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Focal Theme: Sustainable Development from Business and Social Perspective

Date : 5th & 6th September 2023

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Digital Technology Adoption in Manufacturing firms: A Systematic Literature Network approach

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Abstract

Industry 4.0 technologies have transformed the current business and industrial landscape. Especially, during the COVID-19 pandemic, the adoption of digital technologies have been surged and gained considerable researchers' attention. Therefore, this study aims to perform systematic literature on digital technology adoption in manufacturing firms. To achieve the study objectives, a novel technique "systematic literature network approach" is adopted. This approach is a combination of systematic literature and bibliometric analysis. Based on the systematic literature review, thirty (30) articles from 2013 to 2022 have been selected for bibliometric analysis. The results of bibliometric analysis highlight that digital adoption and digital technology are the prominent keywords. The corpus of studies highlights the intellectual structure of the literature in the digital transformation domain. The outcome of this research provides a comprehensive overview of key aspects of digital transformation research that help lay the groundwork to shape the future of this growing field.

Keywords: Digital transformation adoption, manufacturing, bibliometric, systematic literature review

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1. Introduction

In the 21st century, digital transformation (DT) is recognized as an emerging research field and widely adopted in manufacturing & services industries, organizational management, and social sciences (Li et al., 2022). Generally, it redefines the way that how the organization operates. Organizations now realize that they can gain a much better competitive advantage by realigning their strategic plans with digital transformation (Chawla and Goyal, 2021). As a result, digital technologies and their applications are increasingly becoming an integral part of organizational products, processes, and services. Digital transformation refers to the use of new digital technologies to enable major business improvements like enhancing customer experiences, creating new business models, and streamlining operations (Fitzgerald et a. 2013). According to Vial (2019), DT is the process that aims to enhance the firm by triggering significant changes to its operations through combinations of communications, information, computing, and connectivity technologies.

Recently, the DT faced the biggest test during the COVID-19 pandemic. During the COVID-19 pandemic, almost all businesses transform their business model and adopted work-from-home or work-from-anywhere approaches. Consequently, there is a rapid boom in the adoption of digital transformation and still it continues (Shi and Mai, 2022). During the COVID-19 outbreak, digital transformation adoption has gained considerable attention both in the academic and industrial world. The research field has attracted an ample number of researchers from diverse areas of social and management sciences like economics (Chiemeke and Imafidor, 2020), marketing (Salo et al., 2021), operations (Ali & Johl, 2021), technology (Blichfeldt and Faullant, 2021), education (Yong et al., 2022), and society (Chakraborty et al., 2021). This has led to a widespread body of literature.

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In the past literature, there have been a good number of review studies in the digital transformation domain and presented excellent insights (Chawla and Goyal, 2021; Shi and Mai, 2022). But these studies are limited to the specific application of DT and overlook the digital transformation adoption perspective. Furthermore, the past review studies are based on bibliometric analysis and do not give many insights regarding the quality criteria for article selection. Therefore, digital transformation adoption and article selection quality criteria are missing from an academic and managerial perspective. Thus, this study aims will fill these gaps by incorporating the systematic literature network analysis (SLNA) technique. The current study seeks answers to the following questions in the field of DT adoption.

1. What are the publication trends in DT adoption?
2. Who are the influential researchers?
3. What are the distribution and trends of keywords?
4. What is the intellectual structure of literature in DT adoption?

The remainder of the article is structured as follows. First, the article outlines the research methodology. After that bibliometric results are presented, and finally the discussion and conclusion are presented.

2. Materials & Methods

According to Tranfield et al. (2003), “an SLR is a form of research that deals with existing publications and follows a systematic methodology for synthesizing data that is already published”. According to Kraus (2020), “an SLR is a review of an existing body of literature that follows a transparent and reproducible methodology in searching, assessing its quality and synthesizing it, with a high level of objectivity.” A systematic literature review is a beneficial strategy for evaluating a substantial amount of information systematically and efficiently. However, this strategy has certain weaknesses, such as the fact that most SLRs were focused on a particular analysis and did not investigate alternative approaches. Furthermore, many SLRs rely simply on a small database, which may result in selection bias mistakes (Owens, 2021).

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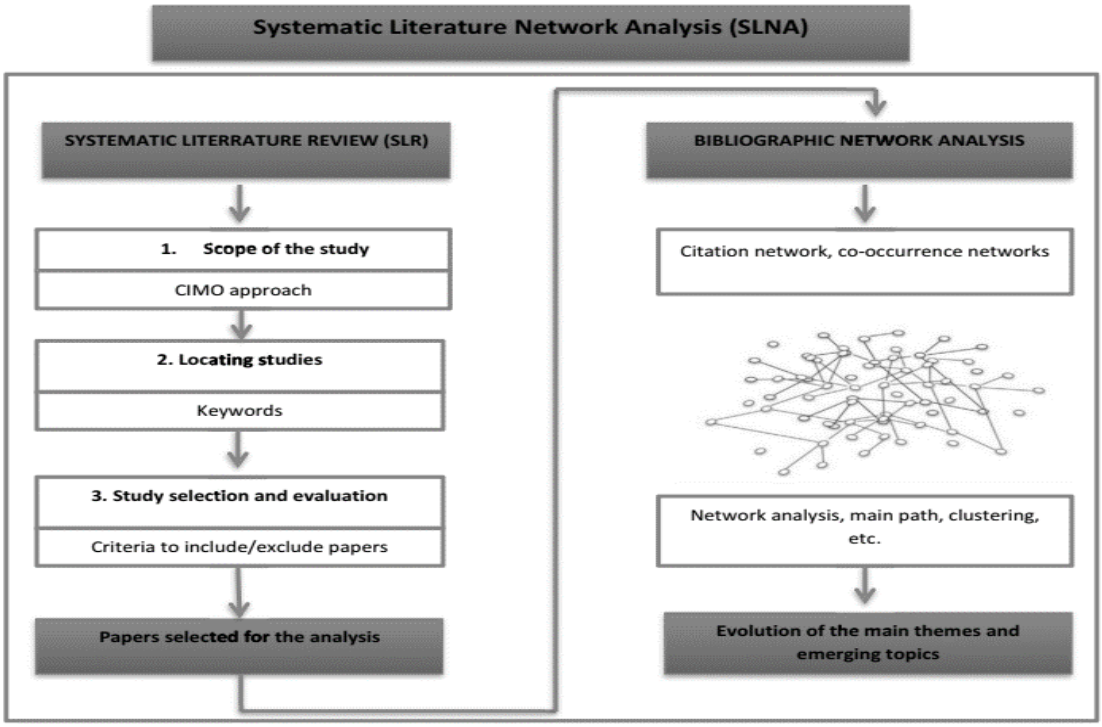
Moreover, search strategies were often not provided in detail. To overcome these limitations, this study adopted Systematic literature network analysis (SLNA).

This review study is based on the Systematic literature network analysis (SLNA) proposed by Colicchia and Strozzi (2012). According to Inamdar et al (2020), an SLNA is a "two-pronged methodology that was undertaken: the SLR approach to perform a first selection of the most relevant articles to be included in the analysis, and bibliometric analysis to carry out a second citation-based selection to explore the process of knowledge transfer and development." As recommended by Colicchia and Strozzi (2012) the SLNA approach is divided into two phases: SLR and bibliometric analysis. In phase 1, three steps process of SLR is performed; formulating research questions based on CIMO (context, intervention, mechanism & outcomes). Next, locating & discovering the studies, and selection & assessment of the study.

In the second phase, bibliometric analysis was performed. This technique employed a quantitative research approach that analyses the bibliographic data of past studies gathered through first phase. Figure 1 shows the complete SLNA process.



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2.1 Phase-I SLR

2.1.1 Scope of the study

In the first step of SLR, the scope of the study in compliance with research objectives and questions is defined. As recommended by Denyer and Tranfield (2009), the study scope must be based on CIMO logic. Based on CIMO logic, the scope of the study is limited to technology adoption in the manufacturing sector from 2013 to 2022.

2.1.2 Locating of studies

In the second step of SLR, keyword identification was carried out; a combination of two keywords was adopted to locate the study. The first keyword is digital transformation, digital revolution, industry 4.0, industrial revolution 4.0, and digitalization. The second keyword refers to manufacturing, smart factories, and production.

2.1.3 Selection and evaluation criteria

In the third step of SLR, the inclusion and exclusion criteria were identified. The identified keywords were used in the Scopus database to extract the items. Only English language articles published from 2013 to 2022 were included in the final dataset. A total of 30 articles were selected for SLR from different journals to answer the RQs. Table 1 shows the inclusion and exclusion criteria. To present the SLR, a PRISMA diagram was used. Figure 2 shows the PRISMA diagram.

Table 1. Study inclusion and exclusion criteria

Particular	Inclusion	Exclusion	Remarks
Study Period	From 2013-2022	Before 2013	To explore the recent research in leadership, this study took articles from 1986 to 2022.

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Database type	Scopus	Other databases	All articles are searched in the Scopus database.
Language	English	Other languages	Only English articles have been considered in SLR.
Keywords	Two sets of keywords; digital transformation and manufacturing	Other related keywords	Only keywords with leadership in the IT industry have been used.
Documents type	Peer-review articles	Unpublished articles, Master, or Doctoral theses & Textbook	Only peer-review research articles have been included.

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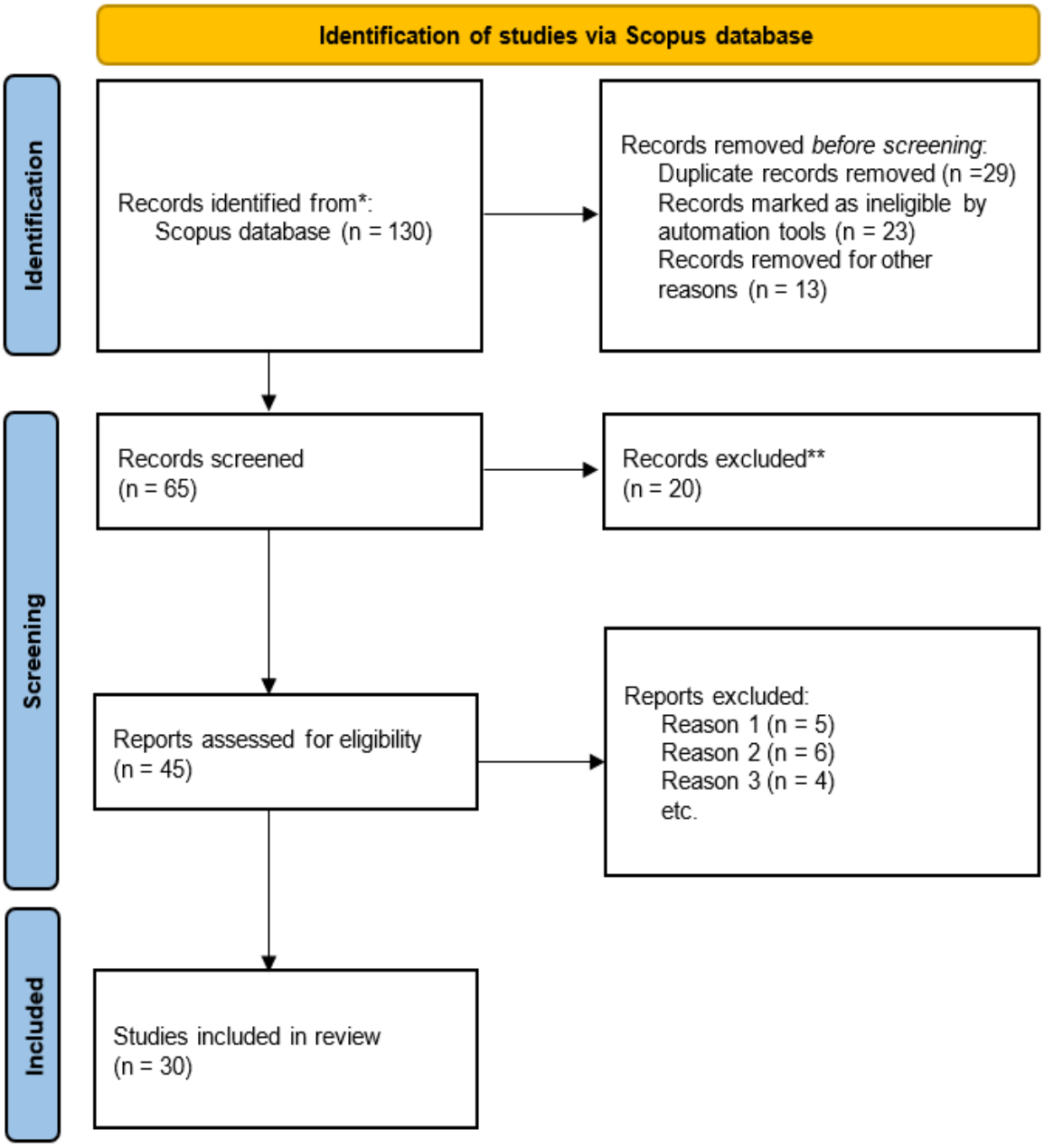

Figure 2. PRISMA diagram

2.2 Phase-II Bibliometric analysis

In the SLNA approach, phase II is bibliometric analysis. According to Fonseca and Borges-Tiago (2021), bibliometric analysis consists of quantitative and qualitative

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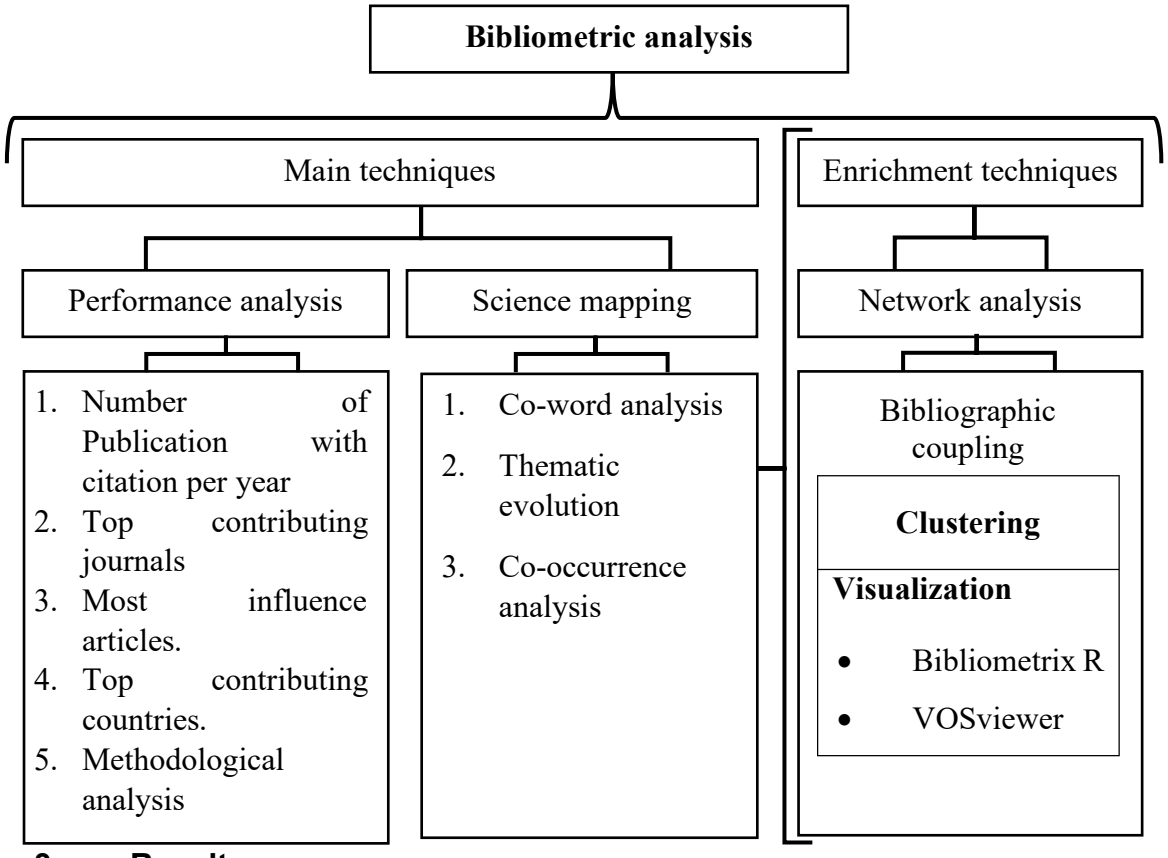
statistical methods to analyze the publication's contents, references, citations, and co-authorship. The bibliometric analysis helps the researchers to explore the citation patterns, author network, knowledge base, trends, reader usage, and impact & significance of the subject (Inamdar et al., 2021). In this study, the bibliometric analysis was performed, and the results were presented in two categories: performance analysis and science mapping (Donthu et al., 2021). The performance analysis techniques identify the contribution of research to a specific field. Performance analysis is the hallmark of bibliometric research and is generally descriptive. In performance analysis, authors, countries, institutions, and journals' contributions are presented. In this analysis, the number of publications and citations per year are the most prominent measures. Because publication is a proxy for productivity and citations measure the influence and impacts (Donthu et al., 2021). On the other hand, the science mapping technique pertains to the structural connections and intellectual interactions among research constituents. This technique includes a wide range of

analyses; citation & co-citation, co-word, co-authorship, and bibliographic coupling (Donthu et al., 2021). Figure 3 shows the bibliometric analysis.

Figure 3. Bibliometric analysis



3. Result

This section describes the bibliometric results in descriptive and science mapping. First, the authors present the descriptive results of thirty articles on digital transformation in manufacturing.

3.2 Descriptive Results

Based on the RStudio, Figure 4 shows the three-fold analysis of 30 studies on digital transformation in manufacturing industries. Figure 4 consists of three areas, the left-side author's name, in the middle of the abstract, and on the right side, the keywords are given. The purpose of this figure is the show the evolution of the study both in abstract and keywords. In the study abstract, digital, technology, and adoption are the most occurring words. In the keywords, the most dominant words are technology adoption and digital technology.

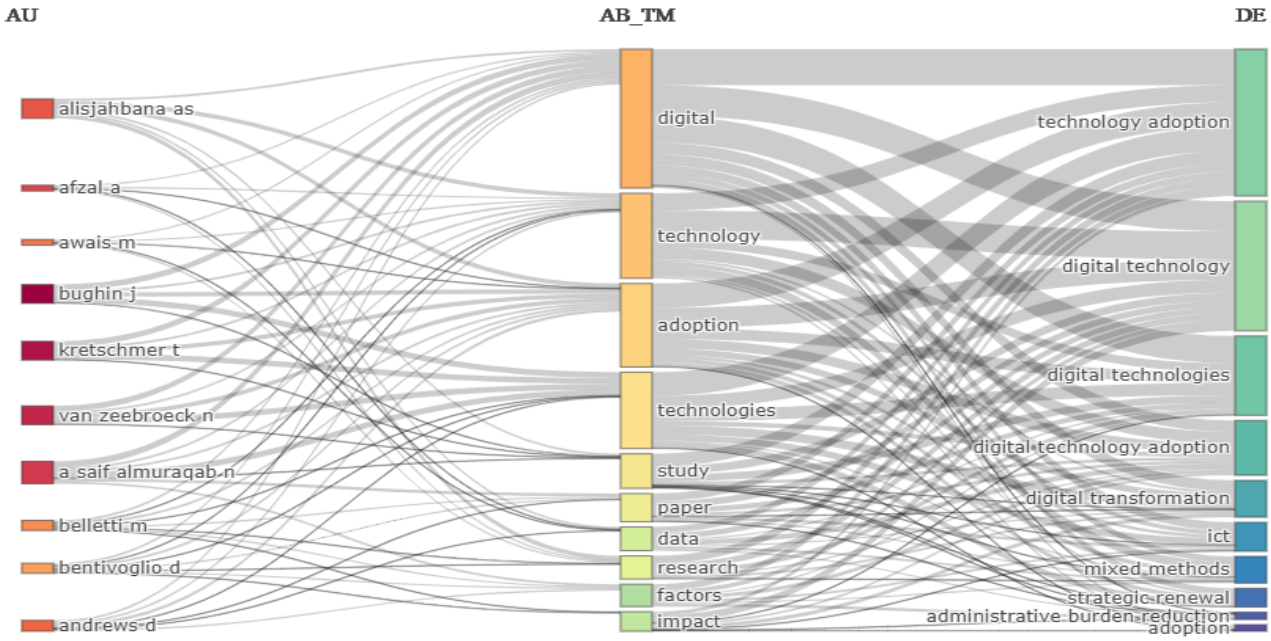


Figure.4 Three-field analysis

3.1.1 Publication trends

In the current study, the data was gathered through the Scopus database from 2013 to 2022. Figure 5 shows the publication trends and citations from 2013-2022. Based on the figure, at the start of digital transformation, there was a limited number of publications available. For instance, one publication is available in 2013, 2016, & 2017. After 2019, the publication trend was rising, like in 2020 six publications were found,

in 2021 nine, and 2022 five. Moreover, articles published in 2018 received the highest citations.

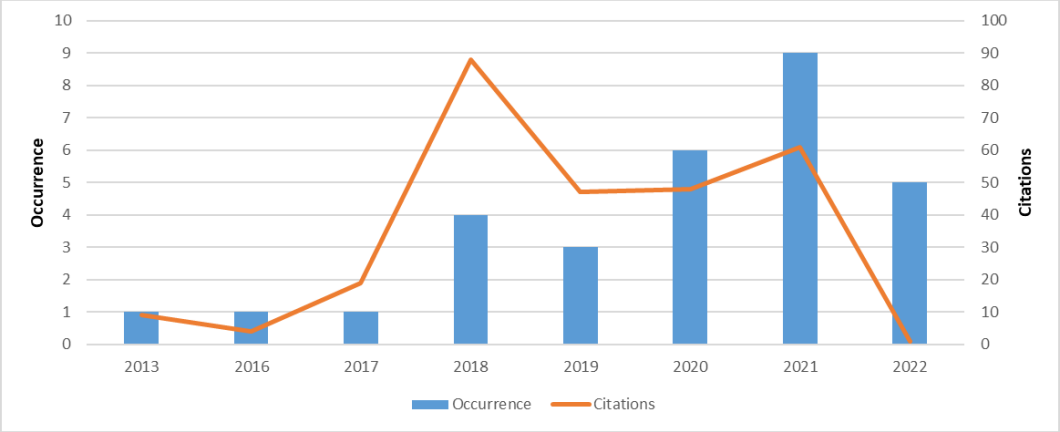


Figure 5. Publication trends and citations

3.1.2 Most productive authors

To measure the author's productivity, different indicators are adopted. As suggested by Donthu et al. (2021), h, g, and m indexes have been used to measure the author's productivity. Table 2 shows the top five productive authors in digital transformation studies.

Table 2. Top five productive authors

Author	year	freq	TC	TCpY	h_index	g_index	m_index
A SAIF ALMURAQABN	2017	1	19	3.167	1	1	0.167
AFZAL A	2022	1	0	0	0	0	0
BUGHIN J	2021	2	3	1.5	1	1	0.500
KRETSCHMER T	2021	2	3	1.5	1	1	0.500
VAN ZEEBROECK N	2021	2	3	1.5	1	1	0.500

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3.2 Science Mapping

In bibliometric analysis, science mapping examines the relationship between research constituents. The following techniques are employed to perform the science mapping, such as word cloud analysis, thematic evolution, co-citation, and co-occurrence analysis. The following sub-sections explain in detail.

3.2.1 Temporal analysis using word clouds

In science mapping, the corpus of publications on digital transformation in the manufacturing sector was analyzed based on authors' keywords. Figure 6 shows the word clouds based on publications keywords. The most frequent keywords are digital transformation, strategic renewal, ICT, mixed methods, digital, etc.

Figure 6. Word cloud analysis

3.3 Network Analysis

The purpose of network analysis is to enrich the assessment of bibliometric analysis, especially, it shed light on the relative importance of research constituents. The

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following sub-sections presented the network analysis in the form of co-occurrence and co-citation techniques.

3.3.1 Co-occurrence analysis

The co-occurrence analysis examines the cross-disciplinary involvement and cooperation in certain research filed. In this technique, the size of the circle represents the occurrence of keywords, and the line represents the node. Figure 1 shows the co-occurrence analysis of authors' keywords in manufacturing sectors from 2013 to 2022. Figure 7 shows that the biggest and core clusters are represented in green and blue colours. The green colour is the most prominent keyword in technology adoption. In the blue cluster, the most prominent keyword is digital technologies.

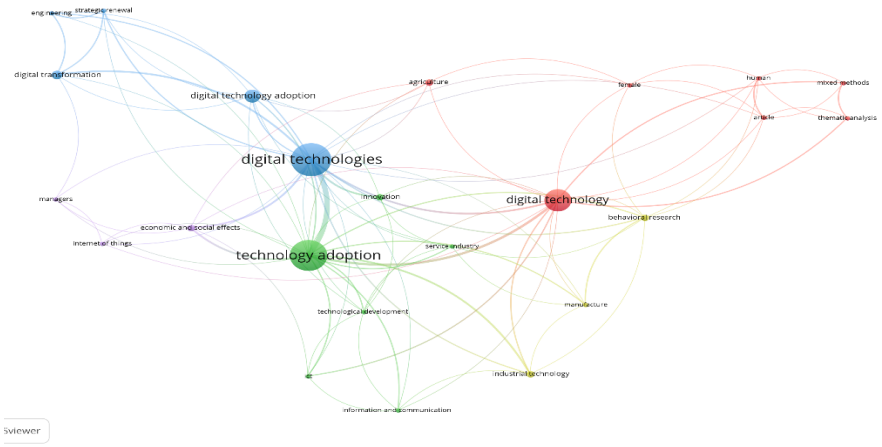

Figure 7. Co-occurrence network

3.3.2 Bibliographic coupling

According to Donthu et al. (2021), bibliographic coupling represents a technique of science mapping that is based on the assumption that two publications that shared common references are also similar in their content. Figure 8 shows the bibliographic coupling based on thirty articles in the area of digital transformation in the manufacturing sector from 2013 to 2022.

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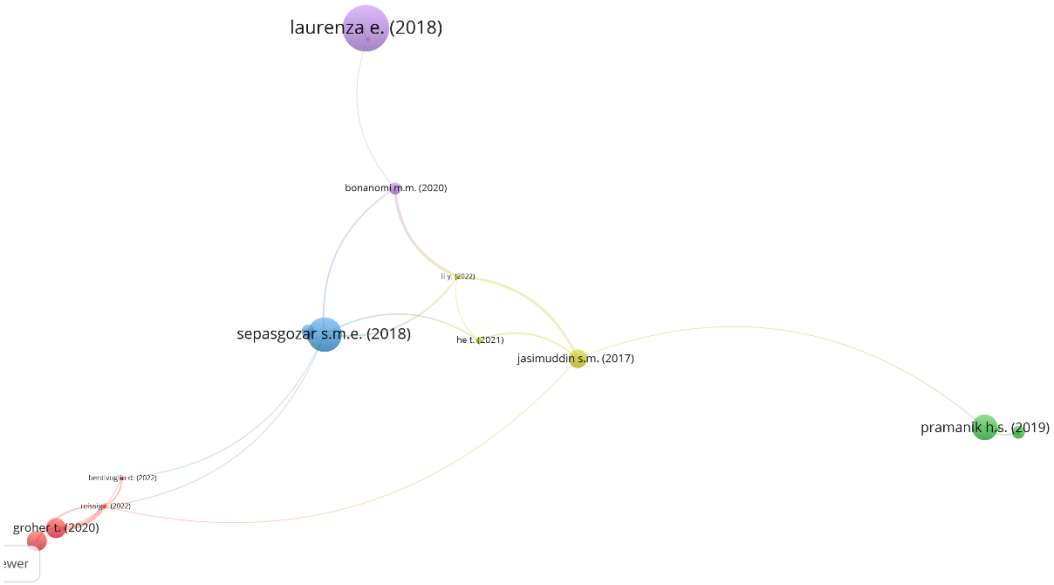

Figure 8. Bibliographic coupling based on articles

3.3.3 Co-citation analysis

In science mapping, co-citation analysis assumes that articles cited together are similar thematically. The outcome of this analysis reveals the intellectual structure of a research field (Donthu et al. 2021). Figure 9 shows the co-citation analysis based on publication references.

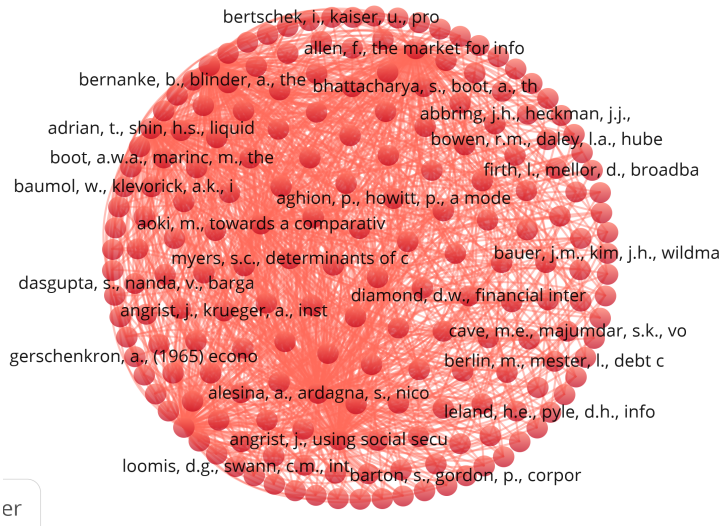

Figure 9. Co-citation based on cited references

4. Discussion

To depict extant research status, this study has performed an extensive investigation of the literature on digital transformation in manufacturing sectors from 2013 to 2022. The authors examined the publication trends, authors' productivity, and most occurring keywords by employing the different approaches of bibliometric analysis. In our endeavour to better understand the overall domain of digital transformation, the research performed keywords, co-occurring, and co-citation analysis

The descriptive analysis of the corpus of publications on digital transformation analyzed the publication trends. The years-wise chronological arrangements of articles highlighted that there is a growing pattern of publication globally. After 2019, the digital transformation gained significant attention in the scholarly world. Moreover, the articles published in 2018 received high citations. The article published in "*Business Process Management Journal*" received the highest citations (47). Moreover, this study performed a three-field analysis, and the results affirmed that in the abstract of publications the most active keyword is digital transformation. Furthermore, the bibliometric analysis highlights the most productive authors in the digital transformation field.

The analysis of science mapping revealed the keywords trends, co-occurrence, bibliographic coupling, and co-citation analysis. The keywords analysis shows that the most prominent keywords in the corpus of publication are digital transformation, ICT, etc. Additionally, the analysis of keyword co-occurrence highlight that the selected articles cover different themes at different levels. But the most prominent themes are technology adoption and digital technologies. Moreover, the bibliographic coupling highlights the different areas of research including niche research streams. Finally, the co-citation of bibliographic depicted that most of the selected studies focus on the digital transformation domain, especially in the manufacturing sector. Overall, the

corpus of selected publications that the concept of digital transformation in manufacturing sectors is an emerging research area, especially in small and medium enterprises.

4.1 Conclusion

The objective of this study is to organize and rationalize the past literature on digital transformation, especially in the manufacturing sector. To achieve the study objectives, a novel research approach was adopted. Systematic literature and network analysis (SLNA) was adopted to organize the evaluate the collected data. The bibliometric analysis revealed that the digital transformation concept has gained popularity both in academic and industrial domains. The findings of the current study have substantial academic and managerial contributions. Firstly, the findings of this study contribute to the current body of knowledge by analyzing the progression of research in the digital transformation domain. Secondly, through descriptive and science mapping analysis, this study consolidated the insights under the digital transformation domain, particularly in the manufacturing sector. Lastly, the application of SLNA as a base for research methodology highlights that the combination of systematic literature review and bibliometric analysis provides more robust results.

Although this research is performed with due diligence still some limitations set off the avenues for future research. Firstly, the data was extracted from the Scopus database, although it is considered the most exhaustive. But some important publications are left. Therefore, in future studies, other databases like web-of-science (WOS) might be considered. Secondly, the data extraction was based on specific keywords. In the literature, there is a variation of keywords. In future studies, more keywords should be included to locate the corpus of publication.

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