

Digitization or digitalization? - Toward an understanding of definitions, use and application in IS research

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Completed Research

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Abstract

Since the dotcom era around the year 2000, we observed a massive increase in technological progress. Nevertheless, with the emergence of new, elaborated digital technologies, theoretical complexity has increased simultaneously. Scholars often conceptualize the implications and the evolutionary process of adapting these technologies as digitization or digitalization. With our research, we aim to provide a clear and inter-subjective basis for common understanding of research terminology, that also supports practitioners in applying strategies with digital technologies. We conducted a systematic literature review, that sheds light on how digitization and digitalization are defined in IS literature, how the terms are used, and how researchers apply them. We present our approach to a definition and give researchers recommendations on how to use the terms explicitly. Subsequently, we discuss the different dimensions of our analysis, finding that to this point, there is no generalized conceptualization of the phenomena but a solid basis for formalizing one.

Keywords

Digitization, digitalization, technical process, data conversion, socio-technical phenomenon, information systems.

Introduction

In 1937, the German engineer Konrad Zuse invented the Z1 – a machine that performed calculations based on binary digits, zeros and ones (Encyclopædia Britannica, Inc. 2021). This revolutionary invention made Zuse a pioneer who created a foundation for almost all computerized technologies that we know and use in our everyday lives. Zuse's invention did not only impact the world of technology (all major digital computer systems that followed the Z1 were based on the principle of Zuse's binary system) but served as the origin of wording for a phenomenon we call digitization. First attempts to develop conceptualizations of the term digitization were made by Shannon (1948) who found that basically all types of information can be stored with the help of binary digits – a conversion of analog into digital signals. In addition, the term digitalization emerged as a parallel concept to digitization. In particular, for the past two decades, information systems (IS) research examined the two concepts in almost all its dimensions. Publications like Legner et al. (2017), Lyytinen et al. (2016), and Sandberg et al. (2020) were able to provide definitions while using the two terms differently and with a variety of applications. However, until today, researchers continued trying to formalize, generalize and ultimately define digitization as well as digitalization and their manifold implications. Despite the considerable interest among scholars, to this point, IS research still lacks a framework for definitions, correct use, and applications of the terminology.

Alongside the terminological discussions, technology progressed further. Today, more than 80 years later, a broad variety of information and digital technologies exist but a common understanding of digitization and digitalization within academia and also industry (Ross 2017), is still missing. For example, 31 % of

executives asked by Bitkom Research (2018) feel hindered by a lack of standards and almost every second executive in Germany fears the complexity of digital applications in his or her company. Furthermore, the Covid-19 pandemic has even accelerated the digitization and digitalization within companies (KPMG LLP 2020). Prospectively, this theoretical and practical need for a clarifying, common understanding to facilitate the connections between academia, industry, and startups, could serve as point of reference for transdisciplinary research (Legner et al. 2017).

Logically, the space for interpretation in the use of the two terms, that is yet undiscussed, motivates our research to shed further light on definitions, use, and application of the two concepts of digitization and digitalization in IS research. For this purpose, we propose the following research question:

“How are the concepts digitization and digitalization defined in IS literature, and how do researchers use and apply the two terms?”

By using a systematic literature review approach (Webster and Watson 2002), this paper contributes to existing literature by reviewing current conceptualizations of the terms digitization and digitalization in IS research. Identifying relevant publications and a subsequent categorization will pave the way for a more generalized understanding of the highly dynamic and complex concepts as well as their manifold implications for research and practice.

Theoretical Foundation

Within IS literature, there is a wide variety of studies analyzing concepts associated with digitization and digitalization using several similar as well as clearly diverging definitions, both in organizational (e.g., Grover and Kohli 2013; Lyytinen et al. 2016; Nambisan et al. 2017) as well as in broader societal contexts (e.g., Clarke 2019; Corrocher and Ordanini 2002; Miranda et al. 2016). Furthermore, there are wider debates in the IS field connected to digitization and/or digitalization analyzing its scalable dynamics (e.g., Benbya et al. 2020), its impact on everyday life and human experiences (Matt et al. 2019; Yoo 2010), and questioning new challenges for IS research (e.g., Baskerville et al. 2020; Legner et al. 2017).

Due to this wide variety of contexts, we establish a pre-understanding of the two concepts digitization and digitalization. Therefore, we choose three exemplary publications, which give representative definitions and present the concepts in a straightforward way reflecting our understanding of an easily understandable definition (see table 1).

Source(s)	Concept for digitization/digitalization	Derived understanding
Legner et al. (2017)	Digitization: “[...] the technical process of converting analog signals into a digital form, and ultimately into binary digits.” (p. 301) Digitalization: “[...] the manifold sociotechnical phenomena and processes of adopting and using these technologies in broader individual, organizational, and societal contexts.” (p. 301)	<ul style="list-style-type: none"> ▪ Preliminary existence of physical carriers ▪ Digital information is a derivate of analog information ▪ Explicit difference between digitization and digitalization
Lyytinen et al. (2016)	Digitization/digitalization: “[...] processing, storing and communicating [...] matter, energy and information comprising our world, using strings of ones and zeroes.” (p. 49)	<ul style="list-style-type: none"> ▪ Innovative character of digitization/digitalization ▪ No explicit difference between digitization and digitalization
Sandberg et al. (2020)	Digitization: “[...] change in a firm’s organizing logic by instilling new properties into product platforms.” (p. 130)	<ul style="list-style-type: none"> ▪ Digitization influences product architectures ▪ Final stage of digitization is a platform-ecosystem

Table 1. Exemplary Concepts for Digitization and Digitalization

Legner et al. (2017) carry out a clear distinction between the two terms. According to them, digitization is the conversion of analog into digital signals, adopting a more technical perspective that is characterized by a dematerialization of information or, in other words: the redundancy of physical assets in terms of

information storage, transmission, and processing. In contrast, digitalization describes socio-technical conditions of the adoption and use of digital technologies – also with a focus on their societal, organizational, and individual impact. At this point, we want to highlight, that according to this definition, the existence of an analog information artifact is a precondition for the digital counterpart. Other authors like Lyytinen et al. (2016) do not distinguish between the terms digitization and digitalization but rather use them interchangeably, favoring the first one. They refer to digitization as processing, storage, and communication of information enabled by the binary system, drawing from other authors (Tilson et al. 2010; Yoo 2012; Yoo et al. 2010). Furthermore, they focus on the innovation aspect of the phenomenon: digitization enables radical product reconfigurations and decouples form and function while allowing for new combinations of previously uncoupled products. Sandberg et al. (2020) recently presented another perspective on digitization: its influence on product platforms and how it changes related organizing logics. They further highlight four unique characteristics induced by digitization: reprogrammability, data homogenization, decoupling, and distributedness.

Resulting from our outline of exemplary definitions, we identify two ways of how authors could use the terms digitization and digitalization in their publications that we later will apply to the analyzed publications. In 2002, Corrocher and Ordanini (2002) already proposed that digitization may be a phenomenon that cannot be described by a clear and synthetic definition as it is too broad. Lyytinen et al. (2016) adopt this perspective and do not differ between digitization and digitalization in their article but rather switch between those two terms. This type of usage will be referred to as *interchangeable* use in our analysis. Both Legner et al. (2017) and Sandberg et al. (2020) deviate from this standpoint and instead give explicit definitions for either one or both terms. We will subsequently refer to this as *explicit* use.

To understand how digitization and digitalization are applied by research, we further developed the framework provided by Alt (2018) and therefore identify three dimensions in the following, also referred to as levels of analysis. Application on the *socio-economic ecosystem level* (1) addresses all aspects of digitization/digitalization regarding its influence on societies, markets, values, and political systems. We decided to further divide the *organization level* (2) into application to the basic structure of an organization, its role as a network or platform, and its business processes. The *individual level* (3) focusses on all implications of the two concepts for individual persons in their work or personal sphere.

Summing up: for the sake of clarity regarding definitions, use, and application of digitization and digitalization, we will first identify relevant publications on the subject and then utilize the frameworks for use and level of analysis that we have developed in this chapter in order to categorize the publications and finally reflect the different definitions.

Methodology

In order to achieve an exhaustive overview of the IS literature on *digitization* and *digitalization* concepts, we use a systematic literature review approach following the guidelines of Webster and Watson (2002) and applying the process of Xiao et al. (2013). We choose the IS basket of eight as our search scope. Moreover, we consider additional peer-reviewed IS journals (*Business & Information Systems Engineering, Decision Support Systems, Electronic Markets, Information & Management, Information and Organization, Information Systems Frontiers, Internet Research, MIS Quarterly Executive*) which ensure both a broader view as well as certain quality and significant impact on the academic discourse. Furthermore, we excluded conference proceedings – usually being working papers that are not completed yet – and only searched for publications between 2000 and 2020 due to the highly dynamic development in digital technologies and their impact.

After setting our search scope, we started to identify relevant keywords that provide a basis for identifying publications including definitions of at least one of our two concepts, digitization or digitalization. A leading source for this purpose were the previously discussed articles (Legner et al. 2017; Lyytinen et al. 2016; Sandberg et al. 2020). To get as many results as possible, we deliberately only used the OR operator, also between the key terms, and added the British English notation. The final search string included *digitization, digitisation, digitalization* and *digitalisation*. By searching title, abstract, and keywords, we could obtain 259 articles in a first step. We started to set up first exclusion rules and adapted them iteratively during the assessment process (table 2). We excluded duplicates as well as articles that did not contain any of our keywords in the abstract or the introductory chapter which lead to 59 remaining articles. We then added

another seven articles using a backward search. We finally assessed the remaining 66 articles by reading them in detail and selecting those that define our subject in a meaningful and relevant context. The exclusion/inclusion rules we used (table 2), are directly related to our research question and are intended to identify those articles that give definitions on either *digitization*, *digitalization*, or both – in a relevant context. Our final pool of papers includes 12 articles. We carefully analyzed and classified the final pool of papers by focusing on definitions of the relevant terms and their use and application. Three of the co-authors independently checked and aligned the classification using deductive and inductive reasoning (Xiao et al. 2013). Eventually, we summarized our results in a concept matrix.

Rule No.	Criteria
1	Exclude if the study does not provide any definition for digitization or digitalization.
2	Exclude if the study does only provide a definition based on references to other articles.
3	Exclude if the study deals with digitization/digitalization in a non-relevant context.
4	Include if the study provides at least interchangeably used definitions for digitization/digitalization in a useful context.
5	Include if the study provides an explicit definition for either digitization or digitalization in a useful context.
6	Include if the study provides an explicit definition for both digitization and digitalization in a useful context.

Table 2. Exclusion and Inclusion Rules

Results

The results of our analysis will subsequently be presented in two sections. In the first part, we present how the publications are distributed in terms of years of publication and used methodology – this will be picked up to discuss further research possibilities. In the following part, we focus on the results that will ultimately answer our research question.

Distribution of papers across years and used methodologies

Between 2000 and 2010, the contribution by Corrocher and Ordanini (2002) provided the most useful definitions on our subject. The authors at that time expressed the view that digitization/digitalization are concepts that are too wide to provide a synthesized definition. However, most contributions on this topic were made between 2010 and today, whereas the majority of found research (seven out of eleven) was published within the last four years. This may be, because of advanced information and communications technologies (ICT) that became more and more ubiquitous in personal and professional applications (for example, Internet of things devices) during this period and thus increasingly raised attention among IS scholars.

Regarding the methodological approaches within our set of literature, we identify a bias towards discussions or research commentaries with a total of seven articles. Among these, there is a significant number of research agendas that mostly motivate for further research (Legner et al. 2017; Matt et al. 2019; Yoo et al. 2010). They reflect the before mentioned position that IS research still lacks knowledge on these fast-developing subjects. Case studies were performed by three authors (El Sawy et al. 2016; Sandberg et al. 2020; Whelan et al. 2013). All of them applied digitization/digitalization on an organizational level – a logic implication as companies offer an excellent foundation for this methodology. Clarke (2019) was the only author within our set that reviewed existing concepts: he discussed a wide range of existing conceptualizations and applied his own framework of a digital surveillance economy to this literature base.

Interchangeable vs. explicit use of concepts

As introduced in the theoretical foundation chapter (2), we will first apply the outlined concepts: interchangeable vs. explicit use. Within our literature base, we find that most authors (nine out of twelve) use explicit definitions for either one of the terms or both digitization and digitalization (see table 3). As it would be inconsequential, none of the authors provides definitions for both terms and then used them

interchangeably. We want to highlight that three publications (Alt 2018; El Sawy et al. 2016; Lyytinen et al. 2016) provided a definition for respectively one of the concepts but subsequently switched between the terms. El Sawy et al. (2016) expanded the interchangeable use even further by emphasizing that digital transformation is the North American term for digitalization. Although Alt (2018) did switch between the terms, the author at least provided a nuanced differentiation for his definition of digitalization (technical and applied), which shows remarkable similarities with other definitions for both terms.

Applications and level of analysis framework

Regarding the applications made within the analyzed literature, we find that the majority (seven out of twelve) of publications applies digitization/digitalization on an organizational level (see table 3). El Sawy et al. (2016) apply digitalization to the organizational structure change at LEGO, finding that it enables new and evolves existing products, services and processes. They furthermore introduce digital leadership, which is the concept of competitive advantage for an enterprise or even the surrounding ecosystem, arising from the successful implementation of digitalization. Other authors (Lyytinen et al. 2016; Sandberg et al. 2020; Tilson et al. 2010; Whelan et al. 2013; Yoo et al. 2010) focus on the implications of digitization/digitalization on an organization's function as a platform or network. For example, Whelan et al. (2013) find that digitalization changes the technological gatekeeper's role, an individual with significant influence on R&D networks' communication flows. It facilitates the external collection of information by the network as a whole. Lyytinen et al. (2016) even further expand that by adding the process level to their application. The authors find that an increased degree of digitization influences a business's innovation and knowledge creation processes either as an operand resource that enhances connectivity within the network by reducing communication costs or as an operand resource that spurs generativity by an increase in digital convergence.

Source(s)	Definition		Use		Level of Analysis (Application)				
	Digitali- zation	Digiti- zation	Explicit	Inter- change- ably	Socio- technical ecosystem	Organization			Individual
						Organizational structure	Platform / network	Process	
Alt (2018)	x			x	x	x			x
Clarke (2019)	x	x	x						x
Corrocher and Ordanini (2002)	x		x		x				
El Sawy et al. (2016)	x			x		x			
Legner et al. (2017)	x	x	x		x				
Lyytinen et al. (2016)		x		x			x	x	
Matt et al. (2019)		x	x						x
Rosner et al. (2014)		x	x		x				
Sandberg et al. (2020)		x	x				x		
Tilson et al. (2010)	x	x	x				x		
Whelan et al. (2013)		x	x				x		
Yoo et al. (2010)		x	x				x		
12 articles	6	9	9	3	4	2	5	1	3

Table 3. Concept matrix (partial extract)

A total of four publications (Alt 2018; Corrocher and Ordanini 2002; Legner et al. 2017; Rosner et al. 2014) analyze the concepts with regards to their influence on society and socio-technical systems as a whole.

Legner et al. (2017) define three waves of digitalization. The use of computers instead of paper as a physical carrier (first wave), an interconnected world with global communication that changes the value creation logic of businesses and creates new business opportunities (second wave), and the ubiquity of computing, which to this day is still a visionary concept that becomes more realistic every day (third wave). Corrocher and Ordanini (2002) also present the negative implications of global digitalization as it leads to a more extensive division in societies due to different digital capability levels. Rosner et al. (2014) instead focus on a more technical aspect of societies' digitization. They address how tacit knowledge that comes with analog information, for example, dog ears in ancient books or in which way an artist has swung the brush while painting, can be stored digitally. They further highlight that the digitization of such artifacts can only be effective if the stored information outlasts the change in the digital technologies used for storage.

The application of digitization/digitalization on an individual level was performed by Clarke (2019): accordingly, the digital surveillance economy – a concept developed by the author that describes the exploitation of large data sets for target advertising, price setting, and manipulating customer behavior – influences almost all individual lives. Matt et al. (2019) draft a research agenda that conceptualizes the digitization of the individual in five roles of the digitized individual: as itself, as a social being, as a citizen, as a customer, and as an employee. Furthermore, they outline behavioral studies on the digitized individual, studies on consequences of the digitized individual on itself and its surroundings, as well as studies on the design of technologies for the digitized individual as relevant angles of research.

Alt (2018), which was the inspiration for our *level of analysis* framework, was the only author within our analysis that included all three levels in his article. Accordingly, the individual dimension is defined by digital technologies emerging in all areas of personal life. The organizational dimension includes the digitalization of enterprises themselves as well as the connections between them. The third dimension, society, describes the role of *digitalization* in social and political communication. He also puts forward the thesis that *digitalization* has to be applied in a broader context than just the technical process associated with keywords like ERP or e-Commerce.

Definitions of digitization and digitalization

To answer the question, how the concepts digitization and digitalization are defined in IS literature, it is a fundamental component to analyze the various definitions provided by researchers. We did this within our review and collected different ways of defining *digitization* or *digitalization*, as it can be seen in table 4. We identify a trend towards a more technical framing for *digitization* (Clarke 2019; Legner et al. 2017; Lyytinen et al. 2016; Rosner et al. 2014; Tilson et al. 2010; Yoo et al. 2010), whereas *digitalization* is mainly framed as an antecedent of digitization (Alt 2018; Clarke 2019) or the use of digital technologies (Corrocher and Ordanini 2002; El Sawy et al. 2016; Legner et al. 2017; Tilson et al. 2010).

Source(s)	Definition	Conceptual clarity/challenge(s)
Alt (2018)	<p>Technological digitalization: "[...] the basis for digitalization in all areas of application. [...] Capturing and executing data automatically with sensors, actuators and other devices at their points of creation and usage." (p. 399)</p> <p>Applied digitalization: "[...] contextualization of data which occurs differently by individuals, in organizations and the society as a whole." (p. 399)</p>	<ul style="list-style-type: none"> ▪ Two rather interchangeable uses for digitalization that include automation on one hand and a broader view on individuals, organizations and society on the other ▪ No clear differentiation
Clarke (2019)	<p>Digitization: "[...] a large proportion of data is now 'born digital', and analogue data can be inexpensively converted into digital form" (p. 59)</p> <p>Digitalization: "interpretation and management of the world [...] [through] processes, that are almost entirely dependent on digital data" (p. 59)</p>	<ul style="list-style-type: none"> ▪ Explicit use of both concepts digitization and digitalization enabling a clear distinction
Corrocher and Ordanini (2002)	<p>Digitalization: "emergence of technological platforms of information and communications technology [...] determining significant and unprecedented changes in many aspects of our social and economic life." (p. 9)</p>	<ul style="list-style-type: none"> ▪ Explicit use of digitalization as broader view on individuals, organizations and society

El Sawy et al. (2016)	Digitization: "process of transforming the structure, processes, people skills and culture of the entire organization so it can use digital technologies to create and offer products, services and experiences that customers, employees and partners find valuable." (p. 142)	<ul style="list-style-type: none"> ▪ Explicit use of digitalization as broader view, though only on organizations ▪ (Interchangeable use of digitization and digital transformation not enabling a clear conceptualization)
Legner et al. (2017)	Digitization: "[...] the technical process of converting analog signals into a digital form, ultimately into binary digits." (p. 301) Digitalization: "[...] manifold sociotechnical phenomena and processes of adopting and using these technologies in broader contexts." (p. 301)	<ul style="list-style-type: none"> ▪ Explicit use of both concepts digitization and digitalization enabling a clear distinction
Lyytinen et al. (2016)	Digitization: "[...] processing, storing and communicating [...] matter, energy and information comprising our world, using strings of ones and zeroes." (p. 49)	<ul style="list-style-type: none"> ▪ Interchangeable use of digitization and digitalization not enabling a differentiation and a clear conceptualization
Matt et al. (2019)	Digitization of the individual: "[...] the proliferation of digital technologies in the lives of individual users." (p. 315)	<ul style="list-style-type: none"> ▪ Digitization as broader view on individuals contrasting other definitions of digitization ▪ Furthermore, no clear definition of digital technologies
Rosner et al. (2014)	Digitization: "[...] capture, storage and representation of material resources, including books, archeological sites, and works of art." (p. 86)	<ul style="list-style-type: none"> ▪ Explicit use of digitization as the technical process/automation
Sandberg et al. (2020)	Digitization: "[...] change in a firm's organizing logic by instilling new properties into product platforms." (p. 130)	<ul style="list-style-type: none"> ▪ Explicit use of digitization as broader view only on organizations contrasting other definitions of digitization
Tilson et al. (2010)	Digitization: "[technical] process of converting analog signals into a digital form, and ultimately into binary digits (bits)" (p. 749) Digitalization: "[...] socio-technical process of applying digitizing techniques to broader [...] contexts" (p. 749)	<ul style="list-style-type: none"> ▪ Explicit use of both concepts digitization and digitalization enabling a clear distinction

Table 4. Definitions of Digitization and Digitalization

Discussion

Our results of the conducted literature review suggest a tendency of the definition of digitization towards explaining a technical process of data conversion, generation, storage, or processing. In contrast, digitalization was mainly referred to as a socio-technical phenomenon, the use of digital technologies, and their influence on societies, businesses, and personal lives.

Specifically, we found that in terms of explicit vs. interchangeable use, the majority of authors use explicit definitions, which in our opinion, is the only way towards a clarification of the concepts. This method directly influences the understandability as it enables a clear delimitation between digitization and digitalization. Based on our findings, we take the liberty to disagree with Alt (2018) and Lyytinen et al. (2016) that digitization and digitalization refer to the same phenomenon. We also challenge the assumptions by El Sawy et al. (2016) because digitization is not the same as digital transformation – digital transformation is rather a concept on its own (e.g., Chanas et al. 2019; Vial 2019) and not subject to this article.

With the application of the *level of analysis* framework, we categorized the reviewed literature in three dimensions according to the applied level of the concepts digitization and digitalization. We based our work on Alt (2018) and implemented three sub-levels to the organization dimension. Due to a growing emergence of digital technologies and their influence on all levels of personal and professional lives, we were confronted with a wide variety of contexts and implications. Furthermore, we could clearly identify Matt et al. (2019) as a cornerstone for the individual level. We disagree with their use of the term and, in this case,

would rather refer to *digitalization*, as they describe a socio-technical phenomenon. Nonetheless, we want to promote their excellent application and research framework at this point.

Further, we want to explicitly highlight the definition of Legner et al. (2017), that was presented in the pre-analysis chapter. According to them and other authors (Tilson et al. 2010; Yoo et al. 2010), digitization can be defined as a technical process which transfers analog signals into digital signals (data conversion). This definition implies evolutionary processing of data, with the analog form being a prerequisite for the final digital product evolving out of it. In contrary to that definition, we would argue that at this point, there is no longer a need for an analog version, as data or even contextualized information can be created independently and solely in digital form (Baskerville et al. 2020). For example, a text document processed on a computer does not need to be written down by hand in advance. Thus, we agree with Clarke (2019) that digitization can also be defined as the fully digital creation of information and data without a physical or analog counterpart. In terms of digitalization, we argue that this phenomenon should be defined in a two-fold way. Digitalization can be defined as (1) the use and application of digital technologies in contexts of individuals, organizations, or society at large, as well as (2) the influences on individuals, organizations, or society at large, induced by this usage. In our opinion, all aspects of digitalization that go beyond this definition, for example, the evolution of existing business models (digital transformation) or the creation of new businesses (digital innovation) that relate to digital technologies, should be subject to future research.

In conclusion, we want to point out that the generated insights reveal a clear foundation for other researchers to continue developing their conceptualizations and help practitioners to better understand digital applications in their respective industries. However, as thought-leaders, it is up to the IS research community to continuously update these definitions and applications. This is a crucial process for fostering connections between academia, industry, and startups, as the introduction demanded.

Limitations and Future Research Opportunities

Like all studies, this one has its limitations. First, we consciously focused the selection of publications, subject to the review, on the IS discipline and selected publications from the last two decades. This served the purpose of increased relevance to the IS research field that we wanted to address. Nevertheless, we are aware of other disciplines, like innovation management, who may also discuss the two concepts and suggest a wider analysis for future research. Our justification for selecting publications from the year 2000 on, is that we focused our work on the digitization/digitalization development since the dotcom era. Second, we found that keywords like digital innovation or digital transformation are sometimes used interchangeably with our keywords. We therefore included them in our first keyword search. Nevertheless, we are aware of the fact that there might be other keywords not included in our search that could have provided additional conceptualizations. Third, it may be subject to controversy, if an explicit definition can be provided for a phenomenon with such fast-changing characteristics in differing applications. The concepts of digitization and digitalization are both influenced by fast developments of information and communication technologies and, therefore, carefully need to be adapted accordingly. Thus, we are aware of our study being limited by the fact that it can only provide a snapshot that may need to be updated as technology continues to develop.

Regarding future research directions, we would like to provide recommendations and point out the following possibilities for further studies: Research on the concepts of digitization and digitalization should explicitly use the terms in a distinguished manner and not mix them with other concepts in IS research. By categorizing research into one dimension of our level of analysis framework, or in other categorization frameworks like Matt et al. (2019), readers can quickly identify interrelated work. When defining the two concepts, we also recommend following our suggested approach or following the overview of definitions provided. This could serve as a starting point for further evolutions of definitions. Based on our findings and following Legner et al. (2017), we would like to call for interdisciplinary research, and for additional literature reviews/quantitative/qualitative investigations with adjacent fields to gain novel insights.

Conclusion

Over time, not only machines became increasingly complex but also related theoretical concepts of digitization and digitalization – to the point, where there are many different definitions, uses, and

applications of the two concepts in IS research. This not only complicates research – especially interdisciplinary studies – but also has implications for the adoption of digital technologies in practice: the complexity of such applications hampers almost every second executive. For this reason and by following calls for further research on this topic, we shed light on definitions, use, and applications of the concepts of digitization and digitalization, guided by the research question: “How are the concepts digitization and digitalization defined in IS literature, and how do researchers use and apply the two terms?”

By answering this research question, we contributed to existing knowledge by providing a framework for the conceptualization of digitization/digitalization. We developed two modes of how the terms can be used: explicit vs. interchangeable. Additionally, we used the application framework of Alt (2018) as reference and further implemented an additional level for the application of digitization/digitalization in organizational settings, referred to as our level of analysis framework.

By conducting a systematic literature review as suggested by Webster and Watson (2002), we were able to identify relevant contributions on the topic and subsequently assessed them in our analysis process. We focused our search to the main IS journals, limited the years of publication to the last two decades, and obtained 259 articles for analysis. We added further publications to this population by searching the references of important contributions and by performing another keyword search with a slightly different combination. After successfully scanning titles, abstracts and introductory chapters for definitions of our subject, we sorted out articles by reading them in detail. This process was supported by transparent inclusion and exclusion rules. In the end, 12 articles remained for the final analysis via a composed concept matrix. Based on the concept matrix, we were able to carve out the definitions of digitization/digitalization and eventually applied our frameworks explicit vs. interchangeable use and level of analysis.

Results enabled us to categorize existing conceptualizations according to our framework. Thereby we were able to evolve current definitions and eventually present our own approach to a conceptualization of digitization and digitalization, taking into account the independence of data from its analog ancestor.

The major finding of this study is, that even with a perfect understanding of the two concepts, research can only provide a snapshot and subsequently has to adapt its concepts to the changes induced by digital technologies. We paved the way for further, interdisciplinary research and recommended future authors to explicitly use the terms while building on existing definitions and evolving them. By taking these simple measures, IS researchers will remain thought-leaders for both digitization and digitalization, and will eventually become pioneers, just like Konrad Zuse has been at the time.

REFERENCES

- Alt, R. 2018. “Electronic Markets on digitalization,” *Electronic Markets* (28:4), pp. 397–402.
- Baskerville, R., Myers, M., and Yoo, Y. 2020. “Digital First: The Ontological Reversal and New Challenges for IS Research,” *MIS Quarterly* (44:2), pp. 509–523.
- Benbya, H., Ning Nan, Tanriverdi, H., and Yoo, Y. 2020. “Complexity and Information Systems Research in the Emerging Digital World,” *MIS Quarterly* (44:1), pp. 1–17.
- Bitkom Research 2018. *Industrie 4.0 – Wo steht Deutschland?*. Retrieved 30. January, 2021, from <https://www.bitkom.org/sites/default/files/file/import/180423-Bitkom-Präsenation-neu.pdf>.
- Chanias, S., Myers, M. D., and Hess, T. 2019. “Digital transformation strategy making in pre-digital organizations: The case of a financial services provider,” *The Journal of Strategic Information Systems* (28:1), pp. 17–33.
- Clarke, R. 2019. “Risks inherent in the digital surveillance economy: A research agenda,” *Journal of Information Technology* (34:1), pp. 59–80.
- Corrocher, N., and Ordanini, A. 2002. “Measuring the Digital Divide: A Framework for the Analysis of Cross-Country Differences,” *Journal of Information Technology* (17:1), pp. 9–19.
- El Sawy, O. A., Kræmmergaard, P., Amsinck, H., and Vinther, A. L. 2016. “How LEGO Built the Foundations and Enterprise Capabilities for Digital Leadership,” *MIS Quarterly Executive* (15:2), pp. 141–166.
- Encyclopædia Britannica, Inc. 2021. *Zuse computer*. in *Encyclopedia Britannica* Retrieved 30. January, 2021, from <https://www.britannica.com/technology/Zuse-computer>.
- Grover, V., and Kohli, R. 2013. “Revealing Your Hand: Caveats in Implementing Digital Business Strategy,” *MIS Quarterly* (37:2), pp. 655–662.

- KPMG LLP 2020. *Digital acceleration*. in KPMG Retrieved 1. March, 2021, from <https://home.kpmg/us/en/home/insights/2020/09/digital-acceleration.html>.
- Legner, C., Eymann, T., Hess, T., Matt, C., Böhmman, T., Drews, P., et al. 2017. “Digitalization: Opportunity and Challenge for the Business and Information Systems Engineering Community,” *Business & Information Systems Engineering* (59:4), pp. 301–308.
- Lyytinen, K., Yoo, Y., and Boland Jr., R. J. 2016. “Digital product innovation within four classes of innovation networks,” *Information Systems Journal* (26:1), pp. 47–75.
- Matt, C., Trenz, M., Cheung, C. M. K., and Turel, O. 2019. “The digitization of the individual: conceptual foundations and opportunities for research,” *Electronic Markets* (29:3), pp. 315–322.
- Miranda, S. M., Young, A., and Yetgin, E. 2016. “Are social media emancipatory or hegemonic? societal effects of mass media digitization in the case of the SOPA discourse,” *MIS Quarterly* (40:2), pp. 303–329.
- Nambisan, S., Lyytinen, K., Majchrzak, A., and Song, M. 2017. “Digital Innovation Management: Reinventing Innovation Management Research in a Digital World,” *MIS Quarterly* (41:1), pp. 223–238.
- Rosner, D., Rocchetti, M., and Marfia, G. 2014. “The digitization of cultural practices,” *Communications of the ACM* (57:6), pp. 82–87.
- Ross, J. 2017. *Don't Confuse Digital With Digitization*. in MIT Sloan Management Review Retrieved 30. January, 2021, from <https://sloanreview.mit.edu/article/dont-confuse-digital-with-digitization/>.
- Sandberg, J., Holmstrom, J., and Lyytinen, K. 2020. “Digitization and Phase Transitions in Platform Organizing Logics: Evidence from the Process Automation Industry,” *MIS Quarterly* (44:1), pp. 129–153.
- Shannon, C. E. 1948. “A mathematical theory of communication,” *The Bell System Technical Journal* (27:3), pp. 379–423.
- Tilson, D., Lyytinen, K., and Sørensen, C. 2010. “Research Commentary—Digital Infrastructures: The Missing IS Research Agenda,” *Information Systems Research* (21:4), pp. 748–759.
- Vial, G. 2019. “Understanding digital transformation: A review and a research agenda,” *The Journal of Strategic Information Systems* (28:2), pp. 118–144.
- Webster, J., and Watson, R. T. 2002. “Analyzing the Past to Prepare for the Future: Writing a Literature Review,” *MIS Quarterly* (26:2), pp. xiii–xxiii.
- Whelan, E., Golden, W., and Donnellan, B. 2013. “Digitising the R&D social network: revisiting the technological gatekeeper,” *Information Systems Journal* (23:3), pp. 197–218.
- Xiao, X., Califf, C. B., Sarker, S., and Sarker, S. 2013. “ICT innovation in emerging economies: a review of the existing literature and a framework for future research,” *Journal of Information Technology* (28:4), pp. 264–278.
- Yoo, Y. 2010. “Computing in Everyday Life: A Call for Research on Experiential Computing,” *MIS Quarterly* (34:2), pp. 213–231.
- Yoo, Y. 2012. “The Tables Have Turned: How Can the Information Systems Field Contribute to Technology and Innovation Management Research?,” *Journal of the Association for Information Systems* (14:5), pp. 227–236.
- Yoo, Y., Henfridsson, O., and Lyytinen, K. 2010. “Research Commentary—The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research,” *Information Systems Research* (21:4), pp. 724–735.