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Research Article

Information Technology in Supply Chain Management: A Systematic Literature Review

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Abstract

This study aims to identify the benefits of information technology (IT) in supply chain management (SCM), through selected and reviewed studies. A systematic review was conducted using the PRISMA method. Inclusion and exclusion criteria were used to analyze original articles from the scientific databases Scopus, Web of Science and Ebsco Host. The studies selected are between 2010 and 2020. The results show 18 articles selected for in-depth analysis. Most of the studies are related to industrial companies located mainly in China. Likewise, important benefits such as operational efficiency, process improvement, cost reduction, integration, collaboration, service, customer satisfaction, reliability and information accuracy are perceived. This article provides evidence that it is necessary for supply chain managers to have access to IT training in order to obtain the above benefits. In addition, the authors provide a theoretical basis on the benefits of IT in supply chain management for academics and practitioners interested in this topic.

Keywords

ICT, Information technology, Supply Chain, Supply Chain Management

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Introduction

Increased global competition, time-to-market and internationalization have forced organizations to understand that they must better manage their supply chains in order to survive (Lee, 2010; Marinagi *et al*., 2015; Varma and Khan, 2014). In this context, we are going through a process of digital transformation, where information technology (IT) and supply chain management (SCM) are of growing importance. In this scenario, IT has become a powerful weapon, as a benefit, for improvements in business performance and efficiency, because it provides a significant flow of information for an efficient decision making (Arévalo-Avecillas *et al*., 2018; Huddiniah and Mahendrawathi, 2019;Khaddam *et al.*, 2020;).

Information technologies are electronic devices that support the processing and accumulation of huge amounts of information, as well as its distribution through communication networks (Cobo, 2009; Torun, 2020). Following this concept, several authors mention that IT is a resource that provides useful information to be shared by supply chain partners, as this will facilitate integration through better coordination among them (Huddiniah & Mahendrawathi, 2019; Khaddam et al., 2020; Vanpoucke, Vereecke, & Muylle, 2017), which, in turn, allows for real-time integration resulting in significantly reduced costs (Prajogo & Olhager, 2012). However, many companies do not realize the potential of IT yet, so it is considered a challenge to demonstrate how companies can leverage IT to make supply chain coordination more successful (Huo, Zhang, & Zhao, 2015). Furthermore, the interaction between this technology and the user's skills can be inimitable (Barney, Wright, & Ketchen, 2001). This is why it is important to train senior management on these technologies to achieve sustainable competitive advantages (Sundarakani, Tan, & Van Over, 2012). Therefore, IT is considered an important requirement for supply chain management because it provides supply chain management visual and auditory information (even it is the vital center of the strategy) through which essential information is absorbed and examined to make good decisions (Varma and Khan, 2014).

Supply chain management (SCM) is associated with sustainability in the planning and delegation of all activities involved in supply, information acquisition, management, logistics and financial transactions within and between companies, with the task of bringing processes and functions to a high degree of performance (Comas *et al.*, 2020; De Barros *et al.*, 2015). In addition, Khaddam *et al.* (2020) also confirm that SCM are activities that apply to suppliers, manufacturers, warehouses and efficiently connected goods, so that these are produced and disseminated in the right quantities, in the right location, according to the time requested to reduce the costs of the whole system. However, globalization has caused vulnerability in this area to increase, resulting in greater supply chain complexity, so managers expect to improve their strategies to achieve efficient management (Gunasekaran, Subramanian, & Papadopoulos, 2017; Guo, Yang, & Tan, 2019). Therefore, companies have been forced to make fundamental changes in the way they manage supply chains (Comas *et al.*, 2020).

In recent years, information technology in the supply chain has become important for both academics and professionals. (Agan, 2011; Basole, Seuss, & Rouse, 2013; Bataineh & Hajar, 2020; Campo, Rubio, & YagüE, 2010; Gunasekaran et al., 2017; Marinagi et al., 2015; Wamba, Akter, Coltman, & Ngai, 2015; Zhang, van Donk, & van der Vaart, 2011). In this way, they highlight the existence of great challenges to achieve efficiency in SCM and the need for further research on this topic. Consequently, the state-of-the-art research on this topic identified two literature reviews that have a similar approach to this study (De Barros *et al.*, 2015; Nair and Anbuudayasankar, 2016). This has motivated the interest in carrying out this study to investigate what benefits the application of information technologies in the supply chain brings and, therefore, how to improve the ability of corporations to become more competitive and to achieve high organizational performance (Bataineh and Hajar 2020; Campo *et al.*, 2010; De Barros *et al.,* 2015; Gunasekaran *et al.,* 2017; Huo *et al.,* 2015; Khaddam *et al.,* 2020; Mathu, 2019; Varma and Khan, 2014; Wamba *et al.*, 2015).

For this reason, this study poses the following research question: what have been the benefits of information technology in supply chain management in the last 10 years? Therefore, the objective is to identify what have been the benefits of information technology in supply chain management in the last 10 years through a systematic review of scientific literature.

Methodology

Type of Study

A systematic review of the scientific literature is carried out following the guidelines and standards established in the PRISMA methodology (Moher *et al.*, 2015; Urrútia and Bonfill, 2010). This is a type of scientific research whose ideal is to objectively and systematically integrate the results of empirical studies on the research question in order to determine the state of the art in this field of research (Meca, 2010).

Information Resources and Search Strategy

To locate and identify relevant studies, a bibliographic search was carried out in academic databases, such as Scopus, Web of Science and Ebsco Host. The selection of these databases is due to the international prestige of these tools, as they are currently the main sources for locating publications with the highest impact.
The search strategy is based on articles published between 2010 and 2020 and the following descriptors are used: "information technology", "information technologies", "ICT", "supply chain", "supply chain management". In addition, the following Boolean operators are used to define the advanced search of scientific literature: [("information technology" OR "information technologies" OR "ICT") AND ("supply chain" OR "supply chain management")].
The specific search paths are described below:
Scopus: (TITLE ("information technology" OR "information technologies" OR "ICT") AND TITLE ("supply chain" OR "supply chain management"))
Web of Science: TI= ("information technology" OR "information technologies" OR "ICT") AND TI= ("supply chain" OR" supply chain management")
Ebsco Host: TI ("information technology" OR "information technologies" OR "ICT") AND TI ("supply chain" OR "supply chain management")

Inclusion and Exclusion Criteria

High-quality, peer-reviewed, original articles published in the scientific databases Scopus, Web of Science and Ebsco Host, with the descriptors used in the search path included in the title, in English, Portuguese and Spanish, between 2010 and 2020, were included. Exclusion criteria were limited to doctoral theses, books, communications, technical reports, conference proceedings and abstracts, as well as all those that did not meet the inclusion criteria.

Data Selection

The search for articles in the aforementioned databases resulted in a total of 299 high-quality studies published between 2010 and 2020 (Figure 1), of which only 109 articles were preserved, distributed in: 31 from Scopus, 5 from Web of Science and 73 from Ebsco Host. From this, 28 duplicate articles were discarded; then, 19 publications that did not have the research focus in the title and abstract were eliminated. Subsequently, 62 studies were retained for in-depth review and to exclude those that did not answer the research question. Finally, 18 research studies were selected for the presentation of results, distributed in: 11 from Scopus, 4 from Web of Science and 3 from Ebsco Host.

Characteristics of the Studies

Figure 2 shows the distribution of the 18 articles included, where 11 belong to Scopus, representing 61%; while 4 of them belong to Web of Science, equivalent to 22%; and the last 3 articles, representing 17%, correspond to Ebsco Host.

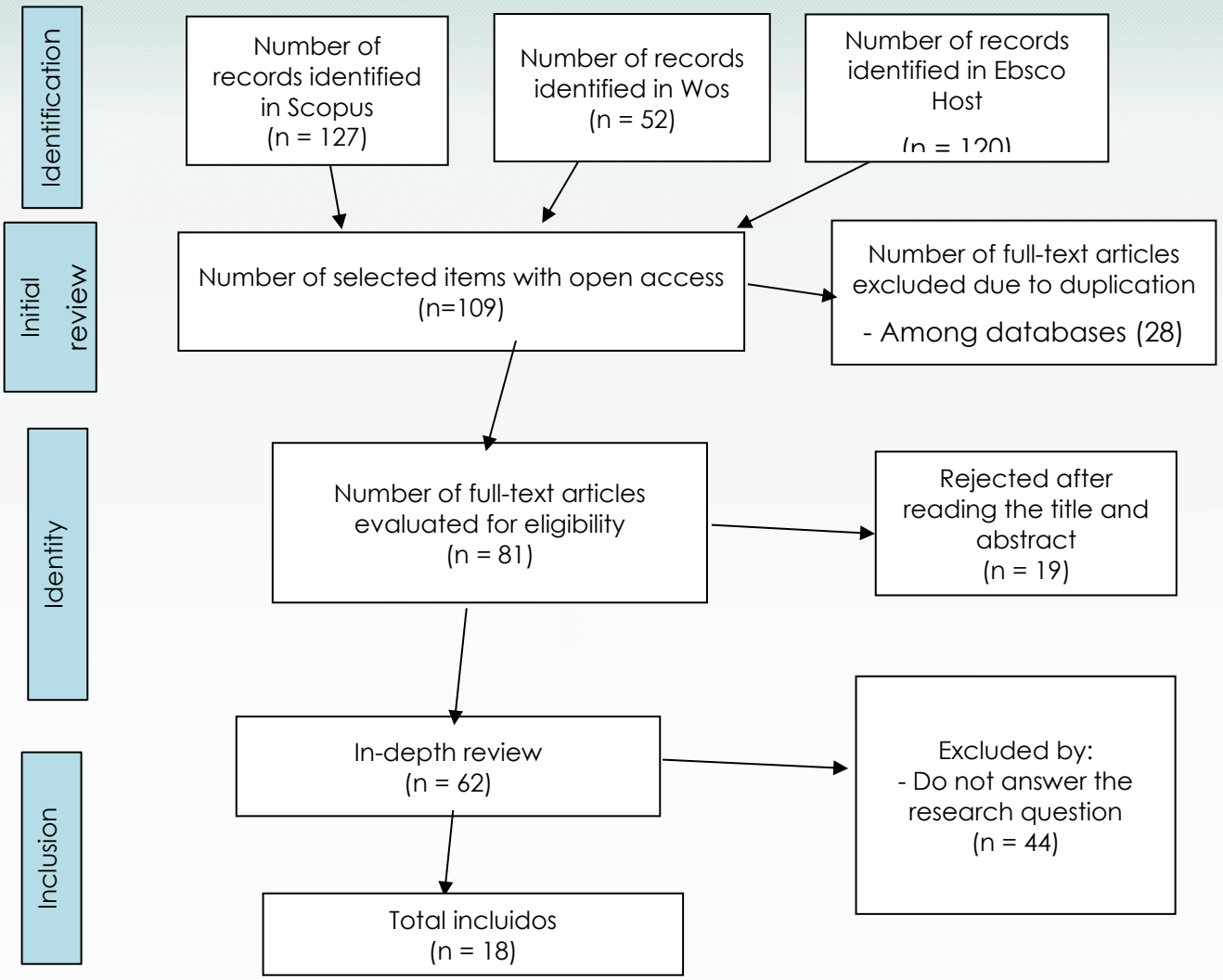

Figure 1. Data selection process

Results

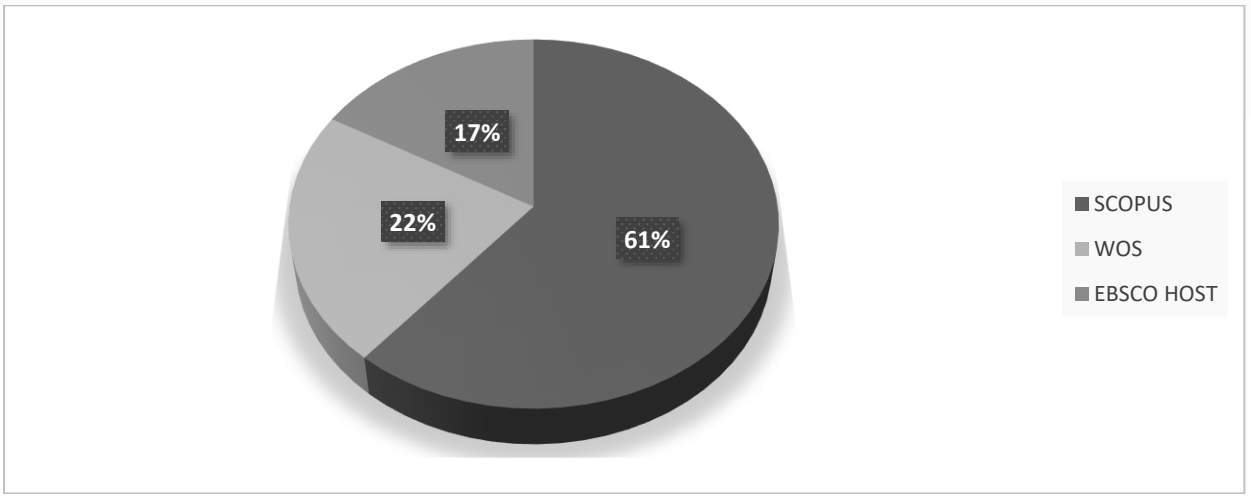

Figure 2. Distribution of publications by database

Table 1 shows the list of countries where the studies were carried out, which were estimated by the country of affiliation of the first author. It was found that 6 of them, representing 33%, belong to China, and 4 of them, corresponding to 17%, to Spain. In addition, there is an equal proportion of 5% for the remaining countries. It can be seen here that Asia concentrates the largest number of publications, followed by Europe and South America.

Table 1
Country of affiliation of the first author

Country	Authors	Total %
China	Huo, Tseng. Agyabeng-Mensah, Liu, Ye and Ngai	6 (33 %)
Spain	Campo, Llach and Gonzálvez-Gallego	3 (17 %)
Jordan	Khaddam	1 (5%)
Australia	Prajogo	1 (5%)
UAE	Sundarakani	1 (5%)
Mexico	García	1 (5%)
Singapore	Ganbold	1 (5%)
Colombia	Pinto	1 (5%)
Malaysia	Sundram	1 (5%)
Portugal	Martinho	1 (5%)
United Kingdom	Oh, Ryu and Yang	1 (5%)

The search for publications was carried out between 2010 and 2020. It was identified that there are more articles selected in the years 2019 and 2020 with a total representation of 33%, corresponding to 3 publications by year. This is followed by the publications of 2010, 2012, 2013 and 2015, with a joint participation of 44 %, corresponding to 2 articles, in each year, and the remaining years represent 22 % together (Figure 3). Likewise, it is observed that there are no publications in 2018. This is because they do not meet the selected criteria or do not respond to the research question.

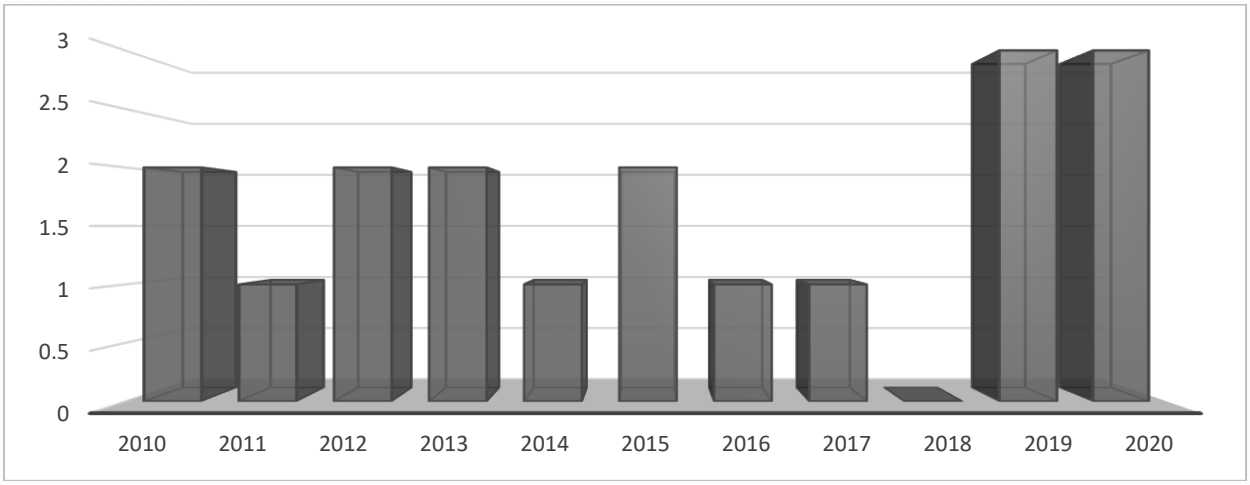

Figure 3. Distribution of publications by year

Table 2 shows the authors and year, the title of the article, the type of study and the type of company that has been classified according to its activity or line of business. It is observed here that most of the empirical articles selected had a quantitative approach and descriptive design, and that 61% of the studies were conducted in industrial companies, followed by service companies, which represent 22%, and 17% of the research works were conducted in commercial companies, as shown in Figure 4.
A number of benefits were identified by the authors (Figure 5). A conceptual model is proposed for a better evaluation of the benefits in order to show the benefits of IT in SCM in a more synthesized way. This model involves cost reduction, operational efficiency and process improvement (increased productivity, greater agility and flexibility, improved inventory management, reduced delivery times and elimination of redundancies in processes or functions), integration and collaboration (strengthened coordination and communication between supply chain partners), information reliability and accuracy (knowledge and accuracy of demand information, better planning and management), customer service and satisfaction (effective and efficient customer service, after-sales service, complaint handling).

Table 2
Authors (year), title of the article, type of study and type of company studied, according to its activity or line of business.

Authors (year)	Article	Type of study	Where was it conducted?
Khaddam, Irtaimeh y Bader (2020)	The effect of supply chain management on competitive advantage: The mediating role of information technology	Mixed Descriptive	industrial company
Campo et al. (2010)	Information Technology Use and Firm's Perceived Performance in Supply Chain Management	Quantitative Descriptive	commercial companies
Huo et al. (2015)	The effect of IT and relationship commitment on supply chain coordination: A contingency and configuration approach	Quantitative Descriptive	industrial companies
Tseng (2015)	Supply chain integration, information technology, market orientation and firm performance in container shipping firms	Quantitative Descriptive	service companies
Prajogo and Olhager (2012)	Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration	Quantitative Descriptive	industrial companies
Sundarakani et al. (2012)	Enhancing the Supply Chain Management performance using Information Technology: some evidence from UAE companies	Quantitative Descriptive	service and industrial companies
Llach and Alonso-Almeida (2015)	Integrating ICTs and supply chain management: The case of micro-sized firms	Quantitative Causal	service companies
Agyabeng-Mensah, Ahenkorah and Osei (2019)	Impact of Logistics Information Technology on Organizational Performance: Mediating Role of Supply Chain Integration and Customer Satisfaction	Quantitative Descriptive	service companies
Liu et al. (2013)	The impact of IT capabilities on firm performance: The mediating roles of absorptive capacity and supply chain agility	Quantitative Descriptive	industrial companies
García, Maldonado, Alor and Sánchez (2017)	The impact of information and communication technologies (ICT) on agility, operating, and economical performance of supply chain	Quantitative Descriptive	industrial companies

Table 2
Continued

Ye and Wang (2013)	**Effects of information technology alignment and information sharing on supply chain operational performance**	**Quantitative Descriptive**	**industrial companies**
Ngai, Chau and Chan (2011)	Information technology, operational, and management competencies for supply chain agility: Findings from case studies	Mixed Descriptive	commercial companies
Ganbold, Matsui and Rotaru (2020)	Effect of information technology-enabled supply chain integration on firm's operational performance	Quantitative Multifunctional	industrial companies
Gonzálvez-Gallego et al. (2010)	ICT effect on supply chain performance: An empirical approach on Spanish and Portuguese large companies	Quantitative Descriptive	commercial companies
Pinto, Garzón and Tarazona Bermúdez (2016)	ICT supply chain management in Bogotá	Quantitative Descriptive	service companies
Sundram et al. (2020)	The Consequences of Information Technology, Information Sharing and Supply Chain Integration, towards Supply Chain Performance and Firm Performance	Quantitative Descriptive	industrial companies
Martinho, Gomes and Yasin (2019)	Information technology and the supply chain integration: a business executives' context	Quantitative Descriptive	industrial companies
Oh, Ryu and Yang (2019)	Interaction effects between supply chain capabilities and information technology on firm performance	Quantitative Analytical	industrial companies

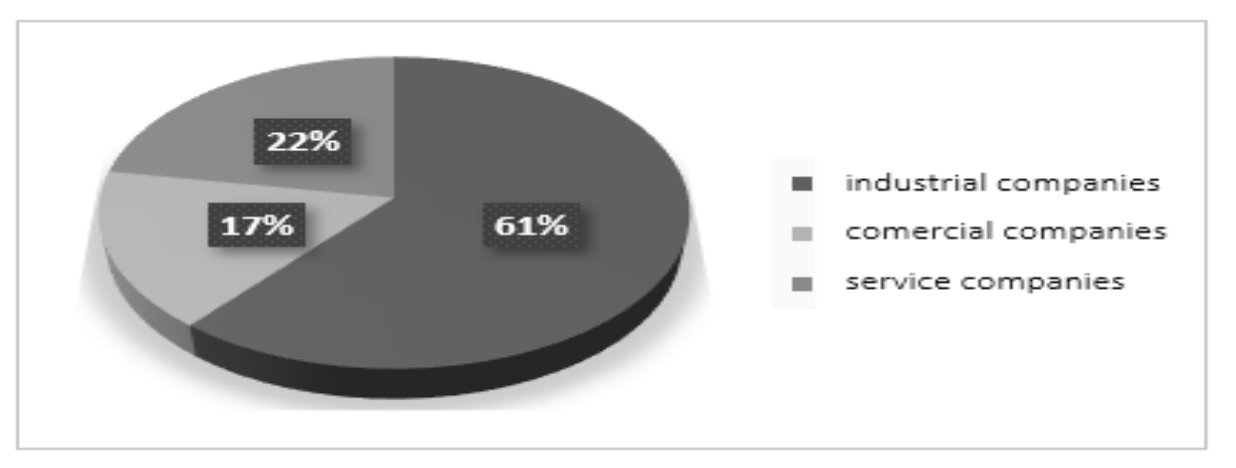

Figure 4. Classification of the companies studied

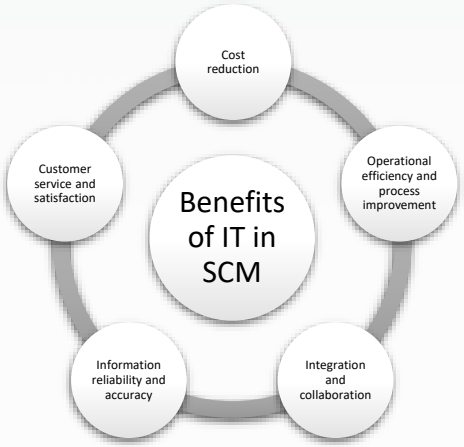

Figure 5. Diagram identifying the benefits of IT in SCM

According to the conceptual model proposed in this study for evaluating the benefits of IT in SCM, Figure 6 shows that there are benefits in operational efficiency and process improvement (14 articles), cost reduction (12 articles), customer service and satisfaction (11 articles), followed by integration and collaboration (9 articles), and information reliability and accuracy (5 articles).

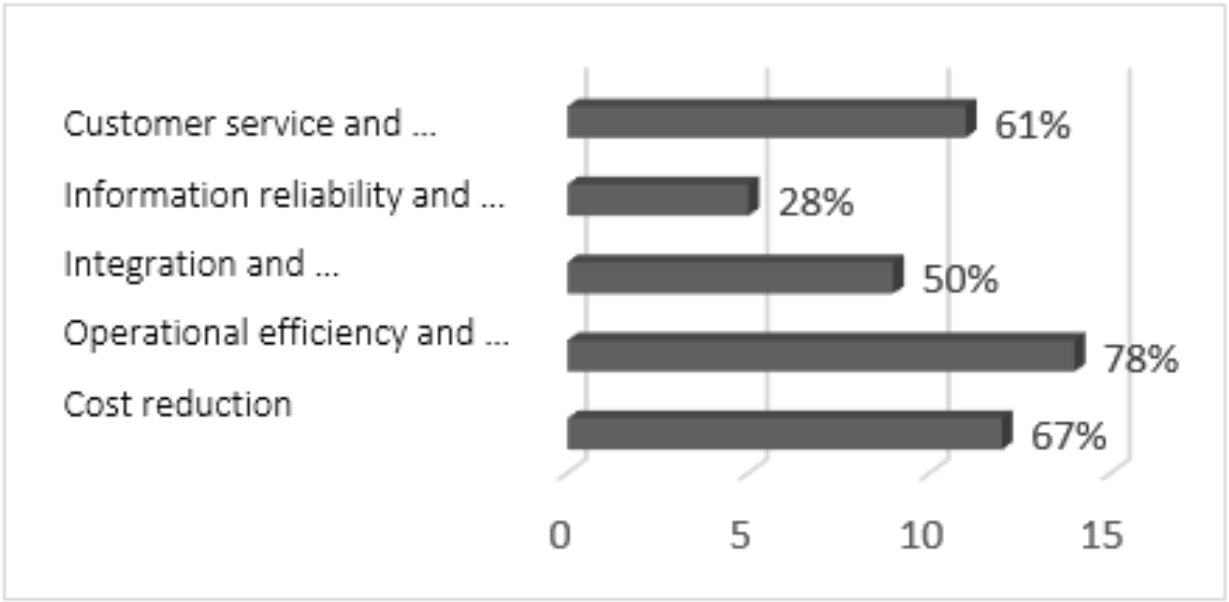

Figure 6. Benefits generated by IT in SCM

Discussion And Conclusions

This research work was conducted in the period 2010 - 2020, finding 18 empirical articles that meet all the inclusion criteria and answer the research question. These articles allow us to affirm that there are indeed many benefits of applying IT in SCM. In this section, it is mentioned, in detail, what improvements have been perceived in each field.

According to the benefits synthesized in the conceptual model proposed, it is evident that the best results are related to operational efficiency and process improvement. From the perspective that encompasses the concept, many authors (García *et al.,* 2017; Huo *et al.,* 2015; Pinto *et al.*, 2016; Llach and Alonso-Almeida, 2015; Martinho *et al.*, 2019; Oh *et al.*, 2019; Sundarakani *et al.*, 2012; Ye and Wang, 2013) mention that IT allows the optimization of processes within the organization and improves productivity, quality and cycle time reduction. These findings are consistent with Agyabeng-Mensah *et al.* (2019); Ganbold *et al.* (2020); Gonzálvez-Gallego *et al.* (2010); Liu *et al.* (2013); Ngai *et al.* (2011); Sundram *et al.* (2020) who confirm the abovementioned, but emphasize that the results fall on major improvements in inventory levels, since there is real-time information about the availability of products, fulfillment and status of orders. This provides greater flexibility to respond to market changes rapidly. Likewise, the benefits are perceived in the reduction of production costs (Martinho et al., 2019; Tseng, 2015) and inventories (Ganbold et al., 2020; Sundarakani et al., 2012). Likewise, the benefits found in services and customer satisfaction are part of the increase in operational efficiency and process improvement. However, García *et al.*, (2017); Huo *et al.* (2015); Ye and Wang (2013) point out that thanks to IT, a more agile response capacity to customers is obtained, since their studies show that customers highly value the immediate response to their complaints and thanks to IT this need can be satisfied (Agyabeng-Mensah *et al.*, 2019; Llach and Alonso-Almeida, 2015) even gaining their loyalty (Campo et al., 2010; Khaddam et al., 2020). An interesting finding evidenced by Campo *et al.* (2010), is that, due to the increased customer satisfaction, the customer is less price sensitive, allowing the company to increase its profit margins. In addition to this, IT also allows for the strengthening of integration and collaboration, where some authors (Agyabeng-Mensah *et al*., 2019; Ganbold *et al.*, 2020; Llach and Alonso-Almeida, 2015; Sundram *et al.*, 2020; Tseng, 2015; Ye and Wang, 2013) say that the impact of this lies in better communication between supply chain partners. However, this finding is compared to the review of years before 2015 by Nair and Anbuudayasankar (2016) where it is shown that the latent challenge for companies was to achieve efficient coordination in the supply chain, due to the distrust of sharing confidential information, then it can be seen that IT has successfully impacted this challenge that plagued supply chain managers, allowing to overcome the barrier of distrust. According to information reliability and accuracy, the research of Ganbold *et al.* (2020); Huo *et al.* (2015); Prajogo and Olhager (2012); Sundarakani *et al.* (2012); and Sundram *et al.* (2020) evidenced that IT helps improve the accuracy of market information and demand forecasting, enabling the supply chain to respond realistically to it and efficiently reduce safety stock and average inventory.

However, only investing in IT does not guarantee improved efficiency; it is key and necessary for supply chain managers to have access to IT training (Gonzálvez-Gallego *et al*., 2010; Llach and Alonso-Almeida 2015; Martinho *et al.*, 2019; Pinto *et al.* 2016 and Sundarakani *et al*. 2012), in contrast to other research work that states that managers do not need "sophisticated" IT skills to obtain the benefits mentioned above (Ngai *et al.,* 2011). In this sense, it is concluded that IT training is necessary, but that it is indeed more necessary for managers of industrial companies, such as those studied in this article, because the supply chain managers of these organizations need to have the capacity and skills to manage more complex IT. Therefore, the education of managers in large companies with many operational processes will not be the same as for executives managing companies with shorter processes.

Another important finding that emerges from this review is that Pinto *et al.* (2016) think that companies face a major problem when considering the use of IT in SCM, due to the high implementation costs. Having said this, Tseng (2015) adds that standard or common IT does not provide benefits in the company's performance, as competitors can easily imitate it. It is, therefore, advisable to invest in more developed IT. Consequently, Tseng (2015) asserts that IT investment has a short-term negative effect on organizational performance and, therefore, these benefits should be evaluated over the long term, an assertion that is confirmed by Campo *et al.* (2010). For this reason, *Ye and Wang (2013) and Zhang et al.* (2011) claim that some companies benefit from IT

and others do not, because they have been evaluated in the wrong time. This statement allows us to understand why companies consider the implementation cost as a disadvantage, because, if they decide to apply IT in their supply chains, these should be superior to those of the competition and, after this decision that incurs large investments, they expect their returns in the short term, so they conclude that there is no benefit. However, this review allows us to identify that the evaluation of IT performance is more effective in the long term when the use and application of IT is more robust in the organization.

It is concluded that the benefits of the implementation and use of IT mainly lie in operational efficiency and process improvement; then, in the reduction of production and inventory costs, in addition to improvements in customer service and satisfaction thanks to the ability to respond quickly to customers; subsequently, in the integration and collaboration by all partners in the supply chain. At this point, it is worth mentioning that in previous research works it was difficult to reduce the distrust of sharing confidential information. However, IT has been able to overcome this obstacle by keeping supply chain stakeholders satisfied. Finally, progress is evident in information reliability and accuracy, specifically in the determination of demand. It should be noted that these are not the only areas where IT effectiveness has been seen, but they are the ones that stand out the most from the research.

In this work, the results were mainly evaluated in industrial companies dedicated to manufacturing, mainly located in China, a country where manufacturing sector is constantly growing thanks to the expansion of international trade. It also shows the importance of training supply chain managers in IT in order to obtain the benefits mentioned in this study. However, it is also necessary for top managers to invest in more developed IT so that they are not easily imitated by competitors and the long-term performance, which is the recommended period for evaluation, can be perceived.

Through the development of this systematic review, a contribution is made to the academic community, since it provides a general but extremely important overview of the benefits of IT in SCM, and the findings of the study help decision-makers in the supply chain field to consider IT as a tool for achieving competitive advantages in the company. In terms of the limitations of the study, the number of search terms used allows for a bias, as relevant works could have been left out; however, the reference framework of the study was respected. For future research works, a greater number of combinations of search terms is recommended and it is suggested to address research on information technologies in supply chain management in Latin American countries. Finally, it is advisable to focus the review on commercial or service companies, such as export companies with a focus on traceability, extra-port warehouses, extra-port terminals or international ports.

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