Literature review on digitalization capabilities: Co-citation analysis of antecedents, conceptualization and consequences

Literature Review on Digitalization capabilities: Co-citation analysis of antecedents, conceptualization and consequences

Abstract

Recent decades have witnessed increased number of studies focusing on digitalization and related capabilities. Across disciplines digitalization capability is viewed as a sources of sustained competiveness. Nonetheless, several issues related to conceptualizing digitalization capabilities remain ambivalent. The present study, uses co-citation analysis to clarify concept of digitalization capability and identify three underlining capabilities, namely digital integration capabilities, digital platform capabilities, and digital innovation capabilities, that represents micro-foundation of digitalization capabilities. Further, a capability-based model is developed which includes antecedents and consequences of digitalization capabilities in an integrated conceptual model. Suggestions for future research, theoretical contributions and managerial contributions are also presented.

Keywords:

Digital transformation, Capabilities, Industry 4.0, dynamic capabilities, digitalization,

1. Introduction

A fast-changing environment obliges companies to adopt and utilize digital technologies that lead to fundamental and non-reversible change in business processes (Lyytinen and Rose, 2003), affecting the very nature of product-service innovations and competitiveness (Porter and Heppelmann, 2014; Yoo et al., 2012). This concept of 'digital transformation' is derived from the term 'digitalization', which is loosely defined as the use of digital technologies to innovate a business model and provide new revenue streams and value-producing opportunities (Parida et al., 2019; Kohtamäki et al., 2019). To achieve the benefits associated with a successful adoption of digital transformation, companies need to seize the initiative and nurture specific capabilities at various organizational and operational levels of their business model (Battistella et al., 2017; Eller et al., 2020). If companies can successfully develop digital resources and capabilities, it is argued they will become better equipped not only to manage but also to gain competitively from digital trans competitively from digital transformation (Chi et al., 2008; Afuah and Tucci, 2003). Thus, digitalization capabilities represent an important precondition for companies to secure a sustained competitive advantage.

Advanced digitalization capabilities can provide scope for new functionality, higher reliability, greater efficiency, and optimization opportunities that exponentially increase the value that companies deliver to customers (Porter and Heppelmann, 2014). More specifically, we argue that companies need to develop digitalization capabilities in the shape of formalized routines that utilize digital resources effectively to ensure competitive advantage. Thus, with the advent of the digital era and the digital transformation of society, businesses are increasingly calling for a greater focus on digitalization in general and digitalization capabilities in particular. However, our current understanding of the existing literature on what digitalization capabilities comprise and what the antecedents and consequences of digitalization capabilities constitute is still lacking. To address these shortcomings, the present study undertakes a co-citation analysis that focuses on digitalization capabilities. Our justification for this review is based on two reasons.

First, the current academic discussion on the topic of digitalization and digitalization capabilities has been developing organically and across a range of disciplines – innovation management (McAfee and Bynjolfsson, 2008), information technology (Sambmurthy et al., 2003; Lyytinen and Rose, 2003), strategic management (Sawy et al., 2016), marketing (Lenka et al., 2017), operations management and manufacturing (Mourtzis, 2020). These rapidly emerging multidisciplinary studies are further influenced by a multitude of technological applications that are closely related to digitalization such as the Internet of Things (IoT),

Industry 4.0, artificial intelligence, automation, remote monitoring, predictive maintenance, smart contracts, big data, the cloud, analytics, and smart connected products offering many business development opportunities (Mourtzis, 2020; Parida et al., 2019; Porter and Heppelmann, 2015; Iansiti and Lakhani, 2014). Although existing studies have made significant contributions by generating novel ideas and insights, the fragmented nature of the research has made it difficult to understand what constitutes digitalization capability, and what are its drivers and antecedents. Without a commonly shared view and vocabulary, we risk developing a literature stream that is devoid of core ideas and well-defined relationships to other organizational constructs. Therefore, we affirm the need to develop and evaluate an integrated knowledge base on the topic of digitalization capabilities.

Second, the many studies on digitalization capabilities directly or indirectly discuss various examples of research that are focused on the relationship between digitalization and related capabilities with topics such as (digital) servitization (e.g. Lenka et al., 2017), value co-creation (Porter and Heppelmann, 2014), and service innovation (Parida et al., 2015), mainly in the context of manufacturing companies. For instance, digitalization is transforming the way manufacturing firms interact with their customers by providing a richer user experience (Nylén and Holmström, 2015), enabling new connected product functionalities and integrating various operational processes so that opportunities to co-create value through advanced service offerings are strengthened (Porter and Heppelmann, 2014; Lenka et al., 2017). To consolidate and categorize these research insights, a holistic capability-based conceptual model that goes beyond the mere stipulation of digitalization capabilities is needed. Through co-citation analysis, we intend to view digitalization capability as a high-order capability and to identify the underlining capabilities that drive company competitiveness. In addition, by applying the technique of co-citation analysis, we seek to identify dominant (i.e. highly cited) and emerging (i.e. low or moderately cited) research themes that, in turn, are capable of guiding future research on this important topic. To achieve the benefits disclosed by a successful path of digital transformation, companies need to address their efforts and nurture specific capabilities at different organizational levels and areas of their business and operating model (Battistella et al., 2017; McAfee and Brynjolfsson, 2008). These opportunities are yet hampered in several companies, especially SMEs, that lack resources and capabilities or suffer from inertia (Cenamor et al., 2019). They are required to properly formalize the routines to effectively utilize, orchestrate and exploit digital resources (or develop new ones), as a source of sustained competitiveness (Björkdahl, 2020). Beyond just stipulating digitalization capabilities, a holistic

capability-based conceptual model that identifies the foundational elements driving the digitalization efforts of companies, is still lacking.

In an effort to enhance understanding of foundational elements behind digitalization transformation at company level, this research project aims to probe the nature and scope of digitalization capabilities. The intention is, therefore, to conduct a co-citation analysis of the antecedents, the concepts, and the consequences of digitalization capabilities. In doing so, we aim to contribute to the growing interest of academics and practitioners in digital transformation and to impart a deeper understanding of digitalization capabilities as the substructure crucial to bringing about company transformation. Thus, the purpose is to uncover recent knowledge on this theme, reveal new insights, stimulate discussion on the current state of development, and explore the opportunities that exist to develop a coherent theoretical stance. More specifically, this study seeks to contribute by a) conceptualizing digitalization capabilities and its foundations, b) identifying the principal antecedents and outcomes of digitalization capabilities, c) proposing an agenda for future research based on co-citation analysis. This systematic approach should enable researchers to critically evaluate different sub-streams of research on digitalization capabilities and focus efforts on less-developed issues related to digitalization capabilities.

The remainder of the paper is organized as follows: Section 2 presents the research protocol and methodology adopted to search, screen and analyse academic literature dealing with digitalization and related capabilities. Section 3 then reports descriptive findings characterising the core of literature analysed, and Section 4 presents and describes thematic areas emerging, followed by the analysis of future research directions. Concluding remarks are reported in Section 5 with the acknowledgement of contributions and limitations of the study.

2. Methodology

To provide a thorough analysis of the core of the literature dealing with digitalization capabilities, we employed a bibliographical analysis, based on co-citations. Bibliometrics provides numerous analytical approaches and measures for understanding scientific publications and related data (Annarelli and Nonino, 2016). The application of bibliometric techniques enables researchers to identify the most influential works and map the intellectual structure underpinning a field of study (Small, 1973) by using citation and co-citation patterns (Callahan et al., 2010) and avoiding subjective bias (Agostini and Nosella, 2018). For example, the collection of sentences that contain the citations to an article X can be framed as a

collaborative summary collecting the elements of *X* that other researchers find innovative, relevant or interesting (Elkiss et al., 2008).

The co-citation analysis has been recently applied for understanding and investigating the research streams on firm capabilities. For example, the dynamic capabilities are explored by Di Stefano et al. (2010), Peteraf et al. (2013) and Fernandes et al. (2017), focusing respectively on the origins and state of development, the domains of knowledge, and the approaches at the base of the construct; Chabowski et al. (2013) examine the global branding literature from a capability perspective; Annarelli and Nonino (2016) focus on the organizational resilience; Apriliyanti and Alon (2017) investigate the absorptive capacity. The bibliographic co-citation analysis represents a necessary methodology to identify the pertinent terms in use (Chabowski et al., 2013) for digitalization capabilities and capture the richness of the construct (Apriliyanti and Alon, 2017), as publications on the topic of digitalization are growing exponentially and in different research fields, lacking a commonly accepted operationalization and interpretation for related firm capabilities. Comparing to other bibliometric methods, bibliographic coupling is strongly weighted to the most recent references (Klavans and Boyack, 2017) and is more accurate for investigating a specific field (Agostini and Nosella, 2018), while direct citations is shown to be more accurate for taxonomies and in detecting disciplines by building directly from influence patterns in studies (Klavans and Boyack, 2017). The analysis undertaken in this study provides the basis for a broader definition of digitalization capabilities starting from the academic debates on the digital transformation of firms, investigating how the inner workings are converging in a cross-disciplinary setting.

Specifically, this research adopts the Citation Proximity Analysis (CPA) as a methodology to uncover the intellectual connections (Small, 1973) and related proximity of the publications contributing to the development of the current literature on digitalization. This methodology can be considered as a refinement of traditional co-citation analysis (Small, 1973; Marshakova, 1973), as it improves its validity and overcomes some limitations in terms of accuracy and quality of the obtained results (Callahan et al., 2010; Gipp and Beel, 2009; Liu and Chen, 2012). Indeed, traditional co-citation analysis does not consider the context in which two papers are co-cited, i.e. the presence of the citations in the same or similar structural location of a document, such as a section or a single sentence (Callahan et al., 2010). Processing the full documents beyond the bibliographic information allows to deepen the analysis on the distribution of references, the identification of related works and their closeness (Callahan et al., 2010; Gipp and Beel, 2009).

Co-citations in an article can occur at different levels and with a different granularity, i.e. within the same sentence, the same paragraph, the same section, the same chapter, the same paper, the same journal or the same journal but different edition (Elkiss et al., 2008; Gipp and Beel, 2009). Papers co-cited at a finer granularity are considered closer (and then related in terms of textual similarity) than papers co-cited at a larger granularity, as in the case of the sentence level in comparison with the paper level (Elkiss et al., 2008; Liu and Chen, 2012). Therefore, the co-citation strength can be calculated as a weight, which grows accordingly to the co-citations more tightly connected (Gipp and Beel, 2009; Callahan et al., 2010).

The review process includes a first step of identification of the body of literature to be analysed through a systematic literature review, followed by mapping the intellectual core of the literature on the investigated topic with the use of bibliographic techniques in the second step.

2.1 Search strategy and sample selection

To identify the studies contributing to a thorough understanding of the digitalization capabilities at firm level, we performed a keyword search. Given the issues of a missing common definition for digitalization capabilities, we set out to identify terms that convey the scope and enable a broad-based, externally valid method to examine them (Chabowski et al., 2013). We first conducted an exploratory literature search for terms relating to the concept of "capability", building on the broader literatures on dynamic capabilities (e.g. Barreto, 2010) and organizational capabilities (e.g. Grant, 1996). We also considered the possible variation of the terminology employed by authors to refer to the firm level. Therefore, we searched for the keywords "capabilit* OR abilit* OR capacit* OR process* OR routine*" in combination with "organization* OR firm* OR compan* OR enterprise*" and "digital*".

We performed the keyword search and thoroughly scanned the Scopus electronic database in May 2020. The sources including the search string in title, keywords or abstract were selected for further analysis. The literature considered in this paper refers to Scopus database, which nowadays represents the biggest database of peer-reviewed literature.

In the second phase, we established the inclusion and exclusion criteria guiding the selection of the publications judged as relevant and pertinent for the aims of the study. We decided to select only articles in English and published in peer-reviewed journals, without restrictions in the time span. Conference papers, industry reports, editorials, books and books reviews were excluded, aiming to include high-quality and reliable sources. A further consideration focused on the subject area of the sources to be selected, as digital transformation is a phenomenon with a broad impact on different research fields. Considering the scope of the analysis, focusing on

the firm level and the core business processes involved, we limited the dataset to the subject areas of "Business, Management and Accounting", "Economics, Econometrics and Finance" and "Decision Sciences". From the use of these filters we obtained a set of 2165 contributions. In the following step, titles and abstracts of these works were thoroughly scanned and read separately by the researchers in order to avoid personal bias while ensuring consistence with the aims of the review. Only works strictly focused on the concept of digitalization from the strategic, organizational, managerial or operational perspectives of firms were considered. Specifically, we agreed on the following criteria for content restrictions:

1) Include papers clearly dealing with digitalization as main context of investigation;
2) Include papers clearly analysing the firm level, excluding papers with a specific focus beyond boundaries of a single company, e.g.:
    a. platforms and marketplaces,
    b. supply chains, inter-firm relationships,
    c. regional systems, government / public administration, policy level (e.g. e-government),
    d. financial systems at macro-level,
    e. specific industry (e.g. media, newspaper industry) dynamics;
3) Exclude papers totally focused on technological aspects, without considering implications in terms of digital transformation of business, e.g. security issues, parameters design, description on how the technology works, functional capabilities in the use of a specific technology for a specific outcome;
4) Exclude papers focused on social issues and use of technologies by or for individuals such as the use of social media or devices on the workplace (e.g. ergonomics, e-learning) and the digital divide at population or country level;
5) Exclude papers showing a too narrow focus on specific industries, with too bounded implications (e.g. cultural heritage organizations, restaurants, construction sector);
6) Exclude papers essentially focusing on firms producing digital products (e.g. software) or sectors (e.g. digital TV)

After the first round of title and abstract review, we cross-read and checked the abstracts identified as fitting to the aims of the study and the ones in doubt and we reached a consensus on the final selection of 401 articles. The sample was further discussed by the authors after full-text reading for share understanding and interpretation. This last step of selection provided us with 249 relevant articles, representing the base for the subsequent bibliographic analysis.

Figure 1 presents the annual distribution of the number of articles investigating the capabilities entailed in the digital transformation of companies, as resulting from the systematic literature review. The growing trend shows the great interest that the topic is attracting in the scientific literature. Specifically, the peak in 2013 corresponds with: (1) the publication of the special issue titled "Digital Business Strategy: Toward a Next Generation of Insights" of the *MIS Quarterly: Management Information Systems* (including 4 papers by Drnevich and Croson, 2013; Grover and Kohli, 2013; Oestreicher-Singer and Zalmanson, 2013; Setia et al., 2013), (2) the call for papers of the *Journal of Operations Management* for the cross-fertilization and collaboration between operations management and IT (with the contributions by Mishra et al., 2013; Setia and Patel; 2013), (3) the focus of the issue in *Technology Analysis and Strategic Management* on the role of digital technologies in the innovation and business strategy (including the contributions by Gagliardi, 2013 and Smith, 2013). Although the last year (2019) shows a contraction in the number of publications, the exponential growth in the last years demonstrates the great attraction that the topic is exerting on academia, in a multi-disciplinary setting.

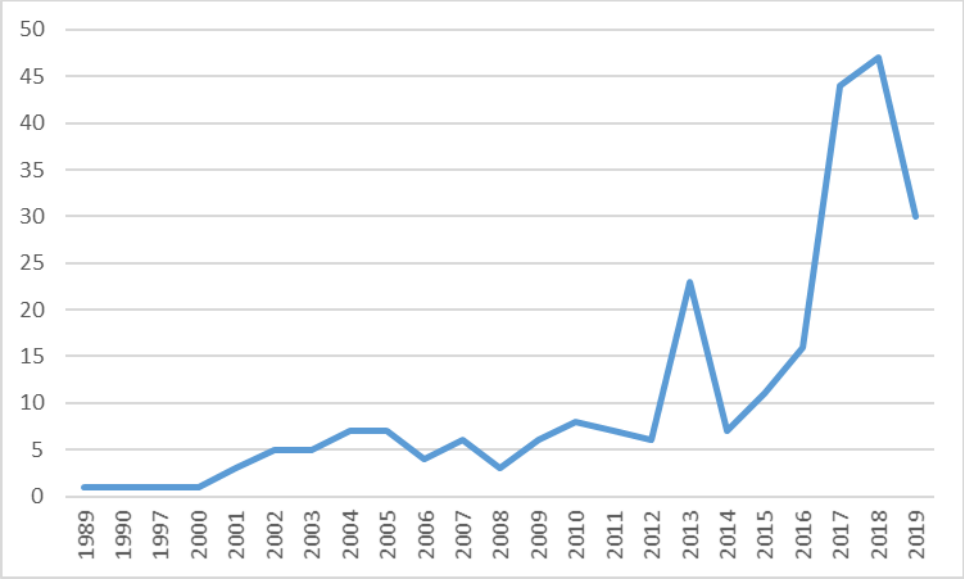

Figure 1 – Temporal distribution of the articles selected after the systematic literature review

2.2 Bibliographic analysis

This study employs a weighted co-citation analysis (Gipp and Beel, 2009; Liu and Chen, 2012), including the steps described as in the following.

Firstly, we constructed a citation matrix with the set of 249 papers, enabling us to identify the works that have been cited by at least one of the others. Secondly, the citation matrix was used

as the base to calculate the frequency of co-citations, i.e. the number of times each pairs of papers have been cited together, to be included in a co-citation matrix. As the aim of the co-citation analysis is to identify the core literature on the topic under investigation, the selection of the papers through the analysis of the co-citation matrix results in the exclusion of the works that received one or more citations but weren't cited together with any other work of the sample, even if they represent relevant recent contributions. This step resulted in the selection of 54 core articles on digitalization capabilities. Thirdly, the co-citation matrix was further refined to perform the weighted co-citation analysis. Even if the obtained number of papers is highly reduced than the first set (22% of the initial 249 papers), the emerging selection highlights the multidisciplinary nature and the broad interest from different research fields on the topic of digitalization capabilities. The frequency of co-citation and the weighting of their proximity confirm the restriction of the following analysis to the core of articles providing the foundations of the concepts, enablers and scope of digitalization capabilities.

A Citation Proximity Index (CPI) is assigned to each pair of papers, according to the proximity of their citations in a citing article. As appropriate weightings of CPI values depend on the research field and type of publication (Gipp and Beel, 2009), we specifically provide a refined measure of textual similarity among papers. Table 1 reports the CPI values and the levels of proximity (indicating the co-citation occurrence) suggested by Gipp and Beel (2009) and the ones proposed in this paper, considering that the similarity of two co-cited papers grows proportionally to the proximity of the citations (Elkiss et al., 2008). Specifically, the distribution of the levels of proximity builds on the works of Elkiss et al. (2008) and Liu and Chen (2012).

Table 1 – Values of the Citation Proximity Index

Gipp and Beel, 2009		***This research***	
Occurrence	**CPI value**	**Occurrence**	**CPI value**
Sentence	1	Sentence	1
Paragraph	1/2	Paragraph or subsection	1/2
Chapter	1/4	Section	1/4
Same paper	NA	Article	1/8
Same journal/same book	1/8	Same journal/same book	NA
Same journal but different edition	1/16	Same journal but different edition	NA

In this study, we measure the strength of co-citations basing on the occurrences of the nearest (or maximum) proximity (Callahan et al., 2010; Liu and Chen, 2012).

Finally, the CPI values were converted into correlation coefficients in order to standardise the co-citation to reduce the number of zeros in the matrix and avoid potential scale effects (Fernandes et al., 2017). The obtained Pearson's correlation matrix was then adopted as an input for Factor Analysis (FA) and Multidimensional Scaling (MDS), two methods employed to identify and analyse factors (or clusters) among selected papers and observe their conceptual proximity (Annarelli and Nonino, 2016; Fernandes et al., 2017). Specifically, for the FA we used the Principal Component Analysis to identify the main components shared by the articles in the sample, the articles belonging to each arising factor and the relative importance in terms of weighting. This analysis allows to identify the literature subfields in which the articles belonging to the sample can be grouped (Agostini and Nosella, 2017). Using the Pearson's correlation coefficients, the MDS produced a bidimensional map displaying how the papers are positioned in accordance to the relationship with the other papers.

Figure 2 summarizes the steps of the methodology adopted in this work, starting from the systematic literature review and the search strategy.

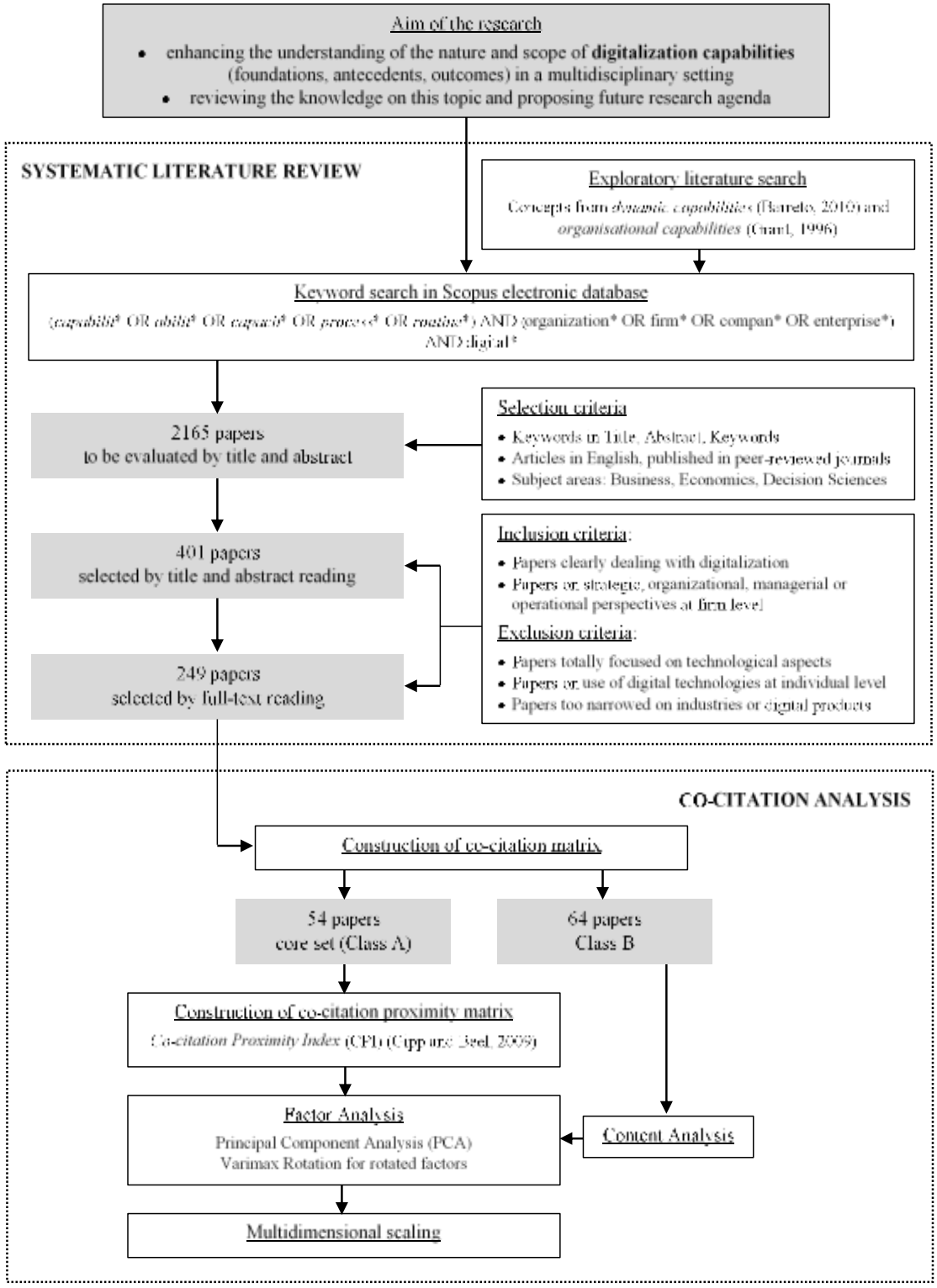

Figure 2 – Process of literature review and bibliographic analysis in this study

3. Descriptive findings

The 249 articles obtained from the systematic literature review are classified in the table of Appendix A. Aiming to inherit the richness of the contributions excluded from the final core

set of 54 articles, we qualitatively analysed these papers by assigning them a class, as in Annarelli and Nonino (2016). Class A identifies the core set, while class B groups the papers that cited or were cited by other papers of the first sample but have never been co-cited with any other. The papers belonging to class C are the ones that neither cited nor were cited by any other article of the sample. The qualitative analysis of papers in class B allowed us to deepen the reflection on the potential future research directions.

The further classification of all papers by methodology highlights the research efforts of the scholars investigating the topic of digitalization capabilities. Specifically, empirical studies are the majority (more than 70% out of the 249 papers), revealing the willingness to develop new knowledge through empirical data on how digitalization capabilities have been developed and emerge along digital transformation of companies. The selected publications are mainly aimed at exploration and providing illustrative case studies in facing the transformation and evolution of strategies, practices and organizational mechanisms. Literature reviews are still scarce and mainly focused on specific technologies and research fields as data processing activities in operations management (Gölzer and Fritzsche, 2017), digital marketing (Kannan and Li, 2017), big data analytics (Saggi and Jain, 2018), digital business strategy studied according to Porter's Five Forces (Singh et al., 2017).

Therefore, we can argue that a sound understanding and building a theory of the digitalization capabilities is still lacking.

Focusing on the core set, Table 2 provides a brief overview of the most cited articles of the set. Focusing on the year of publication, the first core papers on digitalization capabilities appears in 2000. Tripsas and Gavetti (2000) study the organizational adaptation and the evolution of organizational capabilities in the shift to digital, while Sambamurthy and Zmud (2000) focus on the IT capabilities and the need to design more complex organizational structures around them to face the digital era. In the following years, the interest of scholars extends to the business innovation enabled by the use of digital networks (Wheeler, 2002), the impacts of disruptive IT innovations as internet computing (Lyytinen and Rose, 2003), the influence of IT investments and capabilities on firm performance through organizational capabilities and strategic processes (Sambamurthy et al., 2003). The first core papers (among the most cited ones in the sample) show the importance of studying the organizational capabilities required to deal with the digital transformation (starting from the IT capabilities), but also the impact of digital developments on organizational capabilities and innovation patterns.

The number of citations confirms the multiplicity of the nature of digitalization capabilities, as the most cited paper is the one by Sambamurthy et al. (2003), which draws upon strategy,

entrepreneurship and IT management to study the interplay between organizational capabilities, strategic processes and IT investments and capabilities and their impact on firm performance. The relationship between higher order capabilities, specifically a supply chain integration capability, the IT-based platform capabilities and the firm performance is the perspective adopted also by the second most cited work, i.e. the one by Rai et al. (2006).

Finally, the analysis on the employed methodology highlights the prevalence of empirical studies (64%). Among these, case study researches are mainly involving a single (and well-known) company such as Polaroid in Tripsas and Gavetti (2000), DBS bank in Sia et al. (2016), Volvo in Svahn et al. (2017), and are aimed to draft some lesson learned for digital transformation or exploration. The prevalence of surveys (39% of the core set) reveals an attitude of scholars towards testing theoretical models and relationships between constructs, enablers, performance implied in digitalization, but in light of results emerged within focused streams of research beyond capabilities. The only two literature reviews are the ones by Molinillo and Japutra (2017) and Vial (2019). The first review focuses on the enablers and outcomes of digital information and technology adoption in SMEs, where the capabilities are only part of the process; the second review focuses on digital transformation in the IS literature, and identifies eight building blocks emerging from literature.

Table 2 – The core set of papers (almost 80% of overall citations) ordered by number of citations

Authors	**Year**	**# citations**	**Typology**	**Methodology**
Sambamurthy V., Bharadwaj A., Grover V.	2003	27	Conceptual study	-
Pavlou P.A., Sawy O.A.E.	2010	10	Empirical research	Survey
Rai A., Patnayakuni R., Seth N.	2006	9	Empirical research	Survey
Barua A., Konana P., Whinston A.B., Yin F.	2004	7	Empirical research	Survey
Karimi J., Walter Z.	2015	7	Empirical research	Survey
Lyytinen K., Rose G.M.	2003	7	Conceptual study	-
Setia P., Venkatesh V., Joglekar S.	2013	7	Empirical research	Survey
Sia S.K., Soh C., Weill P.	2016	6	Empirical research	Case study
Wheeler B.C.	2002	7	Conceptual study	-
Sambamurthy V., Zmud R.W.	2000	6	Conceptual study	-
Tripsas M., Gavetti G.	2000	5	Empirical research	Case study
Bharadwaj S., Bharadwaj A., Bendoly E.	2007	5	Empirical research	Survey
Kohli R., Johnson S.	2011	5	Empirical research	Case study
Mishra A.N., Konana P., Barua A.	2007	5	Empirical research	Survey
Yeow A., Soh C., Hansen R.	2018	5	Empirical research	Case study
Drnevich P.L., Croson D.C.	2013	4	Conceptual study	-
El Sawy O.A., Malhotra A., Park Y., Pavlou P.A.	2010	4	Conceptual study	-
Grover V., Kohli R.	2013	4	Conceptual study	-
Nylén D., Holmström J.	2015	4	Conceptual study	-

Scuotto V., Del Giudice M., Carayannis E.G.	2017	4	Empirical research	Survey
Svahn F., Mathiassen L., Lindgren R.	2017	4	Empirical research	Case study
Dremel C., Herterich M.M., Wulf J., Waizmann J.C., Brenner W.	2017	3	Empirical research	Case study
Sawy O.A.E., Amsinck H., Kræmmergaard P., Vinther A.L.	2016	3	Empirical research	Case study
Selander L., Henfridsson O., Svahn F.	2013	3	Empirical research	Case study

The distribution of papers by journal outlet further highlight the foundation of digitalization capabilities on the management of information systems and IT, "aspiring to bring technology to the center" (Nylén and Holmström, 2015) and integrating aspects of economics, operations, organization and strategic management. The majority of the papers included in the sample are published in *MIS Quarterly: Management Information Systems* (8 papers), *Information Systems Research* (6 papers), *Information and Management* and *MIS Quarterly Executive* (both 3 papers), as shown in Table 3.

Table 3 – Distribution of papers by journal outlet

Journal outlet	**# papers**
MIS Quarterly: Management Information Systems	11
MIS Quarterly Executive	8
Information Systems Research	6
Information and Management	3
Journal of Strategic Information Systems	3
International Journal of Research in Marketing	2
Journal of Information Technology	2
Bottom Line	1
Business Horizons	1
Creativity and Innovation Management	1
Harvard Business Review	1
International Journal of Electronic Commerce	1
International Journal of Production Research	1
Journal of Business Research	1
Journal of Cleaner Production	1
Journal of Management Information Systems	1
Journal of Operations Management	1
Journal of Product Innovation Management	1
Journal of Research in Interactive Marketing	1
Journal of Technology Transfer	1
Journal of Theoretical and Applied Electronic Commerce Research	1
Long Range Planning	1
Production Planning and Control	1
Strategic Entrepreneurship Journal	1

Strategic Management Journal	1
Technological Forecasting and Social Change	1
Total	*54*

The findings from FA and MDS are presented in the following. The analyses performed allowed us to better identify the main thematic clusters that clearly depict the state of the research on the topic of digitalization capabilities.

4. Thematic areas of digitalization capabilities

We adopted Principal Component Analysis (PCA) as the extraction method, so as to identify factors, and Varimax Rotation for rotated factors: this allowed us to perform a meaningful analysis of contents and interpret results. Furthermore, we employed Kaiser's criterion together with a scree test to determine the number of extracted factors, which have been widely adopted in previous similar studies and have proven to be among the best methods (Di Stefano et al., 2010; Annarelli and Nonino, 2016).

As shown in Table 4 we obtained a set of 10 factors explaining almost 90% of variance, but we decided to take into account the first four factors, comprising 44 papers in our core set, explaining the 72.3% of variance.

Table 4 – Results of Principal Component Analysis

Factor	Value	Percent	Cum %
1	22.68145	42.0	42.0
2	9.87740	18.3	60.3
3	3.60149	6.7	67.0
4	2.88455	5.3	72.3
5	2.13309	4.0	76.3
6	1.95001	3.6	79.9
7	1.59170	2.9	82.8
8	1.29076	2.4	85.2
9	0.98409	1.8	87.0
10	0.89537	1.7	88.7

In Table 5 are listed papers of the core set with the corresponding factor loadings for the first four factors: values represent the correlation between each paper and the factors or they can also be seen as the degree to which each paper belongs to a certain group/cluster. We considered only loadings higher (in absolute value) than 0.4 (Di Stefano et al., 2010), which can be viewed a good threshold value for correlation significance.

Table 5 – Factor loadings [a]

	1	2	3	4
Abrell et al., 2016				0.809
Barua et al., 2004	0.971			
Bharadwaj et al., 2007			0.856	
Dean et al., 2009			0.900	
Dremel et al., 2017	0.954			
Drnevich and Croson, 2013		0.725		
Du et al., 2016	0.966			
Grover and Kohli, 2013				0.899
Gust et al., 2017	0.958			
Hansen et al., 2011	0.954			
Kannan and Li, 2017		0.886		
Karimi and Walter, 2015	0.924			
Lyytinen and Rose, 2003	0.951			
McAfee and Brynjolfsson, 2008		0.895		
Mishra et al., 2007		0.753	0.526	
Nylén and Holmstrom, 2015		0.838		
Oestreicher-Singer and Zalmanson, 2013	0.970			
Oh et al., 2012			0.822	
Pagoropoulos et al., 2017				0.928
Pavlou and Sawy, 2010		0.949		
Rai et al., 2006		0.928		
Ravichandran, 2018	0.723			
Resca et al., 2013	0.961			
Rindfleisch et al., 2017	-0.427		0.808	
Saldanha et al., 2017	0.962			
Sambamurthy and Zmud, 2000	0.718	0.641		
Sawy et al., 2016	0.421			0.554
Scuotto et al., 2017b	-0.407			
Scuotto et al., 2017c	-0.407			
Sedera et al., 2016	-0.407			
Selander et al., 2013		0.822		
Setia et al., 2013	0.966			
Sia et al., 2016	0.951			
Svahn et al., 2017	0.957			
Trantopoulos et al., 2017	0.946			
Tripsas and Gavetti, 2000		0.766		
Vial, 2019		0.880		
Wheeler, 2002		0.953		
Wulf et al., 2017	0.970			
Yeow et al., 2018	0.959			
Zhu et al., 2015	-0.407			

[a] Extraction method: Principal Component Analysis with Varimax Rotation. Variance explained: 72.3%. Only factor loadings higher than 0.4 (absolute value) are reported.

Starting from the analysis of the factor loading(s) of each article and the content of the papers belonging to each factor, we characterized the four factors according to the similarities of the concepts used for categorizing digitalization capabilities studies. Following the research purpose, we structured factors as in the capability-based conceptual model below (Figure 2), to clearly depict relationships among them. The model illustrates that a significant number of studies have viewed digitalization capability as a high order capability, similar to dynamic capability (Wang and Ahmed, 2007) enabling competitive advantage by increasing ability to cope with changing environment in the digital era. In addition, more formalized routines associated with digital integration capabilities represent the micro-foundation of digitalization capabilities. Finally, two addition themes of research categorize studies that represents driver or antecedents for digital transformation and consequences or outcomes of applying digitalization capability for companies. In the following, sections we provide details on the key studies relate to each of these four themes.

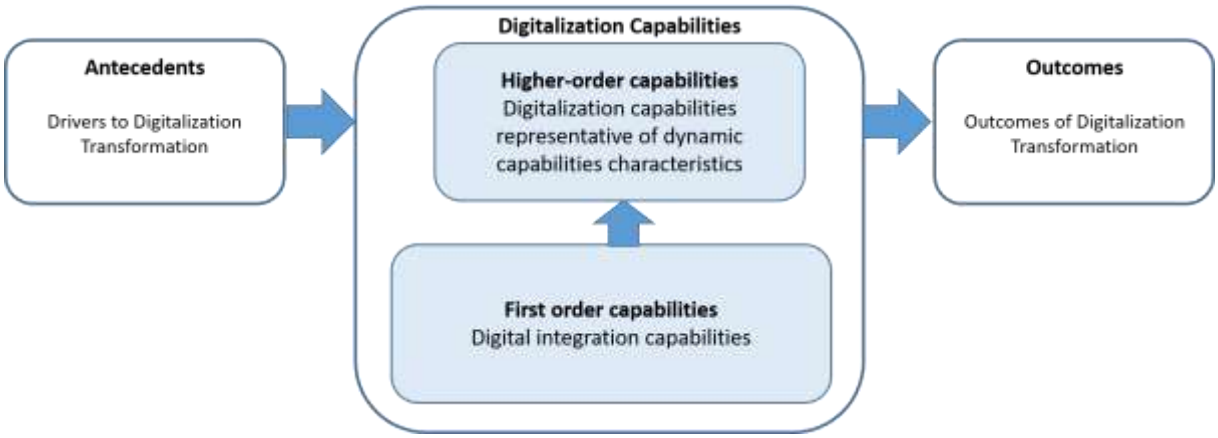

Figure 2 – Capability-based conceptual model for digitalization capability

4.1. Towards a comprehensive definition of digitalization capabilities

Aiming to provide foundation to a unified stream of literature, the first result is a conceptualization of digitalization capabilities that builds on the definitions provided in the core set of papers. We can argue that a sound definition of digitalization capabilities has to capture the richness of the construct, be grounded in conceptual studies from multidisciplinary settings, and developed from the already well-established theories on capabilities as dynamic capabilities and resource-based view. The papers summarized in Table 6 are among the most cited

conceptual papers that represents a reference literature for the notion of digitalization capabilities.

Table 6 – Notions of digitalization capabilities

Reference	Definition / related concepts	Underpinning theory	Scope
Sambamurthy et al., 2003	"technology mediated" and "socially embedded organizational capabilities" that "permit firms to flexibly combine different IT and business resources and stimulate competitive actions through innovations in products, services, and channels"	Dynamic capabilities	Information systems, Strategy
Lyytinen and Rose, 2003	"changes in behaviors" related to disruptive IT innovations that "must be simultaneously pervasive and radical", in addition to "an examination of unmet and unexplored user needs, adequate investments into co-specialized assets, and the creation of socio-technical networks that enable learning around new technology"	Disruptive innovation	Information systems, Innovation
Wheeler, 2002	"net-enablement" of business innovation as "firm's ability to create customer value through the business use of digital networks"	Dynamic capabilities	Information systems, Innovation, Strategy
Drnevich and Croson, 2013	"investments in IT and complementary (digitally connected) organizational capabilities" that change "business-level strategic alternatives and value-creation opportunities that firms may pursue, as well as […] how much of the value from these opportunities, once created, can be captured and accrue to the firms' owners in the form of superior financial returns over time"	Resource-based view of the firm	Information systems, Strategy
Nylén and Holmström, 2015	"embedded digital capabilities" to put in place "appropriate tools" for product and service innovation and "managing new types of digital innovation processes that emerge"	Dynamic capabilities	Innovation, Strategy

Grounding concepts for the definition can be identified in the field of information systems (for the utilization of IT or digital technologies and networks), innovation (including the ability to innovate products, services and channels and to learn around digital technologies), strategy (with implications on business, customer value and competitive opportunities). A key rationale is that investments in digital technologies are mainly supporting functional operations, but they also play a fundamental role in business-level innovation and strategy (Drnevich and Croson, 2013). Therefore, we define digitalization capabilities as *organizational capabilities that allow firms to pervasively combine digital assets and business resources, and leverage digital networks, to innovate products, services and processes for organizational learning and customer value creation, and manage innovation for ensuring sustained competitive advantage*.

4.2 Drivers to Digitalization Transformation

The Digitalization Transformation is guided, as all business activities and initiatives, by a series of multi-faceted drivers gathered in three main clusters: *Capitalizing on Digital Business Intelligence* and *Managing organizational change in Digitalization*.

Digitalization is affecting the way in which companies operate, and this has a non-negligible effect on marketing and *business intelligence* as well.

To this regard, Abrell et al. (2016) focus on *the role of customers in digitalization transformation*: by mean of a multiple case study, involving B2B manufacturing companies, this paper studies how customers and users are perceived as value-carriers, and how companies interact with them (by mean of practices). Authors identify reactive and proactive management of digital innovation as a twofold challenge for manufacturing companies, also because of different roles that customers and users have in the digital innovation process. This brings to different perspectives for *managing customer knowledge and user knowledge*. Results showed that, while "customers fail to provide proper guidance on their needs […] users provide guidance in choosing which capabilities and which kinds of innovations should be developed" (p. 334). On the basis of these results authors conclude that customers are able to provide explicit knowledge and guidance on how short-term needs are affected by innovation, while users can provide useful tacit knowledge to guide long-term goals.

Digitalization shift imposes a need for a focused management of *organizational change* for companies to be effective in this transition. Sawy et al. (2016) identified in *digital leadership* a key element to guide this transition, and they indicated in *capabilities for digital leadership* a whole set of solutions to successfully guide a company through digital transformation.

Adopting a similar perspective Grover and Kohli (2013) developed a framework to guide firms in digital transitions. According to authors, while "deploying digital initiatives, firms should evaluate trade-offs between information content and competitive content" (p. 6) in order to preserve profits and innovation potential. The framework is built upon two dimensions, System Visibility and Appropriated Value: the first one concerns "the revelatory aspects of the three components – software, processes and information (SPI) – that a competitor can observe, replicate, or improve upon" (p. 3); related to this aspect, there is the key issue for companies of identifying and controlling sources of value, depending on the degree of visibility that modifies available strategic options. Therefore, authors define the *management of system visibility* as a key capability for managing organizational change in the digital transformation context, since it can help companies in extending sources of value or create new ones, covering a wide range of options, from proprietary value to open innovation.

Pagoropoulos et al. (2017), by mean of an action research on the implementation of a Product Service System, investigated the role of digital capabilities, proving that they have a key role in facilitating internal development and in favouring the internal network of stakeholders.

4.3 Digital integration capabilities

Papers gathered in this factor study the integration enabled by digitalization from several viewpoints. The development of integration capabilities brought by digitalization can be divided into two main streams, which regard *integrating data and processes for mass customization* and *digitalization-enabled channel integration*.

Looking at the topic of channel integration, this has been developed quite in deep by Oh et al. (2012): they defined the *(IT-enabled) channel integration capability* as "the firm's ability to use IT in integrating cross-functional channel resources and operations in service delivery systems" (p. 370). Authors studied the effects of IT-driven integration in the context of retail industry. By mean of a confirmatory survey, authors tested hypotheses concerning the effect of digitalization-enabled integration to build explorative and exploitative competences, also considering human resource capability as playing an enhancing effect over this relationship. Indeed, authors presented also the concept of cross-channel human resources capability as "the firm's ability to build talented staff that can operate effectively in supporting channel integration activities" (p. 371). The study aimed at proving that both explorative and exploitative competences have a direct and positive impact over firm's performance. Results confirm all hypotheses, proving the significant role played by IT-enabled integration in building key competences for firms' performance.

The paper by Bharadwaj et al. (2007) focus on manufacturing performance and on elements positively affecting it: among these factors, authors study the coordination between manufacturing and information systems (IS) functions as a way to ensure *integrated IS capability*, which can positively affect manufacturing performance. In the authors' opinion, the integration of data and processes can enhance access, visibility and advantages of mass customization to customers. *Integrated IS capability* refers to "the degree to which the focal firm's IS provide integrated data and process integration. It results in the provision of seamless and consistent access and visibility to relevant customer, production, order, and market data and facilitates process integration with supply chain partners" (p. 441). Furthermore, authors proved that "for companies that can seize and develop a superior integrated IS capability, the synergistic benefits with superior coordination between manufacturing, marketing and supply chain can provide substantial gains in performance" (p. 450). Always focusing on the concept

of mass customization, Dean et al. (2009) presented and discussed a case study of mass customization and one-of-a-kind production system. Authors highlighted the concept of digitalization capabilities as a way for integrating manufacturing systems and information systems, within the company and outside its boundaries. The study demonstrates that Digital manufacturing technologies and IS allow integration between design and manufacturing data for enhancing advantages of mass customization in a one-of-a-kind production system, moving toward integrated customer and supplier activities.

The work by Rindfleisch et al. (2017) proposed a new approach named "Innovation as Data" (IAD) that, compared to the traditional approach of "Innovation from Data" (IFD), allows for an all-around involvement and integration of customers into product creation and realization: by analysing roles of customers, firms and products, the paper provides a set of capabilities and guidelines to this new approach employing new opportunities unveiled by digitalization. This paper fosters the concept of integration between firms' and customers' ability of transforming digital data into physical products and vice versa through digital technologies. As stated, Digital transformation enhances both a centralized, firm-led process in which firms use digital tools to acquire, analyse, and act on consumer data to enhance their innovative offerings, and a decentralized, consumer-led process in which consumers use digital tools to acquire and/or generate data to create their own innovative offerings.

4.4 Digitalization capabilities representative of dynamic capabilities characteristics

As already emerges from the factor's label, publications gathered here are closely related to the three main characteristics of dynamic capabilities (Teece, 2007): we can clearly identify three different streams linked to *Sensing opportunities by managing digital ecosystem partnerships*, *Seizing firms' digital capabilities*, *Reconfiguring firms' digital resources and routines*. Furthermore, these characteristics of digitalization capabilities are also closely related to first order capabilities. Figure 3 depicts the conceptual structure of this factor.

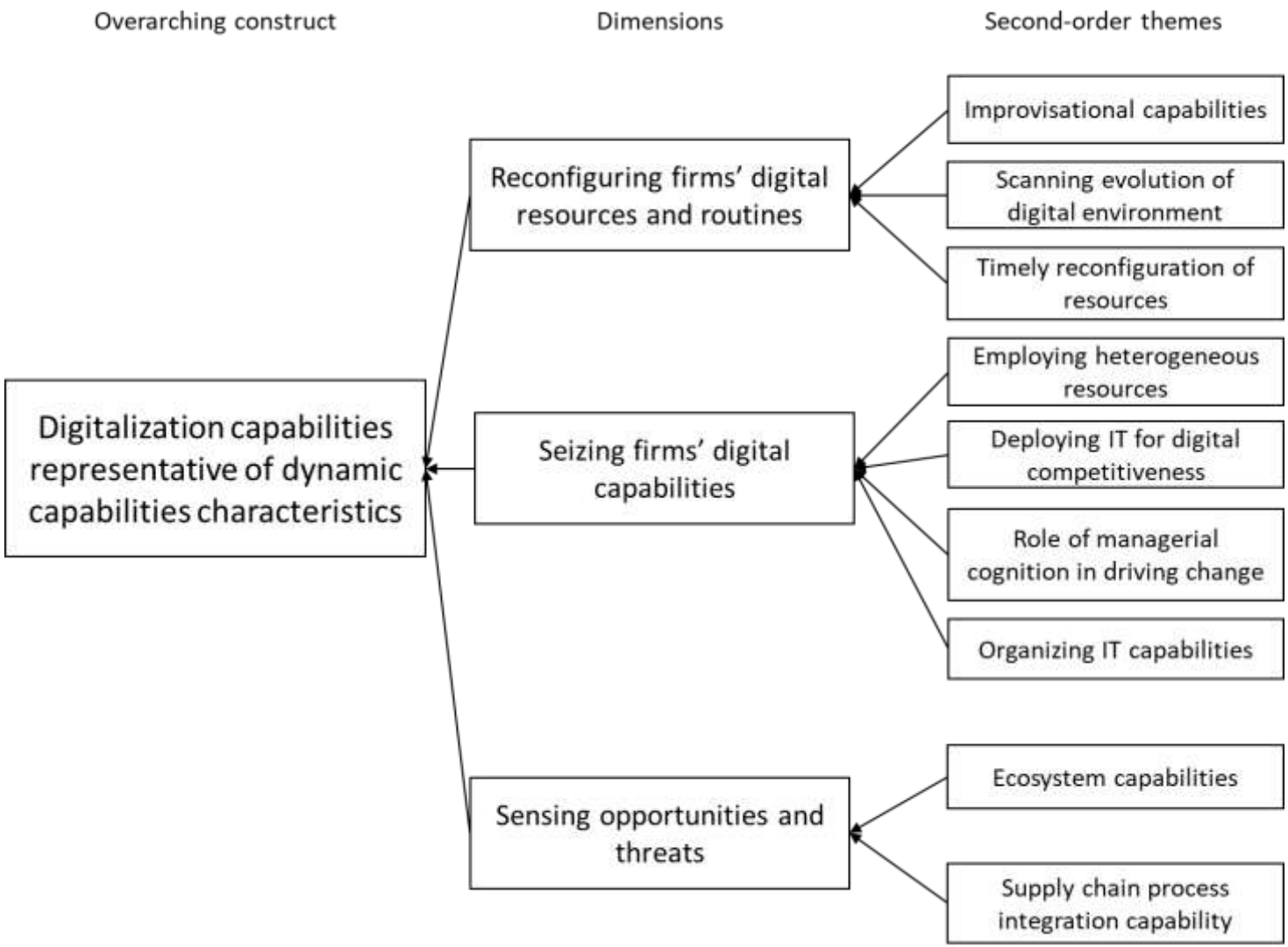

Figure 3 – Digitalization capabilities and dimensions based on second-order capabilities

Firstly, in order to *sense opportunities and threats* linked to the digital context, companies need to develop capabilities oriented at *managing digital ecosystem partnerships*.

Rai et al. (2006) analysed the key role of *digital integration capabilities*: in the context of Supply Chain Management (SCM) the integration of IT infrastructures is a crucial step in building higher-order process capabilities, namely *Supply chain process integration capabilities*, which concern "the degree to which a focal firm has integrated its physical, financial, and information flows with its supply chain partners" (p. 229).

The work by Selander et al. (2013) focused more on how to exploit benefits deriving from cooperation and integration through *ecosystem capabilities*: authors studied processes of capabilities search and capabilities redeem in digital ecosystems, with the aim of nurturing digital innovation capabilities.

Looking at the second stream in this factor, we found a group of papers dealing with capabilities that focus on *Seizing firms' digital capabilities*. The work from McAfee and Brynjolfsson (2008) deals with the deployment of IT for digital competitiveness: according to authors, this can be achieved by fostering digital processes and leveraging opportunities linked to them so as to generate and propagate innovative ideas, relying on innovation capabilities. This work, just like the one from Selander et al. (2013) in the first stream, deals more with "how" digitalization capabilities should be adopted and exploited, rather than studying in detail their very nature. Similarly, Mishra et al. (2007) studied the effective employment of heterogeneous resources that enable digital solutions, looking at different stages of business processes. In this context of research, authors focused on *digital capabilities to exchange and process information* and also *digital capabilities to automate tasks*.

Drnevich and Croson (2013) studied the process of digital transformation by considering the integration of IT in business-level strategy, mixing insights from both strategic management and information systems management streams of research. Authors define *IT capabilities* as a combination of firms' ability to mobilize and deploy *IT-based resources*, together with the ability of combining them with non-IT resources through firm-specific *IT-enabled knowledge and routines*.

The work by Tripsas and Gavetti (2000), by mean of a case study conducted on Polaroid, studied how to understand *the role of managerial cognition in driving change* in the context of firms' digitalization capabilities, moving from the concept of digital innovation capabilities and digitalization as an enabler and a driver of organizational change.

The third stream of this factor deals with *Reconfiguring firms' digital resources and routines*. Indeed, Wheeler (2002) studied the *Net Enablement* as a dynamic capability, which involves

processing multiple and concurrent innovations at a given point in time for an organization. This capability is clearly built upon first order concepts of *digital integration capabilities*. As a matter of fact, a key aspect concerns the *timely reconfiguration of resources to enable digital innovation*: this can be done by choosing and selecting IT resources, exploiting economic opportunities linked to emerging technologies, putting in place business innovations and assessing the value for customers. This is closely related to a capability discusses by Nylén and Holmström (2015), that is *scanning evolution of digital environment* seeking opportunities for *digital innovation*. This is a key aspect, even more important if put in connection with the topic of *improvisational capabilities* discusses in the same paper: according to authors "the malleability of digital technologies affords a higher degree of improvisation than their analog counterparts" (p. 65). The concept of *improvisational capabilities* as a way to *reconfigure firms' resources* also emerged in the work of Pavlou and Sawy (2010). Authors provided a clear contextualization of these capabilities in the digitalization context, defining them as "the ability to spontaneously reconfigure existing resources to build new operational capabilities to address urgent, unpredictable, and novel environmental situations" (p. 444). Similarly, Kannan and Li (2017) stressed the importance of *adaptive capabilities* in the context of digital marketing.

4.5 Outcomes of Digitalization Transformation

This factor collects the majority of the papers, as it includes 25 articles, among the ones with the highest number of citations and co-cited papers. We can then argue that papers belonging to this factor constitute what appears to be the core of literature about digitalization capabilities. In this factor, we could clearly identify three streams of research, the first one with an organizational focus that can be labelled as *building competitive advantage inside the company*, the second one focuses on *building competitive advantage outside the company*, and the third one more oriented toward *value co-creation* enabled by digitalization capabilities.

Two matters of interest in the first research stream are linked to the concepts of *strategic adaptability* and *digital leadership*. Karimi and Walter (2015) focused their study on *digital platform capabilities* looking at results and advantages they can bring to companies, e.g. by providing standards, connectivity, rules and IT capabilities; an important role is also played by first-order dynamic capabilities that contribute in building *digital platform capabilities*.

The works of Hansen et al. (2011) and Sia et al. (2016) focused on the other "internal aspect" of *digital leadership* as a *digitalization capability* and its role in creating and sustaining competitive advantage. *Digital leadership capabilities* must be developed/nurtured to ensure integration between IS and business leadership to seize opportunities and concretize them in

competitive advantage (Hansen et al., 2011), but also to enhance a *Digital Business Strategy (DBS)*, relying on the development of *agile and scalable digital operations* and of *digital innovations* (Sia et al., 2016).

Sambamurthy and Zmud (2000) investigated the concept of organizing IT capabilities by conducting an extensive review of IT capabilities. These capabilities are related to: value innovation, knowledge work leverage, IT-enabled business platforms, operational excellence, value chain extension, solution delivery. By linking to the first order capabilities of *digital integration*, the authors' work focused on identifying the criticality of each capability, on designing relational architectures for IT capabilities, and also on designing specific architectures for the integration of IT capabilities with relational architectures.

Following, there is the second stream focused on *building competitive advantage outside the company*. Indeed, Svahn et al. (2017) dealt with the process of capabilities creation and development driven by the competitive context. Authors report, for instance: *capabilities for cross-fertilization, capabilities to empower independent developers, capabilities to motivate external actors to develop and sustain value co-creation.*

According to Barua et al. (2004) firms must develop online informational capabilities (OIC) that enable readiness in exchanging strategic and tactical information by mean of digital interactions. OICs allow companies to achieve higher levels of business digitalization and consequently competitiveness. Thanks to OICs firms can improve the degree of interaction and cooperation with partners, suppliers and customers.

Lyytinen and Rose (2003) mainly focused on driving disruptive digital innovation by studying the discontinuities in capabilities that are required to be embedded in disruptive IT innovations, e.g. computing capability, conceiving and developing new services, autonomy, agility (or accordingly ability to innovate rapidly), simplicity, concern for flexibility.

In the stream of *value co-creation*, we have the two papers authored by Scuotto et al. (2017b, 2017c) that presented as the focal point of study the implications and the effects deriving from SMNs: both studies conducted a confirmatory survey to test hypotheses concerning the effects of SMNs over the Return On Investments (ROI, Scuotto et al., 2017b) and over the innovation performance of firms (Scuotto et al., 2017c). In the first study (Scuotto et al., 2017b), conducted with a focus on the fashion industry, authors identify five factors of SMNs, namely Structural Dimension, Relational Behaviour, Knowledge Transfer, Legitimization and Cognitive Dimension: the first four were shown to positively affect performance in terms of ROI. In the second study (Scuotto et al., 2017c), authors focus on the use of SMNs and absorptive capacity

as factors having a direct and positive effect over innovation performance of companies. Both factors show a significant effect, especially absorptive capacity, defined as an enterprise ability to convert an external knowledge into an innovation (March and Herbert, 1958; Cohen and Levinthal, 1990; Nicotra et al., 2014), playing a relevant role on their own and in combination with use of SMNs.

The study of Setia et al. (2013) focused more directly over Customer Service Unit (CSU) and the development of dedicated customer-side capabilities that are *customer orientation capability* and *customer response capability*. *Customer orientation capability* was defined as the ability of a CSU to monitor the needs of its customers and enable its business strategies with a focus on customer needs. (Narver and Slater, 1990), while *customer response capability* was defined as the ability to quickly and effectively respond to customer needs and wants. (Jayachandran et al., 2004). In this case too there has been the adoption of a confirmatory survey to test hypotheses concerning the effects of the two identified capabilities over the customer service performance, and also the effects of information quality on the above capabilities. The study, conducted in the Indian Bank industry, shows that "information quality of a CSU is a significant determinant of its customer service capabilities. Further, the relationships between information quality and customer service capabilities are stronger in a CSU with a more sophisticated customer service process" (p. 18).

Looking at the issue of how involving ecosystem actors through digital platforms and related capabilities, we have the two paper authored by Sedera et al. (2016) and Zhu et al. (2015).

Moving from the consideration that digital platforms can yield innovation only through the moderation of the Enterprise System platform Sedera et al. (2016) studied the effects of digital platforms and enterprise system platforms over innovation, where enterprise systems are considered having both a direct and a moderating effect on the effects of digital platforms. The survey, involving Chief Information Officers and Chief Technology Officers from different companies, showed that digital platforms seems not to play a significant effect over innovation performance, while enterprise system platforms have a significant effect in both a direct and moderating way. These results appear to be to some extent in contrast with results obtained by Scuotto et al. (2017c), which makes room for further research in this direction.

Zhu et al. (2015), studied e-business processes between a focal company and its partners. Authors defined *e-business process capability* as the digital operation ability of a firm to conduct supply chain activities in online settings: this can be further divided into *platform capability* and *relational governance*. *Platform capability* is the technical ability of a digital platform to support inter-firm process coupling, data integration and employee participation for

e-business processes, while *relational governance* refers to the use of relational norms and joint actions to maintain supply chain partner relationships based on common goals (Wang and Wei, 2007).

Furthermore, authors identified three distinctive capabilities that are *online procurement capability*, *online channel management capability* and *online service capability*, hypothesising a significant effect respectively on procurement performance, channel management performance and customer service performance. Furthermore, the study also involves platform capability and relational governance as having a positive impact on the above capabilities. Results show that platform capability has a significant effect on the three capabilities concerning procurement, channel management and online service, which play a significant effect over respective managerial areas; on the other hand, this capability does not have a significant effect on procurement capability, but maintains an effect over the other two capabilities.

4.6 Future research direction for digitalization capabilities

The MDS produces a graphic where the position of each paper depends on its relationship with the others of the sample. The bi-dimensional map representing the conceptual proximity among papers is shown in Figure 4. Interpretation of the axes was given according to topics developed by papers being located at the extremes of the map.

The extremes of the y-axis group papers dealing with two different perspectives on the digital transformation: on the lower extreme we have papers dealing with *digital platform capabilities*, while on the upper extreme we have contributions mainly focusing on *drivers for dynamic capabilities*.

On the lower extreme, Scuotto et al. (2017b) focus on the changes and performance implications of leveraging on social media networks for supporting internal innovation search processes. They study the involved activities in terms of structural dimension, relational behaviour, cognitive dimension, knowledge transfers and legitimization (to convert ideas into innovations) and their influence on the innovation search process and performance. Sedera et al. (2016) study the influence of digital and enterprise systems platforms in the process of organizational innovation through the sub-constructs of the support for business requirements, the infrastructure and the expansion capability. Zhu et al. (2015) examine the components, capabilities and enablers integrated to enhance e-business process innovation. The focus on *drivers for dynamic capabilities* of digital transformation of the contributions positioning on the upper extreme has been interpreted from the contributions by Grover and Kohli (2013),

proposing that firms need to balance choices and systems in implementing their digital business strategy and creating and reconfiguring digitalization capabilities; by Drnevich and Croson (2013), exploring the business-level strategic roles of digital technologies and the "digitally attributable capabilities" to create and capture value.

Moving toward the right side of x-axis we have papers that mostly focus on competitive advantage as emerging after the digital transformation (*Digitalization for competitive advantage*), while on the left side there is a focus on capabilities needed to manage and exploit digital integration (*Digital integration capabilities*).

The analysis of MDS also provides some hints to highlight future research directions. Looking at the distribution of papers and factors (represented in Figure 4), we can see how Factor 3 (*Digital integration capabilities*) and Factor 4 (*Drivers to Digitalization Transformation*) are the only ones whose papers are grouped together, while other factors appear to be sparser: this is due to the variety of topics covered, as already evidenced in the analysis of the single factors. This dispersion of papers indicates that literature on this topic is still into a developing phase, with authors studying the topic from different points of view and with different theoretical heritages. This proves that a unified corpus of academic production in the field of digitalization capabilities still has to be developed, as also evidenced by the lack of papers located at the centre of the map. Indeed, according to previous studies (Di Stefano et al., 2010; Annarelli and Nonino, 2016), toward the centre of the map should be located paper with the highest number of co-citations and, in this case, with the highest values of CPI, but the absence of contribution in the central area of the map makes understand that there is not a real core of papers with a high number of co-citations, confirming that literature is still in its early developing phase.

Furthermore, empty areas or "holes" inside the MDS, together with the analysis of factors' composition, could be indicative for future research directions, to allow a contextualized development of research on digitalization capabilities as a research field per se. For instance, Factor 1 (*Outcomes of Digitalization Transformation*) is the factor with the greatest dispersion of papers, presenting two distinct groups of publications: this bring us to the conclusion that there is a need to narrow the investigation on some specific outcomes and results of digital transformation and related capabilities, like for instance detailed insights on approaches, mechanisms, activities and processes for the implementation of digital platforms.

The other factor showing a sparse distribution is Factor 2 (*Digitalization capabilities representative of dynamic capabilities characteristics*), showing that there is a need to consolidate knowledge on the very nature of *higher-order digitalization capabilities* through more theory building and theory testing/confirmation efforts

Finally, even if Factor 3 and Factor 4 appear to be more condensed, with papers showing a greater consensus and uniformity on topics analysed, there is still a need to consolidate knowledge on the role of *digital integration capabilities* and on the characteristics and nature of *drivers to digital transformation*.

Summarizing, the most interesting future research directions on digitalization capabilities are:

1. Theory building and theory testing studies on *Digital integration capabilities* and on *Digitalization capabilities representative of dynamic capabilities characteristics*;
2. Approaches, mechanisms, activities and processes resulting in the implementation of digital platforms and the development of *Digital platforms capabilities*;
3. Empirical studies on the development and exploitation of *Drivers to digitalization transformation*;
4. Correct balance of resources to be allocated in developing digitalization capabilities, according the specific competitive needs of companies;
5. The nature of *Digital innovation* and related *digital innovation capabilities*;
6. The effects of *Digital innovation* and related capabilities in determining competitive advantage.

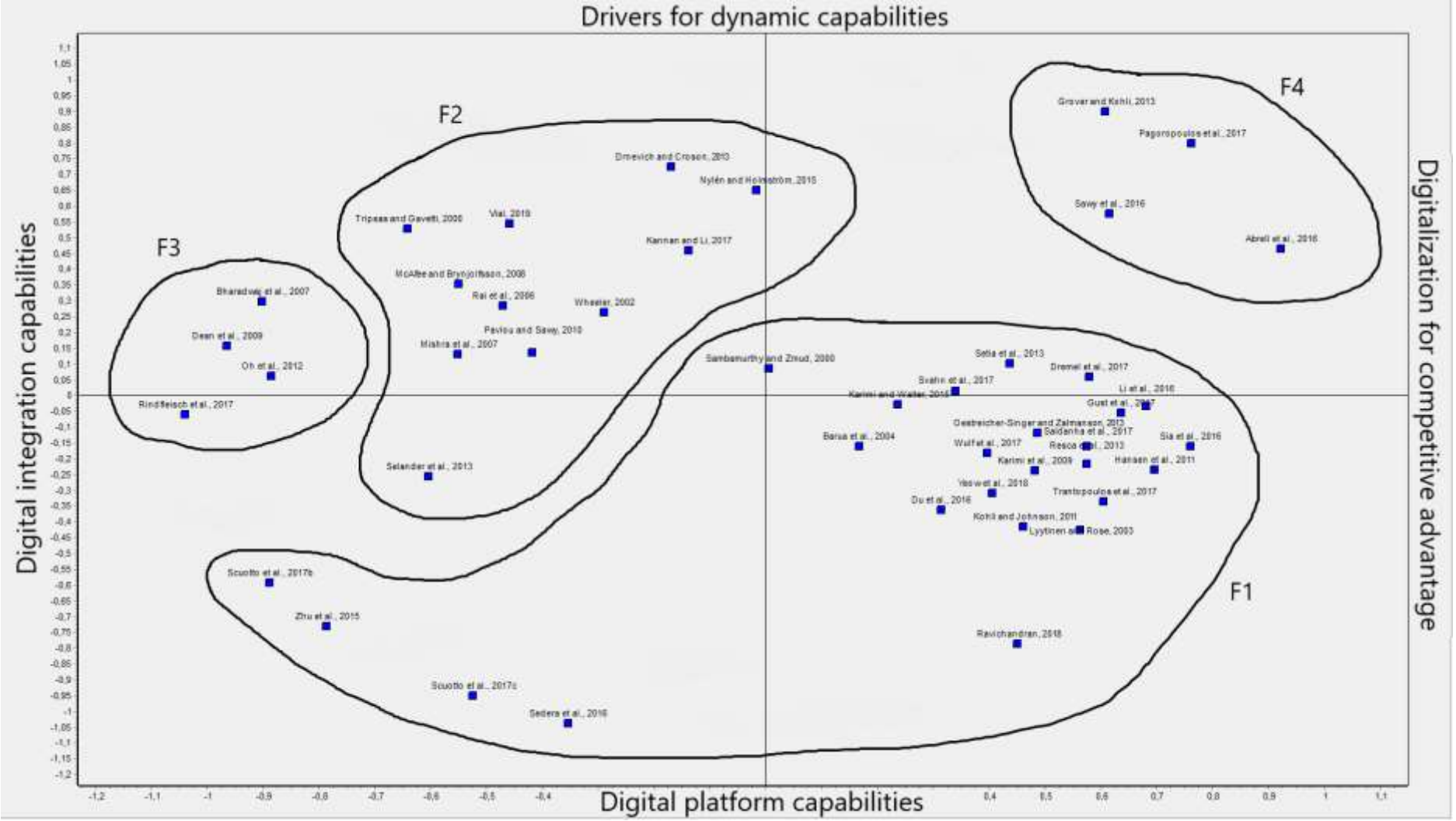

Figure 4 - Multidimensional Scaling with evidence of factors from Factor Analysis

4.7 Findings from the literature outside the core set of papers

As papers belonging to class B are not included in the co-citation analysis but cite or are cited by other papers of the sample, they could provide a fundamental contribution to identify current and future streams of research on digitalization capabilities (Annarelli and Nonino, 2016), adding significant insights on possible evolutions. The table in Appendix B shows the research topic and the related factor which can be associated to the papers included in class B. Specifically, the related factor was assigned basing on the content analysis of the paper and its citations.

The higher number of papers (33%) that can be associated with Factor 2 (*Digitalization capabilities representative of dynamic capabilities characteristics*) confirms the tendency towards consolidating the research streams around the dynamic capabilities as foundation of digitalization capabilities. Following, 50% of class B papers are divided between Factor 1 (*Outcomes of Digitalization Transformation*) and Factor 3 (*Digital integration capabilities*).

The contributions related to Factor 4 (*Drivers to Digitalization Transformation*) follow the sparse location of core papers in the MDS, as they deal with the topic of facilitating technology adoption process and digital transformation through capabilities from the viewpoint of, for example, the accounting information (Bhimani and Willcocks, 2014), the internationalization process (Ojala et al., 2018), the digital servitization (Sánchez-Montesinos et al., 2018), the customer information management (Stone et al., 2017).

Furthermore, there is also a group of papers in class B dealing with the topic of innovation capabilities that testify a tendency of the streams of research towards the capabilities enabled by adoption of digital technologies, rather the ones to handle digital adoption. Indeed, Dodgson et al. (2013) focus on the influence of digital technologies, specifically virtual reality, to overcome constraints of organizational learning; Gastaldi et al. (2018) show that digital transformation programs are fundamental to resolve the exploration-exploitation paradox; Kohler et al. (2009) explore the opportunities of computer-generated physical spaces for opening the new product development process to the interaction with customers; the findings by Laurenza et al. (2018) demonstrate that digital innovation "provide crucial capabilities" in business process management towards better performance.

Hence, class B papers mostly confirm and strengthen the results emerging from the analysis of core literature, and also provide evidence that supports future research directions highlighted.

5. Conclusions

5.1 Theoretical contributions

The purpose of this research was understanding the intellectual structure of the research around the digitalization capabilities of firms, by identifying their 'what', in terms of major research streams and underlying concepts, and 'how', in terms of enablers and scope of digitalization capabilities in the digital transformation of firms. Therefore, we employed a literature search and a proximity co-citation analysis with multivariate techniques, i.e. factor analysis and multi-dimensional scaling.

Based on the analysis of 44 articles (80% of core literature constituting the four factors analysed), we propose three key theoretical contributions for the emerging literature of digitalization capabilities. First, the number of citations and co-cited papers in the set confirms that digitalization capabilities foundations are mainly IT-based, regarding information systems management, but at the interplay with innovation and integration with organizational, strategic, operations and supply chain management issues in order to face the new dynamic competitive landscape. Specially, we found four factors, starting with *Drivers to Digitalization Transformation*, that act as antecedents and bring to the very concept of digitalization capabilities, for which we could identify higher-order capabilities represented by a factor labelled as *Digitalization capabilities representative of dynamic capabilities characteristics* and first order capabilities, namely *Digital integration capabilities*. Last factor represents the *Outcomes of Digitalization Transformation*, and it mostly concerns competitive advantage and value co-creation issues.

Second, conceptualizing digitalization capabilities as dynamic capabilities provide a novel lens towards understanding the foundation of digitalization capabilities. Indeed, as dynamic capabilities, we highlighted how digitalization capabilities allow companies to *reconfigure resources, sense opportunities* (by *managing digital ecosystems*), and *seize existing capabilities*: furthermore, we showed how these capabilities are built on the first order capabilities identified. For instance, firms wanting to *seize digital capabilities* should rely on *digital integration capabilities* and digital innovation capabilities to foster digital processes and leverage opportunities linked to digital innovation (McAfee and Brynjolfsson, 2008). For what concerns the *reconfiguration of digital resources and routines*, firms can build *net enablement* as a dynamic capability based on *digital integration capabilities* to process multiple sources of information and innovation (Wheeler, 2002).

Third, the analysis of factors, together with MDS, allowed us to identify six different future research directions that mainly concern needs for future exploration and study of topics/factors

identified. Among these, there is an important need for future studies to deal specifically with theory building about *Digital integration capabilities* and *Digitalization capabilities representative of dynamic capabilities characteristics*.

5.2 Limitations

The present study contributes by applying CPA as a methodology to investigate a research topic in management literature is innovative and could represent a reference for scholars aiming to deepen future co-citation analyses and provides a first attempt to give an organic view of literature on the topic of digitalization capabilities. However, some limitations must be acknowledged. The adoption of bibliometric techniques could introduce certain distortions that may somehow "force" interpretations of literature and research fields. Indeed, the MDS map is a representation of conceptual proximity of works, even if this is not always true, since positions on the map are relative to the set of items (papers) analysed, and are depending on the basis used to build the correlation index among them. We tried to overcome some limitations of co-citation approach by adopting the CPI, but this method requires a non-negligible effort with bigger dimensions of the core set of papers. Furthermore, there is still not a unique and validated use of the citation proximity analysis: for instance, an open issue concerns if multiple co-citations inside the same source should counted as one (as it is for the simple co-citation-based approach) or considered multiple times as separate citations. Another refinement is analysing the type of section (e.g. "introduction" or "theoretical background") where two papers are cited together, as they differ by importance, deepening and kind of information included. This is surely an interesting development for future applications of this methodology.

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Scuotto, V., Del Giudice, M., Peruta, M.R.D., Tarba, S., 2017b. The performance implications of leveraging internal innovation through social media networks: An empirical verification of the smart fashion industry. *Technological Forecasting and Social Change*, 120, 184-194.

Scuotto, V., Del Giudice, M., Carayannis, E.G., 2017c. The effect of social networking sites and absorptive capacity on SMES' innovation performance. *Journal of Technology Transfer*, 42(2), 409-424.

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Selander, L., Henfridsson, O., Svahn, F., 2013. Capability search and redeem across digital ecosystems. *Journal of Information Technology*, 28(3), 183-197.

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Appendix A

Table A1. Classification of papers selected after systematic literature review, divided in Class A, B and C

Authors	Year	Title	Source
Class A			
Abrell T., Pihlajamaa M., Kanto L., Vom Brocke J., Uebernickel F.	2016	The role of users and customers in digital innovation: Insights from B2B manufacturing firms	Information and Management
Amit R., Han X.	2017	Value Creation through Novel Resource Configurations in a Digitally Enabled World	Strategic Entrepreneurship Journal
Barua A., Konana P., Whinston A.B., Yin F.	2004	An empirical investigation of net-enabled business value	MIS Quarterly: Management Information Systems
Bharadwaj S., Bharadwaj A., Bendoly E.	2007	The performance effects of complementarities between information systems, marketing, manufacturing, and supply chain processes	Information Systems Research
Cenamor, J., Parida, V., Wincent, J.	2019	How entrepreneurial SMEs compete through digital platforms: The roles of digital platform capability, network capability and ambidexterity	Journal of Business Research
Dean P.R., Tu Y.L., Xue D.	2009	An information system for one-of-a-kind production	International Journal of Production Research
Dremel C., Herterich M.M., Wulf J., Waizmann J.-C., Brenner W.	2017	How AUDI AG established big data analytics in its digital transformation	MIS Quarterly Executive
Drnevich P.L., Croson D.C.	2013	Information technology and business-level strategy: Toward an integrated theoretical perspective	MIS Quarterly: Management Information Systems
Du W., Pan S.L., Huang J.	2016	How a latecomer company used IT to redeploy slack resources	MIS Quarterly Executive
El Sawy O.A., Malhotra A., Park Y., Pavlou P.A.	2010	Seeking the configurations of digital ecodynamics: It takes three to tango	Information Systems Research
Gölzer P., Fritzsche A.	2017	Data-driven operations management: organisational implications of the digital transformation in industrial practice	Production Planning and Control
Grover V., Kohli R.	2013	Revealing your hand: Caveats in implementing digital business strategy	MIS Quarterly: Management Information Systems
Gust G., Neumann D., Flath C.M., Brandt T., Ströhle P.	2017	How a traditional company seeded new analytics capabilities	MIS Quarterly Executive
Hansen A.M., Kraemmergaard P., Mathiassen L.	2011	Rapid adaptation in digital transformation: A participatory process for engaging is and business leaders	MIS Quarterly Executive
Kannan P.K., Li H.".	2017	Digital marketing: A framework, review and research agenda	International Journal of Research in Marketing
Karimi J., Somers T.M., Bhattacherjee A.	2009	The role of ERP implementation in enabling digital options: A theoretical and empirical analysis	International Journal of Electronic Commerce
Karimi J., Walter Z.	2015	The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry	Journal of Management Information Systems
Kohli R., Johnson S.	2011	Digital transformation in latecomer industries: CIO and CEO leadership lessons from Encana Oil & Gas (USA) Inc.	MIS Quarterly Executive

Authors	Year	Title	Source
Li W., Liu K., Belitski M., Ghobadian A., O'Regan N.	2016	e-Leadership through strategic alignment: An empirical study of small- and medium-sized enterprises in the digital age	Journal of Information Technology
Lyytinen K., Rose G.M.	2003	The disruptive nature of information technology innovations: The case of internet computing in systems development organizations	MIS Quarterly: Management Information Systems
McAfee A., Brynjolfsson E.	2008	Investing in the IT that makes a competitive difference	Harvard Business Review
Mishra A.N., Konana P., Barua A.	2007	Antecedents and consequences of Internet use in procurement: An empirical investigation of U.S. manufacturing firms	Information Systems Research
Molinillo S., Japutra A.	2017	Organizational adoption of digital information and technology: a theoretical review	Bottom Line
Nylén D., Holmström J.	2015	Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation	Business Horizons
Oestreicher-Singer G., Zalmanson L.	2013	Content or community? A digital business strategy for content providers in the social age	MIS Quarterly: Management Information Systems
Oh L.-B., Teo H.-H., Sambamurthy V.	2012	The effects of retail channel integration through the use of information technologies on firm performance	Journal of Operations Management
Pagoropoulos A., Maier A., McAloone T.C.	2017	Assessing transformational change from institutionalising digital capabilities on implementation and development of Product-Service Systems: Learnings from the maritime industry	Journal of Cleaner Production
Pavlou P.A., Sawy O.A.E.	2010	The "third hand": IT-enabled competitive advantage in turbulence through improvisational capabilities	Information Systems Research
Rai A., Patnayakuni R., Seth N.	2006	Firm performance impacts of digitally enabled supply chain integration capabilities	MIS Quarterly: Management Information Systems
Ramaswamy V., Ozcan K.	2018	Offerings as digitalized interactive platforms: A conceptual framework and implications	Journal of Marketing
Ravichandran T.	2018	Exploring the relationships between IT competence, innovation capacity and organizational agility	Journal of Strategic Information Systems
Resca A., Za S., Spagnoletti P.	2013	Digital platforms as sources for organizational and strategic transformation: A case study of the midblue project	Journal of Theoretical and Applied Electronic Commerce Research
Rindfleisch A., O'Hern M., Sachdev V.	2017	The Digital Revolution, 3D Printing, and Innovation as Data	Journal of Product Innovation Management
Saldanha T.J.V., Mithas S., Krishnan M.S.	2017	Leveraging customer involvement for fueling innovation: The role of relational and analytical information processing capabilities	MIS Quarterly: Management Information Systems
Sambamurthy V., Bharadwaj A., Grover V.	2003	Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms	MIS Quarterly: Management Information Systems
Sambamurthy V., Zmud R.W.	2000	Research Commentary: The Organizing Logic for an Enterprise's IT Activities in the Digital Era - A Prognosis of Practice and a Call for Research	Information Systems Research
Sawy O.A.E., Amsinck H., Kræmmergaard P., Vinther A.L.	2016	How LEGO built the foundations and enterprise capabilities for digital leadership	MIS Quarterly Executive

Authors	Year	Title	Source
Scuotto V., Del Giudice M., Carayannis E.G.	2017	The effect of social networking sites and absorptive capacity on SMES' innovation performance	Journal of Technology Transfer
Scuotto V., Del Giudice M., Peruta M.R.D., Tarba S.	2017	The performance implications of leveraging internal innovation through social media networks: An empirical verification of the smart fashion industry	Technological Forecasting and Social Change
Scuotto V., Santoro G., Bresciani S., Del Giudice M.	2017	Shifting intra- and inter-organizational innovation processes towards digital business: An empirical analysis of SMEs	Creativity and Innovation Management
Sedera D., Lokuge S., Grover V., Sarker S., Sarker S.	2016	Innovating with enterprise systems and digital platforms: A contingent resource-based theory view	Information and Management
Selander L., Henfridsson O., Svahn F.	2013	Capability search and redeem across digital ecosystems	Journal of Information Technology
Setia P., Venkatesh V., Joglekar S.	2013	Leveraging digital technologies: How information quality leads to localized capabilities and customer service performance	MIS Quarterly: Management Information Systems
Sia S.K., Soh C., Weill P.	2016	How DBS bank pursued a digital business strategy	MIS Quarterly Executive
Stone M.D., Woodcock N.D.	2014	Interactive, direct and digital marketing: A future that depends on better use of business intelligence	Journal of Research in Interactive Marketing
Svahn F., Mathiassen L., Lindgren R.	2017	Embracing digital innovation in incumbent firms: How Volvo Cars managed competing concerns	MIS Quarterly: Management Information Systems
Trantopoulos K., Von Krogh G., Wallin M.W., Woerter M.	2017	External knowledge and information technology: Implications for process innovation performance	MIS Quarterly: Management Information Systems
Tripsas and Gavetti	2000		
Vial, G.	2019	Understanding digital transformation: A review and a research agenda	Journal of Strategic Information Systems
Warner, K.S.R., Wäger, M.	2019	Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal	Long Range Planning
Wheeler B.C.	2002	NEBIC: A dynamic capabilities theory for assessing net-enablement	Information Systems Research
Wulf J., Mettler T., Brenner W.	2017	Using a digital services capability model to assess readiness for the digital consumer	MIS Quarterly Executive
Yeow A., Soh C., Hansen R.	2018	Aligning with new digital strategy: A dynamic capabilities approach	Journal of Strategic Information Systems
Zhu Z., Zhao J., Tang X., Zhang Y.	2015	Leveraging e-business process for business value: A layered structure perspective	Information and Management
Class B			
Alshamaila Y., Papagiannidis S., Li F.	2013	Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework	Journal of Enterprise Information Management
Ardito L., Petruzzelli A.M., Panniello U., Garavelli A.C.	2018	Towards Industry 4.0: Mapping digital technologies for supply chain management-marketing integration	Business Process Management Journal
Ardolino M., Rapaccini M., Saccani N., Gaiardelli P., Crespi G., Ruggeri C.	2018	The role of digital technologies for the service transformation of industrial companies	International Journal of Production Research
Bhimani A., Willcocks L.	2014	Digitisation, Big Data and the transformation of accounting information	Accounting and Business Research

Authors	Year	Title	Source
Blackburn M., Alexander J., Legan J.D., Klabjan D.	2017	Big Data and the Future of R&D Management: The rise of big data and big data analytics will have significant implications for R&D and innovation management in the next decade.	Research Technology Management
Büyüközkan G.	2004	A success index to evaluate e-Marketplaces	Production Planning and Control
Candi M., Beltagui A.	2018	Effective use of 3D printing in the innovation process	Technovation
Caputo, A., Fiorentino, R., Garzella, S.	2019	From the boundaries of management to the management of boundaries: Business processes, capabilities and negotiations	Business Process Management Journal
Chellappa R.K., Sambamurthy V., Saraf N.	2010	Competing in crowded markets: Multimarket contact and the nature of competition in the enterprise systems software industry	Information Systems Research
Chi, M., Lu, X., Zhao, J., Li, Y.	2018	The impacts of digital business strategy on firm performance: The mediation analysis of e-collaboration capability	International Journal of Information Systems and Change Management
Coreynen W., Matthyssens P., Van Bockhaven W.	2017	Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers	Industrial Marketing Management
de Vass, T., Shee, H., Miah, S.	2018	The effect of "Internet of Things" on supply chain integration and performance: An organisational capability perspective	Australasian Journal of Information Systems
Dodgson M., Gann D.M., Phillips N.	2013	Organizational learning and the technology of foolishness: The case of virtual worlds at IBM	Organization Science
Esposito De Falco S., Renzi A., Orlando B., Cucari N.	2017	Open collaborative innovation and digital platforms	Production Planning and Control
Ferreira, J.J.M., Fernandes, C.I., Ferreira, F.A.F.	2019	To be or not to be digital, that is the question: Firm innovation and performance	Journal of Business Research
Foroudi P., Gupta S., Nazarian A., Duda M.	2017	Digital technology and marketing management capability: achieving growth in SMEs	Qualitative Market Research
Garcia-Morales V.J., Martín-Rojas R., Lardón-López M.E.	2018	Influence of social media technologies on organizational performance through knowledge and innovation	Baltic Journal of Management
Gastaldi L., Appio F.P., Corso M., Pistorio A.	2018	Managing the exploration-exploitation paradox in healthcare: Three complementary paths to leverage on the digital transformation	Business Process Management Journal
Greenstein S.	2017	The reference wars: Encyclopædia Britannica's decline and Encarta's emergence	Strategic Management Journal
Gurbaxani, V., Dunkle, D.	2019	Gearing up for successful digital transformation	MIS Quarterly Executive
Holmström J., Liotta G., Chaudhuri A.	2018	Sustainability outcomes through direct digital manufacturing-based operational practices: A design theory approach	Journal of Cleaner Production
Järvinen J., Karjaluoto H.	2015	The use of Web analytics for digital marketing performance measurement	Industrial Marketing Management
Järvinen J., Taiminen H.	2016	Harnessing marketing automation for B2B content marketing	Industrial Marketing Management
Jitpaiboon T., Dobrzykowski D.D., Ragu-Nathan T.S., Vonderembse M.A.	2013	Unpacking IT use and integration for mass customisation: A service-dominant logic view	International Journal of Production Research
Khin, S., Ho, T.C.F.	2019	Digital technology, digital capability and organizational performance: A mediating role of digital innovation	International Journal of Innovation Science

Authors	Year	Title	Source
Kitchens B., Dobolyi D., Li J., Abbasi A.	2018	Advanced Customer Analytics: Strategic Value Through Integration of Relationship-Oriented Big Data	Journal of Management Information Systems
Kohler T., Matzler K., Füller J.	2009	Avatar-based innovation: Using virtual worlds for real-world innovation	Technovation
Kuusisto M.	2017	Organizational effects of digitalization: A literature review	International Journal of Organization Theory and Behavior
Laurenza E., Quintano M., Schiavone F., Vrontis D.	2018	The effect of digital technologies adoption in healthcare industry: a case based analysis	Business Process Management Journal
Levallet N., Chan Y.E.	2018	Role of digital capabilities in unleashing the power of managerial improvisation	MIS Quarterly Executive
Li, H., Wu, Y., Cao, D., Wang, Y.	2019	Organizational mindfulness towards digital transformation as a prerequisite of information processing capability to achieve market agility	Journal of Business Research
Li, T.C., Chan, Y.E.	2019	Dynamic information technology capability: Concept definition and framework development	Journal of Strategic Information Systems
Mani R.V.S., Baul U., Mohanty R.P., Rajkumar T.M.	2013	An empirical study of information technology infrastructure capability and its impact on digitally enabled customer management processes in life insurance companies	International Journal of Business Information Systems
Mihardjo, L.W.W., Sasmoko, Alamsjah, F., Elidjen	2019a	Digital leadership impacts on developing dynamic capability and strategic alliance based on market orientation	Polish Journal of Management Studies
Mihardjo, L.W.W., Sasmoko, Alamsyah, F., Elidjen	2019b	The influence of digital leadership on innovation management based on dynamic capability: Market orientation as a moderator	Management Science Letters
Mishra A.N., Devaraj S., Vaidyanathan G.	2013	Capability hierarchy in electronic procurement and procurement process performance: An empirical analysis	Journal of Operations Management
North, K., Aramburu, N., Lorenzo, O.J.	2019	Promoting digitally enabled growth in SMEs: a framework proposal	Journal of Enterprise Information Management
Ojala A., Evers N., Rialp A.	2018	Extending the international new venture phenomenon to digital platform providers: A longitudinal case study	Journal of World Business
Papa A., Santoro G., Tirabeni L., Monge F.	2018	Social media as tool for facilitating knowledge creation and innovation in small and medium enterprises	Baltic Journal of Management
Ramaswamy V., Ozcan K.	2016	Brand value co-creation in a digitalized world: An integrative framework and research implications	International Journal of Research in Marketing
Rashidirad M., Soltani E., Salimian H., Liao Y.	2015	The applicability of Grant's framework in the dynamic digital age: A review and agenda for future research	European Business Review
Riikkinen M., Saarijärvi H., Sarlin P., Lähteenmäki I.	2018	Using artificial intelligence to create value in insurance	International Journal of Bank Marketing
Roden S., Nucciarelli A., Li F., Graham G.	2017	Big data and the transformation of operations models: A framework and a new research agenda	Production Planning and Control
Rolland K.H., Mathiassen L., Rai A.	2018	Managing digital platforms in user organizations: The interactions between digital options and digital debt	Information Systems Research
Roscoe, S., Cousins, P.D., Handfield, R.	2019	The microfoundations of an operational capability in digital manufacturing	Journal of Operations Management

Authors	Year	Title	Source
Rothmann W., Koch J.	2014	Creativity in strategic lock-ins: The newspaper industry and the digital revolution	Technological Forecasting and Social Change
Saggi M.K., Jain S.	2018	A survey towards an integration of big data analytics to big insights for value-creation	Information Processing and Management
Sánchez-Montesinos F., Opazo Basáez M., Arias Aranda D., Bustinza O.F.	2018	Creating isolating mechanisms through digital servitization: The case of Covirán	Strategic Change
Sasmoko, Wasono Mihardjo, L.W., Alamsjaha, F., Elidjena	2019	Dynamic capability: The effect of digital leadership on fostering innovation capability based on market orientation	Management Science Letters
Scuotto, V., Arrigo, E., Candelo, E., Nicotra, M.	2019	Ambidextrous innovation orientation effected by the digital transformation: A quantitative research on fashion SMEs	Business Process Management Journal
Setia P., Patel P.C.	2013	How information systems help create OM capabilities: Consequents and antecedents of operational absorptive capacity	Journal of Operations Management
Shuradze G., Bogodistov Y., Wagner H.-T.	2018	The role of marketing-enabled data analytics capability and organisational agility for innovation: Empirical evidence from German firms	International Journal of Innovation Management
Singh G., Gaur L., Agarwal M.	2017	Factors influencing the digital business strategy	Pertanika Journal of Social Sciences and Humanities
Sjödin, D.R., Parida, V., Leksell, M., Petrovic, A.	2018	Smart Factory Implementation and Process Innovation: A Preliminary Maturity Model for Leveraging Digitalization in Manufacturing	Research Technology Management
Stone M., Aravopoulou E., Gerardi G., Todeva E., Weinzierl L., Laughlin P., Stott R.	2017	How platforms are transforming customer information management	Bottom Line
Tanriverdi H., Konana P., Ge L.	2007	The choice of sourcing mechanisms for business processes	Information Systems Research
Ukko, J., Nasiri, M., Saunila, M., Rantala, T.	2019	Sustainability strategy as a moderator in the relationship between digital business strategy and financial performance	Journal of Cleaner Production
Utoyo, I., Fontana, A., Satrya, A.	2019	The role of entrepreneurial leadership and configuring core innovation capabilities to enhance innovation performance in a disruptive environment	International Journal of Innovation Management
Verhoef, P.C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., Haenlein, M.	2019	Digital transformation: A multidisciplinary reflection and research agenda	Journal of Business Research
Wang F., Zhao J., Chi M., Li Y.	2017	Collaborative innovation capability in IT-enabled inter-firm collaboration	Industrial Management and Data Systems
Witschel, D., Döhla, A., Kaiser, M., Voigt, K.-I., Pfletschinger, T.	2019	Riding on the wave of digitization: insights how and under what settings dynamic capabilities facilitate digital-driven business model change	Journal of Business Economics
Zhao J., Chi M., Zhu Z., Hu L.	2015	From digital business strategy to e-business value creation: A three-stage process model	International Journal of Networking and Virtual Organisations

Authors	Year	Title	Source
Zhu Z., Zhao J., Jin X.	2013	A typology of net-enabled organisational capabilities for digital competitive advantage: The case study of travel and hospitality industry in China	International Journal of Networking and Virtual Organisations
Class C			
Abdullah S.S., Hilman H., Gorondutse A.H., Ramanchandram R., Yahman Z.	2013	Link between e-commerce and e-business in the context of e-strategy	International Journal of Economic Research
Aeron H., Kumar A., Janakiraman M.	2018	Application of data mining techniques for customer lifetime value parameters: A review	International Journal of Business Information Systems
Alkkiomäki V.	2018	The role of service-oriented architecture as a part of the business model	International Journal of Business Information Systems
Al-Mashari M.	2014	Electronic commerce: A comparative study of organizational experiences	Benchmarking
Alos-Simo L., Verdu-Jover A.J., Gomez-Gras J.-M.	2017	How transformational leadership facilitates e-business adoption	Industrial Management and Data Systems
Attaran M., Attaran S.	2004	The rebirth of re-engineering: X-engineering	Business Process Management Journal
Bachmann P., Kantorovï¿½ K.	2018	From customer orientation to social CRM. New insights from central Europe	Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration
Balocco R., Ghezzi A., Rangone A., Toletti G.	2019	A strategic analysis of the European companies in the ICT sales channel	International Journal of Engineering Business Management
Beier G., Niehoff S., Ziems T., Xue B.	2010	Sustainability aspects of a digitalized industry – A comparative study from China and Germany	International Journal of Precision Engineering and Manufacturing - Green Technology
Berman S.	2018	Media and entertainment 2010 scenario: the open media company of the future	Strategy & Leadership
Bienhaus, F., Haddud, A.	2017	Procurement 4.0: factors influencing the digitisation of procurement and supply chains	Business Process Management Journal
Bodily S., Venkataraman S.	2018	Not walls, windows: Capturing value in the digital age	Journal of Business Strategy
Bourke J., Roper S.	2013	AMT adoption and innovation: An investigation of dynamic and complementary effects	Technovation
Braun, T., Sydow, J.	2017	Selecting Organizational Partners for Interorganizational Projects: The Dual but Limited Role of Digital Capabilities in the Construction Industry	Project Management Journal
Burda D., Teuteberg F.	2019	Investigating the needs, capabilities and decision making mechanisms in digital preservation: Insights from a multiple case study	Information Resources Management Journal
Bustinza O.F., Gomes E., Vendrell-Herrero F., Tarba S.Y.	2017	An organizational change framework for digital servitization: Evidence from the Veneto region	Strategic Change
Caesarius L.M., Hohenthal J.	2018	Searching for big data: How incumbents explore a possible adoption of big data technologies	Scandinavian Journal of Management

Authors	Year	Title	Source
Chaffey D.	2018	Applying organisational capability models to assess the maturity of digital-marketing governance	Journal of Marketing Management
Chaffey D., Patron M.	2017	From web analytics to digital marketing optimization: Increasing the commercial value of digital analytics	Journal of Direct, Data and Digital Marketing Practice
Constantinescu C., Lentes J.	2019	Realization of digital production by an app-based approach	Quality - Access to Success
Dahl A., Lawrence J., Pierce J.	2018	Building an innovation community	Research Technology Management
David-West O., Iheanachor N., Kelikume I.	2015	A resource-based view of digital financial services (DFS): An exploratory study of Nigerian providers	Journal of Business Research
Docters R., Bednarczyk S., Gieskes M., Tilstone L.	2016	Pricing in the digital world	Journal of Business Strategy
Doyle G.	2013	Re-invention and survival: Newspapers in the era of digital multiplatform delivery	Journal of Media Business Studies
Fazlollahtabar H.	2019	Applying information technology in developing business models of export	International Journal of Business and Systems Research
Finch G., Goehring B., Marshall A.	2018	The enticing promise of cognitive computing: High-value functional efficiencies and innovative enterprise capabilities	Strategy and Leadership
Fonseca L.M., Domingues J.P.	2009	How to succeed in the digital age? Monitor the organizational context, identify risks and opportunities, and manage change effectively	Management and Marketing
Forman C.	2017	The corporate digital divide: Determinants of internet adoption	Management Science
Franklin M., Searle N., Stoyanova D., Townley B.	2018	Innovation in the application of digital tools for managing uncertainty: The case of UK independent film	Creativity and Innovation Management
Frolov V.G., Kaminchenko D.I., Kovylkin D.Y., Popova J.A., Pavlova A.A.	2018	The main economic factors of sustainable manufacturing within the industrial policy concept of industry 4.0	Academy of Strategic Management Journal
Gagliardi D.	2019	Next generation entrepreneur: Innovation strategy through Web 2.0 technologies in SMEs	Technology Analysis and Strategic Management
Garbellano, S., Da Veiga, M.R.	2019	Dynamic capabilities in Italian leading SMEs adopting industry 4.0	Measuring Business Excellence
Gaskin J., Berente N., Lyytinen K., Yoo Y.	2013	Toward generalizable sociomaterial inquiry: A computational approach for zooming in and out of sociomaterial routines	MIS Quarterly: Management Information Systems
Gilbert A.L., Han H.	2019	Understanding mobile data services adoption: Demography, attitudes or needs?	Technological Forecasting and Social Change
Goel S., Chen V.	2019	Can business process reengineering lead to security vulnerabilities: Analyzing the reengineered process	International Journal of Production Economics
Gottschalk P.	2013	Research propositions for knowledge management systems supporting electronic business	International Journal of Innovation and Learning
Han, Y.	2018	The relationship between ambidextrous knowledge sharing and innovation within industrial clusters: Evidence from China	Interdisciplinary Journal of Information, Knowledge, and Management

Authors	Year	Title	Source
Hannola L., Richter A., Richter S., Stocker A.	2019	Empowering production workers with digitally facilitated knowledge processes – a conceptual framework	International Journal of Production Research
Heinze A., Griffiths M., Fenton A., Fletcher G.	2018	Knowledge exchange partnership leads to digital transformation at Hydro-X Water Treatment, Ltd.	Global Business and Organizational Excellence
Heripracoyo, S., Prabowo, H., Kosala, R., Gaol, F.L.	2018	Innovation capability improvement in digital creative industries	International Journal of Recent Technology and Engineering
Horner-Long P., Schoenberg R.	2016	Does e-business require different leadership characteristics? An empirical investigation	European Management Journal
Ives B., Palese B., Rodriguez J.A.	2015	Enhancing customer service through the internet of things and digital data streams	MIS Quarterly Executive
James R.	2018	Out of the box: The perils of professionalism in the digital age	Business Information Review
Janković S., Mladenović S., Mladenović D., Vesković S., Glavić D.	2017	Schema on read modeling approach as a basis of big data analytics integration in EIS	Enterprise Information Systems
Kane G.C.	2018	Enterprise social media: Current capabilities and future possibilities	MIS Quarterly Executive
Kanter R.M.	2019	The ten deadly mistakes of wanna-dots.	Harvard Business Review
Katsikeas, C., Leonidou, L., Zeriti, A.	2014	Revisiting international marketing strategy in a digital era: Opportunities, challenges, and research directions	International Marketing Review
Kettunen P., Laanti M.	2018	Future software organizations – agile goals and roles	European Journal of Futures Research
Khouja M., Wang Y.	2018	The impact of digital channel distribution on the experience goods industry	European Journal of Operational Research
Kim C., Galliers R.D.	2019	Toward a diffusion model for Internet systems	Internet Research
Klamet A.	2019	Make or Buy? A Qualitative Analysis of the Organisational Handling of Digital Innovations in the German Book Publishing Sector	Publishing Research Quarterly
Kobus J., Westner M., Strahringer S., Strode D.	2013	Enabling digitization by implementing Lean IT: lessons learned	TQM Journal
Koudal P., Wellener P.	2018	Digital loyalty networks: continuously connecting automakers with their customers and suppliers	Strategy & Leadership
Koutsoutos A., Westerholt G.	2017	Business impacts of ICT	International Journal of Technology, Policy and Management
Kulkarni, S., Verma, P., Mukundan, R.	2018	Performance landscape modeling in digital manufacturing firm	Business Process Management Journal
Kyläheiko K., Sandström J.	2017	Strategic options-based framework for management of dynamic capabilities in manufacturing firms	Journal of Manufacturing Technology Management
Laframboise K., Reyes F.	2007	The digitization of an aerospace supply network	International Journal of Enterprise Information Systems
Lai V.S., Guynes J.L.	2019	An assessment of the influence of organizational characteristics on information technology adoption decision: A discriminative approach	IEEE Transactions on Engineering Management

Authors	Year	Title	Source
Lambiase F., Lambiase A.	2019	An integrated approach to the analysis of automotive assembly activities using digital manufacturing tools	International Journal of Internet Manufacturing and Services
Lanzolla G., Giudici A.	2019	Pioneering strategies in the digital world. Insights from the Axel Springer case	Business History
Lau H.C.W., Tsui W.T., Ip R.W.L.	2017	Development of an e-procurement model for global financial institutions	International Journal of Services, Technology and Management
Lee S.M., Olson D.L., Trimi S., Rosacker K.M.	2019	An integrated method to evaluate business process alternatives	Business Process Management Journal
Lekakos G.	2015	Exploiting RFID digital information in enterprise collaboration	Industrial Management and Data Systems
Lenka S., Parida V., Wincent J.	2013	Digitalization Capabilities as Enablers of Value Co-Creation in Servitizing Firms	Psychology and Marketing
Li J., Merenda M., Venkatachalam A.R.	2018	Business process digitalization and new product development: An empirical study of small and medium-sized manufacturers	International Journal of e-Business Research
Li, J., Zhou, J., Cheng, Y.	2018	Conceptual Method and Empirical Practice of Building Digital Capability of Industrial Enterprises in the Digital Age	IEEE Transactions on Engineering Management
Lichtenthaler U.	2014	Shared value innovation: Linking competitiveness and societal goals in the context of digital transformation	International Journal of Innovation and Technology Management
Liu D.-Y., Chen S.-W., Chou T.-C.	2017	Resource fit in digital transformation: Lessons learned from the CBC Bank global e-banking project	Management Decision
Llopis J., Gonzalez M.R., Gasco J.L.	2004	Transforming the firm for the digital era: An organizational effort towards an E-culture	Human Systems Management
Lunn M.	2018	Using business models and revenue streams for digital marketplace success	Information Management and Computer Security
Maier C.D., Ravazzani S.	2019	Framing Diversity in Corporate Digital Contexts: A Multimodal Approach to Discursive Recontextualizations of Social Practices	International Journal of Business Communication
Matthyssens, P.	2010	Reconceptualizing value innovation for Industry 4.0 and the Industrial Internet of Things	Journal of Business and Industrial Marketing
Meraviglia L.	2018	Technology and counterfeiting in the fashion industry: Friends or foes?	Business Horizons
Mihardjo, L.W.W., Sasmoko, Alamsjah, F., Elidjen	2017	The role of distinctive organisational capability in formulating co-creation strategy and business model innovation	Polish Journal of Management Studies
Milbank S.	2018	Marginal gains and innovating in digital marketing-A study on implementing best practice	Journal of Direct, Data and Digital Marketing Practice
Molla A., Cooper V.	2013	Green it readiness: A framework and preliminary proof of concept	Australasian Journal of Information Systems
Ness D., Swift J., Ranasinghe D.C., Xing K., Soebarto V.	2017	Smart steel: New paradigms for the reuse of steel enabled by digital tracking and modelling	Journal of Cleaner Production
Oliver, J.J.	2019	Strategic transformations in the media	Journal of Media Business Studies

Authors	Year	Title	Source
Parmentier G., Mangematin V.	2017	Orchestrating innovation with user communities in the creative industries	Technological Forecasting and Social Change
Paunov C., Rollo V.	2018	Has the Internet Fostered Inclusive Innovation in the Developing World?	World Development
Poulis E., Poulis K., Dooley L.	2018	'Information communication technology' innovation in a non-high technology sector: achieving competitive advantage in the shipping industry	Service Industries Journal
Prescott M.E.	2017	Big data and competitive advantage at Nielsen	Management Decision
Quigley M., Burke M.	2019	Low-cost internet of things digital technology adoption in SMEs	International Journal of Management Practice
Rachinger, M., Rauter, R., Müller, C., Vorraber, W., Schirgi, E.	2018	Digitalization and its influence on business model innovation	Journal of Manufacturing Technology Management
Ramantoko, G., Fatimah, L.V., Pratiwi, S.C., Kinasih, K.	2015	Measuring digital capability maturity: Case of small-medium Kampong-digital companies in Bandung	Pertanika Journal of Social Sciences and Humanities
Randhawa, K., Wilden, R., Gudergan, S.	2016	Open Service Innovation: The Role of Intermediary Capabilities	Journal of Product Innovation Management
Rask M., Ivang R., Hinson R.	2013	B2b inter-organisational digitalisation strategies: Towards an interaction-based approach	Direct Marketing
Remane G., Hanelt A., Nickerson R.C., Kolbe L.M.	2019	Discovering digital business models in traditional industries	Journal of Business Strategy
Rezaee Z., Sharbatoghlie A., Elam R., McMickle P.L.	2018	Continuous auditing: Building automated auditing capability	Auditing
Richir S., Taravel B., Samier H.	2009	Information networks and technological innovation for industrial products	International Journal of Technology Management
Roy R., Lampert C.M., Stoyneva I.	2017	When dinosaurs fly: The role of firm capabilities in the 'avianization' of incumbents during disruptive technological change	Strategic Entrepreneurship Journal
Royer S., van der Velden R.	2018	Economics, e-commerce and strategy development: resources and rent creation for digital goods providers on the internet	International Journal of Management and Decision Making
Salampasis M., Paltoglou G., Giachanou A.	2018	Using social media for continuous monitoring and mining of consumer behaviour	International Journal of Electronic Business
Salo J.	2019	Business relationship digitization: What do we need to know before embarking on such activities?	Journal of Electronic Commerce in Organizations
Sankaran B., O'Brien W.J.	2019	Bayesian Second-Order Factor Model for Maturity Assessment of CIM Technologies and Practices at Highway Agencies	Journal of Construction Engineering and Management
Sayar D., Er Ö.	2013	The antecedents of successful IoT service and system design: Cases from the manufacturing industry	International Journal of Design
Schwer K., Hitz C.	2019	Designing organizational structure in the age of digitization	Journal of Eastern European and Central Asian Research

Authors	Year	Title	Source
Sibanda M., Ramrathan D.	2019	Influence of Information Technology on Organization Strategy	Foundations of Management
Smith D.J.	2013	Power-by-the-hour: The role of technology in reshaping business strategy at Rolls-Royce	Technology Analysis and Strategic Management
Sommer L.	2018	Industrial revolution - Industry 4.0: Are German manufacturing SMEs the first victims of this revolution?	Journal of Industrial Engineering and Management
Stiakakis E., Georgiadis C.K.	2019	Drivers of a tourism e-business strategy: The impact of information and communication technologies	Operational Research
Stoeckli E., Dremel C., Uebernickel F.	2018	Exploring characteristics and transformational capabilities of InsurTech innovations to understand insurance value creation in a digital world	Electronic Markets
Straker K., Wrigley C.	2018	Designing an emotional strategy: Strengthening digital channel engagements	Business Horizons
Su C.-T., Chen Y.-H., Sha D.Y.	2016	Linking innovative product development with customer knowledge: a data-mining approach	Technovation
Suheimat, W., Prætorius, T., Vang, J.	2015	Building dynamic capabilities in large global advertising agency networks: Managing the shift from mass communication to digital interactivity	International Journal of Foresight and Innovation Policy
Szewczak E.J., Snodgrass C.R.	2018	ISDN as an Information Resource for Strategic Management of Multinational Firms	Information Resources Management Journal (IRMJ)
Taiminen H.M., Karjaluoto H.	2017	The usage of digital marketing channels in SMEs	Journal of Small Business and Enterprise Development
Tan F.T.C., Guo Z., Cahalane M., Cheng D.	2018	Developing business analytic capabilities for combating e-commerce identity fraud: A study of Trustev's digital verification solution	Information and Management
Tangpong C., Islam M., Lertpittayapoom N.	2019	The emergence of business-to-consumer e-commerce: New niche formation, creative destruction, and contingency perspectives	Journal of Leadership and Organizational Studies
Thompson P., Williams R., Thomas B.	2014	Are UK SMEs with active web sites more likely to achieve both innovation and growth?	Journal of Small Business and Enterprise Development
Tjan A.K.	2018	Finally, a way to put your Internet portfolio in order.	Harvard Business Review
Trabucchi D., Buganza T., Dell'Era C., Pellizzoni E.	2018	Exploring the inbound and outbound strategies enabled by user generated big data: Evidence from leading smartphone applications	Creativity and Innovation Management
Troilo G., De Luca L.M., Guenzi P.	2019	Linking Data-Rich Environments with Service Innovation in Incumbent Firms: A Conceptual Framework and Research Propositions	Journal of Product Innovation Management
Tumbas S., Berente N., vom Brocke J.	2019	Three types of chief digital officers and the reasons organizations adopt the role	MIS Quarterly Executive
Turulja L., Bajgoric N.	2013	Information technology, knowledge management and human resource management: Investigating mutual interactions towards better organizational performance	VINE Journal of Information and Knowledge Management Systems
Udoka S.J., Nazemetz J.W.	2018	Development of a methodology for evaluating computer integrated manufacturing (CIM) implementation performance	Computers and Industrial Engineering

Authors	Year	Title	Source
Wagner D., Wenzel M., Wagner H.-T., Koch J.	2017	Sense, seize, reconfigure: online communities as strategic assets	Journal of Business Strategy
Wang S., Hong Y., Archer N., Wang Y.	2018	Modeling the success of small and medium sized online vendors in business to business electronic marketplaces in china: A motivation - Capability framework	Journal of Global Information Management
Wang, F., Zhao, J., Hu, L.W.	2017	IT-enabled inter-organisational relationships and collaborative innovation: Integration of IT design and relationships governance	International Journal of Networking and Virtual Organisations
Wardaya, A., Sasmoko, S., So, I.G., Bandur, A.	2007	Mediating effects of digital marketing on dynamic capability and firm performance: Evidence from small and Medium-sized Enterprises (SMEs) in Indonesia	International Journal of Recent Technology and Engineering
Weiner J., Balijepally V., Tanniru M.	2019	Integrating strategic and operational decision making using data-driven dashboards: The case of St. Joseph mercy Oakland hospital	Journal of Healthcare Management
Werbach K.	2019	Using VoIP to compete	Harvard Business Review
Wickramansinghe N., Sharma S.K.	2019	Key factors that hinder SMEs in succeeding in today's knowledge-based economy	International Journal of Management and Enterprise Development
Wilkesmann M., Wilkesmann U.	2017	Industry 4.0 – organizing routines or innovations?	VINE Journal of Information and Knowledge Management Systems
Witjara E.	2019	Enhancing digital business value through implementation of strategic threshold canvas: A model of value-pertaining strategy of transforming Telco	Academy of Strategic Management Journal
Yadav M.S., de Valck K., Hennig-Thurau T., Hoffman D.L., Spann M.	2015	Social commerce: A contingency framework for assessing marketing potential	Journal of Interactive Marketing
Yang S.-M., Yang M.-H., Wu J.-T.B.	2017	The impacts of establishing enterprise information portals on e-business performance	Industrial Management and Data Systems
Zangiacomi A., Oesterle J., Fornasiero R., Sacco M., Azevedo A.	2019	The implementation of digital technologies for operations management: a case study for manufacturing apps	Production Planning and Control
Zeng J., Glaister K.W.	2015	Value creation from big data: Looking inside the black box	Strategic Organization
Zeng J., Simpson C., Dang B.-L.	2017	A Process Model of Dynamic Capability Development: Evidence from the Chinese Manufacturing Sector	Management and Organization Review
Zhou Y., Muller L.M.	2003	Technical, managerial, and organizational changes in adapting an e-commerce model in civil engineering design and consulting services	Leadership and Management in Engineering

Appendix B

Table B1. Classification of papers in class B by topic and related factor

Authors	Year	Topic	Related factor
Alshamaila Y., Papagiannidis S., Li F.	2013	Digital technology adoption process	4
Ardito L., Petruzzelli A.M., Panniello U., Garavelli A.C.	2018	Digital technologies enabling Supply Chain management-marketing integration	1
Ardolino M., Rapaccini M., Saccani N., Gaiardelli P., Crespi G., Ruggeri C.	2018	Digital technologies for service transformation	2
Bhimani A., Willcocks L.	2014	Digital transformation of accounting	4
Blackburn M., Alexander J., Legan J.D., Klabjan D.	2017	Effects of Big Data on R&D management	1
Büyüközkan G.	2004	Evaluation of e-business success	2
Candi M., Beltagui A.	2018	Coordination between IT and manufacturing for digital innovation	3
Caputo, A., Fiorentino, R., Garzella, S.	2019	Facilitation of Business Process Management in digitalization contexts	3
Chellappa R.K., Sambamurthy V., Saraf N.	2010	Multi-market competition integration of digital providers	3
Chi, M., Lu, X., Zhao, J., Li, Y.	2018	Digital Business Strategy and firm performance	1
Coreynen W., Matthyssens P., Van Bockhaven W.	2017	Digitalization enabling servitization as dynamic capability	2
de Vass, T., Shee, H., Miah, S.	2018	Effects of IoT capabilities on Supply Chain integration and performance	3
Dodgson M., Gann D.M., Phillips N.	2013	Organizational learning by use of digital technologies	3
Esposito De Falco S., Renzi A., Orlando B., Cucari N.	2017	Combination of digital platforms and open innovation	3
Ferreira, J.J.M., Fernandes, C.I., Ferreira, F.A.F.	2019	Digitalization performance in terms of innovation	1
Foroudi P., Gupta S., Nazarian A., Duda M.	2017	Digital technologies and marketing management capabilities	1
Garcia-Morales V.J., Martín-Rojas R., Lardón-López M.E.	2018	Digital technologies leveraging on innovation capability	3
Gastaldi L., Appio F.P., Corso M., Pistorio A.	2018	Digital technologies to balance amidexterity along the innovation process	1
Greenstein S.	2017	Inability of established firm to address digitalization	2
Gurbaxani, V., Dunkle, D.	2019	Digital transformation, digital platforms and competitiveness	1
Holmström J., Liotta G., Chaudhuri A.	2018	Digital Direct Manufacturing and improvement on products and processes	1
Järvinen J., Karjaluoto H.	2015	Exploiting digital technologies for marketing performance measurement	3
Järvinen J., Taiminen H.	2016	Integration of digital marketing and selling strategies	3
Jitpaiboon T., Dobrzykowski D.D., Ragu-Nathan T.S., Vonderembse M.A.	2013	IT-enabled capabilities for customer and supplier integration for mass customization	3
Khin, S., Ho, T.C.F.	2019	Effects of digital orientation and digital capability on digital innovation	1
Kitchens B., Dobolyi D., Li J., Abbasi A.	2018	Integration of big data analytics	3
Kohler T., Matzler K., Füller J.	2009	Innovation enabled by digital technologies	3
Kuusisto M.	2017	Organizational capabilities enhanced by digitalization	2

Laurenza E., Quintano M., Schiavone F., Vrontis D.	2018	Effects of digital innovation on business processes	3
Levallet N., Chan Y.E.	2018	Digital capabilities and managerial improvisation	2
Li, H., Wu, Y., Cao, D., Wang, Y.	2019	Impact of organizational mindfulness towards digital transformation	1
Li, T.C., Chan, Y.E.	2019	Dynamic IT capability	2
Mani R.V.S., Baul U., Mohanty R.P., Rajkumar T.M.	2013	Digitally enabled capabilities and resources for customer management process	2
Mihardjo, L.W.W., Sasmoko, Alamsjah, F., Elidjen	2019a	The role of digital leadership on the creation of strategic alliances and dynamic capabilities	2
Mihardjo, L.W.W., Sasmoko, Alamsyah, F., Elidjen	2019b	Digital leadership and innovation capability	3
Mishra A.N., Devaraj S., Vaidyanathan G.	2013	Hierarchy of digitally-enabled procurement capabilities	2
North, K., Aramburu, N., Lorenzo, O.J.	2019	Competitive framework for SMEs in digital contexts	4
Ojala A., Evers N., Rialp A.	2018	Internazionalization of digital technology provider	4
Papa A., Santoro G., Tirabeni L., Monge F.	2018	Digital platforms for for facilitating knowledge creation and innovation	1
Ramaswamy V., Ozcan K.	2016	Digitalized interactive platforms for value creation with customers	1
Rashidirad M., Soltani E., Salimian H., Liao Y.	2015	Dynamic capabilities in the digital age	2
Riikkinen M., Saarijärvi H., Sarlin P., Lähteenmäki I.	2018	Alignment between provider service logic and use of digital technologies	3
Roden S., Nucciarelli A., Li F., Graham G.	2017	Fostering change through Big Data	4
Rolland K.H., Mathiassen L., Rai A.	2018	Capabilities for digital platforms management	2
Roscoe, S., Cousins, P.D., Handfield, R.	2019	Knowledge sharing and operational capabilities	2
Rothmann W., Koch J.	2014	Strategic creativity to benefit from digital transformation	2
Saggi M.K., Jain S.	2018	Successfully deploying big data analytics	4
Sánchez-Montesinos F., Opazo Basáez M., Arias Aranda D., Bustinza O.F.	2018	Capabilities to create isolating mechanisms for digital servitization	4
Sasmoko, Wasono Mihardjo, L.W., Alamsjaha, F., Elidjena	2019	Effects of digital leadership and market orientation in developing dynamic capabilities and innovation capabilities	2
Scuotto, V., Arrigo, E., Candelo, E., Nicotra, M.	2019	Ambidextrous innovation in digital transformation	1
Setia P., Patel P.C.	2013	Digitally-enabled operational absorptive capacity	2
Shuradze G., Bogodistov Y., Wagner H.-T.	2018	Marketing-enabled data analytics capability for organizational agility and innovation success	2
Singh G., Gaur L., Agarwal M.	2017	Factors influencing digital transformation	4
Sjödin, D.R., Parida, V., Leksell, M., Petrovic, A.	2018	Smart Factories: challenges to implementation	4
Stone M., Aravopoulou E., Gerardi G., Todeva E., Weinzierl L., Laughlin P., Stott R.	2017	Capabilities for customer information management through digital platforms	4
Tangpong C., Islam M., Lertpittayapoom N.	2009	E-commerce as strategic imperative for digitalization	2
Tanriverdi H., Konana P., Ge L.	2007	Integration of business processes and digital infrastructure in the choice of sourcing mechanisms	3

Ukko, J., Nasiri, M., Saunila, M., Rantala, T.	2019	Effects of sustainability strategy on digital business strategy and financial performance	1
Utoyo, I., Fontana, A., Satrya, A.	2019	Effects of strategic entrepreneurship on innovation performance and capabilities	1
Verhoef, P.C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N., Haenlein, M.	2019	Growth strategies and characteristics of digital transformation	4
Wang F., Zhao J., Chi M., Li Y.	2017	Inter-firm collaboration enabled by digital platforms capability	1
Witschel, D., Döhla, A., Kaiser, M., Voigt, K.-I., Pfletschinger, T.	2019	Dynamic capabilities as facilitators of digital business models transformation	2
Zhao J., Chi M., Zhu Z., Hu L.	2015	E-business capabilities for value-creation from digital business strategy	2
Zhu Z., Zhao J., Jin X.	2013	Deployment of net-enabled organizational capabilities for digital competitive advantage	2