Digitalization: A Literature Review and Research Agenda

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Abstract. Given the noticeable and quick progress of digitalization it is well accepted that digital practices are changing business landscapes. However, while this concept is being labelled in the literature it is also often used indistinctively. To avoid misconceptions, we propose to clarify the concept by providing an overview of the existing theory. This research is one of the first attempts to define the "digitalization" term, and to make a distinction between similar ones. The authors have conducted a systematic review of the existing literature, by identifying and synthesizing the existing body of knowledge. While going digital, firms are expecting to enhance their competitive advantage by offering services throughout virtual channels and operationalize its operations management. Furthermore, the literature suggested the development of new digital technologies along with automation and artificial intelligence is enabling a new wave of smart companies, a topic that deserves to be studied in the future.

Keywords: Systematic literature review · Automation · Artificial intelligence · Operations management

1 Introduction

Digitalization has been identified as the most significant technological trend that is changing both, society and business [1, 2]. Nowadays, firms are constantly under pressure to use digital technologies and to adapt their business models to this new reality [3]. However, although going digital evokes many benefits, it also requires investments and associated costs [4]. Given the noticeable progress of digital technologies [5], the question is how digitalization is being employed by practitioners and into what extent this progress is being followed by scholars and academics. Therefore,

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our main goal is to illustrate the current state-of-the-art and to provide a better understanding of the digitalization term. Interestingly, there are several articles in the literature on digital transformation, but few on digitalization. One of the first literature reviews on digital transformation were notably conducted by Henriette et al. [6], and followed similar research, such as Gebayew et al. [7], Reis et al. [8], Vukšić et al. [9] and Vial [10]. It is well-known that digital transformation term was coined by business professionals and later studied by academics. On the other hand, we also know that the large knowledge gap is currently present at the governmental level, which accounts for only 1% of world research [8]. In response to the changing expectations, governments are currently changing their mode of operation to improve public service delivery, while public administrators themselves are defining digital transformation in their own day-to-day practices [11]. Thus, in that regard, academics such as Mergel et al. [11] are providing empirical-based definitions of digital transformation retrieved from expert interviews, rather than literature reviews. With regard to digitalization, we could find few literature reviews, one focus on the organizational effects of digitalization by Kuusisto [12] and another research by Parida et al. [13], which developed a framework that communicates and sets the direction for future research by linking digitalization, business model innovation, and sustainability in industrial settings.

This article is structured as follows. Section 2 presents the methodological process, discussing how the systematic review was structured. Section 3 describes the analysis and general discussion of the selected articles. Section 4 concludes the paper, by presenting contributions to theory and practice, as well as the guidelines for future research.

2 Methodology

In order to achieve the stated objective, a systematic literature review was employed in order to clarify the digitalization concept, to provide an overview of the existing theory and to suggest guidelines for future research. This method is of particular value due to the uncertainty about what the evidence says about this topic [14], being the right tool to study the phenomenon.

On March 5th, 2019, a search was conducted using Elsevier's Scopus citation database of peer-reviewed literature. The initial search criterion was based on the word "digitalization" in the article titles. To improve our review process and to justify why we chose a certain type of articles and not others, we applied several filters to exclude irrelevant papers and save time [15]. The initial search revealed 1,441 documents, which included journal articles in the English language to enable interpretation. The inclusion criteria focused on management and social sciences, given they are the most promising ones of theoretical research, due to the existence of extensive empirical evidence. The final systematic literature review included 121 articles. Table 1 presents an overview of the review process.

Table 1. Systematic review process.

Elsevier's Scopus database		Documents
Search term "Digitalization"	All fields	13,194
	Title-Abstract-Keywords	7,954
	Article title	1,441
Language	English	1,018
Source type	Journal	572
Document type	Article	442
Major subject area	Social sciences; Business, management and accounting; and Economics, econometrics and finances	121

We analysed the data through the *content analysis* technique, which is widely used to detail the proportion or percentage of a text dedicated to a determined subject, and that allowed to make evaluative comparisons of materials with established goals [16]. Content analysis can be briefly defined as the systematic, objective, quantitative analysis of message characteristics – it included both human-coded analysis and computer-aided text analysis [17]. Using a computer-assisted qualitative data analysis software NVivo 11 – QSR International [18], we examined the data by generating codes and clustering the text into hierarchized categories and subcategories to identify patters and establish new relations within the literature. After coding the 121 articles in order to coin a consistent definition of "digitalization" we are now presenting the results of the systematic review in the next section.

3 Findings

We have noticed that Nordic European countries are investing on the integration of information and communication technologies (ICT) and digitalization processes [1] in new or existing business models (Fig. 1). While, at the same time, these countries are studying its implications to the business landscape [19], several cases are illustrating the current Nordic investment on digitalization, e.g., manufacturing companies are pursuing servitization strategies, which are increasingly relying on developing digitalization capabilities to interact and co-create value to their customers [20].

Drawing on the results of this research, we found that the development of digital technologies exists along with advancements in artificial intelligence (AI) and automation, which are enabling a new wave of service delivery systems [21–23] and manufacturing innovations [24]. On the other hand, digitalization and servitization of manufacturing processes are moving companies to find competitive advantages through innovative digital business models [25]. Moreover, the literature best identifies supplementary technologies that are identified as facilitator and do have a broader effect on digitalization, examples are: the use of mobile devices that are changing consumer practices and organizational behaviours [19, 26].

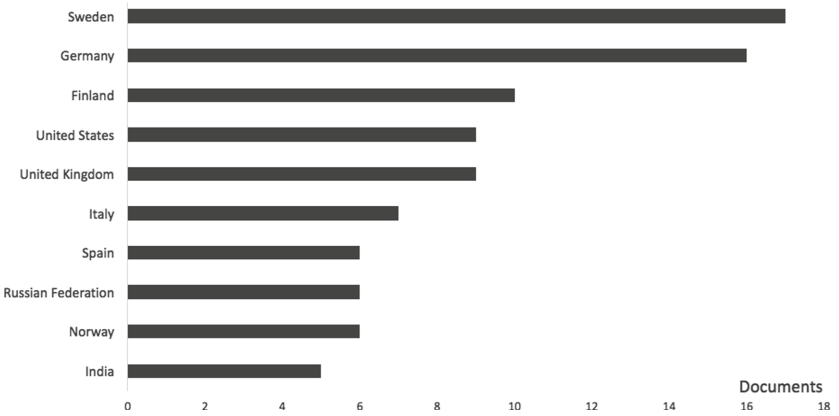

Fig. 1. Documents by country or territory (Top 10).

Interestingly, few articles distinguish between digitalization, digitization, and digitation, which are being sometimes used indistinctly in the literature [8, 27] or, at least, there seems to be quite some confusion regarding the usage of terms [28]. Common themes associated to the aforementioned concepts are digital innovation, digital disruption, digital convergence and digital transformation, which are the abilities of different companies to compete when digitalization alters the dynamics of core technologies and core markets shifts [29]. Srai and Lorentz [30] also argues that much of the literature on digitalization appears to be ambiguous in terms of the exact definition of the term, probably due to the elusiveness of the concept. Only a couple of articles, which are interested in making such distinction, were identified. Notable examples are presented by Clerck [28], where digitalization is presented as "the use of digital technologies and of data in order to create revenue, improve business, replace/transform business processes and create an environment for digital business, whereby digital information is at the core", and Gobble [22] which identifies the term as "digital technologies and probably digitized information, to create the harvest value in new ways". Srai and Lorentz [30] evidences that past contributions mixed e.g. digitalization and digitization, where digitization is the material process of converting analogue streams of information in digital bits [31], thus, digitalization refers to the technology of digitalising information. Ringenson et al. [32] support those definitions and find them useful for highlighting the difference between the technological conditions necessary for digitally related social change (digitization) and the actual change (digitalization). The limited research regarding the usage of terms, evidenced that this is an area to be explored and suggests future research on the topic.

We analysed each definition and then presented the scholar debate around the term, which is summarized in Table 2.

Table 2. Digitalization definitions.

Author(s)	Definition(s)
Maxwell and McCain [33]	Digital technology takes information and breaks it down into its smallest components. By transforming an analogue signal into discrete pieces, digitalization makes it possible to manipulate information, text, graphics, software code, audio, and video in ways never before thought of, thus its informating, transforming capabilities
Hagberg et al. [26]	Digitalization is one of the most significant on-going transformation of contemporary society and encompasses many elements of business and everyday life. Digitalization refers both to a transformation from "analogue" to "digital" (e.g. a shift from cash to electronic payments) and to the facilitation of new forms of value creation (e.g. Accessibility, availability, and transparency) (citing Amit and Zott [34])
Clerck [28]	Digitalization is defined as the use of digital technologies and of data in order to create revenue, improve business, replace/transform business processes and create an environment for digital business, whereby digital information is at the core
Lenka et al. [20]	The industrial management literature defines the digitalization as the phenomenon of intelligent connected machines that information and digital technologies power (citing Lerch and Gotsch [35] and Parida et al. [36])
Machekhina [37]	Digitalization means transformation of all information types (text, sound, visuals, video and other data from various sources) into the digital language
Parviainen et al. [2]	The action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form
Thorseng and Griot [38]	The transformation of existing socio-technical structures that were previously mediated by non-digital artefacts or relationships into ones that are mediated by digitized artefacts and relationships with newly embedded digital capabilities (citing Yoo et al. [39])
Valenduc and Vendramin [40]	The term "digitalisation" is not the irruption of a new revolution, but the pervasive synergy of digital innovations in the whole economy and society (citing Perez [41])
Crittenden et al. [23]	Digitalization creates new forms of interaction between companies and customers through channels (citing Hansen et al. [42])
Devereux and Vella [43]	Digitalization is the process of spreading of a general purpose technology. The last similar phenomenon was electrification. Digitalization of products and services shortens distances between people and things. It increases mobility. It makes network effects decisive. It allows the use of specific data to such an extent that it permits the satisfaction of individual customer needs – be it consumers or businesses. It opens up ample opportunities for innovation, investment, and the creation of new businesses and jobs. Going forward it will be one of the main drivers of sustainable growth (citing Gaspar et al. [44])

(*continued*)

Table 2. (*continued*)

Author(s)	Definition(s)
Eling and Lehmann [27]	The integration of the analogue and digital worlds with new technologies that enhance customer interactions, data availability and business process
Gobble [22]	Digitalization refers to the use of digital technology, and probably digitized information, to create and harvest value in new ways
Morley et al. [45]	Digitalization is the growing application of ICT across the economy "encompassing a range of digital technologies, concepts and trends such as artificial intelligence, the "Internet of Things" (IoT) and the Fourth Industrial Revolution" (citing IEA [46])
Ringenson et al. [32]	Digitalization is about social life's restructuring around digital communication and media infrastructures (citing [31])
Gebre-Mariam and Bygstad [47]	Digitalization refers to the development and implementation of ICT systems and concomitant organizational change, it involves the transformation of socio-technical structures formerly mediated by non-digital artefacts into ones mediated by digitized artefacts (citing Yoo et al. [48])
Srai and Lorentz [30]	Digitalization is defined as the way many domains of social life are restructured around digital communication and media infrastructures. In simple terms, digitalization may be defined as the use of digital technologies

Summarizing the Table 2; the first focused definition was presented by Maxwell and MacCain [33], who considered digitalization as the transformation of analogue signals into digital pieces. The aforementioned description was therefore supported by Hagberg et al. [26], Parviainen et al. [2] and Eling and Lehmann [27]. Whereas Machekhina [37] described digitalization in a broader way, characterizing it as all information types to the digital language. Should be noted that digitalization is the most significant on-going transformation of contemporary society and encompasses several domains of daily life, such as: the social [30, 32], the economic [40], and the organizational domain [27, 47], in order to create and harvest value [22]. In their article, Eling and Lehmann [27] also presented a very similar debate about the concept of digitalization, with the difference that, in the end, they present a middle ground conceptualization, between the broad and the narrow. Likewise, in our view: *digitalization is the phenomenon of transforming analogue data into digital language (i.e. digitization), which, in turn, can improve business relationships between customer and companies, bringing added value to the whole economy and society*.

The above definition is somewhat broader and brings back all the domains that were previously identified in the literature – social, economic and organizational. Therefore, it is not surprising to verify that the major subject areas[1] (Table 1) are tied together with the minor subject areas (Fig. 2): (1) business, management and accounting (30%); (2) social sciences (26%); (3) engineering (10%), and (4) economics, econometrics and finances (8%). During the last two decades, new technological developments such as, the Internet, and smartphones, have profoundly impacted every part of economic, political and social life [49]. The integration of digital devices reorganized the activities of business organization; thus by adopting business process digitalization, companies have started to gain market and operational efficiency [50].

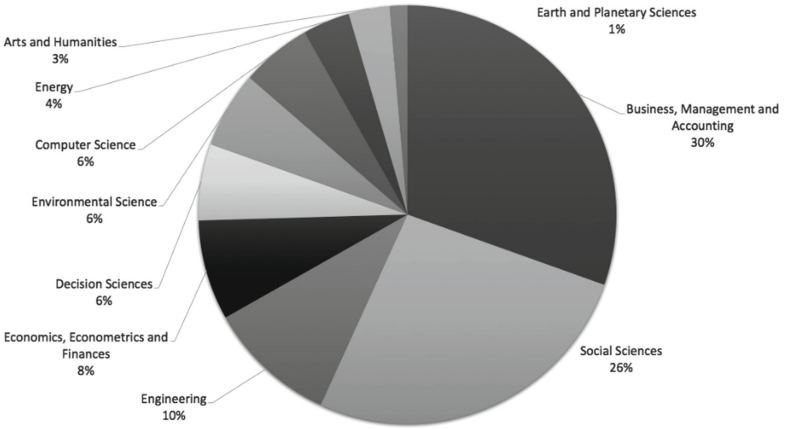

Fig. 2. Documents by subject area.

According to Fig. 2, we could observe that the engineering area has had a great preponderance on the digitalization landscape (10%), as it is influencing, for example: (1) the improvement of manufacturing processes – industrial engineers [30, 40]; (2) the building of applications – systems engineers [52]; (3) the developments of intelligent machines and artificial intelligence technologies – electrical, mechanical and robotics engineers [27].

We have also explored the journal distribution, which refers to the largest number of publications in the digitalization scope (Fig. 3). We also cross-checked the journal distribution with Scimago[2] Journal Ranking (SJR indicator), which measures the journal's impact, influence and prestige that is measured from Q1 (best indexed journals) until Q4 (lowest indexed journals).

[1] Scopus classified the documents under four broad subject clusters (life sciences, physical sciences, health sciences and social sciences & humanities), which are further divided into 27 major subject areas and 300 + minor subject areas [51].

[2] https://www.scimagojr.com.

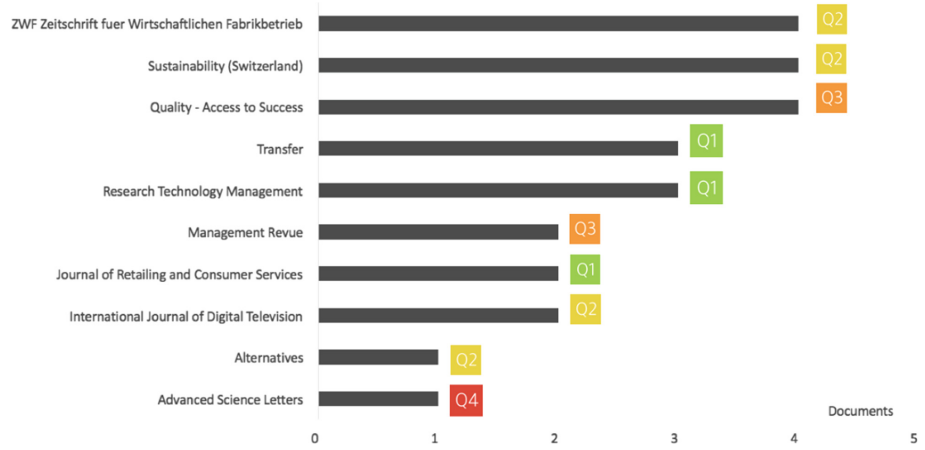

Fig. 3. Documents distribution by journal (Top 10).

The journals with highest percentage of publication were: The German journal of ZWF Zeitschrift für Wirtschaftlichen Fabrikbetrieb, which is mainly addressed to companies' executives and specialists' in production and service engineering domains; the Swiss journal of Sustainability and the Romanian Journal Quality – Access to Success, which are cross-disciplinary, scholarly and open access journals. Although the ones with better quotation were the British Journals Transfer, Research Technology Management, and the Journal of Retailing and Consumer Services. As mentioned above, the highest scientific journal emphasized practice-based research, which is a clear indication that research is largely driven by practitioners; followed by academics, particularly with respect to publications in major journals i.e. between quartiles 1 and 2.

The bars in Fig. 4 illustrate the dispersion of each research approach. Although the Fig. 4 does not present all the research methodologies and methods, we have considered the generic ones with more incidences, giving just a few examples: mixed methodologies included multimethod research or mixed method research; and empirical research included case studies or focus group.

Figure 4 shows that there is a higher incidence of empirical studies when compared to the conceptual ones, which shows that there is still room to study the phenomenon from a conceptual point of view, so future research should focus more on defining the theoretical foundations of the field. We could also verify that most part of the empirical research were qualitative case studies, which according to Yin [53] have no generalization perspectives, only theoretical, and therefore it would be useful to invest on quantitative research methods to allow generalization. There is also a great lack of mixed studies and therefore it would be more valuable to draw more attention in that regard. Mixed studies allow researchers or a team of researchers to combine elements of qualitative and quantitative research approaches for a broader purpose of breadth and depth of understanding and corroboration [54]. Moreover, there is a level of agreement that mixed studies are superior in comparison with single methods [55, 56], as are less prone to errors or biased conclusions [57].

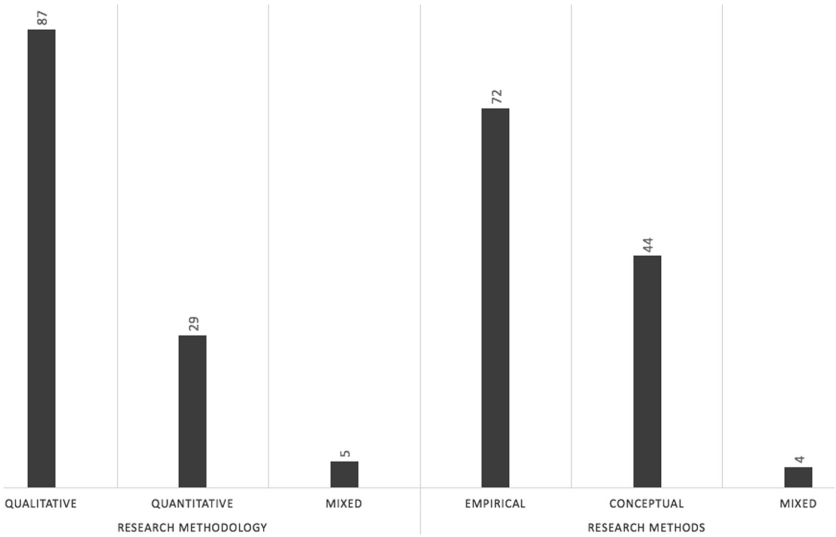

Fig. 4. Major research approaches.

Although the quality of publications increased, i.e. in the first two months of 2019, approximately 70% of publications were Q1, the number of publications also increased progressively over the years (Fig. 5). The document distribution increased mainly due the transition of digital technologies from computer science to the service and manufacturing industry, thus the digital transformation is re-shaping the industrial processes: e.g. industry 4.0, industrial artificial intelligence or internet of things.

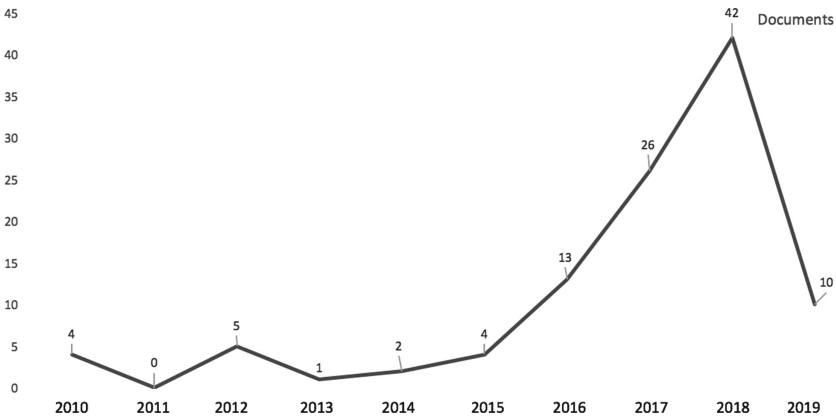

Fig. 5. Documents distribution by year (10 years' period).

The digital era is not only driving innovation into the industry sector, as it seems to being influencing developments in the public sector as well [58]. Moreover, Reis et al. [8] argue the government digitalization is one of the promising themes, with more

prospects for future development. A perspective that has already been verified in the first two months of 2019, with a slight increase of studies related to public education [23, 59] and public health services [47, 51] when compared with the same period in 2018. In the next section we present the conclusions, where is included the contributions to theory and practice, as well as the guidelines for future research.

4 Conclusions

This study draws on evidences that are paving the way on how new technologies are assisting customers and companies to create value. This article provides cutting-edge results: on the one hand, the developments achieved in the service industry are being made in combination with synergies between digital services and other new technologies, such as AI or IoT; on the manufacturing domain, companies are also pursuing new venues in finding competitive advantages by applying innovative digital practices on their industrial process (e.g. servitization strategies).

Moreover, this study contributes to the digitalization literature, by providing a clear understanding of its foundations in regard to the advancements achieved in the last few years. To strengthen the aforementioned argument, several authors [26, 60] have concluded that additional debate on the digitalization agenda is needed, to further develop a deeper understanding on how digital initiatives are changing existing business models.

This article has some limitations: firstly, the way we choose the search term influences which publications were included in the review, while choosing the term "digitalization" many contributions using synonyms were excluded from this work [61], on the other hand, we must accept that in conducting systematic reviews there is a hierarchy of evidence and that what can be empirically stated about the world is derived from studies in which design is explicit and rigorous [62]; secondly, we only include articles in English, excluding all works in other languages, although we recognize that excluded articles may have different results, we decided to give priority an accurate interpretation of the articles, thus avoiding any kind of misunderstanding; finally, we also know that most systematic reviews use more than one database to be more comprehensive in choosing articles, but for this article we decided to prioritize transparency and easy reproducibility of results.

Future research should aim at a broader understanding of the digitalization phenomenon, therefore our research can be enriched by the analysis of related topics, such as digital disruption, digital convergence or digital divide. Such attempts may focus on presenting a clear definition of the conceptual field, as well as a brief bibliometric analysis of each term. Researchers should also draw on the theoretical foundations of the field of digitalization, identifying existing theories or developing new ones in order to theoretically support novel empirical research. The literature review has also presented other perspectives that have received little attention to date, and which are well highlighted by Martín-Peña et al. [25], such as the challenges and success factors in the transformation from traditional to digital business models [63] and the analysis of strategic implications [64], just to mention some.

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