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DIGITAL TRANSFORMATION: mapping trends, sources, and evolution of the literature

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1. INTRODUCTION

Digital Transformation is of interest to diverse subjects of study, yet there is a deficiency of synergy. There are many specific avenues to study the intricated field of digital transformation from a business perspective. As highlighted by Hess, Matt, Benlian, and Wiesböck (2016) combining and examining new digital technologies is one of the biggest challenges that companies face today, which indicates the relevance of this topic for future studies. Differing from other literature review approaches, this systematic literature review does not aspire to a suggestion of an expansive literature specific field within digital transformation research. It is more general in the first instance and sets up the base, enabling the diversified field to be organized.

At last, the most relevant clusters are explored qualitatively to provide an outlook of the foremost tendency and themes studied in these streams. This article aspires to offer an array of studies, a bibliography, and a comprehensive review of academic research dedicated to the field of digital transformation, identifying trends in organizational growth for the evolution of the topic in the field of organization studies. This paper thus contributes to extant discussions on digital transformation by taking a multidisciplinary focus. Additionally, this paper provides to the extant literature on digital transformation, because the rise of digital transformation entails the construction of a scientific knowledge base and unfolding of a research agenda to prompt future research in the manifold domains on this important topic.

This study intends at structuring existing research, characterizing the notable up-to-date tendencies, and for this reason, proposes a synopsis of ongoing research streams and traits in digital transformation from a business standpoint. We contribute to the fruitful field of digital transformation with the understanding of the theoretical background for forthcoming studies. Research areas are pointed out and feasible gaps are established. This effort may remedy pinpoint comparability within areas of digital transformation studies. The importance of the study is verified by the relevance of the theoretical and empirical contributions that derive from it. Many firms are starting to grasp the power of digital transformation, but there are many hurdles to undertake to fulfill the utmost benefits of a digital transformation. The findings may ease the awareness of complementary conclusions from imminent fields and foment a multidisciplinary understanding.

2. DIGITAL TRANSFORMATION

Digital transformation (DT) is an entangled phenomenon that can incorporate distinguishing paths (Remane, Hanelt, Nickerson, Kolbe, 2017). Wide-reaching scholarly attention has been directed toward DT in information systems (IS) research (Vial, 2019). In contrary to digitalization (the process of using digitized transitioning from analog to digital, and making it work in a current business), digital transformation concerns creating exclusively new business concepts compelled by digital technologies (Irniger, 2017). Even though the concept of digital transformation is acclaimed and discussed, the definitions vary between scholars.

For example, Warner and Wager (2019, p. 344) outline digital transformation as “an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization’s business model, collaborative approach, and culture”. Vial (2019, p. 121) studied thirty-three different definitions and offers a conceptual delineation of digital transformation as “a process that aims to improve an entity

by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies." Regardless of an understanding of this phenomenon, there has been "considerable disagreement on the characteristics of an organization's digital transformation" (Riasanow, Soto Setzke, Böhm, & Krcmar, 2019, p. 6).

A few academics label DT as the development of dynamic capabilities, extending the resource-based view to companies (Freitas Junior, Maçada, & Brinkhues, 2017) while other papers relate DT to merely a shift of business models (Amit & Zott, 2012). This demonstrates that there is a necessity for conceptual clarity, above all concerning the organizational attributes of DT. 'By digital transformation we mean the combined effects of several digital innovations bringing about actors, structures, practices, values, and beliefs that change, threaten, replace, or complement existing rules of the game within organizations, ecosystems, industries, or fields (Hinings, Gegenhuber, & Greenwood, 2018).

3. METHODOLOGY

The basic objective of a Systematic Literature Review (SLR) is to gather and evaluate available research related to the subject of interest (the research question), thus obtaining unbiased results that can be audited and repeated. An SLR is a detailed methodological review of research outcomes, the scope is not just to group existing work on the subject; it is also intended to help develop evidence-based guidelines for practitioners involved in the field of study (Kitchenham, 2004). Furthermore, to demonstrate that the work is new to the existing body of knowledge, the results of an SLR must establish the state of the art regarding the research question (Levy & Ellis, 2006). The scope of an SLR involves the formulation of research questions that provide a research plan, context, objective, and basis for operationalizing SLR. The main research questions for this study are:

Question 1. What are the most significant contributions, journals, keywords, and themes, and who are the most influential authors in digital transformation?
Question 2. What are the emerging networks and authors in the field of digital transformation?
Question 3. How to evolve the field of digital transformation?

Research articles for this study were extracted from the Web of Science (WoS) and Scopus databases. Other critical databases, such as Google Scholar, also provide access to academic research. Each database has its own merits and demerits. For example, Google Scholar is the broadest approach, with a wide range of published products, but compromises quality, as it includes citation counts of papers in conference proceedings (Ahmad, Aghdam, Butt, & Naveed, 2020). On the other hand, the Scopus database is considered a quality database, where only citation counts of articles published in journals are listed. This makes it more robust and a higher quality citation when speaking in a database. The Web of Science (WoS) database is a good compromise between the two (Shaffril et al., 2020).

Scopus is a comprehensive online bibliometric database that includes abstracts and the most extensive citation-based information covering thousands of peer-reviewed journals (Fahimnia, Sarkis, & Davarzani, 2015). This study uses the Scopus and Web of Science databases. The first step of the research was the choice of the database. To select the works on Digital Transformation (DT) to be evaluated, we retrieved all articles from the Web of Science (WoS) and Scopus databases. We used the keywords "Digital transformation" OR "Digital Transfor*" simultaneously. Several studies focus on only one keyword and analyze only one or several sections in WoS (Blanco-Mesa, Merigó, & Gil-Lafuente, 2017). We chose to use two keywords and all sections in both databases. This praxis furnished us with more

data than the keyword “Digital transformation.” We conducted the data collection in January 2022 using the date range from 2015 – 2022.

The total sample was reduced considering only the articles in English (Cancino, Merigó, Coronado, Dessouky, & Dessouky, 2017), and non-duplicated articles between the two databases. The final basis of 553 articles with time between 2015 and 2022 were used in VosViewer for the development of this article. We chose this transversal cut because from 2015 onwards the sharpest growth of publications on DT began. The VOSviewer software creates maps for bibliometric network analysis based on data extracted from Scopus and Web of Science databases. The second step was the selection of journals. In this step, we selected journals with at least three publications in the databases. Another criterion adopted was the impact factor of journals and their relevance to the academic world.

The next step consisted of accessing the databases to collect the necessary data for analysis. Bibliometric analysis helps find the principal authors, themes, and collaborations in each area of knowledge (Anwar, Hasnu, Butt, & Ahmed, 2021). The network approach is a quantitative method that analyzes scientific publications and is accepted within bibliometric studies (Randhawa, Wilden, & Hohberger, 2016). Co-word analysis attempts to map out the conceptual structure of a subject by applying the word co-occurrences in a bibliographic collection. This map fosters the researchers to spotlight the dominant theme's connection with the study's rising subfields (Koseoglu & Parnell, 2020). Co-citation analysis uncovers co-citation patterns by searching citation databases in manners that display the intellectual structures of fields based on cited references (Alonso, Castiello, & Mencar, 2018).

4. RESULTS AND DISCUSSION

This section presents descriptive statistics and results from citation and network analysis. Citation analysis includes the temporal trend of publications and citations and identifies the most influential sources, the most prolific authors, and the most influential articles.

4.1 Descriptive statistics

Descriptive statistics show numbers, sources, authors, keywords, publication period, collaboration measures, average citation per article and other information related to the article database. The publication period of 2015 - 2022 entails the total of 553 articles from the Web of Science and Scopus databases. In total, 1,370 authors contributed, showing an average of 2.54 authors per article and a collaborative index of 2.77. Articles with single authors are 67 (12%), while more than one author wrote 486 (88%) articles. Table 1 demonstrates the Baseline Statistics information.

Table 1

Main information about data or Baseline Statistics

Main information	**Numbers**
Time Period of Publications	2015-2022
Documents (articles)	553
Journals	254
Authors’ Keywords	1.665
Authors	1.370
Single-authors	60
Multi-authors	1.310
Articles per author	0.394
Average No of authors per article	2.54
Average No of co-authors per article	2.94
Collaboration Index	2.77

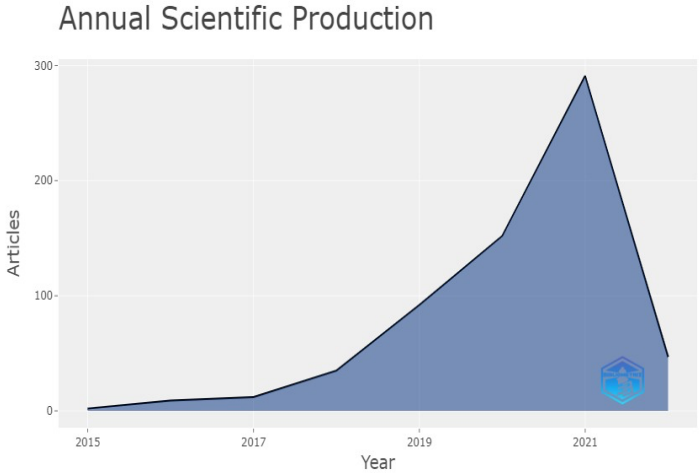
Source: Research Data (2022).

4.2 Annual publication and citation trend

There is a growing trend with some variations of research on Digital Transformation throughout 2015-2022 (Figure 1). The period can be divided into three distinct phases: The infant phase (2015-2017); stable growth stage (2017–2019); and take-off phase (2019-2022). In the infant phase, only 29 articles (5.7%) were published. Figure 1 shows an annual growth rate in citations.

Figure 1

Annual Production

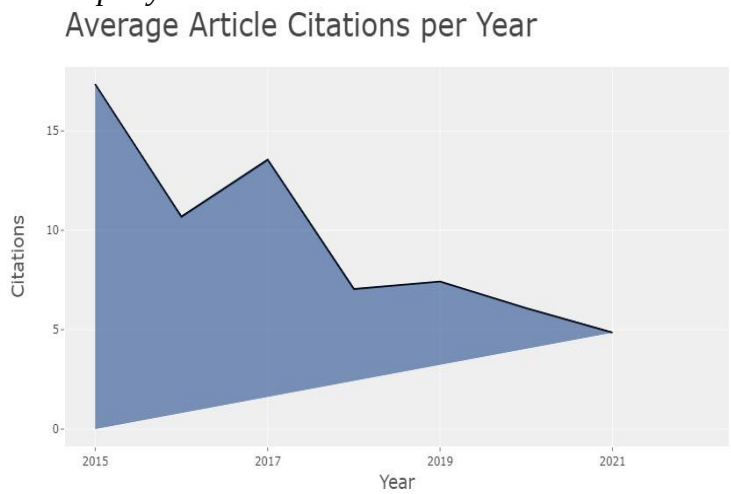


Source: Research Data (2022).

The average number of cited articles reached peaks in the years 2015 and 2017, a reasonable variation in citations since the topic is visibly new in the theoretical field. The descending line for the year 2022 is since data was only collected up to March 2022. Nevertheless, it is important to note that research on the subject continues to grow rapidly. Figure 2 illustrates the average article citations per year.

Figure 2

Citations per year.

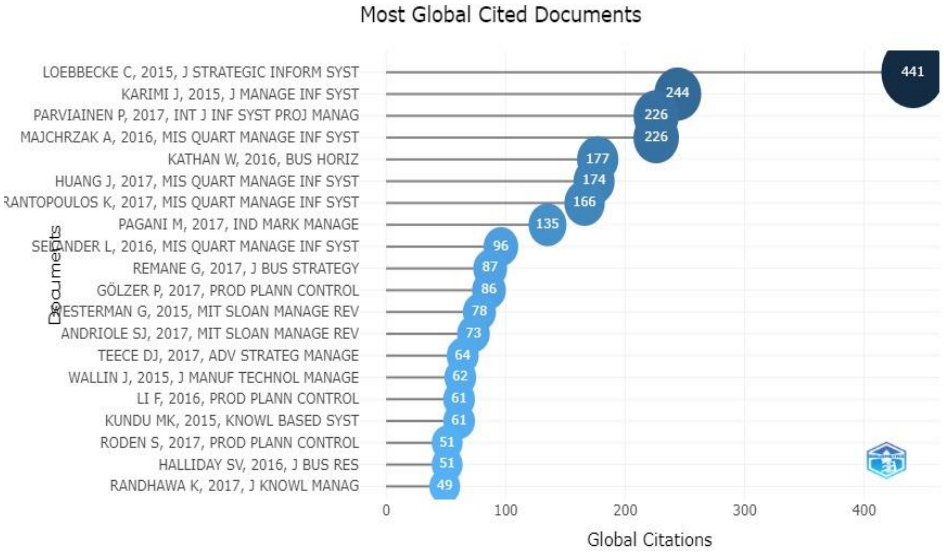


Source: Research Data (2022).

Since we completed the analyses, several new publications have emerged, such as (Gilli, Kippa, & Kappstein, 2022). To better demonstrate the reached peaks in the years 2015 and 2017, Figure 3 presents a summary of the most cited articles and authors.

Figure 3

Most cited documents (2015 – 2017)



Source: Research Data (2022).

In 2015, the most cited article was from Loebbecke and Picot (2015) "*Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda*." where the authors acknowledge the mechanisms handling how digitization and big data analytics prompt the transformation of business and society and delineate the potential effects of digitization and big data analytics on employment – notably in the context of cognitive tasks.

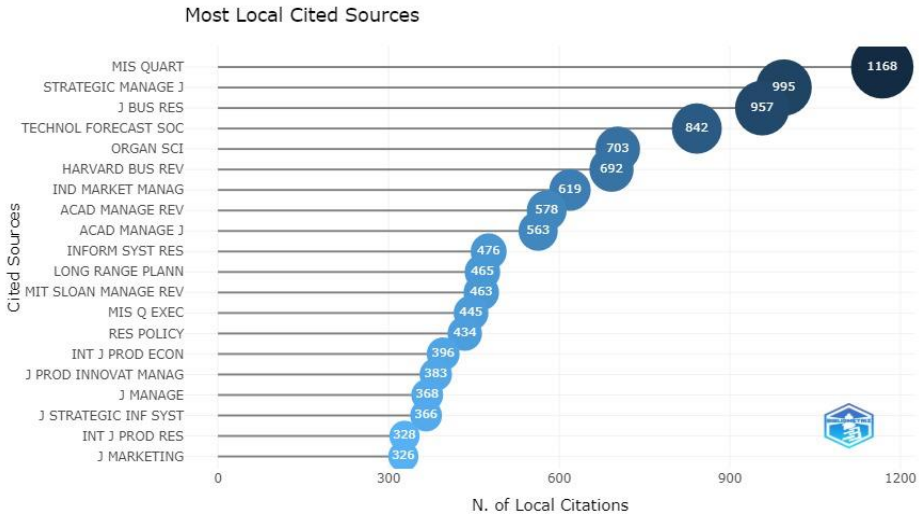
Majchrzak, Markus, and Wareham (2016), the researchers' discourse about the roles of information and communication technologies (ICTs) in an array of leading societal challenges, including employment, climate, health, and human migration. Finally, Parviainen, Tihinen, Kääriäinen, and Teppola, (2017) in "*Tackling the digitalization challenge: how to benefit from digitalization in practice*. The paper outlines the first version of the digital transformation model, obtained from a synthesis of industrial cases, explaining a starting point for a systematic approach to tackle digital transformation.

4.4 Most influential journals

The most influential journals are derived from a ranking based on Bradford's law (Brookes, 1969), where a group of journals is divided into distinct levels. Level 1 lists the three journals with the highest number of publications and citations, which are the most important within the theory of digital transformation. The results for the most influential journals based on total citations are shown in Figure 4.

Figure 4

Total citations per journal

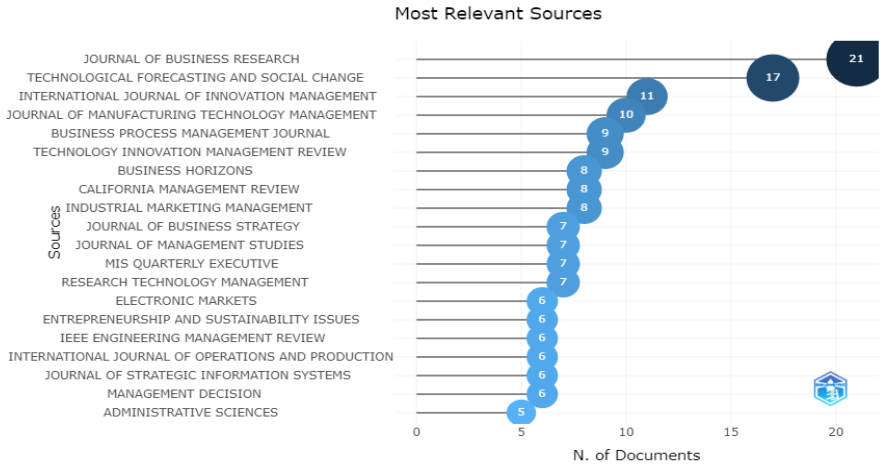


Source: Research Data (2022).

Mis Quarterly holds the top position with a total of 1,168 citations. Strategic Management Journal (SMJ) with 995 citations, is followed by the Journal of Business Research with 957 citations, respectively. These citation counts reflect the citation numbers of articles selected for this study identified using our keywords. Figure 5 shows the classification of journals according to the number of publications between the years 2015 to 2022. Three journals stand out for having more than ten publications on the subject**.** The Journal of Business Research ranked first with 21 articles. Second on the list is Technological Forecast and Social Change, which produced 17 articles.

Figure 5

Publications per journal 2015 - 2022

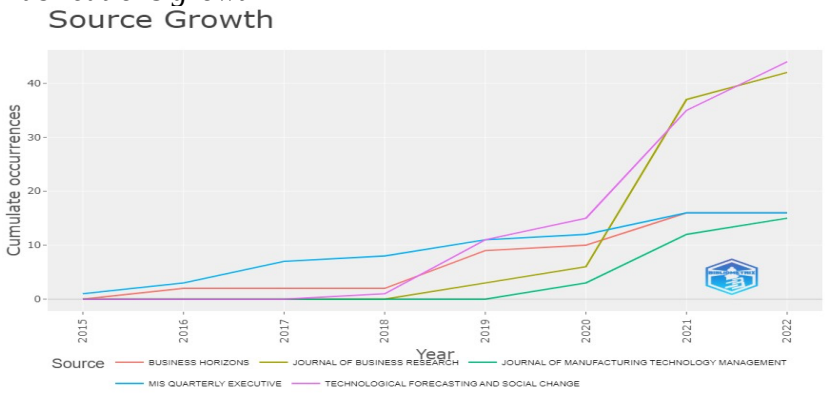


Source: Research Data (2022).

Finally, the third on the list is the International Journal of Innovation Management with 11 published works. Overall, Technological Forecasting and Social Change is the highest-ranked journal with an impact factor of 134 in the management field. Technological Forecasting and Social Change publishes articles that deal directly with the methodology and practice of technological forecasting as a planning tool. Figure 6 provides information on growth in terms of annual production.

Figure 6

Publications growth



Source: Research Data (2022).

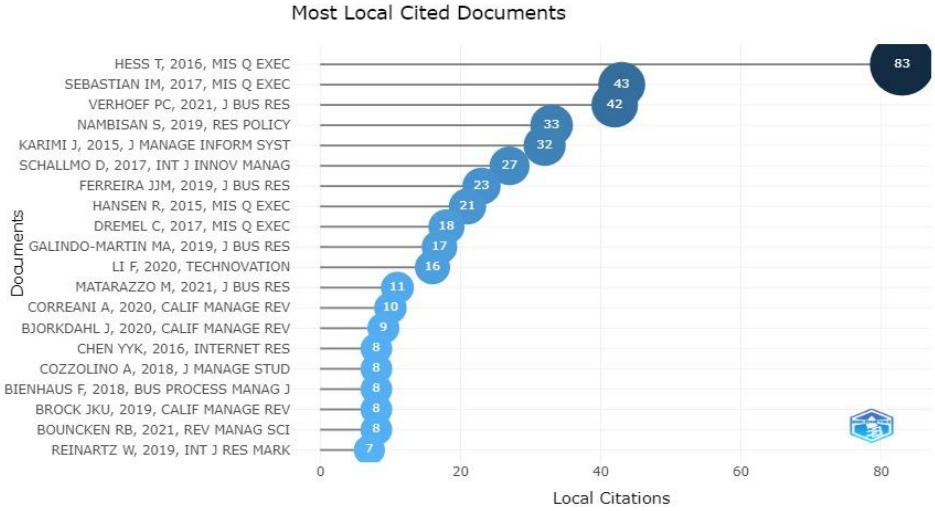
Technological Forecasting and Social Change shows a long-term commitment and has been publishing on digital transformation for a long time, demonstrating significant growth. It is followed by the Journal of Business Research, which also shows massive growth over the last three years. It is important to highlight that although the Journal of Manufacturing Technology began publishing in 2015, its focus on the subject has declined since then.

4.5 The most prolific and influential researchers

There are several metrics to evaluate the scientific production of researchers based on the h-index, g-index, and citations (full Citation, fractional Citation, Citation per year, etc.). A comparison of author rankings based on complete citation count is shown in Figure 7. The results show Hess, T., as the most cited author with 83 citations, followed by Sebastian IM., with 43 citations, and Verhoef PC with 42 articles. (See Figure 7).

Figure 7

Most Cited Documents

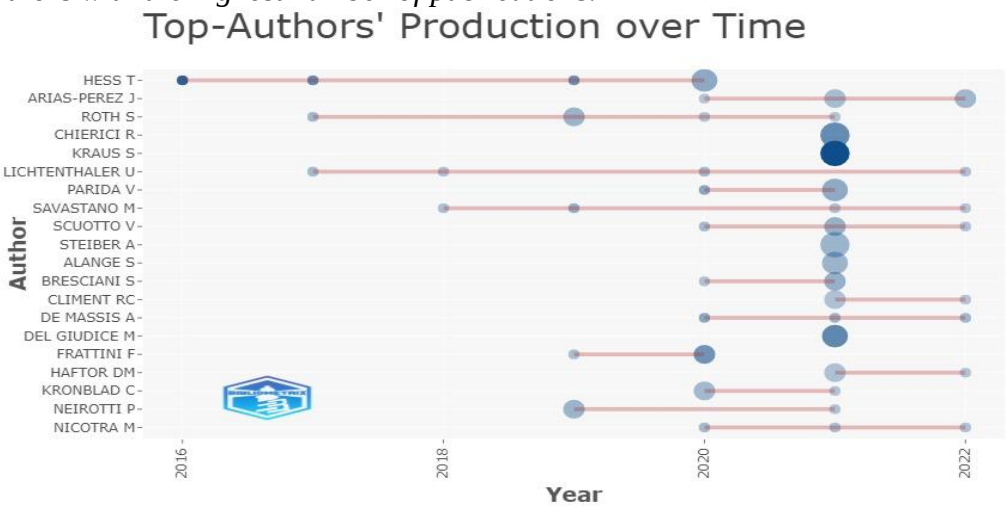


Source: Research Data (2022).

Hess, T., in addition to being the most cited author, is also the author with the highest production on the subject, followed by Arias-Perez. J and Roth. S. It is noticeable the increase in interest in scientific production on digital transformation from the years 2020 when another seven authors started publications on the subject (see Figure 8).

Figure 8

Authors with the highest number of publications.



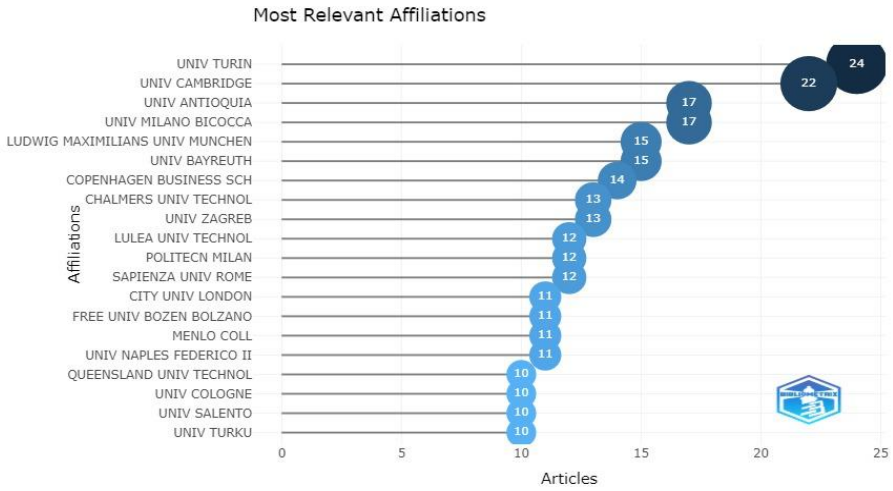
Source: Research Data (2022).

Some of Hess´ most cited articles are "*Options for formulating a digital transformation strategy*" (2016), with 1249 citations where the author discusses the challenges faced by CIOs and other senior executives on how to oversee the opportunities and risks of digital transformation. Another highly cited article is "*How chief digital officers promote the digital transformation of their companies*" (2020), with 522 citations.

In this article, Hess identifies the main factors that drive the employment of Chief Digital Officers (CDOs), the three role types that CDOs primarily play and the skills and competencies they should have for each role type. Figure 9 presents the most relevant affiliations with published works about digital transformation. When it comes to universities, the Italian University of Turin is in the highest ranking, with 24 publications, followed by the University of Cambridge, in the United Kingdom, with 22 publications. (See Figure 9).

Figure 9

Most Relevant Affiliations



Source: Research Data (2022).

We present the data with the number of published works and not by citations because there is a significant limitation of classification based on citations. Citations are given equal weight to all authors in publications by multiple authors, regardless of which author is the

lead author and corresponding author. This practice exaggerates the contributions of minor authors and understates the contributions of authors who have contributed most to a given publication. Unfortunately, there is no accepted mechanism currently available to weigh each author's effort more accurately.

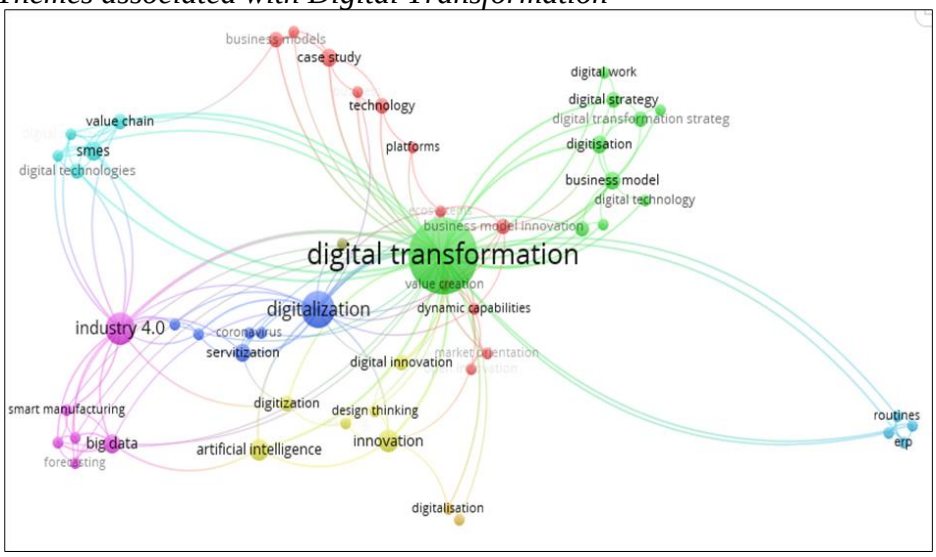
4.6 Main Themes associated with Digital Transformation

Keywords provided by the author are essential information in any published article. Typically, the keywords selected by the authors represent the main themes or important concepts being analyzed in an article. The keyword cloud provided by the author usually features the most important and used keywords. The results reveal 848 keywords. The keyword "Digital Transformation" appeared the most, that is, 340 times in the authors' keyword, followed by "digital" and "digitization" with 98 and 87 times, respectively.

Co-word analysis is a methodology that involves keywords (provided by authors in their publications) of articles to capture scientific networks in a field. Co-word analysis is used to map the conceptual structure of a field based on co-occurrences of particular words in each bibliographic collection. This helps the researcher highlight the central theme's nexus with the study's emerging subfields. The size of the "nodes" represents the frequency of occurrence of the keywords. The higher the frequency, the larger the "node" size. Nine color-coded groups in the co-occurrence network visualization are shown in Figure 10. Each cluster represents a specific theme based on co-occurring keyword.

Figure 10

Themes associated with Digital Transformation



Source: Research Data (2022). Vos Viewer.

The size of the circle refers to the number of appearances of the term. The words present in the clusters are related to each other, corresponding to their separation factor. The size of each word in the cluster is related to its weight, that is, its co-occurrence in publications. The words and terms most closely related to Digital Transformation are included in the green group. In total, 378 words,52 terms and seven groups were listed by the software.

The words presented in each cluster are related to different areas of research and a part has a strong relationship with the Digital Transformation theme. The colors shown in Figure 10 are random, just separating the word groups. Each circle represents a term and only part of

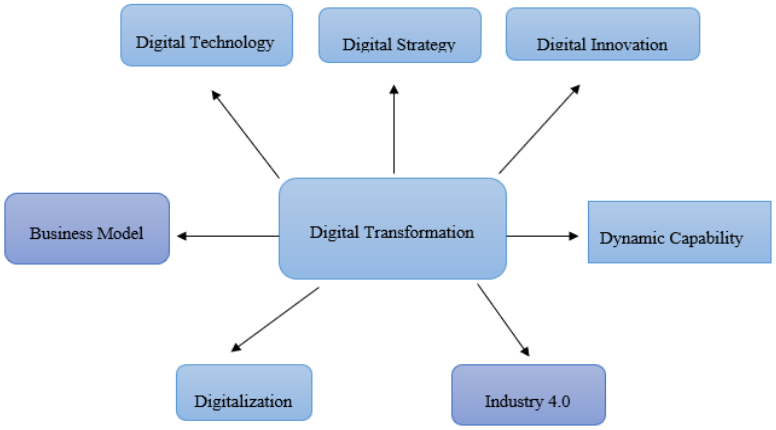
them has its name displayed, as the software, to avoid overlaps, identifies only a few. Figure 13 displays the research streams chosen to be analyzed.

5. RESEARCH AGENDA

Given the above context, there is a need to critically examine research and practice in the field of social sciences to determine gaps and propose solutions. With the support of the VOSviewer software, it was possible to detect the main keywords existing in the titles and abstracts of articles from the selected journals. Using the VOSviewer grouping technique, it is observed that seven groups were formed from 378 words identified algorithmically by the software.

The words presented in each group are related to different areas of research and apart have a strong relationship with the Digital Transformation theme. The terms detected based on the co-occurrence network, are shown in Figure 13. The selected articles were subclassified into seven major groups: *Digital Strategy, Digital Technology, Digital Innovation, Business Model, Capabilities, Digitalization, and Industry 4.0.*

Figure 13
Digital Transformation Groups



Source: The authors (2021).

Below we will briefly discuss about the 7 groups mentioned above which are related to different areas of research with a strong relationship with the Digital Transformation theme.

5.1 Digital innovation

Digital innovation emerges from the expanding pressure on organizations to implement digital technologies in their products and transform existing business models (Kohli & Melville, 2019). The origin of this new type of innovation is digitization, which refers to the embedding of digital technologies into physical products (Holmstrom, 2018). This evolution has fundamental consequences on incumbent firms in the sense that their competitiveness depends on the effective use of digital technologies in innovation (Abrell, Pihlajamaa, Kanto, Vom Brocke, & Uebernickel, 2016). Thus, the phenomenon of digital innovation has obtained an interest in science in current years (Holmstrom,2018). Current works about digital innovation and the alteration in value creation manage preferentially conceptual explanations and frameworks (Henfridsson et al., 2018).

5.2 Business model

Technology has affected businesses in different areas, and, consequently, many companies have found it indispensable to make changes in their structures and business models to improve customer satisfaction. The dynamic capabilities of sensing, seizing, and transforming empower business model innovation. The emerging literature on the cognitive antecedents of business model innovation identifies several sensing capabilities that could facilitate the design of a new business model. Nonetheless, little attention has been paid to the configuration of different patterns of sensing capabilities as enablers of business model innovations over time. A particular focus area of this perspective is the study of how cognition hinders or enables business model innovation.

5.3 Digital technologies

Digital technologies for instance, mobile connectivity, cloud services, the Internet of Things, and artificial intelligence are broadly envisioned to prevail within institutions, societies, and organizations, and it is not abnormal to have them linked to concepts such as "transformation," "paradigm shift," and the "4th Industrial Revolution" (Afuah & Tucci, 2003). The authors also believed that this is an outstanding example of a technological shift that has far-ranging effects on companies across assorted sectors, a pivotal topic in the field of innovation management for some decades. The literature points out that digital technologies referring to the Internet of Things (IoT), social, mobile, analytics, cloud, and digital platforms are the technologies most intertwined with digital transformation (Vial, 2019).

5.4 Digitalization

Digitalization implicates the elevated use of digital technologies (Bresnahan & Trajtenberg, 1995) and their integration and cross-fertilization in the firm's products and inbound and outbound activities. (Björkdahl & Holmén, 2019) believe that the increase of digital technologies and integration in the firm's products and outbound activities can result in fundamental changes, especially to how firms create and capture value. Many firms are not prepared to benefit from digitalization and are concentrated on accomplishing preeminent efficiency through digitalization rather than following a growth agenda Björkdahl (2019). Digitalization consists of more than digital technologies and data.

5.5 Capability

Researchers have widely recognized that resources and new capabilities are indispensable to face a digital age (Vial, 2019; Warner & Wager,2019). Nonetheless, there has been a lasting deliberation in the dynamic capabilities literature on whether dynamic capabilities have the capability to unfold sustainable competitive advantage in swiftly unstable environments, where speed and adaptability are indispensable (Peteraf, Di Stefano, & Verona, 2013). Multinational companies are dealing with the challenge of managing the rapid and unneeded modification of their organizations to suit the unsteady situations of the digital age. In divergent traditional transformations, the target state repeatedly progresses, and the adaptability needed to contest in a digital environment differs from the ordinary approaches of bountiful classic organizations (Sailer, Stutzmann, & Kobold, 2019).

5.6 Industry 4.0

Industry 4.0 is a fresh industrial proposal defined by the merging of the DT into smart socio-economic systems in the value creation practice of industries (Müller, Buliga, & Voigt, 2018). Portrayed as the outcome of the preface of "transformational information technology" (Lucas, Agarwal, Clemons, El Sawy, & Weber, 2013, p. 372), Industry 4.0 includes indispensable changes in the arrangement and accomplishment of business processes (Venkatraman, 1994), operational routines (Chen, Pan, & Ouyang, 2014) and organizational capabilities (Tan, Pan, Lu, & Huang, 2015). Up to recently, research has aided primarily in the technical side of Industry 4.0 (Buchi, Cugno, & Castagnoli, 2020; Osterrieder, Budde, & Friedli, 2020). Studies on management have centralized on theoretical analysis of the industry's 4.0 ontology (Yin, Stecke, & Li, 2018) on its association with other practices such as sustainability (Machado, Winroth, & Ribeiro da Silva, 2020), and lean manufacturing (Rosin, Pascal Forget, Lamouri, & Pellerin, 2020

5.7 Digital Strategy

While many companies are experimenting with digital transformation, recent studies of success stories have shown that the enhanced competitive positioning of successful firms does not depend solely on the technologies they adopt, but, more importantly, builds on the strategies that their leaders deploy. The company's strategical focus on digitalization is done with the intent of recognizing cost advantages, unblocking other sales potential, intensifying productivity, and formulating new business models. A digital strategy is a business strategy that is instigated by the power of superior performance, and easily available technologies while providing exclusive, consolidated business roles that can adjust to fast-changing market conditions (Sebastian, Moloney, Ross, Fonstad, Beath, & Mocker, 2017).

6. FINAL CONSIDERATIONS

Digital transformation is an area in which the academic literature is most interested, but still requires a more in-depth definition of the concept, a better understanding of the requirements, but also a strategic orientation in a long-term perspective. To provide a better characterization for both research and practice, and therefore, to structure the field of digital transformation, we conducted a systematic review. Based on the introduction, our most significant contribution is the array of themes and research gaps described in this article. We hope we can assist researchers at all levels find their theme of interest concerning digital transformation. Regarding journal ranking, the Journal of Business Research ranked first with 21 articles. Second is Technological Forecast and Social Change, which produced 17 articles. Finally, the third on the list is the International Journal of Innovation Management with 11 published articles.

The 378 keywords identified algorithmically based on the co-occurrence network presented seven major themes: *Digital Strategy, Digital Technology, Digital Innovation, Business Model, Capabilities, Digitalization, and Industry 4.0.* Based on complete citation count, the following authors deserve to be highlighted: Hess, T., Sebastian, IM., and Verhoef, PC. The most relevant affiliations we have identified is the Italian University of Turin, and the University of Cambridge, in the United Kingdom as emerging networks. Regarding emerging authors, Hess, T., in addition to being the most cited author, is also the author with the highest production on the subject, followed by Arias-Perez. J and Roth. S. We believe that further research is needed to illuminate the complex theme of digital transformation and to disentangle existing and interconnected research streams.

Therefore, our findings contribute to the ongoing research, aimed at better characterizing, and analyzing the field of DT, and allowed us to highlight useful research guidelines for future academic projects. Many articles were published in the different digital libraries, but we used 553 articles belonging to the Web of Science (WOS) and Scopus databases for quality assessment. Regardless of the level of sophistication, the benefits of digital transformation, such as speed, providing accurate data, a better understanding of the market, aiding in the decision-making process, and, eventually, maximizing revenue, are recognized. Our findings contribute to the ongoing research, and aim at better characterizing, and analyzing the field allowing us to highlight the understanding of digital transformation in organizations and to identify useful research guidelines for future academic projects.

We encourage further work that could provide valuable information to practitioners and support new research and academic findings This study, although, has some limitations. Firstly, a limited list of keywords selected has narrowed down the scope of the study. A wider keyword selection can provide more foresight into Digital Transformation. Secondly, only the Web of Science and Scopus databases were used for sample articles. It is possible that some relevant and interesting articles were missed out because they were not present in the databases.

Future work should compare the present findings with a replication study based on other databases, to verify what continuities and discontinuities emerge from the respective findings of the present work and work based on an analysis of Web of Science and Scopus databases. In the meantime, the present study has gathered and presented sufficient evidence to conclude that Digital Transformation has advanced from a nascent topic into a shiny future. Much has been achieved but there is still a long way to go, and we hope that the findings reported in this paper will instigate researchers and colleagues to come along with us on this exciting journey.

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