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Systematization of the term digital transformation and its phenomena from a socio-technical perspective – A literature review

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SYSTEMATIZATION OF THE TERM DIGITAL TRANSFORMATION AND ITS PHENOMENA FROM A SOCIO-TECHNICAL PERSPECTIVE – A LITERATURE REVIEW

Complete Research

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Abstract

IT-innovation triggers the transformation of society, working life and the behavior of people. Digitization, digitalization, and digital transformation are buzzwords in this context. While existing publications discuss the benefits and consequences connected to the three terms, a proper conceptualization of them is still not available. A common understanding is that digitization and digitalization trigger digital phenomena which allow organizations to operationalize the process of digital transformation. Prior research identified some phenomena, like collaboration and sharing, but a structured analysis of the occurring phenomena is still missing. Embedding digital transformation and the phenomena into the context of socio-technical systems, we conduct a structured literature review to suggest theoretically and practically relevant definitions for the aforementioned terms and create an overview of relevant phenomena. We show that digitization, digitalization, and digital transformation are often used without selective distinctions, even though that it is not appropriate as each term has to take into account different concepts. Furthermore, we identify seven relevant phenomena: collaboration, sharing, communication, connectivity, flexibility, mobility, and co-creation.

Keywords: digitization, digital transformation, digitalization, literature review.

1 Introduction

Digitalization and its consequences are affecting our everyday lives in many ways. Organizations also begin to realize the increasing value digitalization provides (Neumeier, Wolf, and Oesterle, 2017). One main problem is the confusion about and synonymous usage of different terms associated with digitalization like digitization and digital transformation (DT) (Herbert, 2017; Legner et al., 2017). The three terms are in the focus of this research paper. In theory and in practice discussions about the understanding of the terms arise. The concepts behind the three terms oftentimes share some similarities, but are also differing, even contradictory in other aspects. Legner et al. (2017) have already identified the need for a clear definition of the mentioned terms but have not solved this problem completely. Therefore, it is necessary to develop a conceptual differentiation of the terms and suggest precise definitions that are relevant for theory and practice. Herbert (2017) highlights that different understandings of the terms "are the biggest reason" why organizational transformation programs fail. It is important to have a common understanding of the concepts allowing substantial discussions to improve research ideas and provide a basis for empirical studies promoting practical understanding. Only with a common understanding of

the three terms organizations are able to develop strategies, processes and adapt their business models accordingly.

To give some examples which show that terms are used synonymously and have various definitions, Bleicher and Stanley (2016) state that "digitization describes the process of converting data from an analogue to a digital format". Katz and Koutroumpis (2013) go beyond that and do not only consider the technical components when defining digitization but also social aspects. For them "digitization encapsulates the social transformation triggered by the mass adoption of digital technologies that generate, process and transfer information" (Katz and Koutroumpis, 2013). Tay and Low (2017) refer to the process of the transformation from printed to digital resources as DT. The authors write that "digitalization [...] is a complex process" (Tay and Low, 2017).

Organizations are often unable to use the benefits of digitization and digitalization. Along with the different manifestations of digitization, digitalization, and DT new phenomena like collaboration or sharing, are observed (Orellana, 2017; Suominen and Mäenpää, 2017). In contrast to digitization and digitalization the phenomena are more tangible and therefore enable the operationalization of DT in organizations. For organizations understanding the phenomena provides the necessary opportunities to keep up with the ongoing DT and with that increase or maintain their competitive advantages.

Following Schneider (2017), who describes sharing as a "technological phenomenon", we define phenomena connected to the digitalization, digitization, and DT as situations or processes that are characterized by a bidirectional influence of society and technological developments. For example, on the one hand collaboration needs a technological basis like collaboration platforms, and on the other hand the social component must be taken into account (Wulf et al., 2014). Previous work has already identified different phenomena connected to the three terms but a comprehensive overview of the phenomena connected to digitization, digitalization, and DT is still missing.

For our paper, we define two goals: (1) the conceptualization of the terms digitization, digitalization, and DT, and (2) the systematization of the phenomena connected to digitization, digitalization, and DT. The conceptualization and systematization in the context are important to build a basis for further content-focused and scientific discussions. A systematic literature review is used to solve the conflict of different ideas and allows for a proposal of a suitable definition of each of the terms. It further helps to detect inconsistencies in term definitions (Cooper, 1988).

The goals lead to the following research questions which will be answered in this paper:

1. How can the terms digitization, digitalization, and DT be defined and what are the differences between the terms?
2. Which phenomena are mentioned in the context of digitization, digitalization, and DT and how are they interrelated?

We organize our paper following a conservative structure of a systematic literature review. We first introduce our methodology, before the topic is conceptualized and our search results are presented and discussed. The paper closes with a conclusion and provides an outlook for further research.

2 Methodology

2.1 Scope

The scope of our literature review can be systematized referring to the taxonomy of Cooper (1988) as recommended by Vom Brocke et al. (2009). Cooper (1988) subdivides literature reviews into six characteristics: focus, goal, perspective, coverage, organization, and audience of the paper which are further divided into categories (see table 1). Some categories of these six characteristics are mutually exclusive while other characteristics allow for more than one category. Our focus lies on research outcomes. Our goal is the conceptualization of the different terms in different contexts to establish a common understanding (see Strike and Posner (1983)). Within the taxonomy of Cooper (1988) we chose

integration as one goal accordingly. Our second goal is the identification of central issues of digitization, digitalization, and DT which are "questions that should dominate future endeavors" (Cooper, 1988). Further we chose a neutral perspective for the literature review, the presentation of the analysis, and synthesis of the results. The coverage of the literature review is representative as we focused the review on selected conferences and journals. Papers with the same ideas are conceptually organized in sections of this paper. The target groups of the literature review are specialized and general scholars as well as practitioners who request for a clear distinction between the terms used frequently as it effects nearly all aspects of research and business. The following table 1 summarizes the scope of the literature review.

characteristic	categories			
focus	research outcomes	research methods	theories	practices or applications
goal	integration		criticism	central issues
perspective	neutral representation		espousal of position	
coverage	exhaustive	exhaustive with selective citation	representative	central or pivotal
organization	historical		conceptual	methodological
audience	specialized scholars	general scholars	practitioners	general public

Table 1: Positioning of this paper within the taxonomy of Cooper (1988)

2.2 Conceptualization

The classification in the previous section builds the basis for the next step: the conceptualization (Vom Brocke et al., 2009). We therefore start with a basic explanation of the three terms for our paper. *Digitization* relates to the technical potential to separate information from physical data storage and carriers (Legner et al., 2017). For the term *digitalization* we follow the idea by Yoo et al. (2010) that digitalization consists of two dimensions: the social and the technical dimension. This understanding is also in line with Legner et al. (2017), who highlight digitalization as "the manifold sociotechnical phenomena and processes of adopting and using these technologies in a broader individual, organizational and societal context". Our basic understanding of *DT* follows Herbert (2017), who states that DT is not about the pure implementation of new technology into the organizations' processes, but that "it's about directing an organization to be more adopting to change itself" including "adopting processes that allow [...] to investigate, experiment, and strategically employ new technology on an ongoing basis". Based on this understanding we decided to use the concept of socio-technical system (STS) for the conceptualization of the topic.

An STS consists of two components: a technical system and a social system. Bostrom and Heinen (1977) emphasize that these two systems are interrelated but still "existent with their attributes". The technical system implies technical elements like processes, hardware, and technology while the social system addresses human actors with their characteristics like skills or behaviors. An STS does not work autonomously but with the help of human actors (Geels, 2004). Therefore, the relationships and social hierarchy of the human actors in the social system are considered (Bostrom and Heinen, 1977). The general idea of an STS is "to stress the reciprocal interrelationship between human actors and machines and to foster the program of shaping both the technical and the social conditions of work, in such a way that efficiency and humanity would not contradict each other any longer" (Rophol, 1999). A human actor is normally part of a social group. Therefore, it is important to identify certain group characteristics which can be transferred to the individual actors in that group. These characteristics may be roles, responsibilities,

norms, or perceptions (Geels, 2004). Our comprehension of an STS with its elements is shown in figure 1.

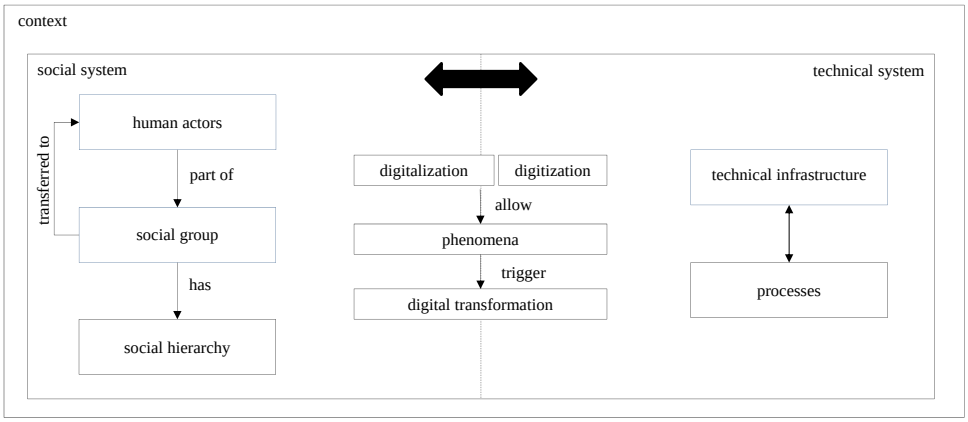

Figure 1: Conceptualization of the paper

Figure 1 shows the terms digitization, digitalization, and DT embedded in the STS and provides the frame of reference in which the terms and the phenomena are analyzed. With respect to our first definition of the terms digitization is allocated to the technical system while digitalization comprises the social and the technical system. Digitalization and DT enable the social and technical development of phenomena. The phenomena include changes in the behavior of society representing the social components of an STS. Furthermore, phenomena need a technological basis for their implementation. The phenomena trigger the process of DT as they allow for organizations to adopt social as well as technical changes. The two sides of the STS are embedded in a specific context.

2.3 Search process

After the conceptualization of the topic this section addresses the search process for the literature review. Our literature search was conducted in September and October 2017 and focuses only on peer-reviewed papers. In the past few years, new and innovative technological solutions have turned up as fast as they have disappeared again. One of the main drivers for this effect is the ambition to meet customer requirements. Therefore, we decided to analyze scientific papers starting from 2012 on to capture the latest definitions and understanding of the terms, as the terms have developed together with this dynamic process. For the systematic search we used the final search query given by:

digitalization
OR *"digital transformation"*
OR *digitization*.

The search query was applied on the abstracts of the papers and was formulated broadly leading to a high number of results. We did not differentiate between American and British English spelling in the search query as our tests resulted in identical numbers of results. Coming from a socio-technical point of view, we focused on information systems literature and chose renowned conferences and journals in this field. We selected the following information systems conferences: American Conference on Information Systems (AMCIS), the European Conference on Information Systems (ECIS), the Hawaii International Conference on System Science (HICSS), the International Conference on Information Systems (ICIS) and the Wirtschaftsinformatik (WI). These conferences are thematically broad and discuss important and current topics of information systems research. All the related conference proceedings are listed in the electronic library of the Association for Information Systems (AISeL), which we used to identify the relevant papers. The search for relevant papers of the HICSS and the WI only showed results for the year

2017. For the other three conferences the number of relevant papers also increased from 2012 to 2017. This suggests that the search terms are of increasing importance for the conferences.
In addition to the named conferences we considered selected journals. We looked at the 30 top ranked journals found in Levy and Ellis (2006). As digitization, digitalization, and DT are discussed in many different fields we defined criteria to limit the results. We focused on literature which analyzes the three terms from an organizational point of view. Therefore, we excluded work with a sole technical focus, for example, innovations of sensor technology as they are not of interest for our analysis. In the following the technical perspective refers to the technical infrastructure and processes of organizations (see 2.2). We also excluded unrelated research fields like artificial intelligence. We considered the following 12 journals: Management Information Systems Quarterly (MISQ), Information Systems Research (ISR), Communications of the Association for Computer Machinery (ACM), Management Science, Journal of Management Information Systems (JMIS), European Journal of Information Systems (EJIS), Communication of the Association for Information Systems (CAIS), Academy of Management Journal, Journal of the Association for Information Systems, Information Systems Frontiers, Organization Science, Business & Information Systems Engineering (BISE).

For the selection of the papers found in the chosen conferences and journals, we followed the steps according to Vom Brocke et al. (2009), starting with the selection on the basis of the paper titles. The papers presented a wide range of topics (eg. e-government, digital currencies, interface design, and digital diversity). We used the same criteria for the selection in this step as we did for the selection of the relevant journals and further exclude specific research fields like health, music, government, and commerce. These fields of research have been excluded from the following analysis, as papers on these topics mainly discuss the technical implementation of innovative technologies in the specific fields. The technological effects and manifestations of digitalization, digitization, and DT are in our case not of interest as our research questions focus on the terms and their definition and conceptualization. This first selection process reduced the overall number of papers from 736 to 217. Papers with less meaningful titles were not yet excluded but considered in the next step. Still following Vom Brocke et al. (2009), the second selection step was based on the reading of the abstracts. We identified the papers whose abstracts still fit the scope and excluded those papers with abstracts belonging to the above mentioned not relevant topics. This step reduced the number of papers to 61 relevant papers. Table 2 presents the quantities of selected papers after each step divided into conference and journal papers.

	2012	2013	2014	2015	2016	2017	sum
conferences							
total	57	44	48	104	131	180	564
1st selection (title)	9	9	16	23	45	64	166
2nd selection (abstract)	0	3	4	5	15	19	46
journals							
total	19	17	34	36	37	29	172
1st selection (title)	5	4	11	13	12	6	51
2nd selection (abstract)	2	2	3	3	0	5	15

Table 2: search results

In a last step the 61 full papers were read and selected in accordance to the selection criteria described above and also used for the other selection steps. Within this last selection step we excluded the proceedings of AMCIS 2017 as they were not available up to the point of the literature analysis in October 2017 leading to a reduction of the relevant papers by 4. We identified 46 papers relevant for the following analysis and synthesis of the literature using the previously described conceptualization of the topic.

3 Results

Section 2 presented the scope of the literature review, the conceptualization of the topic and the description of the search process. The following section now focuses on the results of the review (see table 2).

source	terms			STS		phenomena						
	digitization	digitalization	digital transformation	social perspective	technical perspective	collaboration	sharing	communication	connectivity	flexibility	mobility	co-creation
Andersen and Ross (2016)		x		x		x	x		x			
Avital et al. (2014)					x	x	x				x	
Avital et al. (2015)				x			x					
Baalen, Fenema, and Loebbecke (2016)				x	x							
Blaschke et al. (2016)		x			x							
Bley, Leyh, and Schäffer (2016)	x		x		x							
Boughzala, Vreede, and Limayem (2012)				x	x	x				x		
Braccini and Federici (2013)					x	x						
Brenner et al. (2014)		x		x								
Collins and Gruzd (2017)				x		x	x					
Davison and Ou (2014)				x		x	x		x			
Deng and Christodoulidou (2015)				x	x			x	x		x	
Ebermann et al. (2016)				x								
Freitas Junior et al. (2016)	x		x		x			x	x			
Ghobadi (2014)				x								
Gimpel, Huber, and Sarikaya (2016)		x	x		x			x				
Grover and Kohli (2013)	x				x							
Haffke, Kalgovas, and Benlian (2016)	x		x	x	x			x	x			
Holler et al. (2017)		x			x							
Horlacher (2016)			x	x		x						
Jackson (2015)	x	x		x	x	x		x				
Kelestyn and Henfridsson (2014)	x			x	x	x	x	x		x		
Klötzer and Pflaum (2017)	x	x	x	x	x							
Köffer (2015)				x	x	x		x	x		x	
Lang, Shang, and Vragov (2015)				x	x	x	x					x
Legner et al. (2017)	x	x	x	x	x	x						
Li, Hong, and Zhang (2016)					x	x	x		x			
Lindberg et al. (2013)				x		x						
Literat (2017)				x		x						
Matt, Hess, and Benlian (2015)	x		x	x	x							
Mayer, Quick, and Hauke (2013)				x	x	x						
Mehra et al. (2014)	x			x								
Nambisan et al. (2017)	x				x							
Nastjuk, Hanelt, and Kolbe (2016)					x		x		x	x		
Negi and Brohman (2015)		x		x		x		x	x			x

source	terms			STS		phenomena						
	digitization	digitalization	digital transformation	social perspective	technical perspective	collaboration	sharing	communication	connectivity	flexibility	mobility	co-creation
Nwankpa and Roumani (2016)			x		x							
Paavola, Hallikainen, and Elbanna (2017)			x	x								
Plenter et al. (2017)						x	x					
Remane et al. (2017)			x	x	x							
Schmidt, Drews, and Schirmer (2017)		x	x	x	x			x				
Schneider (2017)	x			x	x		x					
Syler and Baker (2016)				x								
Wilms et al. (2017)			x	x	x	x		x				
Wulf et al. (2014)	x			x	x			x	x			x
Xue et al. (2013)	x				x							
Yoo et al. (2012)	x				x							
sum	15	10	13	31	31	19	11	11	10	3	3	3

Table 3: Analysis of Papers

Table 3 presents a concept matrix which assigns the relevant papers to digitization, digitalization, and DT. We allocated the papers to the terms they refer to and discuss them to answer the first research question. According to our conceptualization we distinguished whether the analysis of the corresponding authors is mainly driven by social or more technical considerations. In addition to the three terms and the allocation of the papers in the two components of the STS we analyzed which phenomena are made subject of discussions in the papers. Despite sharing we identified collaboration, communication, connectivity, flexibility, mobility, and co-creation at least in three of the 46 papers. The identification of the phenomena refers to our second research question which is interesting for organizations as well as for further academic investigations. Table 3 provides an overview of the phenomena connected to digitization, digitalization, and DT broached by the papers. In the following section 3.1 we focuse on the three terms before section 3.2 takes a closer look at the seven identified phenomena in this context.

3.1 Digitization, digitalization, and digital transformation

The following section analyzes the use of the tree terms digitization, digitalization, and DT in the papers found in our literature review. As table 3 shows 15 papers deal with *digitization*. Some papers do not define this term but discuss its benefits, problems or consequences (Kelestyn and Henfridsson, 2014; Mehra et al., 2014; Schneider, 2017). For example, Schneider (2017) arguments that "recent developments in information and communication technologies (ICT) and the digitization have brought forward new business models" but does not further define the term digitization. Similar to that, Mehra et al. (2014) begin their paper with "the ongoing digitization of multiple industries". However, it is not clear what is meant with that and what digitization implies.

Other papers use the term digitization without defining it, but list objects which can be digitized (Grover and Kohli, 2013; Nambisan et al., 2017; Xue et al., 2013). Most of these papers have in common that digitization refers to processes (Jackson, 2015; Nambisan et al., 2017; Xue et al., 2013). Xue et al. (2013) mention that processes cannot only be digitized but that processes can also be optimized by digitization.

Beside the digitization of processes, for Nambisan et al. (2017) outcomes as well as artefacts with their features, functionalities, and affordances fulfill customer or user needs, while for Jackson (2015) and Haffke, Kalgovas, and Benlian (2016) products and services can be digitized. For Jackson (2015) following Brynjolfsson (2014) information and media can be digitized by for example using text, sound, video, sensors. Wulf et al. (2014) define digitization in the context of Massive Open Online Courses (MOOCs). They use the terms digitization and online in the context of MOOCs synonymously which implies that courses are supplied via internet. Furthermore, for them "digitization comprises the learning material, the teaching process, social interaction of participants as well as their examination."
Surprisingly, only three papers define the term digitization (Bley, Leyh, and Schäffer, 2016; Freitas Junior et al., 2016; Jackson, 2015). For Freitas Junior et al. (2016) digitization mean the "encoding of analog information into digital format". Similar to that, Jackson (2015) defines digitization as "a technical process of converting analogue content into bits." Bley, Leyh, and Schäffer (2016) define digitization by using the description of Fichman, Dos Santos, and Zheng (2014) as the "easy-to-use world-wide digital infrastructure of computers, mobile devices, broadband network connections, and advanced application platforms". The paper of Fichman, Dos Santos, and Zheng (2014) does not explicitly define digitization with these words. For our paper we refer to Freitas Junior et al. (2016) and extent their definition. It is in line with our basic explanation given in section 2.2 but extends it. *Digitization is the technological transformation of "analog information into digital format" (Freitas Junior et al., 2016) including the development of digital infrastructure. Objects of digitization are technological processes and "artefacts with their features, functionalities, and affordances" (Jackson, 2015).*
Klötzer and Pflaum (2017) state that the second term of interest *digitalization* goes beyond digitization. The term was identified in ten papers but not all provide definitions of the term. The papers of Blaschke et al. (2016), Gimpel, Huber, and Sarikaya (2016), Holler et al. (2017), Jackson (2015), and Negi and Brohman (2015) refer to digitalization and its impact on organizations but do not define the term explicitly. Andersen and Ross (2016) underline the importance of digitalization for organizations by analyzing the development of the LEGO Group and its change through digitalization. The paper gives many examples how digitalization is effecting the organization (Andersen and Ross, 2016) but only describes indirectly how the term can be understood. Brenner et al. (2014) raise the point that digitalization is affecting business models of organizations in many sectors of the economy. Products which were previously characterized by physical aspects are more and more changing to hybrid products resulting in organizations with digital business models (Brenner et al., 2014). Transforming business models is one result of digitalization effecting the strategy of organizations, the customer interactions and their requirements, and the internal structures of organizations (Schmidt, Drews, and Schirmer, 2017). Klötzer and Pflaum (2017) emphasize that digitalization converts "materials, substances, or components into new products, working together with the target of controlling, managing and improving material and information flows from suppliers to end users". This definition focuses on the digitalization of supply chains and changing business models of organizations through the availability of digital information but the paper also states that the process is characterized by socio-technical structures (Klötzer and Pflaum, 2017). *We define digitalization as the state of an organization or a society referring to its current digital development and usage of ICT innovations. Digitalization takes into account social as well as technical elements.*
The third term of interest is *digital transformation* which is defined in 13 papers. Freitas Junior et al. (2016) and Klötzer and Pflaum (2017) describe DT as the process of digitization in organizations. The paper of Haffke, Kalgovas, and Benlian (2016) underlines this definition as it understands DT as a journey to realize new digital opportunities following the definition of Fitzgerald et al. (2013). Bley, Leyh, and Schäffer (2016) state that "ICT triggers and enables this "transformation" of the company towards a holistic network" and that organizations should undergo the "digital transformation to remain competitive in global markets". The paper of Schmidt, Drews, and Schirmer (2017) points out that organizations need to face DT in order to fulfill the expectations of their customers for the banking sector. This is confirmed more generally for organization's "sales and communication channels, which provide novel ways to interact and engage with customers, and the digitization of a firm's offerings (products and services),

which replace or augment physical offerings" by Haffke, Kalgovas, and Benlian (2016). Two more papers explain DT of organizations by defining stages for the change processes. Paavola, Hallikainen, and Elbanna (2017) use a modular three stage model describing the development of DT over time. Nwankpa and Roumani (2016) follow Libert, Beck, and Wind (2016) and differentiate between digital upgrades and DT of organizations. The digital upgrade refers to the "use of digital technologies to increase efficiency and effectiveness in a firm's business processes" (Libert, Beck, and Wind, 2016; Nwankpa and Roumani, 2016). In addition, the papers underline that organizations face DT when the implementation of digital technologies change the business strategy, the value creation or result in the offering of completely new products. Therefore, Nwankpa and Roumani (2016) underline the importance to understand factors that influence DT and sustain the expansion of IT capabilities to allow for DT to enlarge. In the past DT was mainly addressed by large organizations but as the process is further changing businesses and whole sectors, the process is also an important issue for small and medium sized organizations (Bley, Leyh, and Schäffer, 2016). DT allows for whole supply chains and integrated organizations to generate higher values than before. Nwankpa and Roumani (2016) resume that organizations face DT and its effects in many ways. The paper highlights the need to invest into IT capabilities and thus into DT for "supporting and fostering firm performance" (Nwankpa and Roumani, 2016). Remane et al. (2017) underline that "the phenomenon of digital transformation is context-specific and can take idiosyncratic paths". In addition to the presented understanding of DT in the organizational context (Haffke, Kalgovas, and Benlian, 2016; Horlacher, 2016; Nwankpa and Roumani, 2016; Schmidt, Drews, and Schirmer, 2017) the impact is an object of research in many different other contexts. To name an example Wilms et al. (2017) focus on the impact of DT in the university context and widens the definition to changes through the use of more digital technologies not just for organizations but also for people's everyday life. The paper of Matt, Hess, and Benlian (2015) broaches the issue of DT strategy to provide management support for the change process and to establish an effective implementation of the changes in the organization. In addition to these definitions, the explanation of DT introduced in section 2.2 considers the ability to adopt changes efficiently. *Therefore, we refer to DT as the process of organizational or societal changes driven by innovations and developments of ICT. DT includes the ability to adopt technologies rapidly and affects social as well as technical elements of business models, processes, products and the organizational structure.*

As the terms digitization, digitalization, and DT are still in flux a common definition is still missing. We identified that the terms digitalization and DT are sometimes used synonymously. Our analysis suggests that both terms are used as descriptions of the changes in the socio-technical context but that it is not appropriate to use them synonymously. As defined above, DT refers to the process of organizational or societal changes driven by innovations and developments of ICT, while digitalization describes the current digital development state. The use of a three stage model to describe the process of DT by Paavola, Hallikainen, and Elbanna (2017) with the stages: "core digitalisation", "expanded digitalisation", "shaked down and complementary digitalisation" underlines this.

3.2 Phenomena in the context of digitization, digitalization, and digital transformation

This section focuses on the seven phenomena connected to digitization, digitalization, and DT we identified in at least three or more papers. Other phenomena like involvement (Syler and Baker, 2016) or co-modeling (Brenner et al., 2014) which are mentioned in single papers are not further considered. The phenomena and their interrelations are presented in figure 2. The numbers in brackets behind the phenomena show the frequency of occurrence in the analyzed papers, while the frequency of their interrelationships are presented next to the pillars. The phenomena are sorted by number of appearances in descending order while the most frequent relationships are discussed.

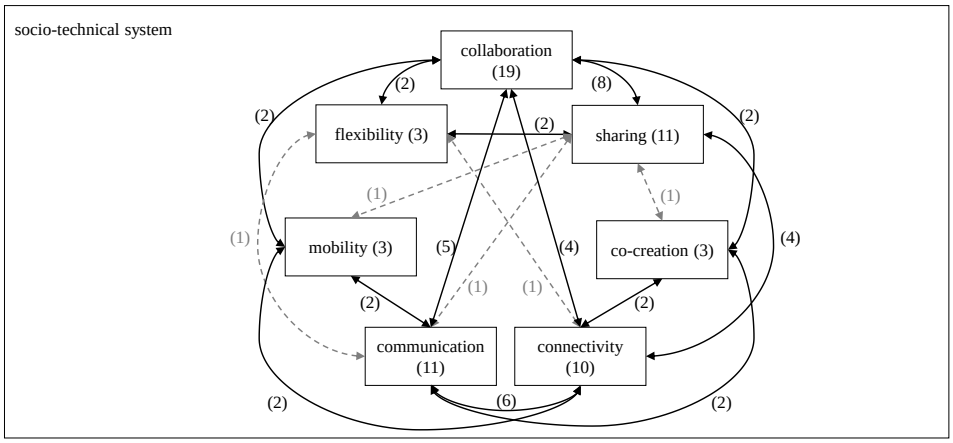

Figure 2: Concept map of the phenomena of digitization, digitalization, and DT

Collaboration is the most frequently mentioned phenomenon. We focus on "digitally-enabled collaboration" which refers to cooperation which "expands across space, time, and organizational boundaries"(Lindberg et al., 2013). The paper of Andersen and Ross (2016) addresses three types of collaboration within the LEGO Group that play an important role for the transformation of the organization. First collaboration between the business leaders, second collaboration between IT and business units and third collaboration between the stores and the headquarter in Denmark are identified for the changing organizational strategy to foster and allow for innovations to develop (Andersen and Ross, 2016). The paper resumes that the expanses toward a more "collaborative culture made it possible to execute an overall strategy" but were high and despite this it "was [...] seen as time well spent". For effective collaborations "social factors and team climate" are of high importance (Boughzala, Vreede, and Limayem, 2012). In addition, the positive effects of collaboration are underlined by Avital et al. (2014) stating that "by lowering marketplace transaction costs; by facilitating 'production' that is more efficient, allowing a greater level of output to be created from the same level of physical assets and labor; and by creating production and exchange opportunities that were not previously possible" are possible efficiency improvements for organizations. Avital et al. (2014) consider collaboration between organizations while Andersen and Ross (2016) and Boughzala, Vreede, and Limayem (2012) focus on collaboration within the organizations' structures. The understanding of Avital et al. (2014) is also supported by the papers of Jackson (2015), Lang, Shang, and Vragov (2015), and Lindberg et al. (2013). The last paper broache the issue of possible collaborations between organizations and its consumers. The inner organizational view (Andersen and Ross, 2016; Boughzala, Vreede, and Limayem, 2012) is supported by Horlacher (2016) broaching the issue of collaboration between the chief digital officer (CDO) and the chief information officer (CIO) for efficient DT. Another topic we identified is collaboration using ICT (Braccini and Federici, 2013; Davison and Ou, 2014) and social media (Collins and Gruzd, 2017; Köffer, 2015). Legner et al. (2017) use collaboration in the context of research collaborations within the industry. The papers of Kelestyn and Henfridsson (2014) and Li, Hong, and Zhang (2016) use the term "collaborative consumption" which is set equal to the next phenomenon: sharing (Li, Hong, and Zhang, 2016). Referring to the STS in our conceptualization, the papers focus on the social as well as the technical component. For the social component each element shown in figure 1 is discussed. Literat (2017) focuses on the human actor especially the intrinsic and extrinsic motivation and characteristics. Boughzala, Vreede, and Limayem (2012) consider collaboration and state that "collaboration is making a joint effort toward a group goal, where joint effort encompasses acts of shared creation and/or discovery" and that it "is one of the essential ingredients of organizational life". Andersen and Ross (2016) discuss the influence of collaboration on the hierarchy in an organization. From technical view platforms (Wilms et al., 2017) as well as the use of information systems (Avital et al., 2014) are discussed.

Sharing economy is defined by Li, Hong, and Zhang (2016) as leveraging "information technology to re-distribute unused or underutilized assets to people who are willing to pay for the services". Sharing between people is nothing new (Avital et al., 2014) but the phenomenon has reached great attention in the context of digitization, digitalization, and DT as sharing of digital content or using platforms to share simplified and enable faster exchanges between people (Avital et al., 2014, 2015; Li, Hong, and Zhang, 2016). The context in which papers refer to this phenomenon reaches from knowledge sharing between organizational units (Andersen and Ross, 2016) over file sharing (Davison and Ou, 2014) and sharing of digital content in general (Collins and Gruzd, 2017; Lang, Shang, and Vragov, 2015) to car and bike sharing (Avital et al., 2014; Nastjuk, Hanelt, and Kolbe, 2016). Schneider (2017) highlights that sharing economy implies "two key components, namely compensation received and the sharing itself". The paper of Kelestyn and Henfridsson (2014) supplements this understanding stating that "newly emerging activities, services and products conceived by the sharing economy convey a very prolific message, stressing the importance of understanding the concepts and behaviors related to the future shaping practices". The examples show that sharing can be analyzed from a social as well as technical perspective as Avital et al. (2015) consider the human actor while Davison and Ou (2014) consider file sharing and sharing platforms (Avital et al., 2014).

The next subsection takes a closer look at the phenomenon of *communication*. Deng and Christodoulidou (2015) define communication as "the ability to inform others and being informed". The information of others can imply different communication relationships. On one hand communication occurs among a homogenous group of people like students (Deng and Christodoulidou, 2015; Wilms et al., 2017; Wulf et al., 2014) or employees (Deng and Christodoulidou, 2015; Köffer, 2015). This horizontal communication in our society becomes more important (Jackson, 2015). On the other hand communication appears between two or more heterogeneous groups, for example students and university employees like professors or scientific assistants (Deng and Christodoulidou, 2015; Wilms et al., 2017) or an organization and its customers (Haffke, Kalgovas, and Benlian, 2016; Negi and Brohman, 2015; Schmidt, Drews, and Schirmer, 2017). Digitization, digitalization, and DT have led to new behaviors in communicating with others. The arising always-on mentality in private as well as professional communication leads to a faster communication (Köffer, 2015). Beside the described social elements of communication, which are the involved human actors and social groups, it is also necessary to consider the technical view. In our literature review we identify different approaches: Jackson (2015) mentions new digital communication platforms but does not further identify them. Wilms et al. (2017) focus on digital learning platforms in the academic context which are used to communicate and collaborate. Köffer (2015) concentrates on social media applications. Other authors concentrate on communication channels (Gimpel, Huber, and Sarikaya, 2016; Haffke, Kalgovas, and Benlian, 2016; Schmidt, Drews, and Schirmer, 2017). To interact with customers, the most important communication channels are websites, call-centers, e-mail, and mobiles (Schmidt, Drews, and Schirmer, 2017). Gimpel, Huber, and Sarikaya (2016) group communication channels into text, audio, and video communication which have different characteristics for example media richness, social presence, synchronism or asynchronism and rehearsability (referring to Massey et al. (2001)). Two papers discuss the hardware which is needed to communicate. Freitas Junior et al. (2016) focus on faster devices in general which improve communication, and Deng and Christodoulidou (2015) concentrate on wearable, which "enables mobility and connectivity so that users can readily access information online and communicate with others instantly when they are mobile."

Connectivity, from a technical view pointb of view, can be understood as internet connectivity which allows users to have access to information and the possibility to communicate with others (Deng and Christodoulidou, 2015). One benefit of digitization is the possibility of always being connected (Köffer, 2015) and furthermore, the quality of connectivity became more powerful and cheaper (Haffke, Kalgovas, and Benlian, 2016). Nastjuk, Hanelt, and Kolbe (2016) consider the connectivity of vehicles, especially in the context of car or bike sharing and discuss new business models with pricing systems. Wulf et al. (2014) see connectivity in the academic context and identify one special type of MOOCs called connectivist Massive Open Online Courses (cMOOCs) which "are based on the pedagogical principles of connectivism"

implying the interaction of students to create knowledge. Similar to that, Li, Hong, and Zhang (2016) also consider connectivity as a platform allowing sellers and buyers to communicate. Andersen and Ross (2016) focus on the possibility of employees to connect and create new networks. Davison and Ou (2014) and Haffke, Kalgovas, and Benlian (2016) concentrate on the users' behavior. The latter identify changes in the behavior of digitally connected customers but do not explicitly mention them. In the paper new forms of communication between customers and an organization are mentioned, which came up as new possibilities to connect with customers arise like touch-points, digital channels or digital services (Haffke, Kalgovas, and Benlian, 2016). Davison and Ou (2014) state that "being connected is what digital natives do but also who they are"(referring to Vodanovich, Sundaram, and Myers (2010)). For digital natives, who grow up with digital technologies, connectivity is a part of their personalities in private life as well as at work (Vodanovich, Sundaram, and Myers, 2010). Beside other characteristics like digital literacy, digital natives are highly connected (Davison and Ou, 2014). To sum up referring to figure 1, connectivity includes the human actor (Davison and Ou, 2014) and the social group (Andersen and Ross, 2016) as well as technical elements like platforms (Li, Hong, and Zhang, 2016; Wulf et al., 2014) or digital infrastructures (Köffer, 2015).

In the literature review we identified *flexibility* as another phenomenon connected to digitization, digitalization, and DT. Flexibility in this context is enabled through the flexible "use of digital technologies and services" (Nastjuk, Hanelt, and Kolbe, 2016). Kelestyn and Henfridsson (2014) referring to the paper of Yoo et al. (2010) highlight that phenomena like sharing and collaboration have become possible due to the increasing flexibility of digital technology. The paper of Boughzala, Vreede, and Limayem, 2012 states that "organizations are trying to take advantage of the flexibility of technology-enabled work to create distributed virtual teams and tap into globally dispersed, cross-functional expertise and competences". Flexibility through digital technologies and services is therefore an important competitive factor for organizations but also for individuals. The increasing flexibility enables totally new handling of different situations of life. Flexibility is more often considered from a technical perspective (Kelestyn and Henfridsson, 2014; Nastjuk, Hanelt, and Kolbe, 2016) but the social perspective in the case of virtual teamwork allowed and improved by flexibility of its members (Boughzala, Vreede, and Limayem, 2012) are also discussed.

The phenomenon *mobility* is highly interrelated with sharing as peer-based mobility "using information systems to coordinate capacity and needs among peers, sharing services in all kinds of industries are growing fast" like car or bike sharing (Avital et al., 2014). Deng and Christodoulidou (2015) further underline that ICT is enabling "mobility [...] so that users can readily access information online and communicate with others instantly when they are mobile." Despite these technical elements, mobility is also important for organizations as it allows for the employees to use the ICT at anytime and anywhere. Therefore, Köffer (2015) notices that "managing the introduction of mobile technologies in the workplace, as well as supporting mobile workers in their work practices" is an upcoming challenge for organizations.

Co-creation implies that customers are involved in the value creation process, like involving customers in the designing of a product (Negi and Brohman, 2015). Co-creation in the academic context refers to the involvement of students. In MOOCs students are involved in the value creation. They have the possibility to create new knowledge by posting comments, writing texts and discussing topics with other students (Wulf et al., 2014). Besides the human actor as a social element, technical elements must be considered as they build the basis for co-creation activities. They take place in online communities or social networks on platforms. Value can be created by sharing content like music, videos, or movies on these platforms (Lang, Shang, and Vragov, 2015).

To sum the discussion up 18 papers do not consider any phenomena but only take into account the terms digitization, digitalization or DT. Ten papers focus on a single phenomenon whereas collaboration is the phenomenon mostly (in six papers) considered separately. Nine papers consider two phenomena, six papers focus on three phenomena, and three papers even take into account four phenomena. Figure 2 shows that nearly all phenomena are interrelated. Only for the three least mentioned phenomena flexibility, mobility, and co-creation we identified no interrelationships. The phenomena which most frequently

occur together are collaboration and sharing (in eight papers), and communication and connectivity which are mentioned together in five papers. The analysis of the eight papers that discuss collaboration and sharing shows that some papers discuss a technological basis like platforms or applications (Andersen and Ross, 2016; Collins and Gruzd, 2017; Davison and Ou, 2014) which have different functionalities enabling communication and sharing between participants. Other papers focus on the social component. For example, Kelestyn and Henfridsson (2014) consider user communities while Plenter et al. (2017) define the group of participants as a peer. For Plenter et al. (2017) peer-to-peer sharing and collaborative consumption are a specific branch of the sharing economy. All papers which consider the phenomena connectivity and communication see connectivity as the needed basis to communicate. The papers only differ in their understanding of connectivity. For some it is seen as a technical component (Freitas Junior et al., 2016; Haffke, Kalgovas, and Benlian, 2016) while for others it is analyzed as a social component (Deng and Christodoulidou, 2015; Köffer, 2015).

4 Conclusion and Further Research

We showed that the terms digitization, digitalization, DT, and the related phenomena are frequently used but a common understanding of the terms and a clear distinction can be rarely found. From the analysis of the papers identified in the literature review we concluded that the synonymous usage of the terms is not appropriate as each term focuses on different concepts. Digitization takes into consideration mainly technical aspects while digitalization includes both components of an STS. Furthermore, digitalization focuses on the current status of an organization or society referring to its current digital development and usage of ICT. In contrast to this, DT describes the change process enabled through ICT innovations taking into account social and technical elements. Our paper suggests definitions of the three terms from a socio-technical perspective. A differentiated understanding is a necessary requirement for further research activities and for the development of holistic transformation concepts either for society or organizations. We additionally identified seven phenomena discussed in literature in the context of the three terms. Additionally, we highlighted that the combined use of the phenomena is often discussed. Knowledge about the existence of the phenomena is relevant for theory and practice. It allows for organizations to choose suitable phenomena and develop a holistic strategy to reach competitive advantages.
The limitations of our paper are twofold. On the one hand the analysis of the discussed terms and connected phenomena is based on an information systems perspective. From the perspective of other disciplines like sociology or psychology the definitions and concepts might differ as the social perspective is more in focus. On the other hand a consequent and in-depth empirical foundation of our results is still missing.
Further research could focus on the three terms as well as on the phenomena. One idea is to verify our findings with empirical approaches, methods or models to identify the cause and effect of the phenomena on the process of DT. For the practical implementation in organizations further research can be conducted through case studies or field experiments. Our literature review showes that digitization, digitalization, and DT are of interest in different contexts. For example, one field of interest is the academic context. Universities have to adapt their learning offerings to satisfy their students which are now mainly digital natives. One main focus of the literature lies in the importance of digitization, digitalization, and DT for business model innovations. Especially, the benefits and challenges of the phenomena for new or adapted business models could be further analyzed.

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