An investigation of the competencies required for working in the digital age

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Overview of research output

The following table contains all my publications in a chronological order. The four papers shaded in light grey are included in the dissertation. They account for **2.55** points according to the rules of the PhD program of ESCP Europe (a minimum of 2 points is required). The other papers do not have a direct relation to the dissertation's topic and are therefore not considered.

Title	Authors	Type of publication	VHB	Status	Points
Comparing Required Competencies of Sales Professionals Servicing Digital and Physical Channels of Sale	Murawski, M.; Blatz, K. C.; Bick, M.	**Proceedings** Hawaii International Conference on System Sciences, 2019	C	Desk reject passed (under review)	0.5
Structural Requirements for Digital Transformation – Insights from German Enterprises	Murawski, M.; Thordsen, T.; Martensen, M.; Rademacher, C.; Bick, M.	**Journal** Journal of Competences, Strategy & Management	C	Revised and resubmitted	0.3
Applying big data analytics for psychometric micro-targeting	Blesik, T.; Murawski, M.; Vurucu, M.; Bick, M.	**Book chapter** In: Machine Learning for Big Data Analytics, De Gruyter, Berlin	-	Accepted for publication	-
How Digital Business Strategy Affects Profitability: Opening the 'Black Box' of Performance	Murawski, M.; Bühler, J.; Martensen, M.; Rademacher, C.; Bick, M.	**Proceedings** Americas Conference on Information Systems, 2018	D	Published in 2018	-
Should we disable the comment function on social media? The impact of negative eWOM on consumers' trust in fashion presentations	Bühler, J.; Murawski, M.; Bick, M.	**Proceedings** Lecture Notes in Computer Science (LNCS 2017)	C	Published in 2017	0.5
Organizational requirements for digital transformation – a first empirical investigation	Murawski, M.; Thordsen, T.; Martensen, M.; Rademacher, C.; Bick, M.	**Proceedings** International Conference on Competence-based Strategic Management, 2017	-	Published in 2017	-
Demanded and Imparted Big Data Competences: Towards an Integrative Analysis	Murawski, M.; Bick, M.	**Proceedings** European Conference on Information Systems, 2017	B	Published in 2017	1
Digital Competences of the Workforce – A Research Topic?	Murawski, M.; Bick, M.	**Journal** Business Process Management Journal	C	Published in 2017	0.75
The Role of Non-social Benefits Related to Convenience. Towards an Enhanced Model of User's Self-disclosure in Social Networks	Thordsen, T.; Murawski, M.; Bick M.	**Proceedings** Lecture Notes in Computer Science (LNCS 2016)	C	Published in 2016	0.5
Location-Based Services	Ryschka, S.; Murawski, M.; Bick M.	**Journal** Business & Information Systems Engineering	B	Published in 2016	0.67

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List of abbreviations

AI	Artificial Intelligence
BPMJ	Business Process Management Journal
CBT	Competence-based Theory
CEO	Chief Executive Officer
DAX	Deutscher Aktienindex
DCT	Dynamic Capabilities Theory
DTF	Digital Transformation Framework
ECIS	European Conference on Information Systems
e.g.	exempli gratia (Latin, means: for example)
et al.	et alii (Latin, means: and others)
HICSS	Hawaii International Conference on System Sciences
ICT	Information and Communications Technology
i.e.	id est (Latin, means: that means)
IS	Information Systems
IT	Information Technology
JCSM	Journal of Competences, Strategy & Management
LDA	Latent Dirichlet Allocation
OECD	Organisation for Economic Co-operation and Development
RM	Research Manuscript
UK	United Kingdom
USA	United States of America

Note: This list of abbreviations refers to the dissertation at hand but does not include abbreviations solely used in the four research manuscripts (section 4). The same applies for the list of figures, list of tables, and the list of references at the end of the document.

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"The real challenge posed by digitalisation […] is preparing workers for the labour market of the future."

(Arntz et al. 2018b, no page)

1. Introduction

The transformation of work

We are living in the times of a fundamental digital transformation of the working environment (e.g., Grant and Parker 2009; Yoo et al. 2012). Machines and programs are now able to take over (routine) tasks that have previously been done by humans; a development which is often labelled as *automatization* (e.g., Arntz et al. 2018a). Taking the example of Germany, millions of current jobs face the challenge of automatization in the near future, covering different sectors and functions such as production, management, logistics, and commerce (Statista 2018). Research on other countries such as the USA yields similar results (Frey and Osborne 2017). DAX companies such as Volkswagen announced to cut 23,000 existing jobs while 9,000 novel jobs are to be created (e.g., Vetter 2016). Other companies such as Siemens or Fujitsu recently announced restructuring their business towards being *more digital*, which, in fact, means a loss of thousands of routine jobs while novel, typically highly-skilled, jobs are in return created during this transition.

Moreover, the working mode is changing, indicated, for example, by an increasing relevance of working in the home office (Statista 2017), a decreasing relevance of the location of work in general, and novel work arrangements such as crowdsourcing (e.g., Amazon Mechanical Turk) and job sharing (Weitzel and Niehaves 2017). Other current topics in this context are fundamental changes in teamwork, leadership, and communication as well as a new work-life setup (Schwarzmüller et al. 2016).

Looking for the drivers, digital transformation is fueled by powerful and increasingly pervasive digital technologies (Yoo et al. 2012). Just to name a few of such digital technologies, recent examples are robotics which increasingly gain importance in healthcare (Qureshi and Syed 2014), 3D printers that are able to create buildings (Hager et al. 2016), chatbots that communicate with customers (Riikkinen et al. 2018), and big data in general, which enables very detailed insights about, for instance, customers and business processes (Chen et al. 2012).

The transformation of work leads to changing and even novel competency requirements. Which competencies does a medical doctor need in order to cooperate with robotics? Which competencies does a sales person need in order to cooperate with chatbots? And which competencies

are necessary in order to exploit the potential of big data? These questions on required competencies for working in the digital age seem to be valid for almost every occupation. But how does the current situation look like? Considering a recent study conducted with 551 employees in Germany, 80% state that digital technologies are already of great importance in their jobs. However, most respondents also state that they do not feel prepared to accommodate this shift but agree that *digital competency* is of growing importance (Bitkom Research 2017). In line with this, there are regular calls from politicians (e.g., N.N. 2017; Quadbeck 2014) and practitioners (e.g., Bröcker and Kowalewsky 2018; Schwan 2017) to integrate "programming" as a subject in schools. But is this very technical focus enough?

Structuring the topic

The shifts in both technology and organizational structure have an impact on the workforce. Generally, work practices become increasingly technology-centric (Davison and Ou 2017). Typical labels for this phenomenon are *digital work* or *working in the digital age*[1]. The topic of working in the digital age can be investigated and researched from several perspectives. Macro-economic scholars put effort in understanding the effects on unemployment rates, focusing on both the creation of new jobs (e.g., software and app developers, data scientists) and the loss of jobs (e.g., routine jobs which can be overtaken by machines) in the context of digitalization (Arntz et al. 2018a; Frey and Osborne 2017). These studies attract great attention and are often the basis for headlines in press and political action.

In this dissertation, the focus is however not placed on the macro-economic impacts of digitalization on work, but on the organizational and even individual employee[2] level. In this field, current calls for research are related to, for example, digital work design, work life balance and the intersection of work and private life, new technologies (e.g., virtual/augmented reality) for digital work, and opportunities and challenges associated with tele work, home office, and job sharing (Richter et al. 2018; Weitzel and Niehaves 2017). Moreover, leadership in the digital business environment gains importance (Phelps 2014). Dettmann et al. (2018) reveal that there seems to be a performance gap between the "pioneers" (digital savvy leaders) and the "laggards" (less digital capable leaders), which could result in severe business consequences for the latter. The main conclusion of their research is that digital savvy leaders are "better at anticipating and responding to the competitive environment, navigating through complexity, and using data and analytics to guide their decision making" (Dettmann et al. 2018, p. 13).

[1] Both labels are used interchangeably in this dissertation.
[2] The terms *worker* and *employee* are used synonymously in this thesis.

What all these examples have in common is that they are associated with a shift in the required individual's competencies (Stettes 2017; Veit 2017). However, there is only little research on both digital work and those competencies which are necessary today and potentially in the future (Bouée 2015; Stettes 2017). Most literature in this regard is of very generic nature. For example, Marr (2018) urges to focus on those tasks that robots cannot do well. He furthermore mentions the constantly growing importance of, among others, *empathy*, *communication*, *critical thinking*, and *creativity* in the future. Moreover, *emotional intelligence* is often mentioned as a competency of increasing relevance in the digital age (McCleskey 2014). However, such recommendations are often neither based on academic rigor nor do they focus on a specific occupation. As a response to the need of gaining a better understanding of competency requirements, scholars have recently started to examine specific occupational fields. For example, Debortoli et al. (2014) investigate the required competencies for business intelligence and big data professionals, and Shahlaei et al. (2017) analyze the communicator's work. Nevertheless, research on the required competencies for digital work is in its early stage, which is indicated by a fragmented and rather unstructured field.

Digital work includes different dimensions. Particularly, the dimensions *human* (i.e., workers), *technology* (i.e., especially digital technology), and *organizations* (i.e., companies) are considered in this dissertation. However, these dimensions are not analyzed independently but mutually. Therefore, the overall approach of this dissertation is a *sociotechnical* one (e.g., Sawyer and Jarrahi 2014; Trist and Bamforth 1951). Sociotechnical systems deal with the interactions of humans and technology while also considering the organizational setup. Digital work combines these three dimensions and can therefore be interpreted as a sociotechnical system (Deuse et al. 2018). It is not about the question *technology or human?* but about the design and optimization of a mutually synchronized system (Hirsch-Kreinsen and Hompel 2016). The four research manuscripts of this dissertation[3] can be assigned to the different areas of a sociotechnical system which will be discussed in detail in Section 5.1.

Developing a research goal

Considering solely technical competencies for understanding the requirements of digital working environments seems to be insufficient (Winde and Schröder 2017). There are obviously other competency fields (e.g., social, operational) which need to be integrated in order to obtain a complete picture (e.g., Dettmann et al. 2018). Established approaches of both classifying and identifying competencies (McClelland 1973; Spencer and Spencer 1993) do not include any

[3] The manuscripts are introduced in Section 3. Please refer to Table 6 (page 17) for an overview.

digital competencies, meaning that they do not account for digital working environments. This issue will be addressed in two of the four manuscripts (i.e., manuscripts 3 and 4). Here, the required competencies for two specific occupations, i.e., big data and sales professionals, are elaborated.

It is important to note that competencies should always be understood within a specific context, e.g., existing systems or work practices (Hoel and Holtkamp 2012; Holtkamp et al. 2015). Broadly speaking, the context considered in this thesis is *work*. Work, in turn, is related to the specific organizational settings, e.g., the information technology (IT) governance structure of a company, which is also reflected by the sociotechnical approach of my dissertation. Davison and Ou (2017) show that such governance structures could lead to tensions between an organization and digitally competent employees, for example because the digital technology favored by the employees is forbidden or unknown in the organization. Putting it in more general and simple terms, one could say that "you could have employees with the highest possible levels of digital competency, but this is useless if the structural framework of a company is not ready for the digital world"[4]. Thus, this "structural framework of a company" will also be subjected to in-depth analyses (especially in manuscript 2).

Due to the novelty of the topic of this thesis (e.g., the first occupations around big data emerged in the years 2010/2011) and the speed of technological progress which impacts digital work, the overall approach of this dissertation is of an explorative nature. A major challenge is that there are hardly any theoretically-oriented studies in this field. The limited number of studies that provide a theoretical framework consider the Competence-Based Theory (CBT) (e.g., van der Heijde and van der Heijden 2006). However, an enhancement of this theoretical school towards the required competencies for digital work is missing, so far. Therefore, a specific objective is shedding light on the theoretical contribution of this dissertation. For this purpose, Section 5.1 contains a discussion of the building blocks of theory development suggested by Whetten (1989).

To summarize, the overall goal of this dissertation is *gaining an enhanced understanding of the required competencies in digital working environments*. This goal is reached as several research contributions, which are based on both the individual manuscripts and the integrating perspective of the dissertation at hand, can be formulated. The main contributions are listed in the following and outlined in detail in the discussion section.

[4] This statement is taken from an informal talk with a digital transformation consultant during my field work.

1. Analysis of the manuscripts in a *sociotechnical* context, i.e., considering and integrating the dimensions *human*, *technology*, and *organization*
2. Enhancing related *theoretical frameworks*
3. Elaboration of *concrete required competencies for two specific occupations*, i.e., big data and sales professionals

This dissertation is structured as follows. First, the underlying context and the current state of research on digital work and (digital) competencies is presented in Section 2. Then I move down to the manuscript level and briefly introduce the four research manuscripts which constitute the basis of the dissertation in Section 3. These four manuscripts build the content of Section 4. After that, I will explicitly address the three main contributions mentioned above and thereby the overall research goal of this dissertation, which is followed by discussing the implications for academia and practice, limitations, and further research opportunities in Section 5. The dissertation ends with a conclusion (Section 6).

2. Working in the digital age and required (new) competencies

This section introduces the general context of this dissertation thesis: *digital work*. Although a rather immature research field, existing studies indicate that digital work is intrinsically tied to changes in the individual worker's competencies. Or, as Davison and Ou (2017, p. 130) put it: "Engaging in digital work requires employees to be digitally literate".

2.1. Characteristics of the digital working environment

The overall characteristic of a digital work environment is the ongoing integration of powerful and often ubiquitous digital technologies. Popular recent examples are big data, artificial intelligence (AI), robotics, and 3D printing (Brynjolfsson and McAfee 2014), which drive the change of entire industries and business functions. Taking the example of AI, customer interaction has changed from human-to-human to chatbot-to-human in many cases, thereby massively changing the call center function (e.g., Riikkinen et al. 2018). Another example is 3D printing, which is nowadays even used for "printing" entire buildings, thereby massively changing the construction industry (e.g., Hager et al. 2016). This list could easily be continued and emphasizes the significant industry transformations which, in turn, lead to changes of many working environments.

While numerous practically-oriented publications about digital work exist (e.g., Accenture 2018; McKinsey 2017), the number of rigor academic studies is small. However, the topic is on the rise. Among such indicators are the specific tracks at leading (IS) conferences which directly aim to investigate the characteristics and consequences of working in the digital age (e.g., the tracks "Digital Work" at the conferences *Wirtschaftsinformatik 2017*[5] and *2019*[6]) and government-funded research projects carried out by leading universities (e.g., the project "Digital Work Design"[7] carried out by the *Technical University Munich*).

One of the few definitions of digital work is suggested by Davison and Ou (2017, p. 130), who understand digital work as "a very broad term that covers a variety of technology-centric work practices." Another even more abstract and philosophically influenced definition is the one by Fuchs and Sevignani (2013, p. 255): "Digital work is the organisation of human experiences with the help of the human brain, digital media and speech in such a way that new products are created. These products can be online information, meanings, social relations, artefacts or social

[5] https://www.wi2017.ch/track4-2.html?url=track4&lc=en [accessed 22.10.2018]
[6] http://wi2019.de/wissenschaftliche-tracks/#DigitalWork [accessed 22.10.2018]
[7] http://www.digitalworkdesign.wi.tum.de/index.php?id=199&L=1 [accessed 22.10.2018]

systems." What both definitions have in common is first the emphasis on technology or digital media and second the very broad approach, meaning that an operationalization is hardly possible.

Aside from the studies dealing with the theoretical concept of digital work, there are research findings that aim at comparing digital and traditional work. For example, Cascio and Montealegre (2016) suggest an up-to-date overview of the role that technology, particularly information and communications technology (ICT), is playing in changing work. They describe how some skills become obsolete while other skills gain importance: "The number of typists, travel agencies, bank tellers, and many production-line jobs has fallen dramatically, but there are ever more computer programmers and web designers" (Cascio and Montealegre 2016, p. 355). They furthermore discuss different technologies (i.e., electronic monitoring systems, robots, teleconferencing, and wearable computing devices) in order to illustrate the impact on specific jobs in a more detailed manner. They assume a future scenario in which (mostly low-skilled) jobs will be taken over by machines on the one hand, but new jobs for human workers will emerge on the other hand. This goes along with workers adjusting their skills and entrepreneurs creating opportunities based on the new technologies which, in turn, outweighs the loss of the low-skilled jobs (Cascio and Montealegre 2016).

Richter et al. (2018) discuss the dimensions on which they show the differences between traditional and digital work design with a focus on production (see Table 1). As many routine tasks can be executed more efficiently by machines, the remaining tasks for the human workers are more complex. Thus, today's workers should be able to "flexibly respond to unforeseen events, learn continuously, or solve novel problems collaboratively" (Richter et al. 2018, p. 260).

Table 1: Traditional vs. digital work (Richter et al. 2018, p. 260)

Dimension	**Traditional work**	**Digital work**
Role of human	Operating tools and machines	Orchestrating tools and machines
Human capabilities	Coordinating and efficient handling of tasks	Creativity, problem solving, learning
Role of ICT	Replacing strenuous human work (machine-centric)	Augmenting human capabilities (human-centric)

Schwarzmüller et al. (2016) conducted a qualitative online expert survey with 49 German-speaking digitalization experts from the industry, research, associations, and politics and identified eight *major work changes* as displayed in Table 2. They furthermore elaborated related

major chances (i.e., more development and learning, more diverse and interesting jobs, increased autonomy, and more flexible work-life-models) and *major risks* (i.e., increased strain and stress, less intense relationships, feelings of insecurity, and job loss). They conclude their study with the statement that digitalization crucially transforms work design, especially with regard to the necessary competencies (Schwarzmüller et al. 2016).

Table 2: Major work changes caused by digitalization (Schwarzmüller et al. 2016)

Major work changes	Details
Enhanced competency requirements	• Higher qualification necessary, more cognitive work • Need for agility, flexibility, IT competencies • Lifelong learning
Increased intensity	• Enhanced complexity • Enhanced intensity • Acceleration
Technologization	• Collaboration with machines • Support through new tools and IT • Automatization
Changes in teamwork	• Increased teamwork • New types of teamwork (dynamic, cross-division and cross-company, diverse, virtual, global)
Changes in communication	• Communication over interfaces (professional and organizational) • Use of new media (chats, social networks)
Structural changes	• Changes in job contents, emergence of new jobs • Enhanced insecurity, lower predictability • Higher competition
Changes in work-life setups	• Increased flexibility • Enhanced availability • Lack of boundaries between work and private life
Increased influence	• Enhanced autonomy • Flatter hierarchies • Democratization and participation

In this dissertation, two occupations are considered in detail: *big data* and *sales professionals*. With regard to digital work, these two occupations are very different. Big data is a very novel occupation (e.g., Provost and Fawcett 2013), which appeared in recent years along the growing opportunities to produce and store enormous volumes of structured, semi-structured, and unstructured data (e.g., Chen et al. 2012; Davenport and Patil 2012). In contrast, sales is a function which is more traditional and established but faces enormous changes caused by digital technologies (e.g., Lambrecht et al. 2014). Both occupations and their digital work aspects are presented in detail in the corresponding research manuscripts 3 and 4.

2.2. Required individual competencies

This section contains an overview of the very broad field of competency research. The focus is placed on the main aspects and basic models. More detailed definitions and remarks are available in three of the four research manuscripts (i.e., research manuscripts 1, 3, 4), which will be presented in Section 4. Generally, in this dissertation, competency is understood at the individual worker level (and not at the organizational level), which corresponds to recent calls for investigating the "digitization of the individual" (Baskerville 2011; Turel et al. 2018).

2.2.1. Traditional competency concepts

Work-related competencies are generally understood as a combination of abilities, (work-related) knowledge, and skills held by an individual (Nordhaug 1993). This is similar to the suggestion by Lambert et al. (2014, p. 87) who define competencies as "a set of skills, behaviors, and attitudes needed to perform an activity or process in a competent manner as defined by a set of parameters that can be measured". Furthermore, competency should always be understood in a specific context, e.g., for a specific occupation (Hoel and Holtkamp 2012). According to Spencer and Spencer (1993), there are five types of competency characteristics which are summarized in Table 3.

Table 3: Five competency characteristics (Spencer and Spencer 1993, pp. 9-11)

Characteristic	Definition	Example
Motives	The things a person consistently thinks about or wants that cause action. Motives drive, direct, and select behavior toward certain actions or goals and away from others.	Achievement-motivated people consistently set challenging goals for themselves, take personal responsibility for accomplishing them, and use feedback to do better.
Traits	Physical characteristics and consistent responses to situations or information.	Reaction time and good eyesight are the physical trait competencies of combat pilots.
Self-Concept	A person's attitudes, values, or self-image.	Self-confidence, a person's belief that he or she can be effective in almost any situation is part of that person's concept of self.
Knowledge	Information a person has in specific content areas.	A surgeon's knowledge of nerves and muscles in the human body.
Skills	The abilities to perform a certain physical or mental task.	A dentist's physical skill to fill a tooth without damaging the nerve.

Spencer and Spencer (1993) furthermore develop a model which contains different levels for the five competency characteristics (see Figure 1). This makes it possible to identify the components that are easier to develop (skills, knowledge), while others can hardly be developed (traits, motives). In addition, Spencer and Spencer (1993) discuss the meaning of competencies for identifying the different performing levels of employees, thereby emphasizing the strong HR / recruiting focus of their work.

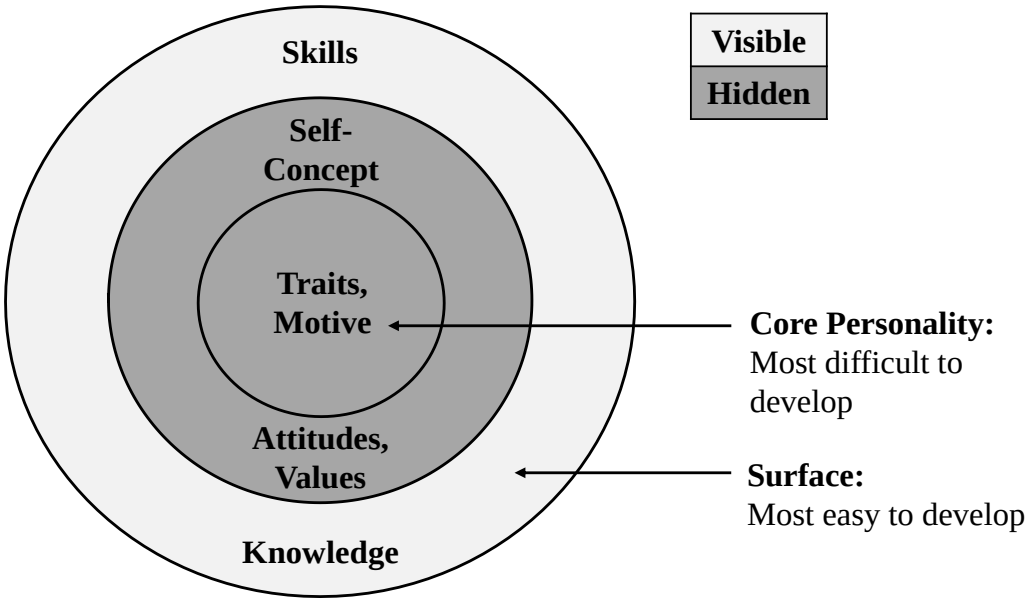

Figure 1: Concept of competency (Spencer and Spencer 1993, p. 11)

Nevertheless, it must be noted that the concept of competency is disputed among scholars. Confusions easily occur because the term is based on "common parlance rather than agreed definition" (Westera 2001, p. 76). This is supported by Shippmann et al. (2000) who listed a range of definitions for competencies in an attempt to identify a common ground, noting that the different definitions could be explained by the number of areas where the term is used and where it may have originated from. Another challenge lies in the wording itself, especially regarding the difference between *competence*, *competency*, and *competencies*. Moore et al. (2002) dedicate an entire article to this topic and suggest a hierarchy (see Table 4).

Although such a hierarchy exists, the terms are often used interchangeably, which is enforced by the fact that there are different understandings between British and American English (Moore et al. 2002). Given that different journals have different requirements regarding language, the use of the terms is not always the same in the four research manuscripts of this dissertation. Aside from the manuscripts, the suggestion by Moore et al. (2002) displayed in Table 4 is followed in this dissertation.

Table 4: Competence, competency, and competencies (Moore et al. 2002, p. 316)

Term	Meaning	Explanation
Competence	An area of work	The competence of an individual may be concerned with a particular trade or profession, such as researching (here: area of competence).
Competency	The behavior(s) supporting an area of work	Within such an area, the decision regarding whether an individual would be regarded as exhibiting competency would be based on their exhibiting the "correct" or relevant behaviors. If, for example, their behaviors included empirical research but did not include theoretical research, they may not generally be regarded as exhibiting competency in their chosen competence.
Competencies	The attributes underpinning a behavior	This lack of competency may, in turn, be attributed to their being deficient in one or more of the attributes underpinning that competency (competencies). They may, for example, lack an attribute such as knowledge of the value of a structured literature review.

2.2.2. Digital competencies

Along with the digitalization, the term digital competency emerged. It gained popularity especially since it has been announced as one of the eight key competencies for lifelong learning by the European Union (Ala-Mutka 2011). Research manuscript 1 addresses several questions related to digital competencies and includes a literature review of the topic as well as concrete practical examples. Therefore, to avoid redundancies, only the core aspects are mentioned in this subsection.

Hatlevik and Christophersen (2013) identify the concept of digital competency being used in three different contexts: politics, education, and research. In this dissertation, the focus lies on the research aspects, and here, on work-related competency research in particular.

The digital competency construct can broadly be described with the abilities, knowledge, mindset and attitudes of using digital technologies (Janssen et al. 2013). These digital technologies consist of both hardware and software electronic technologies that can be used in educational, work or home environments. Hardware and software include mobile devices, desktops, recording devices, applications, Web 2.0 technologies and other Internet resources (Ng 2012). Calvani et al. (2008, p. 186) developed a definition which is kept broad, so it is applicable to various contexts:

> *Digital competency is the capability "to explore and face new technological situations in a flexible way, to analyze, select and critically evaluate data and information, to exploit technological potentials in order to represent and solve problems and build shared and collaborative knowledge, while fostering awareness of one's own personal responsibilities and the respect of reciprocal rights/obligations."*

Also other scholars place importance on keeping the definition of digital competence broad and applicable to numerous contexts (Janssen et al. 2013). Fixing an ultimate definition for such a dynamic subject (e.g., considering the fast-paced technological progress as one of the key characteristics of the digital era) is challenging. Or, as Ilomäki et al. (2016, p. 670) put it after an analysis of 76 academic articles: "There will hardly be any final and single definition for digital competence because of the various points of view surrounding it and because of the rapid changes in the technologies and society." Instead of a definable construct, Ilomäki et al. (2016, pp. 670–671) understand digital competency as a boundary concept applicable to various contexts:

> *"Digital competence consists of the skills and practices required to use new technologies in a meaningful way and as a tool for learning, working and leisure time, understanding the essential phenomena of digital technologies in society as well as in one's own life, and the motivation to participate in the digital world as an active and responsible actor."*

Vieru et al. (2015) suggest the following conceptualization of individual digital competency that consists of the *technological*, *social*, and *cognitive* areas.

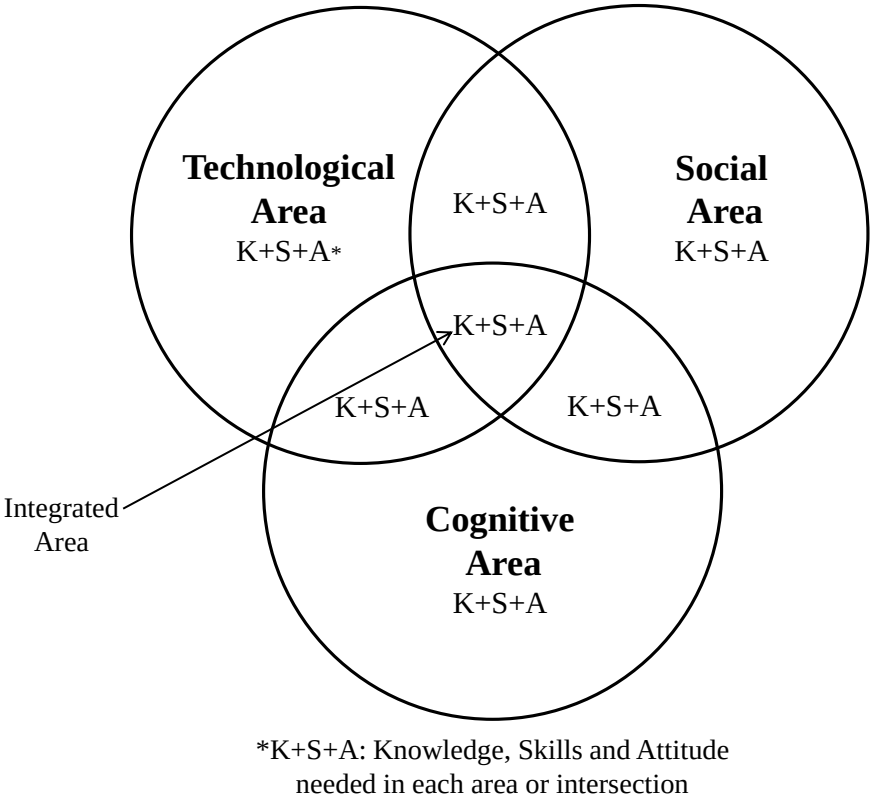

Figure 2: Individual digital competency model (Vieru et al. 2015, p. 4683)

In a subsequent step, Vieru et al. (2015) consider the seven competence areas suggested by Ferrari (2012) and assign them to the areas of their competency model (Figure 2). Further descriptions are provided inTable 5.

Table 5: Integrative view on digital competency (Vieru et al. 2015, p. 4685)

Competence area (Ferrari 2012)	**Assigned area in Figure 2**	**Description**
Information	Intersection of Technological and Cognitive areas	Identify, locate, access, retrieve, store and organize information.
Collaboration	Social area	Link to others, participate in online networks and communities, and interact constructively and with a sense of responsibility.
Communication and sharing	Intersection of Technological and Social areas	Communicate through online tools, considering privacy, safety and netiquette.
Creation of content and knowledge	Cognitive area	Construction of new knowledge through technology and media. Integrate previous knowledge; construct new knowledge.
Ethics and responsibility	Intersection of Social and Cognitive areas	Behave in an ethical and responsible way, aware of the legal frame.
Evaluation and problem solving	Integrated - Technological, Cognitive and Social areas	Identify digital needs, solve problems through digital means, and assess the information retrieved.
Technical operations	Technological area	Use technology and media, perform tasks through digital tools.

As typical for novel research fields, there is no consensus about the terminologies, leading Ferrari (2012, p. 11) to speak about a "jargon jungle". Pasadas Ureña (2010, p. 18) agrees and concludes that there is a "terminological chaos" given the high number of terms that have appeared for describing the construct of digital competency (Ilomäki et al. 2016). Amongst others, this includes specific digital literacies (computer, Internet, media), encompasses the necessary ICT skills, and end at more complex labels that include skills, understandings, norms and practices (Meyers et al. 2013).

Most often, digital competency is mixed up with digital literacy (Ilomäki et al. 2016). It is argued that digital competency and literacy are almost similar but not identical (Gallardo Echenique et al. 2015). However, the terms digital competency and digital literacy are often used interchangeably and are regarded as conceptually equivalent. Digital competency is preferred over the term literacy though because it is referred to more often in both literature and international bodies (Li and Ranieri 2010).

Although many terms, concepts, definitions and explanations of digital competencies have been proposed, scholars agree that concrete descriptions from a practical point of view are missing (e.g., Janssen et al. 2013). This is also one reason as to why an exact measurement of digital competencies in the workforce is difficult. So far, specific and practical explanations do not exist on how to gain a comprehensive overview of these competencies. While addressing these gaps, research manuscripts 3 and 4 both suggest different approaches to how the required competencies for specific occupations could be derived. Both approaches integrate established competency measures and digital competencies.

3. Outline of research manuscripts

In this section, the four manuscripts of this dissertation are introduced while a focus is placed on highlighting the important differences and features thereof. An overview of all four manuscripts is presented in Table 6.

3.1. Research objectives and research questions

Due to the novelty of the research field *required competencies for working in the digital age*, there are various unexplored and under-researched topics. Thus, while aiming to identify different aspects of the research field, the overall nature of this dissertation is explorative. In line with this argumentation, research manuscript 1 deals with a very fundamental question which is also the title of the article: *Digital Competences of the Workforce – A Research Topic?* Manuscript 1 thereby lays the foundation of this dissertation by discussing the usefulness and necessity of researching the topic of digital competencies. It is framed as a position paper in which different opinions and views are discussed. Manuscript 1 has been published in the *Business Process Management Journal* in 2017.

Manuscript 2 deals with the structural requirements for digital transformation in an organizational context. These requirements are derived through a content analysis of expert interview transcripts. The findings (i.e., structural requirements) allow for a better understanding of the organizational settings workers must deal with in the digital age. The organizational level plays an important role when investigating required competencies in digital working environments, as organizations are where the work takes place, where work is organized, and where the competencies of the individual employees are relevant. This, again, emphasizes the sociotechnical perspective of this dissertation.

In the context of the digital transformation, the organizations are subject to massive changes, and these changes and requirements need to be understood as they determine the environment for the individual employees. In a previous version, manuscript 2 has been presented at the *International Conference on Competence-based Strategic Management* in September 2017 in Berlin. Based on the reviews and the feedback at the conference itself, the paper has been revised and further developed, and we followed the invitation to a fast-track of the *Journal of Competences, Strategy & Management*. The version presented in this dissertation has benefitted from two rounds of review and corresponding revisions and is therefore in the third round of review.

Manuscripts 3 and 4 explore the required competencies individual workers should possess in specific occupations, namely big data professionals (manuscript 3) and sales professionals (manuscript 4). Manuscript 3 has been presented at the *European Conference on Information Systems* 2017 in Guimaraes and is published in the conference proceedings. In manuscript 3, the required competencies of data professionals are subject to being elaborated, leading to the research question *What are required competences of data professionals in the UK?* The second objective addressed in manuscript 3 is the comparison between the demanded competencies and imparted competencies in data-related master's programs.

Manuscript 4 has been submitted to the *Hawaii International Conference on System Sciences* and passed the desk reject. It deals with the occupation sales professional and distinguishes two different channels of sale, i.e., physical and digital. The research question is *How do the competencies required for sales professionals differ between digital and physical channels of sale?* While manuscripts 3 and 4 have a similar research objective, their research designs are completely different. This is outlined in detail in the following Section 3.2.

Table 6: Overview of research manuscripts

Manuscript No.	1	2	3	4
Title	Digital Competences of the Workforce – A Research Topic?	Structural Requirements for Digital Transformation – Insights from German Enterprises	Demanded and Imparted Big Data Competences: Towards an Integrative Analysis	Comparing Required Competencies of Sales Professionals Servicing Digital and Physical Channels of Sale
Authors	Murawski, Bick	Murawski, Thordsen, Martensen, Rademacher, Bick	Murawski, Bick	Murawski, Blatz, Bick
Outlet	Business Process Management Journal (BPMJ)	Journal of Competences, Strategy & Management (JCSM)	European Conference on Information Systems (ECIS)	Hawaii International Conference on System Sciences (HICSS)
VHB Ranking	C	C	B	C
Associated Points	0.75	0.3	1	0.5
Publication Status	Published (2017)	Under review (Revised & Resubmitted)	Published (2017)	Desk reject passed
Research Type	Position Paper	Empirical Paper	Empirical Paper	Empirical Paper
Research Objective	Dealing with the question of whether the digital competencies of the workforce is a research topic, particularly for the IS field	Assessing and, if required, extending the DTF by naturalistic evaluation, meaning that findings from other domain experts are analyzed and integrated	Exploring the required competencies of big data professionals in the UK and comparing them with the competencies imparted by data-related master's programs in the UK	Exploring the required competencies of sales professionals in a German children's entertainment company, thereby comparing different sales channels
Research Questions	Is the topic "digital competencies of the workforce" a research topic?	Which structural requirements identified in our cross-domain analysis are not part of the initial DTF of Hess et al. (2016)? Which structural requirements identified in our cross-domain analysis are already part of the initial DTF of Hess et al. (2016)? Which structural requirements of the initial DTF of Hess et al. (2016) could not be identified in our cross-domain analysis?	What are required competences of data professionals in the UK? What competences are imparted by data-related master`s programmes in the UK? How do data-related master`s programmes match competence requirements for data professionals in the UK?	How do the competencies required for sales professionals differ between digital and physical channels of sale?

3.2. Theoretical environments, study designs, and research methods

All four manuscripts are based on the competence-based theory (CBT) (Freiling 2004; Freiling et al. 2008) but focus on different aspects within this theoretical framework (see also Table 7).

In the CBT, the importance of organizational resources and capabilities in creating value and competitive advantage for firms is emphasized (Hazen et al. 2017). Organizational resources are understood as assets that are owned and controlled by an organization and that use other assets or processes to convert them into final products or services. Examples are patents, licenses, machinery, and human resources (Hazen et al. 2017). According to the competence-based theory as a development of the resource-based view of the firm (Barney 1991), competencies are one possible resource category, which enables firms to achieve performance and competitiveness. "In such a context, employee competencies are treated as valuable assets that must be nourished and are interpreted as being beneficial for both employee and organization. As such, occupational expertise and employability provide both work continuity and career development opportunities" (van der Heijde and van der Heijden 2006, p. 451). This statement also includes the perspective of the individual, who might ask why it is important for them to be competent. The answer to this question is, as indicated in the previous quote, *employability* (Hogan et al. 2013; van der Heijde and van der Heijden 2006). Employability encompasses a diversity of career aspects of (potential) employees (e.g., physical and cognitive suitability, flexibility, adaption to new changes, and mobility) but all referring to employment as an outcome (van der Heijde and van der Heijden 2006).

Generally, examining the individual perspective is in line with the so-called *micro-foundation* (Barney et al. 2011; Foss 2011). The core assertion of micro-foundation is summarized by Foss (2011, p. 1414) as "foundations that are rooted in individual action and interaction" in contrast to the pure organizational level considered in the initial resource- and competence-based view. The behavior of an organization is always related to the activities of the individual components and cannot be independent of them - such as the individual workforce. As manuscripts 1, 3, and 4 deal with required individual competencies, they can be assigned to this theoretical stream.

The remaining manuscript 2 deals with another aspect of CBT: the focus is placed on capabilities. Capabilities are defined as "information-based, tangible or intangible processes that are firm-specific and are developed over time through complex interactions among the firm's resources" (Amit and Schoemaker 1993, p. 35) and one of their key characteristics is that they are typically based on creating, utilizing, and exchanging information within organizational human resources (Amit and Schoemaker 1993). Capabilities are often divided in operational

and dynamic capabilities (Hazen et al. 2017). While operational capabilities are associated with day-to-day activities, dynamic capabilities extend, change, or reconfigure other (operational or dynamic) capabilities (e.g., Eisenhardt and Martin 2000; Teece et al. 1997). The associated theory, the dynamic capabilities theory (DCT), aims at investigating how organizations can adequately respond to the specific challenges of a changing market. The DCT is an approach which gained importance in times of ever-changing markets caused by digital technologies (Legner et al. 2017). The core idea of the DCT rests on the distinction between stable and dynamic environments (Bourgeois and Eisenhardt 1988). Associated with this differentiation is the thought that certain so-called "core resources" are more useful to a firm in a relatively stable market. Analogously, dynamic resources are more useful to a firm in unstable, high-velocity or dynamic environments (Eisenhardt and Martin 2000; Teece et al. 1997). The research objective of manuscript 2, i.e., exploring structural requirements for digital transformation, fits this context, as structural requirements can be interpreted as antecedents for dynamic capabilities. Moreover, based on the ideas of the CBT with a focus on the DCT, manuscript 2 deals with a prescriptive model, the digital transformation framework (DTF) of Hess et al. (2016). This model supports managers in their decisions towards a digital strategy and is subject to evaluation and enhancement in manuscript 2.

Although the four manuscripts are framed in the same theoretical framework (i.e., CBT), I have applied different research designs depending on the research questions. Regarding the research type, manuscript 1 is an exception as it is the only study that is not an empirical paper. Instead, manuscript 1 is of conceptual nature and is based on literature as well as our own opinions and views, which fits the publication type that is a position paper. Manuscripts 2, 3, and 4 are of empirical nature. More specifically, they can be assigned to the category of qualitative research. However, manuscript 3 is an exception in this regard as it contains both qualitative and quantitative aspects.

Manuscript 2 is based on 16 semi-structured interviews with German experts in the field of the digital transformation of organizations (e.g., consultants, researchers, professionals from industry). The access to this sample was ensured by two of the co-authors of the paper who were working in the consultancy sector at that time. The transcripts of the interviews were analyzed using a content analysis. More specifically, the *Gioia* methodology (Gioia et al. 2013), which ensures high transparency and reliability, was employed. For the coding categories, we referred to the Digital Transformation Framework (DTF) of Hess et al. (2016).

The design of manuscript 3 deviates from the other manuscripts. First, two separate analyses were conducted in parallel and later integrated. Second, a relatively new analysis approach, a topic model, was applied for one of the analyses. In particular, the first analysis sought to explore the competencies of big data professionals. We used 500 online job advertisements downloaded from the job search engine *monster.com*. After several steps of cleansing the data, we applied a topic model, more specifically the so-called Latent Dirichlet Allocation (LDA) model (Blei 2012; Blei et al. 2003), in order to derive ideal types of data professionals. A topic model has a similar approach as the explorative factor analysis, meaning that it can compute latent factors, respectively *topics*. These topics can be interpreted as ideal types (Müller et al. 2014), in our case ideal types of big data professionals. However, working with the output is a rather interpretative process, indicating qualitative research aspects as well. The associated required competencies per ideal type are also part of the topic model output. The competencies were assigned to the competency categories suggested by Todd et al. (1995). Because of the large sample size and the statistical computations associated with the topic model, this approach includes quantitative elements, as well. The second analysis conducted in this study was the analysis of the curricula of data-related master's programs (Turel and Kapoor 2016). The sample consisted of 12 different curricula and we conducted a deductive category assignment (Mayring 2014), while using the competency framework of Todd et al. (1995) once more. Applying the same competency categories allowed us to compare the required (derived from job advertisements) and imparted (derived from study programs) competencies of big data professionals.

In manuscript 4, a case study approach was conducted. One co-author previously worked for a successful company in the German children's entertainment market and his good relationships to the CEO helped us gain access to both employees and other sources such as internal documents, financial sheets, etc. We then firstly gathered and coded different material (e.g., e-mails with customers, internal reports, and minutes) and developed a competency lexicon. Next, we conducted behavioral event interviews, which is recommended by existing research on discovering competencies (McClelland 1973; Spencer and Spencer 1993). This kind of interview makes the interviewees' report about very negative and positive events, how they felt and how they reacted (Spencer and Spencer 1993). At the time of the case study, the company employed seven sales professionals. Such a small sample size requires a participation rate of 100% (Lucia and Lepsinger 1999). Thanks to the good connections to the company of one of the co-authors, this goal was achieved. The interview transcripts were coded while we used the previously determined competency lexicon as our coding categories. Table 7 provides an overview of the theoretical views and the research design of the four research manuscripts ("RM" in Table 7).

Table 7: Theoretical frameworks and designs of the research manuscripts

RM	Theoretical framework	Research design and methods	
1	Competence-based theory / Micro-foundation	Type	Conceptual
		Method	Literature review; pros and cons debate
2	Competence-based theory / Dynamic capabilities	Type	Empirical
		Methods	Semi-structured interviews, content analysis (Gioia approach)
		Data	Transcribed interviews with 16 German experts
3	Competence-based theory / Micro-foundation	Type	Empirical
		Methods	(i) Text-mining / topic model (ii) Content analysis
		Data	(i) 500 online job advertisements related to data professionals from the UK job market (ii) 12 curricula of data-related master's programs from universities located in the UK
4	Competence-based theory / Micro-foundation	Type	Empirical
		Methods	Case study (including behavioral event interviews, analysis of internal documents, observations)
		Data	Transcribed interviews with seven sales professionals (100% of the sales professionals in the case company) and internal documents (reports, financial sheets, minutes, etc.)

4. Research manuscripts

This section contains the four research manuscripts in their current versions at the time of submission of this dissertation; two papers were accepted and published, and two papers are still under review. Special requirements by the publishers (e.g., regarding citation style) are kept as in the (intended) outlet.

4.1. Manuscript 1: Digital Competences of the Workforce – A Research Topic?

Manuscript No. 1

This manuscript is published as:

Murawski, Matthias; Bick, Markus (2017): Digital competences of the workforce – a research topic? In: *Business Process Management Journal*, Vol. 23 Issue: 3, pp.721-734.

DOI: https://doi.org/10.1108/BPMJ-06-2016-0126

4.2. Manuscript 2: Structural Requirements for Digital Transformation – Insights from German Enterprises

Manuscript No. 2

This manuscript was submitted (status: revised & resubmitted, 3rd round of review) as:

Murawski, Matthias; Thordsen, Tristan; Martensen, Malte; Rademacher, Christina; Bick, Markus: Structural Requirements for Digital Transformation – Insights from German Enterprises.

Intended outlet: *Journal of Competences, Strategy & Management*.

Manuscript 2 is available upon request.

4.3. Manuscript 3: Demanded and Imparted Big Data Competences: Towards an Integrative Analysis

Manuscript No. 3

This manuscript is published as:

Murawski, Matthias; Bick, Markus (2017): Demanded and Imparted Big Data Competences: Towards an Integrative Analysis. In: *Proceedings of the 25th European Conference on Information Systems (ECIS)*, Guimarães, Portugal, June 5-10, 2017, pp. 1375-1390.

ISBN: 978-989-207655 Research Papers

Permanent link: http://aisel.aisnet.org/ecis2017_rp/89

4.4. Manuscript 4: Comparing Required Competencies of Sales Professionals Servicing Digital and Physical Channels of Sale

Manuscript No. 4

This manuscript was submitted (status: desk reject passed) as:

Murawski, Matthias; Blatz, Karl C.; Bick, Markus: Comparing required competencies of sales professionals servicing digital and physical channels of sale: a case study of a German children's entertainment company.

Intended outlet: *Proceedings of the 52th Hawaii International Conference on System Sciences (HICSS)*.

Manuscript 4 is available upon request.

5. Discussion

In the first part of this section, the three main contributions of this dissertation (see introduction) are discussed. Subsequently, the main implications for academia and practice are outlined. The following subsection 5.3 deals with the study's limitations and further research opportunities.

5.1 Contributions

Analysis of the manuscripts in a sociotechnical context, i.e., considering and integrating the dimensions human, technology, and organization

A *sociotechnical system* contains *human*, *technology*, and *organization* components. More specifically, sociotechnical systems deal with the interactions of humans and technology while also considering the organizational infrastructure (Hirsch-Kreinsen and Hompel 2016). Such a system combining these three dimensions reflects the core of the IS discipline (e.g., Sawyer and Jarrahi 2014). The dimension *human* is sometimes replaced by the dimension *management* (e.g., Laudon and Laudon 2014), which is caused by a particular focus on *management* information systems. However, both *human* and *management* are about the actions, behaviors, and characteristics of people. In order to structure the manuscripts of this dissertation, I suggest the following illustration of a sociotechnical system and assign the four manuscripts (depicted as the blue and numbered bullets in Figure 3) according to their scopes.

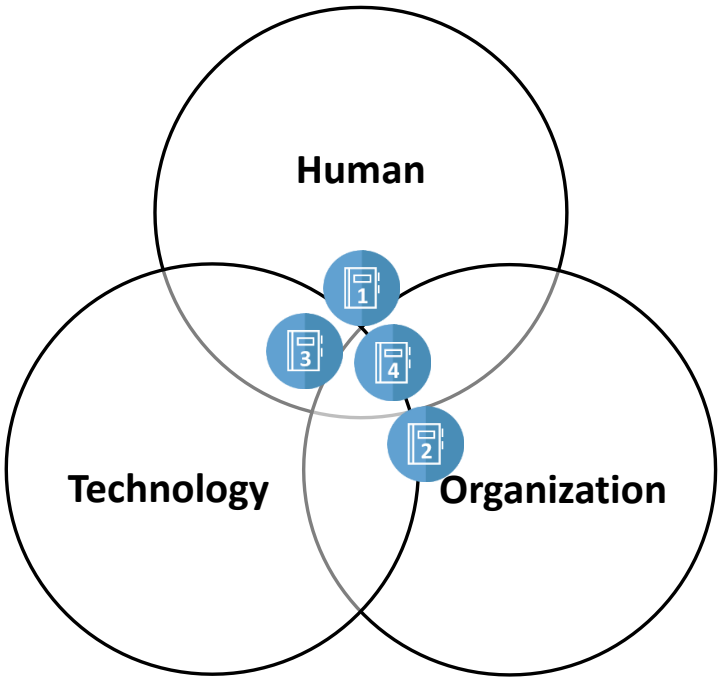

Figure 3: Sociotechnical perspective on the research manuscripts

Manuscript 1 places a strong focus on the individual worker. For example, the question "Which digital competences are required for employability in the digital age?" (manuscript 1, p. 24) refers to an issue individuals are confronted with in a digital working environment. The dimension *organization* is also partly affected. Indicators are some of the potential research questions from the research agenda[8] which deal, for example, with HR-related topics. Furthermore, identified competency areas such as security, communication, and teamwork affect the organizational level. Manuscript 1 also has some touchpoints to digital technology, which is presented in order to emphasize the current technological shifts. Also, some competency fields related to technology are identified. However, *technology* is not in the center of interest in manuscript 1. To sum up, manuscript 1 is assigned to the *human* section with an equal tendency towards the *technology* and *organization* dimensions.

In contrast, manuscript 2 hardly considers any *human*- or individual-related aspects. Though there are some aspects on an individual employee level (e.g., when discussing the development of skills and competencies as part of a structural requirement) and management level (i.e., the DTF is a tool for managers), the overall tenor is *organizational*. The entire analysis including the questions asked during the interviews considers the enterprise level. However, the paper is framed in the context of digital transformation, which, in turn, is strongly linked to digital technologies. Thus, also the *technological* dimension is affected in this paper, but to a lower extent than the *organizational* dimension.

Considering manuscript 3, the analysis takes place on the individual level (i.e., the individual big data professionals) and therefore covers the *human* dimension. The paper also covers the *technology* dimension as digital technology (i.e., big data) constitutes the basis for this novel occupation field. In addition, some of the elaborated required competencies are of technical nature, which further emphasizes the *technology* aspect. As this study also contains imparted competencies by study programs, the *organizational* dimension (i.e., in this case the education institutions) is at least touched, as well. Furthermore, the analyzed job advertisements are published by organizations, i.e., companies which are hiring.

[8] The suggested research agenda underscores the ground-laying character of manuscript 1 and emphasizes its suitability as the first study which I selected for my dissertation project. Referring to the research agenda, I particularly addressed the topics of *demand of digital competencies* (manuscripts 3 and 4, and to some extent also manuscript 2) and *curricula design* (manuscript 3) in the following studies.

Manuscript 4 covers all three dimensions of the sociotechnical view. As in manuscript 3, the required competencies of individual workers (i.e., sales professionals) are derived and the *human* dimension is thus addressed. Furthermore, although it is not the core of the paper, digital *technology* is covered, as a comparison between the physical and digital channels of sales is conducted. These digital channels of sales are based on digital technology, such as streaming. Additionally, at least some technical competencies are elaborated. Due to the study design (i.e., single case study), manuscript 4 affects the *organizational* dimension, as well. The infrastructure, rules, and characteristics of the case company influence the findings of this paper.

Overall, it can be concluded that the four manuscripts contribute to all the three main pillars of the IS discipline. The focus is however placed on the *human* dimension, while the *technology* dimension is also addressed by all papers. The *organization* dimension is covered to a lesser extent than the *human* dimension but is extensively addressed in two of the four manuscripts (i.e., manuscripts 2 and 4). In other words, the four manuscripts mainly address the intersections of the three sociotechnical dimensions. This emphasizes the integrating nature of this dissertation.

Enhancing related theoretical frameworks

The topic of this dissertation is a novel one and it is therefore not surprising that most existing studies are explorative in nature (e.g., Debortoli et al. 2014; Shahlaei et al. 2017). Thus, established and empirically-tested theories dedicated to required competencies in digital working environments do not exist to the best of my knowledge. The literature review conducted in manuscript 1 supports this finding. Academic work on digital competencies is mainly conceptual in nature but there is a lack of solid theoretical development.

The underlying theoretical framework of this dissertation is the CBT (Section 3.2) with a focus on micro-foundations and the relation between competencies and employability (manuscripts 1, 3, 4) on the one hand, and the antecedents of dynamic capabilities on the other hand (manuscript 2). In order to structure the discussion of the theoretical contribution, I will use the building blocks of theory development suggested by Whetten (1989) (see Figure 4). The article of Whetten (1989) has gained popularity among scholars as it addresses those aspects which constitute a theoretical contribution in a very comprehensive and distinct manner. By providing so-called *building blocks*, it forms a suitable framework to structure the following discussion.

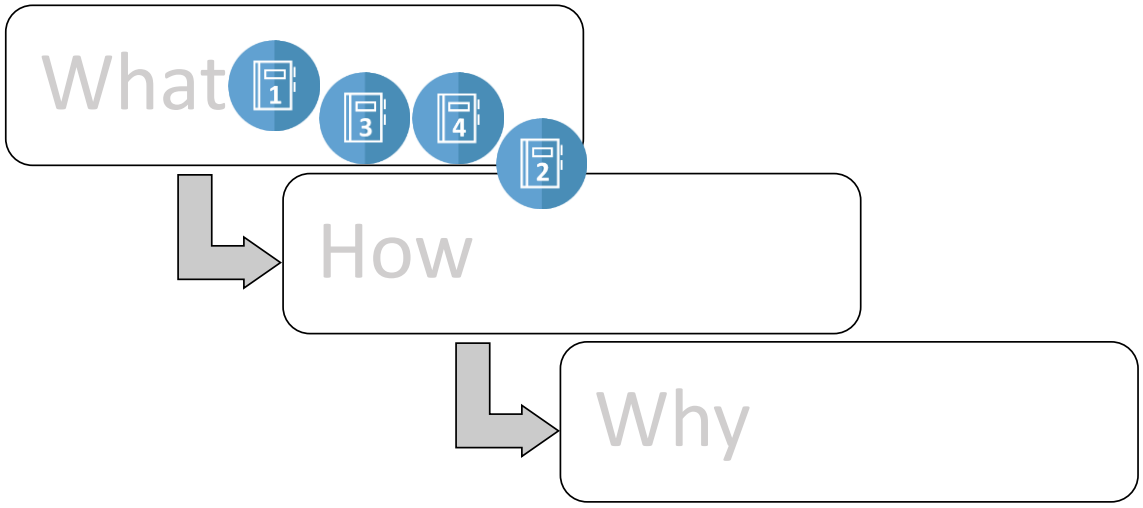

Figure 4: Theoretical contributions of the four manuscripts according to Whetten (1989)

The first building block is the *what*, covering those factors (e.g., variables, constructs, concepts) which "logically should be considered as part of the explanation of the social or individual phenomena of interest" (Whetten 1989, p. 490). The findings of all four manuscripts make a clear contribution to this block.

First, by putting the lens on required competencies, more insights regarding the operationalization of competency as a construct are elaborated. Particularly in the context of CBT and its micro-foundation, in which individual competency impacts the competitive position of a company, a profound and detailed understanding of competency is necessary. The value of this contribution even increases given the unstructured research on required competencies for digital work, which has been elaborated and unified in manuscript 1. Because of this fundamental character, manuscript 1 is placed in the center of this block. Manuscripts 3 and 4 are less basic but contribute with more specific findings. They are therefore placed on a slightly "deeper" level in Figure 4.

Second, considering the organizational perspective of manuscript 2, examining the structural requirements for digital transformation also addresses the *what* according to Whetten (1989). In the context of theory, these structural requirements can be related to the antecedents of dynamic capabilities. As discussed in manuscript 2, these antecedents are – so far – of a rather generic nature. Through our work, we extend the empirical basis of the antecedents of dynamic capabilities, and we put them in the frame of the prescriptive DTF of Hess et al. (2016). Thereby, the DTF benefits from a stronger theoretical attachment. Generally, rigor work on tools for managing digital transformation is rare. Thus, the extended DTF itself is a theoretical contribution.

The second building block is the *how*, referring to the manner in which the identified factors are related (Whetten 1989). This block is also addressed in this dissertation, but to a smaller extent compared to the *what*. In the CBT, the core mechanism is the relationship between – among others – competencies as a resource and competitive advantage of a firm. On the individual level, the main mechanism is the relationship between competencies and employability. However, none of the four manuscripts explicitly elaborates *competitive advantage* or *employability*. Nevertheless, the employability aspect is at least indirectly part of the analysis. Taking the case of manuscript 3, we analyzed job advertisements as a proxy for the required competencies. Fulfilling these competencies is assumed to increase the chances to get employed. Also during the case study in the frame of manuscript 4, we learnt during the interviews that employees are aware of the fact that their competency profiles have an influence on their employability. But aside from these assumptions, there is no empirical test, e.g. in a quantitative design, that analyses the *how*. Manuscript 2 contributes to the *how* as its findings (i.e. structural requirements) relate to the antecedents of dynamic capabilities. These antecedents are clearly defined in terms of their position (i.e., the begin) and their relationships to other elements in the dynamic capabilities approach (Schilke et al. 2018).

The third building block is the *why*, dealing with the question of the "underlying psychological, economic, or social dynamics that justify the selection of factors and the proposed causal relationships" (Whetten 1989, p. 491). This block is hardly addressed in the four studies and this clearly underscores the explorative nature of this dissertation.

As discussed for the *how*, a potential causal relationship, for example the positive impact of a high individual digital competency level on employability, seems intuitively reasonable, but the underlying dynamics and explanations are not empirically analyzed in this dissertation. This indicates the boundaries in terms of the theoretical contribution of this thesis.

Furthermore, Whetten (1989) emphasizes to also consider the temporal and contextual factors which set the boundaries of generalizability, summarized as *Who*, *Where*, *When*. As different data sources have been analyzed (i.e., literature, job advertisements, curricula, cross-domain expert interviews, sales persons during a case study), and as different geographic regions have been selected (especially Germany and the UK), the findings of the manuscripts provide different perspectives but cannot be interpreted as one large integrative study. By explicitly focusing on the novel aspects of the CBT in the context of digital work (e.g., new tasks, new technology), the aim has been to follow the recommendation of Whetten (1989, p. 493): "It is preferable to investigate qualitative changes in the boundaries of a theory (applications under qualitatively

different conditions), rather than mere quantitative expansions". In addition, it must be noted, and this is of importance for such a dynamic topic as digital work, that only limited time frames have been analyzed, which constitutes another boundary of the theoretical contribution.

To summarize, the theoretical contribution of this dissertation is mainly related to a better understanding of individual competencies and structural requirements for organizations, thereby contributing to some of the main factors of CBT. Furthermore, assumptions such as the relation between individual competencies and employability can be supported, but not empirically tested. Further boundaries are set by the contextual settings of the manuscripts.

Elaboration of concrete required competencies for two specific occupations, i.e., big data and sales professionals

Compared to manuscript 1 (conceptual) and manuscript 2 (organizational), manuscripts 3 and 4 mainly consider the individual worker. The major findings of manuscript 3 are a set of five different data professional ideal types including the *demanded competency* categories, and the identification of those *competencies which are imparted* in 12 data-related master's programs. Thereby, manuscript 3 responds to two areas suggested in the research agenda in manuscript 1.

First, the question of *demanded competencies for a specific occupation* is answered. Big data professionals, and this is surprising, should possess high *business* competencies (i.e., domain, management, social), while *technical* competencies (i.e., hardware, software) are of less importance. What we derived from the job advertisements from the UK market is that all five ideal types of data professionals should be "all-rounders", meaning that they should combine high levels of *business* and *system* (i.e., problem-solving, development) competencies supported by basic *technical* competencies.

Second, the *imparted competencies through data-related master's programs in the UK* are investigated and found to be different to the demand side. These programs place the focus on *system* competencies and to a lesser extent on *technical* competencies. They hardly impart *business* competencies. Thus, there seems to be a gap between demand and supply (in terms of imparted competencies). During the discussion of our study at the *ECIS 2017*, I received feedback that also confirms such gaps for other countries such as Germany. One potential explanation for the phenomenon could be that the role of data professionals is quite new (e.g., Davenport and Patil 2012). Thus, on the one hand, job advertisements could be formulated in a very generic manner, covering "everything" related to big data including the interfaces to business.

On the other hand, due to a lack of experience, study programs might also be too generic. Consequently, and this was also mentioned during the discussion at *ECIS 2017*, some scholars expect a convergence in this field.

The main finding of manuscript 4, which also addresses the individual level, is a competency lexicon for the sales professionals of the case company. It contains 18 different competencies, which are mainly based on the categories suggested by Spencer and Spencer (1993), who developed a set of competencies for sales professionals at that time. It was therefore essential to update their 25 year-old set of competencies. Hence, among other updates, we included the category *digital competencies* in the lexicon. Subsequently, we conducted behavioral event interviews with all sales professionals in the case company and applied the competency lexicon for coding purposes. We then distinguished between physical and digital channels of sales and compared the required competencies. We found that for sales professionals servicing digital sales channels, the required competencies most commonly identified are *achievement orientation, teamwork and cooperation, conceptual thinking, analytical thinking,* and *organizational awareness*. For sales professionals servicing physical sales channels, the competencies most often discovered are *analytical thinking, teamwork and cooperation, impact and influence,* and *customer service orientation*. While further details on the results are presented in manuscript 4 itself, we can conclude that *teamwork and cooperation* and *analytical thinking* are generally of utmost importance in the case company.

Confronting these findings with the results from manuscript 3, one essential and even surprising take-away is the fact that both analyses predominantly reveal non-technical competencies as being very important. Considering Germany, calls from politicians (e.g., N.N. 2017; Quadbeck 2014) and practitioners (e.g., Bröcker and Kowalewsky 2018; Schwan 2017) to integrate "programming" as a regular subject in schools do therefore not cover the entire challenge related to digital work. I will add some of my own thoughts on this topic in the conclusion section.

5.2 Implications for academia and practice

Based on the findings and contributions presented previously, I will express the main implications of the dissertation in this section. My overall approach was conducting studies which fulfill both aspects of good research, namely rigor and relevance. In particular, the lack of practical value of IS research is often criticized, leading Peppard et al. (2014) to call for more relevance and practical value of IS research.

The implications for academia include a call for an academic definition of digital competencies. Only a solid understanding of the construct will facilitate sound operationalization and, in turn, empirical investigations. However, it could also be argued that there is no final definition for digital competencies, for example, because of the rapid changes of digital technologies. This corresponds to Ilomäki et al. (2016), who interpret digital competencies as a boundary concept instead of a fixed definition. In general, when it comes to empirical studies, recent publications do not explicitly regard digital competencies, but rather the competencies required for a digital job (e.g., Aničić and Arbanas 2015; Shahlaei et al. 2017). This is the same approach we conducted in manuscripts 3 and 4. In my opinion, this approach is more suitable when considering specific occupations, especially since there are always other competencies besides the digital competencies required for enhanced employability. This is of particular importance if digital competency is primarily understood from a technical perspective but not as broad as, for example, Vieru et al. (2015) who also consider cognitive and social aspects (see 2.2.2).

Another implication for research is related to the standardization of competencies. In manuscript 3, we derived competences from online job advertisements and curricula. For standardization purposes, we applied the competency framework of Todd et al. (1995). This framework is, however, rather generic in nature. The findings of manuscript 4 present an approach as to how digital competencies can be integrated in research on the required competencies for a specific occupation. This was done based on logical reasoning and formal as well as informal communication with the employees in the case company. The development of a competency lexicon is a valuable step as, for example, it can be used for coding.

The methods applied in manuscripts 3 and 4 lead to further implications for research. In manuscript 3, the application of a topic model for deriving competencies is an innovative approach and could act as a starting point for the further deployment of this method. But although recently suggested as a new method for the IS community (Debortoli et al. 2016; Müller et al. 2016), its actual use in the IS field is marginal so far. However, in my opinion, the topic model is very valuable for the objective of our study. It allows analyzing huge amounts of textual data and is easy to interpret, because of its similarity to the well-established explorative factor analysis. A manual analysis of 500 job advertisements (e.g., content analysis) is theoretically possible, but practically difficult to realize given the time and resource constraints in a dissertation project. Considering the method of manuscript 4, the application of behavioral event interviews is not very common in IS research. It has its roots in competency-based approaches (McClelland 1973; Spencer and Spencer 1993), and it is claimed to be superior to traditional interviews. As explained in manuscript 4, this is because individuals are often unable to self-evaluate their own

competencies in an accurate manner. By using behavioral event interviews, competencies are explored by examining critical past events. In my opinion, this type of interview could also be applied in other IS studies as a meaningful alternative to traditional interview designs which dominate the field, especially in studies that deal with self-evaluation.

From a practitioner's perspective, a sound and comprehensive definition of digital competencies is of less importance. However, the research agenda suggested in manuscript 1 contains several practically relevant aspects of digital competencies. One is the alignment of multiple stakeholders for the design of curricula. As shown in manuscript 3 for big data, study programs do often not fit presumed industry needs (see also Turel and Kapoor 2016; Wixom et al. 2014). One potential reason could be the limited inclusion of digital competencies into curricula. Generally, the findings of manuscript 3 are valuable for different groups of practitioners and include implications for them. First, data professionals or people who are interested in this job are, on the one hand, informed about the current requirements regarding their competency profile. On the other hand, they are informed about the current offerings of universities and how these offerings deviate from specific roles. Second, HR professionals are informed about the gap and might consider building better relations to universities for aligning demanded and imparted competencies. Third, universities might adjust their curricula according to the market demand. The implications mentioned in this paragraph underline the need for an interdisciplinary approach.

The practical implications related to manuscript 4 are limited to the case company at first glance. However, I believe that a competency lexicon is a useful tool for any HR department, for example in order to refine the recruitment process. The HR department of the case company even explained that they are willing to integrate behavioral event interviews, which they were introduced to during our field work, in the personnel selection procedure.

Further practical implications on the organizational level can be derived from manuscript 2 and particularly concern managers who must deal with digital transformation and require a supporting tool for related strategy development. The extended version of the DTF of Hess et al. (2016), which has been developed in manuscript 2, benefits from a broader empirical (cross-domain) basis and can support managers to better cope with the digital transformation. Aside from the related theoretical contribution in this regard (see section 5.1), this is a valuable development of a prescriptive tool to manage the digital transformation of a company.

5.3 Limitations and further research

As with every research project, there are also some limitations associated with my dissertation. On a paper-level, they are presented in the single manuscripts. In the following, I will describe the overall limitations of the dissertation and use them as a basis to derive further research opportunities.

Referring to the sociotechnical discussion of the four manuscripts (see 5.1), the focus of this dissertation is placed on the *human* dimension, and – to a lesser extent – on the *organizational* and *technological* dimensions. However, we have seen in the manuscripts, especially in manuscripts 4, that there are always intersections between the human and organizational dimension, e.g., when managing the development of competencies. Further research could place a stronger focus on these intersections to provide useful insights for managers. Another research opportunity could be to put a digital technology (and not an occupation) in the center of interest, and to elaborate related required competencies. This is partly done in manuscript 3 (focus on big data), but there are other increasingly important digital technologies (e.g., AI, blockchain) which could serve as starting points for future research studies.

Furthermore, it must be noted that other involved parties are not considered at all in this dissertation, particularly the *policy* dimension. Digital work takes place in a political framework and various ideas and initiatives in this context are intensively discussed, e.g., regarding changes of the working time act, the employment protection act, employment models, or the introduction of an unconditional basic income (e.g., Veit 2017). Gaining a more enhanced understanding of digital work and the competencies required would also necessitate an integration of the political perspective into the analysis, which, in turn, emphasizes the need for interdisciplinary research on this topic once more.

Another general limitation of the presented research is the time aspect. Both analyses of the required competencies (manuscripts 3 and 4) as well as the structural requirements of organizations (manuscript 2) are snapshots, or in other words considering a specific point in time. Taking the immense speed of technological progress and related future changes of the working environment into account, the findings presented in this thesis could be outdated soon. However, they might serve as reference points for further studies. For instance, it could be interesting to investigate the required competencies of big data or sales professionals on a regular basis (i.e., longitudinal studies). This would potentially allow identifying core competencies, meaning those that are not time-dependent but always essential, and those competencies which are time-dependent and therefore more volatile. Furthermore, the occupations around big data in

particular seem to lack a clear definition. We found several job titles which, in fact, are identical in terms of tasks, responsibilities, and requirements. As scholars such as Provost and Fawcett (2013) have highlighted this issue, I assume that further research could contribute to a better understanding of this occupation. At the moment, there seems to be an agreement on the term *data scientist* (e.g., Schumann et al. 2016) for those jobs we have summarized as *data professionals* in manuscript 3.

Another limitation of this dissertation lays in the fact that only two occupations (i.e., big data and sales professionals) are analyzed. It is therefore not possible to formulate conclusions for the total labor market, especially as two different markets (the UK market for data professionals and one company from the children entertainment industry in Germany) are considered. An opportunity for further research could be the development of a competency lexicon, as it has been developed for the case company in manuscript 4, with a broader perspective. Similar to the work of Spencer and Spencer (1993), an updated competency lexicon covering various jobs could be a valuable asset, for example, for education providers to understand the market demands, for HR professionals to improve the recruitment process, and also for people who are interested in a job and would like to know the required competencies. However, such a competency lexicon would have the same weak point as this dissertation that has been outlined in the previous paragraph: it would be outdated soon.

Another limitation that is also related to the previous aspects is the challenge of measuring competencies. Obviously, given the several different methods applied in the literature, there is no exclusive way for measuring the required competencies. In this dissertation, two different approaches have been employed, i.e., deriving required competencies from (i) an analysis of job advertisements and (ii) an analysis of internal documents combined with behavioral event interviews in the context of a case study. In order to gain a more complete picture, further research studies could combine these methods for triangulation purposes. In addition, conducting measurements is not only challenging for competencies but also for employability. As discussed in Sections 3.2 and 5.1, employability seems to be strongly affected by competencies. But what intuitively sounds clear, leads to a function of which both elements are very difficult to measure. Therefore, further research efforts could be focused on developing robust measurements for both *competencies* and *employability*.

Finally, referring to the discussion of the theoretical contribution of this thesis in Section 5.1, further research opportunities exist regarding theory development. In the words of Whetten (1989), the focus of our theoretical contribution lays on the *what*, and to a lesser extent on the

how. What is missing is the *why*. For example, questions such as *Why do individuals with high digital competency levels have higher chances for being employed?* and *Why do firms with a high share of digitally competent employees have a competitive advantage?* seem to be easy to answer at first glance but putting this in a rigor research design is challenging. However, answering such *why*-questions is very important in my opinion, as further arguments for changing the education and training system could be gathered.

6. Conclusion

The so far limited but increasing research on digital work and required competencies emphasizes the early stage but also the need for further investigations in this field. This dissertation contributes to this stream by exploring different facets, as the selection of manuscripts contributes to the three main dimensions of the IS discipline, i.e., *human*, *technology*, and *organization*. The findings make it possible to derive theoretical contributions as well as implications for both academia and practice, and the identified limitations are the basis for further research opportunities. Thus, the overall objective of this dissertation, that is gaining an enhanced understanding of required competencies in digital working environments, is reached.

The most surprising finding of this dissertation is that the required competencies for working in the digital age are not primarily technical competencies. Technical competencies such as *programming* are gaining importance, but we could show in our studies that competencies regarding *teamwork*, *problem-solving*, *creativity*, and *communication* in digital settings are at least of equal importance. Thus, while placing the focus on Germany, I agree with education researchers such as Andreas Schleicher from the OECD that the education and training system requires a fundamental change, which should include the integration of digital competencies into every subject (Schwan 2017). For instance, why do we not use *design thinking* when teaching pupils to find meaningful solutions in the classroom? There are some very first initiatives (e.g., the *Education Innovation Lab*[9] located in Berlin) which follow this approach, but most of today's pupils never get in touch with these tools. Supporting these thoughts, Veit (2017, p. 13) emphasizes the important role of "meta-competencies" which should be developed as early as possible. This includes, for example, *creativity*, *openness to experimentation*, *transdisciplinary competencies*, the *ability to adapt*, and *critical thinking* (Veit 2017). This is in line with the findings presented in this dissertation and seems to also be useful in the light of increasing automatization, as robots and AI are not expected to possess such competencies in the near future (Marr 2018). However, the progress in these fields is fast and it is therefore very important for everybody to be informed about current technological developments and, if required, to adjust their own competency profile. But does the German education system with some schools that use 25 year-old computers and many teachers who are counterexamples of digital-savvy persons offer such opportunities?

[9] http://education-innovation-lab.de/ [accessed 22.10.2018]

Aside from schools but following the idea of lifelong learning, suitable approaches have to be also found for people who are already on the job. Göbel and Zwick (2010) show that for older employees especially training on the job seems to be promising in terms of effectiveness and efficiency. Thus, the usefulness of legally entitled external training and qualification programs can be brought into question (Stettes 2017). This is another good example of the challenge posed by digital work to the legislative body. Designing laws and enforcing them is time-consuming and slow, but digital work is fast.

Referring to the statement in the beginning of my dissertation, actions from all parties, i.e., politicians, managers and company leaders, education and training providers, and individual workers themselves, are required in order to prepare the workforce for the labor market of the future. It is a long and heavy way to go, but there seems to be no alternative if we want to maintain our status as a leading industrial country.

References

Accenture (2018): Intelligent Enterprise Unleashed. Accenture Technology Vision 2018. Available online at https://www.accenture.com/t20180227T215953Z__w__/us-en/_acnmedia/Accenture/next-gen-7/tech-vision-2018/pdf/Accenture-TechVision-2018-Tech-Trends-Report.pdf, checked on 9/17/2018.

Ala-Mutka, Kirsti (2011): Mapping Digital Competence: Towards a Conceptual Understanding. European Commission, Joint Research Center, Institute for Prospective Technological Studies. European Commission, Joint Research Center, Institute for Prospective Technological Studies.

Amit, Raphael; Schoemaker, Paul J. H. (1993): Strategic assets and organizational rent. In *Strategic Management Journal* 14 (1), pp. 33–46.

Aničić, Katarina Pažur; Arbanas, Krunoslav (2015): Right Competencies for the right ICT Jobs – case study of the Croatian Labor Market. In *TEM Journal* 4 (3), pp. 236–243.

Arntz, Melanie; Gregory, Terry; Zierahn, Ulrich (2018a): Digitalisierung und die Zukunft der Arbeit: Makroökonomische Auswirkungen auf Beschäftigung, Arbeitslosigkeit und Löhne von morgen. Edited by ZEW Zentrum für Europäische Wirtschaftsforschung GmbH.

Arntz, Melanie; Zierahn, Ulrich; Gregory, Terry (2018b): Digitalisation Creates Jobs but Needs Targeted Support. Edited by ZEW Zentrum für Europäische Wirtschaftsforschung GmbH. Available online at https://www.zew.de/en/presse/pressearchiv/die-digitalisierung-schafft-jobs-braucht-aber-gezielte-foerderung/, checked on 8/24/2018.

Barney, J. (1991): Firm Resources and Sustained Competitive Advantage. In *Journal of Management* 17 (1), pp. 99–120.

Barney, Jay B.; Ketchen, David J.; Wright, Mike (2011): The Future of Resource-Based Theory. In *Journal of Management* 37 (5), pp. 1299–1315.

Baskerville, Richard (2011): Individual information systems as a research arena. In *European Journal of Information Systems* 20 (3), pp. 251–254.

Bitkom Research (2017): Berufstätige sehen sich nicht für digitale Arbeitswelt gerüstet. Available online at https://www.bitkom.org/Presse/Presseinformation/Berufstaetige-sehen-sich-nicht-fuer-digitale-Arbeitswelt-geruestet.html, checked on 7/13/2018.

Blei, David M. (2012): Probabilistic topic models. In *Communications of the ACM* 55 (4), pp. 77–84.

Blei, David M.; Ng, Andrew Y.; Jordan, Michael I.; Lafferty, John (2003): Latent Dirichlet Allocation. In *Journal of Machine Learning Research* 3 (1), pp. 993–1022.

Bouée, Charles-Edouard (2015): Digital Transformation Doesn't Have to Leave Employees Behind. Harvard Business Review (online). Available online at https://hbr.org/2015/09/digital-transformation-doesnt-have-to-leave-employees-behind, checked on 8/24/2018.

Bourgeois, L. J.; Eisenhardt, Kathleen M. (1988): Strategic Decision Processes in High Velocity Environments. Four Cases in the Microcomputer Industry. In *Management Science* 34 (7), pp. 816–835.

Bröcker, Michael; Kowalewsky, Reinhard (2018): Vodafone-Chef Ametsreiter im Interview: "Programmieren als Schulfach". Available online at https://rp-online.de/wirtschaft/unternehmen/vodafone-chef-hannes-ametsreiter-programmieren-als-schulfach_aid-17739255, checked on 8/30/2018.

Brynjolfsson, Erik; McAfee, Andrew (2014): The Second Machine Age. Work, Progress, and Prosperity in a Time of Brilliant Technologies. 1st ed. New York, London: W.W. Norton & Company.

Calvani, Antonio; Cartelli, Antonio; Fini, Antonio; Ranieri, Maria (2008): Models and Instruments for Assessing Digital Competence at School. In *Journal of e-Learning and Knowledge Society* 4 (3), pp. 183–193.

Cascio, Wayne F.; Montealegre, Ramiro (2016): How Technology Is Changing Work and Organizations. In *Annual Review of Organizational Psychology and Organizational Behavior* 3 (1), pp. 349–375.

Chen, Hsinchun; Chiang, Roger H.L.; Storey, Veda C. (2012): Business intelligence and analytics: from big data to big impact. In *MIS Quarterly* 36 (4), pp. 1165–1188.

Davenport, Thomas H.; Patil, D. J. (2012): Data scientist: the sexiest job of the 21st century. In *Harvard Business Review* 90 (10), pp. 70–76.

Davison, Robert M.; Ou, Carol X.J. (2017): Digital work in a digitally challenged organization. In *Information & Management* 54 (1), pp. 129–137.

Debortoli, Stefan; Müller, Oliver; Junglas, Iris; and vom Brocke, Jan (2016): Text Mining For Information Systems Researchers: An Annotated Topic Modeling Tutorial. In *Communications of the Association for Information Systems* 39 (7).

Debortoli, Stefan; Müller, Oliver; Vom Brocke, Jan (2014): Comparing business intelligence and big data skills. In *Business & Information Systems Engineering* 6 (5), pp. 289–300.

Dettmann, Joe; Canwell, Adam; Wellins, Richard (2018): Digital-Era Leadership. Ready or Not, Digital Competence Is Already Differentiating Winners from Losers. In Development Dimensions International, Inc., The Conference Board Inc., EYGM Limited (Ed.): The Global Leadership Forecast 2018, pp. 12–13.

Deuse, Jochen; Weisner, Kirsten; Busch, Felix; Achenbach, Marlies (2018): Gestaltung soziotechnischer Arbeitssysteme für Industrie 4.0. In Hartmut Hirsch-Kreinsen, Jonathan Niehaus, Peter Ittermann (Eds.): Digitalisierung industrieller Arbeit. Die Vision Industrie 4.0 und ihre sozialen Herausforderungen. 2. Auflage. Baden-Baden: Nomos Verlagsgesellschaft mbH & Co. KG, pp. 195–214.

Eisenhardt, Kathleen M.; Martin, Jeffrey A. (2000): Dynamic Capabilities: What Are They? In *Strategic Management Journal* 21 (10/11), pp. 1105–1121.

Ferrari, Anusca (2012): Digital Competence in Practice: An Analysis of Frameworks. European Commission, Joint Research Center, Institute for Prospective Technological Studies. European Commission, Joint Research Center, Institute for Prospective Technological Studies.

Foss, Nicolai J. (2011): Why Micro-Foundations for Resource-Based Theory Are Needed and What They May Look Like. Invited Editorial. In *Journal of Management* 37 (5), pp. 1413–1428.

Freiling, Jörg (2004): A competence-based theory of the firm. In *Management Revue* 15 (1), pp. 27–52.

Freiling, Jörg; Gersch, Martin; Goeke, Christian (2008): On the Path towards a Competence-based Theory of the Firm. In *Organization Studies* 29 (8-9), pp. 1143–1164.

Frey, Carl Benedikt; Osborne, Michael A. (2017): The future of employment: How susceptible are jobs to computerisation? In *Technological Forecasting and Social Change* 114, pp. 254–280.

Fuchs, Christian; Sevignani, Sebastian (2013): What is Digital Labour? What is Digital Work? What's their Difference? And why do these Questions Matter for Understanding Social Media? In *TripleC* 11 (2), pp. 237–293.

Gallardo Echenique, E. E.; Minelli de Oliveira, J.; Marqués-Molias, L.; Esteve-Mon, F. (2015): Digital Competence in the Knowledge Society. In *MERLOT Journal of Online Learning and Teaching* 11 (1).

Gioia, Dennis A.; Corley, Kevin G.; Hamilton, Aimee L. (2013): Seeking Qualitative Rigor in Inductive Research. In *Organizational Research Methods* 16 (1), pp. 15–31.

Göbel, Christian; Zwick, Thomas (2010): Which Personnel Measures are Effective in Increasing Productivity of Old Workers? ZEW Discussion Paper No. 10-069. Mannheim.

Grant, Adam M.; Parker, Sharon K. (2009): 7 Redesigning Work Design Theories: The Rise of Relational and Proactive Perspectives. In *The Academy of Management Annals* 3 (1), pp. 317–375.

Hager, Izabela; Golonka, Anna; Putanowicz, Roman (2016): 3D Printing of Buildings and Building Components as the Future of Sustainable Construction? In *Procedia Engineering* 151, pp. 292–299.

Hatlevik, Ove Edvard; Christophersen, Knut-Andreas (2013): Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. In *Computers & Education* 63, pp. 240–247.

Hazen, Benjamin T.; Bradley, Randy V.; Bell, John E.; In, Joonhwan; Byrd, Terry A. (2017): Enterprise architecture: A competence-based approach to achieving agility and firm performance. In *International Journal of Production Economics* 193, pp. 566–577.

Hess, Thomas; Matt, Christian; Benlian, Alexander; Wiesböck, Florian (2016): Options for Formulating a Digital Transformation Strategy. In *MIS Quarterly Executive* 15 (2), pp. 123–139.

Hirsch-Kreinsen, Hartmut; Hompel, Michael ten (2016): „Social Manufacturing and Logistics" – Arbeit in der digitalisierten Produktion. In Bundesministerium für Wirtschaft und Energie (BMWi) (Ed.): Arbeiten in der digitalen Welt. Mensch - Organisation - Technik. München: PRpetuum GmbH, pp. 6–9.

Hoel, Tore; Holtkamp, Philipp (2012): Requirements modelling in international information systems design – what competencies are needed and how to manage them? In *ECKM '12: Proceedings of the 13th European Conference on Knowledge Management, Cartagena, Spain*, pp. 466–475.

Hogan, Robert; Chamorro-Premuzic, Tomas; Kaiser, Robert B. (2013): Employability and Career Success: Bridging the Gap between Theory and Reality. In *Industrial and Organizational Psychology* 6 (01), pp. 3–16.

Holtkamp, Philipp; Lau, Ivan; Pawlowski, Jan Martin (2015): How software development competences change in global settings-an explorative study. In *Journal of Software: Evolution and Process* 27 (1), pp. 50–72.

Ilomäki, Liisa; Paavola, Sami; Lakkala, Minna; Kantosalo, Anna (2016): Digital competence – an emergent boundary concept for policy and educational research. In *Education and Information Technologies* 21 (3), pp. 655–679.

Janssen, José; Stoyanov, Slavi; Ferrari, Anusca; Punie, Yves; Pannekeet, Kees; Sloep, Peter (2013): Experts' views on digital competence: Commonalities and differences. In *Computers & Education* 68, pp. 473–481.

Lambert, Brian; Plank, Richard E.; Reid, David A.; Fleming, David (2014): A Competency Model for Entry Level Business-to-Business Services Salespeople. In *Services Marketing Quarterly* 35 (1), pp. 84–103.

Lambrecht, Anja; Goldfarb, Avi; Bonatti, Alessandro; Ghose, Anindya; Goldstein, Daniel G.; Lewis, Randall et al. (2014): How do firms make money selling digital goods online? In *Marketing Letters* 25 (3), pp. 331–341.

Laudon, Kenneth C.; Laudon, Jane Price (2014): Management Information Systems. Managing the Digital Firm. Thirteenth edition, Global edition. Boston: Pearson.

Legner, Christine; Eymann, Torsten; Hess, Thomas; Matt, Christian; Böhmann, Tilo; Drews, Paul et al. (2017): Digitalization. Opportunity and Challenge for the Business and Information Systems Engineering Community. In *Business & Information Systems Engineering* 59 (4), pp. 301–308.

Li, Yan; Ranieri, Maria (2010): Are 'digital natives' really digitally competent?-A study on Chinese teenagers. In *British Journal of Educational Technology* 41 (6), pp. 1029–1042.

Lucia, Anntoinette; Lepsinger, Richard (1999): The Art and Science of Competency Models: Pinpointing Critical Success Factors in Organizations San Francisco. Hoboken, New Jersey: John Wiley & Sons, Inc.

Marr, Bernard (2018): 7 Job Skills Of The Future (That AIs And Robots Can't Do Better Than Humans). Available online at https://www.forbes.com/sites/bernardmarr/2018/08/06/7-job-skills-of-the-future-that-ais-and-robots-cant-do-better-than-humans/#3aa396506c2e, checked on 9/20/2018.

Mayring, Philipp (2014): Qualitative content analysis: theoretical foundation, basic procedures and software solution. Klagenfurt. Available online at http://www.ssoar.info/ssoar/handle/document/39517, checked on 12/1/2016.

McClelland, D. C. (1973): Testing for competence rather than intelligence. In *American Psychologist* 28 (January), pp. 1–14.

McCleskey, Jim (2014): Emotional intelligence and leadership. In *International Journal of Organizational Analysis* 22 (1), pp. 76–93.

McKinsey (2017): Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners. Available online at https://www.mckinsey.com/~/media/mckinsey/featured%20insights/europe/shaping%20the%20future%20of%20work%20in%20europes%20nine%20digital%20front%20runner%20countries/shaping-the-future-of-work-in-europes-digital-front-runners.ashx, checked on 9/17/2018.

Meyers, Eric M.; Erickson, Ingrid; Small, Ruth V. (2013): Digital literacy and informal learning environments: an introduction. In *Learning, Media and Technology* 38 (4), pp. 355–367.

Moore, David R.; Cheng, Mei-I; Dainty, Andrew R.J. (2002): Competence, competency and competencies: performance assessment in organisations. In *Work Study* 51 (6), pp. 314–319.

Müller, Oliver; Junglas, Iris; Vom Brocke, Jan; Debortoli, Stefan (2016): Utilizing big data analytics for information systems research: challenges, promises and guidelines. In *European Journal of Information Systems* 25 (4), pp. 289–302.

Müller, Oliver; Schmiedel, Theresa; Gorbacheva, Elena; Vom Brocke, Jan (2014): Towards a typology of business process management professionals: identifying patterns of competences through latent semantic analysis. In *Enterprise Information Systems* 10 (1), pp. 50–80.

N.N. (2017): Rede von Bundeskanzlerin Merkel zur Eröffnung der CeBIT 2017 am 19. März 2017. Available online at https://www.bundesregierung.de/Content/DE/Rede/2017/03/2017-03-19-rede-merkel-cebit.html, checked on 8/30/2018.

Ng, Wan (2012): Can we teach digital natives digital literacy? In *Computers & Education* 59 (3), pp. 1065–1078.

Nordhaug, Odd (1993): Human Capital in Organizations. Competence, Training, and Learning. Oslo, New York: Scandinavian University Press; Oxford University Press.

Pasadas Ureña, Cristóbal (2010): Multiliteracy and Social Networks in Higher Education. In *RUSC. Universities and Knowledge Society Journal* 7 (2).

Peppard, Joe; Galliers, Robert D.; Thorogood, Alan (2014): Information systems strategy as practice: Micro strategy and strategizing for IS. In *The Journal of Strategic Information Systems* 23 (1), pp. 1–10.

Phelps, Kirstin C. (2014): "So Much Technology, So Little Talent"? Skills for Harnessing Technology for Leadership Outcomes. In *Journal of Leadership Studies* 8 (2), pp. 51–56.

Provost, Foster; Fawcett, Tom (2013): Data science and its relationship to big data and data-driven decision making. In *Big Data* 1 (1), pp. 51–59.

Quadbeck, Eva (2014): Idee von SPD-Chef Gabriel: Computersprache soll Schulfach werden. Available online at https://rp-online.de/politik/deutschland/sigmar-gabriel-computersprache-soll-schulfach-werden_aid-9190833, checked on 8/30/2018.

Qureshi, Mohammed Owais; Syed, Rumaiya Sajjad (2014): The impact of robotics on employment and motivation of employees in the service sector, with special reference to health care. In *Safety and Health at Work* 5 (4), pp. 198–202.

Richter, Alexander; Heinrich, Peter; Stocker, Alexander; Schwabe, Gerhard (2018): Digital Work Design. In *Business & Information Systems Engineering* 60 (3), pp. 259–264.

Riikkinen, Mikko; Saarijärvi, Hannu; Sarlin, Peter; Lähteenmäki, Ilkka (2018): Using artificial intelligence to create value in insurance. (Online first version). In *International Journal of Bank Marketing* 36 (6), pp. 1145–1168.

Sawyer, Steve; Jarrahi, Mohammed Hossein (2014): Sociotechnical approaches to the study of Information Systems. In Heikki Topi, Allen B. Tucker (Eds.): Computing handbook. Volume 2. Third edition. Boca Raton, FL: Taylor & Francis, 5.1-5.27.

Schilke, Oliver; Hu, Songcui; Helfat, Constance E. (2018): Quo Vadis, Dynamic Capabilities? A Content-Analytic Review of the Current State of Knowledge and Recommendations for Future Research. In *The Academy of Management Annals* 12 (1), pp. 390–439.

Schumann, Conny; Zschech, Patrick; Hilbert, Andreas (2016): Das aufstrebende Berufsbild des Data Scientist. In *HMD Praxis der Wirtschaftsinformatik* 53 (4), pp. 453–466.

Schwan, Ben (2017): OECD-Bildungsexperte: Statt Programmieren als Schulfach lieber "digitale Kompetenz" fördern. Available online at https://www.heise.de/newsticker/meldung/OECD-Bildungsexperte-Statt-Programmieren-als-Schulfach-lieber-digitale-Kompetenz-foerdern-3661023.html, checked on 8/30/2018.

Schwarzmüller, Tanja; Brosi, Prisca; Welpe, Isabell M. (2016): Digital work design – How digitization transforms work and leadership. In *28th Annual Convention of the Association for Psychological Science, Chicago, USA*.

Shahlaei, Charlotte; Rangraz, Masood; and Stenmark, Dick (2017): Transformation of Competence - the Effects of Digitalization on Communicators' Work. In *Proceedings of the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal*, pp. 195–209.

Shippmann, Jeffery S.; Ash, Ronals; Battista, Mariangela; Carr, Linda; Eyde, Lorraine D.; Hesketh, Beryl et al. (2000): The Practice of Competency Modeling. In *Personnel Psychology* 53 (3), pp. 703–740.

Spencer, Lyle M.; Spencer, Signe M. (1993): Competence at work: Models for superior performance. New York: John Wiley & Sons, Inc.

Statista (2017): Home Office in Deutschland. Available online at https://de.statista.com/infografik/9161/verbreitung-von-home-office-in-deutschland/, checked on 10/17/2018.

Statista (2018): Prognose zur Anzahl der potentiell gefährdeten Arbeitsplätze durch die Automatisierung in Deutschland nach Berufen bis zum Jahr 2025* (in Millionen). Available online at https://de.statista.com/statistik/daten/studie/814326/umfrage/prognose-gefaehrdete-arbeitsplaetze-durch-die-automatisierung-in-deutschland/, checked on 10/17/2018.

Stettes, Oliver (2017): Digitalisierung der Arbeitswelt – es bleiben noch viele Fragen offen. In Oliver Stettes, Melanie Arntz, Terry Gregory, Ulrich Zierahn, Katharina Dengler, Daniel Veit, Ulf Rinne (Eds.): Arbeitswelt 4.0: Wohlstandszuwachs oder Ungleichheit und Arbeitsplatzverlust – was bringt die Digitalisierung? ifo Schnelldienst, 70, Nr. 07, 03-18. München, pp. 3-6.

Teece, David J.; Pisano, Gary; Shuen, Amy (1997): Dynamic Capabilities and Strategic Management. In *Strategic Management Journal* 18 (7), pp. 509–533.

Todd, Peter A.; McKeen, James D.; Gallupe, R. Brent (1995): The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements from 1970 to 1990. In *MIS Quarterly* 19 (1), pp. 1–27.

Trist, Eric; Bamforth, Ken (1951): Some social and psychological consequences of the longwall method of coal getting. In *Human Relations* 4, pp. 3–38.

Turel, O.; Cheung, C.; Matt, C.; Trenz, M. (2018): The Digitization of the Individual (DOTI). Special Issue Editorial, forthcoming. In *Information Systems Journal*.

Turel, Ofir; Kapoor, Bhushan (2016): A Business Analytics Maturity Perspective on the Gap between Business Schools and Presumed Industry Needs. In *Communications of the Association for Information Systems* 39 (Article 6).

van der Heijde, Claudia M.; van der Heijden, Beatrice I. J. M. (2006): A competence-based and multidimensional operationalization and measurement of employability. In *Human Resource Management* 45 (3), pp. 449–476.

Veit, Daniel (2017): Der Wandel der Arbeitswelt im Zeitalter der Digitalisierung. In Oliver Stettes, Melanie Arntz, Terry Gregory, Ulrich Zierahn, Katharina Dengler, Daniel Veit, Ulf Rinne (Eds.): Arbeitswelt 4.0: Wohlstandszuwachs oder Ungleichheit und Arbeitsplatzverlust – was bringt die Digitalisierung? ifo Schnelldienst, 70, Nr. 07, 03-18. München, pp. 12–15.

Vetter, Philipp (2016): Das war's noch lange nicht bei Volkswagen. Available online at https://www.welt.de/wirtschaft/article159610472/Das-war-s-noch-lange-nicht-bei-Volkswagen.html, checked on 10/17/2018.

Vieru, Dragos; Bourdeau, Simon; Bernier, Amelie; Yapo, Severin (2015): Digital Competence. A Multi-dimensional Conceptualization and a Typology in an SME Context. In : 2015 48th Hawaii International Conference on System Sciences. 2015 48th Hawaii International Conference on System Sciences (HICSS). HI, USA, 05.01.2015 - 08.01.2015: IEEE, pp. 4681–4690.

Weitzel, Tim; Niehaves, Björn (2017): Digital Work. Track 4 Description, Wirtschaftsinformatik 2017. Available online at https://www.wi2017.ch/track4-2.html?url=track4&lc=en, checked on 7/19/2018.

Westera, Wim (2001): Competences in education: A confusion of tongues. In *Journal of Curriculum Studies* 33 (1), pp. 75–88.

Whetten, David A. (1989): What Constitutes a Theoretical Contribution? In *The Academy of Management Review* 14 (4), pp. 490–495.

Winde, Matthias; Schröder, Jürgen (2017): Hochschul-Bildungs-Report 2020: Hochschulbildung für die Arbeitswelt 4.0. Jahresbericht 2016. Edited by Stifterverband für die Deutsche Wissenschaft e. V. in Kooperation mit McKinsey & Company, Inc.

Wixom, Barbara; Ariyachandra, Thilini; Douglas, David; Goul, Michael; Gupta, Babita; Iyer, Lakshmi et al. (2014): The Current State of Business Intelligence in Academia: The Arrival of Big Data. In *Communications of the Association for Information Systems* 34 (Article 1).

Yoo, Youngjin; Boland, Richard J.; Lyytinen, Kalle; Majchrzak, Ann (2012): Organizing for Innovation in the Digitized World. In *Organization Science* 23 (5), pp. 1398–1408.