lens and conducted an interpretive multi-case study (Keutel et al. 2014; Sarker et al. 2018a) with nine different companies from various industries and of different sizes.

Our study contributes to IS research in three important ways. First, we advance the conversation from taking a purely organizational-level view of bi-modal IT to a micro-foundational perspective that seeks to understand *both* organizational- *and* individual-level phenomena and how they relate to each other. By treating the traditional and agile

IT modes in bi-modal IT as separate units rather than as a single entity, as has largely been the case (Haffke et al. 2017a; Horlach et al. 2017), we are able to uncover between-mode tensions and their underlying paradoxes that exist at multiple levels. Second, through this shift in perspective, we identify novel individual-level tensions and paradoxes that have been largely overlooked in bi-modal IT research. In response to previous calls for research (Putnam et al. 2016; Schad et al. 2016), we particularly highlight the importance of emotional tensions—such as envy, resentment, or fear—as critical manifestations of the underlying individual-level paradoxes. Third, responding to calls for more research into the "real-world" intricacies of IT ambidexterity (Gregory et al. 2015; Montealegre et al. 2019), we contribute by challenging the prevailing notion that separating exploitation and exploration for the IT function is a straightforward solution (O'Reilly and Tushman 2013), as we reveal what problematic knock-on effects the separation can have in actuality. In addition to our research contributions, we provide practical implications for IS practitioners by offering an overview of potential tensions that may arise between the traditional and agile IT modes, and by revealing how these tensions can be remedied using managerial practices (Peppard et al. 2014).

In the following section, we present the conceptual background of our study and related research on bi-modal IT as a form of ambidextrous IT. We then introduce the paradox theoretical lens guiding our research. Next, we outline our interpretive multi-case study approach and present our results, which is followed by a discussion of our findings and a depiction of avenues for future research.

3.2 Conceptual background

3.2.1 Bi-modal IT as a form of IT ambidexterity

The IT function plays an essential role in leveraging digital technologies to create and capture business value, often having to transform itself to be able to sense and seize new digital opportunities (Hess et al. 2016; Vial 2019). Researchers are unanimous in calling such a transformation of the IT function a paradigm shift, as it increasingly moves from being a pure service provider with a reactive posture to an innovator that proactively enables new value propositions in cooperation with business units (Benlian 2013; Peppard 2016; Vithayathil 2018). For example, Sebastian et al. (2017) showed that across all 25 cases studied, the IT function offered "*technology and business capabilities that ensure the efficiency, scalability, reliability, quality, and predictability of core*

operations," while ramping up "*the technology and business capabilities that facilitate rapid development and implementation of digital innovations*" (Sebastian et al. 2017, pp. 201, 203).

These simultaneous yet opposing demands placed on IT functions resonate with the concept of ambidexterity, that is, the challenge of allocating limited resources between the "exploration of new possibilities" and the "exploitation of old certainties" (March 1991). Indeed, organizations that manage this challenge and balance exploration with exploitation achieve better financial performance than organizations focusing on only one of these two aspects (Hughes 2018; O'Reilly and Tushman 2013). While companies use several different approaches for the transformation of their IT functions, an increasingly prevalent concept to incorporate diverging demands is bi-modal IT, a form of ambidextrous IT (Haffke et al. 2017a).

Bi-modal IT, a term initially coined by the market research firm Gartner (2015), establishes two different IT modes within one company to respond to heterogeneous requirements, and both modes are essential in creating substantial value (Gartner 2015). The two modes usually differ in various aspects. Mode 1, referred to as "traditional IT," is optimized for areas that are more predictable and well understood. It focuses on IT exploitation; thus, it runs on the established IT infrastructure and IT architecture, and avoids risks by optimizing reliability, stability, and security (Horlach et al. 2016). Traditional management and IT governance principles are applied (e.g., waterfall-driven approaches in software development), and an IT-centric culture, remote from the customer, is prevalent, leading to a slow speed of delivery (Haffke et al. 2017b; Leonhardt et al. 2017). In contrast, Mode 2, referred to as "agile IT," is exploratory, involves experimentation to solve new problems, and is optimized for areas of uncertainty. It focuses on IT exploration and is responsible for fast consumer-facing digital innovations, emphasizing agility and speed (Haffke et al. 2017a). Cross-functional, co-located teams (e.g., including employees from business units) employ iterative approaches, such as agile software development (Benlian 2022; Mueller and Benlian 2023), to deliver services and products in weeks, while a business-centric culture is emphasized (Horlach et al. 2016).

Previous studies have shown how bi-modal IT has been set up in practice, deriving different organizational archetypes, such as a project-by-project separation of the two

modes, a sub-divisional bi-modal IT, or a divisional separation of the two IT modes (Haffke et al. 2017a; Haffke et al. 2017b). Further research extended this high-level view of archetypes by adding additional dimensions (e.g., data governance, outsourcing state) to the bi-modal IT archetypes (Andersen et al. 2017; Horlach et al. 2017). Follow-up studies have largely focused on the novel agile IT mode with digital labs or digital innovation units as a recent topic in both research and practice, and as a manifestation of an organizationally separated agile IT mode (e.g., Barthel et al. 2020; Fuchs et al. 2019; Joehnk et al. 2017; Raabe et al. 2020). These archetypes fit the common pathway for organizations to become ambidextrous through structural ambidexterity—organizing exploration and exploitation in separate units (Tushman et al. 2010). Finally, Joehnk et al. (2019) uncovered tensions, paradoxes, and practices that were exclusively related to governance on an organizational level between the two modes, which they considered a starting point for more nuanced research on how to manage tensions and address paradoxes in bi-modal IT.

From our review of the literature on bi-modal IT (see Table A.1 in the Appendix), we highlight two salient, interrelated issues that have remained largely unexplored. First, previous research studies on bi-modal IT have predominantly looked at the concept from an organizational-level view and have theoretically and empirically collapsed bi-modal IT into a single aggregate concept, even though it is based on two very different modes (Überbacher 2014). Such accounts have largely overlooked problematizing the interrelationships between the two modes in bi-modal IT. Second, there is a lack of research on the tensions within bi-modal IT between Mode 1 and Mode 2. The few studies that have looked into relationships between both modes and their related tensions have focused on a purely organizational-level view (Joehnk et al. 2019), yet to date, they have largely ignored the micro-foundations of bi-modal IT.

The study of micro-foundations is an emerging research movement in management that seeks potential micro-explanations of aggregated macro-concepts or outcomes, emphasizing the need to examine bottom-up influences and emergence (Foss and Linder 2019). Looking into the micro-foundations has been a *"reaction to an over-emphasis on collective constructs, as well as the seeming disregard for individual-level and social interactional considerations in explaining organizational outcomes"* (Felin et al. 2015, p. 582). Accordingly, while not denying that collective constructs and macro-variables

(e.g., on an organizational level) have explanatory relevance (Barney and Felin 2013; Little 1991), an emphasis on micro-foundations aims to bring individuals back into the equation as a foundation to better understand micro- *and* macro-level phenomena. Indeed, research in related areas has shown that an understanding of micro-elements (e.g., individuals) can lead to a more rigorous understanding of the macro- (e.g., organizational) level, for example, of agility (Crick and Chew 2020), ambidexterity (Rogan and Mors 2014), and also paradoxes (Miron-Spektor et al. 2018).

From this perspective, we run two major risks in bi-modal IT research if micro-foundations are ignored. First, we omit important individual-level tensions and paradoxes, and thus paint an incomplete picture of the intricacies in bi-modal IT. Second, we cannot theoretically grasp the dynamic cross-level interdependencies among tensions, paradoxes, and the corresponding management responses. With this in mind, we introduce the paradox concept below to serve as a theoretical lens through which we unpack the micro-foundations of bi-modal IT.

3.2.2 Paradoxes as a theoretical lens for unpacking bi-modal IT

IS research has seen growing interest in paradoxes in recent years, with digital transformation fostering turbulent environments with competing demands (Danneels and Viaene 2022). Indeed, with the proliferation and intensification of digital technology use, IT functions are urged to embrace IT exploration while sustaining their IT exploitation. Since the simultaneous pursuit of IT exploration and IT exploitation is contradictory yet necessary (Andriopoulos and Lewis 2009), IT ambidexterity aligns well with Smith and Lewis' (2011, p. 382) definition of a paradox, as it consists of *"contradictory yet interrelated elements that exist simultaneously and persist over time."* The elements (i.e., IT exploration and IT exploitation) seem logical individually, but absurd when juxtaposed, and hence this creates seemingly irrational situations and tensions with almost impossible choices (Putnam et al. 2016). Accordingly, a paradox theoretical perspective lends itself to uncovering the conflicts and contradictions in the relationships between two opposing elements, such as IT exploitation and IT exploration.

The most widespread categorization of paradoxes in the literature includes four types that represent the core activities and elements of organizations: *learning* (knowledge), *organizing* (processes), *performing* (goals), and *belonging* (identity/interpersonal relationships) (Lewis 2000; Luescher and Lewis 2008). Following Smith and Lewis

(2011), *learning* paradoxes occur as dynamic systems change, renew, and innovate. *Learning* paradoxes refer to contradictory efforts to build upon and destroy existing capabilities and knowledge to create the future, including radical vs. incremental innovation or episodic vs. continuous change in organizations (Smith and Lewis 2011). *Organizing* paradoxes are contradictions that surface in competing structures or processes. A contradiction might be empowerment vs. direction, for instance, when self-managed teams, designed to be autonomous, have to follow executive mandates (Luescher and Lewis 2008). *Performing* paradoxes are the result of a plurality of stakeholders in organizations that seek and foster competing goals (Smith and Lewis 2011; Soh et al. 2019). Such a paradox arose, for instance, in a newspaper corporation between internal stakeholders (journalists) following gatekeeping practices to maintain legitimacy and external stakeholders looking for participation (e.g., reader-contributed content creation) (Thorén et al. 2018). Finally, *belonging* paradoxes relate to different identities on or across individual and collective levels, with competing yet co-existing values, roles, and memberships (Smith and Lewis 2011). Examples include competing identities that emerge among priests, creating tensions between their professional role and their sense of self (Kreiner et al. 2006). These *belonging* paradoxes have been less researched and often relegated to the background, as they are less evident and more implicit than the other three paradox types (Schad et al. 2016).

While paradoxes as abstract concepts usually remain latent and less tangible in organizations, they become salient and express themselves in tensions, which can then also be dealt with by actors (Johansen 2019; Wimelius et al. 2020). For example, tensions might be related to *learning, organizing,* and *performing* paradoxes, as they manifest in contradictory processes, goals, and structures, while tensions related to *belonging* paradoxes are less visible and often surface in emotional responses (Andriopoulos and Gotsi 2017; Keller and Chen 2017). Understanding the latter, however, has remained relatively vague, as researchers often view paradoxes from a rationalist perspective, largely ignoring emotional conflicts and tensions (Miron-Spektor et al. 2018; Putnam et al. 2016). Some studies have shown that paradoxes can indeed generate emotions such as anger, resentment, or discomfort, notably in situations of belonging paradoxes (Dubé and Robey 2009; Zheng et al. 2011), leading to burnout and even to health issues in some cases (Johansen 2019). Putnam et al. (2016) thus posit

that a better understanding of emotions is necessary to grasp paradoxes and their outcomes more comprehensively.

Despite such calls for a more holistic view of paradoxes, we still know little about emotional tensions as manifestations of paradoxes at the individual level, especially in IT ambidexterity research, as our literature review reveals (see Table A.2 in the Appendix). For example, Gregory et al. (2015) studied IT transformation program ambidexterity and identified six paradoxes, such as IT program agility vs. IT project stability, focusing on *organizing* and *performing* paradoxes at the organizational level. Similarly, Montealegre et al. (2019) examined digital infrastructure ambidexterity from an organizational capabilities perspective and highlighted *learning* and *performing* paradoxes (e.g., digital infrastructures as potentially saving resources vs. as a distraction that can drain resources). To the best of our knowledge, Joehnk et al. (2019) study is the only one to date that has shed light on paradoxes in bi-modal IT. Focusing exclusively on organizational-level tensions, they uncovered five governance paradoxes of bi-modal IT organizations (e.g., simplicity of agile IT vs. complexity due to extra reporting and coordination) that can be related to the *performing* and *organizing* paradox types. Taken together, while previous research has yielded valuable findings by showing that IT ambidexterity entails a complex set of tensions and paradoxes, it has focused primarily on a single level (i.e., the organizational level) and on *organizing*, *performing*, and *learning* paradoxes, neglecting individual-level tensions and paradoxes (i.e., belonging paradoxes) and their cross-level implications.

It is important to note here that even though a paradox involves a dynamic relationship between contradictory elements, it is impervious to resolution (Schad et al. 2016). However, paradoxes still necessitate responses, as they can be detrimental if not recognized or appropriately managed, which can lead to vicious cycles with reinforcing feedback loops (Aubert et al. 2015). Even if paradoxes cannot be definitively resolved, they can be addressed by managing their manifestations in tensions (Johansen 2019). In this regard, scholars have identified two main practices for managing tensions and their underlying paradoxes: *integration* and *differentiation*. Integration refers to emphasizing connections and interdependencies and even capturing synergies between the contradictory elements. Differentiation emphasizes the distinctions between the elements and their unique characteristics and acknowledges them (Smith 2014). Both

practices are complementary, and the simultaneous or successive employment of these practices is not uncommon.

By using paradoxes as a theoretical lens and the micro-foundations perspective, we embark on our investigation of emerging tensions and paradoxes at the individual and organizational levels, the differentiation and integration practices by which they can be managed, and the interrelations between paradoxes and practices on different levels.

3.3 Research methodology

We draw on an interpretive multi-case study approach to examine our research questions for several reasons. First, our understanding of bi-modal IT—the interactions between the two modes, in particular—is still very limited, and an interpretive case study approach is useful for generating insights into new research areas (Walsham 1995). Second, interpretive case studies enable us to study the phenomenon in a real-life setting close to actual IS practitioners. This is important, as we also aim to investigate individual-level tensions, paradoxes, and practices to manage them; hence, we will examine nuanced aspects based on subjective realities (Trauth 2013). Thus, we place ourselves within the tradition of social constructivism as our research philosophy (Sarker et al. 2013; Sarker et al. 2018a). Finally, following previous multi-case studies (e.g., Bunduchi 2005; Kranz et al. 2016), we conducted our research on various unrelated cases to increase the comprehensiveness of the collection of the tensions that could be uncovered. Hence, we paused after each case to analyze and code the case data before beginning with the next case and increased the number of cases until we discovered no new theoretical insights, thus reaching saturation (Keutel et al. 2014; Stake 2005). In terms of the research design, we followed the interpretive research principles of Klein and Myers (1999) (see Table A.3 in the Appendix).

3.3.1 Selection of cases and interviewees

We employed purposeful sampling and selected companies if they fulfilled the following three filter criteria (Li et al. 2017; Palinkas et al. 2015): (1) the company had to be a well-established player within its industry (i.e., we excluded start-ups); (2) the company had to have started the transformation of its IT function into a bi-modal IT two or more years prior to the study to avoid pilot projects or small-scale agile IT modes (e.g., few individuals) and to sufficiently inform the research (Bilgeri and Wortmann 2017); and (3) the first bi-modal IT initiatives (e.g., new digital products or services) had to show

success with customers, going beyond beta versions, thus proving the seriousness of the transformation (Kaltenecker et al. 2015). All case companies had their headquarters in Germany with subsidiaries around the world. In Table 3-1, we give a brief overview of the selected cases, including the industry, revenue, number of employees, and the bi-modal IT archetype (Haffke et al. 2017a). Detailed information on the cases and their contexts can be found in Appendix A.4.

Case ID	Company facts and figures	Bi-modal IT archetype
1	• High-tech • ~ 6 bn EUR revenue • 10,000–50,000 employees	Divisionally separated bi-modal IT (agile IT unit reporting to the CEO, traditional IT unit to the CIO)
2	• Pharmaceutical • ~ 20 bn EUR revenue • > 50,000 employees	Sub-divisionally separated bi-modal IT (both IT modes reporting to the CIO)
3	• Retail • ~ 6 bn EUR revenue • < 10,000 employees	Started with a divisionally separated bi-modal IT (IT modes reporting to the Chief Customer Officer and CIO, respectively), then the company moved toward a reintegrated bi-modal IT
4	• Mobility • ~ 0.8 bn EUR revenue • < 10,000 employees	Started with a divisionally separated bi-modal IT (IT modes reporting to the Chief Digital Officer and CIO, respectively), then the company moved toward a reintegrated bi-modal IT
5	• Automotive • > 100 bn EUR revenue • > 100,000 employees	Sub-divisionally separated bi-modal IT archetype (both IT modes reporting to the CIO)
6	• Utilities • ~ 20 bn EUR revenue • 10,000–50,000 employees	Divisionally separated bi-modal IT (agile IT unit reporting to the CEO, traditional IT unit to the CIO)
7	• Logistics • ~ 1.5 bn EUR revenue • < 10,000 employees	Sub-divisionally separated bi-modal IT (both IT modes reporting to the CIO)
8	• Automotive • ~ 15 bn EUR revenue • > 50,000 employees	Started with a project-by-project bi-modal IT, then the company moved toward a divisionally separated bi-modal IT (agile IT unit reporting to the CEO, traditional IT unit to the CIO)
9	• Software • ~ 20 bn EUR revenue • > 50,000 employees	Divisionally separated bi-modal IT (agile IT unit reporting to the CEO, traditional IT unit to the CIO)

Table 3-1 Overview of case companies

3.3.2 Data collection

Semi-structured interviews formed the basis of the retrospective data collection process and took place face-to-face or by phone. We followed a “key informant” methodology, where targeted respondents assume the role of a key informant who is able to provide

rich information about different units of analysis (i.e., on individual and organizational phenomena) simultaneously (Kumar et al. 1993). For each case company, we interviewed two managers who were intimately involved with and most knowledgeable about the challenges and risks of bi-modal IT for individuals "on the ground" and for the organizational units. Following the methodology of Li et al. (2017) and Hanelt et al. (2017), we included one manager from the agile IT unit (e.g., heads of agile IT units) and one manager from the traditional IT unit (e.g., team leaders within traditional IT units)[1] to discover divergent viewpoints and triangulate the reports (Benlian and Haffke 2016; Myers and Newman 2007). Table 3-2 provides an overview of the 17 interviewees.

Case ID	Sector	Dyadic Interviewees (from Agile IT and Traditional IT)
1	High-tech	Head of agile IT mode, Project manager within traditional IT
2	Pharmaceutical	Management team member of agile IT mode, Team leader within traditional IT mode
3	Retail	Chief Customer Officer (leading agile IT mode), Chief Information Officer (leading traditional IT mode)
4	Mobility	Chief Digital Officer (leading agile IT mode), Chief Information Officer (leading traditional IT mode)
5	Automotive	Management team member of agile IT mode, Team leader within traditional IT mode
6	Utilities	Management team member of agile IT mode, Team leader within traditional IT mode
7	Logistics	Management team member of agile IT mode, Chief Information Officer (leads both IT modes)
8	Automotive	Head of agile IT mode, Team leader within traditional IT mode
9	Software	Team leader within agile IT mode

Table 3-2 Overview of interviewees

After ascertaining that the interviewees were appropriate key informants in terms of their experience, career path, and current role in the selected company, we used open interviewing techniques, asking our interviewees to recount the journey chronicle that led to the current bi-modal IT function (Webb and Mallon 2007). Then, following our interview guidelines, we engaged in a semi-structured interview to comprehensively understand the activities of the respective IT mode and the relationships between the IT modes. We delved into emerging tensions when the interviewees mentioned such topics themselves (which happened in each interview), following the procedures laid down by Andriopoulos and Lewis (2009). When the first interviewee of a case mentioned a tension, we would ask the second interviewee, in case they had not mentioned it, about

[1] For case 9, only one of the targeted managers agreed to be interviewed.

their perspective regarding the situation. As such, we did not mention that the research sought to identify tensions, and we used neither the word “tension” nor any similar terms that might have influenced the interviewees. We tuned our interview guidelines after each case to reflect our latest understanding of interactions between the modes (e.g., adding a question on the handover of digital products; see Table A.5 in the Appendix for the interview guidelines).

The interviews were conducted throughout 2018 and lasted about an hour. We recorded, transcribed, and coded them. For each case, we gathered additional secondary data. We added internal documentation given by interviewees (e.g., board meeting presentations) and public information, such as publicly available interviews, the companies’ websites, or press articles about the company. After the ninth case, we observed that the new case data did not add substantially to our findings and that we had reached theoretical saturation (Eisenhardt 1989; Keutel et al. 2014).

3.3.3 Data analysis

For the data analysis, we went through three phases, following established recommendations for qualitative data analysis (Miles and Huberman 1994). While Phase 1 was based on within-case analysis only, the other two phases included within-case and cross-case analyses.

Phase 1: Understanding bi-modal IT

The first analysis had the objective of developing a comprehensive description of the bi-modal IT setup for each case company. Additional data sources (e.g., public interviews, press releases) were helpful in completing the picture. At the end of this phase, we had detailed descriptions of both IT modes and their interactions for each company, which served as the unit of analysis for our search for tensions in the next phase. These within-case analyses were conducted after each case but were updated at the end of the multi-case study, as we checked the descriptions based on the latest understanding of interaction possibilities after the last case.

Phase 2: Pinning down tensions and paradoxes

For each case, we identified tensions using an open-coding approach. First-order tension codes were identified based on contradictory descriptions, mixed messages, or passages directly referring to tensions (e.g., “envy that the agile IT unit is not bound to corporate

IT policies") within a case following the analysis techniques of Hatch and Ehrlich (1993) and Andriopoulos and Lewis (2009). Each case revealed at least one tension, with 26 unique first-order tension codes in total across all cases. We grouped similar tensions across the cases via axial coding (Flick et al. 2004) and arrived at nine core tensions (second-order tension codes). This grouping emerged from the data and relied on an inductive procedure (Klein and Myers 1999). Based on the same axial coding approach, we abstracted second-order tensions into paradoxes (which act as aggregated dimensions). Although paradox types may overlap (Smith and Lewis 2011), the identified tensions could be clearly connected to a single dominant paradox type (i.e., learning, performing, organizing, or belonging) based on the direct quotes and context information collected in our database. Figure 3-1 depicts our data structure after Phase 2. Further details (i.e., exemplary quotes) are presented in Table A.6 in the Appendix.

Phase 3: Investigating practices to manage tensions and paradoxes

In the third phase, we aimed to identify how IS practitioners use integration or differentiation practices to manage tensions and address the underlying paradoxes. After the identification of tensions and underlying paradoxes in the previous phase, we went back to our data and identified text passages that fit the management practices described in section 2.2 of this paper, similar to Gregory et al. (2015). Figure 3-2 depicts our data structure regarding management practices after Phase 3. Exemplary quotes are presented in Table A.7 in the Appendix. In this phase, we also identified dynamic interrelationships between paradoxes, tensions, and practices at the individual and organizational levels.

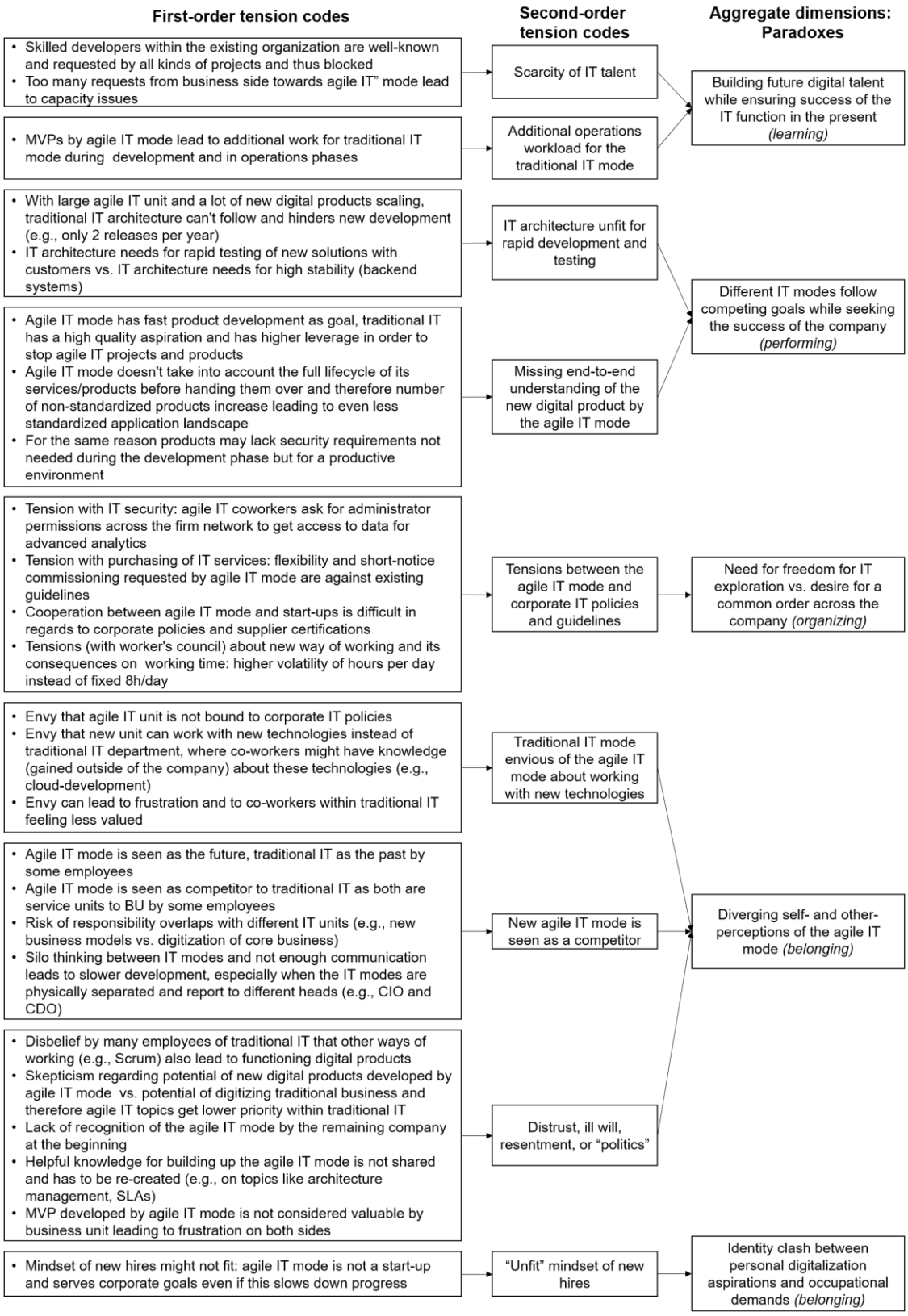

Figure 3-1 Illustration of data structure for tensions and underlying paradoxes

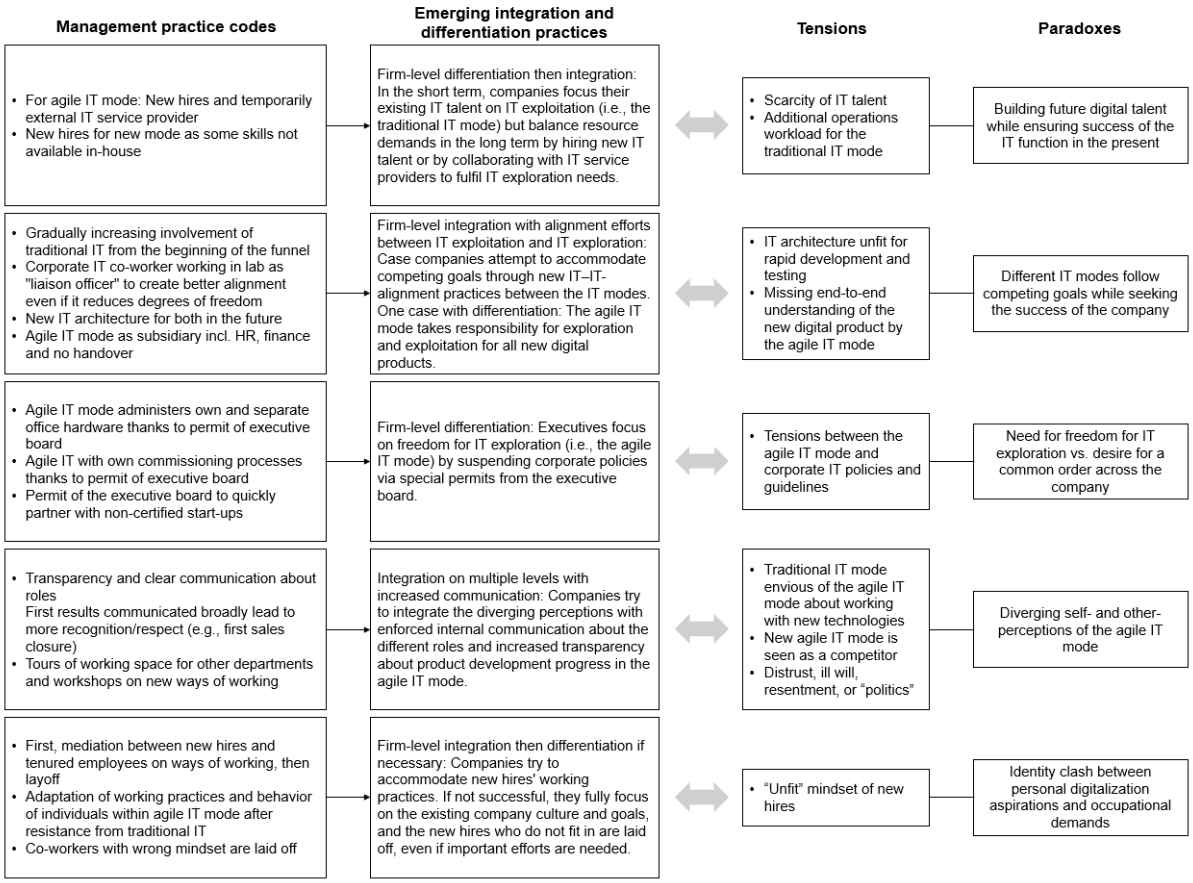

Figure 3-2 Illustration of data structure for management practices addressing tensions and underlying paradoxes

3.4 Results

In this section, we present five core paradoxes that emerged from the tensions identified in our data, as seen in Figure 3-1. We start with the organizational-level paradoxes before presenting the results at the individual level. For each paradox, we summarize the core tensions between the traditional and agile IT modes and show how companies managed these tensions to address the underlying paradox. Table 3-3 summarizes these results. Finally, we present our findings on the dynamic cross-level interdependencies between tensions, paradoxes, and management practices.

Paradox	Core tension	Exemplary management practice
Organizational-level paradoxes		
Paradox 1 – Learning paradox: Building future digital talent while ensuring success of the IT function in the present	Scarcity of IT talent Additional operations workload for the traditional IT mode	**Differentiation then integration**: In the short term, companies focus their existing IT talent on IT exploitation (i.e., the traditional IT mode) but balance resource demands in the long term by hiring new IT talent or by collaborating with IT service providers to fulfil IT exploration needs.
Paradox 2 – Performing paradox: Different IT modes follow competing goals while seeking the success of the company	IT architecture unfit for rapid development and testing Missing end-to-end understanding of the new digital product by the agile IT mode	**Integration** with alignment efforts between IT exploitation and IT exploration: Case companies attempt to accommodate competing goals through new IT–IT-alignment practices between the IT modes. One case with differentiation: The agile IT mode takes responsibility for the exploration and exploitation of all new digital products.
Paradox 3 – Organizing paradox: Need for freedom for IT exploration vs. desire for a common order across the company	Tensions between the agile IT mode and corporate IT policies and guidelines	**Differentiation**: Executives focus on freedom for IT exploration (i.e., the agile IT mode) by suspending corporate policies via special permits from the executive board.
Individual-level paradoxes		
Paradox 4 – Belonging paradox: Diverging self- and other-perceptions of the agile IT mode	Traditional IT mode envious of the agile IT mode regarding working with new technologies New agile IT mode is seen as a competitor Distrust, ill will, resentment, or "politics"	**Integration** on multiple levels with increased communication: Companies try to integrate the diverging perceptions with enforced internal communication about the different roles and increased transparency about product development progress in the agile IT mode.
Paradox 5 – Belonging paradox: Identity clash between personal digitalization aspirations and occupational demands	"Unfit" mindset of new hires	**Integration then differentiation** if necessary: Companies try to accommodate new hires' working practices. If not successful, they fully focus on the existing company culture and goals, and the new hires who do not fit in are laid off, even if important efforts are needed.

Table 3-3 Summary of bi-modal IT paradoxes, tensions, and management practices

3.4.1 Organizational-level paradoxes and corresponding management practices

Paradox 1 (Learning): Building future digital talent while ensuring the success of the IT function in the present

The setup of an additional IT mode usually requires additional IT employees. Given that all case companies tried to staff their new agile IT mode with existing employees, they were soon confronted with the organizational-level issue that well-trained and available IT employees (with appropriate technical and non-technical skills) were scarce. The following quotes illustrate this tension:

> *There is no doubt that there are good colleagues who can do this. But they are, because they are good, rarely available. And then you are faced with a problem.* – Team leader within traditional IT mode (Case 6)

> *Corporate IT has given us very few people. The challenge is simply to keep the capacity situation under control.* – Management team member of agile IT mode (Case 5)

> *Of course, we have some IT talent within the organization. But these people are already overburdened. Or promoted.* – Head of agile IT mode (Case 1)

Allocating existing employees to one IT mode means draining resources from the other mode. This tension mirrors the most frequently discussed issue of resource allocation in the ambidexterity literature. While working in the new agile IT mode requires a different set of technical and non-technical skills compared to the traditional IT mode (e.g., higher autonomy and entrepreneurial work, different programming languages), several interviewees reported that many co-workers within the traditional IT mode had such non-technical skills and could easily acquire the lacking technical skills. While this prevalent organizational-level tension reveals a tension in resource allocation, the overall resource situation is more complex, as the next tension shows.

In nearly all cases, the agile IT mode was responsible for the development of new digital products. However, the traditional IT mode was responsible for the operations and maintenance of these products once productive, and a handover between the modes had taken place. Consequently, traditional IT had to hold back resources for these new digital products, even though these resources were not foreseen in the budgets. Additionally, these products led to a broader application landscape and, due to the use of new

technologies (e.g., cloud technology), to an even more complex application landscape. As team leaders within traditional IT put it:

> *Our IT application landscape and architecture are already very fragmented. When the agile IT unit constantly feeds in new platforms, it gets even less standardized.* – Team leader within the traditional IT mode (Case 5)

> *Then we're back to the capacity issue, that just because there's an agile IT unit, they have to kind of increase central IT as well. Just to absorb what's coming in.* – Team leader within the traditional IT mode (Case 2)

The two tensions highlight how strongly both IT modes are intertwined, indicated by numerous handovers that have to be managed and the diverse resources and skills that need to be allocated. In fact, both IT modes need to build up resources to cover the responsibilities for the development, operations, and maintenance split between the agile IT mode and the traditional IT mode.

Our cases showed an underlying paradox manifested in these two tensions: Bi-modal IT functions need to build capabilities for future technologies (e.g., cloud development) in both modes without draining resources from the traditional IT mode that are necessary for running existing products and performing in the present. As it is centered on knowledge and capabilities, this paradox is a prime example of a *learning* paradox in ambidextrous IT and goes beyond the often-discussed pure resource-allocation issue of existing resources in ambidexterity research.

To manage these tensions and their underlying paradoxes, managers and executives from all cases in our study used an organizational-level differentiation practice regarding talent *in the short term*. Even if many interviewees acknowledged that several employees within the IT function had the necessary technical and non-technical skills, the agile IT mode was mainly staffed with new hires (having profiles such as UX/UI designers, data scientists, front-end and back-end developers, agile coaches), which required additional time and resources for recruiting and onboarding. Senior managers of the new mode were always staffed from within the existing organization. Another case company used a build–operate–transfer model, with external service providers contributing to the development in the beginning, continuously moving out and being replaced by new hires in the end. In the *longer term*, regarding the additional resource needs of traditional IT, we noted a firm-wide integration practice concerning the workload. The traditional IT

mode opened up its application landscape to new technologies that could also replace existing products and architecture (e.g., cloud technology), but it also obligated the agile IT mode to rework some digital products in order to reach a certain level of harmonization with existing products. Our interviewees also reported that these combined practices benefited both modes, as they led to reduced innovativeness in the short term but increased it in the long term, as operations and maintenance could now be taken over more easily by the traditional IT mode, while the agile IT mode could focus entirely on innovation. Thanks to these dynamic practices, tensions were resolved once resources in both modes were no longer scarce, although tensions might surface again once new resources were needed, for instance, due to additional digital product initiatives.

Paradox 2 (Performing): Different IT modes follow competing goals while seeking the success of the company

The agile IT mode usually has different goals than the traditional IT mode (e.g., agility and speed vs. reliability and stability), which translate into IT architecture requirements that contradict the existing IT architecture requirements of the traditional IT mode (e.g., in terms of fast testing and deployment). All case companies faced this tension on an organizational level regarding how to manage these requirements. As one IT manager stated:

> *As long as I am in a research and development phase, it does not make sense to use corporate IT infrastructure, because it is like an engine room, far away from the customer. We have an ambidexterity there—a large area of tension. We still need to operate some topics in a highly stable and very cost-efficient manner. However, this world does not fit to "Let me try this" or "I need to change something quickly."* – Team leader within the traditional IT mode (Case 6)

We observed a similar tension due to the different goals for feature prioritization for new digital products. Several interviewees described a tension that surfaced during the handover of a digital product from agile IT to traditional IT. While agile IT optimizes speed during the development of an innovative digital product and might assign a lower priority to other product features, traditional IT might miss these features in favor of stable product operations. One IT manager summarized it as follows:

> *In the development phase, other things must also be considered (e.g., security, appropriate tools) in order to be able to hand them over at all. We have, by then, already completely shot down some products.* – Team leader within the traditional IT mode (Case 2)

IT executives are confronted with the fact that the primary goals they want to achieve with a bi-modal IT—namely, IT exploitation and IT exploration—conflict as soon as the two IT modes interact (e.g., during handovers, when working on the same architecture). From our data, tensions emerged that pointed toward the paradox that different IT modes follow competing goals, even though both seek the success of the company. With such competing goals, this presents a *performing* paradox on an organizational level. Although the organizational separation of the IT exploitation and IT exploration goals is the fundamental assumption of structural IT ambidexterity, this finding again highlights that, with a bi-modal IT function, both IT modes heavily interact.

In most cases, the case companies established integrational initiatives to manage the paradox and the inherent tensions. While the agile IT mode built up a separate IT architecture in all cases, regular exchange was ensured between the IT modes to learn from the new IT architecture, and in one case, it was used as a blueprint to modernize the IT architecture of the traditional IT mode. Increasing alignment between the IT modes was another significant integrative action in that context. Day-to-day practices included the placement of integrative roles such as “liaison officers” from the traditional IT mode within the agile IT mode, as one interviewee described it, for a regular exchange. Also, the further a product’s development progressed, the more the companies increased IT–IT alignment: Several traditional IT co-workers who were responsible for the future operations and maintenance of the product would work closely together (co-located) with the agile IT mode in the last phase of product development. Job rotations between traditional IT and agile IT units were employed in two cases and were highlighted by our interviewees as a measure to increase alignment in the long term. While alignment efforts required resources and slowed down the processes of both IT modes, they helped both IT exploration and IT exploitation in the longer term, as one executive explained. Nevertheless, the paradox persists, and this management practice requires a continuous balance, as it bears the risk of eventually favoring one IT mode. One interviewee explained it as follows:

> *We need to drive both simultaneously. We need to develop our IT strategy as in the last years, and we need to continue investing in our existing IT services, not only in the new stuff.* – Team leader within the traditional IT mode (Case 2)

Additionally, we observed one case in which the company decided on a differentiation practice and founded a new subsidiary company based on the agile IT mode, adding HR and finance functions to it. In that particular case, the agile IT mode did not collaborate with the traditional IT mode anymore, and was responsible for the whole product lifecycle, integrating IT exploitation and IT exploration for novel digital products. This comprehensive responsibility also led to the better balancing of IT architecture requirements and feature-prioritization goals, thus resolving the tensions.

Paradox 3 (Organizing): Need for freedom for IT exploration vs. desire for a common order across the company

In each case, the interviewees stated that corporate IT policies and guidelines restricted certain activities to retain a common order across the company. However, with the objective being to innovate and with freedom being an essential enabler of innovation (Arvidsson and Troels 2018), several interviewees described tensions between the agile IT mode and existing corporate IT policies and guidelines enforced by the traditional IT mode:

> *Yes, the digital innovation unit needs freedom regarding IT, but we had some serious disputes about this in the beginning. Wishes did not meet reality. They wanted to have access to all firm data. That was their ambition. In my IT role, I said: Forget it.* – Team leader within the traditional IT mode (Case 8)

> *Freedom was not given to us in the beginning. We had several confrontations with the executive board about this.* – Management team member of the agile IT mode (Case 6)

> *We asked to get access to some ports to test a peer-to-peer protocol (for a blockchain product). Our IT security manager freaked out and said, "Only over my dead body!"* – Team leader within the agile IT mode (Case 9)

The agile IT mode usually requested a maximum of freedom for digital innovation, which notably included access to large amounts of (company) data and reduced compliance requirements in terms of security and safety standards that IT policies typically

encompass. Submission of the agile IT unit to the same policies and guidelines as the rest of the company was at the expense of innovativeness. Based on our analysis, we observe a paradox between the need for freedom for IT exploration and the desire to retain common order across the company. As the paradox consists of contradictory processes and structures, we identify it as an *organizing* paradox.

Across different cases, we noticed a differentiation practice on an organizational level to address the paradox. Executives and board members in these cases gave the agile IT mode the requested freedom after several escalations and discussions by suspending corporate policies for the agile IT unit, which were still valid for other parts of the organization. Thus, they coped with the paradox by emphasizing the differences between the IT modes and the uniqueness of the situation. As a result, the agile IT mode had the leeway it needed, for example, concerning IT procurement or IT security.

3.4.2 Individual-level paradoxes and corresponding management practices

Paradox 4 (Belonging): Diverging self- and other-perceptions of the agile IT mode

In each case, the interviewees reported that the agile IT mode had the responsibility for developing new digital products and services based on new technologies (e.g., cloud development, machine learning). Even if these new technologies were not previously used by the IT function, knowledge and interest from some co-workers in the traditional IT mode might already have existed. As others in the same company could now test and use the new technologies, emotional tensions of frustration and envy arose on an individual level. The envy increased when traditional IT employees perceived the new, often divisionally separated IT mode as an extension of the existing IT mode (compared to a new non-related unit). As a consequence, these employees had difficulties understanding why budgets were given to the new unit instead of the existing IT division. As one interviewee explained:

> *An IT that has been doing this for 20–30 years knows what innovations there are and would like to do more than it can and is slowed down by savings in the department. When a new area is created that is allowed to do the cool shit, it makes for a massive envy factor*. – Team leader within the traditional IT mode (Case 8)

Beyond envy, we identify a related tension. With divisionally separated IT units and each unit working together with business units, rivalry can arise. In detail, two interviewees stated the following:

> *There is a certain competitive situation between the agile IT unit and central IT, since both are, in principle, service centers for the business areas. Of course, central IT could say that "innovative IT is also my turf," but this is not so much decided on the board level. If you ask the business organizations, then the situation looks different again, because, in the end, they do not care where they got their services from.* – Project manager within the traditional IT mode (Case 1)

> *They [employees within the traditional IT unit] have always felt like those who sit on systems, procedures, and processes, which are obsolete. Then there was the fast IT—the new IT. I think you have to do something here so that you do not get a vast cultural gap.* – Chief Information Officer (Case 4)

While both IT modes belong to the same company, employees create identities regarding their modes (based on roles and responsibilities) that do not correspond to the identity perceived by employees in the other IT mode. For instance, employees within the agile IT mode may see the mode as an innovation unit coincidentally using IS but being non-related to the IT function. The business-centric culture of this mode might enforce this perception, as employees might see themselves as being closer to the business units than to the traditional IT mode. At the same time, employees within the traditional IT mode with its IT-centric culture might focus on the fact that the agile IT mode develops software and perceive the novel mode as an enlargement of the traditional IT mode or even as a replacement and thereby a rival to traditional IT. In our cases, such diverging perceptions were especially intense when both IT modes were divisionally separated, reporting to different executives. In addition to these emotional tensions of envy and rivalry, nearly all examined cases reported tensions in terms of distrust, ill will, or resentment of varying intensity against the agile IT mode by individuals:

> *We were smiled at in the beginning. Many did not quite understand why we should be needed. The employees could not identify with us.* – Management team member of the agile IT mode (Case 7)

> *Some said at the beginning: these odd sandbox players. Running around, sitting on colorful cushions with MacBooks, and just having fun.* – Head of the agile IT mode (Case 1)

> *Of course, there are people who look at it with ill will. In every organization, there is politics; that is just the way it is. All in all, a good image, in some places, ill will.* – Chief Information Officer (Case 7)

It is worth highlighting the differences from the previous emotional tensions of envy and rivalry. While the previous tensions occur between the IT modes, this tension touches the broader company and is based on the repulsion felt for the agile IT mode by some employees due to its novelty and otherness. In many cases, this otherness led employees to create an alienated perception of the agile IT mode that was viewed as a playground or small experiment rather than as a supporter or enabler of digital technologies.

The underlying paradox that emerges across these tensions is that the same agile IT mode may be simultaneously perceived by some employees as part of the IT function and by others as a non-IT function. As this paradox touches on the identity of individuals and collectives, it marks an example of a *belonging* paradox, going beyond the paradox types discussed previously in IT ambidexterity and bi-modal IT research, emphasizing the subjectivity and emotional tensions in organizational paradoxes that are *per se* non-rational.

We often observed an integration practice on multiple levels to address this paradox, consisting of enforced internal communication to highlight the importance of the agile IT mode for the success of the (digital) transformation of the company and to value the work of the traditional IT mode as a foundation and precursor for digital transformation. This practice did not necessarily lead to an overarching perception of the agile IT mode, thus maintaining the paradox, as expected by theory. However, resentment, envy, and rivalry tensions decreased as employees in the traditional IT mode felt valuable (again) and as recognition of the agile IT mode increased. More specifically, agile IT mode co-workers increased their informal communication toward other units about the particularities of their mode and why it was necessary nowadays, while taking care not to be arrogant, as one manager insisted:

> *The secret is that you work at eye level with your colleagues and do not make yourself the kind of person who has eaten wisdom with spoons.* – Management team member of the agile IT mode (Case 6)

On a team level, discussions between IT modes took place to clarify roles, and the intensity of internal communication by the agile IT mode was increased (e.g., internal blog posts, newsletters, guided tours through agile IT workplaces). The internal communication focused on (1) explaining new ways of working and (2) reporting on the progress and success of IT exploration—namely, new digital products (e.g., first customer or first revenue)—thus helping to increase the appreciation of the new IT mode in some cases. As one manager summarized:

> *It was a difficult discussion up to this day, but it has now been resolved. For me, corporate IT is an extremely important function. But that does not mean that it should compete with me. That was not clear until now. They have to provide infrastructure. They have implemented an Enterprise Service Bus (ESB). This thing is the best thing they have done for the business for decades. Without this ESB, I would be lost. That is the gold nugget to scale up.* – Head of the agile IT mode (Case 1)

Paradox 5 (Belonging): Identity clash between personal digitalization aspirations and occupational demands

Many interviewees reported that the agile IT mode had hired new employees, sometimes competing against technology companies or start-ups (e.g., Facebook) in the recruiting process. However, even if the activities in terms of IS development are similar to those of start-ups, new employees face a different culture. Established companies in our sample had a tradition of building fail-safe products, which contradicts the fault-tolerant, fast, and agile software development approaches expected by new IT talent. Collaboration with the non-agile traditional IT mode and business units, for which products are developed, often requires an adaptation of methods in the agile IT mode, which slows down development. Newly hired individuals experience that their expectations and reality collide, and frustration might be the consequence. In addition, while the goal of the agile IT mode is to explore new digital products, performance targets, such as revenue or the number of pilot clients, are also set for this mode. Such targets might restrict experimentation and exert unexpected pressure on new employees.

Consequently, individuals might primarily face tension in their thoughts, beliefs, values, and emotions, as the following quotes succinctly summarize:

> *This new [agile IT] unit hired a lot of very talented IT people. They have a drive, but then run up against walls, which causes frustration. And even if this unit has a somewhat good reputation by now, you will not break down these walls.* – Project manager within the traditional IT mode (Case 1)

> *They [newly hired IT talent] forget that life is not full of bliss and that this is not a playground, but a full-grown company. Their performance is very well tracked, and they are measured by their results.* – Management team member of the agile IT mode (Case 5)

With such conflicting values and beliefs, the new hires face an emotional identity crisis and tension that points toward an underlying paradox on the individual level: New hires' identities based on their understanding of an employee in modern IS development clashes with their occupational demands. More specifically, they have the same role and are supposed to execute similar tasks and activities as in previous jobs but now face prior unmet methods and organizational goals. With tensions affecting individuals' identities, this presents a *belonging* paradox on an individual level.

As we learned from different interviewees across cases, managers often organized workshops with new hires and representatives of both IT modes (and business units) on how to adapt working practices to meet each other's expectations and to achieve a better mutual understanding, thus, following an integrative approach. As one manager puts it:

> *"They want things and need things and mean to be right, which I question. But that's helped a lot of times after we discussed it. Both sides of the card. I think it's important."* – Project manager within the traditional IT mode (Case 1)

However, if the integrative approach was unsuccessful, companies decided to lay off new hires that didn't fit to the bi-modal IT world with two very different modes having to collaborate. This is especially noteworthy, as for some of the case companies, firing is a rare and extra-ordinary event. The following quotes summarize this differentiation approach:

> *"I fired three people because the mindset was wrong. And that is also a success factor in removing them immediately."* – Head of the agile IT mode (Case 1)

> *"More specifically, you have some people who want to continue playing so to speak but at a certain size you have to do business. Some then had to leave."* – Management team member of the agile IT mode (Case 5)

> *"Firing is sometimes more difficult at our company. But clear and consistent management is important."* – Management team member of the agile IT mode (Case 7)

3.4.3 Dynamic cross-level interrelationships between paradoxes, tensions, and practices

The tensions, paradoxes, and management practices we identified in our interviews did not emerge in isolation but were often interrelated with one another. Indeed, we found that individual-level paradoxes can become salient due to management practices that target organizational-level tensions and paradoxes. Conversely, we also uncovered how management practices dealing with individual-level tensions and paradoxes can make organizational-level paradoxes more salient again. For the sake of illustration, we focus on three informative instances that emerged from our data.

First, we noted that the organizational-level paradox 2 (different IT modes follow competing goals while seeking the success of the company) and its manifestations as tensions (inadequate IT architecture and missing end-to-end understanding) were addressed by an *individual-level* integration practice in one case: one team member of the traditional IT mode took a second role within the agile IT mode, now wearing "two hats," making alignment and communication through this unique position easier:

> *And the great thing is that our Head of Development is also the Chief Architect of the IT function. He set up the initial tech stack for our agile IT mode, and with his double role, this initial tech stack becomes the main tech stack for IT.* – Management team member of the agile IT mode (Case 2)

Second, we observed that a *differentiation* practice to manage organizational-level tensions and their underlying paradox made an individual-level paradox more salient. As mentioned above, in another case, we found that the organization opted for a differentiation practice to attend to paradox 2 and its emerging tensions, strictly

separating both IT modes. This differentiation practice made the individual-level paradox 4 (diverging self-perceptions and perceptions by others of the agile IT mode) more salient and reinforced envy among the members of the traditional IT mode, as the following quote mirrors:

> *The department that is supposed to take care of all the innovative topics is taken out of IT. There is no exchange taking place, and all learning is made again on the side of the agile IT mode. They would not ask us, and we would not want to answer. In sum, this creates enormous envy among us.* – Team leader within the traditional IT mode (Case 8)

Similarly, we identified knock-on effects on the individual level triggered by a *differentiation* practice organizations used to deal with tensions arising from paradox 3 (need for freedom for IT exploration vs. desire for a common order across the company). The practice of giving leeway to the agile IT mode often made paradox 4 more salient again, creating envy among other employees who still had to align with corporate IT policies and who would have preferred to do otherwise. Thus, a new emotional tension arose on an individual level.

Third, paradoxes and practices at the organizational level can not only be a consequence of, but also a precursor to paradoxes and practices at the individual level. Especially for paradox 5 (identity clash between personal digitalization aspirations and occupational demands), we observed that if the integration practice we discussed above (adapting working practices to meet each other's expectations) was not effective, individuals opted for a *differentiation* practice (leaving the unit or company). Such a separation would only resolve tensions for former employees but would also lead to a higher salience of paradox 1 and an exacerbation of resource tensions, as the following quote illustrates:

> *Let me put it this way: Keeping the organization agile in its size is an ongoing task. Once a person joins or leaves, the whole thing is a bit on the brink of collapse. It's really a very, very sensitive construct.* – Management team member within the agile IT mode (Case 8)

Overall, the dynamic, cross-level interrelationships between paradoxes, tensions, and practices that can be derived from the above cases highlight the importance of the micro-foundations perspective for a more comprehensive understanding of bi-modal IT.

3.5 Discussion

The goal of this research was to deepen our understanding of the multi-layered nature of tensions and paradoxes in bi-modal IT and to unearth promising practices to manage them. Previous research has conceptualized bi-modal IT largely as a single, aggregated entity without paying much attention to paradoxical interdependencies between the two constituent IT modes. Moreover, it has primarily focused on tensions and associated paradoxes in terms of goals, structures, and processes on an organizational level, disregarding emotional responses on the individual level. Against this background, our study shows that these tensions and paradoxes can be much more intricate and far-reaching than previously discussed in the IT ambidexterity literature. In this vein, our micro-foundations perspective reveals important individual- and organizational-level paradoxes, tensions, and management practices as well as dynamic cross-level interdependencies, as summarized in Figure 3-3.

The transformation of the IT function into bi-modal IT not only presents organizational-level challenges in terms of structures, processes, capabilities, and goals; it may also engender paradoxes that are felt at the individual level and cause organizational actors to experience serious emotional tensions (e.g., envy or ill will). Management practices that address such tensions can in turn mitigate or resolve conflicts, or even trigger negative feedback cycles that make lower- or higher-level paradoxes salient (again). We found that differentiation practices, in particular, can lead to unintended ripple effects. On the one hand, by addressing organizational-level tensions and their underlying paradoxes (e.g., P2 and P3), differentiation practices may have knock-on effects on individual-level paradoxes (e.g., P4) and tensions. On the other hand, and conversely, they may also render a paradox at an organizational level salient again (e.g., P1) by dealing with individual-level tensions and their underlying paradoxes (e.g., P5). Collectively, these dynamic, cross-level interdependencies highlight the importance of considering paradoxes and tensions at both the organizational *and* individual levels to obtain a more comprehensive account of the inner workings and challenges of bi-modal IT.

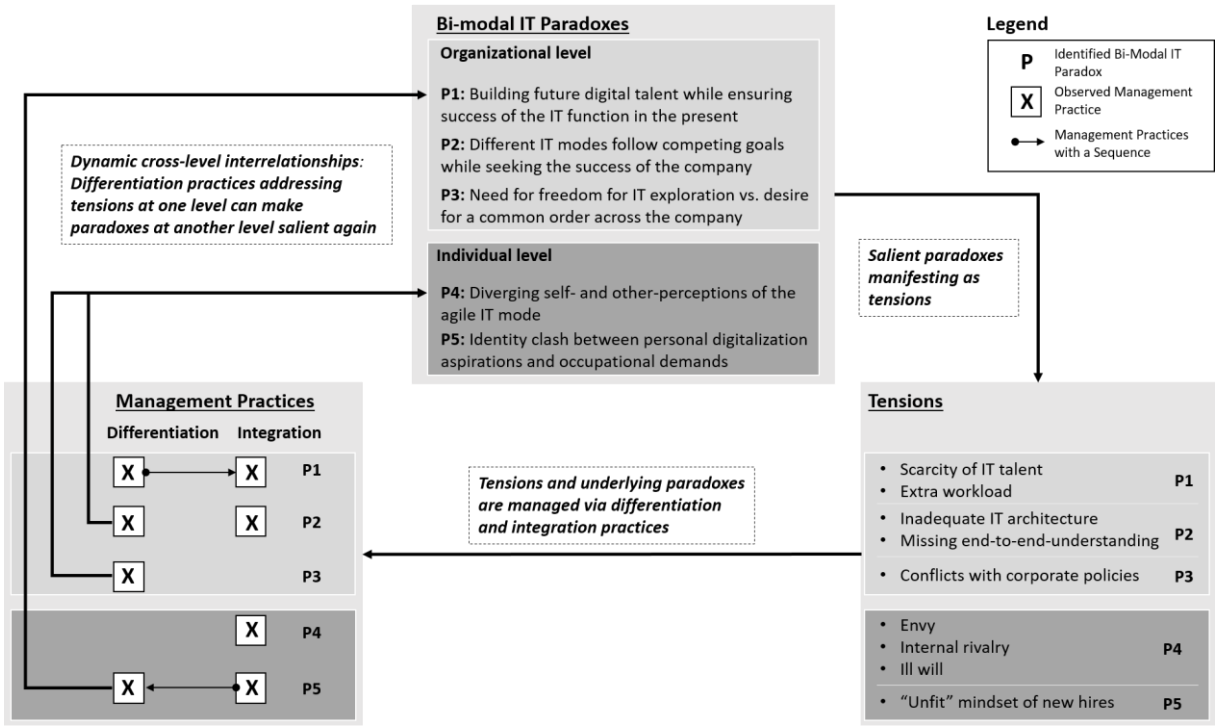

Figure 3-3 Emergent model of interrelationships between paradoxes, tensions, and management practices in bi-modal IT

3.5.1 Contributions to theory, research, and practice

This study makes three important contributions to IS research. First, our study offers novel insights into the nascent research on bi-modal IT. Previous studies have largely focused on phenomenological descriptions of the bi-modal IT concept using an organizational-level perspective (Haffke et al. 2017a; Joehnk et al. 2019). In doing so, they treated bi-modal IT largely as a single entity without paying much attention to the complicated set of tensions inherent in the interactions between the two constituent IT modes. In contrast, our study introduces a micro-foundational perspective that seeks not only to understand organizational-level *and* individual-level tensions and paradoxes, but also to shed light on their intricate interrelationships. This emphasis on individual-level paradoxes and cross-level interdependencies is aligned with the emerging view that a full understanding of organizational phenomena is incomplete without an understanding of their micro-foundations (e.g., Felin et al. 2015). From this perspective, we advance previous research by unpacking the intricacies in bi-modal IT and uncovering the dynamic interlinkages between paradoxes and tensions emerging at multiple levels. Consequently, we advocate paying increased research attention to the micro-foundations of bi-modal IT, which is to date largely missing in the literature yet burgeoning in related fields (e.g., Miron-Spektor et al. 2018).

Second, through this shift toward a micro-foundational perspective, we uncover novel individual-level tensions and paradoxes that have been largely overlooked in bi-modal IT and IT ambidexterity research that mainly assumed a rational perspective to make sense of paradoxes (Joehnk et al. 2019). In answering the calls by Putnam et al. (2016) and Schad et al. (2016) for more research into non-rational responses to paradoxes, our study identifies envy as a salient emotional tension along with other related affective responses (e.g., fear, ill will/resentment) as manifestations of paradoxes on the individual level. Accounting for the emotional side of paradox responses adds a new dimension to our conversation about bi-modal IT and opens up multiple avenues for combining rational and non-rational perspectives.

Third, we contribute novel findings that challenge previous structural ambidexterity theory (Christensen 2013; Raisch and Birkinshaw 2008) and advance "the world as-is" understanding of ambidextrous IT organizations (Grover and Lyytinen 2015). In contrast to the prevailing notion that separating exploitation and exploration for the IT function is an effective solution (Raisch and Birkinshaw 2008), we found that the differentiation practices put in place often exacerbated—rather than mitigated—tensions between traditional and agile IT, spurring negative feedback loops. We even found the tensions to be most evident in cases of divisionally separated bi-modal IT, with the traditional IT mode reporting to the CIO and the agile IT mode reporting to the CEO. As such, and in response to calls for research into the complexities of IT ambidexterity (Gregory et al. 2015; Montealegre et al. 2019), we demonstrate that the interactions between traditional and agile IT modes are not always clear-cut and straightforward but are often messy and contested, with potentially problematic ripple effects throughout the organization.

Our results also provide several practical implications for managers who are responsible for handling emerging tensions and inherent paradoxes in bi-modal IT. First, IT managers may want to use the tensions and paradoxes summarized in Table 3-3 and Figure 3-1 as a blueprint to identify the types of tensions in their respective bi-modal IT structures. This may accelerate processes to diagnose the root causes of problems and issues during the implementation of bi-modal IT. We specifically point out the importance of managers having their eyes and ears wide open to identify emotional tensions (such as envy and resentment) early on. Second, in analyzing how practitioners

manage bi-modal IT tensions, we answer the call by Karpovsky and Galliers (2015) for increased inquiry into what IS practitioners do on the ground to balance alignment with progress. We demonstrate that both integration practices (e.g., liaison officers, job rotation, internal communication) and differentiation practices (e.g., new hiring, special permits, exemptions) are used—in isolation or in conjunction—to address emerging tensions and underlying paradoxes. Practitioners are encouraged to use these integration and differentiation practices as a source of inspiration for individual adaptations. Finally, the dynamics in the relationship between traditional and agile IT indicate that practitioners should continuously reflect on the current state of bi-modal IT in their respective organizations and on how to adapt in light of emerging tensions. As such, IT managers are advised to handle bi-modal IT as a continuous and recursive "work in progress" toward a moving target instead of a linear process with a fixed goal.

3.5.2 Limitations and future research

As with any research, our study is subject to several limitations that should be kept in mind when interpreting our results. We acknowledge that the selection of our cases has limitations. We had to balance the in-depth observations of each case with the number of cases to reach a comprehensive coverage of tensions, paradoxes, and management practices we were aiming for. Thus, the depth of the observations might be limited. Moreover, and although we followed common guidelines (Klein and Myers 1999; Walsham 1995), the headquarters of all nine case companies were in Germany. Even if they are multi-nationals, companies from different geographies or cultures might face other bi-modal IT tensions and paradoxes and might manage them differently. Therefore, our results should be seen in light of the contexts of our cases (Davison 2014). Furthermore, we employed retrospective data collection to capture relevant developments in the IT function, as has been done in previous IS research (e.g., Li et al. 2017; Ramesh et al. 2007). However, ethnographic methods and continuous longitudinal data collection may have allowed for the collection of even more relevant data. Moreover, while we uncovered multiple bi-modal IT tensions and paradoxes in our study, deriving their relative importance for organizations was beyond the scope of our study. Quantitative studies could be helpful in this respect; they could complement our qualitative findings and explore our research questions on a larger scale.

Our study also opens up new directions for future research. Future studies could evaluate which external tensions (e.g., conflicts with existing and new customers), in combination with internal tensions that were the focus of our study, impact and shape organizations. Future research endeavors are also invited to examine the activities at the interface of traditional IT, agile IT, and other parts of the company in more detail to increase our understanding of the paradoxical concept of bi-modal IT. For instance, bi-modal IT re-integration, as seen in two of our cases, might be a relevant research topic for further studies. Finally, future research could provide a more fine-grained view on IT ambidexterity and bi-modal IT by taking an IS artifact-level perspective to study how the differentiation between IT exploitation and IT exploration affects system applications' evolution (e.g., in terms of features, releases) over time.

3.6 Conclusion

Bi-modal IT is a powerful engine to leverage digital technologies for value creation and value capture in organizations. Despite its increasing prevalence, previous research has paid little attention to how tensions between the traditional and agile IT modes emerge and how the underlying paradoxes can be managed in practice. Our study contributes to research by revealing nine core tensions in bi-modal IT that can be traced back to five fundamental paradoxes and managed via specific integration and differentiation practices. Based on a micro-foundations perspective, we suggest that an incomplete picture is painted when only organizational-level paradoxes are considered and cross-level interdependencies are overlooked, which is unfortunately common practice in the bi-modal IT literature. In doing so, we not only uncover novel emotional tensions at the individual level. Counter to the prevailing view that divisional separation is a straightforward solution, we also show that the value of structural ambidexterity for the IT function is constantly contested. We hope that our findings lay useful conceptual foundations and provide food for thought in future research, which is needed to expand our current understanding of bi-modal IT.

4 Outcomes of Changes in Digital Channels in a Customer Context

Title:	Investment Decisions with Robo-Advisors: The Role of Anthropomorphism and Personalized Anchors in Recommendations
Authors:	Martin Adam, Technische Universität Darmstadt, Germany Jonas Toutaoui, Technische Universität Darmstadt, Germany Nicolas Pfeuffer, Goethe-Universität Frankfurt, Germany Oliver Hinz, Goethe-Universität Frankfurt, Germany
Published in:	Proceedings of the Twenty-Seventh European Conference on Information Systems (ECIS 2019), Stockholm-Uppsala, Sweden

Abstract

The current wave of digitalization forces companies to adapt their offline activities to meet contemporary customer expectations and technological possibilities. One current challenge for the financial services sector is to shift its traditional, in-person advisory process into a digital, automated service (i.e., robo-advisory) to reduce costs as well as to reach a wider audience of prospective customers. By neglecting to increase and invest their savings, customers run the risk of making suboptimal economic decisions that may negatively affect their economic futures. Drawing on social response as well as anchor-adjustment theory, we investigate anthropomorphism (i.e., the attribution of human characteristics and goals to non-human agents) and personalized anchors in recommendations as IS design elements in the context of robo-advisory for investment decisions. Our results from an online experiment with 278 participants show that anthropomorphism (i.e., triggered by verbal and visual cues) and personalized anchors in recommendations lead to higher social presence which in turn lead to increased investment volumes. Additionally, we demonstrate that personalized anchors in recommendations directly increase investment volume. Thus, our results contribute by providing novel findings on how anthropomorphism and personalized anchors in recommendations can be used to improve economic decision-making.

Keywords: Robo-advisory, Nudging, Anthropomorphism, Anchor, Online recommender systems, Financial support systems

4.1 Introduction

Digitalization is a significant topic that is no longer dispensable. Caused by an increasing infusion of information systems (IS) into everyday activities and the rise of ubiquitous technologies, digitalization has an impact in various areas in economy and society, of which the financial services industry is no exception (Alt and Puschmann 2016).

As a result, new financial services, such as "robo-advisory," have emerged. Robo-advisors are IS that guide users through an automated investment advisory process by means of interactive and intelligent user support components (Jung et al. 2018; Sironi 2016). Consequently, robo-advisory allows a larger audience to access and use a professional asset management at low costs, which before has been affordable by only wealthy investors who could pay costly human advisors (Jung et al. 2018, p. 83). Indeed, A.T. Kearney estimates that assets under management by U.S. robo-advisors alone will grow to 2.2 trillion dollars by the end of 2020 (A.T. Kearney 2015).

Because digital services replace the traditional human-to-human interaction between human advisors and their customers, one challenge that financial service companies face is the design of adequate robo-advisory services that are accepted by potential investors (Jung et al. 2017, p. 368). Yet, little is known on how the design and mechanics of robo-advisory can improve economic decision making. Today's customers might not save enough money for their future (Skinner 2007), often being influenced by heuristics in their economic decision-making (Fleischmann et al. 2014), leading to biases against saving (Benartzi and Thaler 2007). In offline contexts, several nudges have already demonstrated to improve the economic decision-making of customers regarding their saving and investment decisions (e.g., Cronqvist and Thaler 2004; Thaler and Sunstein 2008). However, online contexts such as robo-advisory may open the opportunity for new approaches to further improve economic decision-making.

Robo-advisory is a phenomenon that is still in its infancy in finance and IS, so that only few researchers have devoted their attention to this support system. Recent robo-advisory research draws on foundations from related fields, such as the development of portable advisory tools (Heinrich et al. 2014; Moewes et al. 2011) and the design of

financial encounters (Dolata and Schwabe 2016) to increase comprehension and success with regard to the configuration and profiling of users in form of user investment behaviour (Kilic et al. 2015; Musto et al. 2015) and the design of user interfaces to improve user experience (e.g., Heyman and Artman 2015; Nueesch et al. 2014). An important theory for forming a more natural bond between the user and the system may be found within anthropomorphism. Anthropomorphism leads humans to attribute human characteristics and intentions towards non-human agents (Epley et al. 2007), resulting in social behaviour even with non-human agents. Although anthropomorphism has been a topic of interest for scant research works in IS (e.g., Qiu and Benbasat 2009; Qiu and Benbasat 2010) and has even been researched in the context of robo-advisors by employing a simple name (Hodge et al. 2018), no study has yet explored the usage of anthropomorphism in the form of visual and verbal cues to increase investment volumes. Such visual and verbal cues have been proven to be decisive design elements in other fields like marketing and researchers have provided evidence that these cues can positively impact product likeability and product purchase intention (e.g., Holzwarth et al. 2006) and promise even more fruitful ventures in the future (Seymour et al. 2018). Based on such previous research findings, Pfeuffer et al. (2019) argue that the conventionally personal consultation talks between investor and investment advisor call for a more natural design of the human-computer interaction in robo-advisory. Therefore, it appears logical that employing an anthropomorphic conversational recommendation agent may lead to a higher efficiency of robo-advisory. Moreover, the emergence of robo-advisors as real-time recommender systems also raises questions with regard to how the provision of fast and personalized recommendations based on user input further shapes investors' investment decisions. Thus, this paper aims to investigate the following research questions:

RQ1: How does anthropomorphism in robo-advisors affect investors' investment volumes?

RQ2: How do personalized recommendations in robo-advisors affect investors' investment volumes?

To answer our research questions, we employed an online experiment with 278 participants in a 3 (Anthropomorphism: Absent vs. Low vs. High) x 2 (Personalized Recommendation: Absent vs. Present) between-subject design and systematically analysed the first steps in a robo-advisory onboarding process and assessed the intended

investment volumes. Consequently, we examined the impact of anthropomorphism, manipulated by verbal and visual design elements, as well as of personalized recommendations, operationalized through a user-input dependent numerical anchor in a recommendation by the robo-advisor. In doing so, we contribute to IS research and practice in several important ways. First, following the emergence and important growth of robo-advisory (A.T. Kearney 2015; Jung et al. 2018) we address the theoretically and practically neglected effects of anthropomorphism and personalized recommendations as effective nudges in the newly emerging robo-advisory context. Second, we provide an explanation for these observations through the mediating effect of social presence, which is built upon the general bias towards social orientation of human being (Nass and Moon 2000). Third, we depart from prior research by investigating how these influences improve economic decision-making like investment and savings behaviour. Lastly, we show the possibility of IS to provide real-time personalization in a financial context that would not be possible in a traditional offline setting. Thus, we not only shed theoretical light on our investigated effects, but also derive learnings for providers of financial services to increase investment volumes to improve economic welfare.

4.2 Theoretical Background

4.2.1 Robo-advisors and recommendations

Robo-advisors as financial support systems provide financial advice to potential investors based on algorithms that analyse financial information with less human intervention than ever before (Jung et al. 2018; Jung et al. 2017). As a result, robo-advisors challenge the traditional fund and wealth management industry (Phoon and Koh 2017). Robo-advisors have several important applications, and depart from existing services (e.g., online investment platforms and online brokerage) with regard to customer assessment and customer portfolio management (e.g., Jung et al. 2018; Tertilt and Scholz 2017): The traditional investor profiling that is normally conducted during offline human-to-human interviews is replaced by online questionnaires and self-reporting processes. Therefore, the user-provided answers (e.g., with regard to investment purpose or risk affinity) are used as inputs for algorithms and automated processes, instead of being processed by human advisors. Subsequently, the robo-advisor translates this information in real-time into an adequate portfolio of financial products, provides users with personalized recommendations as well as automatically manages the investment portfolio.

Previous research on automatically generated and personalized recommendations have primarily focused on exploring the effects in traditional online marketplaces, such as the trust in and adoption of such systems (e.g., Benbasat and Wang 2005; Hess et al. 2009b), the influence on customer's choice (e.g., Adam and Pecorelli 2018; Benlian et al. 2012; Senecal and Nantel 2004), or satisfaction (e.g., Holzwarth et al. 2006; Jiang et al. 2010). Yet, besides one exception (Hodge et al. 2018), research lacks investigations of recommendations in connection with the non-traditional context of robo-advisory (Jung et al. 2018).

4.2.2 Anchoring-and-adjustment effect

A recommendation by a robo-advisor can include a piece of information that a user can use as an anchor for further decision-making. The anchoring-and-adjustment effect, or often simply called anchoring effect, is the disproportionate influence on decision-makers to make judgments that are biased toward an initially presented information (Epley and Gilovich 2006). Heuristics reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations (Kahneman and Tversky 1974). Accordingly, decisions are made using the given anchor regardless of whether the anchor is relevant and useful for the decision (Furnham and Boo 2011). Kahneman and Tversky (1974) provide one classical example to demonstrate the anchoring effect. They interviewed their study participants on the fraction of African nations in the United Nations. Based on a generated random number they asked in a first round whether the right answer is higher or lower than the random number. Afterwards, the participant should give a concrete answer to the question. The results showed that the answers of the participants were numbers close to the anchor they were given in the first round.

This experiment shows that the anchor is used as a starting point for a decision, which is adjusted until it matches the anchor (Janiszewski and Uy 2008). After nearly 40 years' worth of research on the effect, the anchoring effect can be considered one of the most robust psychological processes that influences human decision-making (Furnham and Boo 2011). The anchoring effect is usually interpreted as a sign of human irrationality, but recently studies suggested that the anchoring effect results from people's rational use of their finite time and limited cognitive resources (Lieder et al. 2018).

The effect has been demonstrated in various domains such as real estate valuation (by experts and amateurs) (Northcraft and Neale 1987), purchasing of consumer products

(Wansink et al. 1998), or savings (Cronqvist and Thaler 2004). Especially in the area of financial decision-making, anchors seem to play an important role because humans typically do not (want to) spend much time on decision-making in this area (Benartzi and Thaler 2007). One large impediment to the anchoring effects in savings is liquidity constraints of each customer: Extreme anchor values can have no effect if customers do not have the liquidity to save such or similar volumes (Loibl et al. 2016). Vice-versa, (Braeuer et al. 2017) indicated that small anchors in robo-advisory have little or no effect on customers who aim to invest large volumes.

4.2.3 Anthropomorphism, avatars and social presence

A current trend in designing IS and specifically robo-advisory (Hodge et al. 2018) comprises the employment of anthropomorphic cues. Anthropomorphism describes the attribution of humanlike characteristics, behaviour, and emotions to nonhuman agents (Epley et al. 2007). It can be understood as a human heuristic to alleviate the understanding of unknown agents by applying anthropocentric knowledge (Epley 2004; Griffin and Tversky 1992). Accordingly, Pfeuffer et al. (2019) define anthropomorphic IS as "IS in which the technical and informational artefacts possess cues that tend to lead humans to attribute human-like physical or non-physical features, behaviour, emotions, characteristics and attributes to the IS." Thus, the thoughtful design of anthropomorphic cues can lead to an increased recognition of anthropomorphic features by humans, likeability, ease of use, and efficacy of an IS (Burgoon et al. 2000; Epley et al. 2007).

Because anthropomorphism as an innate tendency that influences the decisions and judgements of humans to a large extent, various research fields have been exploring its capabilities and effects in product design and on human behaviour (e.g., Aggarwal and McGill 2007; Nass et al. 1999; Wang 2017). Studies drawing on social response theory (Nass and Moon 2000) provide strong evidence that in various situations, humans tend to apply social rules and heuristics to anthropomorphically designed computers. While mental features such as the ability to chat may increase the perception of intelligence in a non-human technological agent, the main goal of visual features, such as appearance or embodiment, is to improve the social connection by implementing motoric and static human features (Eyssel et al. 2010). As such, static and motoric human-like embodiments through avatars (e.g., Holzwarth et al. 2006) have been observed in previous research as an important factor in influencing trust and forming social bonds

with virtual agents (e.g., Broadbent et al. 2013; Goetz et al. 2003a; Qiu and Benbasat 2009).

Since IS research is partly concerned with the amalgamation of existing theory with novel aspects of technology, the effects of such anthropomorphic design-elements on the perception of human-likeness must be made measurable and theoretically explainable. Previous efforts in IS research have employed and tested the construct of social presence as a measure of the perception of human-likeness in an interaction partner (Gefen and Straub 2003; Qiu and Benbasat 2009). Social presence theory originally describes the awareness of another human partner within a social interaction (Short et al. 1976). The idea to apply the theory of social presence in the form of a psychometric construct to the context of IS arose from the suggestions that theories from (social) psychology may in principle also be applicable to human-computer interaction (Nass et al. 1994). Indeed, previous research in IS has shown that social presence is well applicable as a means of measurement of the perception of a human touch within various IS contexts (Holzwarth et al. 2006; Qiu and Benbasat 2009). In fact, it appeared that through the construct of social presence, effects of anthropomorphic cues on likeability, trusting beliefs, perceived enjoyment and other important determinants of systems success could be explained (Cyr et al. 2007; Gefen and Straub 2003; Tourangeau et al. 2003).

4.3 Research Framework and Hypothesis Development

Based on what has been presented so far, a research model was developed that explicates how a robo-advisory's personalized anchor and anthropomorphism increase investment volume directly or by enhancing social presence. Figure 4-1 illustrates our conceptual research framework. Subsequently, we present the derivations for each of our hypotheses.

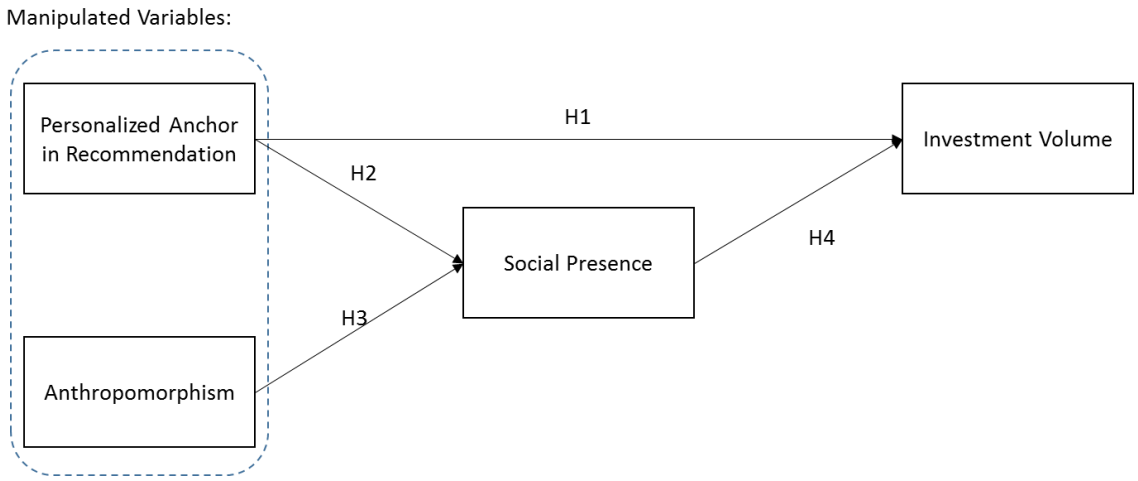

Figure 4-1 Research framework

4.3.1 The effect of personalized recommendations on investment volume

The previous section mentioned that the anchoring effect is a well-known effect that exists in many domains. However, in an investment or savings context, results from studies that manipulate anchors are mixed. Loibl et al. (2016) provided evidence that the same quantitative anchor for all investors had no effect on investors, who were restrained to reach the anchor by their personal liquidity constraints. Simultaneously, low anchors in an investment context revealed to have little or no effect on investors with large investment volumes (Braeuer et al. 2017).

Moreover, there is a shift from traditional offline banking services to online services like robo-advisory which increases the occurrence of decision-making environments in an investment context. Generally, customers tend to underinvest, which may be grounded in the hyperbolic discounting bias (Laibson 1997). In effect, this bias leads customers to value their present liquidity higher than possible gains in the future, thus discounting their future financial welfare. In the context of robo-advisory, the presence of this bias may influence customers to underinvest, which hinders the possibility of otherwise greater future savings through higher investments for these customers. Addressing this issue within robo-advisory is inevitable, since not only financial service providers may profit from higher investments, but foremost customers may experience greater economic welfare. Based upon the anchoring effect, we aim to demonstrate that an anchor can be placed successfully for all robo-advisory users in such an environment to influence their economic decision-making. The anchor should effectively influence the propensity of customers to invest a higher amount relative to his or her liquidity

constraints, thus being personalized and countering under-saving effects. Therefore, we state our first hypothesis:

H1: A personalized anchor in a recommendation increases a user's investment volume.

4.3.2 The effect of personalized recommendations on social presence

Recommendations can help in the decision-making process, especially if given by an expert agent (Dalal and Bonaccio 2010). Through an explicit recommendation for example, the decision of a person can be led into a special direction. Also, a specified recommendation against an option may make the decider to not consider this option anymore. Furthermore, a recommendation without an explicit advice can be made through additional information that was given to one of the options, making certain options more attractive to the decider (Dalal and Bonaccio 2010). Moreover, recommendations do not only have the function to guide a person in a certain direction but also serve as social support. The existence of a recommendation gives individuals the feeling that they are not alone with making a critical decision, hence creating social presence. This could be achieved through showing compassion and understanding of the feelings associated with the decision (Dalal and Bonaccio 2010; e.g., Horowitz et al. 2001). Based on these findings, we choose to provide some users with a personalized recommendation, which includes a personalized anchor that is dependent on the user's input. Finally, we derive the following hypothesis regarding the recommendation including personalized anchor:

H2: A personalized anchor in a recommendation increases the social presence of a robo-advisor.

4.3.3 The effect of anthropomorphism on social presence

A robo-advisor is an IS designed to provide financial advice and can reduce the costs of contemporary human advice services. Therefore, it is important to design a trustworthy, serious, and social atmosphere for the customer when interacting with the robo-advisor (Jung et al. 2017). Anthropomorphic design cues in human-computer interfaces could create this required atmosphere. Holzwarth et al. (2006), for example, showed in several experiments that using an avatar in online shopping positively influences a customer's attitude towards the product as well as purchase intentions. Additionally, the social presence elicited by an anthropomorphic avatar appears to increase customer satisfaction with the retailer (Holzwarth et al. 2006), trust in the presented information on the

website, and pleasure to visit and use the website (Etemad-Sajadi 2016). Qiu and Benbasat (2009) present more specific research findings on decision aiding systems, especially on recommender systems and anthropomorphic design. Their study, for example, revealed that while an anthropomorphic avatar for a recommendation agent had a direct influence on social presence. Thus, we derive the following hypothesis:

H3: Anthropomorphism increases the social presence of a robo-advisory.

4.3.4 The effect of social presence on investment volume

As robo-advisory is a relatively new phenomenon (Jung et al. 2018), we use insights from neighbouring domains to derive our next hypotheses. Essentially, financial investment decisions via a robo-advisor base on the relationship between the investor and the advisor who offers financial products. In this respect, the investor-advisor relationship bares similarities to the investor-founder relationship that is developed in the crowdfunding domain (Agrawal et al. 2010). Within the crowdfunding domain, the aspect of social presence has gained some attention (Raab et al. 2017; Zhang and Benyoucef 2016). Findings from this domain suggest that social presence is of importance to build a strong investor-founder relationship (Lu et al. 2016) and that social presence positively influences the success of a crowdfunded initiative in terms of pledged money. Based on these results from the crowdfunding domain and the results regarding the effects of anthropomorphism and recommendations on social presence as mentioned above, we hypothesize that social presence affects a user's investment volume.

H4: Social presence of a robo-advisor increases a user's investment volume.

4.4 Experimental Design

To test our hypotheses, we conducted an online experiment with a 3x2 full factorial design. We simulated an online investment decision with the aid of a robo-advisor, using all six possible combinations of the two independent variables: (1) the degree of anthropomorphism (no, low, or high) and (2) the presence or absence of a personalized anchor in a recommendation.

4.4.1 Manipulation of anthropomorphism

To examine the influence of anthropomorphism, we designed three robo-advisors with different degrees of anthropomorphism. We used various verbal cues to operationalize the degree of anthropomorphism: Both the low and high anthropomorphism conditions

welcomed and took leave of the participants, but only in the high anthropomorphism condition did the robo-advisor introduce itself and used personal pronouns (e.g., “I” and “me”) to signal a personality and identity (Pickard et al. 2014). Additionally, we employed some visual cues that are displayed in Table 4-1.

Degree of Anthropomorphism	**None**	**Low**	**High**
Picture	-		
Name	-	“Robo-Advisor“	“Robin“
Speech Bubble	No	Yes	Yes

Table 4-1 Operationalization of anthropomorphism based on visual cues

The first operationalization (i.e., no anthropomorphism) lacked any anthropomorphic design elements. For this treatment, we designed the robo-advisory as very anonymous without any visual or verbal cues (e.g., no picture or speech bubble).

The second operationalization (i.e., low anthropomorphism) employed a few anthropomorphic design elements. The robo-advisor displayed a picture in form of a pictogram and a non-human, function-oriented name (“Robo-Advisor”). Moreover, we designed the interaction as a dialogue between the pictogram and the user by using speech bubbles, signaling rudimentary cues of an actual conversation.

The third and last operationalization used an avatar with a human embodiment adopted from Wuenderlich and Paluch (2017) to ascertain tested humanlike appearance cues for the design of the avatar. We, however, gave up other anthropomorphic elements like a voice output or any animations because previous studies have demonstrated that their effects depend on the context and the expectations the user has with regard to the services placed on the website (McBreen and Jack 2001; Powers et al. 2003). Moreover, the robo-advisor used first-person singular pronouns as well as displayed a gender-neutral name (i.e., “Robin”) (e.g., Hodge et al. 2018; Nass et al. 1997) and introduced itself to the customer at the beginning of the robo-advisory interaction.

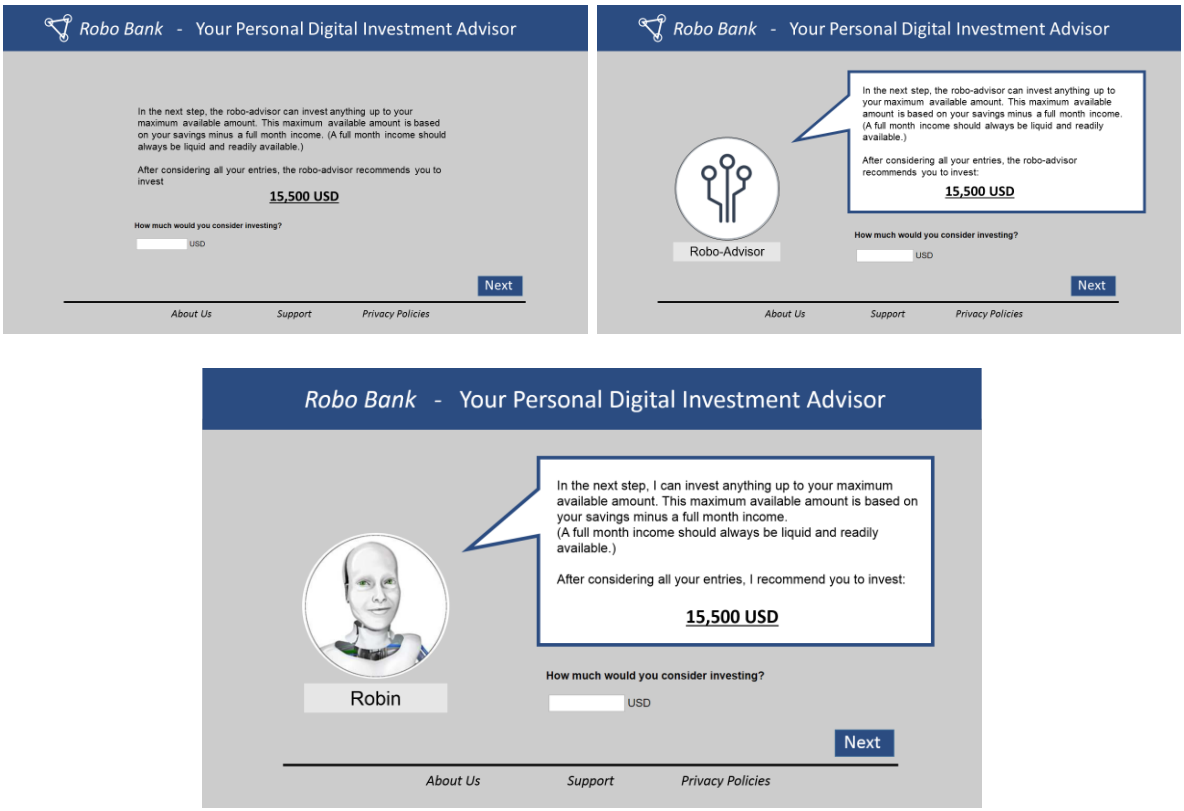

Figure 4-2 Screenshot of the recommendation page with no, low, and high degree of anthropomorphism (from top left to top right to bottom screenshot)

4.4.2 Manipulation of personalized anchors in recommendation

To operationalize and calculate a suitable and realistic personalized anchor we designed a recommendation based on contemporary robo-advisors in practice as references.

In the first step, our system calculates the personal maximum possible investment volume of the participant. The personal maximum available investment volume is based on a user's entries with regard to current savings and income per month. Based on contemporary practices, we argued that a full month income should always be liquid and readily available for unexpected emergencies (Havlat 2018). In contrast, many participants may prefer a higher liquidity instead of investing their savings. Yet, insisting on a higher liquidity than necessary is suboptimal, since the participant may lose out on the possibility of increased economic welfare. Consequently, the personal maximum possible investment volume is calculated per participant as following:

$$Personal\ Maximum\ Investment\ Volume = Savings - 1 * Full\ Month\ Income.$$

Subsequently, our system calculates the personalized anchor in real time. We used 90 percent of the personal maximum investment volume as our anchor value:

$$Personalized\ Anchor = \text{Personal Maximum } Investment\ Volume * 0.9.$$

The personalized anchor was rounded off to hundreds to avoid concurrent adjustment effects due to the different precision of different anchors, as more precise anchors lead to less adjustment (Janiszewski and Uy 2008). Personalized anchors were combined with an investment recommendation (i.e., "The robo-advisor recommends you to invest…" or "I recommend you to invest…"). The control group did not receive a recommendation and, thus, no personalized anchor. All groups subsequently made an entry about the volume they would invest.

4.4.3 Dependent variables, control variables and manipulation checks

We focus on *Social Presence* and *Investment Volume* as dependent variables. The items to measure the dependent variable *Social Presence* were adapted from Gefen and Straub (2003) (e.g., *"There is a sense of human warmth in the website")*. They were presented on a 7-point Likert-type scale ranging from *strongly disagree* to *strongly agree*. We measured the second dependent variable *Investment Volume* by the numerical answer the user provided for the question: "*How much would you consider investing?*". Users entered absolute values (e.g., 500€) which were then normalized for each user by its personal maximum investment volume for analysis of results later on.

In addition, we also tested various demographics (i.e., *Age*, *Gender*, and *Previous Experience with Robo-Advisory*) and control variables that have been identified as the most influential drivers in extant literature: The items for *Personal Innovativeness* were adapted from Agarwal and Prasad (1998) **(**e.g., "I like to experiment with new information technologies"), Trusting Disposition (e.g., "I generally trust other people") and Product Knowledge (e.g., "How much do you know about robo-advisory services?") from Qiu and Benbasat (2010), Institution-Based Trust from Hess et al. (2009b) (e.g., "I am comfortable making decisions using decision-making software"), Plan for Money Long-Term from Netemeyer et al. (2018) (e.g., "I set financial goals for the next 1-2 years for what I want to achieve with my money"), Product Involvement from Zaichkowsky (1985) (e.g., "I am interested in robo-advisory services like the one provided by Robo Bank") and Willingness to Take Investment Risks from Netemeyer et al. (2018) (e.g., "When thinking of your financial investments, how likely are you to take risks?"). Additionally, we asked some multiple-choice questions to test the Financial Literacy of the participants (Netemeyer et al. 2018) (e.g., "When an investor spreads his

money among different assets, I believe that the risk of losing a lot of money will: increase/decrease/stay the same/don't know"). As manipulation checks, the participants stated whether there was an assistant who helped in making an investment decision and whether the robo-advisor recommended a possible investment volume.

4.4.4 Experimental procedure

We segmented the experiment in six steps, in which all participants received the same questions (Figure 4-3): (1) The first part started with a random assignment of the participants as well as with a short introduction of the experiment's rule set, followed by (2) a simple explanation of the use and functions of contemporary robo-advisors. (3) Participants received the information that they would be interested in investing money and that they would consider investing it in a robo-advisor. Afterwards, participants saw the ad of the fictional company 'Robo Bank', and received the instructions to start the advisory service. (4) Comparable to the traditional human advisory process (Jung et al. 2018), the next step represented the configuration phase, where the information asymmetry between the user and the robo-advisor was reduced: Here, similar to contemporary robo-advisors, the robo-advisor introduced itself and asked the user some questions about his or her demographics as well as financial situation and preferences. (5) Subsequently, in the matching & customization phase, the user chose the investment volume. In the personalized recommendation conditions, the robo-advisor would place a personalized anchor in form of a recommendation about the investment volume based on the user's former entries. In the other conditions, the robo-advisor would just ask the user for the desired investment volume without any indication how much he or she should invest. (6) The final part of the experiment was a survey about the participants' advisory experience over multiple pages, ending in a short debriefing.

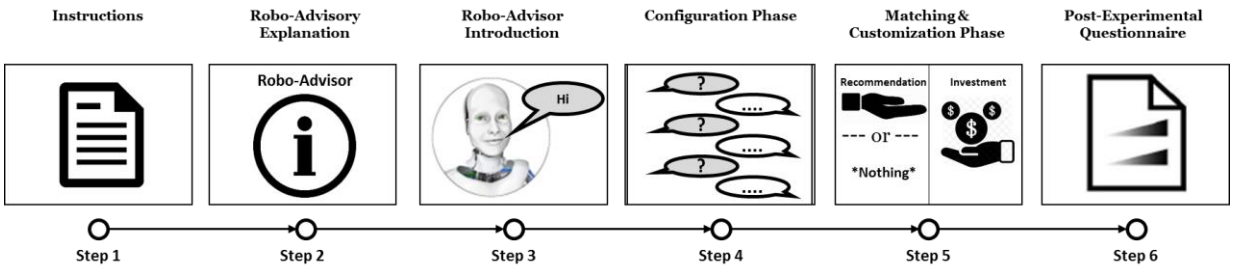

Figure 4-3 Experimental procedure

4.5 Analysis and Results

4.5.1 Sample description, controls and manipulation checks

We recruited a total of 557 participants through the crowdsourcing marketplace *Amazon Mechanical Turk,* a suitable platform to get in touch with Internet-savvy users, who are potential users of robo-advisors. Moreover, we restricted participation to users who are U.S. residents with at least 95 percent approval rate (Goodman and Paolacci 2017). 145 participants were excluded due to failing manipulation checks as they did not recognize the presence of an avatar and/or a recommendation. Out of the remaining 412, we further screened for participants to ensure eligibility of our participants for robo-advisory services and ascertain the validity of our data: We excluded those who (1) intended to invest more than their actual savings, (2) declared an unusual high monthly income of more than $5,000, and/or (3) were not eligible for robo-advisory services as they declared to have higher monthly costs than income. After all these checks, the final data set consisted of 278 participants.

Groups	**N**	**Female**	**Average Age (StD)**	**Previous Experience with Robo-Advisory: yes**
1: no recommendation & no anthropomorphism	40	52%	37 (13)	8%
2: recommendation & no anthropomorphism	51	53%	39 (12)	12%
3: no recommendation & low anthropomorphism	36	44%	37 (13)	6%
4: recommendation & low anthropomorphism	45	56%	36 (10)	16%
5: no recommendation & high anthropomorphism	55	56%	39 (13)	5%
6: recommendation & high anthropomorphism	51	53%	41 (15)	16%

Table 4-2 Descriptive statistics of the sample

We conducted several one-way analyses of variance (ANOVAs) to confirm the random assignment to the different experimental conditions and to check our control variables. There were no significant differences in demographics in terms of *Gender* ($F=0.281$, $p>0.1$), *Age* ($F=0.799$, $p>0.1$) or *Previous Experience with Robo-Advisory* ($F=1.121$, $p>0.1$) between the six experimental groups and no significant differences regarding

Personal Innovativeness, Trusting Disposition, Product Knowledge, Institution-based Trust, Plan for Money Long-Term, Product Involvement, Financial Literacy or *Willingness to Take Investment Risks* (all $p>0.1$), indicating that these (control) variables did not confound our dependent variables.

4.5.2 Reliability and validity

Table 4-3 shows that both, the construct's Cronbach's alpha (0.956) and composite reliability 0.955), were above the recommended level of 0.70 and show a high internal consistency (Nunnally and Bernstein 1994). We measured *Investment Volume* directly via the numerical answer of the users and, thus, the construct has the highest reliability. We tested convergent validity based on the values of the loadings and the average variance extracted (AVE). The results show that the loadings of all items were higher than 0.70. AVE was 0.811 and above the recommended level of 0.50, suggesting that on average, the construct explains more than half of the variance of its indicators (Hair et al. 2014). These results confirm the convergent validity of the measures.

Construct	**Number of items**	**Loadings range**	**Composite reliability**	**Cronbach's alpha**	**AVE**
Social Presence	5	0.866-0.940	0.955	0.956	0.811

Table 4-3 Reliability and convergent validity of our principal construct

We used the heterotrait-monotrait ratio of correlations (HTMT) for assessing discriminant validity as there is evidence of its superior performance to Fornell-Larcker test (Henseler et al. 2015). The maximum value of HTMT was 0.397, below the maximum value of 0.9 suggested by Teo et al. (2008), indicating that the constructs differ from each other and discriminant validity is supported. We also tested for multicollinearity by calculating the maximum variance inflation factor (VIF) which was equal to 1.013. Mason and Perreault (1991) indicate that a VIF of 10 or higher is an evidence for multicollinearity, which is not the case in our data, indicating the absence of multicollinearity.

4.5.3 Hypotheses testing

We used a partial least squares approach, with the SmartPLS 3 software as widely accepted tool (e.g., Mero 2018). PLS suits this research as the primary focus is on the path relationships and variance explained of the constructs rather than on the model fit

per se (Sarstedt et al. 2014)[2]. A path-weighting scheme was used to estimate the path coefficients. A two-tailed bootstrapping with 5,000 subsamples determined the significance levels, reliability, and validity. The model fit determined by SRMR (Henseler et al. 2016) was 0.066, below the cut-off value of 0.08 indicating a good model fit (Hu and Bentler 1999). Figure 4-4 indicates path coefficients and significance levels.

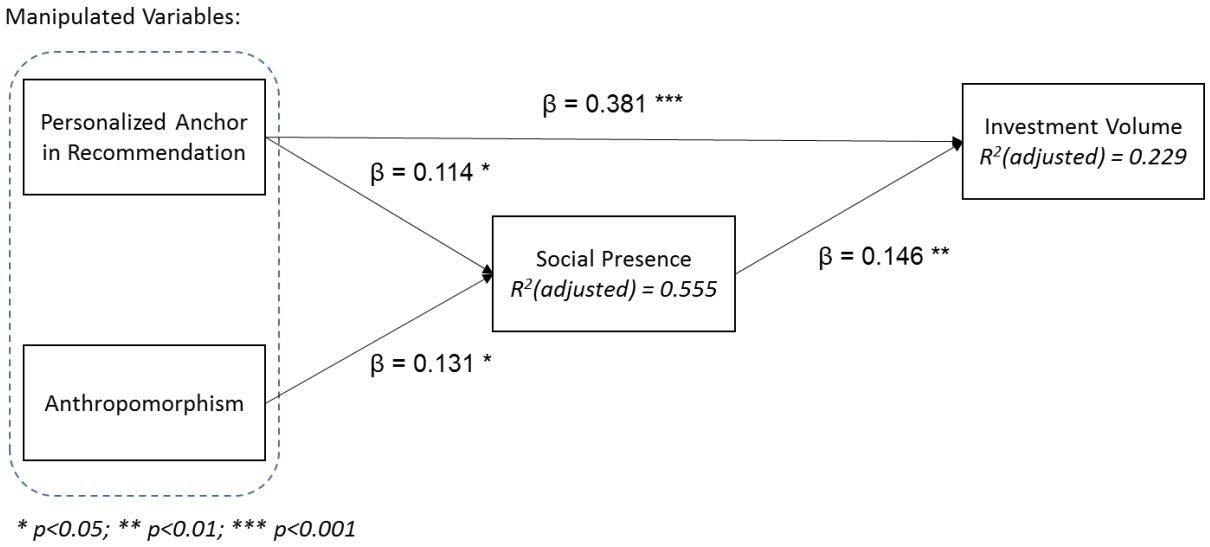

Figure 4-4 Research model including path coefficients results

Overall, the results support our theoretical model and hypotheses. The personalized anchor in a recommendation had a positive direct effect on *Investment Volume* (relative to personal maximum investment volume) with $\beta=0.381$ and $p<0.001$, thus supporting H1 and meaning that the presence of a personalized anchor in a recommendation increased the investment volume independently of the personal maximum investment volume available. The recommendations including personalized anchors had also an effect on *Social Presence* ($\beta=0.114$ with $p<0.05$) which supports H2. Moreover, as expected, a higher degree of anthropomorphism led to a higher degree of *Social Presence* ($\beta=0.131$, $p<0.05$), supporting our hypothesis H3. Increasing *Social Presence* further resulted in a higher *Investment Volume* (relative to personal maximum investment volume), supporting H4 with $\beta=0.146$ and $p<0.01$. The anchoring effect was also clearly demonstrated in Figure 4-5 showing the average investment volumes (relative to the personal maximum investment volume) across the different groups. On the horizontal axis, the figure displays the six different experiment groups (see also Table 4-2). On the

[2] Additional ANOVAs and planned contrast analyses were conducted that support the results of the PLS analysis.

vertical axis, the average investment volume selected by the participants is shown. All groups with a personalized anchor in a recommendation are hatched. For the different conditions of anthropomorphism, the figure illustrates that once the robo-advisor placed a personalized anchor in a recommendation, the average investment volume nearly doubled.

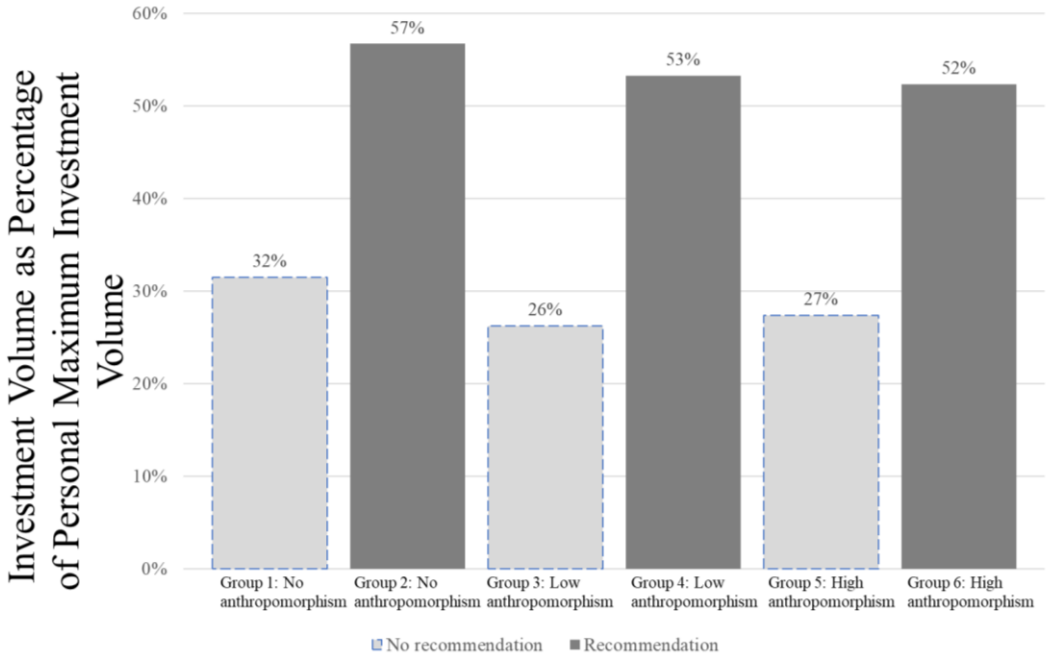

Figure 4-5 Average investment volume as percentage of the personal maximum investment volume over the six experimental groups

4.6 Discussion

The effective design of interfaces between users and IS has become an increasingly relevant topic for both researchers and practitioners, as the ongoing technological advancements force companies to rethink contemporary services. This piece of research aimed to show possibilities of effectively designing financial support systems - such as robo-advisors - to increase not only user acceptance and investment volume, but also the propensity to invest. Thus, robo-advisors may help in countering systematic under-savings that reduces economic welfare. Precisely, we examined the effects of advisors with varying degree of anthropomorphism in combination with a personalized anchor placed in a recommendation, whereby the anchor was calculated based on information the user provided.

The most important finding of our study demonstrates that an increasing degree of anthropomorphism in robo-advisors leads to higher perceptions of social presence, which

in turn leads to higher investment volumes as well as higher usage intentions. Moreover, our research reveals that personalized anchors in recommendations not only positively influence the perception of social presence, but also have a direct positive effect on investment volumes.

4.6.1 Implications for research and practice

Our paper contributes to research by providing a novel perspective on the nascent area of designing financial support systems but has unprecedented impetus for financial service providers as well.

Following the call to further explore nudging, especially personalization in recommender systems (e.g., Goes 2013; Weinmann et al. 2016), and to explore the novel robo-advisory phenomenon (Jung et al. 2018), we address the theoretically and practically neglected effects of anthropomorphism and personalized anchors in recommendations as effective nudges in the robo-advisory context (Jung et al. 2018). First and foremost, we provide first empirical evidence that a personalized anchor in a recommendation carried out by a robo-advisor directly increases the investment volume of users. Furthermore, we demonstrate how anthropomorphic design cues in conjunction with personalized recommendations can additionally increase the investment volumes through the mediation effect of social presence. Most importantly, we depart from prior research by examining how these anthropomorphic design elements impact economic decision-making. These findings may provide a foundation for further research in the directions of robo-advisory, service personalization or impact of human-like IS on economic behaviour.

From a managerial point of view, our research has relevant implications for financial service providers as well. Building a familiar, socially oriented atmosphere through anthropomorphic design elements in form of verbal and visual cues as well as the pronunciation of a personalized anchor may be simple mechanisms for robo-advisors because it can increase the investment the user would make. We showed how robo-advisory can profit from IS by calculating personalized anchors in real-time. These anchors served as cues that effectively mitigate possible underinvestment and therefore influenced users to make more future-oriented economic decisions. Thus, we not only shed theoretical light on our investigated manipulations and derived learnings for

providers of financial services to increase investment volumes, but also discovered IS design elements with a possible impact on the future welfare of today's society.

4.6.2 Limitations, directions for future research and conclusion

Despite the aforementioned contributions of this research, the conducted studies should be treated as an initial examination into the research field of financial support systems. Therefore, we want to point out some noteworthy limitations and directions for future research.

First, our experiment was designed as an online survey, so that the results do not represent actual robo-advisory with a binding investment decision. It would be interesting to test our hypotheses in a field study with a real robo-advisor to further explore external validity. Second, we also examined only social presence as a potential mediator. Here, further mediators and moderators which are also relevant in the research of the effect of computational agents like trusting beliefs and perceived enjoyment could be examined. Also, other dependent variables, such as user satisfaction or financial well-being, could be explored. Third, further research could investigate the degree of anthropomorphism that is accepted by the customer. In our experiment, for example, the chosen avatar was a gender-neutral static picture with a humanlike looking but without any motions. Some possible research directions would be the influence of an animated avatar, the effect of a voice output, or the influence of an avatar with a clear gender. However, the designers should be careful: The use of anthropomorphism must be coordinated with the context and the number of anthropomorphic elements should be well-thought-out (e.g., Seymour et al. 2018). In case that the anthropomorphic design of the system deviates from the expectations of the users, it may create a feeling of eeriness and may lead to a decrease of trust in the system (i.e., "uncanny valley") (Mori, 1970).

Overall, our study is an initial step towards better understanding how the design of interfaces may improve economic decision-making in the context of financial support systems. Specifically, we shed light on the effects of anthropomorphism and personalized anchors in recommendations in the design of robo-advisors. We hope that our study provides impetus for future research on digital nudges as well as actionable recommendations for designing IS.

5 Outcomes of Changes Digital Channels in an Employee Context

Title:	Mr. and Mrs. Conversational Agent – Gender Stereotyping in Judge-Advisor Systems and the Role of Egocentric Bias

Authors:	Nicolas Pfeuffer, Goethe-Universität Frankfurt, Germany Martin Adam, Technische Universität Darmstadt, Germany Jonas Toutaoui, Technische Universität Darmstadt, Germany Oliver Hinz, Goethe-Universität Frankfurt, Germany Alexander Benlian, Technische Universität Darmstadt, Germany

Published in:	Proceedings of the Fortieth International Conference on Information Systems (ICIS 2019), Munich, Germany

Abstract

Current technological advancements of conversational agents (CAs) promise new potentials for human-computer collaborations. Yet, both practitioners and researchers face challenges in designing these information systems, such that CAs not only increase in intelligence but also in effectiveness. Drawing on social response theory as well as literature on trust and judge-advisor systems, we examine the roles of gender stereotyping and egocentric bias in cooperative CAs. Specifically, by conducting an online experiment with 87 participants, we investigate the effects of a CA's gender and a user's subjective knowledge in two stereotypical male knowledge fields. The results indicate (1) that female (vs. male) CAs and stereotypical female (vs. male) traits increase a user's perceived competence of CAs and (2) that an increase in a user's subjective knowledge decreases trusting intentions in CAs. Thus, our contributions provide new and counterintuitive insights that are crucial for the effectiveness of cooperative CAs.

Keywords: Conversational Agents, Intelligence Augmentation, Anthropomorphism, Judge-Advisor Systems, Gender Stereotyping, Egocentric Bias

5.1 Introduction

Although the idea of communicating with information systems (IS) via natural language already emerged in the 1960s (Weizenbaum 1966), conversational agents (CAs), such as chatbots, have only recently experienced a renewed interest. Thanks to technological advancements in artificial intelligence (AI), CAs have improved in various analytical abilities and visual cues (Anderson et al. 2018) and are tremendously permeating and shaping private and work lives (Edlich et al. 2019; Luger and Sellen 2016). Gartner (2019), for example, predicts that whereas only 2% of all current digital workers (i.e., people who use IT to increase workplace efficiency) utilize a virtual workplace assistant, this percentage will rise to 25% by 2021, topping $3.5 billion in customer and business spending. Similarly, 56% of CIOs and CTOs surveyed by Accenture revealed that CAs are driving disruption in their industry (Srinivasan et al. 2018).

Despite the soar in importance and permeation of CAs, the experience of early adopters revealed that such IS encounter new challenges and concerns regarding biases, competence and trust (Faraj et al. 2018). Consequently, some IS scholars have called for research towards CAs that are able to provide both intelligent advice as well as natural user experience for the effective augmentation of human intelligence (Jain et al. 2018; Maedche et al. 2016). Previous research on CAs has mostly focused on rather competitive contexts (e.g., sales agents in e-commerce) (e.g., Dalal and Bonaccio 2010; Qiu and Benbasat 2009) in which users may not fully trust CAs' advice as users naturally assume that the CAs also act in their employer's interest, thus creating a tension in the customer-seller-relationship (i.e., customer surplus vs. the company's profit) (Evans and Beltramini 1987). We intend to depart from these rivalry contexts and extend research by investigating CAs in the hitherto neglected cooperative contexts, in which human users make the decisions, while the cooperative CAs advise the users in the sole interest of the users. We do so by incorporating two distinct and hitherto neglected perspectives: (1) a CA's gender and (2) a user's knowledge.

Regarding a CA's gender[3] , humans socially respond to human-like IS in the same manner as they would respond to humans (Nass and Moon 2000). Accordingly, by increasing

[3] For examples on gendered CA, see: noora.ch, talmundo.com, askformoon.io, boibot.com, eviebot.com

human-likeness of CAs, designers may not only trigger favorable social responses, but also unfavorable ones (e.g., Bargh 1999; Beldad et al. 2016). As such, IS designers experienced the employment of gender cues in a CA's appearance as a double-edged sword (e.g., Nass et al. 1997; Tay et al. 2014): While, for example, the employment of female gender cues causes gender stereotyping in a user and thus leads to an increased perception of warmth, it typically also leads to a decrease in the perception of competence, especially for stereotypical male topics (Nass et al. 1997). Yet, although social psychology indicated that gender stereotyping has profound implications on the perception of competence (Hollingshead and Fraidin 2003; Koch et al. 2015a) as well as on trust and advice-taking (Sniezek and Van Swol 2001), research has neglected the importance of a CA's gender and a user's perception of stereotypical male (i.e., agentic) (e.g., cold and ambition) and female (i.e. communal) traits (e.g., reliability and helpfulness) on a user's perceived competence of a CA in cooperative contexts (Twyman et al. 2008).

Regarding a user's knowledge, scholars have observed that biases from personal beliefs about one's own knowledge can also lead to advice discounting, such that judges are less likely to follow the advice given by their advisors (Van Swol and Sniezek 2005). Especially egocentric bias, which we define as the irrational valuation of one's own (subjective) knowledge over the knowledge of others, appears to be a strong factor for advice discounting (i.e., reduction in value) and thus may result in a decrease in trust in advice given by CAs (Bonaccio and Dalal 2006). However, IS research has so far neglected the effects of a user's subjective knowledge on a user's trust in CAs, although the effect may severely impede the effectiveness of advice-giving of a CA.

To summarize, in this study we investigate gender stereotyping as well as egocentric bias that result from a CA's gender as well as from a user's (subjective) knowledge. The selected factors are connected by the important aspect that all are concerned with a user's trust perceptions of cooperative CAs and thus have serious consequences on the effectiveness and success of CAs that will shape Human-Computer Interaction (HCI) in the upcoming years. Consequently, we postulate the following research question:

RQ: How do gender stereotyping and egocentric bias affect a user's trust in cooperative CAs?

To address this research question, we conducted an online experiment, in which participants interacted with an AI-based CA via an instant messaging user interface. Drawing on social response theory (Nass and Moon 2000) and literature on trust

(McKnight et al. 2002) and judge-advisor systems (Sniezek and Van Swol 2001), we empirically examined how both a CA's gender and a user's subjective knowledge affect a user's trusting intentions in a CA in two stereotypical male knowledge fields (i.e., math and finance). Consequently, we demonstrate the relevance of gender stereotyping and egocentric bias in user interactions with cooperative CAs. In doing so, we derive four major contributions for IS practitioners and researchers: (1) First, we provide counterintuitive evidence that users perceive a female CA significantly more competent than their male counterpart in stereotypical male knowledge fields. We thus introduce a new perspective of contextual reasoning, in that users assess a fit between a CA's gender and the cooperative context at hand, irrespective of the CA's traits and knowledge field. (2) Second, we extend prior research by demonstrating that the direct effect of a CA's gender cannot be solely ascribed to a change in perceptions of stereotypical female (i.e., communal) and male (i.e., agentic) traits. We therefore note that the effects of gender cues cannot be fully grasped by mediations through agentic and communal traits. (3) Third, we show that specifically communal traits positively influence a user's perceived competence of a CA. In contrast, we found that agentic traits have no significant effect on a user's competence perceptions. Thus we provide valuable insights into differences between cooperative and competitive settings, in that users in cooperation with CAs seem to appreciate communal traits in a CA per se, while agentic traits do not seem necessarily important. (4) Lastly, we present very first evidence that an increase in a user's subjective knowledge decreases a user's trust in a CA. Therefore, our findings highlight that practitioners and researchers need to consider not only the design of a CA when attempting to create and measure effective CAs, but also a user's characteristics.

5.2 Related Work and Theoretical Background

5.2.1 Conversational Agents as Anthropomorphic Information Systems

CAs can be defined as IS that enable the interaction with users via natural language (Luger and Sellen 2016). Research on CAs is multifaceted, since CAs may be employed in any field that implies HCI, such as service personnel in customer service contexts (e.g., Gnewuch et al. 2017), as advisors for special purposes like vending movie tickets (e.g., Nunamaker et al. 2011) or as product recommendation/sales agents in e-commerce (e.g., Beldad et al. 2016; Qiu and Benbasat 2009). Since conversational interaction via natural language is probably the most natural way for humans to interact, CAs are

inherently anthropomorphic (Pfeuffer et al. 2019). Anthropomorphism can be defined as a deeply ingrained human innate tendency which leads humans to attribute human-like physical or non-physical traits, characteristics and emotions to inanimate objects and non-human agents (Epley and Gilovich 2006; Pfeuffer et al. 2019). When humans interact with unknown human or non-human agents, they apply anthropomorphism to better understand and connect with the other agent. Accordingly, Nass et al. (1994) introduced the social response theory, postulating that humans socially respond to human-like IS in the same manner as they would respond to humans.

Newly arising technological possibilities to increase human-likeness of CAs aim to harness the positive effects that anthropomorphism can invoke, which may lead to an increased acceptance and employment of CAs (e.g., Benlian et al. 2020). Yet, anthropomorphism also bears the downsides of heuristics and biases (Epley 2004; Epley et al. 2007): Although heuristics may lead to faster decisions with little cognitive effort (Epley 2004), these mindless automatisms in social interactions may also lead to inadequate behavior that may result in the discrimination of others or a wrong assessment of the situation, resulting in a reduced effectiveness of the interaction (Bargh 1999; Eyssel and Hegel 2012).

5.2.2 Conversational Agents in Judge-Advisor Systems

Literature from psychology suggests that people tend to adjust their actions and reasoning to the context, combining knowledge learned from prior similar situations with information derived from present contextual cues (Rooderkerk et al. 2011). For example, scholars from psychology found that whereas people showed cooperative reactions to people who expressed happiness (e.g. smiling) in cooperative contexts, people demonstrated exploitative behavior when recognizing people with similar expressions in competitive situations (e.g., negotiations) (Van Kleef et al. 2010).

When thinking of typical CAs, they often exert guidance, recommendation or assistance for a user in competitive contexts (Beldad et al. 2016; Qiu and Benbasat 2009). For example, CAs in the domain of e-commerce often fulfill the role of a sales agents, hence they usually advise their customers with recommendations for or against products with the intention to persuade the customers to buy the product and to use the agent and website again (e.g., Dalal and Bonaccio 2010; Qiu and Benbasat 2009). Whereas the employment of recommendation and sales agents is intended to primarily drive profits

and customer satisfaction (e.g., Adam et al. 2019; Qiu and Benbasat 2009), the employment of cooperative CAs aims to predominantly assist and improve the decision-making process of the user for the sole benefit of the user (Sniezek and Van Swol 2001). Therefore, the context of cooperative CAs is clearly non-adversarial, in contrast to the fuzzy context of interactions with recommendation and sales agents (Branzei et al. 2008). Thus, human reasoning may be systematically different in contexts with cooperative CAs. Yet, past research on CAs has largely focused on competitive contexts and assumed similar conditions for cooperative contexts.

To adequately investigate the interaction between users and their CAs in cooperative contexts, a suitable theoretical basis is needed. As such, literature on judge-advisor systems (Sniezek and Buckley 1995; Sniezek and Van Swol 2001) seems promising. Within judge-advisor systems, one person takes the role of the judge and one takes the role of the advisor to cooperatively assist the judge in his or her decision-making in the judge's interest. Typically, only the judge makes the decisions, whereas the advisor provides advice to the judge on decisions (Sniezek and Buckley 1995). Although judge-advisor systems are cooperative by definition, they are not immune to inefficiencies: Due to uncertainty and imperfect information about the situation and the advisor, judges face the risk of acting on bad advice from an advisor (Sniezek and Van Swol 2001). Accordingly, trust, which may be understood as "the expectation that the person is both competent and reliable and will keep your best interests in mind" (Sniezek and Van Swol 2001), p. 289), is a core component of whether an advice by a CA (i.e., advisor) is perceived as useful so that the user (i.e., judge) intends to utilize the advice.

5.3 Research Framework

Figure 5-1 presents the paper's research framework on the role of gender stereotyping and egocentric bias in the context of cooperative CAs. The research framework thereby builds on three major theoretical building blocks: social response theory, IS literature on trust and literature on judge-advisor systems.

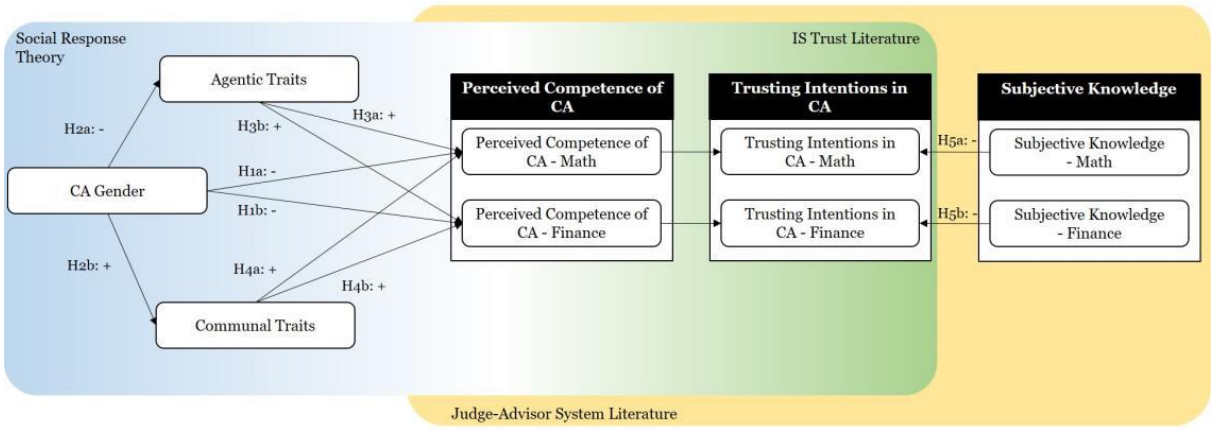

Figure 5-1 Research framework[4]

While we draw on research from social response theory for the investigation of the effects of CA's gender cues and a user's stereotypical attributions on competence (Nass et al. 1997), we also couple the theory with constructs from IS literature on trust to explain the link between competence and trust (McKnight et al. 2002). Furthermore, we also draw on literature on judge-advisor systems for the investigation of the effect of a user's subjective knowledge on a user's trusting intentions in a CA (Bonaccio and Dalal 2006). Thus, we connect complementary building blocks from literature on CAs and HCI in the light of cooperative CAs. Because CAs are usually required to provide knowledge in specific domains, we tested our hypotheses in the context of two exemplary knowledge fields, namely math and finance. We chose these two fields because each of them has a specific stereotypical male association: Male mathematicians or financial investors are just examples of how these knowledge fields are subject to stereotyping (Cheryan et al. 2011; Koch et al. 2015a). As specific competences in a determined field are of importance for the abilities of such CAs (McKnight et al. 2002) and may be subject to stereotypical beliefs, it is crucial to understand how gender cues affect the perception of competence for different knowledge fields and in which context these cues may be employed most effectively. To increase the robustness of our findings, we thus investigate not only one stereotypical male knowledge field but two, which are increasingly permeated by Cas, such as math tutors in education (Kulik and Fletcher 2016) and robo-advisors in financial markets (Jung et al. 2018).

4 We do not hypothesize the paths between Perceived Competence of CA and Trusting Intentions in CA as they have been already confirmed (e.g., McKnight et al. 2002, Sniezek and van Swol 2001).

5.4 Hypothesis Development

5.4.1 The effect of a CA's gender on a user's perceived competence of the CA

As social response theory states, users treat computers with social cues as social actors and socially respond to them to alleviate the HCI (Nass and Moon 2000). Accordingly, we suggest that if gender cues are present in a CA, users will engage in gender stereotyping in a similar manner to how they react to gender cues in humans. Gender stereotyping may be described as the biased attribution of human, gender stereotypical traits to a CA based on its visual or audible attributes or behavior (Tay et al. 2014). Especially when people need to make inferences about someone's knowledge or characteristics and have little knowledge about their conversational partners, they often subconsciously apply gender stereotyping to ease decision-making (Hollingshead and Fraidin 2003). This claim is in line with several previous socio-technical studies: Nass et al. (1997) demonstrated that even computers with minimalist gender cues, such as a male or female voice, evoked gender stereotyping, which resulted in computers with male voices being rated better in stereotypical male subjects and computers with female voices being rated better in stereotypical female subjects. Similarly, Eyssel and Hegel (2012) discovered that even a distinctively male or female haircut of a robot was enough to activate gender stereotyping, whereby users consistently rated the male robot as more suitable for male tasks (e.g., handcrafting) and the female robot as more suitable for female tasks (e.g., childcare). Beldad et al. (2016) further found that advice acceptance and competence perceptions were strongly related to gender-congruency of the agent with the product it gave advice on.

In judge-advisor systems, users need to trust the advice that a cooperative CA provides. Since not much information is provided in an initial interaction between both parties, users therefore utilize present cues to better assess the level of competence of the advisor (Sniezek and Van Swol 2001). Yet, while congruency between gender and an assigned task has positive effects on the perception of competence, perceived "mismatches" between gender and an assigned task have been observed to have strong negative effects (e.g., Hollingshead and Fraidin 2003; Koch et al. 2015a; Tay et al. 2014). Consequently, we hypothesize that gender stereotyping affects a user's perceived competence of a CA. Yet, the bias is also contingent on the knowledge field, so that a male CA in contrast to a female CA should appear more typical and thus competent in male knowledge fields.

H1: A male (vs. female) CA leads to higher perceived competence of the CA in stereotypical male knowledge fields.

5.4.2 The effects of a CA's gender on a user's perceived traits of a CA

In conjunction with the direct effect of a CA's gender lies the perception that male and female individuals differ substantially in fundamental psychological characteristics. Accordingly, the attribution of gender stereotypical traits has often been shown to be connected to two basic scales of human personality, namely the ascription of agentic traits (e.g., assertive, cold) to men and the ascription of communal traits (e.g., friendly, empathetic) to women (Eyssel and Hegel 2012; Wojciszke 1997). This, however, does not mean that women can not bear agentic traits and men vice versa communal traits. It is rather the case that, although people tend to bear a mixture of the two types of traits, communal traits are more stereotypically associated with women as agentic traits are with men (Helgeson and Fritz 1999). Eyssel and Hegel (2012) transferred the concept to human-robot interaction and found that agentic traits are rather associated with male robots, and communal traits are associated with female robots, thus forming a dispositioned perception of the robots' skills (Eyssel and Hegel 2012; Koch et al. 2015b). This replication of the effects from social psychology on the domain of anthropomorphic robots raises the question if these findings are also applicable to anthropomorphic IS, which do not have physical embodiments. Since the robots of Eyssel and Hegel (2012) were manipulated only by their visual appearance (i.e., haircut), we believe the same observations will also hold for gendered visual appearances of CAs.

H2: A CA's gender affects a user's perceptions of agentic and communal traits in CAs;

H2a: A male (vs. female) CA positively affects a user's perceptions of agentic traits;

H2b: A female (vs. male) CA positively affects a user's perceptions of communal traits.

5.4.3 The effects of a user's perceived traits on a user's perceived competence of a CA

The importance of agentic and communal traits becomes particularly clear in the light of the findings of Wojciszke (1997) and Abele and Wojciszke (2007): They demonstrated that agentic traits are largely associated with individualistic values (e.g., intelligence and ambition) and interest of the self, while communal traits are largely associated with collectivistic values (e.g., reliability and helpfulness) and interests of others. Abele and Wojciszke (2007) also stated that although agentic traits are considered signals of competence and highly desired and important from the perspective of the self as well as

of some interdependent other, communal traits may be valued as well and even more, especially in cooperative settings. From an evolutionary and social functionalist perspective, communion has proven to be essential for survival. Consequently, a person or CA that displays communal traits may thus be also considered competent to facilitate communion-related activities, such as cooperation to solve a task. These claims are congruent with findings of Cottrell et al. (2007) who suggest that communal values are generally more important to people than agentic values, when people need to cooperate. Thus, we theorize that both agentic and communal traits affect a user's perceived competence of a CA, since both kinds of traits are helpful for a CA in effectively performing in a judge-advisor system.

H3a/b: An increase in perceived agentic traits of a CA positively affects a user's perceived competence of the CA in (a) math-related subjects and (b) finance-related subjects.

H4a/b: An increase in perceived communal traits of a CA positively affects a user's perceived competence of the CA in (a) math-related subjects and (b) finance-related subjects.

5.4.4 The effects of a user's subjective knowledge on a user's trusting intentions in a CA

Lastly, a user's perceived competence of a CA may not be the only variable that affects a user's trusting intentions in a CA. A user's subjective assessment of his or her own knowledge may also pose an influence. This claim is consistent with several studies on judge-advisor systems, in which participants biasedly tended to neglect or discount advice that was not consistent with their own opinion (Yaniv 2004; Yaniv and Choshen-Hillel 2012; Yaniv and Kleinberger 2000). An established reason for this behavior is the phenomenon of egocentric bias: Egocentric bias describes a strong self-centeredness and reliance on the own perspective that leads to valuing oneself or one's own knowledge above others, thus causing a discounting of the advisor's trust and advice (Krueger 2003; Ross et al. 1977). As Krueger (2003) and Bonaccio and Dalal (2006) state, this behavior may often lead to ineffective decisions, since judges can in many cases profit from considering the advisors' advice to increase accuracy in their decision (Yaniv 2004). Even if a user knows a lot in one domain, he or she may be better off by listening to an advice and rejecting it after deliberate considerations than by discounting the advice right away. Substantial research has been conducted to analyze the reason why an increase in subjective knowledge exacerbates this egocentric advice discounting, whereby

researchers explained this phenomenon in different ways: Yaniv (2004) argues that advice discounting occurs because judges have access to their internal justifications for arriving at their particular decision, whereas judges do not have access to the advisor's reasoning, thus discounting the advisor's advice the stronger the subjective knowledge and thus the internal reasoning is. Alternatively, egocentric advice discounting may also emerge due to an anchoring and adjustment effect (e.g., (Kahneman and Tversky 1974), such that the judge's formed opinion serves as an anchor that is subsequently (insufficiently) adjusted in response to the advisor's advice (Epley 2004; Harvey and Fischer 1997) . The last explanation for egocentric advice discounting provided in this section is a general tendency to believe that one's own opinion is superior to those of others, which is reflected in decision-making in novel situations or when the judges receive advice prior to seeing the decision task (Krueger 2003). Thus, egocentric bias even emerges (1) when judges cannot rely on their own supporting knowledge for a decision (Cadinu and Rothbart 1996) and (2) when there is no initial opinion that can serve as an anchor (Clement and Krueger 2000). As such, advice-discounting due to egocentric bias may also be a threat for effective interactions between users and their cooperative CAs. Thus, we conclude that users evaluate how much they trust a CA based on their own subjective knowledge within a field.

H5: Subjective knowledge affects a user's trusting intentions in a CA;

H5a: An increase in a user's subjective knowledge in math negatively affects a user's trusting intentions in a CA on math advice.

H5b: An increase in a user's subjective knowledge in finance negatively affects a user's trusting intentions in a CA on finance advice.

5.5 Experimental Design

We employed a between-subject design with two conditions (CA gender: male vs. female) and tested the hypotheses by means of a randomized online experiment. The CA was self-designed and took form in an instant messaging interface (Figure 5-2). The CA was built on the Dialogflow (Google 2019) engine, which utilizes machine learning algorithms and natural language processing for natural language understanding and output. The CA asked in all conditions for textual input.

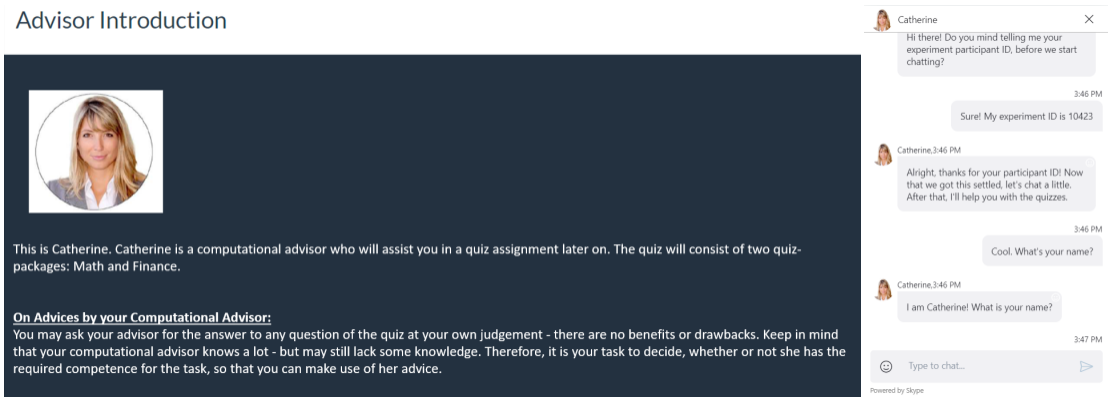

Figure 5-2 Screenshots of the employed female CA in the experiment: The initial CA introduction page (left); the instant messaging interface (right)

5.5.1 Manipulation of CA Gender

To examine the influence of a CA's gender, we designed two different CAs, which differed only in visual cues (i.e., embodiment/avatar) and a verbal cue (i.e., name) (see Table 5-1). We adopted the human embodiments from Wuenderlich and Paluch (2017) to ascertain adequate and tested humanlike appearances for our embodiments. We, however, refrained from employing more complex anthropomorphic elements (e.g., voice output and animations), as previous research found that their influences depend on the applications and users' expectations (Goetz et al. 2003b; McBreen and Jack 2001). Other cues (e.g., style of clothing) as well as the conversational output of the CA were similar in both conditions.

CA Gender	**Male**	**Female**
Avatar		
Name	Charles	Catherine

Table 5-1 Operationalization of a CA's gender

We conducted two pretests (N=30 and N= 73) with U.S. participants from Amazon Mechanical Turk to further check the stimuli of our main study for biases in the experimental design concerning (1) the gender cues (i.e., avatar pictures), (2) the language style of the CA and (3) the examined knowledge fields: We showed each participant the two avatar pictures in random order and asked them which gender they associate to the avatar picture (i.e., female, male, no gender) and how competent they consider the avatar. Regarding our female avatar picture, 100% of the participants selected female gender. For the male avatar picture, all participants except one chose

male gender. A single sample t-test resulted in no significant difference ($p>0.05$) between this sample and a hypothetical sample in which all participants chose male gender. Moreover, participants perceived no significant difference in competence when looking just at the pictures of the avatars ($p>0.1$). We therefore conclude that the gender cues within the avatar pictures worked as intended and that users can correctly assign the avatars to the corresponding (i.e., male or female) gender and do not perceive a difference in competence by just looking at the pictures. Furthermore, each pretest participant saw a video depicting a pre-recorded conversation between the CA and a study participant. The conversation in this video did not include any avatar picture. Participants were then asked whether the language of the CA can be associated with one gender (i.e., 1 as female, 4 as neutral, 7 as male on a seven-point scale). A single sample t-test comparing the sample mean to 4 (as neutral) resulted in no significant difference ($p>0.05$). Thus, we conclude that the language of the CA itself does not construe a gender-specific cue and does not confound our results. Lastly, we asked participants whether they consider math and finance rather typical male or typical female knowledge fields (i.e., 1 as female, 4 as neutral, 7 as male on a seven-point scale). Our results and statistical tests provide support for our assertion that these fields are considered rather typical male by the U.S. participants (math: $p<0.001$; finance: $p<0.01$).

5.5.2 Dependent Variables, Control Variables and Checks

We focus on *Perceived Competence* and *Trusting Intentions* as dependent variables. The items to measure the dependent variable *Perceived Competence* were adapted from Hess et al. (2009a) and McKnight et al. (2002) (e.g., "*The advisor will be competent and effective in providing finance advice*") and *Trusting Intentions* (i.e., subjective probability of depending— follow advice) from McKnight et al. (2002) (e.g., "*I would feel comfortable acting on finance information given to me by the advisor*"). Moreover, we also measured the variables *Agentic Traits* (e.g., "*How would you describe your advisor?" – "assertive"*) and *Communal Traits* (e.g., "*How would you describe your advisor?" – "friendly"*) based on items used by Eyssel and Hegel (2012) as well as *Subjective Knowledge* from Flynn and Goldsmith (1999) (e.g., "*I know pretty much about finance*"). All items were presented on 7-point Likert-type scales ranging from *strongly disagree* to *strongly agree* and adjusted to the respective knowledge field.

Additionally, we also measured demographics (i.e., participant's *Age* and *Gender*) and control variables from extant literature that we considered most influential: We adapted

items for *Trusting Disposition* from Gefen and Straub (2004) (e.g., "*I generally trust other people*"), *Trusting Disposition – Competence* from Lankton et al. (2016) (e.g. "*I believe that most professional people do a very good job at their work*"), *Product Knowledge* from Flynn and Goldsmith (1999) (e.g., "*I know pretty much about conversational agents/chatbots*") and *Personal Innovativeness* from Agarwal and Prasad (1998) (e.g., "*I like to experiment with new information technologies*").

As manipulation checks, we asked whether participants interacted with a human or computational advisor and whether the advisor was male, female, or genderless. Moreover, we also implemented an attention check to test whether participants carefully read the content of the advisor's output.

5.5.3 Experimental Procedure

Consistent with previous studies (e.g., Nass et al. 1997), the experimental procedure consisted of a conversation with a gendered CA: (1) First, the participant had to read the experimental instructions. (2) Subsequently, we informed the participants about the upcoming cooperation between them and the CA, reflecting a typical judge-advisor system (Sniezek and Van Swol 2001): We told participants to get familiar with a computational advisor, which should assist them in a quiz on the two knowledge fields (i.e., math and finance) later on in the experiment (see Figure 5-3). Since the advisor was described as having possibly imperfect knowledge and as it would only assist them in fulfilling the task, not to learn from it, the advisor was not introduced as a teaching agent, but solely as an advisor. (3) Participants then introduced themselves and talked to the CA, whereby the participant should gather initial information on the characteristics of the CA. (4) The final part of the experiment was a questionnaire, including the participants' CA experience, perceptions and expectations over multiple pages. (5) Lastly, we debriefed participants and informed them that the experiment would end without the initially mentioned cooperation with the CA.

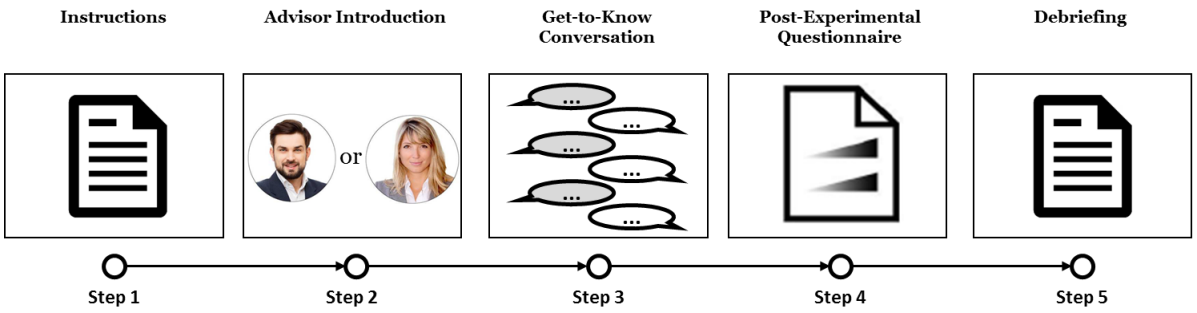

Figure 5-3 Experimental procedure

5.6 Analysis and Results

5.6.1 Sample Description, Controls and Manipulation Checks

93 participants from Amazon Mechanical Turk completed our experiment without any suspicious click-through behaviour. We chose Mechanical Turk as an appropriate source for participants because previous research demonstrated that data from Mechanical Turk respondents has high reliability and may even be of higher quality than data from student or online convenience samples (Steelman et al. 2014). Moreover, Mechanical Turk respondents are considered tech- and Internet-savvy and thus potential users of CAs, hence representing an adequate sample for our setting. Following Goodman and Paolacci (2017), all participants were U.S. residents with a minimal approval rate of 95% on the platform. Out of these 93 participants, we removed 6 because they failed at least one of our checks, resulting in a final sample size of 87 participants. Table 5-2 summarizes the descriptive statistics of our study.

Groups	**N**	**Female**	**Average Age (Std.Dev.)**
1: CA with "Female cues"	47	40%	37 (12)
2: CA with "Male cues"	40	50%	36 (12)

Table 5-2 Descriptive statistics of the sample

Several one-way analyses of variance confirmed the successful randomized assignment to the different experimental conditions: We did not observe any significant differences in terms of participant's *Gender, Age, Trusting Disposition, Trusting Disposition – Competence, Product Knowledge* or *Personal Innovativeness* between the two treatment groups (all $p>0.05$), indicating that these (control) variables did not confound our dependent variables.

5.6.2 Reliability and Validity

Table 5-3 shows that both measures for high internal consistency (i.e., Cronbach's alpha and composite reliability) were above the recommended level of 0.70 (Nunnally and Bernstein 1994). We tested convergent validity based on the values of the loadings and the average variance extracted (AVE). Loadings of all indicators were higher than 0.70. AVE values were above the recommended level of 0.50, suggesting that on average, each construct explains more than half of the variance of its indicators (Hair et al. 2014). Hence, we found convergent validity with respect to the used measures. To assess discriminant validity of our results we used the heterotrait-monotrait ratio of correlations (HTMT) as there is evidence of its superior performance to the Fornell-Larcker test (Henseler et al. 2015). The maximum value of 0.852 was below the threshold of 0.90 indicated by Teo et al. (2008). Hence, discriminant validity of our results is supported. We also tested for multicollinearity by calculating the maximum variance inflation factor (VIF) which was equal to 1.107. As Mason and Perreault (1991) state that a VIF of 10 or higher is an evidence for multicollinearity, we concluded absence of multicollinearity in the results. Finally, we determined the model fit by SRMR (Henseler et al. 2016) which was equal to 0.063 and below the cut-off value of 0.080, indicating a good model fit (Hu and Bentler 1999).

Construct	**Cronbach's alpha**	**Composite reliability**	**Loadings range**	**AVE**
Agentic Traits	0.794	0.871	0.779 – 0.879	0.692
Communal Traits	0.856	0.901	0.719 – 0.892	0.695
Perceived Competence of CA in Math	0.976	0.982	0.962 – 0.970	0.932
Perceived Competence of CA in Finance	0.952	0.965	0.914 – 0.947	0.873
Trusting Intentions in CA – Math	0.907	0.931	0.757 – 0.920	0.731
Trusting Intentions in CA – Finance	0.957	0.967	0.893 – 0.948	0.854
Subjective Knowledge – Math	0.953	0.889	0.927 – 0.944	0.871
Subjective Knowledge – Finance	0.903	0.938	0.906 – 0.927	0.836

Table 5-3 Reliability and convergent validity of selected measures

5.6.3 Hypotheses Testing

To test our hypotheses, we conducted multivariate linear regressions (e.g., Schaarschmidt et al. 2018) and bootstrap analyses with 5,000 samples and 95% bias-corrected confidence intervals based on PROCESS (Hayes 2018) to test direct and indirect (i.e., mediation) effects. Figure 5-4 summarizes the results in an easier-to-read visual way, which is similar to our research framework (Figure 5-1).

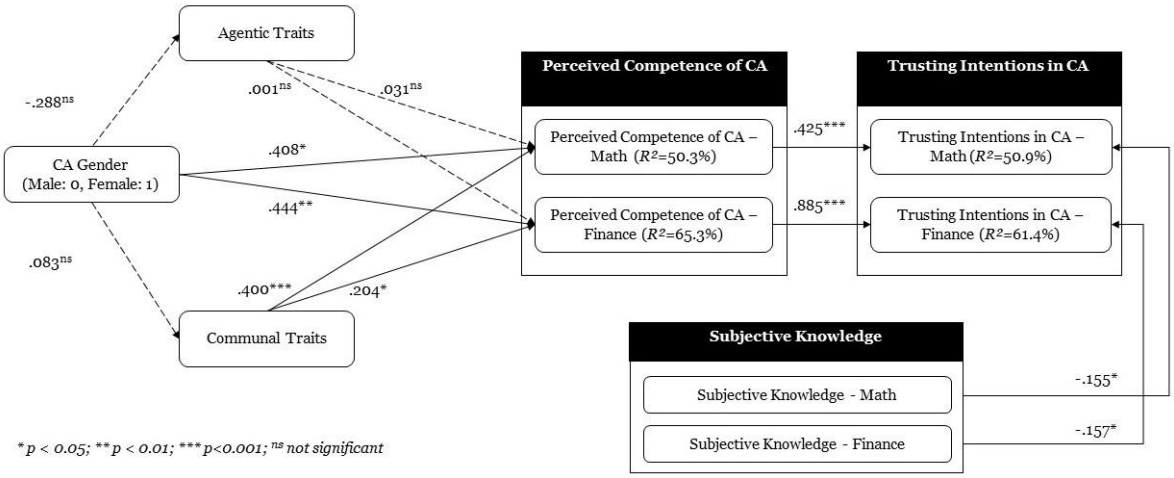

Figure 5-4 Research model including path coefficients results, significance levels, and adjusted coefficients of determination

Table 5-4 and Table 5-5 offer exhaustive two stage hierarchical regression results on the dependent variables *Perceived Competence of CA* and *Trusting Intentions in CA,* respectively. We hereby coded *CA Gender* as a binary variable, which equals 0 when the CA was male and 1 when it was female.

Table 5-4 contains the regression results concerning the dependent variables *Perceived Competence of CA – Math* and *– Finance*. Consistent with other studies (e.g., Schaarschmidt et al. 2018), we first included all control variables (model 1) related to *Perceived Competence of CA – Math*, then added our independent and mediating variables (model 2). Similarly, model 3 includes all control variables and model 4 all variables related to *Perceived Competence of CA – Finance.* Contrary to H1a and H1b, we found evidence that a female (vs. male) CA leads to higher levels of *Perceived Competence of the CA* in math-related (β=.408, $p<0.05$, model 2) and finance-related subjects (β=.444, $p<0.01$, model 4). Regarding H2a and H2b, we found an insignificant effect of *CA Gender* on *Agentic Traits* (β=-.288, $p>0.05$) as well as on *Communal Traits* (β=.083, $p>0.05$).

	Model 1	**Model 2**	**Model 3**	**Model 4**
Variables	**Perceived Competence of CA – Math**	**Perceived Competence of CA – Math**	**Perceived Competence of CA – Finance**	**Perceived Competence of CA – Finance**
Independent Variables				
CA Gender		.408*		.444**
Mediating Variables				
Agentic Traits		.031^{ns}		.001^{ns}
Communal Traits		.400***		.204*
Indirect Effect of CA Gender via Communal Traits (LLCI, ULCI)		.008 (-.350, .081)^{ns}		0.013 (-.114, .075)^{ns}
Covariates				
Subjective Knowledge – Math		.011^{ns}		.024^{ns}
Subjective Knowledge – Finance		.044^{ns}		.067^{ns}
Controls				
Gender	.028^{ns}	.289^{ns}	-.013^{ns}	.125^{ns}
Age	.079^{ns}	.004^{ns}	.025^{ns}	-.0003^{ns}
Trusting Disposition	-.063^{ns}	-.021^{ns}	-.157^{ns}	-0.065^{ns}
Trusting Disposition – Competence	.298**	.080^{ns}	.464***	.232*
Personal Innovativeness	.077^{ns}	.043^{ns}	.124^{ns}	-.055^{ns}
Product Knowledge	.403***	.263*	.062^{ns}	-.006^{ns}
R^2	.248	.503	.159	.653

Note: *p<0.05; **p<0.01; ***p<0.001; ^{ns} not significant

Table 5-4 Results of hierarchical regression model for Perceived Competence of CA

Furthermore, we found insignificant effects of *Agentic Traits* on *Perceived Competence of the CA* for both knowledge fields (H3a and H3b, model 2 and model 4 respectively). Next, we found support for H4a and H4b as *Communal Traits* significantly increased the *Perceived Competence of the CA* in math-related subjects (β=.400, p<0.001, model 2) and finance-related subjects (β=.204, p<0.05, model 4). We also tested for significant indirect effects of *CA Gender* on *Perceived Competence of the CA*. *CA Gender* had no significant indirect effect on *Perceived Competence of the CA* via *Communal Traits* (LLCI=-.350, ULCI=.081). Since *Agentic Traits* had no significant direct effects on *Perceived*

Competence of the CA, a prerequisite for a significant indirect effect was not given. We also entered the other explicit variables of the research framework (i.e., *Subjective Knowledge – Math* and – *Finance*) as covariates into the regression. However, no significant direct effects were found (all $p>0.05$, model 2 and model 4).

Table 5-5 indicates the regression results concerning the dependent variables *Trusting Intentions in CA – Math* and – *Finance.* Alike Table 5-4, in models 5 and 7 we first entered only the control variables, then entered our independent variables in model 6 and 8, respectively. Our hypotheses concerning the effects of *Subjective Knowledge* on *Trusting Intentions in CA* are supported for both knowledge fields: *Subjective Knowledge* in math (H5a) and finance (H5b) significantly affected the *Trusting Intentions in CA* in the respective fields (H5a: $\beta=-.155$, $p<0.05$, model 6; H5b: $\beta=-.157$, $p<0.05$, model 8). Also, we could confirm previous research on the significant effects of *Perceived Competence in CA* on *Trusting Intentions in CA* for math- ($\beta=.425$, $p<0.001$, model 6) and finance-related subjects ($\beta=.885$, $p<0.001$, model 8). We also tested for the effects of the other variables of the research framework (i.e., *CA Gender*, *Agentic Traits*, and *Communal Traits*) on *Trusting Intentions in CA* but uncovered no significant effects (all $p>0.05$, model 6 and model 8).

	Model 5	**Model 6**	**Model 7**	**Model 8**
Variables	**Trusting Intentions in CA – Math**	**Trusting Intentions in CA – Math**	**Trusting Intentions in CA – Finance**	**Trusting Intentions in CA – Finance**
Independent Variables				
Subjective Knowledge – Math		-.155*		-.053^{ns}
Perceived Competence in CA – Math		.425***		-.086^{ns}
Subjective Knowledge – Finance		.010^{ns}		-.157*
Perceived Competence in CA – Finance		.040^{ns}		.885***
Covariates				
CA Gender		.028^{ns}		-.611^{ns}

Agentic Traits		.072^{ns}		.116^{ns}
Communal Traits		.136^{ns}		.016^{ns}
Controls				
Gender	-.203^{ns}	-.319^{ns}	-.088^{ns}	-.056^{ns}
Age	.205^{ns}	.009^{ns}	.047^{ns}	.001^{ns}
Trusting Disposition	.098^{ns}	.126^{ns}	-.122^{ns}	.067^{ns}
Trusting Disposition – Competence	.234*	.003^{ns}	.220^{ns}	-.157^{ns}
Personal Innovativeness	.206^{ns}	.183^{ns}	.296*	.244*
Product Knowledge	.038^{ns}	-.106^{ns}	-.033^{ns}	.027^{ns}
R^2	.119	.509	.044	.614

Note: *p<0.05; **p<0.01; ***p<0.001; ^{ns} not significant

Table 5-5 Results of hierarchical regression model for Trusting Intentions in CA

5.7 Discussion

The continuous permeation of AI-enabled CAs in business and private lives offers new opportunities to shape and improve the collaboration of humans and computers. Yet, despite the apparent success of CAs, both practitioners and researchers still face challenges in designing these new IS. To come one step closer to solving this challenge, we examined cooperative CAs, which are majorly concerned with the provision of advice to users in cooperative settings. We investigated gender stereotyping and egocentric bias as influences within HCI that may arise from a CA's design cues and a user's subjective knowledge.

Within our online-experiment, we observed that, in contrast to most extant literature, the female CA was rated more competent than the male CA in stereotypical male knowledge fields. Though our findings seem to provide conflicting findings on the effects of gender stereotyping, we strive to provide a solution to solve this conflict and extend research by explaining our observations with contextual reasoning of users (Rooderkerk et al. 2011): Users may have acquired context-specific information regarding gender in early childhood, such as the mother being more present in cooperative situations (Zemore et al. 2000). This deeply embodied information is then used within contextual reasoning to assess the fit of a gender in similar (cooperative) situations, which explains why users more strongly associate the female CA with competence in a cooperative CA context, irrespective of the CA's traits and knowledge field. Thus, our observations

indicate the interpretation that female CAs are generally associated more with cooperative settings and thus perceived as more competent in various cooperation task settings, thus more suitable for service or assistance contexts (Beldad et al. 2016). Additionally, we observed that effects of CA's gender on a user's perceptions of agentic and communal traits did not significantly differ between the male and female CA. In light of our explanation for the direct effect of CA gender on user's perceived competence in a CA, we note that the effects CA gender may not be fully grasped by agentic and communal traits. We argue that, although being good proxies for the measurement of simplistic design cues (e.g. female haircut vs. male haircut) in situations without specific contextual dependencies (Eyssel and Hegel 2012), perceived agentic and communal traits may not be perfectly suitable measures for gender effects that stem from contextual dependencies. This may be specifically the case, when CA design includes several cues (e.g., clothes) that render female and male CAs to be on similar levels concerning agentic and communal traits. Perhaps, in these cases, agentic and communal traits may rather be operationalized as measures for perceived personality traits which are elicited by the implemented design cues (Abele and Wojciszke 2007).

Moreover, whereas a CA's communal traits significantly affected a user's perceived competence of the CA, a CA's agentic traits did not. Thus, the results further suggest that the context of cooperative CA is substantially different from the competitive ones of classic sales and recommendation agents in e-commerce. Indeed, in a cooperative context, competence seems to be more strongly related to communal traits, as literature from social psychology suggests (Abele and Wojciszke 2007). Agentic traits, however, seem to not be valued by users in our cooperative settings. An explanation for this observation is that participants might have perceived that the CA had no or little influence on the participants' well-being and goal pursuit. As such, due to the little outcome dependency, only the CA's communal traits counted (Abele and Wojciszke 2007). Thus, one may derive the learning that whereas in competitive contexts a user is per se dependent on the CA and thus may consider a CA's agentic cues, this is only the case in cooperative contexts when the user seems to depend on the CA to reach a user's goal.

Lastly, the significant effects of a user's subjective knowledge on a user's trusting intentions in a CA provide support for our hypothesis that higher perceptions of one's own knowledge lead to a decrease of trust in a CA. Similar to prior research from

psychology and judge-advisor systems, we relate this finding to the existence of an egocentric bias that negatively affects the advice effectiveness of cooperative CAs (Bonaccio and Dalal 2006). Moreover, within our experiment the CA did not provide any advice and the users still appeared to trust the advisor less the more they felt knowledgeable. This particular circumstance further strengthens our findings, which are in line with recent research that connects little trust in advice to advice discounting (Wang and Du 2018). Thus, our results indicate that users can behave biasedly in judge-advisor systems based on their subjective knowledge, which can affect the HCI between users and cooperative CAs.

5.7.1 Implications for Theory and Practice

First of all, we provide counterintuitive evidence that CAs with female gender cues are perceived as significantly more competent than their male counterpart in stereotypical male knowledge fields. This observation seems to contradict previous research on interactions with computers and robots (Eyssel and Hegel 2012; Nass et al. 1997). However, we explain this phenomenon and thus extend theory by stating that users apply contextual reasoning to assess the fit of a gender in similar situations, which explains why users more strongly associate the female CA with competence in a cooperative CA context, irrespective of the CA's traits and knowledge field. We therefore support and further explain the notion by scholars like Beldad et al. (2016) that female representations appear to be more suitable for advice-giving IS.

Second, we deliver insights to research that the effects of gender cues may not be mediated by agentic and communal traits. Although the effects of the CA's gender on competence were significant, the effects of a CA's gender on agentic and communal traits were not, which means that the male and female CA did not significantly differ in perceived agentic and communal traits. We thus introduce IS research to the idea that gender cues comprise more than what we can potentially measure with agentic and communal traits, and that further research may focus on investigating contextual differences for gender cues and various representations of gendered CAs.

Third, our observations of the significant effect of communal traits and the insignificant effect of agentic traits on a user's perceived competence of a CA provide a new perspective in that cooperative HCIs appear to be different from competitive ones. For example, research on recommendation agents continuously postulates that cues that convey competence are most important for competence perception of such agents

(Komiak and Benbasat 2008). Thus, we enrich research on CAs by providing evidence that in interactions with cooperative CAs, communal traits lead to significant increases in a user's perceived competence of a CA, while agentic traits seem to be valued less. Fourth and lastly, we point out the conflict that an increase in user's subjective knowledge leads to a decrease in trust in CAs irrespective of the knowledge field. Our research therefore also draws the attention away from the anthropomorphic design of IS and looks at the characteristics of users. Consequently, analogous to the design of a CA's gender, our research suggests that CA designers and researchers must consider various cues and biases to understand a user's acceptance of CAs.

For practitioners, the first implication lies therein that especially in a cooperative context, designers should pay attention to imbuing CAs with female gender cues and communal traits. This should increase the perception of competence in the IS. Nevertheless, this general conclusion should be further evaluated in usability-tests, because in related research, scholars found that the congruency between context and CA's gender also leads to a higher credibility and trust in advice (Beldad et al. 2016). Moreover, in contexts in which users perceive to be more dependent on the CA, more agentic traits in design of the CA might be suitable (Abele and Wojciszke 2007). Thus, practitioners must carefully consider in what context the CA should provide advice on. Furthermore, we discovered that especially users with high subjective knowledge are prone to advice discounting. This implies that the use of CAs can be more effective in the intelligence augmentation of users who consider themselves unknowledgeable, such as when a user needs advice in novel and unfamiliar knowledge fields.

5.7.2 Limitations and Directions for Future Research

The contributions of this research should be considered with some limitations in mind. First, the short, experimental setting of "getting to know the advisor" may differ from those in real practice when interacting with a CA over a longer period. Furthermore, our research focused on U.S. participants. Thus, future research may want to investigate the phenomenon longitudinally, beyond an initial encounter and across several cultures to derive more expanding learnings. Moreover, future research can investigate if our hypotheses also find support in stereotypical female knowledge fields.

Second, although we deem using a holistic design with context specific cues appropriate for our research purpose, the holistic design integrates several cues (e.g., clothing and smile) and thus does not allow us to statistically determine, which cues were more

important for a user's perception of agentic and communal traits. Therefore, a comparison of our findings with an additional treatment group with a less anthropomorphized (e.g., genderless) CA may be a viable option to derive further learnings. Apart from that, IS research can further investigate the use of holistic CA designs that combine several design cues adjusted to specific contexts. Moreover, additional research can dive into the linkage between these design cues and performance of IS users and further examine the impact on task performance.

Regarding the literature on judge-advisor systems, our experiment profited from past knowledge and was able to extend IS research by new findings. Future research may analyze, for example, other biases, such as anchoring and differential information and how they can be leveraged (Epley 2004).

6 Thesis Contributions and Conclusion

DT of established companies has become a major concern for IS researchers and practitioners alike. The purpose of this thesis is to contributes to DT research by shedding light on so far understudied outcomes of changes in value creation paths. While previous studies investigated whether DT reached their longer-term goals on an organizational level such as increased firm performance, they neglected outcomes specific to the DT's changes in value creation paths (e.g., paradoxes within the IT function, synergies with platform-based digital business models) and, additionally, neglected outcomes on an individual level (e.g., emotional tensions for employees). Using qualitative and quantitative data, inductive and deductive methods, across four articles in this thesis, I aimed to contribute and add novel perspectives to DT research. The main theoretical contributions lie in novel outcomes of DT on different levels that are unveiled. Nonetheless, this thesis also provides actionable recommendations for practitioners currently managing their companies' DT as discussed in the following sections.

6.1 Theoretical Contributions

Overall, the thesis provides a deeper and more detailed understanding of the outcomes of DT of established companies and thereby contributes in several important ways to the IS research, namely to business model research, ambidexterity and paradox theory, anthropomorphism, nudging, and judge-advisor literature.

More specifically, the articles 1 and 2 provide new findings concerning outcomes of DT on an organizational level. Prior research dominantly focused on organizational level concepts such as firm performance, known from prior IT-enabled transformations and not specific to DT. The articles consider novel digital technologies specific to DT – digital platforms and modern IT architecture – and examine the outcomes of the affordance actualization of these digital technologies. Article 1 unveils outcomes of changes of value propositions and value networks. Indeed, synergies of cost and value between an established business model and a novel digital platform-based business model (created during DT) within a single established company accelerate the growth of the new BM but also foster innovation of the established BM, even if not originally intended in the creation of the new BM, marking a prime example of prior unknown (and unintended) outcome of affordance actualization in DT, and contributing to business model research.

The findings of article 2 highlight outcomes of the affordance of increasing agility and ambidexterity. Indeed, DT often entails the creation of ambidextrous IT functions which create tensions and paradoxes within the IT function. The findings especially contribute to paradox theory as they unveil the importance of emotional tensions in paradoxes and demonstrate how interrelated paradoxes and paradox management approaches on different levels (organizational and individual) are. Additionally, the findings contribute to ambidexterity theory as they call into question the effectiveness of structural ambidexterity: tensions and paradoxes are even stronger when both IT modes report to different executives.

Whereas articles 1 and 2 uncovered outcomes on an organizational level of value proposition & value network and agility & ambidexterity, articles 3 and 4 offer new insights regarding outcomes on an individual level of digital channels and contribute to literatures on anthropomorphism, digital nudging, and judge-advisor-system. Digital channels now permeate private and work lives. Article 3 highlights ways to use design elements of conversational agents in financial services to increase investment volumes and to overcome hyperbolic discounting bias of individuals. Thereby, the article uncovers changes in savings behavior as additional outcome of digital channels, now on an individual level for customers, going beyond DT's organizational goals and contributes to robo-advisory, anthropomorphism, and digital nudging research. Article 4 demonstrates that users apply gender-stereotypes to conversational agents if gender cues are attributed to these agents, even if users were briefed that they are interacting with a non-human algorithm. Such stereotypes reduce the effectiveness of the interaction, thus of the digital channel overall. The study shows the outcomes for an individual of anthropomorphism in digital channels, hence, contributing to judge-advisor-system literature and conversational agent literature in general.

Finally, the outcomes revealed and studied in this thesis happen on or across different levels (organizational level, individual level). Prior research dominantly took an organizational-level perspective and shoved outcomes on other levels into the background. However, important individual-level findings in this thesis highlight the relevance of studying other levels to gain a comprehensive picture of the phenomenon of DT and its value creation paths and support the claim of the micro-foundations movement in different research fields (e.g., Felin et al. 2015; Miron-Spektor et al. 2018;

Peppard et al. 2014). I therefore plead for a consensus shift in DT outcome research, switching from a dominant organizational-level perspective toward other levels or multi-level perspectives.

6.2 Practical Contributions

Besides theoretical contributions, this thesis offers a multitude of practical contributions. For companies which plan to build a new digital platform-based business model (or already are in the process), article 1 presents potential value and cost synergies between the established and the new digital business model to fuel the success of both. Additionally, practical guidelines to unlock these synergies are shown such as creating acceptance for the digital platform-based business model by clear top-management communication on the roles of the BMs and establishing knowledge transfer between the business models (e.g., by round tables, mutual workplace visits, job rotations, “liaison officers”). Managers may use these guidelines as a blueprint to design and implement interventions to continuously identify and unlock synergies.

Across industries, IS managers and executives may use findings from article 2 regarding paradoxes and ways to approach them as guidance and reminder of difficulties in the DT of the IT function. IS managers may want to use the uncovered tensions and paradoxes as a blueprint to identify the types of tensions in their respective bi-modal IT structures as it is important that managers have their eyes and ears wide open to identify emotional tensions (such as envy and resentment) early on. Furthermore, practitioners are encouraged to use integration (e.g., liaison officers, job rotation, internal communication) and differentiation practices (e.g., new hiring, special permits, exemptions) to address the tensions and paradoxes. Finally, IT managers are advised to handle DT of the IT function as a continuous and recursive “work in progress” toward a moving target instead of a linear process with a fixed goal.

Finally, for companies digitizing their channels (e.g., sales channels, internal communication), especially in the financial services industry, articles 3 and 4 in this thesis offer practical contributions regarding the design of CAs. We showed that robo-advisors can benefit from IS by calculating personalized anchors in real-time and can build a social atmosphere through anthropomorphic design elements and mitigate underinvestment. Moreover, CA designers must carefully consider in what context the

CA should provide advice on as imbuing CAs with female or male gender cues influences trust and effectiveness of the interaction.

6.3 Limitations and Directions for Future Research

Despite the aforementioned theoretical and practical contributions, this thesis comes with noteworthy limitations, which also open up directions for future research.

First, this thesis presents novel findings on outcomes of changes in value creation paths during the DT of established companies. However, it is by no means a comprehensive and exhaustive list of all potential outcomes across all levels. For instance, research on individual-level outcomes of changes in value proposition and value networks was not pursued. Similarly, studies across value creation paths were not in focus of this thesis which might be conducted by researchers in the future.

Second, data collection across the four articles presented in this study poses some geographical limitations. Participants came, mostly for language reasons, from Germany (studies 1 and 2) or the US (studies 3 and 4). Similar studies in other cultural contexts might reveal different results, as for instance management styles (for studies 1 and 2) follow different patterns and cooperation and conflicts might unfold differently.

Third, the qualitative studies conducted for articles 1 and 2 have limited generalizability as often with qualitative research even if the researchers followed accepted guidelines (e.g., Sarker et al. 2018a; Sarker et al. 2018b). Quantitative studies may validate and increase generalizability of the findings from these qualitative studies.

Further avenues for future research include multi-level studies that examine several levels simultaneously to better identify how one outcome (e.g., on an organizational level/individual level) might have effects up or down the levels of analysis (Morgeson and Hofmann 1999; Rousseau 1985). Furthermore, DT is a process and therefore might never be finished. In the future, however, with more established companies reaching a high level of digital maturity (Thordsen and Bick 2020), researchers should evaluate the outcomes found in this thesis. For instance, research should evaluate whether these were only temporary until a certain level of maturity was reached or whether they persist. Longitudinal research over several years might also answer such research questions. Finally, it is relevant to study outcomes based on completely novel digital technologies

and new actors that appear with ongoing DT, such as the phenomenon of algorithmic management (Benlian et al. 2022; Cram et al. 2022; Wiener et al. 2021).

6.4 Conclusion

In this thesis I investigated outcomes of new value creation paths during the DT of established companies. So far, research had focused on longer-term organizational-level outcomes like firm performance and treated other outcomes of DT insufficiently, thereby creating a concept of DT skewed toward the organizational level and missing explanations for the low success rate of DT. To offer a more complete picture of DT and answering numerous calls of researchers, I studied and uncovered outcomes on an individual and organizational level through four different articles presented in this thesis. I hope that my results will encourage researchers to take new perspectives when studying DT as well as practitioners to have an open mind about the many affordances and their potential outcomes and to be cautious to not overlook potential hindering outcomes which need to be addressed.

References

A.T. Kearney, C. 2015. "Hype Vs. Reality: The Coming Waves of “Robo” Adoption," Insights from the A.T. Kearney 2015 Robo-Advisory Services Study, https://www.atkearney.com/documents/10192/7132014/Hype+vs.+Reality_The+Coming+Waves+of+Robo+Adoption.pdf.

Abele, A. E., and Wojciszke, B. 2007. "Agency and Communion from the Perspective of Self Versus Others," *Journal of Personality and Social Psychology* (93:5), p. 751.

Adam, M., and Pecorelli, M. 2018. "Recommendations in Augmented Reality Applications - the Effect of Customer Reviews and Seller Recommendations on Purchase Intention and Product Selection," *European Conference on Information Systems (ECIS)*, Portsmouth, United Kingdom.

Adam, M., Roethke, K., and Benlian, A. 2022. "Human Versus Automated Sales Agents: How and Why Customer Responses Shift across Sales Stages," *Information Systems Research* (Ahead of Print), pp. 1-21.

Adam, M., Toutaoui, J., Pfeuffer, N., Benlian, A., and Hinz, O. 2019. "Investment Decisions with Robo-Advisors: The Role of Anthropomorphism and Personalized Anchors in Recommendations," *Twenty-Seventh European Conference on Information Systems (ECIS)*, Stockholm - Uppsala.

Agarwal, R., and Prasad, J. 1998. "A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology," *Information Systems Research* (9:2), pp. 204-215.

Aggarwal, P., and McGill, A. L. 2007. "Is That Car Smiling at Me? Schema Congruity as a Basis for Evaluating Anthropomorphized Products," *Journal of Consumer Research* (34:4), pp. 468-479.

Agrawal, A., Catalini, C., and Goldfarb, A. 2010. "The Geography of Crowdfunding," *NET Institute Working Paper* (10:08).

Alt, R., and Puschmann, T. 2016. *Digitalisierung Der Finanzindustrie*. Berlin: Springer.

Andersen, P., Svejvig, P., and Heeager, L. T. 2017. "Ambidextrous It Governance: The Art of Balancing Exploration and Exploitation in It Governance," *Selected Paper of the IRIS* (8:2).

Anderson, J., Rainie, L., and Luchsinger, A. 2018. "Artificial Intelligence and the Future of Humans," Pew Research Center, p. 123.

Andriopoulos, C., and Gotsi, M. 2017. "Methods of Paradox," in *The Oxford Handbook of Organizational Paradox,* W.K. SMITH, M.W. LEWIS, P. Jarzabkowski and A. LANGLEY (eds.). United Kingdom: Oxford University Press.

Andriopoulos, C., and Lewis, M. W. 2009. "Exploitation-Exploration Tensions and Organizational Ambidexterity: Managing Paradoxes of Innovation," *Organization Science* (20:4), pp. 696-717.

Arvidsson, V., and Troels, M. 2018. "Generating Innovation Potential: How Digital Entrepreneurs Conceal, Sequence, Anchor, and Propagate New Technology," *The Journal of Strategic Information Systems* (27:4), pp. 369-383.

Aubert, B. A., Kishore, R., and Iriyama, A. 2015. "Exploring and Managing the “Innovation through Outsourcing” Paradox," *The Journal of Strategic Information Systems* (24:4), pp. 255-269.

Badr, N. G. 2018. "Enabling Bimodal It: Practices for Improving Organizational Ambidexterity for Successful Innovation Integration," *Twenty-fourth Americas Conference on Information Systems*, New Orleans, USA.

Bargh, J. A. 1999. "The Cognitive Monster: The Case against the Controllability of Automatic Stereotype Effects," in *Dual Process Theories in Social Psychology,* S.C.a.Y. Trope (ed.). New York, USA: Guilford Press, pp. 361-382.

Barney, J., and Felin, T. 2013. "What Are Microfoundations?," *The Academy of Management Perspectives* (27), pp. 138-155.

Barthel, P. 2021. "What Is Meant by Digital Transformation Success? Investigating the Notion in Is Literature," in: *16th International Conference on Wirtschaftsinformatik*. Essen, Germany.

Barthel, P., Fuchs, C., Birner, B., and Hess, T. 2020. "Embedding Digital Innovations in Organizations: A Typology for Digital Innovation Units," in: *Wirtschaftsinformatik 2020*. pp. 780-795.

Beattie, V., Fearnley, S., and Brandt, R. 2004. "A Grounded Theory Model of Auditor-Client Negotiations," *International Journal of Auditing* (8:1), pp. 1-19.

Beldad, A., Hegner, S., and Hoppen, J. 2016. "The Effect of Virtual Sales Agent (Vsa) Gender–Product Gender Congruence on Product Advice Credibility, Trust in Vsa and Online Vendor, and Purchase Intention," *Computers in Human Behavior* (60), pp. 62-72.

Benartzi, S., and Thaler, R. H. 2007. "Heuristics and Biases in Retirement Savings Behavior," *Journal of Economic Perspectives* (21:3), pp. 81-104.

Benbasat, I., and Wang, W. 2005. "Trust in and Adoption of Online Recommendation Agents," *Journal of the Association for Information Systems* (6:3), p. 4.

Benlian, A. 2013. "Effect Mechanisms of Perceptual Congruence between Information Systems Professionals and Users on Satisfaction with Service," *Journal of Management Information Systems* (29:4), pp. 63-96.

Benlian, A. 2020. "A Daily Field Investigation of Technology-Driven Spillovers from Work to Home," *MIS Quarterly* (44:3).

Benlian, A. 2022. "Sprint Zeal or Sprint Fatigue? The Benefits and Burdens of Agile Isd Practices Use for Developer Well-Being," *Information Systems Research* (33:2), pp. 557-578.

Benlian, A., and Haffke, I. 2016. "Does Mutuality Matter? Examining the Bilateral Nature and Effects of Ceo–Cio Mutual Understanding," *The Journal of Strategic Information Systems* (25:2), pp. 104-126.

Benlian, A., and Hess, T. 2011. "Opportunities and Risks of Software-as-a-Service: Findings from a Survey of It Executives," *Decision Support Systems* (52:1), pp. 232-246.

Benlian, A., Kettinger, W. J., Sunyaev, A., and Winkler, T. J. 2018. "Special Section: The Transformative Value of Cloud Computing: A Decoupling, Platformization, and Recombination Theoretical Framework," *Journal of Management Information Systems* (35:3), pp. 719-739.

Benlian, A., Klumpe, J., and Hinz, O. 2020. "Mitigating the Intrusive Effects of Smart Home Assistants by Using Anthropomorphic Design Features: A Multimethod Investigation," *Information Systems Journal* (30:6), pp. 1010-1042.

Benlian, A., Titah, R., and Hess, T. 2012. "Differential Effects of Provider Recommendations and Consumer Reviews in E-Commerce Transactions: An Experimental Study," *Journal of Management Information Systems* (29:1), pp. 237-272.

Benlian, A., Wiener, M., Cram, W. A., Krasnova, H., Maedche, A., Möhlmann, M., Recker, J., and Remus, U. 2022. "Algorithmic Management," *Business & Information Systems Engineering* (64:6), pp. 825-839.

References

Berlin, M. 2022. "2022 Ey Us Ceo Survey." EY.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., and Venkatraman, N. 2013. "Digital Business Strategy: Toward a Next Generation of Insights," *MIS Quarterly* (37:2), pp. 471-482.

Bilgeri, D., Fleisch, E., Gebauer, H., and Wortmann, F. 2019. "Driving Process Innovation with Iot Field Data," *MIS Quarterly Executive* (18:3), pp. 191-207.

Bilgeri, D., and Wortmann, F. 2017. "Barriers to Iot Business Model Innovation," in: *Proceedings of the 13th International Conference on Wirtschaftsinformatik*. Switzerland: Leimeister, J.M.; Brenner, W, pp. 987-990.

Bonaccio, S., and Dalal, R. S. 2006. "Advice Taking and Decision-Making: An Integrative Literature Review, and Implications for the Organizational Sciences," *Organizational behavior human decision processes* (101:2), pp. 127-151.

Bossert, O., Ip, C., and Laartz, J. 2014. "A Two-Speed It Architecture for the Digital Enterprise," *McKinsey on Business Technology* (36:Winter 2014).

Braeuer, K., Hackethal, A., and Scheurle, S. 2017. "Fund Savings Plan Choices with and without Robo-Advice," Observatoire de l'épargne européenne, Paris.

Branzei, R., Dimitrov, D., and Tijs, S. 2008. *Models in Cooperative Game Theory*. Springer Science & Business Media.

Broadbent, E., Kumar, V., Li, X., Sollers 3rd, J., Stafford, R. Q., MacDonald, B. A., and Wegner, D. M. 2013. "Robots with Display Screens: A Robot with a More Humanlike Face Display Is Perceived to Have More Mind and a Better Personality," *PloS one* (8:8), p. e72589.

Bunduchi, R. 2005. "Business Relationships in Internet-Based Electronic Markets: The Role of Goodwill Trust and Transaction Costs," *Information Systems Journal* (15:4), pp. 321–341.

Burgoon, J. K., Bonito, J. A., Bengtsson, B., Cederberg, C., Lundeberg, M., and Allspach, L. 2000. "Interactivity in Human–Computer Interaction: A Study of Credibility, Understanding, and Influence," *Computers in Human Behavior* (16:6), pp. 553-574.

Bygstad, B., and Iden, J. 2017. "A Governance Model for Managing Lightweight It," in *Recent Advances in Information Systems and Technologies*. pp. 384-393.

Cadinu, M. R., and Rothbart, M. 1996. "Self-Anchoring and Differentiation Processes in the Minimal Group Setting," *Journal of Personality and Social Psychology* (70:4), p. 661.

Cennamo, C., and Santalo, J. 2013. "Platform Competition: Strategic Trade-Offs in Platform Markets," *Strategic Management Journal* (34:11), pp. 1331-1350.

Chanias, S., Myers, M. D., and Hess, T. 2018. "Digital Transformation Strategy Making in Pre-Digital Organizations: The Case of a Financial Services Provider," *The Journal of Strategic Information Systems* (28:1), pp. 17-33.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., and Kim, S. 2011. "Do Female and Male Role Models Who Embody Stem Stereotypes Hinder Women's Anticipated Success in Stem?," *Social Psychological Personality Science* (2:6), pp. 656-664.

Christensen, C. M. 2013. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business Review Press.

Ciriello, R. F., Richter, A., and Schwabe, G. 2018. "The Paradoxical Effects of Digital Artefacts on Innovation Practices," *European Journal of Information Systems* (28:2), p. 24.

Clement, R. W., and Krueger, J. 2000. "The Primacy of Self-Referent Information in Perceptions of Social Consensus," *British Journal of Social Psychology* (39:2), pp. 279-299.

Cottrell, C. A., Neuberg, S. L., and Li, N. P. 2007. "What Do People Desire in Others? A Sociofunctional Perspective on the Importance of Different Valued Characteristics," *Journal of Personality and Social Psychology* (92:2), p. 208.

Cram, W. A., Wiener, M., Tarafdar, M., and Benlian, A. 2022. "Examining the Impact of Algorithmic Control on Uber Drivers' Technostress," *Journal of Management Information Systems* (39:2), pp. 426-453.

Crick, C., and Chew, E. K. 2020. "Microfoundations of Organizational Agility: A Socio-Technical Perspective," *Communications of the Association for Information Systems*), pp. 273-295.

Cronqvist, H., and Thaler, R. H. 2004. "Design Choices in Privatized Social-Security Systems: Learning from the Swedish Experience," *American Economic Review* (94:2), pp. 424-428.

Cyr, D., Hassanein, K., Head, M., and Ivanov, A. 2007. "The Role of Social Presence in Establishing Loyalty in E-Service Environments," *Interacting with computers* (19:1), pp. 43-56.

Daimler AG. 2018. "A New Record: 22.9 Million Customers Worldwide Trust in Mobility Services from Daimler Ag." Retrieved 05.06.2019, 2018, from https://bit.ly/2MuWCii

Dalal, R. S., and Bonaccio, S. 2010. "What Types of Advice Do Decision-Makers Prefer?," *Organizational Behavior and Human Decision Processes* (112:1), pp. 11-23.

Danneels, L., and Viaene, S. 2022. "Identifying Digital Transformation Paradoxes," *Business & Information Systems Engineering* (64:4), pp. 483-500.

Davison, R. M. 2014. "Editorial," *Information Systems Journal* (24:3), pp. 203-205.

de la Boutetière, H., Montagner, A., and Reich, A. 2018. "Unlocking Success in Digital Transformations," *McKinsey & Company* (October), pp. 1-14.

Diegmann, P., Dreesen, T., Binzer, B., and Rosenkranz, C. 2018. "Journey Towards Agility: Three Decades of Research on Agile Information Systems Development," *Thirty Ninth International Conference on Information Systems*, San Francisco, USA.

Dolata, M., and Schwabe, G. 2016. "More Interactivity with It Support in Advisory Service Encounters?," *Mensch und Computer 2016* J.B. W. Prinz, M. Ziefle (ed.), Aachen, Germany: Gesellschaft für Informatik e.V.

Dremel, C., Wulf, J., Herterich, M. M., Waizmann, J.-C., and Brenner, W. 2017. "How Audi Ag Established Big Data Analytics in Its Digital Transformation," *MIS Quarterly Executive* (16:2).

Dubé, L., and Robey, D. 2009. "Surviving the Paradoxes of Virtual Teamwork," *Information Systems Journal* (19:1), pp. 3-30.

Edlich, A., Ip, F., and Whiteman, R. 2019. "How Bots, Algorithms, and Artificial Intelligence Are Reshaping the Future of Corporate Support Functions," McKinsey.

Eisenhardt, K. M. 1989. "Building Theories from Case Study Research," *Academy of Management Review* (14:4), pp. 532-550.

Epley, N. 2004. "A Tale of Tuned Decks? Anchoring as Accessibility and Anchoring as Adjustment," in *The Blackwell Handbook of Judgment and Decision Making,* D.J.K.a.N. Harvey (ed.). Malden, MA, USA: Blackwell Publishing, pp. 240-256.

References

Epley, N., and Gilovich, T. 2006. "The Anchoring and Adjustment Heuristic," *Psychological Science* (17:4).

Epley, N., Waytz, A., and Cacioppo, J. T. 2007. "On Seeing Human: A Three-Factor Theory of Anthropomorphism," *Psychological Review* (114:4), pp. 864-886.

Etemad-Sajadi, R. 2016. "The Impact of Online Real-Time Interactivity on Patronage Intention: The Use of Avatars," *Computers in Human Behavior* (61), pp. 227-232.

Evans, K. R., and Beltramini, R. F. 1987. "A Theoretical Model of Consumer Negotiated Pricing: An Orientation Perspective," *Journal of Marketing* (51:2), pp. 58-73.

Eyssel, F., and Hegel, F. 2012. "(S) He's Got the Look: Gender Stereotyping of Robots," *Journal of Applied Social Psychology* (42:9), pp. 2213-2230.

Eyssel, F., Hegel, F., Horstmann, G., and Wagner, C. 2010. "Anthropomorphic Inferences from Emotional Nonverbal Cues: A Case Study," *RO-MAN*, pp. 646-651.

Faraj, S., Pachidi, S., and Sayegh, K. 2018. "Working and Organizing in the Age of the Learning Algorithm," *Information and Organization* (28:1), pp. 62-70.

Felin, T., Foss, N. J., and Ployhart, R. E. 2015. "The Microfoundations Movement in Strategy and Organization Theory," *The Academy of Management Annals* (9:1), pp. 575-632.

Fleischmann, M., Amirpur, M., Benlian, A., and Hess, T. 2014. "Cognitive Biases in Information Systems Research: A Scientometric Analysis," in: *ECIS*. Tel Aviv, Israel.

Flick, U., von Kardorff, E., and Steink, I. 2004. *A Companion to Qualitative Research*. London: Sage Publications.

Flynn, L. R., and Goldsmith, R. E. 1999. "A Short, Reliable Measure of Subjective Knowledge," *Journal of Business Research* (46:1), pp. 57-66.

Fortmann, L., Haffke, I., and Benlian, A. 2019. "Navigating through Digital Transformation Using Bimodal It: How Changing It Organizations Facilitates the Digital Transformation Journey at Deutsche Bahn Vertrieb Gmbh," in *Digitalization Cases: How Organizations Rethink Their Business for the Digital Age,* N. Urbach and M. Roeglinger (eds.). Cham: Springer International Publishing, pp. 393-410.

Foss, N. J., and Linder, S. 2019. "Microfoundations: Nature, Debate, and Promise." Cambridge: Cambridge University Press.

Fowler, M., and Highsmith, J. 2001. "The Agile Manifesto." from http://agilemanifesto.org/

Fromm, J., Mirbabaie, M., and Stieglitz, S. 2020. "A Systematic Review of Empirical Affordance Studies: Recommendations for Affordance Research in Information Systems," in: *Twenty-Eigth European Conference on Information Systems*. Marrakesh, Morocco.

Fuchs, C., Barthel, P., Herberg, I., Berger, M., and Hess, T. 2019. "Characterizing Approaches to Digital Transformation: Development of a Taxonomy of Digital Units," in: *14th International Conference on Wirtschaftsinformatik*. Germany: pp. 632-646.

Furnham, A., and Boo, H. C. 2011. "A Literature Review of the Anchoring Effect," *The Journal of Socio-Economics* (40:1), pp. 35-42.

Gartner. 2015. "How to Innovate with Bi-Modal It." *Smarter with Gartner* Retrieved 01/29, 2019, from https://www.gartner.com/smarterwithgartner/how-to-innovate-with-bimodal-it/

Gartner. 2019. "Gartner Predicts 25 Percent of Digital Workers Will Use Virtual Employee Assistants Daily by 2021."

Gefen, and Straub. 2003. "Managing User Trust in B2c E-Services," *e-Service Journal* (2:2), pp. 7-24.

Gefen, D., and Straub, D. 2004. "Consumer Trust in B2c E-Commerce and the Importance of Social Presence: Experiments in E-Products and E-Services," *Omega* (32:6), pp. 407-424.

Gerlach, J. P., and Cenfetelli, R. T. 2020. "Constant Checking Is Not Addiction: A Grounded Theory of It-Mediated State-Tracking," *MIS Quarterly* (44:4), pp. 1705-1732.

Gerster, D., Dremel, C., and Kelker, P. 2018. "Scaling Agility: How Enterprises Adopt Agile Forms of Organizational Design," *Thirty Ninth International Conference on Information Systems*, San Francisco, USA.

Gibson, J. J. 1977. "The Theory of Affordances," *Hilldale, USA* (1:2), pp. 67-82.

Gnewuch, U., Morana, S., and Maedche, A. 2017. "Towards Designing Cooperative and Social Conversational Agents for Customer Service," *Thirty Eighth International Conference on Information Systems*, South Corea.

Goes, P. B. 2013. "Editor's Comments: Information Systems Research and Behavioral Economics," *MIS Quarterly* (37:3), pp. 3-8.

Goetz, J., Kiesler, S., and Powers, A. 2003a. "Matching Robot Appearance and Behavior to Tasks to Improve Human-Robot Cooperation," *Proceedings of the 12th IEEE international workshop on robot and human interactive communication*: IEEE Press Piscataway, NJ, pp. 55-60.

Goetz, J., Kiesler, S., and Powers, A. 2003b. "Matching Robot Appearance and Behavior to Tasks to Improve Human-Robot Cooperation," in: *The 12th IEEE International Workshop on Robot and Human Interactive Communication, 2003. Proceedings. ROMAN 2003.* IEEE, pp. 55-60.

Goodman, J. K., and Paolacci, G. 2017. "Crowdsourcing Consumer Research," *Journal of Consumer Research* (44:1), pp. 196-210.

Google. 2019. "Dialogflow."

Gregory, R. W., Keil, M., Muntermann, J., and Mähring, M. 2015. "Paradoxes and the Nature of Ambidexterity in It Transformation Programs," *Information Systems Research* (26:1), pp. 57-80.

Griffin, D., and Tversky, A. 1992. "The Weighing of Evidence and the Determinants of Confidence," *Cognitive Psychology* (24:3), pp. 411-435.

Grover, V., and Lyytinen, K. 2015. "New State of Play in Information Systems Research: The Push to the Edges," *MIS Quarterly* (39:2), pp. 271-296.

Haffke, I., Kalgovas, B., and Benlian, A. 2017a. "Options for Transforming the It Function Using Bimodal It," *MIS Quarterly Executive* (16:2).

Haffke, I., Kalgovas, B., and Benlian, A. 2017b. "The Transformative Role of Bimodal It in an Era of Digital Business," in: *Hawaii International Conference on System Sciences*. Hawaii.

Hair, J. F. J., Hult, G. T. M., Ringle, C., and Sarstedt, M. 2014. *A Primer on Partial Least Squares Structural Equation Modeling* Sage Publications Ltd.

Hanelt, A., Bohnsack, R., Marz, D., and Antunes Marante, C. 2020. "A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change," *Journal of Management Studies* (58:5), pp. 1159-1197.

Hanelt, A., Busse, S., and Kolbe, L. M. 2017. "Driving Business Transformation toward Sustainability: Exploring the Impact of Supporting Is on the Performance Contribution of Eco-Innovations," *Information Systems Journal* (27:4), pp. 463-502.

Hansen, R., and Sia, S. K. 2015. "Hummel's Digital Transformation toward Omnichannel Retailing: Key Lessons Learned," *MIS Quarterly Executive* (14:2).

Harvey, N., and Fischer, I. 1997. "Taking Advice: Accepting Help, Improving Judgment, and Sharing Responsibility," *ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES* (70:2), pp. 117-133.

Hatch, M. J., and Ehrlich, S. B. 1993. "Spontaneous Humour as an Indicator of Paradox and Ambiguity in Organizations," *Organization Studies* (14:4), pp. 505-526.

Havlat, O. 2018. "Finanzglossar - Durchblick Von a Wie Aktien Bis Z Wie Zins," V. Bundesverband (ed.). www.verbraucherzentrale.de: Verbraucherzentrale NRW e.V.

Hayes, A. F. 2018. *Introduction to Mediation, Moderation and Conditional Process Analysis*, (2nd ed.). The Guilford Press.

He, Z.-L., and Wong, P.-K. 2004. "Exploration Vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis," *Organization Science* (15:4), pp. 481-494.

Heinrich, P., Kilic, M., Aschoff, F.-R., and Schwabe, G. 2014. "Enabling Relationship Building in Tabletop-Supported Advisory Settings," *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing*: ACM, pp. 171-183.

Helgeson, V. S., and Fritz, H. L. 1999. "Unmitigated Agency and Unmitigated Communion: Distinctions from Agency and Communion," *Journal of Research in Personality* (33:2), pp. 131-158.

Henseler, J., Hubona, G., and Ray, P. 2016. "Using Pls Path Modeling in New Technology Research: Updated Guidelines," *Industrial Management & Data Systems* (116:1), pp. 2-20.

Henseler, J., Ringle, C. M., and Sarstedt, M. 2015. "A New Criterion for Assessing Discriminant Validity in Variance-Based Structural Equation Modeling," *Journal of the Academy of Marketing Science* (43:1), pp. 115-135.

Hess, T., Fuller, M., and Campbell, D. 2009a. "Designing Interfaces with Social Presence: Using Vividness and Extraversion to Create Social Recommendation Agents," *Journal of the Association for Information Systems* (10:12), pp. 889-919.

Hess, T., Matt, C., Benlian, A., and Wiesböck, F. 2016. "Options for Formulating a Digital Transformation Strategy," *MIS Quarterly Executive* (15:2).

Hess, T. J., Fuller, M., and Campbell, D. E. 2009b. "Designing Interfaces with Social Presence: Using Vividness and Extraversion to Create Social Recommendation Agents," *Journal of the Association for Information Systems* (10:12), p. 1.

Heyman, S., and Artman, H. 2015. "Computer Support for Financial Advisors and Their Clients: Co-Creating an Investment Plan," *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*: ACM, pp. 1313-1323.

Hill, C. W. L., and Hoskisson, R. E. 1987. "Strategy and Structure in the Multiproduct Firm," *The Academy of Management Review* (12:2), pp. 331-341.

Hodge, F. D., Mendoza, K. I., and Sinha, R. K. 2018. "The Effect of Humanizing Robo-Advisors on Investor Judgments." Retrieved Mach 20, 2019, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3158004

Hollingshead, A. B., and Fraidin, S. N. 2003. "Gender Stereotypes and Assumptions About Expertise in Transactive Memory," *Journal of Experimental Social Psychology* (39:4), pp. 355-363.

Holzwarth, M., Janiszewski, C., and Neumann, M. M. 2006. "The Influence of Avatars on Online Consumer Shopping Behavior," *Journal of Marketing* (70:4), pp. 19-36.

Horlach, B., Drews, P., and Schirmer, I. 2016. "Bimodal It: Business-It Alignment in the Age of Digital Transformation," *Multikonferenz Wirtschaftsinformatik*, Germany: Volker Nissen, Dirk Stelzer, Steffen Strassburger, Daniel Fischer, pp. 1417-1428.

Horlach, B., Drews, P., Schirmer, I., and Böhmann, T. 2017. "Increasing the Agility of It Delivery: Five Types of Bimodal It Organization," *Hawaii International Conference on System Sciences*, Hawaii, USA.

Horowitz, L. M., Krasnoperova, E. N., Tatar, D. G., Hansen, M. B., Person, E. A., Galvin, K. L., and Nelson, K. L. 2001. "The Way to Console May Depend on the Goal: Experimental Studies of Social Support," *Journal of Experimental Social Psychology* (37:1), pp. 49-61.

Hoßbach, N. 2015. "Dual Business Models: Going Beyond Spatial Separation," in: *Twenty-first American Conference on Information Systems (AMCIS)*. Puerto Rico.

Hu, L. t., and Bentler, P. M. 1999. "Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives," *Structural Equation Modeling: A Multidisciplinary Journal* (6:1), pp. 1-55.

Hughes, M. 2018. "Organizational Ambidexterity and Firm Performance: Burning Research Questions for Marketing Scholars," *Journal of Marketing Management* (34:1), pp. 178-229.

Hutchby, I. 2001. "Technologies, Texts and Affordances," *Sociology* (35:2), pp. 441-456.

Jain, H., Padmanabhan, B., Pavlou, P. A., and Santanam, R. T. 2018. "Call for Papers—Special Issue of Information Systems Research—Humans, Algorithms, and Augmented Intelligence: The Future of Work, Organizations, and Society," *Information Systems Research* (29:1), pp. 250-251.

Janiszewski, C., and Uy, D. 2008. "Precision of the Anchor Influences the Amount of Adjustment," *Association for Psychological Science* (19:2), pp. 121-127.

Jansen, J. J. P., Van Den Bosch, F. A. J., and Volberda, H. W. 2006. "Exploratory Innovation, Exploitative Innovation, and Performance: Effects of Organizational Antecedents and Environmental Moderators," *Management Science* (52:11), pp. 1661-1674.

Jiang, Y., Shang, J., and Liu, Y. 2010. "Maximizing Customer Satisfaction through an Online Recommendation System: A Novel Associative Classification Model," *Decision Support Systems* (48:3), pp. 470-479.

Joehnk, J., Oesterle, S., Winkler, T. J., Norbjerg, J., and Urbach, N. 2019. "Juggling the Paradoxes : Governance Mechanisms in Bimodal It Organizations," in: *27th European Conference on Information Systems (ECIS)*. Sweden.

Joehnk, J., Roeglinger, M., Thimmel, M., and Urbach, N. 2017. "How to Implement Agile It Setups: A Taxonomy of Design Options," in: *European Conference on Information Systems*. Portugal.

Johansen, J. H. 2019. *Paradox Management: Contradictions and Tensions in Complex Organizations*. Cham, Switzerland: Springer International Publishing AG.

Jung, D., Dorner, V., Glaser, F., and Morana, S. 2018. "Robo-Advisory," *Business & Information Systems Engineering* (60:1), pp. 81-86.

Jung, D., Dorner, V., Weinhardt, C., and Pusmaz, H. 2017. "Designing a Robo-Advisor for Risk-Averse, Low-Budget Consumers," *Electronic Markets* (28:3), pp. 367-380.

Kahneman, D., and Tversky, A. 1974. "Judgment under Uncertainty: Heuristics and Biases," *Science* (185:4157), pp. 1124-1131.

Kaltenecker, N., Hess, T., and Huesig, S. 2015. "Managing Potentially Disruptive Innovations in Software Companies: Transforming from on-Premises to the on-Demand," *The Journal of Strategic Information Systems* (24), pp. 234-250.

Karpovsky, A., and Galliers, R. D. 2015. "Aligning in Practice: From Current Cases to a New Agenda," *Journal of Information Technology* (30:2), pp. 136-160.

Keller, J., and Chen, E. W. 2017. "A Road Map of the Paradoxical Mind: Expanding Cognitive Theories on Organizational Paradox," in *The Oxford Handbook of Organizational Paradox,* W.K. SMITH, M.W. LEWIS, P. Jarzabkowski and A. LANGLEY (eds.). United Kingdom: Oxford University Press.

Keutel, M., Michalik, B., and Richter, J. 2014. "Towards Mindful Case Study Research in Is: A Critical Analysis of the Past Ten Years," *European Journal of Information Systems* (23:3), pp. 256-272.

Kilic, M., Heinrich, P., and Schwabe, G. 2015. "Coercing into Completeness in Financial Advisory Service Encounters," *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*: ACM, pp. 1324-1335.

Klein, H., and Myers, M. D. 1999. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems," *MIS Quarterly* (23:1), pp. 67-94.

Koch, A. J., D'Mello, S. D., and Sackett, P. R. 2015a. "A Meta-Analysis of Gender Stereotypes and Bias in Experimental Simulations of Employment Decision Making," *Journal of Applied Psychology* (100:1), p. 128.

Koch, P., Ahlemann, F., and Urbach, N. 2015b. "Die Innovative It-Organisation in Der Digitalen Transformation," in *Managementorientiertes It-Controlling Und It-Governance,* S. Helmke and M. Uebel (eds.). Springer.

Komiak, S. Y. X., and Benbasat, I. 2008. "A Two-Process View of Trust and Distrust Building in Recommendation Agents: A Process-Tracing Study," *Journal of the Association for Information Systems* (Volume 9:Issue 12), pp. 727-747.

Kranz, J. J., Hanelt, A., and Kolbe, L. M. 2016. "Understanding the Influence of Absorptive Capacity and Ambidexterity on the Process of Business Model Change - the Case of on-Premise and Cloud-Computing Software," *Information Systems Journal* (26:5), pp. 477-517.

Kreiner, G. E., Hollensbe, E. C., and Sheep, M. L. 2006. "Where Is the "Me" among the "We"? Identity Work and the Search for Optimal Balance," *Academy of Management Journal* (49:5), pp. 1031-1057.

Krueger, J. I. 2003. "Return of the Ego--Self-Referent Information as a Filter for Social Prediction: Comment on Karniol (2003)," *Psychological Review* (110:3), pp. 585-590.

Kulik, J. A., and Fletcher, J. 2016. "Effectiveness of Intelligent Tutoring Systems: A Meta-Analytic Review," *Review of Educational Research* (86:1), pp. 42-78.

Kumar, N., Stern, L. W., and Anderson, J. C. 1993. "Conducting Interorganizational Research Using Key Informants," *Academy of Management Journal* (36:6), pp. 1633-1651.

Laibson, D. 1997. "Golden Eggs and Hyperbolic Discounting," *The Quarterly Journal of Economics* (112:2), pp. 443-477.

Lankton, N. K., McKnight, D. H., Wright, R. T., and Thatcher, J. B. 2016. "Research Note—Using Expectation Disconfirmation Theory and Polynomial Modeling to Understand Trust in Technology," *Information Systems Research* (27:1), pp. 197-213.

Lee, G., and Xia, W. 2010. "Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data on Software Development Agility," *MIS Quarterly* (34:1), pp. 87-114.

Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., Mädche, A., Urbach, N., and Ahlemann, F. 2017. "Digitalization: Opportunity and Challenge for the Business and Information Systems Engineering Community," *Business & Information Systems Engineering* (59:4), pp. 301-308.

Leonhardt, D., Haffke, I., Kranz, J., and Benlian, A. 2017. "Reinventing the It Function: The Role of It Agility and It Ambidexterity in Supporting Digital Business Transformation," *European Conference on Information Systems*, Portugal.

Lewis, M. W. 2000. "Exploring Paradox: Toward a More Comprehensive Guide," *Academy of Management Review* (25:4), pp. 760-776.

Li, L., Su, F., Zhang, W., and Mao, J.-Y. 2017. "Digital Transformation by Sme Entrepreneurs: A Capability Perspective," *Information Systems Journal* (28), pp. 1129– 1157.

Lieder, F., Griffiths, T. L., QJ, M. H., and Goodman, N. D. 2018. "Empirical Evidence for Resource-Rational Anchoring and Adjustment," *Psychon Bull Rev* (25:2), pp. 775-784.

Lindgren, R., Mathiasen, L., and Schultze, U. 2020. "The Dialectics of Technology Standardization," *MIS Quarterly* (45:3), pp. 1187-1212.

Little, D. 1991. *Varieties of Social Explanation: An Introduction to the Philosophy of Social Science*. Westview Press.

Loibl, C., Jones, L., Haisley, E., and Loewenstein, G. 2016. "Testing Strategies to Increase Saving and Retention in Individual Development Account Programs."

Lu, B., Fan, W., and Zhou, M. 2016. "Social Presence, Trust, and Social Commerce Purchase Intention: An Empirical Research," *Computers in Human Behavior* (56), pp. 225-237.

Lu, Y., and Ramamurthy, K. R. 2011. "Understanding the Link between Information Technology Capability and Organizational Agility: An Empirical Examination," *MIS Quarterly* (35:4), pp. 931-954.

Luescher, L. S., and Lewis, M. W. 2008. "Organizational Change and Managerial Sensemaking: Working through Paradox," *Academy of Management Journal* (51:2), pp. 221-240.

Luger, E., and Sellen, A. 2016. ""Like Having a Really Bad Pa" the Gulf between User Expectation and Experience of Conversational Agents," in: *Conference on human factors in computing systems*. pp. 5286-5297.

Maedche, A., Legner, C., Benlian, A., Berger, B., Gimpel, H., Hess, T., Hinz, O., Morana, S., and Söllner, M. 2019. "Ai-Based Digital Assistants," *Business & Information Systems Engineering* (61:4), pp. 535-544.

Maedche, A., Morana, S., Schacht, S., Werth, D., and Krumeich, J. 2016. "Advanced User Assistance Systems," *Business & Information Systems Engineering* (58:5), pp. 367-370.

Majchrzak, A., Markus, M. L., and Wareham, J. 2016. "Designing for Digital Transformation: Lessons for Information Systems Research from the Study of Ict and Societal Challenges," *MIS Quarterly* (40:2), pp. 267-277.

March, J. G. 1991. "Exploration and Exploitation in Organizational Learning," *Organization Science* (2:1).

Markides, C., and Charitou, C. D. 2004. "Competing with Dual Business Models: A Contingency Approach," *The Academy of Management Executive* (18:3), pp. 22-36.

Markus, M. L., and Rowe, F. 2021. "Guest Editorial: Theories of Digital Transformation: A Progress Report," *Journal of the Association for Information Systems* (22:2), pp. 273-280.

Mason, C. H., and Perreault, W. D. 1991. "Collinearity, Power, and Interpretation of Multiple Regression Analysis," *Journal of Marketing Research* (28:3), pp. 268-280.

Matt, C., Hess, T., and Benlian, A. 2015. "Digital Transformation Strategies," *Business & Information Systems Engineering* (57:5), pp. 339-343.

McBreen, H. M., and Jack, M. A. 2001. "Evaluating Humanoid Synthetic Agents in E-Retail Applications," *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans* (31:5), pp. 394-405.

McIntyre, D. P., and Srinivasan, A. 2017. "Networks, Platforms, and Strategy: Emerging Views and Next Steps," *Strategic Management Journal* (38:1), pp. 141-160.

McKinsey. 2019a. "Digital Transformation: Improving the Odds of Success." 2022, from https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-transformation-improving-the-odds-of-success

McKinsey. 2019b. "The Right Digital-Platform Strategy," in: *McKinsey Quarterly,* T.C. Jacques Bughin, and Miklós Dietz (ed.).

McKnight, D. H., Choudhury, V., and Kacmar, C. 2002. "Developing and Validating Trust Measures for E-Commerce: An Integrative Typology," *Information Systems Research* (13:3), pp. 334-359.

Mero, J. 2018. "The Effects of Two-Way Communication and Chat Service Usage on Consumer Attitudes in the E-Commerce Retailing Sector," *Electronic Markets* (28:2), pp. 205-217.

Miles, M. B., and Huberman, A. M. 1994. *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, California: Sage Publications.

Milgrom, P., and Roberts, J. 1995. "Complementarities and Fit Strategy, Structure, and Organizational Change in Manufacturing," *Journal of Accounting and Economics* (19), pp. 179 -208.

Miron-Spektor, E., Ingram, A., Keller, J., Smith, W. K., and Lewis, M. W. 2018. "Microfoundations of Organizational Paradox: The Problem Is How We Think About the Problem," (61:1), pp. 26-45.

Moewes, T., Puschmann, T., and Alt, R. 2011. "Service-Based Integration of It-Innovations in Customer-Bank-Interaction," *Proceedings der Internationalen Tagung Wirtschaftsinformatik (WI 2011)*).

Montealegre, R., Iyengar, K., and Sweeney, J. 2019. "Understanding Ambidexterity: Managing Contradictory Tensions between Exploration and Exploitation in the Evolution of Digital Infrastructure," *Journal of the Association for Information Systems*), pp. 647-680.

Morgeson, F. M., and Hofmann, D. A. 1999. "The Structure and Function of Collective Constructs: Implications for Multilevel Research and Theory Development," *Academy of Management Review* (24:2), pp. 249-265.

Mueller, L., and Benlian, A. 2023. "Too Drained from Being Agile? The Self-Regulatory Effects of Agile Isd Practices Use and Their Consequences for Turnover

Intention," *Journal of the Association for Information Systems* (23:6), pp. 1420-1455.
Musto, C., Semeraro, G., Lops, P., De Gemmis, M., and Lekkas, G. 2015. "Personalized Finance Advisory through Case-Based Recommender Systems and Diversification Strategies," *Decision Support Systems* (77), pp. 100-111.
Myers, M. D., and Newman, M. 2007. "The Qualitative Interview in Is Research: Examining the Craft," *Information and Organization* (17:1), pp. 2-26.
Nadkarni, S., and Prügl, R. 2020. "Digital Transformation: A Review, Synthesis and Opportunities for Future Research," *Management Review Quarterly* (71), pp. 233–341.
Nass, C., and Moon, Y. 2000. "Machines and Mindlessness: Social Responses to Computers," *Journal of Social Issues* (56:1), pp. 81-103.
Nass, C., Moon, Y., and Carney, P. 1999. "Are People Polite to Computers? Responses to Computer-Based Interviewing Systems 1," *Journal of Applied Social Psychology* (29:5), pp. 1093-1109.
Nass, C., Moon, Y., and Green, N. 1997. "Are Machines Gender Neutral? Gender-Stereotypic Responses to Computers with Voices," *Journal of Applied Social Psychology* (27:10), pp. 864-876.
Nass, C., Steuer, J., and Tauber, E. R. 1994. "Computers Are Social Actors," *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Boston, Massachusetts, USA, pp. 72-78
Netemeyer, R. G., Warmath, D., Fernandes, D., Lynch, J. G., Fischer, E., and Toubia, O. 2018. "How Am I Doing? Perceived Financial Well-Being, Its Potential Antecedents, and Its Relation to Overall Well-Being," *Journal of Consumer Research* (45:1), pp. 68-89.
Newell, S., and Marabelli, M. 2015. "Strategic Opportunities (and Challenges) of Algorithmic Decision-Making: A Call for Action on the Long-Term Societal Effects of 'Datification'," *The Journal of Strategic Information Systems* (24:1), pp. 3-14.
Ngai, E. W. T., Chau, D. C. K., and Chan, T. L. A. 2011. "Information Technology, Operational, and Management Competencies for Supply Chain Agility: Findings from Case Studies," *The Journal of Strategic Information Systems* (20:3), pp. 232-249.
Northcraft, G. B., and Neale, M. A. 1987. "Experts, Amateurs, and Real Estate: An Anchoring-Andadjustment Perspective on Property Pricing Decisions," *Organizational Behavior And Human Decision Processes* (39), pp. 84-97.
Nueesch, R., Puschmann, T., and Alt, R. 2014. "Realizing Value from Tablet-Supported Customer Advisory: Cases from the Banking Industry," *Bled eConference*, p. 34.
Nunamaker, J. F., Derrick, D. C., Elkins, A. C., Burgoon, J. K., and Patton, M. W. 2011. "Embodied Conversational Agent-Based Kiosk for Automated Interviewing," *Journal of Management Information Systems* (28:1), pp. 17-48.
Nunnally, J. C., and Bernstein, I. H. 1994. "The Assessment of Reliability," *Psychometric Theory* (3), pp. 248-292.
O'Reilly, C. I., and Tushman, M. 2013. "Organizational Ambidexterity: Past, Present and Future," *Academy of Management Perspectives* (27:4), pp. 324-338.
Osterwalder, A., and Pigneur, Y. 2010. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley & Sons.

Osterwalder, A., and Pigneur, Y. 2013. "Designing Business Models and Similar Strategic Objects: The Contribution of Is," *Journal of the Association for Information Systems* (14:Special Issue), pp. 237-244.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., and Hoagwood, K. 2015. "Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research," *Adm Policy Ment Health* (42:5), pp. 533-544.

Peppard, J. 2016. "Rethinking the Concept of the Is Organization," *Information Systems Journal* (28:1), pp. 76-103.

Peppard, J., Galliers, R. D., and Thorogood, A. 2014. "Information Systems Strategy as Practice: Micro Strategy and Strategizing for Is," *The Journal of Strategic Information Systems* (23:1), pp. 1-10.

Peters, P. 2013. *The Cambridge Dictionary of English Grammar*. Cambridge: Cambridge University Press.

Pfeuffer, N., Benlian, A., Gimpel, H., and Hinz, O. 2019. "Anthropomorphic Information Systems," *Business & Information Systems Engineering* (61:4), pp. 523-533.

Phoon, K., and Koh, F. 2017. "Robo-Advisors and Wealth Management," *The Journal of Alternative Investments* (20:3), pp. 79-94.

Pickard, M. D., Burgoon, J. K., and Derrick, D. C. 2014. "Toward an Objective Linguistic-Based Measure of Perceived Embodied Conversational Agent Power and Likeability," *International Journal of Human-Computer Interaction* (30:6), pp. 495-516.

Porter, M. E. 1980. *Competitive Strategy*. New York: The Free Press.

Porter, M. E., and Heppelmann, J. E. 2015. "How Smart, Connected Products Are Transforming Companies," in: *Harvard Business Review*.

Powers, A., Kiesler, S., and Goetz, J. 2003. "Matching Robot Appearance and Behavior to Tasks to Improve Human-Robot Cooperation," *Proceedings of the 12th IEEE International Workshop on Robot and Human Interactive Communication.*, Millbrae, CA, USA.

Putnam, L. L., Fairhurst, G. T., and Banghart, S. 2016. "Contradictions, Dialectics, and Paradoxes in Organizations: A Constitutive Approach†," *The Academy of Management Annals* (10:1), pp. 65-171.

Qiu, L., and Benbasat, I. 2009. "Evaluating Anthropomorphic Product Recommendation Agents: A Social Relationship Perspective to Designing Information Systems," *Journal of Management Information Systems* (25:4), pp. 145-182.

Qiu, L., and Benbasat, I. 2010. "A Study of Demographic Embodiments of Product Recommendation Agents in Electronic Commerce," *International Journal of Human-Computer Studies* (68:10), pp. 669-688.

Raab, M., Friedrich, T., Schlauderer, S., and Overhage, S. 2017. "Understanding the Role of Social Presence in Crowdfunding: Evidence from Leading U.S. And German Platforms," *25th European Conference on Information Systems*, Portugal, pp. 1758-1774.

Raabe, J.-P., Horlach, B., Schirmer, I., and Drews, P. 2020. "Digital Innovation Units: Exploring Types, Linking Mechanisms and Evolution Strategies in Bimodal It Setups," in: *Wirtschaftsinformatik 2020*. Germany: pp. 844-858.

Radszuwill, S., and Fridgen, G. 2017. "Forging a Double-Edged Sword: Resource Synergies and Dependencies in Complex It Project Portfolios," in: *Thirty Eighth International Conference on Information Systems (ICIS)*. South Korea.

Raisch, S., and Birkinshaw, J. 2008. "Organizational Ambidexterity: Antecedents, Outcomes, and Moderators," *Journal of Management* (34:3), pp. 375-409.
Ramesh, B., Cao, L., and Baskerville, R. 2007. "Agile Requirements Engineering Practices and Challenges: An Empirical Study," *Information Systems Journal* (20:5), pp. 449-480.
Remane, G., Hanelt, A., Nickerson, R. C., and Kolbe, L. M. 2017a. "Discovering Digital Business Models in Traditional Industries," *Journal of Business Strategy* (38:2), pp. 41-51.
Remane, G., Hanelt, A., Wiesböck, F., and Kolbe, L. M. 2017b. "Digital Maturity in Traditional Industries - an Exploratory Analysis," in: *European Conference on Information Systems*. Portugal.
Remfert, C., and Stockhinger, J. 2018. "Evaluating the Two-Speed It Concept for Digitalization," *International Conference on HCI in Business, Government, and Organisations,* B.S.X. Fiona Fui-Hoon Nah (ed.), Las Vegas, USA, pp. 162-174.
Ridder, H.-G. 2017. "The Theory Contribution of Case Study Research Designs," *Business Research* (10:2), pp. 281-305.
Robey, D., Anderson, C., and Raymond, B. 2013. "Information Technology, Materiality, and Organizational Change: A Professional Odyssey," *Journal of the Association for Information Systems* (14:7), pp. 379-398.
Robins, J., and Wiersema, M. F. 1995. "A Resource-Based Approach to the Multibusiness Firm: Empirical Analysis of Portfolio Interrelationships and Corporate Financial Performance," *Strategic Management Journal* (16:4), pp. 277-299.
Rogan, M., and Mors, M. L. 2014. "A Network Perspective on Individual-Level Ambidexterity in Organizations," *Organization Science* (25:6), pp. 1860-1877.
Rooderkerk, R. P., Van Heerde, H. J., and Bijmolt, T. H. 2011. "Incorporating Context Effects into a Choice Model," *Journal of Marketing Research* (48:4), pp. 767-780.
Ross, J. W. 2017. "How to Develop a Great Digital Strategy," *MIT Sloan Management Review* (58:2), pp. 7-9.
Ross, J. W., Sebastian, I. M., Beath, C., Mocker, M., Moloney, K. G., and Fonstad, N. O. 2016. "Designing and Executing Digital Strategies," *Thirty Seventh International Conference on Information Systems*, Dublin.
Ross, L., Greene, D., and House, P. 1977. "The “False Consensus Effect”: An Egocentric Bias in Social Perception and Attribution Processes," *Journal of Experimental Social Psychology* (13:3), pp. 279-301.
Rousseau, D. M. 1985. "Issues of Level in Organizational Research: Multi-Level and Cross-Level Perspectives," *Research in Organizational Behaviour* (7), pp. 1-37.
Sarker, S., Chatterjee, S., Xiao, X., and Elbanna, A. 2019. "Research Commentary: The Sociotechnical "Axis of Cohesion" for the Is Discipline: Its Historical Legacy and Its Continued Relevance," *MIS Quarterly* (43:3), pp. 695-720.
Sarker, S., Xiao, X., and Beaulieu, T. 2013. "Qualitative Studies in Information Systems: A Critical Review and Some Guiding Principles," *MIS Quarterly* (37:4), pp. 3-18.
Sarker, S., Xiao, X., Beaulieu, T., and Lee, A. S. 2018a. "Learning from First-Generation Qualitative Approaches in the Is Discipline: An Evolutionary View and Some Implications for Authors and Evaluators (Part 1/2)," *Journal of the Association for Information Systems* (19), pp. 752-774.
Sarker, S., Xiao, X., Beaulieu, T., and Lee, A. S. 2018b. "Learning from First-Generation Qualitative Approaches in the Is Discipline: An Evolutionary View and Some

Implications for Authors and Evaluators (Part 2/2)," *Journal of the Association for Information Systems* (19), pp. 909-923.
Sarstedt, M., Ringle, C. M., Smith, D., Reams, R., and Hair, J. F. 2014. "Partial Least Squares Structural Equation Modeling (Pls-Sem): A Useful Tool for Family Business Researchers," *Journal of Family Business Strategy* (5:1), pp. 105-115.
Saunders, C., Benlian, A., Henfridsson, O., and Wiener, M. 2020. "Is Control and Governance," in: *MIS Quarterly Research Curations,* B. A and A. Rai (eds.).
Sava, J. A. 2022. "Spending on Digital Transformation Technologies and Services Worldwide from 2017 to 2025." Retrieved June 8th 2022, from https://www.statista.com/statistics/870924/worldwide-digital-transformation-market-size/
Schaarschmidt, M., Walsh, G., and Evanschitzky, H. 2018. "Customer Interaction and Innovation in Hybrid Offerings: Investigating Moderation and Mediation Effects for Goods and Services Innovation," *Journal of Service Research* (21:1), pp. 119-134.
Schad, J., Lewis, M. W., Raisch, S., and Smith, W. K. 2016. "Paradox Research in Management Science: Looking Back to Move Forward," *The Academy of Management Annals* (10:1), pp. 5-64.
Schreieck, M., Wiesche, M., and Krcmar, H. 2016. "Design and Governance of Platform Ecosystems - Key Concepts and Issues for Future Research," in: *Twenty-Fourth European Conference on Information Systems (ECIS)*. İstanbul, Turkey.
Schwaber, K., and Sutherland, J. 2011. *The Scrum Guide*.
Sebastian, I. M., Mocker, M., Ross, J. W., Moloney, K. G., Beath, C., and Fonstad, N. O. 2017. "How Big Old Companies Navigate Digital Transformation," *MIS Quarterly Executive* (16:3), pp. 197-213.
Senecal, S., and Nantel, J. 2004. "The Influence of Online Product Recommendations on Consumers' Online Choices," *Journal of Retailing* (80:2), pp. 159-169.
Seymour, M., Riemer, K., and Kay, J. 2018. "Actors, Avatars and Agents: Potentials and Implications of Natural Face Technology for the Creation of Realistic Visual Presence," *Journal of the Association for Information Systems* (19:10).
Short, J., Williams, E., and Christie, B. 1976. *The Social Psychology of Telecommunications*.
Sia, S. K., Soh, C., and Weill, P. 2016. "How Dbs Bank Pursued a Digital Business Strategy," *MIS Quarterly Executive* (15:2).
Singh, J., Sharma, G., Hill, J., and Schnackenberg, A. 2013. "Organizational Agility: What It Is, What It Is Not, and Why It Matters," in: *Academy of Management Annual Meeting*
Sironi, P. 2016. *Fintech Innovation: From Robo-Advisors to Goal Based Investing and Gamification*. John Wiley & Sons.
Skinner, J. 2007. "Are You Sure You're Saving Enough for Retirement?," *Journal of Economic Perspectives* (21:3), pp. 59-80.
Smith, W. K. 2014. "Dynamic Decision Making: A Model of Senior Leaders Managing Strategic Paradoxes," *Academy of Management Journal* (57:6), pp. 1592-1623.
Smith, W. K., Binns, A., and Tushman, M. L. 2010. "Complex Business Models: Managing Strategic Paradoxes Simultaneously," *Long Range Planning* (43:2-3), pp. 448-461.
Smith, W. K., and Lewis, M. W. 2011. "Toward a Theory of Paradox: A Dynamic Equilibrium Model of Organizing," *Academy of Management Review* (36:2), pp. 381-403.

Sniezek, J. A., and Buckley, T. 1995. "Cueing and Cognitive Conflict in Judge-Advisor Decision Making," *ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES* (62:2), pp. 159-174.

Sniezek, J. A., and Van Swol, L. M. 2001. "Trust, Confidence, and Expertise in a Judge-Advisor System," *ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES* (84:2), pp. 288-307.

Soh, C., Yeow, A., Goh, Q., and Hansen, R. 2019. "Digital Transformation: Of Paradoxical Tensions and Managerial Responses," in: *Fortieth International Conference on Information Systems*. Munich, Germany.

Srinivasan, K., Nguyen, C., and Praveen Tanguturi, P. D. 2018. "Chatbots Are Here to Stay," Accenture.

Stake, R. E. 2005. "Qualitative Case Studies," in *The Sage Handbook of Qualitative Research, 3rd Ed.* Thousand Oaks, CA: Sage Publications Ltd, pp. 443-466.

Steelman, Z. R., Hammer, B. I., and Limayem, M. J. M. Q. 2014. "Data Collection in the Digital Age," *MIS Quarterly* (38:2), pp. 355-378.

Steininger, D. M., Hoelz, J., and Veit, D. 2012. "Comparing Traditional and Electronic Business Models of the Music Industry: A Content Analytical Approach," in: *Proceedings of the ConLife Academic Conference*.

Svahn, F., Mathiassen, L., and Lindgren, R. 2017. "Embracing Digital Innovation in Incumbent Firms: How Volvo Cars Managed Competing Concerns," *MIS Quarterly* (41:1), pp. 239-253.

Tallon, P. P., and Pinsonneault, A. 2011. "Competing Perspectives on the Link between Strategic Information Technology Alignment and Organizational Agility: Insights from a Mediation Model " *MIS Quarterly* (35:2), pp. 463-486.

Tanriverdi, H. 2006. "Performance Effects of Information Technology Synergies in Multibusiness Firms," *MIS Quarterly* (30:1), pp. 57-77.

Tanriverdi, H. s., and Venkatraman, N. 2005. "Knowledge Relatedness and the Performance of Multibusiness Firms," *Strategic Management Journal* (26:2), pp. 97-119.

Tay, B., Jung, Y., and Park, T. 2014. "When Stereotypes Meet Robots: The Double-Edge Sword of Robot Gender and Personality in Human–Robot Interaction," *Computers in Human Behavior* (38), pp. 75-84.

Teo, T. S. H., Srivastava, S. C., and Jiang, L. 2008. "Trust and Electronic Government Success: An Empirical Study," *Journal of Management Information Systems* (25:3), pp. 99-132.

Tertilt, M., and Scholz, P. 2017. "To Advise, or Not to Advise – How Robo-Advisors Evaluate the Risk Preferences of Private Investors." Retrieved March 20, 2019, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2913178

Teubner, R. A., and Ehnes, D. 2018. "The Corporate It/Is Function: Competences and Organization for a (Digital) Future," in: *Multikonferenz Wirtschaftsinformatik*. Germany.

Thaler, R. H., and Sunstein, C. R. 2008. *Nudge*. Yale University Press.

Thordsen, T., and Bick, M. 2020. "Towards a Holistic Digital Maturity Model," in: *Forty-First International Conference on Information Systems (ICIS)*. A virtual AIS conference.

Thorén, C., Ågerfalk, P. J., and Rolandsson, B. 2018. "Voicing the Puppet: Accommodating Unresolved Institutional Tensions in Digital Open Practices," (39:7), pp. 923-945.

Tiwana, A. 2014. *Platform Ecosystems Aligning Architecture, Governance, and Strategy*. Waltham, MA: Elsevier.

Tourangeau, R., Couper, M. P., and Steiger, D. M. 2003. "Humanizing Self-Administered Surveys: Experiments on Social Presence in Web and Ivr Surveys," *Computers in Human Behavior* (19:1), pp. 1-24.

Toutaoui, J. 2019. "When 1+1 Is Greater Than 2: Concurrence of Additional Digital and Established Business Models within Companies," in: *14th International Conference on Wirtschaftsinformatik*. Siegen, Germany: pp. 1803-1808.

Trauth, E. M. 2013. "Editorial," *Information Systems Journal* (23:1), pp. 1-3.

Tushman, M., Smith, W. K., Wood, R. C., Westerman, G., and O'Reilly, C. 2010. "Organizational Designs and Innovation Streams," *Industrial and Corporate Change* (19:5), pp. 1331-1366.

Twyman, M., Harvey, N., and Harries, C. 2008. "Trust in Motives, Trust in Competence: Separate Factors Determining the Effectiveness of Risk Communication," *Judgment and Decision Making* (3:1), p. 111.

Überbacher, F. 2014. "Legitimation of New Ventures: A Review and Research Programme," *Journal of Management Studies* (51:4), pp. 667-698.

Urbach, N., Ahlemann, F., Böhmann, T., Drews, P., Brenner, W., Schaudel, F., and Schütte, R. 2018. "The Impact of Digitalization on the It Department," *Business & Information Systems Engineering* (60:6), pp. 1-9.

Urbach, N., Drews, P., and Ross, J. W. 2017. "Digital Business Transformation and the Changing Role of the It Function," *MIS Quarterly Executive* (16:2), pp. 2-4.

Urbach, N., and Röglinger, M. 2018. "Introduction to Digitalization Cases: How Organizations Rethink Their Business for the Digital Age," in *Digitalization Cases - How Organizations Rethink Their Business for the Digital Age*. Cham: Springer International Publishing, pp. 1-12.

Van Kleef, G. A., De Dreu, C. K., and Manstead, A. S. 2010. "An Interpersonal Approach to Emotion in Social Decision Making: The Emotions as Social Information Model," in *Advances in Experimental Social Psychology*. Elsevier, pp. 45-96.

Van Swol, L. M., and Sniezek, J. A. 2005. "Factors Affecting the Acceptance of Expert Advice," *British Journal of Social Psychology* (44:3), pp. 443-461.

Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T., Kundisch, D., Leimeister, J. M., Loos, P., and Spann, M. 2014. "Business Models," *Business & Information Systems Engineering* (6:1), pp. 45-53.

Vial, G. 2019. "Understanding Digital Transformation: A Review and a Research Agenda," *The Journal of Strategic Information Systems* (28:2), pp. 118-144.

Vithayathil, J. 2018. "Will Cloud Computing Make the Information Technology (It) Department Obsolete?," *Information Systems Journal* (28:4), pp. 634-649.

Volkoff, O., and Strong, D. M. 2013. "Critical Realism and Affordances: Theorizing It-Associated Organizational Change Processes," *MIS Quarterly* (37:3), pp. 819-834.

Vom Brocke, J., Simons, A., Riemer, K., Niehaves, B., Plattfaut, R., and Cleven, A. 2015. "Standing on the Shoulders of Giants: Challenges and Recommendations of Literature Search in Information Systems Research," *Communications of the Association for Information Systems* (37:1), pp. 205-224.

Walsham, G. 1995. "Interpretive Case Studies in Is Research: Nature and Method," *European Journal of Information Systems* (4:2), pp. 74-81.

Wang, C., and Zhang, P. 2012. "The Evolution of Social Commerce: The People, Management, Technology, and Information Dimensions," *Communications of the ACM* (31:1), p. 5.
Wang, H., Wang, J., and Tang, Q. 2018. "A Review of Application of Affordance Theory in Information Systems," *Journal of Service Science and Management* (11:01), p. 56.
Wang, W. 2017. "Smartphones as Social Actors? Social Dispositional Factors in Assessing Anthropomorphism," *Computers in Human Behavior* (68), pp. 334-344.
Wang, X., and Du, X. 2018. "Why Does Advice Discounting Occur? The Combined Roles of Confidence and Trust," *Frontiers in Psychology* (9), p. 2381.
Wansink, B., Kent, R. J., and Hoch, S. H. 1998. "An Anchoring and Adjustment Model of Purchase Quantity Decisions," *Journal of Marketing Research* (35), pp. 71-81.
Webb, B., and Mallon, B. 2007. "A Method to Bridge the Gap between Breadth and Depth in Is Narrative Analysis," *Journal of the Association for Information Systems* (8:7), pp. 368-381.
Weinmann, M., Schneider, C., and vom Brocke, J. 2016. "Digital Nudging," *Business & Information Systems Engineering* (58:6), pp. 433-436.
Weizenbaum, J. 1966. "Eliza—a Computer Program for the Study of Natural Language Communication between Man and Machine," *Communications of the ACM* (9:1), pp. 36-45.
Wendt, C., Adam, M., Benlian, A., and Kraus, S. 2022. "Let's Connect to Keep the Distance: How Smes Leverage Information and Communication Technologies to Address the Covid-19 Crisis," *Information Systems Frontiers* (24:4), pp. 1061-1079.
Wessel, L., Baiyere, A., Ologeanu-Taddei, R., and Cha, J. 2020. "Unpacking the Difference between Digital Transformation and It-Enabled Organizational Transformation," *Journal of the Association for Information Systems* (published online).
Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., and Blegind Jensen, T. 2021. "Unpacking the Difference between Digital Transformation and It-Enabled Organizational Transformation," *Journal of the Association for Information Systems* (22:1), pp. 102-129.
Wiener, M., Cram, W., and Benlian, A. 2021. "Algorithmic Control and Gig Workers: A Legitimacy Perspective of Uber Drivers," *European Journal of Information Systems* (published online), pp. 1-23.
Wiener, M., Hoßbach, N., and Saunders, C. 2018. "Omnichannel Businesses in the Publishing and Retailing Industries: Synergies and Tensions between Coexisting Online and Offline Business Models," *Decision Support Systems* (109), pp. 15-26.
Wimelius, H., Mathiassen, L., Holmström, J., and Keil, M. 2020. "A Paradoxical Perspective on Technology Renewal in Digital Transformation," *Information Systems Journal* (31:1), pp. 1-28.
Wirtz, B. W., Pistoia, A., Ullrich, S., and Göttel, V. 2016. "Business Models: Origin, Development and Future Research Perspectives," *Long Range Planning* (49:1), pp. 36-54.
Wojciszke, B. 1997. "Parallels between Competence-Versus Morality-Related Traits and Individualistic Versus Collectivistic Values," *European Journal of Social Psychology* (27:3), pp. 245-256.

Wuenderlich, N. V., and Paluch, S. 2017. "A Nice and Friendly Chat with a Bot: User Perceptions of Ai-Based Service Agents," in: *Thirty Eigth International Conference on Information Systems*. Seoul, South korea.

Yaniv, I. 2004. "Receiving Other People's Advice: Influence and Benefit," *ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES* (93:1), pp. 1-13.

Yaniv, I., and Choshen-Hillel, S. 2012. "Exploiting the Wisdom of Others to Make Better Decisions: Suspending Judgment Reduces Egocentrism and Increases Accuracy," *Journal of Behavioral Decision Making* (25:5), pp. 427-434.

Yaniv, I., and Kleinberger, E. 2000. "Advice Taking in Decision Making: Egocentric Discounting and Reputation Formation," *ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES* (83:2), pp. 260-281.

Yeow, A., Soh, C., and Hansen, R. 2018. "Aligning with New Digital Strategy: A Dynamic Capabilities Approach," *The Journal of Strategic Information Systems* (27:1), pp. 43-58.

Yin, R. K. 2003. *Case Study Research: Design and Methods*. Thousand Oaks: Sage Publications.

Zaichkowsky, J. L. 1985. "Measuring the Involvement Construct," *Journal of Consumer Research* (12:3), pp. 341-352.

Zemore, S. E., Fiske, S. T., and Kim, H.-J. 2000. "Gender Stereotypes and the Dynamics of Social Interaction," in *The Developmental Social Psychology of Gender,* T.E.a.H.M. Trautner (ed.). Mahwah, USA: Lawrence Erlbaum Associates, pp. 221-256.

Zhang, K. Z. K., and Benyoucef, M. 2016. "Consumer Behavior in Social Commerce: A Literature Review," *Decision Support Systems* (86), pp. 95-108.

Zheng, Y., Venters, W., and Cornford, T. 2011. "Collective Agility, Paradox and Organizational Improvisation: The Development of a Particle Physics Grid," *Information Systems Journal* (21:4), pp. 303-333.

Zott, C., Amit, R., and Massa, L. 2011. "The Business Model: Recent Developments and Future Research," *Journal of Management* (37:4), pp. 1019-1042.

7 Appendix

Table A.1

Literature review on bi-modal IT. We followed the recommendations of Vom Brocke et al. (2015) for a sequential review of IS research on bi-modal IT and searched for "bi-modal" OR "bimodal" OR "two-speed" in keywords (or abstracts when possible) within the Senior Scholars' Basket of Journals[5]. As this revealed not a single fitting publication, we searched in the proceedings of major IS conferences (ECIS, ICIS, HICSS) and found four articles (Haffke et al. 2017b; Horlach et al. 2017; Joehnk et al. 2019; Joehnk et al. 2017). Backward and forward searches on these articles revealed more completed and peer-reviewed studies focusing on bi-modal IT, all summarized below.

Reference	Research question(s)	Study design/ methodology	Important findings and contributions (in light of this study)	Focus on interactions between IT modes
Badr (2018)	What practices would empower IT organizations in IT services companies in order to successfully integrate innovation?	Two case studies with semi-structured interviews and brainstorming sessions	General mechanisms and practices to balance exploration and exploitation capabilities for an ambidextrous IT organization	No
Bygstad and Iden (2017)	Which models are available for reasonable governance of lightweight IT?	Four cases with more than 100 interviews	Governance models to manage lightweight and heavyweight IT, bi-modal IT, in general, is one of these governance models	No
Fortmann et al. (2019)	How are sales channels managed in a bi-modal IT?	Single case study and semi-structured interviews	IT was re-organized twice: first split into bi-modal IT then re-integrated into one large agile IT – both organizational forms created conflicts	No
Haffke et al. (2017a)	Reasons to engage in a bi-modal IT transformation	19 cases studies semi-structured interviews	Guidelines for practitioners on bi-modal IT and observation of tensions, e.g., resource management and cultural divide	No

[5] See https://aisnet.org/page/SeniorScholarBasket for the full list of journals

Haffke et al. (2017b)	What are the drivers and manifestations of bi-modal IT?	19 case studies with semi-structured interviews	Three different archetypes exist of bi-modal IT leading ultimately to a re-integrated IT	No
Horlach et al. (2016)	How is business-IT alignment affected by a bimodal IT organization?	Review of practitioners' documentation and one scientific article	Overview of bi-modal IT governance modes, processes, and skills and observation that it has an impact on bi-modal IT alignment and bi-modal business-IT alignment	No
Horlach et al. (2017)	How is bimodal IT realized in practice? How is business-IT alignment affected by bimodal IT, and what approaches do companies use to enable alignment within IT and in relation to business in the bimodal IT environment?	Nine semi-structured interviews	Five different archetypes of bi-modal IT mainly based on IT outsourcing state	No
Joehnk et al. (2017)	What are the design options for agile IT setups?	Taxonomy development process with seven semi-structured expert interviews	Seven characteristics practitioners have to decide on to set-up and agile IT unit (scope, institutionalization, accountability, governance, location, staffing, technical integration)	No
Joehnk et al. (2019)	Which structural, procedural, and relational governance mechanisms are employed in bimodal IT organizations, and how do these mechanisms relate to challenges associated with organizational ambidexterity?	Two case studies with semi-structured interviews	Governance tensions in bi-modal IT and general mechanisms to approach the tensions, concluding with five paradoxes in bi-modal IT	Yes, focusing exclusively on organizational-level tensions
Remfert and Stockhinger (2018)	How do IT managers understand and evaluate the two-speed IT concept?	Eight semi-structured interviews across eight companies	All case companies used one of the bi-modal IT archetypes of Haffke et al. (2017a), even if not under the specific term. Bi-modal IT has the danger to create a "two-class IT"	No

Appendix

Table A.2

Literature review on paradox lens in IS. We performed a sequential literature review in the Senior Scholars' Basket of Journals[2], following the recommendations of Vom Brocke et al. (2015) searching for "paradox* theory" OR "paradox* lens" in the full text. After reading through, we discarded papers that mentioned paradox theory in passing without employing it in their studies. We arrived at nine papers of which only two focus on the IT function. Therefore, we extended our literature review and searched in the proceedings of major IS conferences (ECIS, ICIS, HICSS) which revealed another two completed studies focused on the IT function and employing a paradox lens.

Reference	Study context	Associated theory or research stream	Level of analysis	Findings of emotional tensions
Dubé and Robey (2009)	Empirical qualitative (exploratory) study based on 42 interviews uncovering five paradoxes in virtual teams and strategies to "survive" them	Virtual Teamwork	Team	Yes
Zheng et al. (2011)	Empirical qualitative study on six improvisation paradoxes that build collective agility	Agility, Organizational Improvisation	Multi-level	Yes
Aubert et al. (2015)	Conceptual paper exploring the cognitive tensions, then paradoxes, approaches, and virtuous cycles in the innovation-outsourcing relationship	IS Outsourcing and Innovation	Intra-organization	No
Gregory et al. (2015)	Empirical multi-year qualitative study at one bank using grounded theory to show resolution strategies for ambidexterity paradoxes in six areas in large IT programs (e.g., IT program planning, IT architecture change)	IT Ambidexterity	Organization	No
(Ciriello et al. 2018)	Empirical qualitative multi-year field study at one firm identifying three paradoxes of PowerPoint use in innovation practices	Digital Innovation	Multi-level	No
Yeow et al. (2018)	Empirical qualitative study on the aligning process and emerging tensions in this process	IT-business alignment, Dynamic capabilities	Organization	No
Joehnk et al. (2019)	Empirical qualitative study at two organizations identifying transformational and operational governance tensions in bi-modal IT and general mechanisms to approach the tensions,	Governance mechanisms, IT Ambidexterity	Organization	No

	concluding with five paradoxes in bi-modal IT			
Montealegre et al. (2019)	Empirical qualitative in-depth case study theorizing a digital infrastructure ambidexterity model that includes higher-order organizational capabilities (i.e., structure and leadership)	Digital Infrastructure, IT Ambidexterity	Multi-level	No
Soh et al. (2019)	Empirical qualitative study uncovering paradoxes in the digital transformation, sequences of paradoxes, and combined defensive and receptive responses based on one case study	Digital transformation	Organization	Yes
(Lindgren et al. 2020)	Empirical qualitative action research study of a twelve-year Swedish IT initiative in road haulage firms	Technology standardization	Multi-level	No
(Wimelius et al. 2020)	Empirical qualitative longitudinal case study of a 9-year-long digital platform renewal at a Swedish health service provider showing virtuous and vicious cycles in the responses to three paradoxes	Technology renewal	Organization	No

Table A.3

Case research principles by Klein and Myers (1999) applied to this study

Case research principle	How it was applied in this study
The Fundamental Principle of the Hermeneutic Circle: This principle suggests that all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all the other principles.	After each interview dyad, we reflected based on the coding of the cases on the tensions we had identified and used them to tune our interview guideline further and ask the next interview partners for the same or similar experiences. During our data analysis, we constantly iterated our coding based on novel published studies on digital transformation; therefore, following the principle of the hermeneutic circle.
The Principle of Contextualization: Requires critical reflection of the social and historical background of the research setting, so that the intended audience can see how the current situation under investigation emerged.	We followed the principle of contextualization by collecting various public and non-public documentation besides our interview transcripts and by starting each interview in a narrative way, asking our interview partners the context that led to their current bi-modal IT.
The Principle of Interaction Between the Researchers and the Subjects: Requires critical reflection on how the research materials (or "data") were socially constructed through the interaction between the researchers and participants.	By interviewing two strategic employees from the two different IT modes, we were able to collect data from complementary and often very different perspectives. Thus, the critical reflection on the data was facilitated.
The Principle of Abstraction and Generalization: Requires relating the idiographic details revealed by the data interpretation through the application of Principles 1 and 2 to theoretical, general concepts that describe the nature of human understanding and social action.	Based on our iterative data analysis and also relying on existing studies, we could link our findings to existing theoretical background (from ambidexterity and paradox theory).
The Principle of Dialogical Reasoning: Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings ("the story which the data tell") with subsequent cycles of revision.	Our findings (e.g., Table 2) have continually evolved via numerous cycles based on the involvement of different researchers critically reviewing the manuscript. Simultaneously these researchers were less biased by existing theory (e.g., paradox theory) of which they were not fully knowledgeable.
The Principle of Multiple Interpretations: Requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the same sequence of events under study. Similar to multiple witness accounts even if all tell it as they saw it	We interviewed different stakeholders across different hierarchy levels of both IT modes with varying degrees of involvement in the build-up and operations of the second IT mode.
The Principle of Suspicion: Requires sensitivity to possible "biases" and systematic "distortions" in the narratives collected from the participants.	Based on the different perspectives of the employees of each IT mode on the other IT mode, we gathered narratives with often opposing biases that then clearly surface and exclude each other. Also, by comparing the narratives with archival data, we crosschecked our interpretations.

A.4
Details on the cases

Case 1: High-tech company with ~6bn EUR revenue and 10,000-50,000 employees

Based on a company-wide digital transformation strategy of smartly enriching the core business (Hess et al. 2016), a new centralized agile IT unit was created in 2016 in a new location, directly reporting to the CEO, acting as supporter to business units in their digital transformation. Case 1 thereby follows divisionally separated bi-modal IT. As of today, nearly 100 experts in digital product development (e.g., UI/UX designer, scrum master, front-end developer, data scientists) develop digital products for end customers together with the business units (e.g., a digital platform for imagery analyses). Business units have to nominate a full-time product owner and sponsor the project. A newly developed product will eventually, once it reaches a particular maturity, be handed over to the traditional centralized IT. This centralized IT primarily manages the corporate application landscape and develops internally used software products with several hundreds of employees.

Case 2: Pharmaceutical company with ~20bn EUR revenue and more than 50,000 employees

The centralized IT is deeply involved in day-to-day business activities as it manages regulated activities such as drug safety or global reporting to agencies but also develops and manages software used by physicians. Bi-modal IT efforts started in 2016, and in 2017 an agile unit was established with today more than 50 co-workers. Case 2 presents a sub-divisional bi-modal IT as the new agile IT unit reports to the CIO. Its goal was first to develop innovative digital products with the business units and thereby support them in their digital transformation. So far, digital products are handed over to traditional IT and the business side once a minimum viable product (MVP) is developed and tested. Now, the agile IT unit is transforming into an incubator and company-builder function and has established a second location thereby moving from a supporter to an enabler role and developing new digital business models for the business units on its own initiative, following the overall digital transformation strategy of the company.

Case 3: Retail company with ~6bn EUR revenue and less than 10,000 employees

The centralized IT was mainly responsible for supporting internal processes (e.g., logistics). A new agile IT unit was built up around 2012 to develop a webshop. In 2015 the unit had around

50 co-workers already, and responsibilities started to shift as the traditional IT took over responsibility for the continuous technical development of the webshop, whereas the agile IT unit maintains its responsibility for customer analytics, online marketing, assortment. As such, the company started with a divisionally separated bi-modal IT, where both modes acted self-sufficiently and reported to CIO and Chief Customer Officer (CCO), respectively. To increase customer experience and customer engagement, the company's strategy envisioned more omni-channel capabilities and moved towards a reintegrated bi-modal IT.

Case 4: Mobility company with ~0.8bn EUR revenue and less than 10,000 employees

A second, agile IT department was created more than a decade ago to support the digital sales channels of transportation tickets. This department could then respond to the constantly changing requirements in online channels. The traditional IT would focus on supporting back-end systems of traditional offline channels (e.g., sales agents). From an organizational perspective, the company had chosen a divisionally separated bi-modal IT with both modes reporting to CIO and Chief Digital Officer (CDO) respectively. However, due to interdependencies, both modes were involved in most IT projects, and activities of the agile IT mode were handled as a subproject of an overall project. Both IT modes started to re-integrate from 2015 into one larger IT department reporting to one executive to enable omnichannel capabilities (e.g., customer journey through different channels) following an updated customer engagement strategy (Sebastian et al. 2017). At this point, the agile IT mode had about 200 employees, while the traditional IT had over 1,000 employees.

Case 5: Automotive company with more than 100bn EUR revenue and more than 100,000 employees

A central IT function already developed customer-facing software (e.g., car entertainment). A new agile IT unit was set up in 2013 at a separate location to create value from existing company data. Its location closer to top universities enables recruiting of lacking data scientists, and the agile IT unit now develops internal analytics-based solutions for all company functions (e.g., parts logistics) with more than 50 employees and more than 100 projects already finished. By that the company follows a strategy of exploiting selected digital opportunities for which the bi-modal IT acts as supporter (Hess et al. 2016). Once a solution is developed, it is handed over to the central IT function for further operations and maintenance. External, customer-facing digital

products are planned for the future. Both IT modes report to the CIO, marking a sub-divisionally separated bi-modal IT.

Case 6: Utilities company with ~20bn EUR revenue and 10,000-50,000 employees

The case company explicitly decided not to create a company-wide digital transformation strategy. Each business unit is responsible for driving digitalization as needed. Besides the centralized IT function, a new centralized agile IT unit was created in 2015, directly reporting to the CEO. It supports the business units on digitalization initiatives and now employs around 30 people. The main activity is the development of digital products and new digital business models in collaboration with the business units once they request it. Once the development phase is finished, commercial responsibility stays with the business units, and the traditional IT takes over operations and maintenance as a service unit for the business units. Additionally, the agile IT mode develops product ideas based on technical knowledge. Thereby, this case presents an example of divisionally separated bi-modal IT.

Case 7: Logistics company with ~1.5bn EUR revenue and less than 10,000 employees

So far, a decentralized IT managed corporate applications (e.g., ERP systems) within the different business units and led the digitalization of existing processes. A new unit was set up in 2016, also reporting to the CIO and separated on its own campus. By that, case 7 presents a sub-divisionally separated bi-modal IT. The digital transformation strategy of the company described the creation of a new digital business model targeting novel customer segments for which the agile IT unit is responsible for. Currently, the new unit maintains responsibility for the core digital product of the new digital business model even after the development phase.

Case 8: Automotive company with ~15bn EUR revenue and more than 50,000 employees

A central IT managed corporate applications with little experience in customer-facing products (including UI/UX design). Initially (around 2014), a single project with high involvement of the IT function had the task of tackling the digital transformation of the company. With the development of an overarching digital transformation strategy, which includes bi-modal IT as enabler of new digital business models, responsibilities changed. The digitalization of existing processes (e.g., IT helpdesk automation) and products are

led by the traditional IT and business units, respectively. A new agile IT unit was set up at a new location end of 2016, directly reporting to the CEO with the goal of developing new digital products and business models. Before the launch of the first digital product, the agile IT unit became a separate subsidiary company with more than 100 employees and a new brand within the overall corporate group. Thereby this case marks a journey from project-by-project bi-modal IT to extreme divisionally separated bi-modal IT.

Case 9: Software company with ~20bn EUR revenue and more than 50,000 employees

IT development as the backbone of the business model was split up. As the company's digital strategy consisted in exploiting selected digital opportunities (Hess et al. 2016), several new agile IT units were opened around the globe in 2013, each focusing on exploring new solutions based on specific technologies (e.g., blockchain) and reporting to the Group CEO. Hence, case 9 shows a divisionally separated bi-modal IT. Today, these units have in total more than 100 employees compared to thousands within the traditional IT mode. Once a new solution has proven technically and commercially viable with first customers, it flows into the established continuous development roadmap of traditional IT and commercial responsibility is given to the business units. At the same time, the product owner also moves from the agile IT unit to the business unit.

Table A.5
Interview guide for semi-structured interviews

Guiding question	Objective
What is your background (educational & professional)? What is your current role, and for how long do you have this role?	Interviewee demographics and context
Please recall and guide us through the digital transformation of the company and especially the IT function.	Case context
Could you please elaborate on the main activity of the company's IT and especially the main activity for your IT mode? What is the desired outcome of the activity? What people and skills are represented in the IT mode? By what means (e.g., tools) are you carrying out the activity? Are there any rules/regulations governing this activity? Who are other actors and skills with which the activity is carried out? Who are the major stakeholders? (Boards etc.) Who is responsible for what when carrying out this activity, and how is the IT organized for that? Is there evidence in the form of task descriptions, documented results, work-products, etc.?	Comprehensive understanding of the bi-modal IT
Only if mentioned by interview partners: Can you please elaborate on the conflict you mentioned?	Tensions and management approaches

What other conflicts do you see when this activity is being carried out? What was done or decided to do in order to resolve this conflict?

Table A.6
Exemplary quotes for first-order tension codes

Second-order tension	First-order tension	Exemplary quotes
Scarcity of IT talent	Skilled developers within the existing organization are well-known and requested by all kinds of projects and thus blocked	*"There is no doubt that there are good colleagues who can do this. But they are because they are good, rarely available. And then you are faced with a problem."* *"We have great difficulty in finding the appropriate and available internal people"* *"The corporate IT has given us very few people. The challenge is simply to keep the capacity situation under control."* *"We have 250-300 software developers in corporate IT, and then you just take 50 out, and they do the new stuff. This does not work. I make a very large part of our income from care contracts or licenses. I have to provide the customer with added value on a regular basis, and I cannot tell the customer that they have to pay fees every year, but for the next five years, you do not get any benefit from that."* *"Of course, we have some IT talents within the organization. But these people are already overburdened. Or promoted."*
	Too many requests from business side towards agile IT mode lead to capacity issues	*"As we have too many requests, the challenge is simply to do the right things. Identifying the things in the portfolio that bring the greatest added value for the company."* *"Now, the demand is clearly above the existing capacities. Where do you put your people with the skill?"* *"The challenge is simply to have a good grip on the capacity situation."*
Additional operations workload for the traditional IT mode	MVPs by agile IT mode lead to additional work for traditional IT mode during development and in operations phases	*"But there is also a lot of old things that are necessary to make something like this [agile IT] possible. But no one is willing to make concessions: more topics are added, but jobs are cut."* *"Traditional IT gets something thrown over the fence, has to integrate it."* *"Then we're back to the capacity issue, that just because there's the agile IT unit, they have to kind of increase central IT as well. Just to absorb what's coming across."* *"They have their own IT infrastructure and architecture and that makes each*

		handover even more complex as deployment processes are different." *"Our model is that the IT unit takes over the service later for operations."* *"Our colleagues in corporate IT take over service functions. They have to be trained for that, have to be on-site during the development time."* *"Our IT application landscape and architecture are already very fragmented. When the agile IT unit constantly feeds in new platforms, it gets even less standardized."*
IT architecture unfit for rapid development and testing	With large agile IT unit and a lot of new digital products scaling, traditional IT architecture cannot follow and hinders new development (e.g., only two releases per year)	*"We notice that due to the strong interdependencies in the legacy architecture, it is currently very difficult for us to cut reasonably scaled release trains. Everything is so interconnected, but we should not have more than 100-150 people in such a release train."* *"At the same time, the mindset and mentality of this agile unit was "oh we should" and "here now quickly" and that of the traditional unit was "oh why don't they integrate with the 3 releases we have."* *"Quite challenging, not at all easy. Because the classic projects on the back end also ran very traditionally in the past - waterfall - and were also handled very classically. Then also with different lead times, a release twice a year, whereas at that time online/mobile already had 6-8 releases and were therefore also timed differently and were set up differently."* *"So, our classic IT process made 2 to a maximum of 4 releases a year, while with online/mobile we already had the requirement to be able to react more strongly and more quickly."* *"The expectations are relatively simple. I have just written roughly in the book; we want to be 5 times faster than before."*
	IT architecture needs for rapid testing of new solutions with customers vs. IT architecture needs for high stability (backend systems)	*"As long as I am in a research and development phase, it does not make sense to use corporate IT infrastructure, because it is like an engine room, far away from the customer. We have there an ambidexterity, a large area of tension. We still need to operate some topics in a highly stable and very cost-efficient manner. However, this world does not fit to "Let me try this" or "I need to change something quickly"."* *"As far as the topic of central IT is concerned, they like to live in their structures, demand boards, etc. It is clear that there is a certain potential for friction."*
Missing end-to-end understanding of the new digital	Agile IT mode has fast product development as goal, traditional IT has a high-quality aspiration and has higher leverage in order	*"We [traditional IT mode] have then already completely shot down some products."*

product by the agile IT mode	to stop agile IT projects and products	*"From time to time we [agile IT mode] tried a bit naively to push some interesting concepts. Some were not shot down and made it"* *"At every handover, we [traditional IT mode] are like "Let's see what's in the grab bag."*
	Agile IT mode does not take into account the full lifecycle of its services/products before handing them over, and therefore the number of non-standardized products increase leading to even less standardized application landscape	*"They do not consider lifecycle e2e. Not only a proof-of-concept, but also product! That was a big hurdle and it rumbled a lot: what came out of the lab was not ready for product. You don't just have to check whether it's market-ready, but also product-ready."* *"In the development phase, you have to think about topics like IT security of the tools employed in order to handover and deploy the product. They have to learn this."* *"In the development phase, other things must also be considered (e.g., security, right tools) in order to be able to hand them over at all. "*
	For the same reason, products may lack security requirements not needed during the development phase but for a productive environment	*"And that was a tough discussion, I was completely at odds with the architect, too. But that is just a few rules, that is where it just stops. As long as the boys stay on their home turf, they can really play games, that is, VR glasses and programming things that do not fit into the architecture here. But I have to make certain restrictions because I will not install something in our clients' production line that could lead to problems there."*
Tensions between the agile IT mode and corporate IT policies and guidelines	Tension with IT security: agile IT coworkers ask for administrator permissions across the firm network to get access to data for advanced analytics	*"Yes, the [agile IT mode] needs IT freedom, but there was a lot of friction at the beginning. Wishes do not always correspond to reality. The requirement was that we go to a provider somewhere, buy a big-data server, and put all our data into it. That was the requirement. IT was "Forget it". This is far too sensitive a body of knowledge to run it somewhere unsecured on rented hardware."* *"Colleagues say they want access to all data, few restrictions, and full admin rights. With such a requirement, they fly out of the window when it comes to IT security."*
	Tension with purchasing of IT services: flexibility and short-notice commissioning requested by agile IT mode is against existing guidelines	*"The point was simple: It took seven days until an IP of Amazon Webservices was unlocked for us so that the developers could get back on it. Apart from the fact that we had no choice in what development computers we use, we only got two days' time of admin access after a ticket and several calls. I can say for myself I can't work like this. This is a maximum obstacle and nothing goes forward."* *"Take purchasing as an example: We have very stringent and formal purchasing processes, such as the tendering of*

		services. When [the agile IT mode] says: "We are agile working, we work in sprints" but now realizes that in four weeks, they need a certain service provider and that it will be employed for the next three months. That is when the old and the new world come together in terms of processes and organization. That is when it becomes clear how serious a company means it with two IT modes within a company."
	Cooperation between agile IT mode and start-ups is difficult in regards to corporate policies and supplier certifications	*"Should we work with startups and integrate their digital products if they don't have the huge backing or can vouch for liability risks? That's a topic for which we have to develop new governance."*
	Tensions (with worker's council) about new way of working and its consequences on working time: higher volatility of hours per day instead of fixed 8h/day	*"So, for example, employee leasing in the agile context is a big topic. This is being hotly debated right now because our current guidelines simply don't work."* *"In a start-up environment, colleagues want to work until 10:00 in the evening. Our working time models do not allow for such a situation."*
Traditional IT mode envious of the agile IT mode about working with new technologies	Envy that agile IT unit is not bound to corporate IT policies	*"We do not use corporate IT, but we really have our own computer with admin access, we get to develop completely online. Many in our company envy us."* *"I think it also became a cultural problem later on, because of course you always have the people who are in the new, sexy topics, who are allowed to act differently and for whom different rules apply than for the people who do classic IT."*
	Envy that new unit can work with new technologies instead of traditional IT department, where co-workers might have knowledge (gained outside of the company) about these technologies (e.g., cloud-development)	*"The people who are there don't get the time to try these things out, someone else gets it, which of course also leads to the frustration issue. Because every time the feeling arises, I have now successfully developed for ten or fifteen years for the company and I am not allowed to play with these beautiful toys, especially young people, also want to do cloud development. You have to manage these things."* *"This new mode makes an enormous envy factor in the organization. An IT that has been doing this for 20-30 years knows what innovations there are and would like to do more than it can and is slowed down by savings in the department. When a new area is created that is allowed to do the cool shit, it makes a massive envy factor."* *"Of course, there are other people who also want to push innovative and digital topics and look at us with a mixture of envy and resentment."*
	Envy can lead to frustration and to co-workers within traditional IT feeling less valued	*"Then came the envy from employees and the management levels and performance suffered as a result and I still discuss this topic with my management today."*

		"There is friction and that is a challenge. The challenge is to manage this in such a way that it doesn't lead to frustration for people, but rather enriches them." *"In the end, that was also difficult in terms of interaction. Also, in terms of the appreciation that people felt. Because they always felt like they were the ones who were sitting on systems, procedures and processes that were being phased out."*
New agile IT mode is seen as a competitor	Agile IT mode is seen as the future, traditional IT as the past by some employees	*"Some people feel like: I am still the old one here and they are the new one there."* *"They felt that they are working on systems that were no longer being approached in the way they are today. This may lead to a huge issue."*
	Agile IT mode is seen as a competitor to traditional IT as both are service units to BU by some employees	*"What happened: You got two mice in the track, then you let them both run, and each one of them has a certain good track. There is not always a winner, but both races lead to cheese. Now one is afraid that she is going to lose some of her cheese."* *"There is a certain competitive situation between the agile IT unit and central IT since both are in principle service centers for the business areas. Of course central IT could say that "innovative IT is also my turf", but this is not so decided on the board level. If you ask the business organizations, then the situation looks different again, because, in the end, they do not care where they got their services from."* *"Actually, both want to have application developers, and now they would rather go to the new one than to the central IT department."*
	Silo thinking between IT modes and not enough communication leads to slower development, especially when the IT modes are physically separated and report to different heads (e.g., CIO and CDO)	*"One [mode] would not ask and the other would not want to answer either."* *"When the departments were formalized, with the departments came the departmental identity, and later silo thinking, which then sets in in such units."*
	Risk of responsibility overlaps with different IT units (e.g., new business models vs. digitization of core business)	*"We have other places within the company where similar issues are dealt with. We are clearly focused on company's core business digitalization but it is not always possible to draw a clear line."*
Distrust, ill will, resentment, or "politics"	Disbelief by many employees of traditional IT that other ways of working (e.g., Scrum) also lead to functioning digital products	*"Nevertheless, of course, the classic managers somehow said, "That cannot be. How can it work that they come here laughing all the time with a kicker, and then somehow something comes out that works."*

		„Of course, there are people who look at it with ill-will. In every organization, there is politics, that is just the way it is. All in all, a good image, in some places ill-will."
	Skepticism regarding potential of new digital products developed by agile IT mode vs. potential of digitizing traditional business and therefore agile IT topics get lower priority within traditional IT	*"What we often got as an answer back then, "our core business is selling vehicles and not those digital gadgets."* *"The problem is then: In the management of the classical function, which is still partially reserved, according to the motto, "Can we rely on our traditional business instead of somehow trying out digital products here and spending a lot of time on it? In the end, nothing will come out of it."*
	Lack of recognition of the agile IT mode by the remaining company at the beginning	*"There is resentment and that is actually important to understand why it is not accepted. Did I not understand the mission, did I not understand the Helping Hands, do I have completely different concerns? Someone afraid for his or her role, position? That's Maslow's pyramid up and down."* *"Some said at the beginning: these odd sandbox players. Running around, sitting on colorful cushions with MacBooks, and just having fun."* *"There is a lot of hype on this unit, and with all the internal marketing for it, many get even more skeptical. We should not forget to invest in the development of existing IT co-workers and IT services."*
	Helpful knowledge for building up the agile IT mode is not shared and has to be re-created (e.g., on topics like architecture management, SLAs)	*"There was also no exchange or limited exchange during the build-up of the agile IT unit and then all learnings were made again."*
	MVP developed by agile IT mode is not considered valuable by the business unit leading to frustration on both sides	*"We built prototypes and prototypes and MVPs, but then nothing happened. And we had to stop that. We did a lot of things and everything nice and well and also fun. But all were frustrated in the end of course because it didn't fit to the BUs and it wasn't getting to the market."* *"We built the MVP back then and were ready to throw the prototype back to the departments and say "Here's our idea. We've tried this, there seems to be a market. Make something out of it." We teased that a little bit, talked to a department where we thought at the time it would be a pretty good fit. They had hardcore not-invented-by-me; "this can't work and that's where we've thought about it before and it's not going to work now".*
Unfit mindset of new hires	Mindset of new hires might not fit: agile IT mode is not a start-up and serves corporate goals even if this slows down progress	*"I do not need an elite force that thinks they are better than others. We are very good but complementary. There are other very good at our company. Some have not understood that."*

		“This new organization is now hiring many young, talented, and committed people. Of course, they have a drive. They come in and want to step on the gas. Now someone comes in, sometimes a little naive, and explains how everything should go better, and we have already tried that, and it does not work that way. Then a frustration arises because suddenly, these new ones are hyped as salvation bringer. And another one says, "I told this already ten years ago, nobody wanted to hear it because I did not tell it right". The same can happen on the other side; the young people run into these walls. Sometimes they just do not understand that it is not as easy as they say.” *“You have to be careful that those who come with change don't get frustrated and pull the ripcord at some point and say we don't want that.”* *“They [newly hired IT talent] forget that life is not full of bliss and that this is not a playground but a full-grown company. Their performance is very well tracked, and they are measured by their results.”*

Table A.7
Exemplary quotes for paradox management practice codes

Paradox management practice codes	Exemplary quotes
For agile IT mode: New hires and temporarily external IT service provider	*"We call it BOT: build, operate, transfer. We looked for an external service provider who would build up the topic purely externally. He drives, operates, and builds it. Especially now for new business models. When I see that the market accepts it, the business case starts to bear fruit; then, I successively put internal employees."* *"At that time, there were internal employees, I would say three or four, with an incredible amount of external support. That means that in the nine months, we have really brought meat to these skeletons of ideas through external support."*
New hires for new mode as some skills not available in-house	*"Data science and UX were definitely skills we did not have in-house and for which we needed new hires."* *" And If the internal was not good enough, I hired externally. All still quite surprising with fair salaries. But important is that I was allowed to hire them."*
Gradually increasing involvement of traditional IT from the beginning of the funnel	*"At the beginning of every new project, we start by bringing the [traditional] IT colleagues on board. Slowly introduce the IT team to what they are going to be doing after the development phase. That means that a certain IT project manager will be added to the team. The developers will be added to the team perhaps two months before the end of the project and will learn bit by bit."* *"Our collaboration improves thanks to physical proximity. It allows us to better learn from each other."* *"We are in the middle of a transition as to what such a collaboration model looks like. But one of the models is that the unit that takes over the service participates more in our agile IT. Unfortunately, it is not yet possible for the colleagues to send members on a full-time basis, so they are not permanently at our place, but similar to the specialist department, they simply come to the site on a project basis."*
Corporate IT co-worker working in the lab as "liaison officer" to create better alignment even if it reduces degrees of freedom	*"All in all I think that the link to traditional IT is less our problem. Because we also have a management team that knows the IT department very well, two come from there. One of our managers also has an additional role as chief architect in traditional IT. Also, our big sponsor is former CIO and now CFO."* *"From December on we [="traditional IT" mode] will have one of our own IT employees in there as "liaison officer."*
New IT architecture for both in the future	*"Goal is to have a common consolidated architecture. Our initial technology stack now becomes the overall IT tech stack."* *"We are still in the process of introducing this technology. So we have our own game platforms and sandboxes. And now you have to bridge the gap to production, and of course you can only do that if you work on the target platforms where the rest of your colleagues are. So then the goal is to have a common consolidated architecture."*
Agile IT mode administers own and separate office hardware thanks to permit of executive board	*"And so back then, we got the exception permission that we have our own networks in which we work and that the developers simply do not have to take a Windows machine."* *"As the only department in the entire conglomerate they got the permission to set up another separate company network, which they then also manage themselves."*
Agile IT with own commissioning processes thanks to permit of executive board	*"So we went to the chief procurement officer, and he gave us special dispensations."*

Permit of the executive board to quickly partner with non-certified start-ups	*"We escalated and our CEO, and he said: "Okay, do not let that stop you."*
Transparency and clear communication about roles	*"We also say quite openly that in three to five years [our agile mode] will hopefully no longer exist. Because then the whole company will be working like this. Including IT. That often takes away the fear if the appearance of two classes of IT was created before."* *"It was a difficult discussion up to this day, but it has now been resolved. For me, corporate IT is an extremely important function. But that does not mean that it should compete with me. That was not clear until now. They have to provide infrastructure. They have implemented an Enterprise Service Bus (ESB). This thing is the best thing they have done for the business for decades. Without this ESB, I would be lost. That is the gold nugget to scale."*
First results communicated broadly lead to more recognition/respect (e.g., first sales closure)	*"It's improving now, the more products we hand over. Because more and more areas in traditional IT are learning: "they're doing MVP style and then they're handing it over to us." It's a very collaborative approach. After all, the traditional IT also understands that they are getting new opportunities to expand their capabilities. Now it's really getting better with real examples."* *"But the point is that we always have extreme transparency through and through. I also believe that the extremely good quality of service that we have developed means that we were not vulnerable."* *"Stupid sayings because of Weber grill existed, you have to breathe that away. When we already wrote a first invoice after one year, those were milestones and results that people think are good."*
Tours of working space for other departments and workshops on new ways of working	*"We often have open house days, and there is always a full house."* *"In the meantime, there were more than 200 people in the agile IT workplace for workshops or appointments (leadership circle), which you also just do there."*
First, mediation between new hires and tenured employees on ways of working, then layoff	*"These new hires inspire me and I curse them. That is it of course again and again a pain point for me and them, because they want things and need things and mean to be right. Which I question, but that's helped a lot of times after we discussed it. Both sides of the card. I think it's important."*
Co-workers with wrong mindset are laid off	*"I fired four people, and three of them because mindset was wrong. And that is also a success factor in removing rotten apples immediately."* *"Firing is sometimes more difficult at our company. But this clear consistent management is important. Also, the guys often realize themselves that they do not fit in."* *"More specifically, you have some people who want to continue playing so to speak but at a certain size you have to do business. Some then quite frankly say "I misunderstood this" and leave."* *"The people who want to work here like to work independently et cetera. But then suddenly people can no longer work so freely with all the legacy systems and processes. That has repelled some and then you should not hold them back either."*
Adaptation of working practices and behavior of individuals within agile IT mode after resistance from traditional IT	*"I have often seen myself in an intermediary position, explaining to the team, "Guys, it is all good what you have done here. You have to understand, on the other hand, we have a measurement system that is used by 30,000 customers, which is relevant to quality in production. And we will not do continuous delivery of software development when we have a regulated area here.*

	Medical technology, aerospace technology, this is where both worlds meet. You have to give both processes a transition."