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A BIBLIOMETRIC ANALYSIS OF INTERNATIONAL LITERATURE ON COLLABORATION IN SUPPLY CHAIN

UMA ANÁLISE BIBLIOMÉTRICA DA LITERATURA INTERNACIONAL SOBRE COLABORAÇÃO NA CADEIA DE SUPRIMENTOS

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ABSTRACT

Collaboration has been recognized as an important strategy for supply chain management success. However, previous studies suggest that this issue is little understood and explored, in terms of identifying and organizing the content already developed, as well as in providing reflections and alternatives for its appropriation in the organizational environment. This work sheds light on these issues and aims at systematically mapping the international scientific production on collaboration in supply chain. Bibliometric methods were used by means of structured mapping and systematic analysis of publications found on the Web of Science – Social Sciences Citation Index (WoS-SSCI) database up to 2014. As a result, 173 were retrieved, which were published in 68 journals and written by 380 authors associated with 226 institutions of 32 countries. The bibliometric analysis allowed us to identify the journals that stand out because of the high count of citations and number of articles, which could be used as reference for future studies in this area; among them is the Supply Chain Management an International Journal. From the systematic analysis of highly cited papers and recent papers, we observed a predominance of quantitative studies using surveys and some using structural equation modeling. Based on the paper analysis, we identified some gaps and opportunities for future research. It thus follows that collaboration within the supply chains context is a relevant matter with increasing academic interest, which needs to be further studied for theoretical development and practical implications.

Keywords: collaboration, supply chain, bibliometric study.

RESUMO

A colaboração tem sido reconhecida como uma importante estratégia para o sucesso da gestão da cadeia de suprimentos. Entretanto, estudos anteriores sugerem que se trata de um tema pouco compreendido e explorado, tanto no sentido de identificar e organizar o conteúdo já desenvolvido quanto no de proporcionar reflexões para a sua apropriação no ambiente organizacional. Este trabalho lança luz sobre essas questões e tem por objetivo mapear sistematicamente a produção científica internacional sobre a colaboração na cadeia de suprimentos. O método utilizado foi o estudo bibliométrico, por meio do mapeamento estruturado e da análise sistemática das publicações localizadas na base *Web of Science – Social Sciences Citation Index (WoS-SSCI)* até

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o ano 2014. Como resultado, foram recuperados 173 artigos, os quais estão publicados em 68 periódicos e escritos por 380 autores vinculados a 226 instituições de 32 países. Entre outros resultados da análise bibliométrica, foram identificados os periódicos que se destacam devido aos altos números de citações e quantidades de artigos, os quais poderão ser tomados como referência para futuras pesquisas nesta área – entre eles está o *Supply Chain Management an International Journal*. A partir da análise sistemática, verificou-se que a maioria dos artigos selecionados são estudos empíricos com abordagem quantitativa que utilizam *survey* e alguns que empregam a modelagem de equações estruturais. Nos textos analisados, foi identificado um amplo leque de lacunas e oportunidades para a realização de futuros estudos na área. Conclui-se, portanto, que a colaboração no contexto da cadeia de suprimentos é um assunto relevante e de crescente interesse acadêmico que ainda carece de estudos aprofundados para desenvolvimento teórico e implicações práticas.

Palavras-chave: colaboração, cadeia de suprimentos, estudo bibliométrico.

INTRODUCTION

Although over time the studies on supply chain (SC) have focused mainly on its implementation and management (Fisher *et al.,* 1997; Lambert and Cooper, 2000, Christopher, 2000; Lee, 2002), collaboration between the players of these chains has been identified as a relevant study matter, which can help broaden the understanding of this research field (Hudnurkar *et al*., 2014).

A major concern in SC management is to determine how to coordinate different independent players so that they can work together as a unit towards a common goal (Montoya-Torres and Ortiz-Vargas, 2014). That is why collaboration is intrinsically related to effective SC management, being its driving force (Baihaqi and Sohal, 2013; Min *et al*., 2005) and the key to value creation (Horvath, 2001).

However, collaboration within the SC context is a rather embryonic subject, which emerged in the second half of the 1990s as Collaborative Planning, Forecasting, and Replenishment – CPFR (Barratt, 2004). Since the beginning of 2000 the interest in this subject has increased both in the industry and in universities (Kumar and Banerjee, 2012). However, it is widely believed that few companies have really understood and leveraged its potential (Min *et al*., 2005; Fawcett *et al*., 2012), and that scientific production on the matter is limited in providing concepts that explain aspects of collaboration in the SC (Hudnurkar *et al*., 2014; Kumar and Banerjee, 2014). Collaboration is a very broad and generic term, and when used in the context of SC, it needs to be clarified (Barratt, 2004).

In addition to being such a broad and fuzzy term, recent research shows that there are gaps in the integration and collaboration practices between SC companies and that collaborative management performance can be quite fragile in this kind of organizational arrangement (Montoya-Torres and Ortiz-Vargas, 2014; Andrade and Paiva, 2012; Moori *et al*., 2007). These studies show that discussions in this area are still incipient, both in terms of surveying and organizing the information already available on the subject and in providing reflections and alternatives for its appropriation in the organizational environment. Therefore, mapping the literature on this topic can bring contributions to the area, considering the aspects presented.

In order to gain further insight into the development of the area and to understand how research in this field of study has evolved, the goal of this paper is to systematically map international scientific publications on collaboration in SC. Thus, we carried out a bibliometric analysis of the scientific literature indexed to a database recognized by the international academic and scientific community, the Web of Science – Social Sciences Citation Index (WoS-SSCI) database.

Unlike other recent literature review papers that investigate aspects related to collaboration in SC – which randomly selected the articles for analysis (Hudnurkar *et al*., 2014) or determined a specific period in approximately ten years of publications (Montoya-Torres and Ortiz-Vargas, 2014) – this paper employs bibliometric and systematic analysis techniques to trace the trajectory of publications over the years and produce a broad overview of scientific production on the subject, identifying: the chronological distribution of publications; the most representative journals – (i) those with the most articles on the topic, and (ii) those most cited in research on the topic; researchers/authors who stand out for the number of published articles and for the impact (citations) of their research on the topic; and, finally, a systematic analysis based on the selection and reading of full texts of two publication groups: highly cited papers and recent papers (as detailed in the methodological procedures described in *Methodological procedures*). From this work, the study sought to answer the following question: How the international scientific literature has addressed the topic collaboration in the SC?

This paper is organized in five parts. After the introduction, we present a few aspects describing the field of study on

collaboration in SC (*Collaboration in supply chain*), followed by the methodological procedures adopted to conduct this study (*Methodological procedures*). Later, we present and analyze the main results (*Results*), concluding this paper with our final considerations (*Conclusions*), followed by the references.

COLLABORATION IN SUPPLY CHAIN

Collaboration has been extensively discussed in the academic and business environment (Barratt, 2004; Kumar and Banerjee, 2012; Hudnurkar *et al*., 2014). As Min *et al.* (2005) state, the collaboration issue has been widely investigated in many areas, including sociology, psychology, marketing, management and business. Recently it has been the focus of research in the field of SC management, which seeks to investigate collaboration within the SC (Min *et al*., 2005; Hudnurkar *et al*., 2014), even using the term "SC collaboration" (Matopoulos, 2007; Cao and Zhang, 2011; Ramanathan and Gunasekaran, 2014).

Overall, in the management and business fields, the term collaboration has usually been used as a synonym for cooperation, however, some scholars have called attention to the fact that both terms are concepts with distinct meanings (Winckler and Molinari, 2011; Gulati *et al*., 2012). Winckler and Molinari (2011) assert that the two terms mean "work together", but they are different because collaboration occurs in horizontal and vertical level in support of a company to another, and cooperation occurs in horizontal level with gains for the partners involved. In this regard, it is believed that a successful collaboration can develop into cooperation. Gulati *et al.* (2012), on the other hand, consider that the cooperation and coordination are facets of interorganizational collaboration, in other words, are two integral parts of collaborative efforts. The main focus is on the distinction between cooperation and coordination. Interorganizational cooperation is defined as "joint pursuit of agreed-on goal(s) in a manner corresponding to a shared understanding about contributions and payoffs", while coordination is defined as "the deliberate and orderly alignment or adjustment of partners' actions to achieve jointly determined goals" (Gulati *et al*., 2012, p. 3, 7).

Previous studies of the SC make clear the differences between collaboration and cooperation (Kanda and Deshmukh, 2008), while other studies are not concerned with establishing a conceptual difference between the terms (Matopoulos *et al*., 2007).

In general, the SC literature is clear that collaboration and coordination are components of SC integration, and so are different elements (Gomes and Kliemann Neto, 2015), but there is still no consensus on the conceptual distinction between collaboration and cooperation. In this article, the terms integration, coordination, collaboration and cooperation are considered different concepts. However, this work does not intend to deepen the discussion about these differences and its scope is limited to use of term collaboration in the SC literature.

Within the SC context, collaboration is a mostly social process (Kumar and Banerjee, 2014), where many agents of the SC work together – sharing common goals, trust, respect, resources, skills and knowledge, risks and rewards – to create a sustainable competitive edge and obtain greater benefits than could be achieved by isolated actions (Simatupang *et al.,* 2004; Min *et al*., 2005). Within this context, collaboration can also be defined as "an act of properly combining (relating, harmonizing, adjusting, aligning) a number of objects (actions, objectives, decisions, information, knowledge, funds) for the achievement of the chain goal" (Montoya-Torres and Ortiz-Vargas, 2014, p. 344). Collaboration in SC refers to the union of two or more autonomous companies to work effectively together, planning and executing SC operations towards common goals (Cao *et al*., 2010).

Collaboration is seen as a strategy for effective management of the SC (Kumar and Banerjee, 2012; Min *et al*., 2005). As pointed out by Baihaqi and Sohal (2013), the core principle of effective management of a SC is collaboration between its members. The general idea is that collaboration between the agents of a SC can lead to many benefits. According to Kumar and Banerjee (2014), some of these benefits are: higher service levels, increased flexibility, greater satisfaction of end customer, reduced cycle time, as well as dealing with great demand uncertainties. Successful collaboration within the SC context includes results of increased efficiency, effectiveness and better market positions for the companies involved (Min *et al*., 2005).

"Collaboration has been referred to as the driving force behind effective SC management and may be the ultimate core capability" (Min *et al*., 2005, p. 237). This means that collaboration helps in the development of a relation-based business strategy, which competitors may have a hard time duplicating (Kumar and Banerjee, 2014). This could be the reason why new collaboration practices and models specifically geared towards SC are referred to as areas of great potential (Horvath, 2001).

In SCs, the activities undertaken by all players are important and interdependent, that is, if an activity fails, the chain is broken, negatively impacting the performance and destabilizing the work production in other areas, thus compromising the effectiveness of the whole chain. Therefore, in order to provide higher service levels and effectiveness, every activity along the chain needs to be in balance (Stevens, 1989). The main goal is to create or increase the value for the end customer and doing that requires coordinated efforts between the players throughout the SC (Keller *et al*., 2001). This could explain the fact that issues such as SC collaboration and SC coordination are so closely related in academic research, as shown by Hudnurkar *et al.* (2014).

The impact of lack of collaboration is difficult to identify in standard operations of an organization but it becomes clear

in a SC. The bullwhip effect (Lee *et al*., 2004) is an example of that, which can only be avoided if the buyer trusts the supplier to correctly interpret the demand for information and if the supplier trusts the buyer to provide correct demand estimates (Akkermans *et al*., 2004). In addition to trust, many authors mention benefit reciprocity, information exchange, and risk sharing as the base for collaboration (Barratt, 2004). Within this context, information technology can be the backbone of the business structure of SCs, being used to acquire, process, and convey information between the chain members, thus improving communication and decision-making processes (Sanders, 2002).

According to (Barratt, 2004), there are many forms of potential collaboration in SC, which can be divided into two main categories: (i) vertical, including collaboration with customers, internal collaboration (between functions), and with suppliers; and (ii) horizontal, comprising collaboration with competitors, internal collaboration (between functions), and with non-competitors. In any of these collaboration forms, the performance management system should be in line with the common goal in order to encourage collaborative work and avoid conflicting goals (Stank *et al*., 1999). Chains that are managed through collaboration to integrate demand and supply are believed to have a significantly better performance (Barratt, 2004). Akkermans *et al.* (2004) suggest, for instance, that the more partners in a SC work collaboratively together, the more they will trust each other and the more they will be willing to share information and data. In other direction, this will improve their performance level when working together, thus further increasing their trust, and so on.

In view of the challenges and benefits associated with SC collaboration, many companies have been striving to reach the desired level of collaboration and the rewards that come with it, and have been seeking to deal with critical details, such as selecting the adequate partner, aligning interorganizational needs and capabilities, and establishing standards and goals (Nyaga *et al*., 2010).

Thus, the behavior and collaboration activities in SC have gained considerable importance both in the practical and theoretical sense (Hudnurkar *et al*., 2014). A number of studies on collaboration issues within the SC context have been published; however, the strategies and collaborative processes were not well understood, making it relevant to conduct literature reviews in this area (Fawcett *et al*., 2012; Montoya-Torres and Ortiz-Vargas, 2014). In the next section, we will describe the methodological procedures adopted in this study.

METHODOLOGICAL PROCEDURES

This is a bibliometric study that uses bibliographic data and indicators to trace the development trajectory of scientific production (Araujo, 2007; Machado, 2007) and analyze relevant papers in a given field of research (Santos *et al*., 2011). The field of bibliometrics as a whole includes quantitative aspects and models of scientific communication and storing, dissemination and retrieval of scientific information (Kobashi and Santos, 2006). Therefore, bibliometric studies have also been applied to measure the impact of published papers, by counting the number of citations, in different knowledge areas (Lazzarotti *et al*., 2011). Additionally, they provide essential information for a systematic analysis of qualitative data from the selected work (Kurtz *et al*., 2013).

The procedures adopted in this work were similar to those used in other bibliometric studies and systematic literature review (Crossan and Apaydin, 2010; Kurtz *et al*., 2013; Santos *et al*., 2011). They were carried out in two stages: (i) systematic search and (ii) systematic analysis of literature.

STAGE 1 – SYSTEMATIC SEARCH

The paper search was carried out at the Web of Science – Social Sciences Citation Index (WoS-SSCI) database, considering all available years in the database until the date on which the research was conducted: from 1956 to 2014/August 28 (date that should be considered as reference for the number of citations mentioned in this paper). The WoS-SSCI database was chosen because it is one of the most comprehensive databases for journals, reviewed by renowned peers in the international scientific community, focusing on academic and scientific production in areas related to applied social science as well as incorporating bibliometric and citation analysis tools (Crossan and Apaydin, 2010; Kurtz *et al*., 2013; Watanuki *et al*., 2014).

To conduct searches of international publications indexed in WoS-SSCI database, we sought to identify keywords that allow to retrieve articles about collaboration in the SC. The keywords search is a useful procedure to ensure objectivity and replicability of the process of collecting/locating papers for literature reviews (Fawcett *et al*., 2012). It was initially consulted the searchable thesaurus of WoS-SSCI, which allows to identify synonymous referring to a research topic. Additionally the titles, abstracts, keywords and references cited by some articles were consulted: Barratt (2004), Fawcett *et al.* (2012), Hudnurkar *et al.* (2014), Montoya-Torres and Ortiz-Vargas (2014), among others. Using these procedures about 50 words potential to be used as search terms in this study (including variations in the plural and singular) are listed – among them, there were individual words (such as collaboration, cooperation, agreements, partnership, integration, coordination) and words that form a specific term (such as collaborative action, collaborative engagement, collaborative relationships, collaborative strategy, relational view, cooperative strategy, cooperative process, etc.). Each word/term was searched individually in WoS-SSCI database combined with "SC" and each search result was observed (from reading the titles and abstracts of articles, we analyze whether the text was adherent to the focus of this bibliometric study).

After these procedures, it was found that most of the articles on collaboration in SC used the terms "supply chain collaboration" and/or "collaborative supply chain" – both terms were added to the search procedures allowing to locate 89 and 39 publications, respectively. Other terms were excluded because they carried the articles that are beyond the thematic scope of this study – for example, "collaborative program" and "cooperation activity" usually referred to the collaboration between researchers and R&D cooperation. Furthermore, using the combination of "supply chain" with the terms "agreements" and "partnership" (and similar) articles that did not deal specifically about collaboration in SC were recovered (it was observed that the articles using those terms to address the collaborative relationships also have the term "collaboration" in Topic).

After the procedures mentioned above, the keywords used as search terms were (collaborati* = collaboration or collaborative): "supply chain" AND "collaborati* activit*", "supply chain" AND "collaborati* practice*", "supply chain" AND "collaborati* process*", "supply chain" AND "collaborati* strateg*", "supply chain" AND "organi?at* collaboration*", "collaborative supply chain", "supply chain collaboration", and its derivatives. These terms were searched under Topic (title, keywords, and abstract for the publications indexed in the WoS-SSCI). Searches were refined by "article" and "review", resulting in 173 publications (128 publications use "supply chain collaboration" and/or "collaborative supply chain" in Topic).

The same combinations of words used with the term collaboration were used with the term cooperation, and its derivatives (cooperati* = cooperation or cooperative). Searches were refined by "article" and "review", resulting in 32 publications (21 publications use the term "supply chain cooperati*" in Topic). In analyzing this result, it was found that 12 of these 32 articles were already between the 173 publications located above (these 12 papers make no distinction between the terms of collaboration and cooperation). To avoid leaving out some important article to this study, the remaining 20 articles on cooperation were analyzed and it was found that four of them do not address in depth the cooperation (the concept is not one of the main topics of the article and is sporadically mentioning in the text) and other articles address issues that are not part of the thematic scope of this study, for example, R&D cooperation, cooperative and non-cooperative settings, horizontal cooperation, inter-organizational cooperative innovation, revenue-sharing contract, peer-to-peer cooperation process in SC.

Considering some inclusion/exclusion aspects – such as that it is not the objective of this paper to discuss the differences between the two terms (collaboration and cooperation), and that the inclusion of these 20 articles in the bibliometric study could generate a bias to the representativeness of literature on collaboration in SC – only 173 articles previously located were included. Thus, the systematic search of the literature conducted in this study are delineated the scope that includes only the scientific literature on collaboration in SC, without considering their similarities and differences with other terms, such as cooperation, integration and coordination in the SC context.

The results of the bibliometric analysis of these papers are shown in the results section of this paper (*Results*).

STAGE 2 – SYSTEMATIC ANALYSIS

Based on the 173 papers previously identified, we sought to identify papers that could be considered relevant within SC collaboration. In order to do that, two groups of papers were formed from the following selection criteria:

Group 1 – Most cited papers: initially all papers were listed in descending order, according to the number of citations they received among these 173 papers. For such, we used the bibliometric indicator TLCS (Total Local Citation Score), which shows the count of citations among the papers that address SC Collaboration. The first 15 papers were selected, considering up to 4 citations in the group collection. Later, we read the titles and abstracts of these 15 papers and observed that 4 of them did not specifically address SC Collaboration. This group was then reduced to 11 papers, which were thoroughly read and analyzed.

Group 2 – Most recent papers: we initially selected papers published in the last two years: 2013 and 2014 (totaling 29 articles). As they were recent papers, where the number of citations to them is not significant and cannot be used to select relevant papers on a subject (Crossan and Apaydin, 2010), the selection criterion we adopted was filtering the articles that were published in high impact journals (based on the number of citations) – the list of journals used as reference for this selection is shown in the results section below –, obtaining a total of 14 papers. After reading their titles and abstracts, as was done for the most cited papers group (group 1), we verified that only 7 of them focused on SC collaboration. These 7 papers were advanced to the next stage.

Groups 1 and 2 represent a total of 18 papers, which were thoroughly read in their entirety and analyzed as for the conceptual focus of the research (definitions and key aspects of SC collaboration), identification of research type (theoretical or empirical), and approach (qualitative e/or quantitative), as well as gaps and opportunities for future studies.

THE STUDY LIMITATIONS

On the one hand, bibliometric studies such as this allow to recover and condense large amounts of bibliographic information, on the other hand, they have several limitations. The limitations of this study are related to at least two issues that are intrinsically related, which are: (i) the variance in

human judgment, and (ii) characteristics of the database and the citation counts for analysis.

The realization of searches in a single database (Web of Science – Social Sciences Citation Index/WoS-SSCI), although justified, is a choice linked to the human judgment and shows an evident limitation to the research fields representation under study as it includes a small "sample" of articles. Thus, the publications mapped in this bibliometric study represent only one part of the scientific production of the subject and the results may not be generalized to all research field of collaboration on SC. Therefore, researches published in other databases and languages (including Brazil) are not represented in this study. Web of Science's own characteristics – such as indexed journals, citation counting, and indexing references – also influences directly the publication recovery and selection process, and, consequently the results.

As described previously (*Stage 2 – Systematic analysis*), the citations count was used to select some articles considered relevant for analysis and illustration of the researches on the topic. To minimize bias, in this study the citation count was measured by the number of citations that each article received within the collection database (articles on specific subject: collaboration in SC), instead of using the number of citations that each article received in throughout WoS (articles database that covers many subject and areas). Similarly, it was used the citations received within the collection (indicator TLCS – Total Local Citation Score) to identify/select the journals that stand out in the subject, instead of using the Journal Impact Factor (measure reflecting the average number of citations to articles published in science and social science journals – Garfield, 1982 – regardless of the subject). The realization of a citation analysis requires human judgment to determine how many articles/journals must be included in the dataset and, consequently, it affects the general representation of the standards adopted citations and the selection of the analyzed articles selection. The purpose of the application of citations count as a bibliometric indicator – i.e. using the number of the received citations by articles/journals within the collection – was to establish an initial starting point and minimized the subjectivity in the articles selection to the complete text analysis (group 1 and 2). However, in these procedures the human judgment is unavoidable, because it determines what is relevant and what is not relevant in the analyses process. It is worth mentioning that among the limitations of the use of bibliometric indicators based on citation is the fact that the type of the predominant references between the knowledge diverse areas can vary and depends on the way that the citations are registered in the database indexers (Garfield, 1982; Hicks, 1999). In this way, the count of books (and other works) citations, for example, were not considered in this work.

These limitations must be considered when viewing the results presented in this article.

RESULTS

As described above, 173 papers on SC collaboration were retrieved after bibliometric survey in the Web of Science – Social Sciences Citation Index (WoS-SSCI) database. These papers are published in 68 journals and were written by 380 authors associated with 226 institutions of 32 different countries. We also observed that these 173 papers used 7,041 bibliographic references, an average of 40 references per paper. Table 1 shows an overview of general results (bibliographic data) obtained in the research.

Regarding the distribution of the publications over time, we verified that, within the available period in the database (from 1956 to 2014, 28 August), the first paper on collaboration in SC was published in 1996, and the second was published in 1999. After 2000, the interest in the topic seems to have grown and the number of publications increased, going from 7 papers in 2001 to 13 in August 2014 (totaling 29 papers in 2012-2013). By analyzing the number of papers published biannually, we observed that this number exceeded 30 papers in three consecutive periods: 2007-2008, with 31 papers; 2009-2010, with 37 papers; and 2011-2012, with 41 papers. Figure 1 shows the chronological distribution over time of those publications.

Among the 68 journals with papers on collaboration in SC, we tried to identify the most representative ones for this research. Two bibliometric indicators were considered: the number of papers published in each journal and the number of citations to each journal. Table 2 shows the list of top journals for the number of articles on the subject. Table 2 also shows the citation rate to these journals, measured by TLCS (Total Local Citation Score), which means the number of citations these journals received in the 173 papers (analyzed collection). These journals (see Table 2) are responsible for the publication of 98 papers on collaboration in SC, corresponding to 57% of total. The top three journals with the highest number of papers on the subject, above ten papers, are, respectively: SC Management – an international journal, with 20 papers;

Table 1. *General results: publications on collaboration in SC.*

Bibliographic data	Quantity
Articles	173
Journals	68
Authors	380
Institutions (author's affiliation)	226
Countries	32
Cited references	7.041

Source: Social Sciences Citation Index – SSCI / Web of Science, from 1956 to 2014 (August 28).

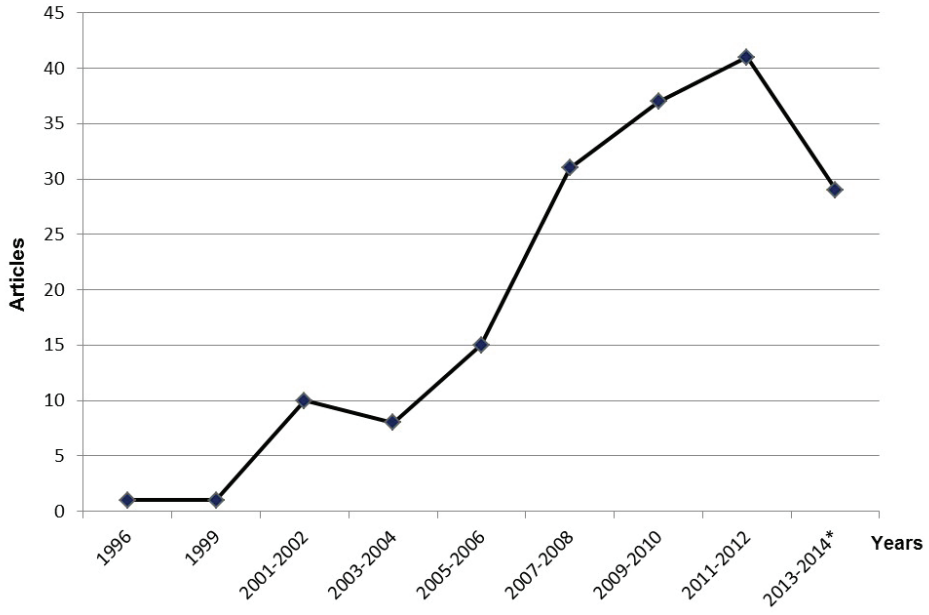

Figure 1. *Chronological distribution of publications on collaboration in SC.*

Note: (*) Value estimated based on data until August 2014.
Source: Data collected from Social Sciences Citation Index – SSCI / Web of Science.

Table 2. *Top journals in the collection listed by amount of articles on collaboration in SC.*

Journals	Quantity of articles	Citation count*
Supply Chain Management – An International Journal	20	55
International Journal of Production Economics	17	21
International Journal of Operations & Production Management	13	22
Industrial Management & Data Systems	7	3
International Journal of Production Research	7	4
Journal of Operations Management	6	25
Production Planning and Control	6	0
International Journal of Computer Integrated Manufacturing	5	1
Production and Operations Management	5	5
Decision Support Systems	4	0
European Journal of Operational Research	4	5
International Journal of Physical Distribution & Logistics Management	4	1
Total	**98**	**142**

Note: (*) August 28, 2014.
Source: Data collected from Social Sciences Citation Index – SSCI / Web of Science.

International Journal of Production Economics, with 17 papers; and International Journal of Operations & Production Management", with 13 papers. These results allow us to infer that, on the one hand, the editorial line of these journals are showing interest in research on this specific topic and, on the other hand, researchers recognize these journals as relevant channels to communicate their findings in this research field.

To identify the journals with the highest impact, all 68 journals were listed in descending order according to the number of citations in the 173 papers (a total of 177 citations,

an average of 2.6 citations per journal). This shows that when researchers on collaboration in SC cite papers on this subject they often use the papers published in these journals (Table 3). Altogether, these journals were cited 161 times within the collection, corresponding to 90% of a total of 177 citations.

Tables 2 and 3 show us that *SC Management – An International Journal* has the highest number of publications on the subject (20 papers), also being the one with the highest citation impact (55 citations). The International Journal of Production Economics, ranking second in number of publications (17 papers), comes fourth among the journals with highest impact (21 citations). However, three of the journals with only one paper on the topic (see Table 3) are in the list of the most cited journals in the collection on collaboration in SC. They are: *Transportation Journal*, with 6 citations; *Journal of Business Logistics*; *Communications of the ACM*; and *MIS Quarterly*, with 3 citations each.

Table 4 lists the authors with the highest number of papers published on collaboration in SC. The publications of these authors represent 26% of the papers identified in this study (45 out of 173 papers). These authors are associated with institutions of different countries in Europe (France, Spain, Greece, and the United Kingdom), Asia (Malaysia and Taiwan), and the United States. The list of all represented countries (with research institutions of authors) does not include any South American country (including Brazil). In general terms, 59% of the institutions represented by authors with papers mapped in this study are located in the USA (27%), UK (13%), Taiwan (9%), China and Spain (5% each). A similar result was found by Hudnurkar *et al.* (2014), who conducted a literature review on the factors affecting collaboration in SC and found that most studies on the subject were carried out by researchers associated with institutions in the USA and UK.

The nationalities of the institutions which the authors with the highest number of papers on collaboration in SC (Table 4) are associated with may be diverse, but the same is not true for the authors with the highest number of citations (Table 5). The ten most cited authors are researchers associated with institutions in the United States, except for Robert D. Klassen (University of Western Ontario, Canada). Three authors stand out as most productive and most cited: Fawcet (Brigham Young University, USA), Magnane (Seattle University, USA) and Sheu (Kansas State University, USA).

Table 5 also shows that, similarly to other authors (such as Magnan and McCarter), Chwen Sheu and Stanley Fawcett have 5 published papers on the subject and 10 citations. However, one of Sheu's paper is cited 9 times and one of Fawcett's paper is cited 7 times. This means that both Sheu and Fawcett are in the list of authors with the most papers on the subject (Table 4) and most cited authors within the analyzed collection (Table 5), and that each of them is the main author of highly cited papers (as will be shown in the next section).

Table 3. *Top 10 journals: Most cited journals in the collection on collaboration in SC.*

Journals	Quantity of articles	Citation count*
Supply Chain Management – An International Journal	20	55
Journal of Operations Management	6	25
International Journal of Operations & Production Management	13	22
International Journal of Production Economics	17	21
Transportation Journal	1	6
European Journal of Operational Research	4	5
Production and Operations Management	5	5
International Journal of Production Research	7	4
Communications of the ACM	1	3
Expert Systems with Applications	2	3
Industrial Management & Data Systems	7	3
Information Systems Research	2	3
Journal of Business Logistics	1	3
MIS Quarterly	1	3
Total	**87**	**161**

Note: (*) August 28, 2014.
Source: Data collected from Social Sciences Citation Index – SSCI / Web of Science.

Table 4. *Authors with the most publications on collaboration in SC.*

Authors	Article count*	Institutions (author's affiliation)	Country
Fawcett, S.E.	5	Brigham Young University	USA
Chong, A.Y.L.	4	INTI International University	Malaysia
Magnan, G.M.	4	Seattle University	USA
Ramanathan, U.	4	Northumbria University	UK
Sheu, C.	4	Kansas State University	USA
Bouras, A.	3	University of Lyon	France
Cao, M.	3	University of Wisconsin	USA
Fawcett, A.M.	3	Brigham Young University	USA
Gimenez, C.	3	University Ramon Llull	Spain
Lin, C.H.	3	National Cheng Kung University	Taiwan
Neubert, G.	3	University of Lyon	France
Pramatari, K.	3	Athens University Econ & Business	Greece
Zhang, Q.Y.	3	Arkansas State University	USA

Note: (*) until 28 August 2014.
Source: Data collected from Social Sciences Citation Index – SSCI/Web of Science.

Table 5. *Most cited authors in the collection on collaboration in SC.*

Authors	Citation count*	Institutions (author's affiliation)	Country
Barratt, M.	25	Arizona State University	USA
Cao, M.	11	University of Wisconsin	USA
Klassen, R.D.	11	University of Western Ontario	Canada
Vachon, S.	11	Clarkson University	USA
Zhang, Q.Y.	11	Arkansas State University	USA
Fawcett, S.E.	10	Brigham Young University	USA
Magnan, G.M.	10	Seattle University	USA
McCarter, M.W.	10	University of Illinois	USA
Sheu, C.	10	Kansas State University	USA

Note: (*) 28 August 2014.
Source: Data collected from Social Sciences Citation Index – SSCI / Web of Science.

SYSTEMATIC ANALYSIS RESULTS

As described in the methodological procedures section, two groups of paper were selected: most cited papers (Table 6) and most recent papers indexed in high impact journals (Table 7), totaling 18 papers. Table 6 shows that Barrat's paper (2004) stands out among the most cited papers with 25 citations. This means that it was cited by 25 of 173 papers in the analyzed collection.

After applying the selection criteria for most recent papers, published between 2013 and 2014 and indexed to high impact journals on collaboration in SC (Table 3), the list was comprised of 7 papers, 3 of which were published in 2013 and 4 in 2014. The papers in this group are published in the following journals: *Decision Support Systems* (1 paper), *International Journal of Computer Integrated Manufacturing* (1 paper), *International Journal of Production Economics* (2 papers), *International Journal of Production Research* (2 papers), and *Production Planning & Control* (1 paper). This information allows us to know which high impact journals in the field have published papers recently (last two years) on collaboration in SC.

Table 6. *Most cited articles in the collection on collaboration in SC.*

Authors (Year)	Article Title	Journal	Citation count*
Barratt (2004)	Understanding the meaning of collaboration in the SC.	*Supply Chain Management – An International Journal*	25
Sheu, Yen and Chae (2006)	Determinants of supplier-retailer collaboration: Evidence from an international study.	*International Journal of Operations & Production Management*	9
Vereecke and Muylle (2006)	Performance improvement through SC collaboration in Europe.	*International Journal of Operations & Production Management*	9
Nyaga *et al.* (2010)	Examining SC relationships: Do buyer and supplier perspectives on collaborative relationships differ?	*Journal of Operations Management*	9
Cao and Zhang (2011)	SC collaboration: Impact on collaborative advantage and firm performance.	*Journal of Operations Management*	8
Fawcett *et al.* (2008)	Benefits, barriers, and bridges to effective SC management.	*Supply Chain Management-an International Journal*	7
Vachon and Klassen (2008)	Environmental management and manufacturing performance: The role of collaboration in the SC.	*International Journal of Production Economics*	7
Matopoulos *et al.* (2007)	A conceptual framework for SC collaboration: empirical evidence from the agri-food industry.	*Supply Chain Management-an International Journal*	6
Akkermans *et al.* (2004)	Travail, transparency and trust: A case study of computer-supported collaborative SC planning in high-tech electronics.	*European Journal of Operational Research*	5
Klassen and Vachon (2003)	Collaboration and evaluation in the SC: The impact on plant-level environmental investment.	*Production and Operations management*	4
Sanders (2007)	An empirical study of the impact of e-business technologies on organizational collaboration and performance.	*Journal of Operations Management*	4

Note: (*) August 28, 2014.
Source: Data collected from Social Sciences Citation Index – SSCI / Web of Science.

The papers listed in Tables 6 and 7 were read and analyzed. First, we searched these 18 papers for definitions and/or key concepts that help understand the meaning of collaboration and/or which aspects are relevant to its operation in the SC. In general terms, few papers provide an explicit definition for collaboration. Out of 18 analyzed papers, only the papers by Sheu *et al.* (2006), Sanders (2007), and Cao and Zhang (2011) provide clear definitions of collaboration in SC (see Chart 1). For these authors, collaboration refers to interdependence between parties in a SC oriented for long-term relationship (Sheu *et al.*, 2006), which is directly related to human interaction (Sanders, 2007) and is implemented in the partnership process focused on planning and executing SC operations towards common goals and mutual rewards (Cao and Zhang, 2011).

Some key aspects for understanding and implementing collaboration in SCs are highlighted in the analyzed papers (Chart 1). Barratt (2004) and Matopoulos *et al.* (2007), for instance, draw attention to the importance of setting selection criteria to determine with whom companies should collaborate. Complementarily, Jayaram and Pathak (2013) highlight the relevance of choosing partners strategically, as knowledge integration may not have any impact if conditions are not well defined or if wrong partners are involved. On the other hand, Cao and Zhang (2011) advocate that all parties should collaborate for collaboration to be rewarding. Aspects regarding information sharing, long-term relationship, trust, organizational competences, and information technology usage are also mentioned (Akkermans *et al.*, 2004; Baihaqi and Sohal, 2013; Sheu *et al.*, 2006; Cao and Zhang, 2011). In short, several authors have defined collaboration in SC differently. The analyzed papers do not seem to have the intention to conceptually define the term collaboration. Focus is on discussing its importance and the aspects or factors involved which could affect collaboration within this context. This result could be partially explained by the type of research carried out (mostly empirical quantitative studies). Next section presents and discusses the profile of these papers according to the type of research.

Table 7. *Recent articles in the collection on collaboration in SC (2013-2014).*

Authors	Article Title	Journal	Year
Chong and Zhou	Demand chain management: Relationships between external antecedents, web-based integration and service innovation performance.	*International Journal of Production Economics*	2014
Ganesh, Raghunathan, and Rajendran	The value of information sharing in a multi-product, multi-level SC: Impact of product substitution, demand correlation, and partial information sharing.	*Decision Support Systems*	2014
Kuo, Hsu, Huang, and Gong	Data sharing: a collaborative model for a green textile/clothing SC.	*International Journal of Computer Integrated Manufacturing*	2014
Ramanathan, Gunasekaran	SC collaboration: Impact of success in long-term partnerships.	*International Journal of Production Economics*	2014
Baihaqi and Sohal	The impact of information sharing in SCs on organizational performance: an empirical study.	*Production Planning & Control*	2013
Cai, Goh, de Souza, and Li	Knowledge sharing in collaborative SCs: twin effects of trust and power.	*International Journal of Production Research*	2013
Jayaram and Pathak	A holistic view of knowledge integration in collaborative SCs	*International Journal of Production Research*	2013

Source: Data collected from Social Sciences Citation Index – SSCI/Web of Science, until August 28, 2014.

Chart 1. *Definitions and key aspects of collaboration in SC.*

Definitions and key aspects of collaboration in SC	Authors (year)
It is the interdependence when one party does not entirely control SC operations and it is positively related to firm's long-term relationship orientation.	Sheu, Yen, and Chae (2006, p. 26)
SCC is defined as a partnership process where two or more autonomous firms work closely to plan and execute SC operations towards common goals and mutual benefits.	Cao and Zhang (2011, p 166)
Collaboration is a result of human interactions which can be supported by IT, one of which are e-business technologies, but not replaced.	Sanders (2007 p. 1343)
The more SC partners work closely together, the more they will trust each other, and the more data they will dare to share.	Akkermans *et al.* (2004, p. 446)
We probably only need to collaborate with a small number of strategically important customers and suppliers.	Barratt (2004, p. 33)
SC collaboration also helps firms avoid internalizing an activity that may not be aligned with their competencies.	Cao and Zhang (2011, p. 164)
Companies in the real business world are interacting with a number of suppliers and customers. Obviously, not all of them can become close collaborators and under this prism. A selection is needed, based on the expectations, perceived benefits and drawbacks, and the "business fit" of companies.	Matopoulos *et al.* (2007, p. 178)
Information sharing should be used to increase collaboration with SC partners and to enhance the organization's internal integration practices. Information sharing, facilitated by IT, serves as the backbone for SC integration.	Baihaqi and Sohal (2013, p. 750)
Knowledge integration may have no impact at all if the conditions are not right or if the wrong partners are involved.	Jayaram and Pathak (2013, p. 1959)

Source: Data collected from analyzed articles from Social Sciences Citation Index – SSCI/Web of Science.

RESEARCH TYPE AND PAPER APPROACH

As shown in Figure 2, regarding research type, quantitative studies are predominant (61% of analyzed papers), while qualitative studies represent 22%. There are also two theoretical studies (2% of papers) and only one paper adopted a qualitative-quantitative approach. Except for two theoretical papers, all other papers are empirical.

Regarding the research techniques adopted, all qualitative studies use case study as a research strategy. The quantitative studies use surveys and some employ structural equation modeling. Only one study uses data triangulation, presented here as qualitative-quantitative research. Chart 2 shows, in chronological order of publication, research type, context, and main results and conclusions of analyzed papers.

Barrat (2004) proposes associating collaboration and organizational strategy through the analysis of cultural, strategic, and implementation elements and SC segmentation, based on the buying behavior of customers and service demands. In another literature review article, Ganesh *et al.* (2014) discuss information sharing under the aspect of substitute products, analyzing the impact of substitution in a global SC with several levels that provide multiple substitute products.

According to Fawcet *et al.* (2008), three macro-aspects should be analyzed: (i) Forces that lead to collaboration in the chain (increased competitive intensity, more demanding customers, power change in the channel, economic globalization, tighter alliance relationship, reduced product cycles, new information technologies, etc.); (ii) Benefits (unmatched products and services, faster P&D cycle times, higher quality, cost competitiveness, reduced order cycles, flexible response to customer, improved delivery performance, improved asset management, etc.); and (iii) Barriers (lack of high management support, operational and strategic policies not in line with the company's philosophy, inability to share information, lack of trust between chain parties, lack of commitment to share risks and rewards, inflexible organizational systems and processes, resistance to change, etc.).

Klassen and Vachon's (2003) paper addresses the environmental approach to collaboration in SC, focusing on environmental investment. The studies of Vachon and Klassen (2008) and Kuo *et al.* (2014) also deal with the environmental issue but focusing on collaborative activities and data sharing, respectively.

Chong and Zhou (2014) analyze the relation between the adoption of e-SC integration and performance in service innovation from the perspective of SC management. The model proposed verifies the relation of technological and collaborative structures with chain management of web-based demand and with innovation of processes and products relative to services.

Akkermans *et al.* (2004) focuses on the collaborative planning process and analyzes the interactions between the trust level of partners, information transparency, and improvements resulting from the SC performance. Along the same line, Ramanathan and Gunasekaran (2014) seek to identify the impact of collaborative planning, collaborative decision making of chain supply partners, and collaborative execution of all SC processes for successful collaboration, using as constructs collaborative planning, collaborative execution, collaborative decision making, successful collaboration, and long-term collaboration or future collaboration.

Even though the association between collaboration and organizational performance is mentioned in the papers in general, three of them mention it as a direct goal: (i) Vereecke and Muylle (2006) aims at empirically testing the relation between SC collaboration and improved performance through hypotheses developed from the existing literature, incorporating the dimensions of customer and supplier collaboration as well as performance improvement; (ii) Sanders (2007) proposes and tests a model for the relation between the organizational use of e-business technologies, organizational collaboration (intra- and inter-collaboration), and performance, using empirical data; (iii) Cao and Zhang (2011) aim at discovering the nature of SC collaboration and exploring its impact on a company's performance based on a collaborative advantage paradigm.

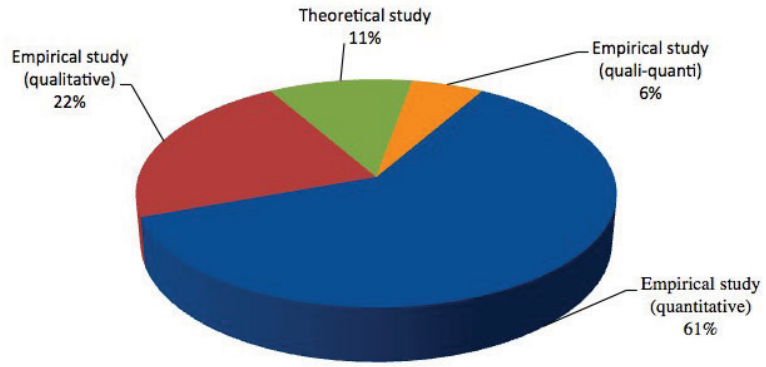

Figure 2. *Breakdown of articles by study type.*

Source: Data collected from analyzed articles (Social Sciences Citation Index – SSCI/Web of Science).

Chart 2. *Main results and conclusions appointed by articles on collaboration in SC.*

Authors (Year)	Type of Study	Context	Main results and conclusions
Klassen and Vachon (2003)	Empirical (quantitative) – Survey	202 Canadian Industries	There is a significant relation between collaboration in SC and the level and form of investment in environmental technologies. The increase in collaboration was also significantly related with a major global investment in environmental programs. On the other hand, only one very limited evidence was identified showing that evaluative activities influence investment, with some indication that a great evaluation by suppliers increases investment.
Akkermans *et al.* (2004)	Empirical (qualitative) Case Study	1 manufacturer of integrated circuits (ICs), contract manufacturer (CMS) for the assembly of subsets and 1 producer of parts	In order to reach the required levels of transparency, high levels of trust are essential. And such levels of trust and transparency can only be attained through the hard work of everyone involved. Once this is done, the SC partners will find themselves in a virtuous cycle of continuous improvement of the chain development.
Barratt (2004)	Theoretical	Literature review	Collaboration in SC requires the use of significant resources to implement it, and those organizations that try to collaborate with a high number of customers and suppliers will not be successful. The proposal is limiting the collaboration with a small number but critical of customers and suppliers.
Sheu *et al.* (2006)	Empirical (qualitative) Case Study	Five pairs of suppliers and retailers in Taiwan.	With the exception of the long-term length or orientation, all the variables are found as criticism regarding the supplier-retailer collaboration. It is the intensity, opposite to the length of the relation, which influences the retailer-supplier relation.
Vereecke and Muylle (2006)	Empirical (quantitative) – Survey	374 engineering/ assembly companies in 11 European countries	There was a strong empirical support for the hypothetical high levels of collaboration among companies that show a higher performance improvement.
Matopoulos (2007)	Empirical (qualitative) Case Study	Agro-food industry, in the producer-processing party interface, in small and medium-sized enterprises (SMEs)	The case study identified the importance of elements such as trust, power, reliability and sharing of risk/reward in the company and the maintenance of relationships in the chain, as well as the role of these elements to select partners and decide on the depth and amplitude of collaboration.
Sanders (2007)	Empirical (quantitative) Survey	245 Industries in the USA	The use of e-business technology has an impact on performance, directly and indirectly through the promotion of both collaboration measures (intra and inter). The intra-organizational collaboration also has a direct impact on organizational performance. However, this impact is verified as being only indirect, through the impact of intra-organizational collaboration. These results reveal the complexity of organizational collaboration, stress how important it is for companies to promote internal collaboration and invest on information technologies that facilitate them.
Fawcett *et al.* (2008)	Empirical (quantitative and qualitative) Triangulation: literature review, survey and case study	Manufacturing and logistics purchase senior-manager were the target of the survey with 254 companies.	Every manager acknowledges technology, information and measurement systems as the main barrier hindering the success of SC collaboration. However, people-related issues – such as culture, trust, aversion to change, and the will to collaborate – are harder to solve. People are the key bridge for a successful collaborative innovation and should not be ignored when companies invest in SC facilitators, such as technology, information and measurement systems.

Chart 2. *Continuation.*

Authors (Year)	Type of Study	Context	Main results and conclusions
Vachon and Klassen (2008)	Empirical (quantitative) Survey	North-American manufacturers (USA and Canada)	The benefits of "green" collaboration practices with suppliers were broader. On the other hand, collaboration with customers obtained mixed results. In general, evidence showed that upstream practices are more intimately connected with process-based performance, while downstream collaboration was associated with product-based performance.
Nyaga *et al.* (2010)	Empirical (quantitative) Structural equations modeling	Executives from several industrial activities and services in the USA	Results show that collaborative activities, such as information sharing, relationship, joint effort and dedicated investments, lead to trust and commitment. Trust and commitment, on their turn, result in more satisfaction and better performance. Results from the two independent studies present similarities and differences; however, buyers focus more in results related to relationship, while suppliers try to protect their investments on specific assets through information sharing and effort in joint relationship.
Cao and Zhang (2011)	Empirical (quantitative) Structural equations modeling	Manufacturing companies in the USA, in several industries. People with experience or knowledge in SC, such as CEOs, presidents, vice-presidents, directors, or managers.	Results indicate that collaboration in the SC improves collaborative advantage and plays an influence on the company performance. Collaborative advantage is an intermediary variable, which allows the SC partners to obtain synergies and create a better performance. A deeper analysis on the effect of moderation of the company dimension reveals that collaborative advantage is the mediator of the relation between the SC collaboration and the organizational performance in small companies, while it acts a partial mediator in those relations with medium-sized and big companies.
Baihaqi *et al.* (2013)	Empirical (quantitative) Structural equations modeling	150 manufacturing companies	Integrated information technologies and the quality of information have a positive influence on the intensity of information sharing. However, sharing cost-benefits and internal integration do not relate to the intensity of information sharing. Information sharing dos not directly relates to organizational performance. Its relation is mediated by the collaborative practices with the SC partners. It suggests that information sharing is essential, but not enough on itself only to bring significant performance improvement.
Cai *et al.* (2013)	Empirical (quantitative) Structural equations modeling	198 industries from several segments, according to data from Singapore Logistics Association.	Trust has significant effects on the technical interchange and technology transfer. Besides, power also significantly affects technology transfer and technical interchange, although impacts seem to be weaker than in trust. Power and trust variables collectively account for knowledge sharing in the SC.
Jayaram and Pathak (2013)	Empirical (quantitative) Survey	435 industries of industrial equipment, computers, electronic products, and electrical equipment.	Knowledge sharing and enrichment are important mechanisms for the integration of knowledge in collaborative chains. The focus on the efficiency of product concept and on the process performance for new product development (NPD) is appropriate, for these constructs are positively and significantly related to the financial development of NPDs.
Chong and Zhou (2014)	Empirical (quantitative) *Survey*	256 health industry companies	Collaboration structure (for instance, competitive pressure, trust, information sharing, and environment uncertainty) and technological structure (as security) have a positive and significant influence on the decision of an organization to adopt the integration of web-based demand chain management. However, the collaboration structure has the highest influence in the adoption of integration of web-based demand chain management of an organization. Results also show strong evidence that the integration of web-based demand chain management improves the performance of services innovation. We suggest that organizations must, first of all, focus on improving their collaboration structure with suppliers and customers, before considering their technological structure.

Chart 2. *Continuation.*

Authors (Year)	Type of Study	Context	Main results and conclusions
Ganesh *et al.* (2014)	Theoretical	Literature review	Results suggest that replacing different products can reduce the value of information sharing for all SC companies. This reduction is bigger (i) for upstream companies, (ii) when the degree of replacement is higher, (iii) when the number of products in replacement is higher, (iv) when product demands are more correlated, and (v) when the degree of information sharing is higher.
Kuo *et al.* (2014)	Empirical (qualitative) Case study	Clothing/Textile Industry	A comprehensive project analysis and the proper follow-up during the production process through a web-based system will significantly reduce the environmental impact on the textile industry. There is also a cultural gap of indulgence for data sharing. Many companies are not willing to share information yet, due to confidentiality concerns and due to fear of losing competitiveness.
Ramanathan and Gunasekaran (2014)	Empirical (quantitative) Structural equations modeling	Textile company customers	Analysis results confirm that collaboration factors have an impact on the success of SCs that lead to future collaborations. The collaborative execution of the SC plans will also have an impact on future collaborations. Companies that are interested in SC collaborations may consider getting involved in long-term collaboration, depending on the success of current collaborations.

Source: Data collected from analyzed articles (Social Sciences Citation Index – SSCI/Web of Science).

From the perspective of the relationship between partners, Matopoulos *et al.* (2007) create a model based on two pillars: (i) Design and governance of SC activities; (ii) Establishing and maintaining SC relationships.

Nyaga *et al.* (2010) examine collaboration relationships in two distinct studies: one analyzes the buyers' perception and the other analyzes the suppliers' perception. Both studies are then compared to determine the economic and relational factors driving satisfaction and performance from the viewpoint of each party.

Sheu *et al.* (2006) develop a comprehensive supplier-retailer relationship model with specific investigation positions: business relationship between supplier-retailer (interdependence, intensity, trust) affects the long term orientation; business relationship between supplier-retailer affects the SC architecture (information sharing, inventory system, information technology resources, coordination structure); long-term relationship affects the SC architecture; SC architecture affects the level of collaboration between supplier and retailer; and collaboration between supplier and retailer improves the performance of supplier and retailer.

From the perspective of sharing, Baihaqi and Sohal (2013) conceptualize and evaluate several factors that influence the level of information sharing in SCs, namely integrated information technologies, internal integration, information quality, and cost-effectiveness of sharing, and the relation with information sharing intensity, collaboration, and organizational performance.

Cai *et al.* (2013) discuss the mechanisms underpinning knowledge sharing in SC. The study particularly focuses on knowledge sharing in a dyadic buyer-supplier relationship. It refers to trust and power as two important antecedents of two types of knowledge sharing between buyer and supplier, namely technical exchange (generally simple and direct, involving small work units or independent individuals), and technology transfer (which involves complex challenges, such as coding and communication capabilities) and its relation with organizational performance.

From the perspective of new product development projects, Jayaram and Pathak (2013) propose two different types of mechanisms within a collaborative SC: short-term knowledge sharing and iterative knowledge enrichment. They investigate the effects of knowledge sharing and enrichment between companies and their collaborative network partners on product concept effectiveness and process performance.

AVENUES FOR FUTURE STUDIES

Chart 3 shows the main gaps and opportunities for future research as indicated by the authors of the analyzed papers.

While pointing out the need for a future research focused on the impact of the specific collaboration activities into the SC, Klassen and Vachon (2003) connect environmental management, SC management and SC collaboration. The authors posit that it may be expected that specific collabora-

Chart 3. *Main gaps and opportunities for future research identified in the articles on collaboration in SC.*

Authors (year)	Main gaps and opportunities for future research
Klassen and Vachon (2003)	These authors examine in greater detail the implications of collaborative activities under the environmental management and the performance of SCs. It is very likely that specific activities will prove more beneficial in particular contexts and circumstances.
Barratt (2004)	This paper identified a significant number of collaboration elements, however, it is not clear yet how these elements (such as culture, trust, information exchange) are inter-related.
Akkermans *et al.* (2004)	A research effort would be to evaluate several collaborative planning configurations in a similar way and generalize based on a cross-analysis of these cases.
Sheu *et al.* (2006)	The authors suggest four paths for future research: (i) deeper studies of the relations between the elements, such as trust, information sharing and collaboration; (ii) examining if the effect of duration/stability of the supplier-retailer relationship depends on the environment or other factors; (iii) the influence of internal integration in the supplier-retailer relationship dependent on other relationship factors, such as trust and interdependence; and (iv) future studies should investigate the influences of the national differences in the supplier-retailer collaboration.
Vereecke and Muylle (2006)	Future research must investigate the use of different forms of collaboration (supply and demand factors), in order to increase even further the comprehension of researchers and managers about the relation between collaboration in SC and performance improvement.
Sanders (2007)	Future research must explore our initial discoveries considering the impact of specific information technologies about the collaboration and organizational performance. Future studies must consider expanding this relation to include the SC integration stage. Future research must take into account the relation between specific types of information technologies and their connection with specific collaboration needs.
Matopoulos *et al.* (2007)	Expanding the investigation focus for more complex SC relations throughout the chain; also examine the risks of collaboration in the SC; and the way how the elements trust, power and dependency interact in the process of collaboration construction.
Fawcett *et al.* (2008)	There are research gaps concerning the interrelationship between benefits, barriers, and bridges to collaboration in SC. There is a need, for example, for research on the impacts of different types of barriers to collaboration in the SC, such as technology issues (e.g., technology, information, measurement systems) and people issues (e.g., culture, trust, aversion to change, and willingness to collaborate).
Vachon and Klassen (2008)	The capacity of an organization to absorb knowledge could have increased the understanding about the relationship between collaboration ("collaboration with suppliers" and "collaboration with customers") and performance ("manufacturing performance").
Nyaga *et al.* (2010)	More research focusing on practices, mutual efforts and the value derived from relationships between buyers and their strategic suppliers are fundamental.
Cao and Zhang (2011)	Other studies could be developed with a focus on collaboration in dyadic relationships within chains, "collecting information from both sides of the manufacturer–supplier dyad rather than just from one organization". Also to investigate the relationships "between SC collaboration, collaborative advantage, organizational performance" (p.176).
Baihaqi and Sohal (2013)	How does power affect the nature of the collaboration among the SC partners? How does the competitive environment and the institutional isomorphism influence information sharing and SC collaboration?
Cai *et al.* (2013)	The authors suggest future researches to examine genuine dyadic relationships, which should collect information from both sides. The use of other methods, such as the analysis of social networks, may help to explain the different collaboration configurations inside the SCs.
Jayaram and Pathak (2013)	The authors suggest that future studies should examine the SC from a network structure (collaborative network, and investigate the knowledge creation within the context of the collaborative network.
Chong and Zhou (2014)	The authors state that there is a need for comparative studies between various SCs from different industries.

Chart 3. *Continuation.*

Authors (year)	Main gaps and opportunities for future research
Kuo *et al.* (2014)	As global warming issues are gaining increased attention, future research must focus on sharing information related to carbon emission in the SC. There is a space for empirical studies about data sharing among enterprises within green SCs in the different industries, not only in the textile/clothing industry.
Ganesh *et al.* (2014)	The authors believe there should be more understanding about the relative incentives from enterprises in several levels within a SC, in order to share information with its trade partners.
Ramanathan and Gunasekaran (2014)	The author suggest the examination of the success of collaboration and its impact on future collaborations by involving several of SC partners.

Source: Data collected from analyzed articles (Social Sciences Citation Index – SSCI / Web of Science).

tion activities will turn out to be more beneficial in specific circumstances. For instance, in some contexts, environmental focused collaboration activities (e.g., technical interchanges to develop pollution prevention) may be critical to durable goods and less important to consumer goods. Moreover, the authors suggest "the physical or organizational distance from commodity material suppliers and end-consumers, might create additional challenges for managers seeking to develop a greener SC" (Klassen and Vachon, 2003, p. 349). The exploration of these aspects in empirical researches (in survey and case studies, for example) appears to be a promising path. In this direction, Kuo *et al.* (2014) study points to the company's interest in establishing green SCs and proves, through the study of an illustrative case in a textile/clothing SC, that the sharing of data related to environmental impacts is a key factor of success for developing this kind of chain. The authors point out that there is a space for future researches that will examine in the different SCs (not only in the textile/clothing industry) how the information related to environmental impacts (*e.g.*, carbon emission information) is shared by the agents in these chains. The mentioned articles (Klassen and Vachon, 2003; Kuo *et al.*, 2014) reveal that there are still many paths to be followed by future researches that might explore the aspects that involve the Green SC Management, especially collaboration and data sharing among enterprises within green SCs.

In the conceptual discussion of the importance of understanding the meaning of collaboration in the context of the SC, Barratt (2004) brings out new elements that characterize the collaboration in this context (such as collaborative culture, external and internal trust, mutuality and information exchange). It suggests that future empirical researches will examine deeply the interrelations between these collaboration elements. Complementarily, Sheu *et al.* (2006) point to the need for carrying out deeper studies of the relations between the elements that make up the collaboration and determine its essence. There is an opportunity to study how the elements trust, power and dependence interact in the process of conception and development of the SC collaboration (Matopoulos *et al.*, 2007).

There is also a range of possibilities for future researches focused on the factors that affect SC collaboration. Sheu *et al.* (2006), for instance, recommend the development of studies to examine if the duration/stability of SC collaboration is affected by environmental factors or other factors and how it happens; and, also, to look into the influences of the national differences in collaboration. It seems that there is a research gap in the exploration of questions regarding the *SC collaboration* in the international environment (Sheu *et al.*, 2006). There is also the opportunity to research how power affects the nature of collaboration between the various SC agents; and how the competitive environment influences this collaboration (Baihaqi and Sohal, 2013). Subsequent studies may also analyze deeply the impact of information technologies into collaboration (and organizational performance), regarding the relation between the specific types of information technologies and their connection with the specific needs of the SC collaboration (Sanders, 2007).

Other research suggestions are directed towards the relation between collaboration and performance. Future studies might research more empirical evidence that help explain the influence of collaboration on the company's performance in the SC, since the companies that show a better performance are not always the ones that provide the highest levels of collaboration (Vereecke and Muylle, 2006). These authors describe two different forms of the SC collaboration – a collaboration focused on the exchange of information (on forecasts, planning, inventory and delivery) and a more structural collaboration, focused on geographical proximity – and suggest that future empirical studies may bring forth new evidences that will allow to explain how each of these forms of collaboration (or the entire group of them) may affect the performance improvement, "i.e. the four traditional areas of delivery, cost, quality, and flexibility, as well as two additional areas: procurement (cost and lead time), and innovativeness (time to market)" (Vereecke and Muylle, 2006, p. 1192). When mentioning that it is a cross-sectional study, Vereecke and Muylle (2006) suggest that there is a gap to be explored through the carrying out

of researches with a longitudinal approach to examining the relations between SC collaboration and performance improvement. Recently, Ramanathan and Gunasekaran (2014) suggest examining the success of collaboration and its impact on future collaborations by involving several of SC partners. Companies that are interested in SC collaborations can consider (or not) engaging in long-term collaboration, regarding the success of actual collaborations (Ramanathan and Gunasekaran, 2014). In this direction, longitudinal studies may help explain how actual collaboration can affect future collaborations and, consequently, the obtained benefits/results.

According to Fawcett *et al.* (2008), the benefits that companies may obtain from the SC collaboration can be noticed – however, some barriers could block the obtaining of these benefits. "Understanding these barriers can lead to designing bridges to allow companies obtain SC benefits" (Fawcett *et al.*, 2008, p. 45). There is indeed the need for more researches that allow to increase the understanding of benefits, barriers, and bridges to collaboration in SC. For instance, researches on different types of barriers to collaboration in SC, such as technology issues (e.g., technology, information, measurement systems) and people issues (e.g., culture, trust, aversion to change, and willingness to collaborate), are empirical studies that must be done.

There is also a need for comparative studies between various SCs from different industries (Chong and Zhou, 2014) in order to generalize the results beyond the specific SCs. It must be included on these studies the analyses of the different collaboration configurations (for instance, collaborative planning) (Akkermans *et al.,* 2004), the risks of collaboration in SC (Matopoulos *et al.*, 2007), and the companies related incentives in different levels of the SC in order to share information with their commercial partners (Ganesh *et al.,* 2014).

Some studies are limited to the study of collaboration in SCs in a dyadic relation, from a one sided point of view (e.g. in the relationship supplier-buyer only one of the sides answer the survey questions). This gap suggests the carrying out of future researches to examine genuine dyadic relationships, which should collect information from both sides (Cao and Zhang, 2011; Cai *et al.*, 2013). Cai *et al.* (2013), for instance, requested the survey informants to choose a key supplier to answer the survey questions related to the exchanges with the chosen supplier. Although it is recurrent to adopt this type of strategy to collect data in the SCs surveys, the opportunity for future researches that will explore both points of view together is opened. These studies may also contribute to improve the understanding of the relationships "between SC collaboration, collaborative advantage, organizational performance [...] providing more interesting and useful results for researchers and practitioners" (Cao and Zhang, 2011, p. 176). Nyaga *et al.* (2010) also suggest that studies focused on practices, mutual efforts and value from relationships between the buyers and their strategic suppliers are essential for the research field of SC collaboration.

Furthermore, Cai *et al.* (2013) posit that the use of other methods, such as the analysis of social networks, may help explain the different collaboration configurations inside the SCs, in both the individual company's level and the global chain's level. Jayaram and Pathak (2013) mention that it is worth considering that network structures may have significant implications with respect to how companies manage the information stream in the SC. In this direction, there is the possibility to extend the opportunity of carrying out researches that may contribute to the theoretical and methodological improvements in the field.

Some other articles suggest the carrying out of future researches which might use another constructs, such as absorptive capacity (Vachon and Klassen, 2008) and knowledge creation (Jayaram and Pathak, 2013), to help explain some aspects related to collaboration in SC. For instance, a study focused on the role of absorptive capacity in the relationship between collaboration in SC ("collaboration with suppliers" and "collaboration with customers") and manufacturing performance would be welcomed. "It can be expected that a higher degree of absorptive capacity will moderate the collaboration–performance relationship" (Vachon and Klassen, 2008, p. 312). Based on the analyzed articles we realize that there is a lack of other constructs that might be useful to add knowledge in the research field of SC collaboration. Some of them are: organizational and interorganizational learning, leadership, organizational memory, and dynamic capabilities, among others.

In the next section, we conclude this paper with a few considerations (conclusions) drawn from the results shown, and other future research directions.

CONCLUSIONS

In order to really understand the research field and be able to provide theoretical and practical contributions, the development of quality scientific research requires access to foundations and accumulated knowledge (from previous studies) on a specific subject.

Therefore, this study contributes to the development of research on SC by means of bibliometric and systematic study of the scientific production on the subject. This study may be a guide for researchers doing their research in this area, especially researchers that are not familiar with the subject.

By providing the chronological distribution of publications, this work allows to trace the trajectory of the scientific production on the subject over time. The first two papers retrieved from the database were published in 1996 and 1999, confirming that, as pointed out by other researchers, collaboration within the SC context is a relatively new subject and has attracted the interest of the scientific community after the second half of the 1990s. The growing interest and relevance of collaboration in SC is demonstrated by the significant increase

in the number of publications along the years 2000 to current days (taking as reference the date this bibliometric study was carried out: August 2014).

This bibliometric study also allowed us to identify journals and papers that stand out in the research field on collaboration in SC. Two journal lists were presented in this paper: (i) journals with the highest number of papers and (ii) most cited journals by papers on the subject (high impact journals). These results show that most journals focus on Operational Research and Production/Operations Management. The papers that most stand out in the area, papers with a high count of citations, and papers published in the last two years in high impact journals were also listed. These lists (presented along this paper) enable researchers to know where to start/further their research on the subject and to become familiar with the most influential studies in the area, that is, the papers that other researchers have used to support their research and that have high impact.

This paper also provided a comprehensive analysis of selected papers, showing gaps and opportunities for future research on collaboration in SC. With this information, researchers interested in the subject could use the results as input to conduct their research. The opportunities for future research include the need to carry out in-depth research exploring the inter-relationships between the aspects of collaboration within the SC context.

Some limitations of this article are related to the bibliometric method used. The use of the citation counts – to select journals and articles – does not allow us to understand the context in which the article/journal has been cited in the bibliographical collection analyzed, since a reference can be cited sporadically (once or twice in the text) or as a essential way for the construction of the arguments. Future research may include all papers initially retrieved in the database and analyze the content of the articles to understand how the citation was made and which references are really representative as foundations for the development of research on SC collaboration field.

In short, the mapping of the field of research on collaboration in SC presented in this paper allows for learning about the history and current state of this research field at the international level from bibliographical data retrieved from Web of Science – Social Sciences Citation Index (WoS-SSCI). However, other limitation of this study is due to the use of a single database, the WoS-SSCI. In spite of the importance this database has in the scientific community, we suggest that future bibliometric studies on this topic should also include other databases, such as Scopus, Science Direct, EBSCO, and Scielo. One of many other ways to conduct literature review studies on collaboration in SC is mapping the scientific production of Brazilian researchers, both in Brazilian and international journals. It would also be interesting to conduct literature reviews on subjects related to collaboration in SC, such as cooperation, integration, and coordination.

Although it was mentioned that collaboration and cooperation are different concepts, this work did not look for analyzing and exploring the existence of these differences. To fill this gap, it is perceived an opportunity for future studies to analyze in depth how both terms are used in the SC literature and in what ways it occurs in the practical context of organizations. Theoretical essays, structured literature review and even empirical studies can be conducted to expand the understanding of the differences and complementarities of both types of strategies in the SC context.

This study shows several opportunities for future research and contributes to the understanding of the bibliographic framework of collaboration within the SC, providing input that enriches the discussion on the possible directions that research in this area has taken and scientific trends for researchers and/or those interested in the topic.

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