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An exploration of scientific research on digital transformation in the disciplinary field of economics: A bibliometric study from 2015 to 2024

Une exploration de la recherche scientifique sur la transformation digitale dans le champ disciplinaire de l'économie : Une étude bibliométrique de 2015 à 2024

JANATI-IDRISSI Farid

Enseignant chercheur

Faculté d'Économie et de Gestion de Guelmim

Université Ibn Zohr

Laboratoire de Recherche en Management, Innovation et Recherche Appliquée

MAROC

TGHALI Amal

Doctorante

Faculté d'Économie et de Gestion de Guelmim

Université Ibn Zohr

Laboratoire de Recherche en Management, Innovation et Recherche Appliquée

MAROC

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Résumé

Cet article examine les publications scientifiques concernant la transformation digitale (TD) de 2015 à 2024 dans le domaine de l'économie, en utilisant la base de données Scopus et les logiciels VOSviewer et R. Au début de la procédure, nous avons identifié un total de 29 977 articles, cependant, seuls 1660 sont sélectionnés pour l'étude. L'analyse se concentre sur les revues, les articles, les chercheurs, les institutions et les pays, en utilisant des indicateurs bibliométriques tels que la productivité, les citations et les valeurs de l'indice H. Les présentations graphiques mettent en évidence les analyses de co-citations, de co-auteurs, de fréquences des mots, des sujets de recherche et des chercheurs influents. Cette analyse vise à dévoiler les structures intellectuelles et les connaissances accumulés dans la littérature existante tout en décortiquant les tendances émergentes dans lesquels les chercheurs sont incités à approfondir leurs recherches. Les résultats se complètent et montrent que la Chine, l'Allemagne, l'Ukraine et l'Espagne sont les pays les plus productifs en matière de recherche sur la TD.

Mots clés : Transformation digitale, analyse bibliométrique, logiciel VOSviewer, cartographie bibliométrique, H index.

Abstract

This article examines scientific publications concerning digital transformation (DT) from 2015 to 2024 in the field of economics, using the Scopus database and software packages VOSviewer and R. At the start of the procedure, we identified a total of 29,977 articles, however, only 1660 are selected for the study. The analysis focuses on journals, articles, researchers, institutions and countries, using bibliometric indicators such as productivity, citations, H-index values. Mapping analyses highlights co-citation, co-authorship, word frequency, research topics and influential researchers. This analysis aims to unveil the intellectual structures and accumulated knowledge in the existing literature while analyzing the emerging trends that encourage researchers to deepen their scientific investigations. The results complement each other and show that China, Germany, Ukraine and Spain are the most productive countries for DT research.

Keywords: Digital transformation, bibliometric analysis, the VOSviewer software, bibliometric mapping, H index.

Introduction

In an ever-changing world, digital transformation is emerging as an essential catalyst not just for businesses, but for all aspects of human life, as (Stolterman & Fors, 2004) mentions. Embracing this change ensures that we remain relevant and competitive in an increasingly connected landscape. The field of digital transformation research is well-established, having emerged alongside the massive adoption of digital technologies within society, industry and organizational management (Hess & al.,2016).

According to (Vial, 2021), digital transformation (DT) is defined as a process aimed at improving an entity by triggering significant changes in its properties through combinations of information, communication, computing and connectivity technologies. This definition of digital transformation revolves around four key elements: the target (entity, company, industry), the scope of change, the technologies used and the expected results. The author points out that this evolutionary process is not limited to companies, and requires structural and cultural changes to adapt to the new digital realities.

According to (Bellany & Dhiba, 2024), digital transformation is both a complex and essential concept for adapting to the contemporary economic environment. This idea is corroborated by (Janati-Idrissi, 2020), who describes it as a "protean" concept, with no single definition. This polysemous nature, which encompasses multiple changes brought about by digital technologies in all aspects of life, makes its understanding and application intrinsically difficult.

The main objective of this study is to assess the evolution of research in DT, to identify influential authors, institutions and journals, and to highlight emerging trends. As a result, bibliometric analysis is the preferred tool for obtaining these insights, as it is a popular and rigorous method for exploring and analyzing large volumes of scientific data. It allows us to unravel the evolving nuances of a specific field, while highlighting emerging areas within it (Donthu & al., 2021).

Indeed, researchers use bibliometric analysis for a variety of reasons, including to discover emerging trends in articles and journals, patterns of collaboration and research constituents, and to explore the intellectual structure of a specific field in the existing literature (Donthu et al., 2021a; Verma & Gustafsson, 2020; Donthu & al., 2020c). Based on the above discussion, in order to achieve the objectives of this research, they have been transformed into five research questions:

- **RQ1:** What's the trend in digital transformation publications?
- **RQ2:** Who are the most productive and influential contributors (authors, countries, and
- journals) to this topic?
- **RQ3:** What are the most influential publications concerning DT?
- **RQ4:** What are the themes and topics associated with this intellectual structure?

In order to study the evolution of research on digital transformation in the field of economics, we used a quantitative bibliometric approach. Data were extracted from the Scopus database using a specific query and filtered for the period 2015-2024. The analysis, carried out with VOS viewer software, enabled us to map author networks and identify dominant and emerging research themes. This method provides an objective overview of publication and scientific collaboration dynamics.

This article is structured as follows. To begin with, the article describes the methodology used in the present study. After that, the results of the bibliometric and mapping analyses are presented. In the end, the main conclusions are discussed.

1. Method and materials

1.1 Research method: bibliometric analysis

This study uses bibliometric analysis. Bibliometrics is a branch of scientometrics that focuses primarily on the quantitative study of scientific publications for statistical purposes. It performs three main functions: scientific and technological description, evaluation and monitoring, and scientific and technological assessment and monitoring (Polanco, 1994). Our key objective is to reveal the intellectual structures and knowledge accumulated in a specific area of existing literature. It is currently recognized as an important instrument for assessing the performance of research units (e.g., authors, institutions, countries, and journals).

According to (Gauthier, 1998), as a descriptive tool, bibliometrics provides an account of publication activity at the level of countries, provinces, cities or institutions, and is used for comparative analyses of productivity. The data can then be used to assess the performance of research units, complementing standard evaluation procedures. Bibliometric data also serve as a benchmark for monitoring science and technology, as longitudinal studies of scientific output make it possible to identify developing or declining areas of research.

As indicated by (Noyons & al., 1999a; Van Raan, 2005a) and reported by (Cobo & al., 2011), there are two major methods in bibliometrics: performance evaluation and scientific mapping. Performance evaluation aims to assess the impact of the activity of various scientific actors (countries, universities, departments, researchers) on the basis of bibliographic data.

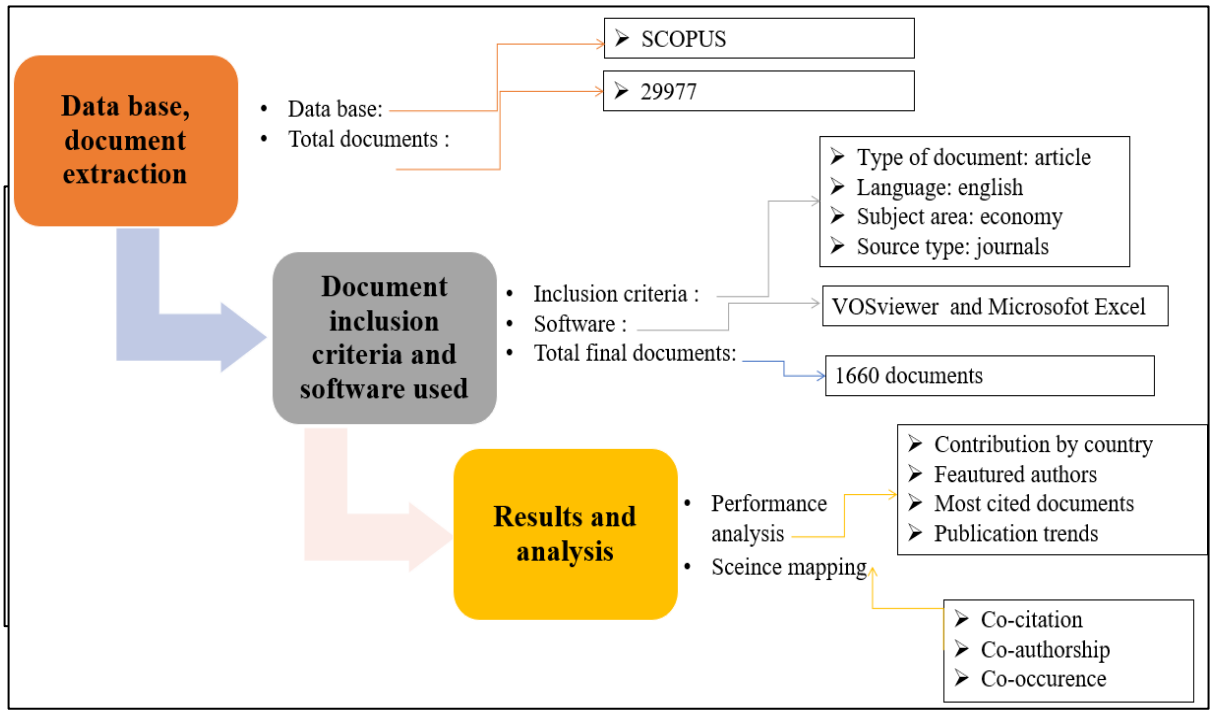
Science mapping uses bibliometric methods to examine how disciplines, fields, specialties, and individual papers are related to one another. It produces a spatial representation of the findings analogous to geographic map (Calero-Medina & Van Leeuwen, 2012; Small, 1999). It focuses on the relationships between research constituents (Donthu & al.,2021).

1.2 Data collection

The data were extracted from the Scopus database within December 6 and 10, 2024. Advanced exclusion and inclusion criteria were used to refine the results. Firstly, the analysis retained the publication period from 2015 to 2024. 2025 is excluded because it has not yet been completed, and earlier years. using advanced search parameters, which allowed the following search equation (Topic search): TITLE-ABS-KEY ("digital transformation") AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "ECON")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (PUBSTAGE , "final")). The total number of documents obtained was 1665.

1.3 Research design

Figure 1: Bibliometric research methodology



Source: Author compilation

2. Results and discussion

2.1 Performance analysis

Figure 2: Performance analysis overview

Source: Biblioshiny using Scopus database

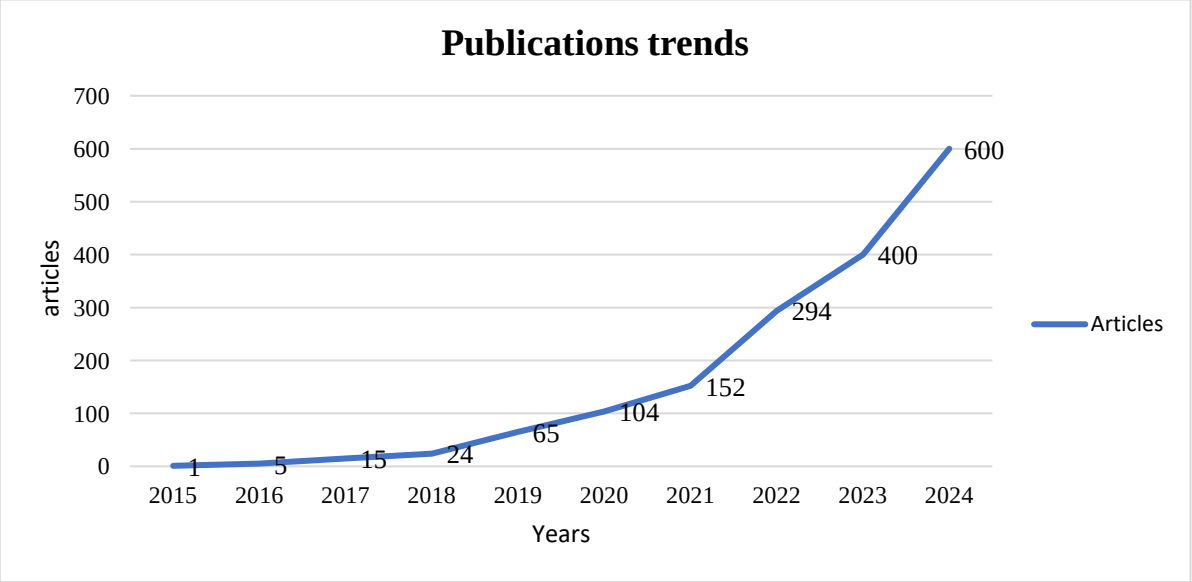
Between 2015 and 2024, an analysis of the data revealed several key insights. A total of 425 papers was published in journals, representing annual growth of 103.56%. The average age of papers is 1.5 years, with an average of 19.07 citations per paper and a total of 82,311 references. In terms of content, there are 1,644 Plus keywords and 4,582 Author keywords. In terms of authors, 4,711 contributors were identified, 198 of whom produced solo documents. In terms of collaboration, 206 documents are individual works, with an average of 3.12 co-authors per document, and 22.65% of co-authors are of international origin. Finally, the majority of publications - 1,660 - were articles.

2.2 Publication trends

Figure 3 shows the annual trend in publications and total citations on DT from 2015 to 2024. While an upward trend is generally observed, two distinct periods have marked the dynamic

growth of articles published in Scopus. Indeed, research in this field remained depressed until approximately 2021. From 2020 onwards, the volume of publications increased substantially, reaching a peak in 2024 with 600 articles published. Over 80% of articles were published in the last eleven years, indicating that the scientific community's interest in DT had increased in recent years.

Figure 3: Year wise publication of DT between 2015 and 2024



Source: Author compilation

2.2.1 Most cited countries

In terms of geographical distribution, Table 1 uses the corresponding Author's Country to list the top 10 most productive countries for research on digital transformation in the field of economics. China represents the highest contribution with 451 articles (27.2%), followed by Germany (70 articles, 4.2%), Ukraine (46 articles, 2.8%), Spain (43 articles, 2.6%) and UK (43 articles, 2.6%). The two indicators single-country publications (SCP) and multiple-country publications (MCP) respectively divide publications into two types of collaboration: national (i.e. collaboration of authors within the same country) and international (i.e. collaboration of authors across two or more countries). In this way, they provide an overview of the international collaboration network that has developed in this field of research.

As the same source shows, China turned out to have the highest SCP (364) and MCP (87) among all countries. But the ration MCP/SCP de UK (53.5%), Korea (29,6%) et USA (28,6%) was the

highest among the countries studied, indicating that these countries are more involved in international collaboration than others.

In addition, figure 4 presents the top ten influential countries in the field along with their citations achieved (TC) and average article citations. We found out that China (6477, 14.40%), Germany (2499, 56.30%), UK (2423, 56.30%), Brazil (2295, 153%) and Italy (1140, 27.80%) are the most influential countries.

Based on Arsène (2019), Yu Hong's book, China's leading position in digitalization is the result of a strategic model based on massive and constant investment in digital infrastructures since the 1980s. Under the aegis of a bold government strategy (the "Internet +" and "Made in China 2025" programs), China has exploited its huge market and entrepreneurial ecosystem to stimulate innovation and the rapid integration of digital technologies, despite social disparities and an initial dependence on foreign aid.

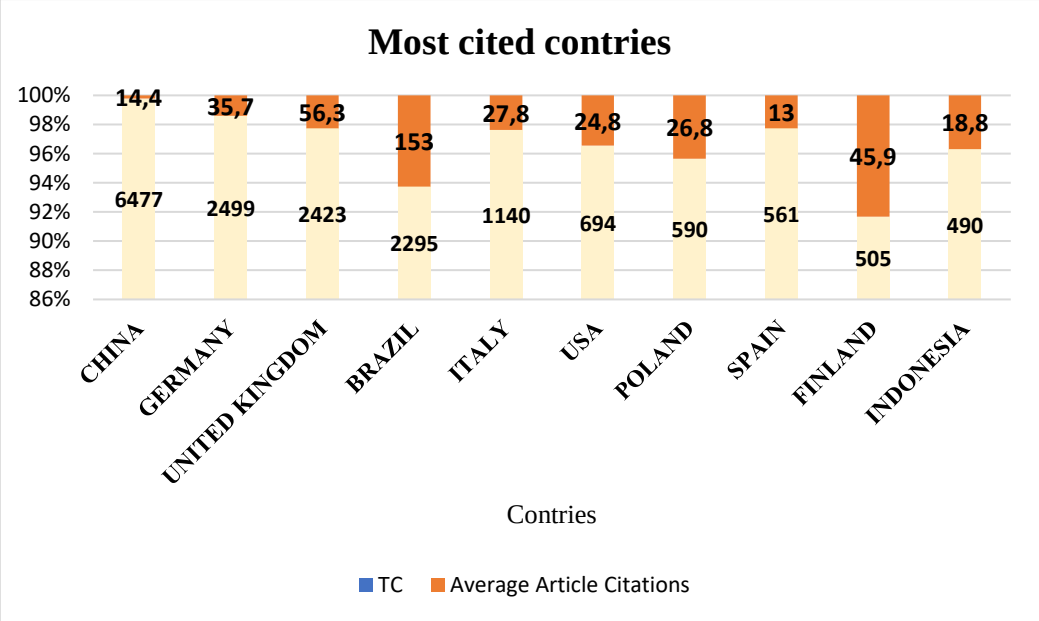
Table 1: Top 10 publishing countries based on identical trends in authors and collaborations

Country	Articles	Articles %	SCP	MCP	MCP %
CHINA	451	27,2	364	87	19,3
GERMANY	70	4,2	55	15	21,4
UKRAINE	46	2,8	40	6	13
SPAIN	43	2,6	36	7	16,3
UNITED KINGDOM	43	2,6	20	23	53,5
ITALY	41	2,5	31	10	24,4
USA	28	1,7	20	8	28,6
INDIA	27	1,6	20	7	25,9
KOREA	27	1,6	19	8	29,6
INDONESIA	26	1,6	23	3	11,5

Note: SCP: Single country publications, and MCP: Multiple country publications.

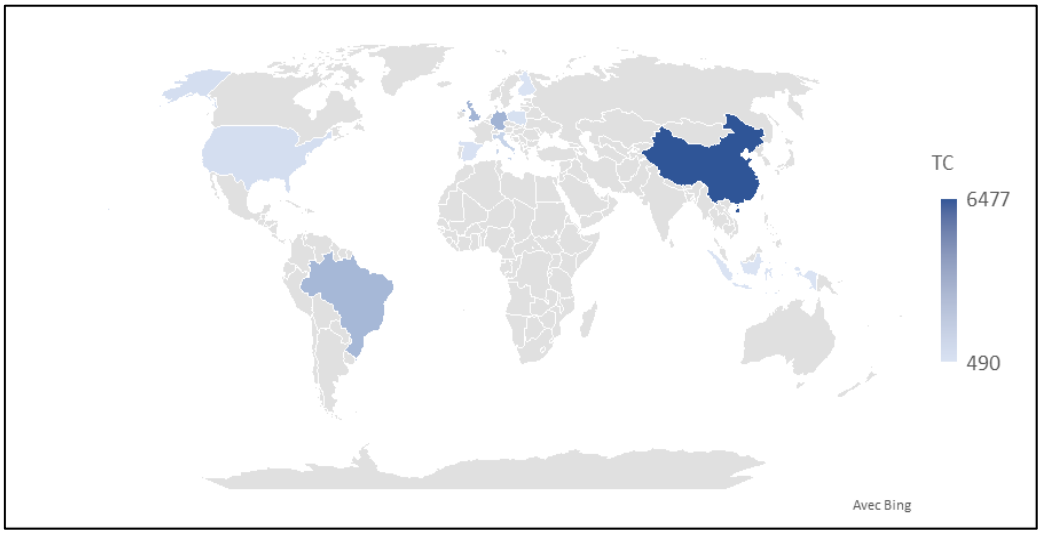
Source: Biblioshiny using Scopus database

Figure 4: Most cited countries



Source: Biblioshiny using Scopus database

Figure 5: Referenced countries



Source: Biblioshiny using Scopus database

2.2.2 Most cited documents

This section presents an analysis of the documents, their content and references, bearing in mind that the 1660 articles studied contain 91165 references in their bibliographies, with an average citation per doc of 19.07 and a document average Age of 1.5. Table 2 shows the 30 most cited

documents worldwide. Global citations measure the number of citations a document has received from documents in Scopus, showing its impact on the bibliographic database as a whole.

As a result, the paper with the greatest impact with 1846 Total Citations (TC), 307.67 Total Citations per Year (TCPY) and 24.44 Normalized Total Citations (NTC) is authored by FRANK AG (2019) and published in International Journal PROD ECON. The paper's title is « Industry 4.0 technologies: Implementation patterns in manufacturing companies ». This publication of the International Journal of Production Economics, examines the adoption of Industry 4.0 technologies in manufacturing companies. Indeed, (Frank& al., 2019), proposes a conceptual framework distinguishing "front-end", operations- and market-oriented technologies (such as smart manufacturing and connected products) from "back-end" technologies that provide connectivity and intelligence (such as the Internet of Things and data analytics). Through a survey of companies, the article identifies different adoption patterns and reveals that the implementation of façade technologies is often systemic, while that of core technologies remains a challenge for many companies.

The second most cited article (TC = 1401, TCPY= 233.50, NTC= 18.55) is « Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal » and is published in, Long Range Plann in 2019 by Warner KSR. Actually, this paper examines how established companies in traditional sectors are developing dynamic capabilities to undertake digital transformation (Warner & Wäger, 2019).

The third most cited article titled: Options for formulating a digital transformation strategy » is published by MIS Quarterly Executive in 2016, it received about 1260 TC, 140 TC per Year, and 4,44 Normalized TC. The authors explore digital transformation in depth as a priority management challenge for companies in all sectors. It highlights the need for executives to formulate and execute strategies that integrate digital technologies to remain competitive, illustrating the consequences of inaction with concrete examples. (Hess & al., 2020).

Table 2: Most cited published documents

Paper	DOI	TC	TCPY	NTC
Frank ag, 2019, int j prod econ	10.1016/j.ijpe.2019.01.004	1846	307,67	24,44
Warner ksr, 2019, long range plann	10.1016/j.lrp.2018.12.001	1401	233,50	18,55
Hess t, 2016, mis q exec		1260	140,00	4,44
Sebastian im, 2017, mis q exec		616	77,00	4,78
Culot g, 2020, int j prod econ	10.1016/j.ijpe.2020.107617	464	92,80	9,12
Singh a, 2017, mis q exec		454	56,75	3,52
Priyono a, 2020, j open innov: technol mark complex	10.3390/joitmc6040104	360	72,00	7,08
Bouwman h, 2019, telecommun policy	10.1016/j.telpol.2019.101828	352	58,67	4,66
Osterrieder p, 2020, int j prod econ	10.1016/j.ijpe.2019.08.011	346	69,20	6,80
Neumann wp, 2021, int j prod econ	10.1016/j.ijpe.2020.107992	342	85,50	15,41

Note: TC: Total Citations; TCPY: Total Citation Per Year; NTC: Normalized Total Citations

Source: Biblioshiny using Scopus database

2.2.3 Featured authors

Totally 4711 authors have participated in 1660 articles in this field of study. Table 4 shows the top 10 of the most relevant authors using the Scopus database.

The most active author, whether in terms of number of articles published (np), total number of citations or h-index, is Carayannis Elias G from the George Washington University in USA. He ranks first with 6 articles, 496 citations and an h-index of 6. His significant influence is most

influential in the fields of innovation, entrepreneurship and innovation systems (Carayannis & Campbell, 2009).

The second most productive author is Hess Thomas, from Ludwig-Maximilians-Universität, Munich, Germany, with 6 articles and 2029 citations and an h index of 5. He is an expert in digital strategy and innovation in technology. His influence is particularly evident in the analysis of digital trends and their impact on contemporary business models (Hess & Benlian, 2015; Hess & al., 2016; Legner et al., 2017). Other scholars who made significant contributions to the research community include Herciu, Cifuentes-Faura, Couchoro, Dobos, Dwivedi, Eckert and Frank.

Table 4: Top 10 most productive authors.

Authors	Articles	Articles Fractionalized	Total citations	h-index
CARAYANNIS, ELIAS G.	6	2,28	496	6
HESS, THOMAS	6	2,17	2029	5
HERCIU, MIHAELA	5	2,5	29	2
CIFUENTES-FAURA, JAVIER	4	1,58	21	2
COUCHORO, MAWULI K.	4	0,87	21	3
DOBOS, IMRE	4	1,33	73	2
DWIVEDI, YOGESH K.	4	0,71	21	2
ECKERT, CHRISTIAN	4	1,5	76	3
FRANK, ALEJANDRO G.	4	1,03	155	3
GUERRA, KATIA	4	0,58	66	3

Source: Biblioshiny using Scopus database

2.3 Science mapping analysis

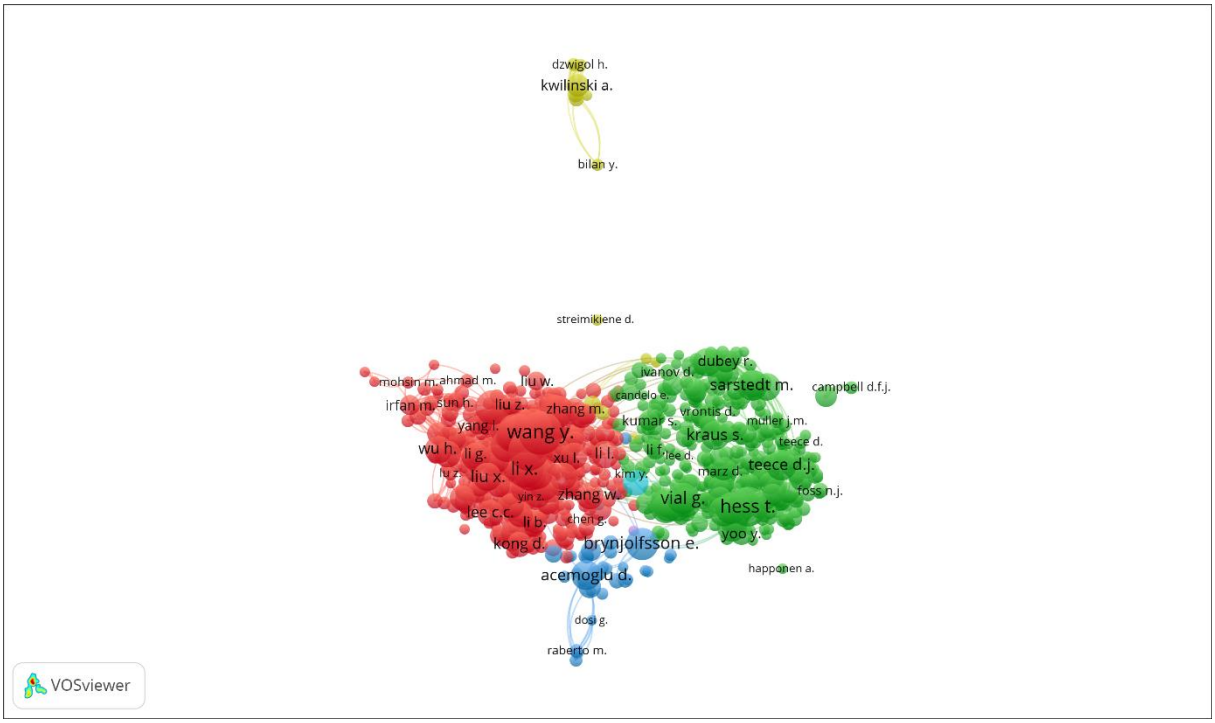
The bibliometric mapping tool VOSviewer, developed by (Van Eck & Waltman, 2010) and available for free at "www.vosviewer.com", greatly simplifies the analysis of complex data. It excels in the graphical representation of large maps, making the analysis of complex data much easier. The tool allows you to build maps based on co-citation or co-occurrence, offering

detailed exploration thanks to its interactive viewer. This is a major asset for the analysis of relationships in scientific literature.

2.3.1 Co-Citation analysis

Co-citation analysis of the 836 selected authors has enabled them to be grouped into six distinct clusters. Three of these clusters, which are particularly important and interconnected, reflect the main currents of thought, specializations and fields of study that form the foundations of knowledge on digital transformation. The first three clusters account for over 98% of authors. The first cluster comprises 398 authors, the second 389 authors and the third 13 authors. The large red cluster is led by author Wang Y. The green cluster, headed by Vial G. and Hess T., The authors (Hess & al., 2015; Vial, 2019) focuses on strategic management, innovation and business models. Finally, the blue cluster, centered on Brynjolfsson E., is interested in the digital economy, artificial intelligence and their societal impacts (Brynjolfsson & McAfee, 2014). Less related research niches may be indicated by the two tiny, separate yellow clusters.

Figure 6: Author Co-Citation Analysis

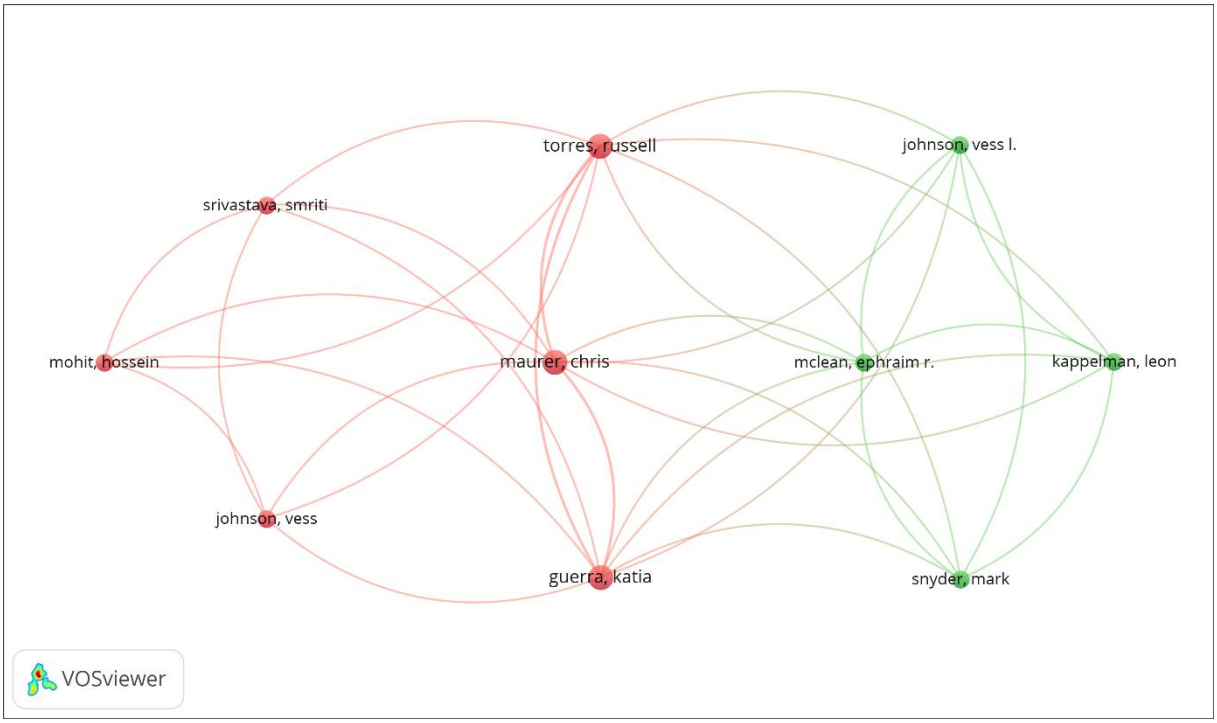


Source: VOSviewer software output

2.3.2 Co-authorship analysis

Six authors are grouped into two interconnected clusters to form the largest connected set of authors, based on the co-author analysis of 316 authors with at least two published papers. The red cluster's nodes are bigger than the green clusters, as seen in Figure 7. The majority of the chosen researchers in these clusters have published more papers than other researchers, according to this visualization. However, there is still little cooperation in the field, so it requires more work. Only 316 out of 4765 researchers actively collaborated with other researchers in the field, according to the co-author analysis.

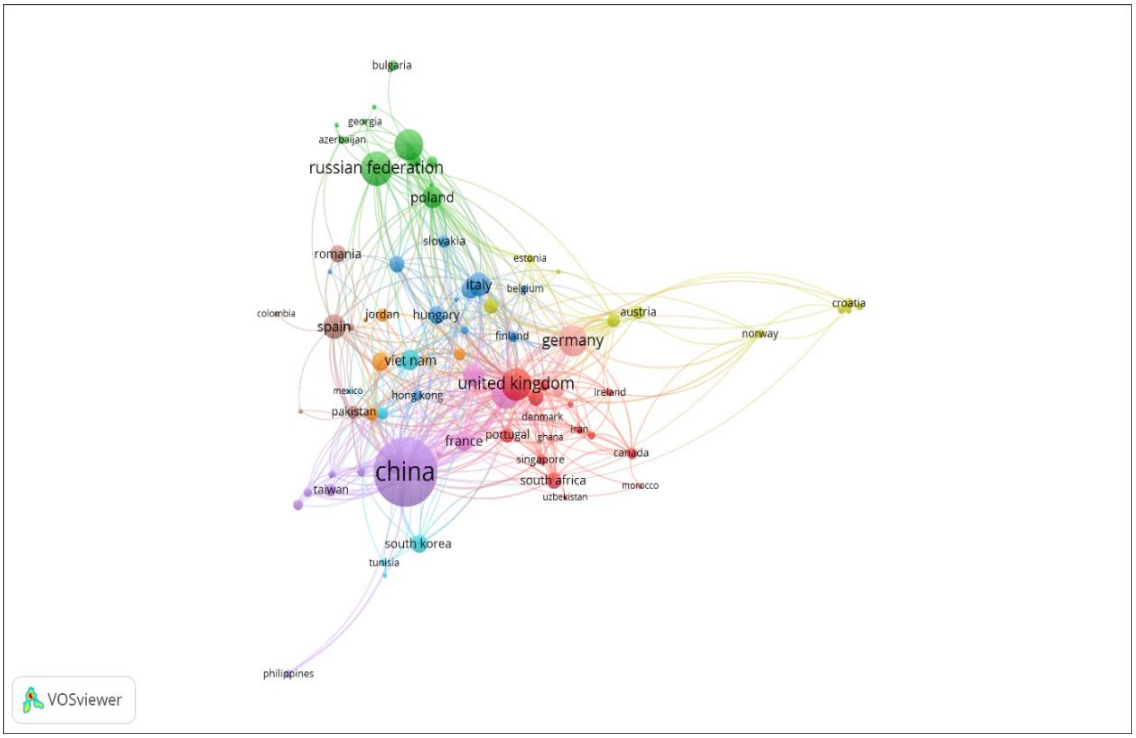
Figure 7: Coauthorship network in the digital transformation field:



Source: VOSviewer software output

As shown in figure 8, 86 countries are collaborating closely to form a network of 10 interconnected clusters. China, the Russian Federation and the United Kingdom are the most influential countries in the field of research into digital transformation in the economy. With a number of 505 papers, China is the most developing nation in this discipline, followed by Russia 125 papers and United Kingdom 111 papers. Indeed, the relatively high number of publications by researchers from these three countries shows that a potential trend towards monopoly is emerging in the field of digital transformation research.

Figure 8: Collaboration among researchers from different countries in the field of digital transformation



Source: VOSviewer software output

2.3.3 Co-occurrence keywords

According to the co-occurrence analysis, a total of 4852 keywords were used in 1660 publications, and we selected only those keywords mentioned in at least 15 publications. As a result, we obtained 55 keywords.

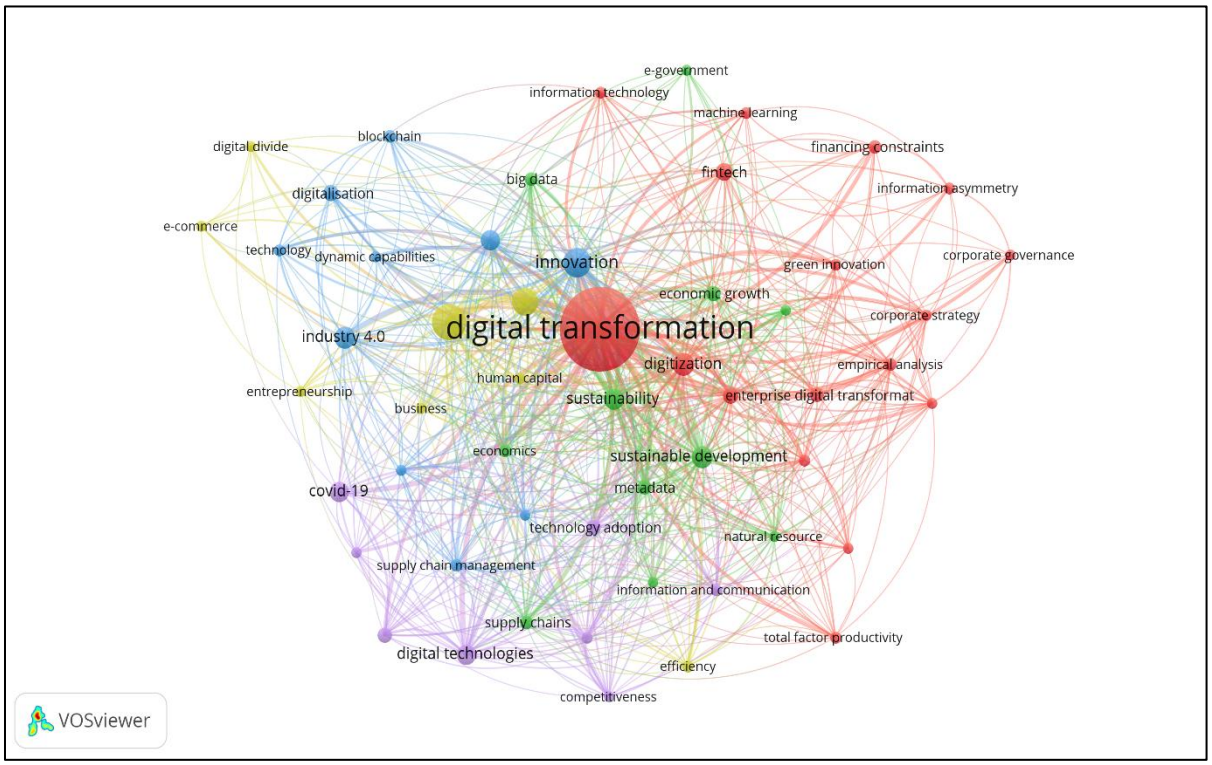
The occurrence of the keywords is illustrated with circles (Figure 9), and it represents the frequency with which the keywords co-occurrence.

The four main keywords in our research topic are “digital transformation” (854 occurrences and 887total Link strength), “innovation” (108 occurrences and 263 total link strength), “digitization “(64 occurrences and 203 total link strength), and “digitalisation” (33 occurrences and 40 total link strength).

The visualization map (Figure 9) shows five colored clusters (red, green, blue, yellow, and violet) related by 675 links. The red cluster totals a number of 17 items; the main ones are “digital transformation” (occurrence = 854), “digitization” (occurrence = 64), and “fintech” (occurrence = 37). For the green cluster, it comprises 11 items; the main ones are the following:

"sustainability" (occurrence = 55), "sustainable development" (occurrence = 61), and "economic growth" (occurrence = 28). The blue cluster presents a total number of 10 items, where the main ones are "innovation" (occurrence = 108), "industry 4.0 (occurrence = 58), and "artificial intelligence" (occurrence = 53). The yellow cluster comprises fewer items (N = 8), with "digitalization" (occurrence = 158), "digital economy" (occurrence = 93) as the main items. As for the violet cluster, it contains 8 items, which are "digital technologies" (occurrence = 53), and "covid 19" (occurrence = 52).

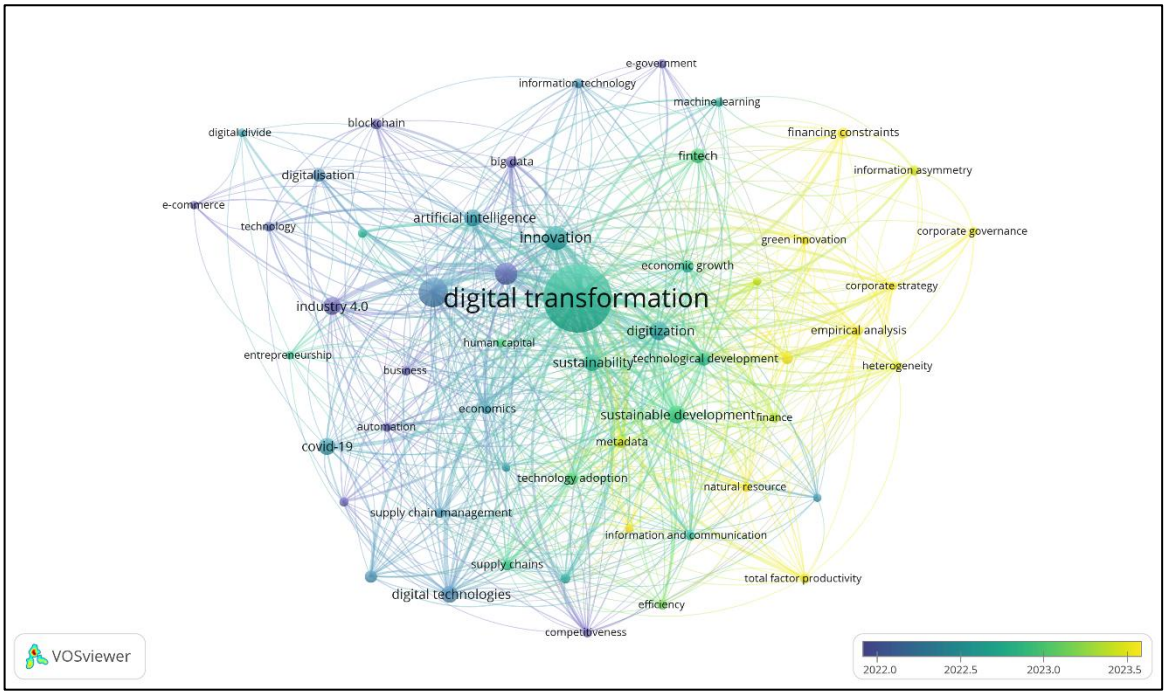
Figure 9: Network of co-occurrence of keywords



Source: VOSviewer software output

The trend around the keyword "digital transformation" changed significantly between 2022 and 2023 (figure 10). Blue (Older - 2022.0) discussions were largely centered on emerging technologies such as blockchain, e-commerce, digitalization and big data, reflecting a focus on optimizing business processes and improving the customer experience. Green (Mid-period - 2022.5), the discourse shifted to concepts such as digitization, fintech and innovation, suggesting a deeper integration of digital technologies into financial services and a constant quest for innovation. Yellow (Newer - 2023.0 - 2023.5), the introduction of themes such as metadata, green economy and green innovation indicates a growing concern for sustainability and resource efficiency. This evolution shows that digital transformation is no longer limited to

simple technological adoption, but encompasses a strategic vision integrating sustainability and



innovation.

Figure 10: Temporal visual analysis of keyword co-occurrences

Source: VOSviewer software output

Conclusions

In summary, this bibliometric analysis has enabled us to draw up a comprehensive map of the research landscape on digital transformation in the field of economics between 2015 and 2024, based on 1660 articles extracted from Scopus database. This bibliometric analysis reveals significant trends, notably the predominance of the Asian giant, followed by other countries such as: Germany, Ukraine and Spain in terms of scientific output. These results underline the growing importance of digital transformation in economic research, and the commitment of institutions in these countries to exploring the economic implications of this transition.

However, several limitations and shortcomings need to be taken into account. Firstly, the study focuses exclusively on the field of economics, which may omit crucial perspectives from other disciplines, such as business, technology or management, that could enrich the understanding of digital transformation. Furthermore, while bibliometrics offers an overview of publication trends, it does not provide in-depth qualitative analyses of article content, this may limit understanding of the specific contexts and issues addressed in this kind of study.

Methodologically, bibliometrics should be combined with case studies or longitudinal analyses. Indeed, the latter are beneficial because they facilitate a better understanding of the phenomena studied.

Therefore, the future research on digital transformation in the economy should focus on more detailed analyses. It is recommended to study impacts on specific sectors rather than the economy as a whole, and to explore social and ethical consequences, such as digital inequalities.

All in all, while this research provides significant insights, a deeper understanding of the challenges and opportunities of digital transformation in today's economy requires a more nuanced and multidisciplinary investigation.

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