

A benchmarking of the recent literature of Digitalization in Supply Chain of Web of Science Database from 2010 to 2021

Rachid EL GADROURI, (*Doctor of Management Sciences*)

*National School of Business and Management
 Ibn Zohr University, Agadir, Morocco*

Adresse de correspondance :	National School of Business and Management Rue Hachtouka Hay Salam, BP: 37/S – Agadir – Morocco +212 5 28 22 57 48 / 39 encg-agadir@uiz.ac.ma
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Abstract

Digital technologies, a phenomenon that has been in search for a few years. This appearance is linked to the implementation and the dynamization of the industry 4.0, to the progress of the digital technologies but also to the specificities of the competition context, particularly in terms of complexity, uncertainty and great dynamics.

Therefore, in order to be able to do so, companies must now integrate digital technologies into their supply chain management systems because they create a competitive advantage through the availability of the product offer, the reduction of costs but also the increase of market shares. They also enable the integration of practices that improve access to information, increase responsiveness and collaboration capabilities, and even agility.

This article examines, through a systematic review, what the scientific community says about the main technologies and characteristics of digital technology adoption in supply chains.

We evaluated 96 articles on Digitalization in Supply Chain research. While indicating that the main contribution of this work is that empirical studies relating to digitalization in Supply Chain are still rare and even absent in developing countries.

Keywords: Supply Chain, Digital technology, Technology adoption.

JEL Classification: O14, N70.

Paper type: Theoretical Research

1. Introduction :

The recent technological progress illustrated by the emergence of a range of digital technological tools has concerned the consideration of firms and scientific academics. Because the use of these emerging technologies can present significant opportunities for the supply chain, particularly in improving the connection between information flows, goods flows, financial flows and also the flow of people (Ibarra et al., 2018), while creating a new mode of supply chain management. This phenomenon is called the Digital Supply Chain, also known as Supply Chain 4.0, which is unveiled as the application of digital technologies to the Internet of Things, advanced robotics, Big Data analysis in supply chain management while creating automated networks to significantly improve performance and customer satisfaction (Alicke et al., 2016). Otherwise, these technologies have the ability to reform supply chains into more agile and resilient networks because they improve performance in key supply chain qualities such as partnership, clearness, suppleness, reaction and efficiency.

The implementation of digital technologies in supply chains is a developing concept resulting from a transformational approach to supply chain management that uses disruptive Industry 4.0 technologies to rationalize supply chain processes, activities, and relationships to generate significant strategic benefits for all supply chain stakeholders. Some see it as an ecosystem of mass and customized (digital and physical) products and services, through data mining and data trends, even predicting customer need lifecycles, adapting their operations for quick and optimal responses (Garay-Rondero et al., 2019). However, other researchers argue that there are two aspects to this concept: the first relates to the implementation of novel numerical tools in supply chain processes that enable the creation of business relationships with suppliers and customers, while the second relates to the roles of these technologies in transforming supply chain capabilities and operational performance (Ehie & Ferreira, 2019). Similarly, (Ernst & Young, 2016) have defined Digitalization in Supply Chain as the development of data structures then the implementation of advanced tools that improve supply chain integration and agility, thereby improving purchaser facility and viable organizational performance.

However, before this phenomenon quickly and widely aroused interest in theoretical and empirical research, it was the result of remarkable historical transformations, depending on different global circumstances: historical, human, natural and societal (Ivanov, 2020b). This author has made clear, in a sense that the advent of digital technologies or the era of digitalization is even outdated, after this post-pandemic period that has been a real test for sustainability, resilience, agility and integration of supply chains. He argues for a new reflection of a model called Viable supply chain.

Moreover, the scientific literature on this subject is not limited to the conceptualization of the notion itself, but the theoretical and empirical research conducted has tried to demonstrate the relationships and intersections between digital technologies and supply chain management. Notably, (Queiroz & Telles, 2018) and (Queiroz et al., 2020) have respectively conducted empirical studies on the adoption of Big Data Analytics (BDA) in the supply chain and also on the relationship between the determinants of Blockchain (BC) adoption and supply chain performance; (Ghadge et al., 2020) studied the employment of Industry 4.0 technologies in the supply chain. (Kouhizadeh et al., 2021) theoretically explored the obstacles to implementation of Blockchain (BC) tools on sustainable supply chain; (Koh et al., 2019) clarified the disruptions of Industry 4.0 technologies on supply chain operations and managing; (Ehie & Ferreira, 2019) developed a conceptual framework of the Digital Supply Chain. (Y. Wang et al., 2020) established a conception of the supply chain, activated by Blockchain (BC) technology. Very recently the covid-19 pandemic has expanded the field of scientific research into other aspects of the supply chain, particularly resilience, sustainability, and agility (Ivanov, 2020a). while taking advantage of the circumstances of this ever-evolving sphere of digitalization; (Koh et al.,

2019) disrupt the management of all phases of the supply chains (Korpela et al., 2017), for example the development of transactions and the conquest of new partners in the relationship: Buyers-Suppliers, while using digital technologies. At the similar period, the adoption of numerical tools will certainly face obstacles influencing the application of supply chain technologies due to various organizational, operational and financial constraints.

Therefore, this paper aims to deliver a state of the art on the emerging practice of digital technologies in supply chains. First, it provides an overview of the different digital tools involved in supply chain management, as well as their benefits and characteristics. Second, it provides a review of studies focused on the acceptance of digital technologies in the supply chain in order to motivate researchers and practitioners to give greater concern to this topic.

2. Literature review and background

The scientific literature debates some of the purported objectives or potential benefits of implementing digital technologies of the Supply Chains, in particular its ability to reduce costs; and improve performance; while promoting seamless supply chain collaboration (Stank et al., 2019). In addition to other benefits related to improving the company's operational performance by influencing its products, business processes, sales channels and supply chain (Matt et al., 2015).

The many Scientifics researches related to digital technologies of the Supply Chains is problematic in many respects. Questions about the definition and understanding of digital strategy; its characteristics; its capabilities; its ambiguities and threats when implementing digital initiatives; as well as the mechanisms used to achieve competitiveness, performance and value creation when adopting digital technologies of the Supply Chains. Although scientific research has explained the potential benefits of all these new digital technologies, research on the adoption of digital technologies of the Supply Chains tools lacks the diversity, theoretical applications and explanations to adequately answer the questions relating to this field. The authors have drawn on several theories in this respect: Resource Based View theory, Diffusion of Innovation Theory, Institutional Theory.

The proliferation of digital technologies and their use will allow companies to create savings in production process costs, as well as create new types of jobs (Manyika et al., 2017). The era of digitalization has enabled the implementation of a range of digital technologies, which have affected supply chain management, which has also led to the development of innovative features of the supply chain. The scientific literature on the subject(BÜYÜKÖZKAN FEYZİOĞLU & Gocer, 2018); (Chick & Handfield, 2014); (Demetriou, 2011);(Dubey et al., 2020);(Frederico et al., 2019);(Ivanov et al., 2019);(Koh et al., 2019);(Lohmer et al., 2020);(Queiroz et al., 2019);(Queiroz & Telles, 2018);(Wu et al., 2013). Specifically cited Digital technologies that have the role of developing a Supply Chain with respect to: Artificial Intelligence (AI), Cloud Computing (CC), Cyber Security Systems (CPS), Big Data analytics (BDA), Blockchain (BC), Internet of Things (IoT), and Robotization (R). We have illustrated through (see table 1) some definitions from the literature on digital technologies in supply chain.

Table 1. Digital Technologies in supply chain

Tools	Sources	Description
Cyber Systems Security (CSS)	(S. Wang et al., 2016)	Network structure with implanted strategies (sensors) allowing self-management of physical processes and their feedback.
	(Hofmann & Rüsç, 2017)	Digital technologies that control physical processes not only in one direction, but also linked to feedback loops with the system, while allowing real-time harmonization of information and physical flows.
Big Data Analytics (BDA)	(Wamba et al., 2015)	A global approach to obtaining actionable information to create a competitive advantage that differs from the business analysis approach in terms of 5V: volume, variety, speed, truthfulness and value.
	(Bahrin et al., 2016)	Allows data to be collected from a variety of sources and fully analyzed, allowing immediate-time choice making based on the results of the data analysis.
	(Hu et al., 2014)	The procedure of using analysis algorithms to expose capacities concealed in big data, such as hidden patterns or unknown correlations.
Artificial Intelligence (IA)	(Haenlein & Kaplan, 2019)	Are tools based on intelligence, while referring to theories and techniques..
	(Chung, 2018; Pei et al., 2019)	Production system that uses machines that fully imitate the tasks performed by human labor.
	(Mishra et al., 2018, 2019)	Artificial intelligence is any device or facility that uses computer skills to operate as or replace employees.
Internet of things (IoT)	(Okano, 2017)	An internet-based technical infrastructure that enables the transfer of goods and services in the international supply chain network.
	(Majeed & Rupasinghe, 2017)	The Internet of Things brings elements of response by integrating several information and communication technologies. For example, tools and software for storing, extracting and analyzing information as well as electronic equipment for connecting users or sets of materials.
	(Queiroz et al., 2019)	A device of objects intended to ensure the connection between them, without having to resort to human means.
Blockchain (BC)	(Swan, 2015)	A large register of transaction data recorded in a multi-member network. Its transaction data is stored in folders that are arranged in historical order.

	(Al-Saqaf & Seidler, 2017)	A large digital ledger that is used to share and distribute transactions within a network.
	(Y. Wang, 2019)	A digital directory that is encrypted and hosted on multiple servers in a public or private network. Once these folders are assembled in a chain, they are unchangeable and cannot be deleted. Instead, they are controlled and administered through automated and joint management procedures.
Robotisation (R)	(Ivančić et al., 2019)	A new technology that focuses on the dematerialization of repetitive, routine and standards-based human operations, with the aim of generating gains for companies that choose to deploy such technology.
	(Huang & Vasarhelyi, 2019)	A pre-configured programming interface that uses operating principles and a set of predetermined tasks to automatically execute a sequence of procedures, operations, exchanges, and assignments in one or more non-associated software systems to produce a result or service with human exception handling.
	(Lacity et al., 2017)	The dematerialization of the execution of operations while using structured information flow management mechanisms, leading to a precise decision and a deterministic result.
Cloud computing (CC)	(Badger et al., 2012; Mell & Grance, 2011)	Cloud computing is a system offering accessibility to a generalized network, containing a set of configurable computer data (networks, servers, storage, applications and services) that can be delivered and unlocked in a rapid manner with minimal management effort or interaction with service providers.
	(Mitra et al., 2017)	Cloud computing is a digital technology for storing and processing huge amounts of data, which boosts the productive system of companies and brings them higher performance and lower costs.
	(Aviles, 2015)	Cloud computing is turning Information Technologies into utility computing accessible to all organizations for managing and delivering services over the internet.

Source: by author

However, all its digital technologies play important roles in supply chain management, as an example, researchers (Gunasekaran et al., 2017) have analyzed the impact of the use of BDA in improving supply chain performance under different facets: visibility, robustness, resilience. (CC) further contributes to developing the responsiveness and yield of supply chain processes (Jede & Teuteberg, 2015), while (IoT) facilitates supply chain coordination, programming and monitoring processes (Ben-Daya et al., 2019).

In addition to the plurality of digital tools used in supply chain management, this wave of digitalization also results in supply chains acquiring new properties and characteristics (Bechtold et al., 2014; Hanifan et al., 2014); (Schrauf & Bertram, 2016); (Schrauf & Bertram, 2016). Table 2 sign the main characteristics of the numerically technologies in supply chain from the scientific literature.

Table 2. Characteristics of the digital technologies in supply chain

Characteristics	Sources	Description
Intelligence	(Bechtold et al., 2014; Hanifan et al., 2014)	Characterized by intelligence that enables better autonomous decision-making, automated execution, self-learning, and promotes innovation in supply chain operations due to the options offered by the use of technology means.
Scalability	(Bechtold et al., 2014; Hanifan et al., 2014)	Beyond the problem of responding to changes in the size of supply chains, while making it possible to optimize processes and identify anomalies and errors.
Speed	(Hanifan et al., 2014; Raj & Sharma, 2014)	Makes it possible to achieve the speed desired by organizations that are always looking for ways to achieve rapid delivery.
Transparency	(Schrauf & Bertram, 2016)	The scheduling of flows within the supply chain. It is, among other things, the modeling of the supply chain networks by the fact of mobilizing in real time to the changes.
Flexibility	(Hanifan et al., 2014; Schrauf & Bertram, 2016)	The ability to ensure operational agility in the face of market volatility and changing circumstances. Otherwise, this digitalization allows supply chains to respond effectively and efficiently to its circumstances through the active use of collected and specified data.
Connectivity global	(Hanifan et al., 2014; Schrauf & Bertram, 2016)	Establishing a way, via digital technologies, to build efficient global centers to provide goods and services locally, rather than transporting them to around the world.
Innovation	(CUKIER & MAYER-SCHONBERGER, 2014)	A key feature to ensure that digital technologies remain scalable to change. The world is awash in a generation of technologies at an unprecedented rate. Digital technologies are expected to find better ways to integrate these advances into processes to maintain competitiveness and supply chain excellence.

Source: by author

3. Methodological procedures

We chose for the conduct of this study, the protocols of (Tranfield et al., 2003), which included the following steps: (1) Planning the review, (2) Conducting the review, and (3) reporting the results of the review, of 96 articles identified in relevant journals in the use of technology means in supply chains fields.

Firstly, the study also included conceptual and empirical scientific articles related to management and social sciences, in order to examine even recent perspectives on the digitalisation of the supply chain. We also included all articles focusing on one or more digital technologies at least one stage of the supply chain. We applied temporal restrictions: our search included peer-reviewed articles in scientific journals published between 2010 and 2021. In addition, only publications in English were taken into account.

Study selection is the second step of the benchmarking of the recent literature protocol (Tranfield et al., 2003), our search was limited to peer-reviewed English journal articles, to ensure a certain level of quality (Burgess, Singh, and Koroglu, 2006); we identified all possible articles related to (DSC) and also those related to digital technologies in supply chains.

The search queries for WoS were structured as follows:

Include any combinations of strings of "digit*" OR "digital technologies" OR "Technology Transfer "OR "digital technology adoption" AND ("Supply Chain "or" Supply Chain management" We used all these key-words to retrieve all possible results.

The initial search yielded 2999 articles from the 'Web of Science' database using the above keyword combination. Inclusion and exclusion criteria were then defined and applied to narrow down the selection of studies (n = 517).

We analyzed the abstracts of these 220 articles, and carefully assessed the main purpose of these articles. Next, 96 articles were considered relevant to the study.

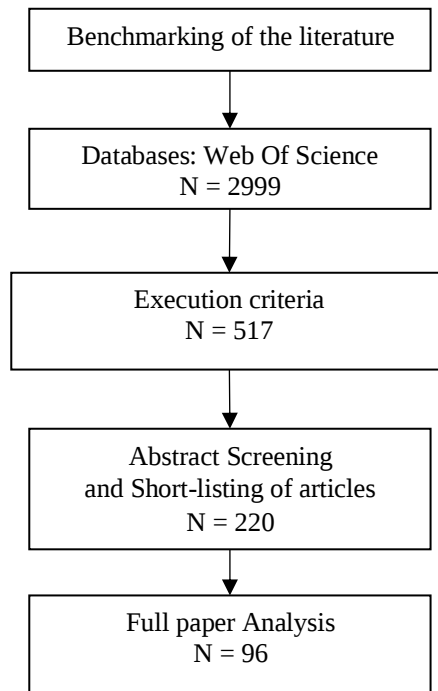
Table 3 and figure 1 provides a clear picture of our study approach, targeted databases, type of publication, and use of keywords in the search structure.

Table 3. Research protocol parts

Research protocol	Details description
Research databases	Web of Science (However, WoS covers a wide-ranging number of disciplines, and its records go back to 1900) (Meho & Yang, 2007). Therefore, we chose WoS as our source to extract articles information (Tranfield et al., 2003).
Publication type	Peer-review journal publications.
Language	English language.
Date range	We did not apply restrictions on time, in order to include all possible studies into our list; the latest search was done in mid-2021.
Search fields	Titles, abstracts & keywords.
Search terms	Include any combinations of strings of "digit*" OR "digital technologies" OR "Technology Transfer " OR "digital technology adoption" AND ("Supply Chain " or " Supply Chain management" We used all these key-words to retrieve all possible results.
Criteria for inclusion	Direct connection to the article research objectives (Build on digital technologies focus on one or more specific digital technologies enabling the digitalization of the supply chain) and focus in 'Operations Research and Management Science', 'Business', 'Management' and 'Economics'.
Criteria for exclusion	No direct relationship with the research objectives of the article (Not to focus on articles dealing with technical aspects).
Data analysis and synthesis	All types of analysis.

Source: by author

Fig. 1: The literature Review Protocol

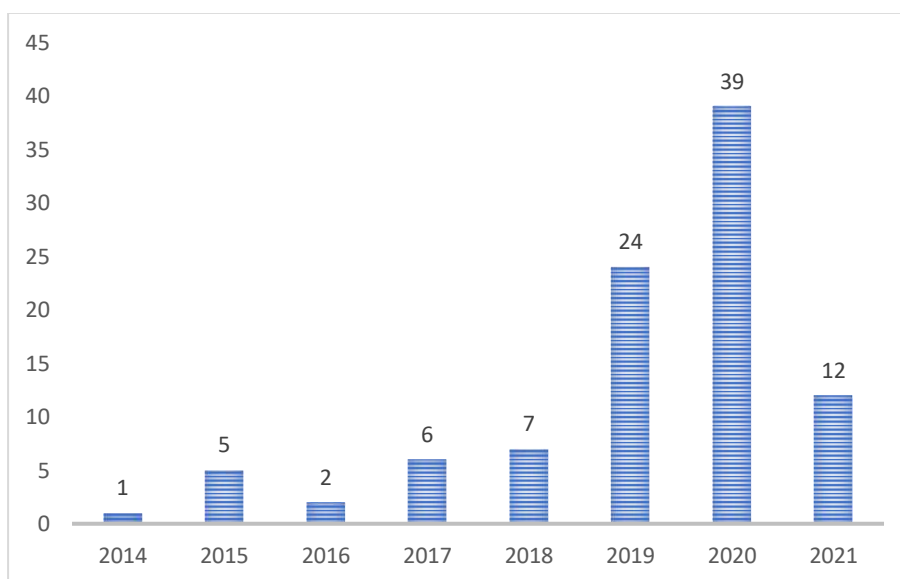


Source: by author

4. Resultats

All the selected articles published from the year 2014 onwards, the majority of them in the years 2019 and 2020, which is strong evidence that the scientific approach in relation to the employment of digital technologies in supply chain management is in search. Illustrated in Figure 2, the distribution of selected papers according to their year of publication. Before the year 2018, there were less than seven articles published per year on this subject. But in the year 2019, the level of publication has skyrocketed and a large volume of articles has been produced during the 2019 and 2020, including twenty-four articles in 2019, thirty-nine articles in 2020 and twelve articles 2021 (knowing that our search was limited in June 2021).

Fig. 2. Distribution of papers by publication year



Source: by author

However, the 96 articles selected in this study distributed in 41 journals, as exposed in Table 4 the journal "Production Planning & Control" dominated this distribution, with 15 articles published on this topic. followed by several other journals "Supply Chain Management-An International Journal" (6 articles), International Journal Of Production Research (6 articles), International Journal Of Production Economics (6 articles), International Journal Of Physical Distribution & Logistics Management (5 articles) and International Journal Of Logistics Management (4 papers). The main authors are, Wamba, Ivanov, Dolgui, Queiroz and Seyedghorban.

Table 4. Distribution of papers by journals.

Journals	No. of Articles
Production Planning & Control	15
Supply Chain Management-An International Journal	6
International Journal Of Production Research	6
International Journal Of Production Economics	6
International Journal Of Physical Distribution & Logistics Management	5
International Journal Of Logistics Management	4
Transportation Research Part E-Logistics And Transportation Review	3
Industrial Marketing Management	3
International Journal Of Operations & Production Management	3
Business Process Management Journal	3
Production And Operations Management	2
Logistics-Basel	2
International Journal Of Business Analytics	2
Supply Chain Forum	2
Operations And Supply Chain Management-An International Journal	2
International Journal Of Logistics-Research And Applications	2
Business Horizons	2
Journal Of Modelling In Management	2
Logforum	2
Benchmarking-An International Journal	2
Journal Of Manufacturing Technology Management	2
Journal Of Business Logistics	2
Technological And Economic Development Of Economy	1
Journal Of Business Ethics	1
International Journal Of Lean Six Sigma	1
Journal Of Industrial Integration And Management-Innovation And Entrepreneurship	1
Journal Of Business Research	1
Brazilian Journal Of Operations & Production Management	1
Journal Of Engineering And Technology Management	1
International Journal Of Mathematical Engineering And Management Sciences	1
Estudios De Economia Aplicada	1
Journal Of Purchasing And Supply Management	1
Applied Stochastic Models In Business And Industry	1
Industry And Innovation	1
Systems Research And Behavioral Science	1
Engineering Construction And Architectural Management	1
Technovation	1
Management Science	1
Journal Of Enterprise Information Management	1
Oeconomia Copernicana	1
Total	96

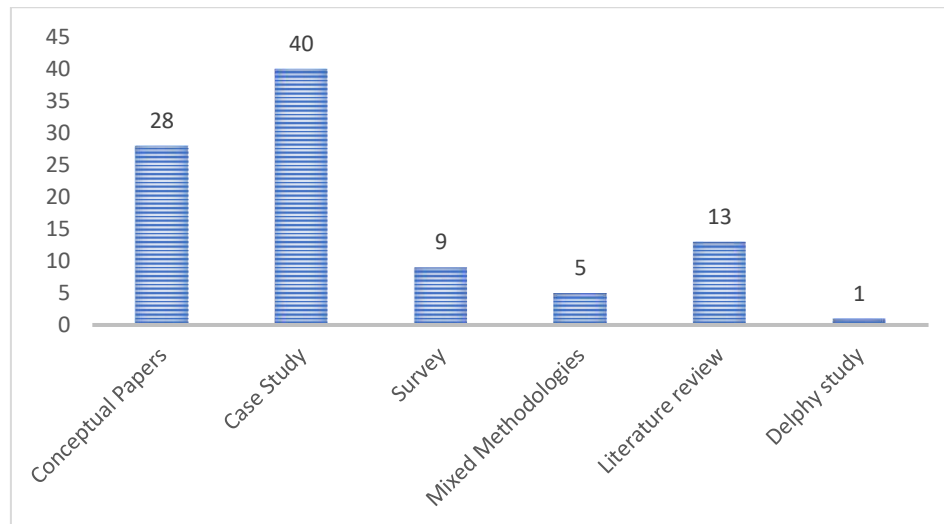
Source: by author

Figure 3 analyses the set of research methods used in the selected articles were analysed It results that the case study monopolizes the most used methods (40 papers), followed by

conceptual analysis (28 papers), literature review (13 papers), as well as and other methods, such as mixed (5 papers) and Delphi (1 paper).

We also analyzed the distribution of articles by country presented in Table 5. The analysis highlights that the number of publications comes from only 11 countries. It should be noted in this sense that more than 62.5% of the articles come from England, followed by the USA (13.5%). The results in Table 2 clearly show that the first two countries (England and USA) contribute more than 76% of the total contributions. This inequality calls into question the interest in this subject or the scarcity of data in this field in other countries.

Fig. 3. Publications by research methodology



Source: by author

Overall, the main objective of a literature review is to provide an overview of the concepts to be studied. It crucially illustrated that benchmarking has a conceptualization that is still in its infancy and has not yet reached maturity. Existing studies have approached the subject of digital technologies adopted in the supply chain from different angles and definitions are, to some extent, scattered. In this study, existing research on digitalization in supply chain comprising 96 articles synthesized using a literature review. The vast majority of them focus essentially on the theoretical aspect of the term. This leads us to suggest that future research on digital supply chain must imperatively carry out empirical work to analyze the impact of this digitalisation and the role of different technological tools in supply chain management. As well as their impacts in terms of performance, visibility, agility, resilience, sustainability and viability, put to the test by the different circumstances of the global sphere.

Table. 5. Countries and Number of Publications.

Country	No. of articles	Percent
England	60	62,5
USA	13	13.5
Netherlands	11	11,45
Poland	3	3.25
Switzerland	2	2,08
Indonesia	2	2,08
Spain	1	1,04
Singapore	1	1,04
Brazil	1	1,04
India	1	1,04
Lithuania	1	1,04
Total	96	100

Source: by author

However, several managerial implications arise from the findings of this research. Firstly, this review supports a deeper knowledge and understanding of digitalisation in supply chain. An understanding of the phenomenon would enable managers to implement a plan to transform the traditional Supply Chain into a Digital Supply Chain more fundamentally and with more knowledge. In addition, this study helps managers to broaden their perception of digital supply chain transformation beyond a technology implementation project, helping them to take a realistic approach to the possibility of remodeling towards a Digital Supply Chain. This is crucial in some cases, where it assumed that the introduction of digital technologies into the supply chain would guarantee the exploitation of all the corresponding benefits and advantages. On the contrary, it could be a costly risk leading to wasted resources and inefficiencies in such projects due to a lack of awareness of issues such as change management, trust management and partnership.

In summary, although this review presents relevant ideas, further research is required to overcome the limitations associated with validating the proposed concepts. As the literature is still sparse and nascent, further concepts added in the future as the understanding of digital supply chain evolves. However, there is a fruitful field of research to explored, both empirically and theoretically.

5. Conclusion.

This study, which analyzed 96 articles according to the literature review method, makes an important contribution to the scientific community of supply chain management, highlighting the different digital technologies adopted in the supply chain literature, as well as their characteristics and benefits. Our results expose the presence of a restricted sharing of articles (96 papers in 41 journals), indicating that the implementation of supply chain digitalization in academic research, is so far limited to a few variety of journals (England, USA). Which is suggestive to the researchers of its countries to coordinate with researchers of countries with low publications, especially Africa, Asia and Latin America, in order to exchange and grow the degree of emergence of scientific research in this area on a global scale. Moreover, what also explains that this field is in its early stages is the nature of the research, which remains limited to case studies (40 of 96 articles) and conceptual analyses (28 of 96 articles). This may also require researchers to conduct empirical validation and confirmation studies. In other words, this study can be blamed for limitations related mainly to the exclusion criteria chosen by us, having eliminated all articles written in languages other than English. In addition to the fact that this paper also eliminated book chapters, books and conference proceedings, considered then as a loss for the exploitation of other data that may be very relevant for this analysis.

Overall, the supply chain has recently entered a new phase of digitization, in which it differs from previous phases in terms of scope, responsiveness, transformative capacity and complexity. This article has examined the peculiarities, which are likely to occur in any implementation of supply chain technologies, keeping in mind without any uncertainty that the ability to use its digital technologies has the power to continue and better refine the criteria of supply chain management. In contrast, the adoption of digital technologies in supply chains can surely face obstacles to overcome and overcome, through the exact capture of new technologies and their disruptions.

In this sense, we can see that the scientific research that analyzes the levers and obstacles to the use of digital technologies is still scarce, both theoretically and empirically. For this reason, we consider that it is convincing to carry out in-depth works in this field in order to guarantee to explain and test the contribution of this phenomenon.

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