

Mapping the Supply Chain Digitalization: An Exploratory Bibliometric Analysis

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Abstract

In a global business environment facing more and more risks (recession risk, geo-economic risk, natural risks) digitalization can represent a solution for increasing resilience at the level of the supply chain. The development of new technologies has created the premises for the transformation of traditional logistics chains into digital logistics chains and the pandemic crisis accelerated the process for most companies and institutions.

The scope of this paper is identifying the interest in researching the subject of supply chain digitalization. The study is based on a quantitative research method, bibliometric analysis. A query was conducted on the Scopus platform database to identify scientific works (research articles, books, papers presented at conferences) that include keywords specific to our topic, in the title, abstract or body.

The results of our study confirm a growing scientific interest for researching the topic of supply chain digitization: from 2002 to February 2023, 913 documents addressing this subject or related issues were identified.

Keywords

Digital supply chain, bibliometric analysis, VOSViewer, Scopus

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Introduction

Following the processes of economic globalization and rapid development of information technology, companies have tried to develop and implement global networks that integrate the sources of supply, production, and distribution of finished products. Thus, traditional supply chains appeared, networks containing suppliers, manufacturers, distributors located in different areas of the globe. During the Covid-19 pandemic, a series of dysfunctions appeared at the supply chain level: problems with the supply of raw materials or semi-finished products (e.g., the microchip crisis), problems related to production activity (insufficient staff), difficulties in organizing logistics activities (container crisis, significant increase in shipping prices). Covid-19 health crisis generated transport and delivery disruptions which intensified the need for digital transformation of the supply chain (Sharma, et al., 2020). Under these conditions, companies took advantage of the development of new technologies and began or intensified the process of supply chain digital transformation to achieve digital connectivity between SC participants (Nasiri, et al., 2020).

Digitalization of the supply chain is a theme that has been increasingly addressed in the scientific literature in recent years. More and more research papers deal with this process of transforming the traditional supply chain using new information technologies. We can say that the interest in the topic increased with the emergence of the Covid-19 pandemic, when a major concern of those involved in supply chain management

was to ensure the resilience of the global supply chain. The terms specific to the supply chain digitalization process used are smart supply chain (Wu, et al., 2016), digital supply chain (Ivanov and MacCarthy, 2022; Büyükoçkan and Gocer, 2018), supply chain 4.0 (Frederico, et al., 2019) and supply chain 5.0 (Frederico, 2021).

This article analyzes scientific papers addressing the topic of supply chain digitalization and several questions were formulated: What are the main topics addressed in terms of supply chain digitalization? What is the most frequent keyword used in the analyzed articles? What is the trend regarding the publication of research papers (articles, papers presented at conferences) in the field of supply chain digitization?

Starting from these questions, the research objectives were established. The main objective is to analyze the situation of research papers with the theme of supply chain digitization, from a bibliographic point of view. Secondary research objectives are:

- evaluation of links between keywords and articles published in different journals classified in the Scopus database.
- analysis of research articles on supply chain digitalization, considering the co-authorship, journals and year of publication.

1. Review of the scientific literature

The IT revolution impacts all types of organizations (from both public and private sector) that process, store and transmit information, reshaping the entire economic-social life. Digital revolution is considered by some authors as a component of this process and by others, a new phase of it. The digital revolution means the transition from mechanical technology and analog electronic technology to digital electronic technology, a change initiated, from the late 1950s to the late 1990s, by the introduction and expansion of the use of digital computers and digital data storage and became decisive in the following decades. The central place in this revolution belongs to series production and the ever-wider use of digital logic circuits, as well as complementary technologies (computers, mobile phones), as well as the spectacular development of the Internet. Digital revolution is considered as a 3rd revolution in human history, after the agricultural revolution and the industrial revolution took place in the past historical eras. An important characteristic of this revolution is changing the business models by implementing digital technologies with the scope of identifying new profit opportunities (Popa and Belu, 2018).

Supply chain is a complex logistic system in which raw materials - production factors - are transformed into finished products and then distributed to end users (individual consumers or companies). It includes suppliers, processing centers, warehouses, distribution centers and retail outlets (Bhardwaj et. al., 2021). In the current conditions (problems related to the supply of raw materials or semi-finished products, the increase in the price of transport, areas with armed conflicts, areas affected by earthquakes) supply chain management is increasingly complex. Several factors have also contributed to making SC management more complex — the quest for sustainability, globalization, trade liberalization and implementation of new technologies. SC management is a vital factor in increasing the competitiveness of an organization (Saber, et al., 2019).

The digitization of the supply chain is enhanced by the process of innovation in logistics, being driven by the development of certain technologies and their increasingly frequent use in the management of activities related to the supply of raw materials (digitalization of procurement), processing/production (smart factory) and distribution of finished products (smart warehouses, digital platforms).

Supply chain digitization helps companies become more flexible when facing challenges like disruption risks or increased level of competition. To implement the process of SC digitization, organizations must have the internal capability to absorb new information and methods. The "ability of a firm to understand, assimilate and apply the knowledge possessed by another international joint venture partner" is defined as absorptive capacity (Fang and Zou, 2010). We can say that SC digitization is a solution that improves risk management at the supply chain level (Ivanov and Dolgui, 2019).

Digital supply chain is defined as a cyber network with end-to-end visibility representing a physical supply chain with associated operational data and performance evaluations (Ivanov and McCarthy, 2022). Digital supply chain presents several advantages, such as: reducing costs, accelerating innovation, reducing time-to-market (see figure no. 1)

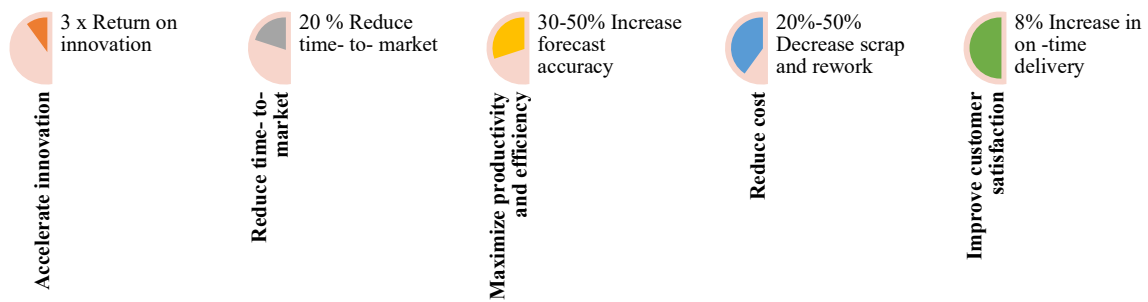


Figure no. 1. Digital supply chain benefits

Source: Jenkins, 2022

In traditional supply chains, activities are carried out based on transaction history, so we can say they are mostly static and have a linear representation, while in digital supply chains activities can be adapted to changes in real time, so we can say they are dynamic, and we can represent them graphically as a network.

If until 2020, the supply chain management was guided by *just in time* principle (the right quantity of goods with the quality in accordance with requirements at the right time and the right price), the new phrase that will be the basis of supply chain reconfiguration will be *just in case*.

2. Research methodology

The paper aims to identify the scientific interest in the field of supply chains digitalization. For this purpose, we used bibliometric analysis. According to (Donthu, et al., 2021), bibliometric analysis has gained great popularity in business research, as bibliometric software, and databases (Web of Science, Scopus, etc.) became easier to access. Bibliometric methodology is a transdisciplinary approach and can be used for information science and business research.

Considering previous research carried out in the field (Krajka, et al., 2022; Cristian, et al., 2022; Wang, 2022), the research methodology involves going through some stages (see figure 2). Thus, the research methodology includes three stages: in the first stage, *Research development*, we established the research objectives and the selection of data from Scopus platform; the second stage, *Bibliometric analysis*, the use of VOSviewer analysis and map visualization and the last stage, *Results and discussions*, in which the conclusions, research limits and future research directions are presented.

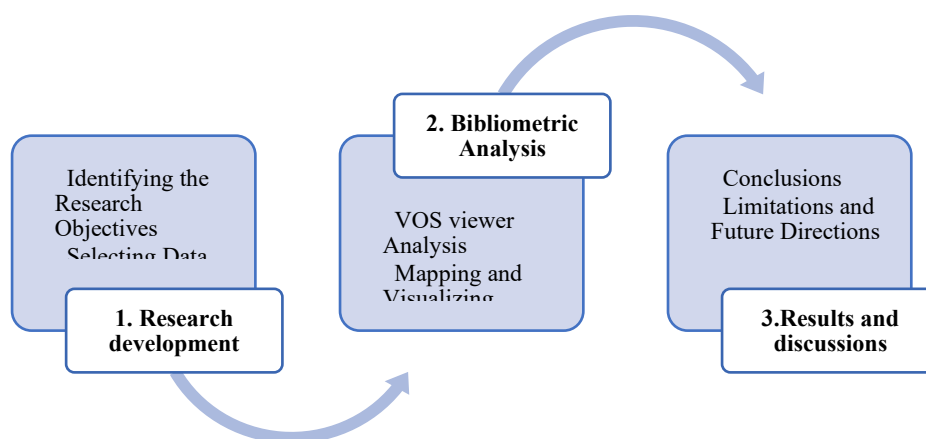


Figure no. 2. Flow Chart

We conducted an analysis using information from the query of Scopus database - on scientific journals, articles, books, and others. The software product VOS viewer, version 1.16.19, was used for performing a quantitative analysis on the scientific interest in the digitization of supply chains and for creating maps

which graphically represent the links between the words that appear most frequently in the documents resulted from the query (Van Eck and Waltman, 2010; Van Eck and Waltman, 2011).

The database chosen for data collection is Scopus, one of the most important abstract and citation indexing platform. The query was performed using several filters in order to identify the articles to be analyzed. Following the query, a number of 1064 documents were identified that satisfy the query keywords: TITLE-ABS-KEY ("supply chains" and "digitalization"). Later, following successive refinements, the final number of documents analyzed was 913 documents.

3. Results and discussion

Querying the Scopus database led to the identification of a number of 913 scientific documents containing the terms "supply chains" and "digitalization" in their title, summary or keywords. The analyzed documents are articles (56.1%), conference papers (32.3%) and book chapters (11.6%). Regarding the temporal distribution of the selected works, the analyzed period is 2002-2023. From the analysis of the information, until 2016, the topic of the digitalization of supply chains was not at the center of concerns, with values between 0-3 per year being recorded, and starting from 2016, there is an increase in the number of papers presenting this subject, which shows an awareness of the advantages of supply chain digitalization (see figure 3).

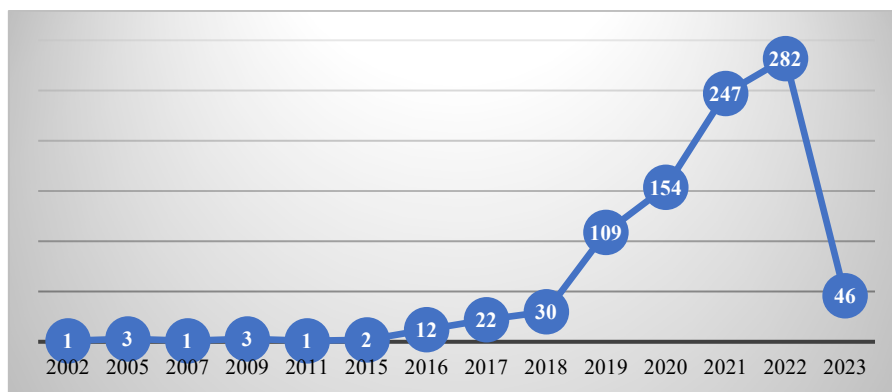


Figure no. 3. Temporal distribution of articles published in the period 2002-2022

Source: Scopus

Regarding the semantic analysis of the keywords with the highest number of occurrences in the analyzed documents, we present in table no. 1 a selection of the top 10 keywords, according to the strength of the links (given by the number of co-occurrences) they have created with other keywords.

Table no. 1. Top ten keywords in the literature on supply chain digitalization

Keyword	Occurrences	Total link strength
Supply chains	333	1419
Digitalization	254	904
Supply chain management	211	849
Industry 4.0	161	668
Supply chain	120	436
Decision making	72	380
Blockchain	84	334
Sustainable development	56	330
Digital transformation	75	323
Internet of things	62	293

Source: by the authors using VOSviewer

In figure no. 4, the links between keywords are highlighted, graphically presented by the branches connecting the different keywords (represented by larger or smaller circles, depending on the frequency of appearance in the analyzed works). Depending on the strength of the links, the lines are thicker or thinner. For example, a strong link, given by a number of 254 co-occurrences, appears between digitization and supply chains. It is necessary to specify the fact that 106 keywords are included in figure no. 5, each of them having a minimum of ten occurrences in the documents of the collection. They were grouped into 7 clusters according to the distance between them (by positioning them in a two-dimensional plane).

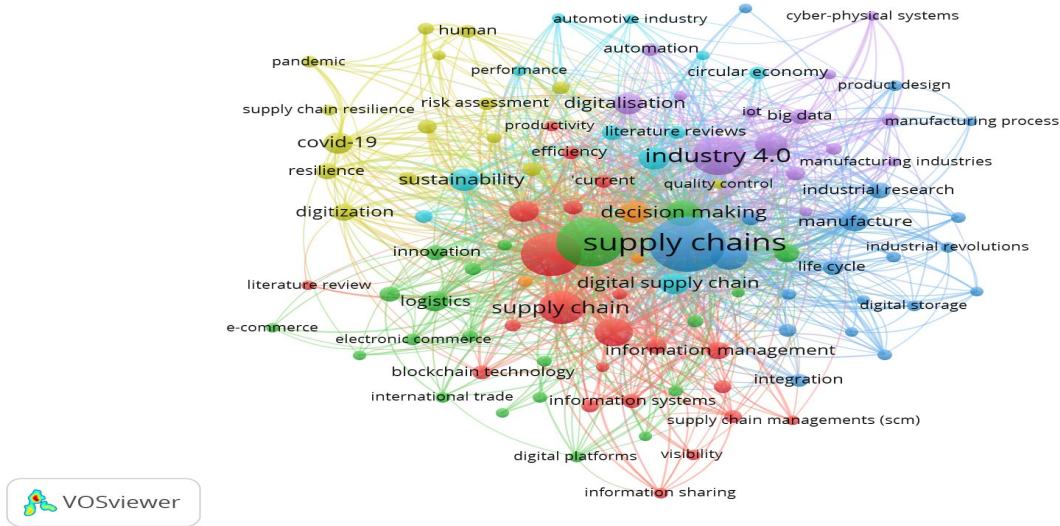


Figure no. 4. Link map between keywords

Source: by the authors using VOSviewer

As can be seen in figure no. 5, the density visualization map based on the criterion of the minimum number of 10 articles/country, Germany represents the with the highest density, because at the level of this country 129 specialized papers were published. Along with Germany there are other countries with a large number of works such as: Great Britain 103, India 86, Russian Federation 86, Italy 76, China 68.

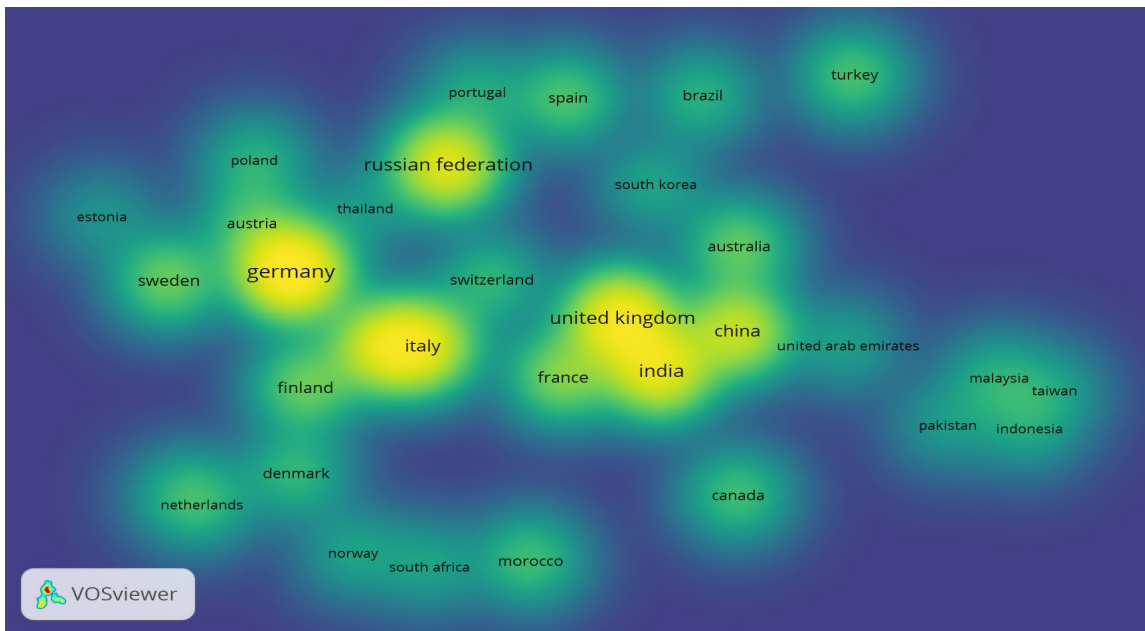


Figure no. 5. Bibliometric analysis of works containing the key terms by country of origin

Source: by the authors using VOSviewer

Conclusions

Following our analysis, we can formulate the following conclusions: publishing of scientific papers in the field of supply chain digitization began in 2002, reaching a maximum in 2022 - a fact that indicates the importance of digitization in supply chain management; the map of links between keywords highlights the importance of applying new technologies in supply chain management. The motivation for managers to implement new technologies in their companies and digitize their logistic network are increase of transparency, agility and security, easier cooperation between supply chain participants and higher quality services offered to consumers. All these advantages ultimately led to an increase of overall business performance and profit.

The increasing growth rate of scientific works that address digitization in supply chain management area, reflect the awareness of scholars about the importance of the subject and multiplies the effect of dissemination and information sharing, both in the form of theory and practices.

As for the limits of this research, they refer to the database used in the analysis, but taking into account the similarity of the most important databases that store scientific works globally, we believe that this limitation does not have an important effect on the results of the work.

Whether we are comfortable with the idea or not, the future of international business is closely linked with automation and artificial intelligence, so as further research direction we propose to investigate the implementation of AI in logistic networks.

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