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Review

A systematic literature review on green supply chain management: Research implications and future perspectives

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ABSTRACT

This article aims to present the Green Supply Chain Management (GSCM) practices from a comprehensive point of view and to analyze the subject's behaviour in the last ten years, through a systematic literature review/bibliometric analysis in articles published from 2006 to 2016. Through the research profiling method, we identified that (i) the most frequent research contexts were "GSCM financial impact" and "motivations to GSCM implementation", (ii) the automotive, textile/manufacturing and electronic sectors were the most discussed, (iii) the most used research methods were those involving empirical procedures, iv) Web of Science and Scopus databases gathered 96.7% of the articles used in this analysis, (v) there is a high concentration of researches from countries academically established and recognized, while developing countries are also present, (vi) Journal of Cleaner Production was the most cited journal and with more publications about GSCM, (vii) Samir Srivastava's article had the highest Citation Score, and (viii) there are 11 GSCM research clusters. In addition, we discuss the content covered in the literature review, seeking to extend the understanding of the scenario where the GSCM is inserted nowadays and helping to identify research opportunities for researchers interested in such subject.

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1. Introduction

Green Supply Chain Management (GSCM or GrSCM) became an ever growing complex challenge for organizations in nowadays world scenario. Suppliers, customers, government, legal defence organizations are increasingly demanding solutions and responses from companies that cause significant environmental impacts in their production cycle activities (Jabbour et al., 2014a,b). Companies are looking to evolve from a reactive strategy to a proactive positioning, developing and implementing new management approaches, incorporating sustainable development practices into their strategies, and institutionalizing them as part of the business culture company policies.

Although Ahi and Searcy (2013) identified 22 different definitions for Green Supply Chain Management (GSCM), we observed that the most widely used definition in the literature comes from Srivastava (2007), which defines GSCM as "Integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as the end-of-life management of the product after its useful life".

According to Srivastava (2007), GSCM's scope ranges from reactive monitoring of general environmental management programs to more proactive practices implemented through various Rs (Reduce, Re-use, Rework, Refurbish, Reclaim, Recycle, Remanufacture, Reverse logistics, etc.).

The adoption of the GSCM surpasses environmental subjects, since a good corporate image implies in higher profits, cost reduction and generation of business value (Srivastava, 2007). According to Chan et al. (2012), green practices such as green purchasing and GSCM activities significantly increase corporate performance. The authors highlight the importance of encouraging the creation of a pro-environmental corporate culture, considering stakeholders' needs and requirements to improve the integrated green supply chain management.

According to Vanalle et al. (2017), green supply chain management (GSCM) is considered by organizations as a viable option to reduce the environmental impact of operations, while improving operational performance. Initially the GSCM was driven by environmental deterioration, diminishing raw material resources, and increasing levels of pollution (Srivastava, 2007); nowadays its implementation by organizations enables their performance improvement (Zhu et al., 2017).

Such findings are corroborated by Agi and Nishant (2017), who studied the implementation of GSCM practices, which is affected by the size of the company, the top management commitment, the implementation of quality management and the employees training and education.

The GSCM relevance can also be inferred by two evidences: (i) The geometric growth in the number of academic publications in this field, as identified by Fahimnia et al. (2015), who reported a total of 1586 articles about the theme, using the keywords (1) Green AND Supply Chain, (2) Environmental AND Sustainable AND Supply Chain, (3) Environmental AND Sustainability AND Supply Chain and (4) Ecological AND Supply Chain, to search in Scopus database; (ii) The publication of literature reviews about the subject: the very first peer-reviewed GSCM literature review seems to be published by Srivastava (2007), who analyzed publications about GSCM between 1990 and 2006, identifying studies context and methodological procedures used by authors. Sarkis, Zhu and Lai (2011) review focused to the organizational theories applied to GSCM, while Sarkis (2012) developed a framework to understand and to evaluate the relationships of various research streams and GSCM-related topics. Min and Kim (2012) reported the GSCM research evolution, synthesizing areas and identifying emerging perspectives, as well as future research opportunities about GSCM. Ahi e Searcy (2013) identified and analyzed several different definitions of Green supply chain management (GSCM) and Sustainable supply chain management (SSCM), while Gurtu, Cory and Jaber (2015) presented the most common keywords used in GSCM researches. Finally, Fahimnia et al. (2015) performed a bibliometric analysis and network analysis about GSCM published between 1992 and 2013.

Literature reviews usually intend to cover aspects not discussed by previous researches. In this sense, the present research, a green supply chain management literature review, purposes to present a broad and integrated view of the latest 10-year GSCM literature, analyzing the subject's behaviour along the 2006–2016 period.

The existing GSCM literature encompasses different approaches, such as Green Market (Xu et al., 2015), supplier selection and development (Bai et al., 2010; Wu and Barnes, 2016), reverse logistics (Bennekrouf et al., 2013), product life cycle (Besbes et al., 2013), Green Design (Sheu, 2016), Environmental and Operational performance (Woo et al., 2016; Shahryari et al., 2016). Therefore, aiming to enable the construction of a current and multidisciplinary scenario, ten years after Srivastava's seminal paper publication, "Green Supply Chain Management: A state-of-the-art literature review" (Srivastava, 2007), the present research purposes, based on the up-to-date literature, i.e., from 2006 on, to answer the author's questions, i.e.: i) which were the contexts of the problems addressed by GSCM literature? ii) which were the methodological procedures used by the authors to develop their research on GSCM area?

We also intend to expand the original research by adding the following questions: iii) which economic sectors were studied by authors to develop their researches? iv) what is the theme bibliometric profile (most used keywords, most cited authors, and journals and authors with more publications about the theme, etc.)? v) how had such research field evolved along the past ten years? vi) which are the major GSCM research area clusters? vii) which are the main research areas of GSCM?; viii) which are the most relevant citation networks?

The relevance of the present research is based on the following aspects: i) GSCM is a field with many aspects and facets, as pointed out by Srivastava (2007); ii) Research on GSCM are growing gradually along with the importance of its implementation (Lee, 2008; Tian et al., 2014); iii) There is a lot of pressure from stakeholders to have the topic widely discussed and applied (Huang et al., 2015; Kuei et al., 2015; Mathiyazhagan and Haq, 2013; Lee and Klassen, 2008; Diabat and Govidan, 2011; Chiou et al., 2011; Luthra; Garg and Haleem, 2016).

This paper is organized into six sections: Section 1 presents the introduction and research objectives; Section 2, the research methodology; Section 3, the literature review; Section 4, the research profile; Section 5, results and discussion, and Section 6, the conclusions of this study and future prospects of the research field, followed by References.

2. Methodological aspects of the research

In order to answer to the research questions identified, the research followed the eight steps presented in Fig. 1.

Upon establishing the 2006–2016 period to develop the literature review, starting from the end point of Srivastava's study (and expanding the author's analysis), we defined search arguments, keywords and databases to be used.

Therefore, we identified articles published from 2006 to 2016, in five databases: Web of Science, Scopus, Taylor & Francis, Science Direct and Ingenta Connect, using the "advanced search" tool, with the expressions "Green Supply Chain Management", "GSCM" and/

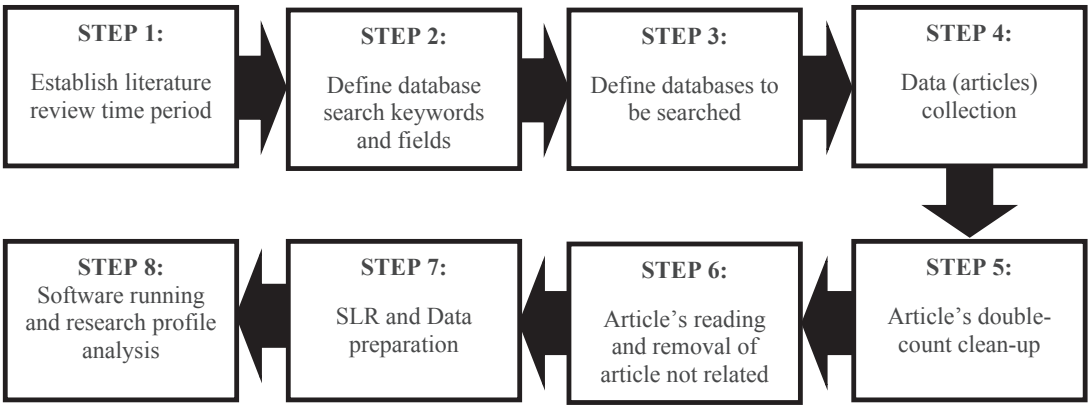

Fig. 1. Research steps. **Source:** Authors.

or "GrSCM" as argument in the title, abstract and keywords.

The database selection was based on the fact that, according to Chadegani et al. (2013), Mongeon and Paul-Hus (2016), Vieira and Gomes (2009), Bar-Ilan (2010), and Abrizah et al. (2013), Web of Science and Scopus are the most extensively database used in literature search tasks and most of bibliometric analysis use their data. As De Oliveira et al. (2017) study indicated that Web of Science and Scopus encompassed 95% of the researched articles, we decided to thoroughly extend the research potential sources by including three other well-known databases: Taylor & Francis, Science Direct and Ingenta Connect.

In regards to the keywords, Gurtu, Searcy e Jaber (2015) studied the most frequently keywords used in peer-reviewed literature on green supply chain management during the period of 2007 and 2012, identifying that the use of terms explicitly focused on "green supply chains" is increasing, while the use of "reverse supply chains", "reverse logistics", "responsible supply chains", "environmentally friendly logistics" and "eco-supply chains/logistics", is decreasing and/or has not drawn much attention among authors. However, a search on Scopus database for "Supply Chain" AND "Green" showed a total of 23,584 documents.

A funnelling process was used to select the articles to be analyzed, which includes: use "Green Supply Chain Management" in the title, abstract and keyword, in order to prevent getting search responses not related to the theme, as the ones found within the 23,584 documents, such as: a) "A review of the coordination chemistry of hydrothermal systems, or do coordination changes make ore deposits?"; b) "Food and viral contamination: Analytical methods"; c) "Accomplishing simple, solubility-based separations of rare earth elements with complexes bearing size-sensitive molecular apertures"; d) "A new barrier for the future of energy market in Turkey: Internal capital adequacy assessment process (ICAAP)"; e) "Holistic-indicator model for predicting factors that generate visual health affections". We have also limited the search to articles published in journals, since conference papers usually have a tighter limit of pages and less restrictive reviewing process, presenting earlier-term work or being used for "announcing/marking an idea". A summary of the funnelling process is presented in Table 1.

Raw researched data was filtered, using the following criteria: i) articles published from 2006 on; ii) articles published in journals; and iii) articles in English. Results of this step are shown in Table 2.

In the next step, we checked articles redundancy: using articles found in Web of Science articles as reference (due to the fact that such database held more articles than all the others), we removed all double-counted articles in the other databases. The results after this process are shown in Table 3.

Upon reading the articles, we identified 68 articles not related to Green Supply Chain Management, due to the fact that the acronym "GSCM" may have other meanings, such as, Geometry-based Stochastic Channel Models, Granular Secondary Construction Material, Generalized Self Consistent Method, Germ-line Stem-cell Culture Medium, among others. Those articles were excluded from the analysis, reducing the total of articles from 407 to 339, as shown in Table 4.

From this point on, the research was split in two blocks: Systematic Literature Review (SLR) and Research Profiling.

The Systematic Literature Review aimed to organize the state of the art in GSCM literature along the last ten years, increasing the visibility and contributing to the theme investigative process, while provided a historical perspective and consolidated the individual research efforts in the area (Meredith, 1993; Easterby-Smith et al., 2002).

The Research Profiling aims to map the research, expanding the literature analysis by scanning the publications in order to answer questions such as: Who are the most cited authors in this particular area? Which are the top topics studied within this theme? Where are most of the articles from? When does each topic appear in the literature? Which are the major GSCM research area clusters? Which are the main research areas of GSCM? Which are the most relevant citation networks?

The choice for the Research Profiling method is justified by the fact that it expands the scope of a bibliometric research to levels high above the usual in typical literature studies, by scanning and thoroughly examining the publications, extending the understanding of research domains and existing patterns (Porter et al., 2002; Bragge et al., 2012; Martinez et al., 2012). According to the authors, topical relationships, trends, and complementary capabilities can be discovered, such as the identification of a range of information sources and techniques, insight about how innovation is progressing from literature distribution patterns, find active organizations and individuals whose research relates to the studied topic, generate research opportunities in combining techniques, etc.

Such method was used by different authors to map their research domain (Börner et al., 2003; Nerur et al., 2008; Porter and Youtie, 2009; Pei and Porter, 2011).

We read the 339 articles, tabulating and sorting them according to the problem context, research area, and methodology adopted, with the intent of easier understanding of different aspects and facets of GSCM literature, but not aiming to take account of all their interactions and relationships, as defended by Srivastava (2007).

Research problem context, related to research surroundings and content focus, was broken down into three broad categories: a)

Table 1
Scopus database search summary (2006–2016).

Keywords	Field	Type of document	Language	Quantity
"Supply Chain" *AND* "Green"	All	All	All	23,584
"Green Supply Chain"	All	All	All	6390
"Green Supply Chain Management"	All	All	All	5434
"Green Supply Chain Management"	All	Journal articles	English	3022
"Supply Chain" *AND* "Green"	Title, abstract, keywords	All	All	2492
"Supply Chain" *AND* "Green"	Title, abstract, keywords	Journal articles	English	1302
"Green Supply Chain"	Title, abstract, keywords	All	All	1301
"Green Supply Chain"	Title, abstract, keywords	Journal articles	English	697
"Green Supply Chain Management"	Title, abstract, keywords	Journal articles	English	226

Source: Authors.

Table 2
Number of articles per database.

Database	Quantity of Articles
Web of Science	261
Scopus	226
Taylor & Francis	77
Science Direct	32
Ingenta Connect	7
TOTAL	603

Source: Authors.

Table 3
Quantity of unduplicated articles.

Data base	Quantity of articles after redundancy elimination
Web of Science	261
Scopus	108
Taylor & Francis	32
Science Direct	4
Ingenta Connect	2
TOTAL	407

Source: Authors.

Table 4
Number of articles by database.

Data base	Quantity of Articles
Web of Science	220
Scopus	108
Taylor & Francis	10
Ingenta Connect	1
Science Direct	0
TOTAL	339

Source: Authors

Importance of GSCM, b) Green Operations, and c) Others. Even though there could be more categories, such as Motivation, Green technologies, Green materials, Green Management, Environmental after use operational and etc., we followed the three-branch context classification used by Srivastava (2007), expanding although, the third Srivastava's research array from "Green Design" to "Others": originally encompassing environment conscious design and lifecycle assessment of the product/process, we broadened the branch to accommodate other themes, such as Green innovation and training, Sustainability practices, etc.

On Research method, i.e., systematic procedures applied by authors to describe, analyze and explain the phenomena, we have also attained to use Srivastava's research classification: a) Empirical Study (also known as field studies), i.e., practical tests about a phenomenon, using interviews, questionnaires, field researches, laboratory experiments and game simulations (Srivastava, 2007); b) Mathematical Modelling; and c) Literature Review, consisting of a theoretical research conducted through a bibliographic data survey, intended to analyze a particular theme (Tabesh et al., 2016), based on the fact that since 2007 such kind of GSCM research became present to the literature.

Such classification is not rigid, as pointed by Srivastava (2007). Articles that could fit in more than one category were classified in the most relevant one, with the intent of preventing duplications in the tabulation. For example, in the De Giovanni (2012) study, a mathematical model was developed to support an empirical study and, therefore, we classified the research as "Empirical Study". Also, Laosirihongthong, Adebanjo and Tan (2013) used a multivariate linear regression model to validate criterion on an empirical study, which was classified as "Empirical Study".

However, while Srivastava's study excluded papers addressing firm-level or specific operational issues, we added it as an additional class: Research area, i.e., location or scenario where the studies were conducted: a) Industrial Sectors; and b) Others. Summary map of the research is show in Fig. 2.

Data was then prepared to be analyzed according to the research profiling questions. We loaded the data into the VantagePoint software, chosen for its efficiency and practicality in the treatment of collected data (Eldridge, 2006; Kim et al., 2012). The Web of Science and Scopus data bases generate files that contain all information necessary to automatically conduct the research profiling by simply inserting these files into the software. As the other bases do not provide such information, we performed that task manually.

Data was organized by VantagePoint, standardizing journal titles, author names, keywords, and other terms, with the intent to eliminate any software reading error that may cause double-counting. For instance, the author Joseph Sarkis was found as "Sarkis, J.", "J. Sarkis" e "Sarkis, Joseph". The software identified such occurrence and standardized the author's name as "Sarkis, Joseph".

The processed articles' data were exported to a spreadsheet, so that tables and graphs could be created, and to two other citation-based tools to respond the research profiling questions: CitNetExplorer, used to map the citation networks, and CitEspace, used to identify research clusters and how authors are positioned into those clusters.

The results of the systematic literature review and the research profile analysis are presented in the next sections.

3. Systematic literature review

In this section we present the results of the Systematic Literature Review, organized according to the map shown in Fig. 2.

3.1. Research context

3.1.1. Importance of GSCM

Management of Sustainable Supply Chains is a growing theme

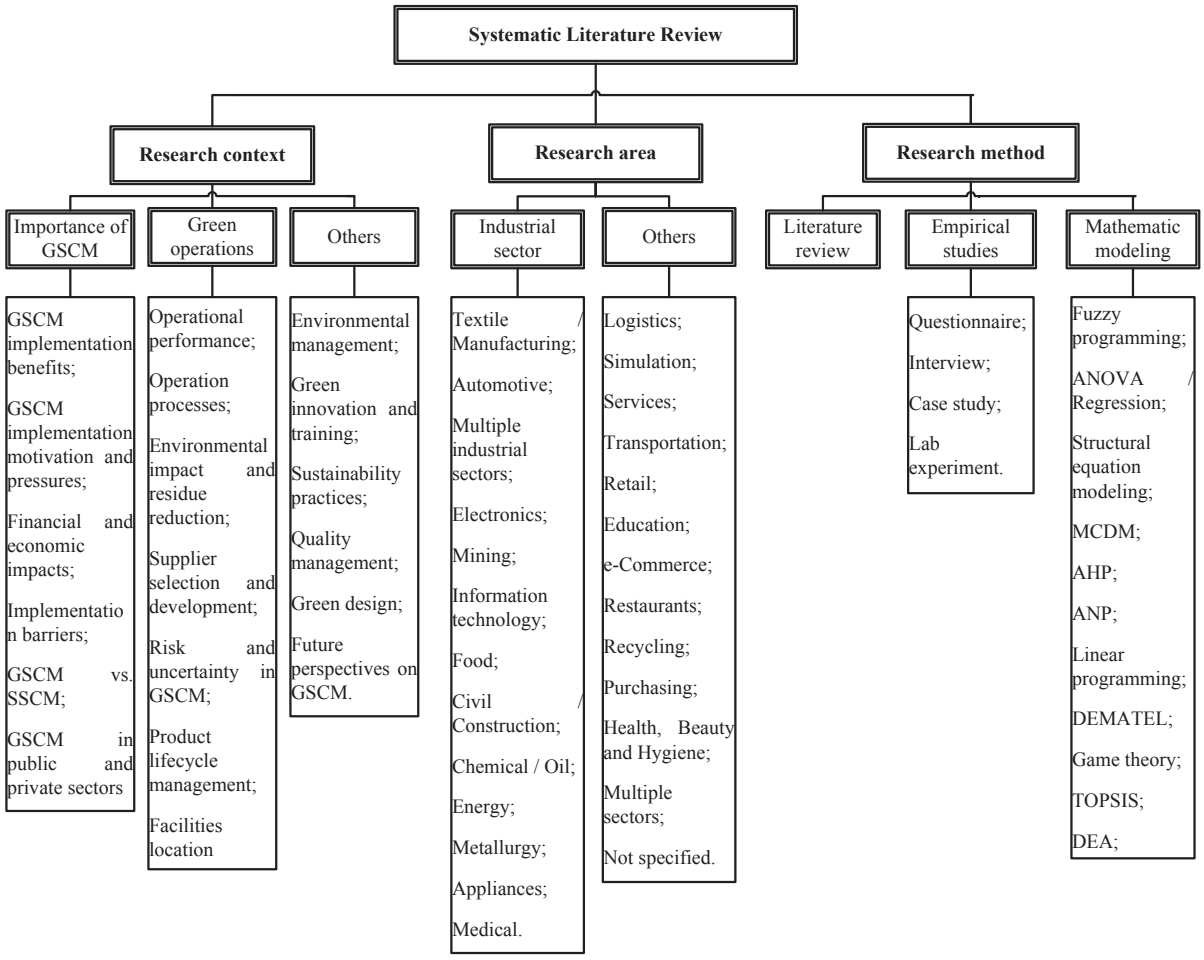

Fig. 2. Systematic literature review map. Source: Authors.

of interest in academic and professional circles, focused on process improvement, waste reduction and increase of the product life cycle quality (Srivastava, 2007). In this context, several studies are conducted to explore the issue, related to the importance and benefits of GSCM, barriers and pressures to adopt this new method of management, and its economic impact. Thus, 40% of the articles analyzed in this study fit into this category.

GSCM (Green Supply Chain Management) and SSCM (Sustainable Supply Chain Management) are two distinct concepts. Based on the literature, GSCM is more limited, emphasizing environmental characteristics, closely related to the environmental practices (Sarkis, 2012; Ahi and Searcy, 2013), while SSCM is linked to economic, social and environmental characteristics related to stakeholders. Therefore, SSCM can be understood as an extension of GSCM.

In the articles analyzed in this research, several factors that encourage companies to adopt Green Supply Chain Management practices are found, such as stakeholders' pressure (Mathiyazhagan and Haq, 2013; Huang et al., 2015; Kuei et al., 2015), customer-related concerns (Lee and Klassen, 2008; Sarkis et al., 2011; Hitchcock, 2012; Mathijazhagan, Govindan and Haq, 2014; Hoejmose et al., 2014; Chavez et al., 2016), company environmental concerns (Lee and Klassen, 2008; Diabat and Govindan, 2011; Chiou et al., 2011; Luthra; Garg and Haleem, 2016), the influence of environmental regulations and standards (Zhu et al., 2008c, 2011; Zhu et al., 2008a; Chen and Sheu, 2009; Yang et al., 2010; Sheuand Chen, 2012; Wu et al., 2012; Mosgaard et al., 2013; Xu et al., 2013), green marketing (Zhu et al., 2008d), cost reduction (Zhu et al., 2008c; Kim and Rhee, 2012; Mohanty and Prakash, 2014), competitors (Nelson, 2008), ethical and/or commercial motivations (Testa and Iraldo, 2010; Wu et al., 2012), ISO 14,000 (Gomez and Rodriguez, 2011; Arimura et al., 2011), and Customer cooperation practices enhancing company competitive strength (Zhu and Sarkis, 2007; Soler et al., 2010).

However, to effectively implement the GSCM, it is necessary to have senior management support, commitment of all actors involved in environmental policies (Wu and Chang, 2015) and an adequate strategic planning (Sivaprakasam et al., 2015). Moreover, the main barriers to GSCM implementation, based on the literature, are involved actors' lack of understanding (Mehrabi et al., 2012; Mathiyazhagan et al., 2013), lack of adequate training (Govindan et al., 2014.; Wang et al., 2016), government intervention (Sheu and Chen, 2012), supply partners dependence (Rauer and Kaufmann, 2015), financial constraints and resistance to the adoption of advanced technology (Dube and Gawande, 2016).

Companies' financial performance is also discussed, characterizing the GSCM as an effective and efficient strategy to reduce environmental impact and to leverage long term financial benefits (Zhu, Sarkis and Lai, 2007a; Chien and Shi, 2007; Thun and Muller, 2010; Lee et al., 2012; Olugu and Wong, 2012; De Giovanni, 2012; Mavi et al., 2015; Laari et al., 2016; Kushwaha and Sharma, 2016; X. Wang et al., 2016). The economic perspective of the literature indicate that GSCM helps the company to gain competitive advantage and to increase stock prices (Cegielski and Hanna, 2011;

Green et al., 2012; Hazen et al., 2012a).

Another factor analyzed was the profit in a green supply chain, with Hasani et al. (2015) proposing a model to maximize the after-tax profit, while Li et al. (2016) analyzed the supply chain to discuss the best strategies to balance prices and sustainability. To achieve better environmental and economic performance, Zhu et al. (2012b) report that it is necessary to coordinate internal and external GSCM practices. Bojarski et al. (2009) also emphasizes that better planning and supply chain sourcing can generate positive environmental and economic impacts. Based on this principle, Hazen et al. (2011), Green et al. (2012) and Shi et al. (2012) developed mathematical models to assess the impacts of decisions made by supply chain players and their operational performance.

Table 5 reflects the subjects addressed by the authors in the context of GSCM importance and its percentage, in descending order. The most common topic was "benefits the GSCM implementation" with 38%, comprising the steps and various considerations about the implementation of green practices. Then, the motivations and pressures to implement the GSCM appear with 27%, and financial and economic impact with 24%. Papers that approach GSCM financial impact elucidate that gains are feasible only in the long run: expensive implementation of GSCM practices are often described as barriers.

3.1.2. Green operations

Due to increasing pressures experienced by organizations, they are likely to adopt GSCM practices (Lee, 2008; Tian et al., 2014). 45% of the total articles encompassed by this study addressed green operations.

Zhu et al. (2008b) and Soda et al. (2015) found in their researches that the level of green practices usage varies according to the company industry sector. In this regard, Chan and Wang et al. (2013), Tseng et al. (2014) and Malviya and Kant (2016) developed models to evaluate the most efficient practices for each type of business.

The most cited GSCM practices in literature refer to waste disposal, supply chain risk management (Govindan et al., 2014; Wong et al., 2015), customers' and vendors' partnership, and product lifecycle management (Azevedo et al., 2011; Luthra; Garg and Haleem, 2015).

Perotti et al. (2012) and Govindan et al. (2015) studied logistics companies, analyzing their decision-making process practices, while Colicchia et al. (2016) carry out their studies in logistics companies and verified that the optimization of the network causes positive environmental impacts, despite the increase in costs involved in the operation. In this context, Azadi et al. (2014) and Gorane and Kant (2016) presented several mechanisms applied to logistic chain better planning, while Wang and Hsu (2010a), Pelton and Smith (2015), Savino et al. (2015), addressed the reduction of activity-related environmental impacts. In addition, Sadagheih et al. (2010) studied the decision-making on plant sourcing and transportation modes.

Table 5
Topics on GSCM importance.

Relevance of GSCM	Absolute	%
Benefits of GSCM implementation	52	38%
Motivations and Pressures to Implement GSCM	37	27%
Financial and Economic Impact	33	24%
Barriers to Implementation	11	8%
GSCM Versus SSCM	2	1%
Public versus Private Sector GSCM	1	1%
Total	**136**	**100%**

Source: Authors

Sundarakani et al. (2010), Martí et al. (2015) and Liou (2015) addressed the supply chain carbon issue, proposing a model to measure carbon emissions caused by activities. Besides that, Sheu (2008), Zhao et al. (2012) and Suzuki (2016) proposed methods to reduce carbon emissions, while Muduli et al. (2013) proposed a resource availability optimization model. Mangla, Kumar and Barua (2015), Sivaprakasam et al. (2015) and Namegembe, Sridharan and Ryan (2016) indicated the existence of risks associated to the implementation of GSCM practices, imposing to the companies the need to work with internal and external environmental guidelines to achieve superior operating results (Chan et al., 2012; Lee, 2015).

Some studies analyzed the financial impacts of environmental practices, such Tognetti et al. (2015), who investigated the impacts of carbon gas emissions, which could be minimized through the use of a decision making model developed by Martí et al. (2015). Mathematical models that help solving problems related to environmental impacts were developed by Pelton and Smith (2015) and Chanchaichuit et al. (2016), for food and rubber industries, respectively.

Business performance indicators upon the adoption of GSCM practices were developed by Martinsen and Abrahamson (2012), Wei et al. (2014), Mirhedayatian et al. (2014), Lan and Dai et al. (2015), Sharna, Chandana and Bhardwaj (2015), and Bjorklund et al. (2012). Management analysis models aimed to reduce pollution were developed, as well as an approach to assess environmental risks related to steel production (Tseng, 2011; Gallear; Ghobadian and He, 2011; Lake et al., 2015).

According to Mitra and Datta (2014), suppliers cooperation is one of the most adopted GSCM practices, being crucial to green practices efficiency, since it helps companies to achieve higher operational performance in terms of flexibility, delivery time, quality and costs (Yu et al., 2014; Choi and Hwang, 2015; Ji et al., 2015). For this reason, several models were developed to help managers to select sustainable suppliers (Lu et al., 2007; Hsu and Hu, 2009; Tseng and Chiu, 2013; Caniel; Gehrsitz and Semeijin, 2013; Dou et al., 2014; Kuo et al., 2015; Mahdilo; Saem and Lee, 2015; Guo and Tsai, 2015; Kannan et al., 2015; Freeman and Chen, 2015; Hashemi et al., 2015; Trapp and Sarkis, 2016; Bhardwaj, 2016; Wu and Barnes, 2016).

Swami and Shah (2013) analyzed the cooperation between manufacturers and retailers, claiming that such cooperation is decisive to enable better performance. Lo (2015) identified the strategies used by companies to manage the relationship with suppliers, while Wu, Cheng and Huang (2010) evaluated as the information exchange between actors involved in GSCM ensures the process success.

Table 6 shows operation performance as the most common item within the analyzed articles (33% of the total), inferring that the main objective of companies when adopting and refining green practices is to make them effective to enable higher operational performance. Operational processes appear in 25% of the articles,

Table 6
Topics on green operations.

Green operations	Absolute	%
Operation performance	51	33%
Operational processes	38	25%
Reduction of Waste and Environmental Impacts	19	12%
Selection and/or Suppliers Development	15	10%
GSCM Considering Risks/Uncertainties	13	8%
Product Lifecycle Management	8	5%
Pollutants Management	6	4%
Location facilities	4	3%
Total	**154**	**100%**

Source: Authors

denoting the commitment of companies to address green practices into their processes. In contrast, waste and environmental impacts reduction shows only 12% of the total, indicating that financial and operational results still prevail over environmental results.

We infer that there has been very little research related to purely environmental subjects, such as preservation and conservation, while GSCM operational aspects importance is evident. Therefore, it is expected that operational activities keep on being adapted to environmental practices, in order to reduce impacts along the whole supply chain.

3.1.3. Others

"Others" research context represented only 14% of the articles analyzed in this study. Dai, Cantor and Montabon (2015) analyzed how a competitor and suppliers can induce a company to promote sustainable innovations. Through a literature review, Tachizawa and Wong (2015) evaluated whether the corporate governance mechanisms also influence the innovation within the company, while Wu (2013) and Jayaram and Avittathur (2015) conducted their research about sustainable innovation, examining how customers stimulate companies to adopt green innovations. Addressing the same subject, Zhu et al. (2012) assess whether companies are likely to innovate or imitate actions successfully implemented by other companies when adopting sustainable practices. Therefore, the communication process between parties involved becomes an important mechanism for business competitiveness (Woo et al., 2016).

Tseng et al. (2013) analyze the supply chain practices driven by sustainability principles (economic, social and environmental), identifying prominent factors such as advanced green technology, green consumption, green innovations and appropriate sustainable business models. Prajogo, Tang and Lai (2014) attest how environmental management encourages the adoption of GSCM practices, concluding that companies that practice environmental management are more likely to produced green products and processes. However, some factors may impact the environmental performance and, therefore, Liou et al. (2016) formulates a model to identify the source of these problems, enabling, thereafter, the development of countermeasures.

Moreover, Liu et al. (2015) investigate the correlation between supplier selection and the complexity of business environmental management. Dubey, Gunasekaran and Ali (2015), in a similar study, focused on rubber industry, observed the total quality management complementing the environmental management. Khaksar et al. (2016) analyzed cement industry, pointing strong correlation between green suppliers and the development of green innovation. However, Teixeira et al. (2016) state that GSCM practices are only effective if a green training is previously applied. In this context, Jabbour and Jabbour (2016) propose a new approach to human resource management, with incentives to GSCM.

Table 7 breaks down the "Others" category, showing environmental management with 39% of the occurrences, followed by innovation and green training, which seems to be the most proactive approach, by proposing to generate less environmental impacts and reducing resources and costs, with 20% of the total, sustainable practices with 18% and quality management with 12%. Few studies addressed the future prospects of GSCM, its implications on public and private contexts, as well as green design. These are gaps to be considered for future research.

Table 7
Topics on other contexts.

Other Contexts	Absolute	%
Environmental management	19	39%
Innovation and Green Training	10	20%
Sustainable practices	9	18%
Quality management	6	12%
Green Design	4	8%
Future Prospects of GSCM	1	2%
Total	**49**	**100%**

Source: Authors

3.2. Research areas

3.2.1. Industrial sector

This section discusses researches performed in different industrial sectors, encompassing 57% of the articles analyzed.

Gil and De la Fe (1999) emphasize that the production process in the auto industry is based on economies of scale and experiential learning, leading towards production rationalization, cost reduction and continuous development, while uncertainties and difficulties are minimized along the processes.

Chinese, Portuguese and German companies that integrate automotive supply chains are experiencing increasing regulatory and market pressures, together with the internal pressures for best practices (Zhu; Sarkis and Lai, 2007b; Azevedo et al., 2011; Caniëls; Gehrsitz and Semejin, 2013; Tomasic et al., 2013; Yu et al., 2014; Yu and Hou, 2016). Govindan et al. (2014) details a proposed model that highlights the practices that impact most the automotive supply chain sustainability, such as "waste disposal", "cleaner production" and "supply chain risk management", while "flexible transport", "flexible delivery" and "reverse logistics" do not cause significant impacts.

Thun and Muller (2010) analyzes the GSCM through the perception of an automotive industry professional in regards to green management implementation, driving forces, objectives and realization. Carbon emissions, a major criticism in automotive sector, also were embroidered by Lee and Cheong (2011), who acknowledge that the development of a carbon footprint assessment program in the supply chain provides support for innovation. Investigations about interaction between carbon emissions and related costs in the supply chain were also developed (Tognetti et al., 2015).

Chien and Shih (2007) researched the electronic industry and identified a relationship between GSCM practices and the environmental and financial sector performance. Jabbour et al. (2014a,b) studied the same industry, analyzing the relationship between the environmental maturity level and the adoption of GSCM practices. According to the authors, the company environmental maturity level positively influences the adoption of GSCM practices. Also, authors infer that internal practices are more easily accepted than external ones.

Khor and Udin (2013) and Khor et al. (2016) emphasize that reverse logistics and product design are related and both are important to the electronic industry. Waste generation in this industry led the development of different ways to retrieve and reuse the product content, making company and environment benefits feasible. Kuo (2010) collaborates with this thinking approach, unveiling a collaborative design platform that supports the recycling processes analysis through information collection, resource planning, and development of product lifecycle management systems.

Laosirihongthong et al. (2013) studied Thailand manufacturing companies, apprehending that reverse logistics practices had no significant impact on the GSCM performance, and that ISO 14,001 certified companies adopt reactive posture in regard to the adoption of GSCM practices, sagging under legislation and regulation pressures. Lee et al. (2014), by the other side, conducted their work in manufacturing companies in Malaysia, linking technological

innovation to GSCM practices, concluding that green practice approach helps a more effective technological development.

Zhu et al. (2008a) present results of a cross-sectional survey in Chinese power generation industries (chemical, oil, electricity, etc.) where GSCM practices were evaluated, providing insights about uneven capabilities and incentives to Chinese industries in adoption of green actions in different contexts. Tsireme et al. (2013) adds that, in some cases, environmental legislation, market regulation instruments, and regulatory incentives can play a critical role in managerial decisions about adopting GSCM practices, while in other cases, such instruments do not influence managers' decisions. The power generation sector is studied by Stefanelli et al. (2014), presenting the results of a survey in Brazilian bio-energy companies (sugarcane and ethanol), indicating that GSCM practices aggrandize environmental performance.

Kannan et al. (2014) highlight the importance of selecting green suppliers in a Brazilian electronics company and propose the use of fuzzy TOPSIS method, also studied in Arimura et al. (2011), to select the best criteria for choosing suppliers, considering the GSCM practices. Results indicated top management commitment to GSCM, materials, components and energy recycle and reuse approaches on product designs, compliance with relevant legislation and audit programs, and toxic or harmful material usage avoidance as dominant criteria in choosing suppliers.

Muduli et al. (2013b) studied the mining industry, reporting the dependency among factors in this area, which are influenced by human behavior and nature dynamics. Factors affecting GSCM implementation were identified and classified by an interpretative structural modelling (ISM), used to draw the interrelationships among the behavioural factors, helping the management in such mutable environment, as also pointed out by Kusi-Sarpong et al. (2015). A study using the DEMATEL method (structural model that analyzes the causal relationship between established criteria) held by Govindan et al. (2016) in a mining industry in India identified some GSCM implementation critical factors, such as competitiveness, while employee internal pressures were considered a low importance issue.

Chinese manufacturers were also analyzed with respect to performance contexts versus GSCM practices, as well as the evaluation of such practices implementation (Zhu and Sarkis, 2007; Zhu et al., 2008a). Lee and Klassen (2008) studied suppliers and buyers within the supply chain context, corroborating with the findings about the fact that synergistic relationships and capability development results in better adherence to environmental practices, which is reinforced by Yang et al. (2010). The adoption of an Integrated Management System (IMS) was considered critical to the initiation and control of green business practices, since such adoption contributes to organizational learning about the related practices (Zhu et al., 2008c; Nawrocka, 2008).

Table 8 presents the industrial sectors studied, being textile/manufacturing on the top, with 23%, followed by the automotive sector, with 20%. Important to say that automotive sector is emblematic and a subject of interest for future research, due its pioneering in production processes innovative actions. "Multiple industries", encompassing researches developed in more than two industrial sectors (usually to evaluate and compare the performance of various sectors in regard to GSCM practices adoption), comes after, with 15%. Electronic industry appear in 14% of articles, being an interesting sector to study, due to the fact that, as major export player, must adhere to several regulations and legal aspects. Mining, information technology and food represent, respectively 8%, 4% and 4% of the articles, while chemical/oil sector, even though representing only 3%, demand additional studies, since the industry is constantly associated to significant environmental impacts. Power generation, metallurgy, consumer goods, health, beauty and hygiene and medicine had low attention, offering opportunities for future researches.

Table 8
Topics on industrial sectors.

Industrial sectors	Absolute	%
Textiles/Manufacturing	45	23%
Automotive	39	20%
Multiple Industrial Sectors	29	15%
Electronics	27	14%
Mining	15	8%
Information Technology	8	4%
Alimentary	7	4%
Chemical/Oil	6	3%
Construction	5	3%
Power generation	4	2%
Metallurgy	4	2%
Consumer goods	2	1%
Health, Beauty and Hygiene	2	1%
Medicine	1	1%
Total	**194**	**100%**

Source: Authors

3.2.2. Other Sectors

This section exposes the studies classified as "others", which represented 43% of the total. Bala et al. (2008) presents the strategy and procedures adopted by Univesitat Autònoma de Barcelona (Autonomous University of Barcelona) to diffuse green purchasing practices throughout their administration and supply chain. Dukic, Cesnik and Opetuj (2010) studied warehouses, presenting a comprehensive overview of order selection methods and techniques, as well as projects for process improvement based on travel distance reductions. B2C and B2B projects were also addressed in the GSCM context by Hoejmose et al. (2012), analyzing different reasons for green practices and their adoption confidence level in UK markets.

Lee et al. (2012) explored the GSCM practices and its relationship with organizational performance in small and medium enterprises, indicating that business performance is improved when GSCM enhances operational efficiency. On the other hand, aiming to fulfill the lack of studies on GSCM in food production processes, Wang et al. (2013), developed an empirical study to examine green practices in hospital restaurants in Taiwan, apprehending that the main practices adopted are: low environmental impact equipments and facilities, sustainable management and social responsibility.

Lin (2013) states that companies with proactive approaches in adopting green supply chain management achieve superior economic and environmental performance, comprehending practices, performance, and external pressures. Thus, it is essential to identify the pressures to be able to develop and incorporate strict ethical, environmental practices in organizations (Mathiyazhagan and Haq, 2013).

Constant supply chain operation restructuring actions brings uncertainties to companies. How organizations deal with short-term pressures and effectively remain economically feasible while implementing GSCM practices are issues addressed by Wu and Pagell (2011), who analyze short-term profitability and sustainable development in an ever-growing uncertainty market scenario. Tian, Govindan and Zhu (2014) analyze such perspective through game theory considering stakeholders such as government, enterprises and consumers, with the intent to orient the development of subsidy policies and incentives to spread the GSCM in China.

The following authors also developed researches in other non industrial sectors, mainly addressing the adoption of GSCM and its implications: Chen and Sheu (2009); Sundarakani et al. (2010); Bai and Sarkis (2010); Sadegueih, Sribenjachot and Drake (2010);

Hazen et al. (2011); Kim and Rhee (2012); De Giovanni and Vinzi (2012); Zao et al. (2012); Yang et al. (2013); Hasani et al. (2015); Sheu (2016); Trapp and Sarkis (2016); and Coelho et al. (2016).

Table 9 shows the topics on Other Sectors. "No specification" represents literature review articles, not focused on any specific economic sector (30% of the articles). "Multiple Sectors" reflects articles where more than two sectors were addressed, analyzing and comparing different sectors in a single article, with 19%. "Simulation" encompasses non empirical researches, focusing only on development and analysis of mathematical models and/or business games to simulate expected results in a controlled environment. The logistics sector appears in 14% of articles in this category, followed by the service sector, which deals with intangible products, a study field with potential for future researches.

In general, GSCM researches covered various fields. However, very few studies were related to education (i.e.: universities and schools), health, e-commerce, shopping, and restaurants were found. Moreover, recycling, an important subject that significantly helps in mitigating environmental impacts, is also not widely studied, indicating an opportunity for further studies in the context of GSCM.

Table 10 shows authors, numbered according to the ordering in References section, and work intersections (i.e.: research area and context). For instance, "Abdullah, R.; Mat Daud, MS; Ahmad, F.; Shukti, AA; Shah, MZ Green logistics adoption Among 3 PL companies. International Journal of Supply Chain Management, Vol. 5, n. 3, pp. 82–85. 2016." is author number "1", since it appears as the first reference listed in the References section. As seen in Table 10, author "1" developed a research related to "Importance of GSCM", focused on "Other Sectors".

Such table configuration, also used on Tables 11–15, indented to accommodate the high data volume used in this article, while keeping it easy to be understood by readers.

3.3. Research methods

This category identifies the research methods used in the studied articles, i.e., literature review, empirical studies and mathematical models. Only 11% of the articles analyzed were classified as literature review, while 52% were empirical studies. Authors, previously numbered, are seen in Table 11.

Table 12 categorizes the empirical studies carried out by the authors. According to this table, most of them were questionnaires and case study.

Different types of mathematical models were used by 37% of the authors, being the FUZZY programming, applied to model the decision-making processes (Brandenburg, 2015), the most used, as seen in Table 13. Statistical analysis ANOVA/Regression and Structural Equation Modelling comes after. Two other techniques widely used were the Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP), both used for project selection and prioritization. The AHP method considers that analysis criteria are independent of each other, while ANP considers the criteria interrelationship (Srivastava, 2008; Lam and Dai, 2015).

Table 9
Topics on other sectors.

Other Sectors	Absolute	%
No Specification	43	30%
Multiple Sectors	28	19%
Simulation	25	17%
Logistics	20	14%
Services	8	6%
Transport	5	3%
Retail	5	3%
Recycling	3	2%
Shopping	2	1%
Education	2	1%
E-commerce	1	1%
Electronic	1	1%
Restaurant	1	1%
Cheers	1	1%
Total	**145**	**100%**

Source: Authors

3.4. Research cross reference analysis

Is this section, we cross referenced the information in regards to research context, research area, and research method.

Table 14 correlates the research method with the research context, indicating the authors in each intersection of those dimensions.

Table 15 shows the relationship between the research methods used and research area in which the articles were developed.

4. Research profile

This section presents the results of the research profiling on the GSCM researches, based on information extracted from VantagePoint software, CitEspace and CitNetExplorer tools, answering the questions iv) what is the theme bibliometric profile?, vi) which are the major GSCM research area clusters? vii) which are the main research areas of GSCM?; viii) which are the most relevant citation networks?, as follows:

1. Who are the most productive authors? – Table 17
2. What periodicals publish the most articles in the area studied? – Table 20
3. What institutions are most productive? – Table 16
4. What countries are most representative in the production in the area? – Table 19
5. Who are the most referenced authors? – Table 18
6. What are the most referenced periodicals? – Table 21
7. What years have seen the largest number of citations? – Fig. 4
8. When were the largest volume of articles in the area published? – Fig. 3
9. What keywords are most used? – Table 22
10. Which are the most relevant citation networks? – Fig. 5
11. Which are the major research area clusters? – Fig. 8
12. Which are the main research areas? – Fig. 9

In regards to the quantity of publications on GSCM per year, one can notice in Fig. 3 an increase in the quantity of publications from the year 2009 on, as a consequence of the growing importance that environmental issues have in the context of supply chains, as highlighted in the first part of this article.

Table 16 shows the GSCM top ten publishing author's institution affiliation.

Table 17 shows the twenty authors who published most on GSCM.

Table 18 shows the most cited authors within the analyzed articles. We established the following criteria to count such citations: every author that was cited in an article counts one record to him/her and, if the cited author had more than one reference in the same article, every reference would count as "citation".

Cross referencing Tables 17 and 18, one can notice that only six of the top publishing authors are also listed as the most cited, which can be explained by the fact that whoever writes about GSCM, usually cites authors and literature related to several different areas, such as Supply Chain Management, sustainable

Table 10
Authors by area of research and research context.

	Research Area	
Research context	Industrial sector	Other Sectors
Importance of GSCM	2, 4, 10, 21, 22, 23, 32, 36, 41, 48, 52, 53, 59, 69, 71, 74, 76, 79, 81, 90, 96, 104, 105, 119, 138, 152, 154, 160, 167, 175, 178, 186, 190, 191, 192, 194, 195, 204, 205, 210, 220, 222, 223, 226, 229, 235, 236, 246, 247, 250, 258, 267, 278, 283, 298, 301, 302, 334, 339, 340, 343, 344, 346, 354, 355, 356, 359, 361, 362, 364	1, 7, 11, 15, 16, 18, 25, 27, 28, 33, 44, 50, 51, 70, 73, 80, 88, 89, 112, 113, 114, 122, 125, 129, 130, 133, 142, 146, 149, 155, 162, 172, 184, 209, 214, 218, 219, 227, 231, 240, 245, 251, 252, 260, 263, 265, 271, 274, 275, 276, 277, 279, 280, 281, 303, 318, 320, 326, 328, 335, 336, 337, 342
Green operations	14, 30, 34, 37, 39, 40, 43, 49, 56, 68, 77, 91 93, 97, 99, 100, 101, 102, 106, 110, 117, 118, 120, 121, 124, 126, 132, 134, 135, 136, 145, 147, 150, 158, 159, 161, 164, 170, 171, 173, 177, 181, 185, 187, 188, 189, 196, 199, 206, 207, 208, 215, 224, 225, 228, 234, 249, 253, 254, 258, 261, 266, 268, 269, 271, 273, 282, 284, 288, 289, 291, 292, 297, 299, 306, 308, 309, 317, 322, 327, 330, 331, 333, 341, 348, 349, 351, 352, 353, 357, 358, 360, 363	12, 13, 17, 29, 38, 46, 54, 55, 60, 61, 64, 67, 75, 78, 83, 84, 92, 95, 98, 109, 115, 116, 123, 127, 140, 143, 148, 157, 165, 168, 169, 179, 180, 200, 213, 216, 221, 233, 241, 255, 257, 259, 290, 304, 307, 311, 312, 316, 319, 321, 322, 324, 325, 329, 345, 350, 364
Others	8, 18, 46, 81, 97, 102, 107, 126, 130, 138, 140, 150, 162, 173, 175, 181, 182, 193, 202, 232, 238, 239, 262, 306	56, 61, 62, 64, 65, 106, 127, 136, 152, 155, 196, 202, 243, 247, 270, 284, 293, 294, 295, 299, 309, 312, 337, 346

Source: Authors

Table 11
Research methods.

Methods	Articles
Literature review	6, 15, 37, 43, 56, 57, 65, 82, 106, 127, 129, 148, 159, 199, 202, 213, 226, 244, 249, 257, 258, 259, 262, 274, 276, 281, 284, 285, 293, 294, 309, 327, 328, 340, 341
empirical studies	1, 2, 7, 9, 10, 13, 16, 17, 19, 21, 22, 23, 28, 29, 32, 41, 44, 47, 51, 52, 54, 55, 60, 61, 63, 70, 71, 78, 83, 89, 91, 94, 95, 96, 97, 100, 101, 103, 109, 112, 113, 114, 115, 116, 117, 121, 122, 123, 124, 125, 126, 128, 136, 137, 140, 141, 144, 146, 148, 149, 150, 151, 153, 155, 156, 162, 163, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 181, 183, 184, 185, 188, 190, 192, 194, 196, 203, 204, 205, 206, 214, 215, 216, 218, 219, 221, 223, 224, 227, 228, 229, 231, 234, 236, 239, 240, 243, 246, 247, 249, 252, 253, 260, 261, 263, 267, 275, 277, 278, 279, 282, 283, 286, 290, 291, 292, 295, 297, 299, 300, 301, 302, 303, 304, 305, 308, 311, 312, 315, 317, 318, 326, 329, 330, 332, 333, 335, 337, 338, 342, 343, 344, 347, 348, 350, 351, 352, 353, 354, 355, 357, 358, 359, 360, 361, 363, 364

Source: Authors.

Table 12
Types of Empirical Studies used by authors.

Empirical method	Articles
Questionnaire	2, 10, 17, 23, 28, 32, 41, 44, 47, 51, 52, 55, 70, 71, 95, 101, 103, 114, 115, 116, 117, 121, 123, 126, 128, 136, 137, 140, 141, 144, 149, 155, 163, 165, 167, 168, 169, 170, 172, 174, 177, 178, 179, 190, 192, 194, 204, 224, 227, 243, 246, 253, 275, 279, 286, 290, 291, 295, 299, 300, 311, 312, 329, 333, 344, 347, 348, 350, 351, 354, 355, 357, 358, 359, 360, 361, 363, 364
Interview	9, 19, 22, 83, 89, 91, 112, 122, 173, 183, 184, 205, 206, 214, 215, 218, 219, 228, 234, 239, 261, 301, 317, 318, 352
Case study	1, 7, 13, 16, 21, 29, 54, 60, 61, 63, 78, 94, 96, 97, 100, 113, 124, 125, 146, 148, 150, 151, 153, 156, 162, 163, 166, 171, 176, 181, 185, 188, 196, 203, 216, 221, 223, 229, 231, 240, 247, 249, 252, 260, 263, 267, 277, 278, 282, 283, 292, 297, 302, 303, 304, 305, 308, 315, 326, 330, 332, 335, 337, 338, 342, 343, 353
Laboratory experiment	109, 175, 236

Source: Authors

Table 13
Mathematical models used.

Method	Articles
FUZZY programming	11, 53, 66, 76, 79, 80, 107, 133, 135, 157, 160, 198, 207, 208, 222, 235, 251, 257, 265, 270, 296, 306, 307, 318, 321, 322
Statistical analysis ANOVA/Regression	34, 36, 64, 68, 81, 88, 110, 126, 142, 152, 168, 182, 188, 200, 238, 245, 272, 280, 340, 345, 346, 356
Structural Equation Modelling	4, 18, 30, 59, 62, 69, 102, 103, 138, 145, 154, 193, 220, 271, 289, 298, 316, 319, 364
ANP	39, 40, 48, 67, 77, 109, 119, 164, 209, 310
Linear Programming	14, 46, 49, 73, 97, 233, 254, 266, 286, 331
DEMATEL	87, 98, 99, 105, 120, 180, 197, 334
AHP	27, 92, 118, 186, 187, 232, 268, 269
Game Theory	50, 131, 273, 336, 339, 349
TOPSIS	90, 134, 225, 325
DEA	12, 195, 212
MCDM	33, 38, 161
Others	25, 74, 75, 132, 250

Source: Authors

development, environmental topics, etc., not being limited to cite GSCM literature only.

As a complement to Table 18, Fig. 4 shows the evolution in the quantity of citations over the last 30 years (1986–2016).

Table 19 presents the top ten publications on GSCM country of origin, indicating a high concentration (65%) of researches from

Table 14
Methods used and research context.

	Research Context		
Method used	Importance of GSCM	Green operations	other Contexts
Literature review	6, 43, 57, 129, 159, 244, 249, 258, 274	37, 82, 257, 327	56, 65, 106, 127, 293
Empirical studies	1, 9, 10, 13, 17, 19, 23, 32, 47, 51, 52, 70, 71, 78, 89, 95, 103, 112, 113, 121, 124, 128, 136, 137, 141, 148, 150, 153, 167, 171, 174, 177, 183, 188, 191, 194, 202, 203, 215, 216, 221, 227, 228, 234, 239, 245, 261, 263, 275, 276, 277, 278, 282, 297, 299, 300, 301, 326, 332, 334, 337, 341, 342, 353, 354, 357, 360, 362	7, 13, 16, 28, 41, 44, 54, 55, 60, 63, 83, 91, 94, 96, 97, 108, 114, 115, 116, 117, 122, 123, 125, 126, 140, 143, 144, 149, 156, 158, 163, 165, 167, 169, 170, 172, 176, 178, 179, 184, 185, 204, 205, 213, 248, 251, 253, 267, 290, 312, 329, 351	8, 61, 130, 140, 151, 155, 162, 173, 175, 181, 192, 196, 231, 236, 241, 247, 261, 263, 283, 292, 294, 298, 303, 308, 311, 336
Mathematical models	14, 25, 27, 30, 34, 40, 49, 50, 68, 69, 76, 80, 88, 104, 110, 118, 129, 132, 154, 161, 188, 189, 193, 197, 207, 208, 212, 219, 220, 224, 225, 233, 244, 250, 256, 265, 269, 272, 273, 279, 316, 318, 321, 333, 335, 338, 340, 344	4, 11, 18, 33, 36, 38, 39, 48, 53, 59, 66, 67, 74, 77, 92, 98, 100, 101, 105, 109, 119, 120, 133, 134, 135, 145, 157, 164, 168, 181, 186, 187, 195, 197, 206, 210, 231, 232, 253, 254, 257, 267, 268, 271, 280, 285, 288, 295, 297, 305, 306, 309, 315, 317, 320, 321, 322, 330, 339, 353, 363	46, 62, 64, 81, 97, 102, 107, 126, 152, 180, 199, 200, 236, 270, 345

Source: Authors

Table 15
Methods used and research area.

	Research Area	
Method	Industrial sector	other Sectors
Literature review	57, 129, 148, 159, 257, 294	6, 15, 37, 43, 56, 82, 106, 127, 243, 249, 258, 274, 327, 340
Empirical studies	7, 8, 9, 19, 29, 47, 51, 53, 55, 78, 89, 95, 96, 101, 103, 112, 116, 117, 123, 125, 128, 130, 137, 140, 144, 149, 151, 153, 158, 162, 163, 165, 169, 170, 174, 175, 176, 177, 181, 184, 185, 188, 190, 191, 192, 202, 203, 213, 221, 222, 223, 226, 227, 231, 234, 236, 245, 248, 251, 253, 259, 261, 263, 267, 282, 286, 290, 291, 292, 297, 299, 308, 312, 325, 329, 332, 341, 342, 347, 349, 350, 353, 354, 357, 358, 359, 360, 361, 362	1, 17, 23, 28, 61, 70, 71, 94, 141, 155, 169, 178, 179, 183, 196, 214, 215, 216, 218, 228, 239, 241, 247, 263, 277, 278, 294, 298, 301, 302, 310, 311, 323, 326, 334, 336, 337, 343
Mathematical Models	4, 18, 30, 33, 34, 36, 38, 39, 40, 46, 48, 67, 68, 76, 80, 81, 90, 92, 97, 99, 101, 102, 103, 105, 107, 109, 118, 119, 120, 126, 131, 133, 135, 138, 157, 160, 180, 182, 186, 187, 189, 193, 197, 199, 206, 208, 219, 220, 224, 231, 233, 236, 244, 254, 256, 257, 265, 267, 268, 271, 280, 285, 295, 297, 306, 315, 324, 330, 338, 339, 344, 355	11, 12, 15, 25, 27, 49, 50, 53, 59, 62, 64, 66, 69, 74, 75, 77, 88, 110, 132, 145, 152, 154, 164, 168, 188, 207, 196, 212, 225, 232, 250, 253, 269, 272, 273, 279, 288, 305, 307, 309, 316, 317, 318, 319, 320, 321, 322, 333, 335, 345, 348, 363

Source: Authors

United States and Asian countries such as China and India, which are recognized by the volume and quality of their scientific productions in areas related to GSCM.

In regards to periodicals, the "Journal of Cleaner Production" was the journal that presented more publications about GSCM, as seen in Table 20.

In order to identify the journals with more citations, we established the same criteria previously used for authors' counting, i.e.,

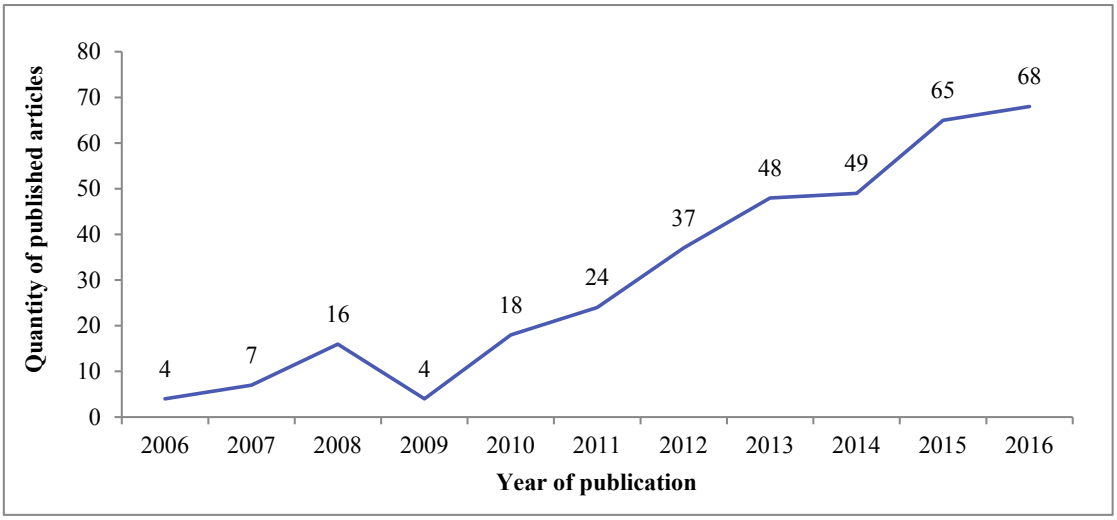

Fig. 3. Quantity of publications per year. Source: Authors.

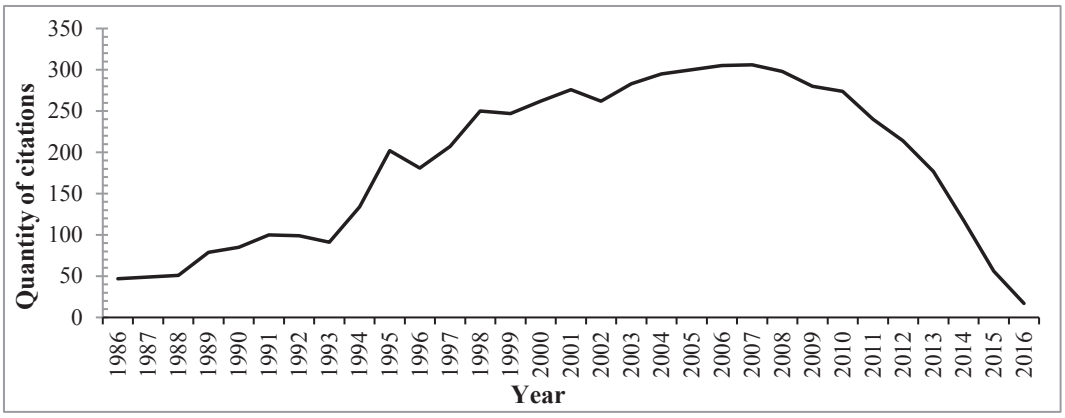

Fig. 4. Citations on GSCM over the last 30 years. Source: Authors.

every journal article cited counts as one record, while multiple journal citations would be counted as "citation". As it can be seen in Table 21, "Journal of Cleaner Production" was the most cited journal on GSCM with a total of 271 records, followed by the "International Journal of Production Economics" and "Journal of Operation Management", with 251 and 225 records, respectively. The three journals together hold 26% of total citations in the top 20 most cited journals, being the main references on GSCM topics.

Table 22 shows the 20 most used article keywords, with "Green Supply Chain Management", "Supply Chain Management" and "Green Supply Chain" on the top of the list. Although, we must warn that even though "GSCM" appears in the forth position, such acronym my lead researchers to other subjects not related to green supply chain management, as previously stated.

Those findings are relevant to researchers who intent to study GSCM, guiding their literature search to start by those keywords and/or those journals. Nevertheless, the presence of keywords such as "Sustainability", "Reverse Logistics" and "Selection Supplier" in

Table 16
GSCM top ten publishing author's institution affiliation between 2006 and 2016.

Institution	Publications
Dalian University of Technology	19
National Institute of Technology, India	18
University of Southern Denmark	11
State University of São Paulo	10
Clark University	8
University of Sheffield	8
Indian Institute of Technology Bhubaneswar	7
St. Vincent Pallotti College of Engineering and Technology	6
University of East Anglia	6
The Hong Kong Polytechnic University	5

Source: Authors

Table 17
List of the top 20 authors who publish on GSCM between 2006 and 2016.

Author	Publications
Sarkis, Joseph	22
Zhu, Qinghua	18
Govindan, Kannan	16
Lai, Kee-Hung	12
Lopes de Sousa Jabbour, Ana Beatriz	11
Chiappetta Jabbour, Charbel Jose	10
Koh, SC Lenny	9
Haleem, Abid	8
Luthra, Sunil	8
Barve, Akhilesh	7
Garg, Dixit	7
Geng, Yong	7
Kaliyan, Mathiyazhagan	7
Kannan, Devika	7
Muduli, Kamalakanta	7
Diabat, Ali	6
Bai, Chunguang	5
De Giovanni, Pietro	5
Hsu, Chia-Wei	5
Saen, Reza Farzipoor	5

Source: Authors

Table 18
List of the 20 most cited authors, by quantity of records.

Author	Records	Citations
Zhu, Q.H.	255	1025
Sarkis, J.	249	1014
Rao, P.H.	169	254
Srivastava, S.K.	155	165
Vachon, S.	150	251
Lai, K.H.	137	356
Handfield, R.B.	134	205
Klassen, R.D.	131	290
Carter, C.R.	119	214
Min, H.	114	133
Seuring, S.	113	190
Holt, D.	107	127
Walton, S.V.	103	126
Govindan, K.	102	281
Green, K.W.	100	135
Hervani, A.A.	93	96
Geng, Y.	88	152
Bowen, F.E.	83	98
Hsu, C.W.	82	118
Lamming, R.C.	78	107

Source: Authors

Table 19
Top ten countries with publication on GSCM.

Countries	Publications
U.S.A.	74
India	63
China	55
Taiwan	48
United Kingdom	40
Denmark	21
Iran	21
Malaysia	17
Brazil	16
Australia	13

Source: Authors

Table 20
List of 20 journals with more publications about GSCM.

Journals	Publications
Journal of Cleaner Production	36
International Journal of Production Economics	21
International Journal of Production Research	17
International Journal of Logistics Systems and Management	12
Transportation Research Part E: Logistics and Transportation Review	12
Supply Chain Management	11
Resources, Conservation and Recycling	9
Production Planning and Control	8
Expert Systems with Applications	7
Benchmarking: An International Journal	6
International Journal of Operations and Production Management	6
International Journal of Physical Distribution and Logistics Management	6
International Journal of Procurement Management	6
International Journal of Services and Operations Management	6
Journal of Manufacturing Technology Management	6
Management Research Review	6
Business Strategy and the Environment	5
Journal of Industrial Engineering and Management	5
The International Journal of Advanced Manufacturing Technology	4
International Journal of Environmental Science and Technology	4

Source: Authors

the list reinforces the broadness of the theme.

In order to visualize and to analyze the citation networks, we used the CitNetExplorer, which focuses on the topic of field-normalized citation impact indicators: 37,774 citation links, out of the 3487 GSCM articles citations within 2006–2016 in Web of Science.

Fig. 5 shows the 100 most frequently cited publications (select based on their Citation Score) which are clustered based on their citation relations, where the curved lines represent citation relations among publications (represented by circles, i.e. nodes). Citations point in upward direction, i.e., the cited publication is always located above the citing publication. The horizontal location of a publication is determined by its citations relations with other publications, while the vertical location is determined by its publication year. Publications are labelled by the last name of the first author (although some labels may not be displayed to prevent overlapping).

Publications assigned to the same cluster tend to be closely connected to each other in the citation network. Each group shown in Fig. 5 corresponds with one of the 11 publication clusters that have been identified and the colour of a publication indicates the group to which the publication is assigned:

- Group 1: light blue, 1518 publications;
- Group 2, dark green, 584 publications;
- Group 3, purple, 561 publications;
- Group 4, orange, 371 publications;
- Group 6, brown, 137 publications;
- Group 9, light green, 15 publications.

Low Citation Score groups (i.e., 5, 7, 8 10 and 11, with publication quantities of, respectively, 138, 81, 35, 12, and 11) are not shown.

Fig. 5 allows the visualization of the most relevant citation networks along the time and existing groups, having Srivastava's paper “Green Supply Chain Management: A state-of-the-art literature review” (2007) positioned in the centre of the GSCM publication network, due to its highest Citation Score of all.

From Srivastava's focal point (Srivastava, 2007), we drew the 100 GSCM most significant knowledge route in ten years, as shown in Fig. 6, where curved lines represent the knowledge flow from the cited publication downward to the citing ones, what partially answers the research question v) “how had such research field evolved along the past ten years?” (Throughout analysis is found in section 5).

As it can be noticed, there is no node in the year 2016, what can be explained by the fact that, as new publications, none has achieved high Citation Score yet. Among the top 100 most cited, the latest publications appear in the year 2015, i.e., Tseng and three others.

Since Tseng occupies a more central position, representing the highest Citation Score among the four, we purposed to identify the knowledge dissemination along the last ten years by tracking the knowledge flow path between Srivastava and Tseng.

Fig. 7 presents such paths (subnetworks):

Table 21
Top 20 most cited journals.

Journal	Records	Citations
Journal of Cleaner Production	271	1282
International Journal of Production Economics	251	978
Journal of Operation Management	225	699
International Journal of Production Research	211	560
International Journal of Operation & Production Management	187	569
European Journal of Operation Research	168	413
International Journal of Management Review	161	166
Omega	144	250
Production and Operation Management	141	263
Transportation Research Part E-Logistics and Transportation Review	126	228
Supply Chain Management	126	228
Greener Management International	113	254
International Journal of Physical Distribution & Logistics Management	106	160
Harvard Business Review	106	219
Supply Chain Management: An International Journal	105	166
Strategic Management Journal	103	243
Benchmarking: An International Journal	95	203
Industrial Management Data System	93	131
Business Strategy and the Environmental	93	143
Computer and Industrial Engineering	88	208
Computer and Industrial Engineering	84	116

Source: Authors

Table 22
Top 20 most used keywords.

Key words	Records
Green supply chain management	161
Supply chain management	50
Green supply chain	35
GSCM	29
Sustainability	29
Environmental management	28
Green Supply Chain Management (GSCM)	24
Environmental performance	19
Reverse logistics	16
Supply chain	13
Sustainable development	12
Supplier selection	11
Environment	10
China	9
Fuzzy set theory	9
India	9
Interpretive structural modelling	9
Barriers	8
Environmental sustainability	8
Case study	7

Source: Authors

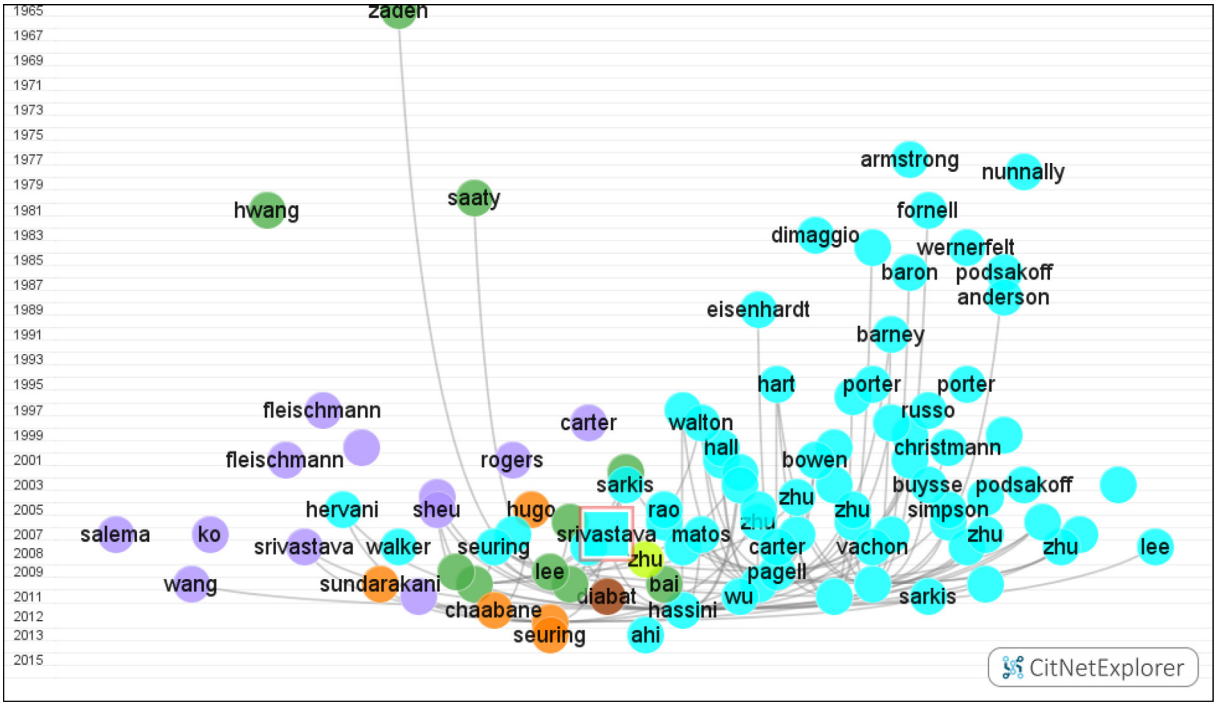

Fig. 5. Citation networks. Source: Authors.

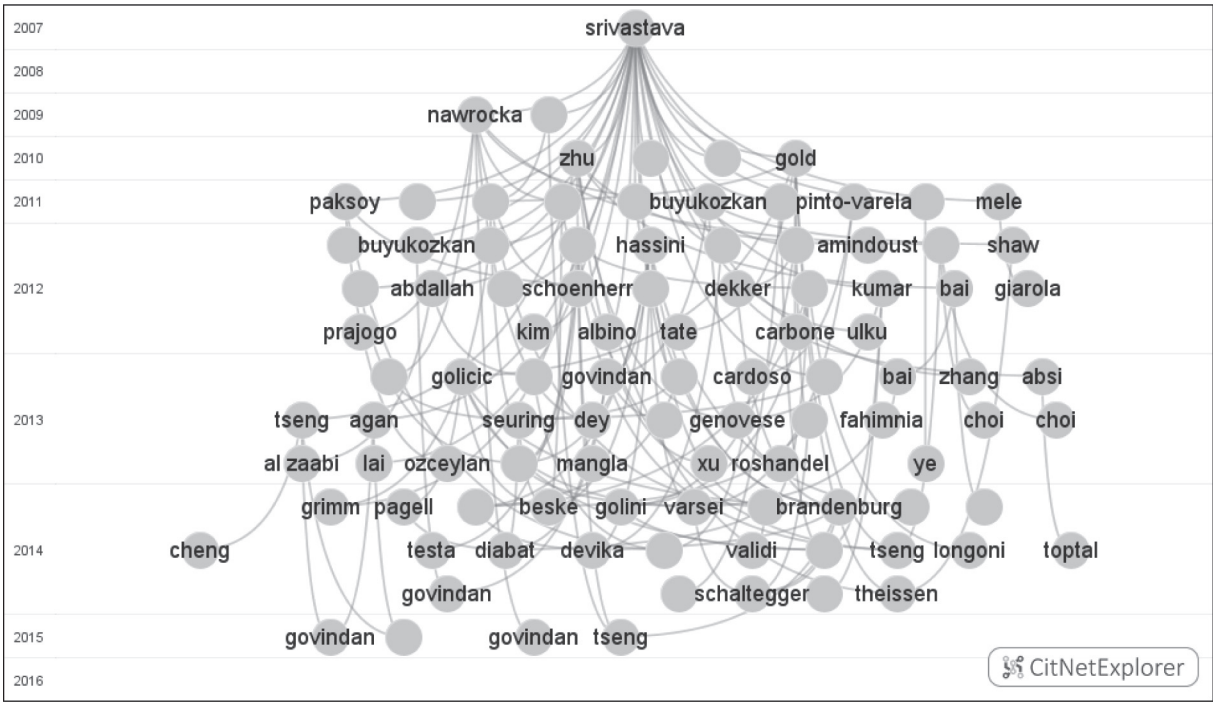

Fig. 6. Citation network evolution from Srivastava's publication. Source: Authors.

- Srivastava-Nawrocka-Van bommel-Ageron-Tseng, which is focused on supply chain environmental practice frameworks;
- Srivastava-Ates-Dekker-Brandenburg-Tseng, which is concentraded supply chain proactive environmental strategiess; and
- Srivastava-Gold-Golicic-Brandenburg-Tseng, on related to Sustainable Supply Chain Management (SSCM).

We then used CiteSpace to identify the major GSCM research area clusters. Fig. 8 organizes authors in clusters, considering the 2006–2016 period, with the label font sizes proportional to the Citation Scores, while Fig. 9 has the same configuration of Fig. 8, but it consolidates research areas in lieu of authors, showing eleven research areas, in cluster size descending order.

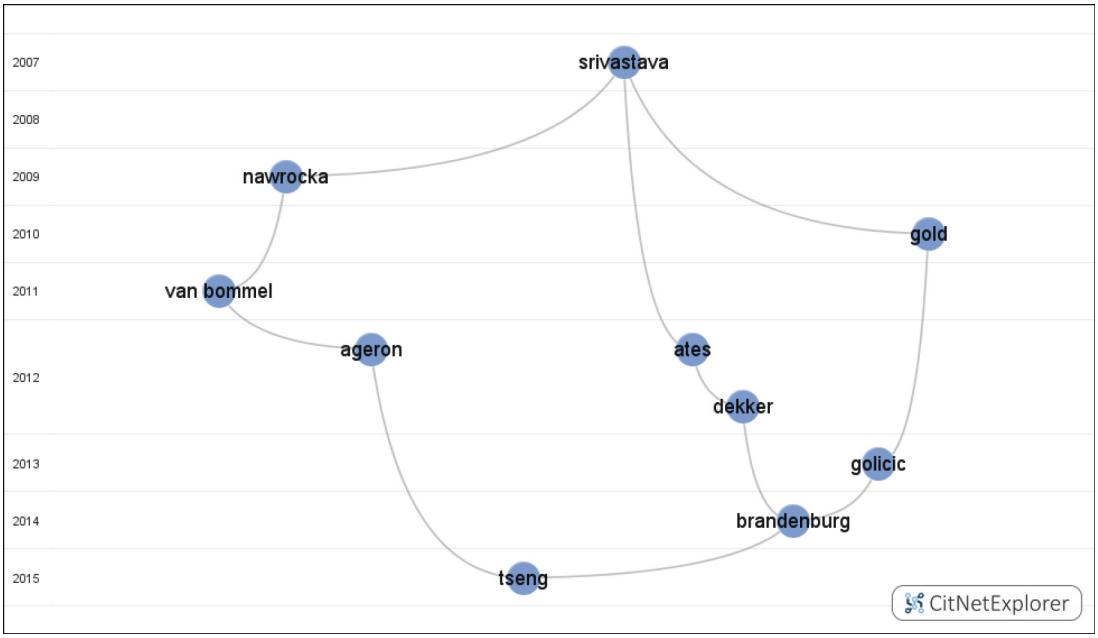

Fig. 7. Longest paths between Srivastava and Tseng. Source: Authors.

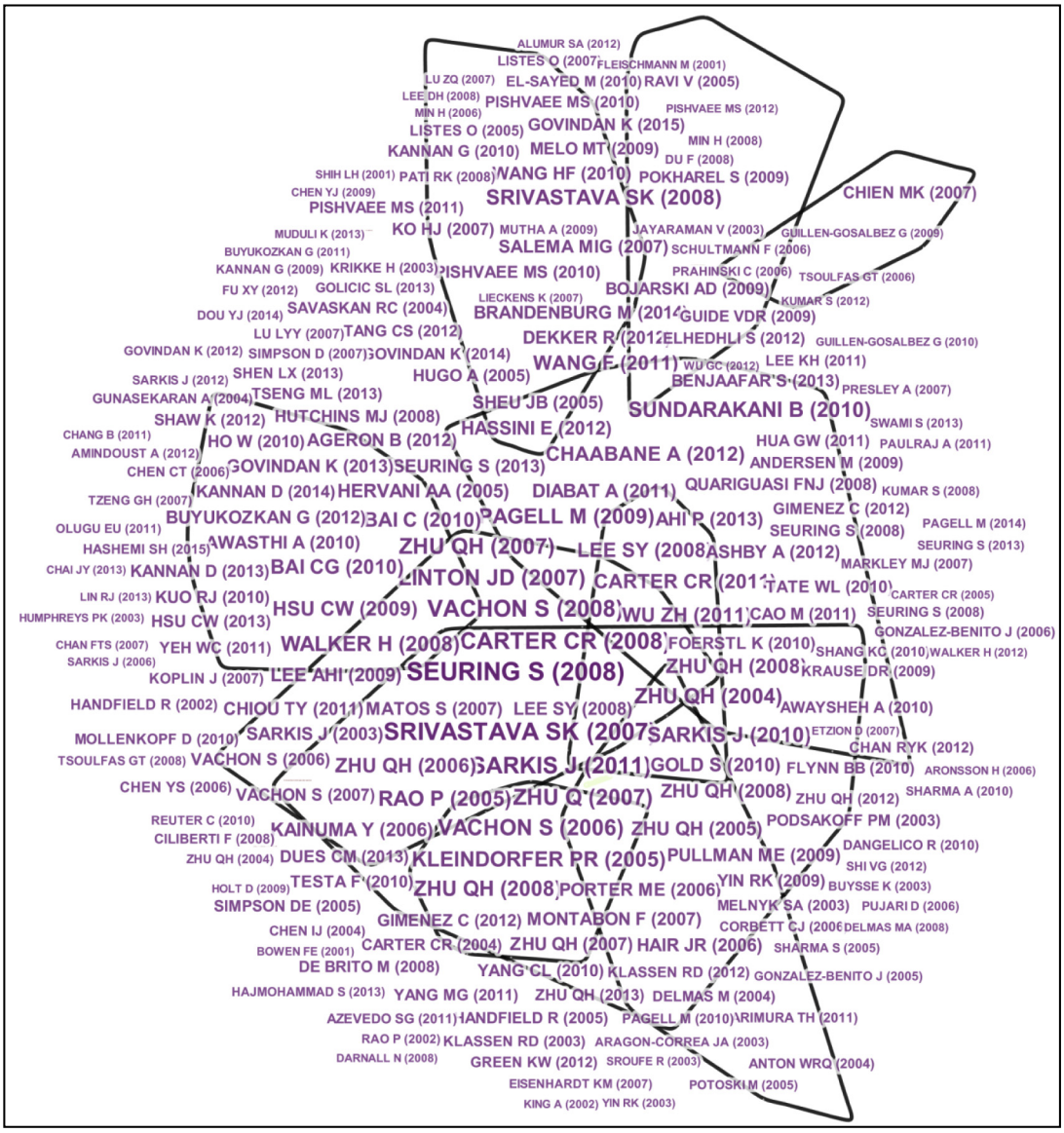

Fig. 8. Clusters of 2006–2016 GSCM authors. Source: Authors.

As it can be noticed, Srivatava (2007) is again at the top position, together with Seuring (2008). Although, it is important to highlight that Seuring and Müller (2008) studied SSCM, wich, according to Ahi and Searcy (2013), is more holist than GSCM. Therefore, even though Seuring (2008) is on the spotlight, due to the fact that SSCM has a broaden approach, we funnelled our whole study on GSCM.

Fig. 9 reveals that the top GSCM research area is "Global Supply Chain" (cluster # 0), followed by "Environmental-Oriented Supply Chain Cooperation", "Paper Recycling Reverse Logistics" and "Supplier Selection".

It is important to notice that the research area "Developing new products" (cluster #7 in the low left corner) is positioned far away from the other clusters, what is explained by the fact that, even though publications are related to GSCM, citations are exclusive, self-contained into this research area cluster, not referencing/being cited in publications from other areas.

5. Results and discussion

In this section, research question v) "how had such research field evolved along the past ten years?" is answered. To do so, articles were separated in four different timeframes, so that the studies' behaviour could be analyzed: the 2006–2008 triennium, 2009–2011 triennium, 2012–2014 triennium, and 2015–2016. Upon collecting information from the VantagePoint processing, a Pareto analysis was performed to identify the top 20% most cited articles in each period, as detailed in Tables 23–26.

It can be noticed that along the 2006–2008 period, the green practices had a reactive approach, with studies focusing on pressure for implementation, barriers and motivations. As a matter of fact, within the top 20% articles, Srivastava (2008) is the only one to propose a proactive approach.

Table 24 refers to the 20% most cited articles in the second three-year period (2009–2011).

We noticed an approach changing in the second three-year period, not so focused on legislation compliance, but authors considering the reduction of long-term environmental impacts, investigating the impact of carbon emissions, analyzing the possibility to consider waste management issues as part of the supplier selection processes, etc., denoting a wider and more innovative approach.

The articles analyzed in the third triennium are detailed in Table 25:

The third period addressed "best practices" on GSCM practices

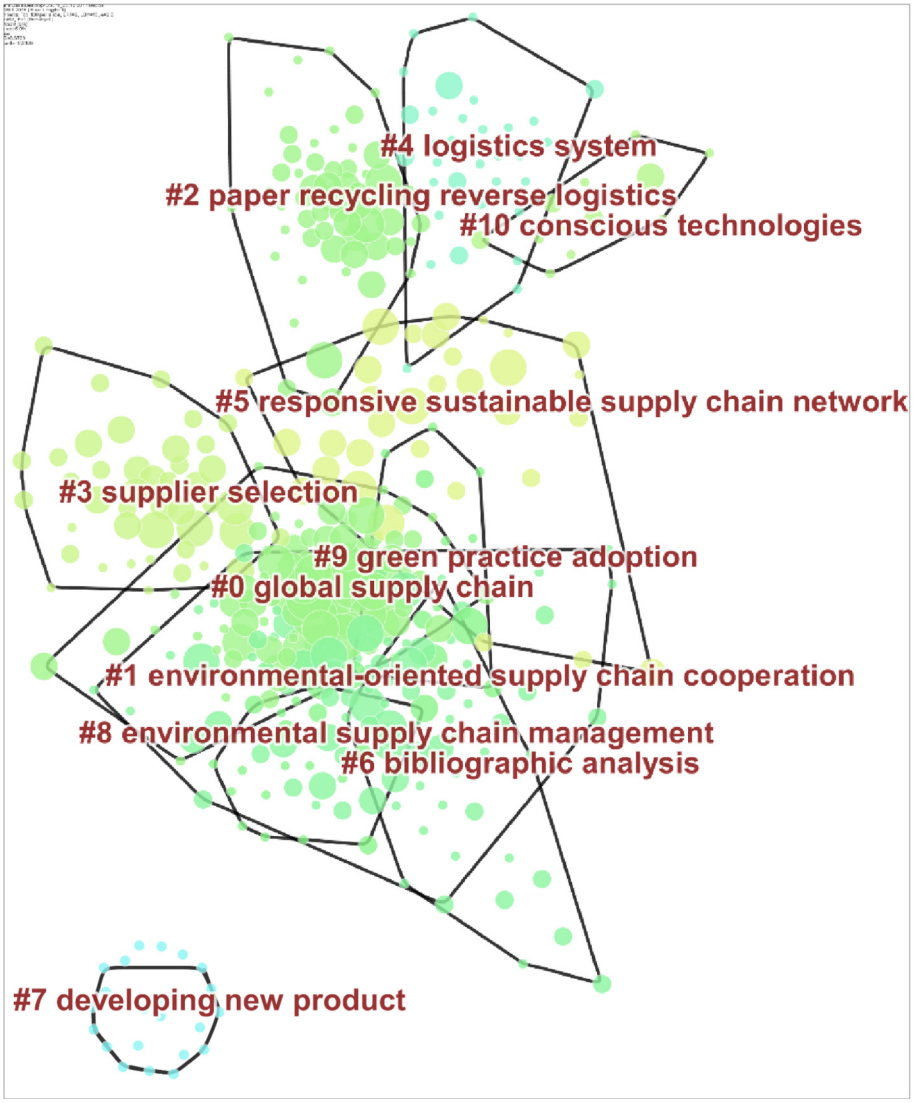

Fig. 9. Main GSCM research areas. Source: Authors.

Table 23
The 20% most cited articles of the triennium 2006–2008.

Article	Research description
Walker et al. (2008)	Performed a literature review aiming to identify motivators and barriers to GSCM implementation in both public and private sectors.
Srivastava (2008)	Intended to help the construction of a waste reverse logistics chain.
Darnall et al. (2008)	Analyzes the pressures suffered by companies to implement more sustainable business practices in their activities.
Zhu; Sarkis and Lai (2007)	Presents the pressures suffered by Chinese automotive companies, correlating them with the practices and companies performance.
Zhu et al. (2008)	Investigates how GSCM practices implementation in Chinese industries is evaluated.

Source: Authors

Table 24
The 20% the most cited articles of the triennium 2009–2011.

Article	Research description
Hsu and Hu (2009)	Infers the possibility of considering waste management in the process of supplier selection.
Wu and Pagell (2011)	Exposes the conflict between increasing short-term profitability and reducing long-term environmental impacts.
Sundarakani et al. (2010)	Investigates the consequences of carbon emissions along the supply chain.
Testa and Iraldo (2010)	Investigates companies' motivation to implement GSCM practices, which could be ethical and/or marketing-related.
Bai and Sarkis (2010)	Developed a model to help developing suppliers more environmentally friendly.
Holt and Ghobadian (2009)	Studies how U.K. plants are transitioning to greener practices.
Azevedo et al. (2011)	Describes the relationship between the adoption of green practices with the supply chain performance.
Luthra et al. (2011)	Analyzes the GSCM practices implementation barriers in India's automotive industry.

Source: Authors

Table 25
The 20% most cited articles in the triennium 2012–2014.

Article	Research description
Buyukozkan and Cifci (2012)	Uses mathematical models to assist in the choice of green suppliers.
Ahi and Searcy (2013)	Performs a literature review to conceptualize Green Supply Chain Management and Sustainable Supply Chain Management.
Lin (2013)	Analyzes pressures, practices and performance of GSCM through mathematical models.
Mathiyazhagan et al. (2013)	Studied GSCM practices implementation barriers in Indian automobile industry.
Govindan; Kaliyan and Kannan (2014)	Studies the difficulties of implementing green practices in industrial supply chains in India.
Zhu et al. (2012)	Evaluates the balance between external and internal GSCM in regards to environmental, economic and operational performance.
Tseng and Chiu (2013)	Helps in sorting and selecting green suppliers.
Green et al. (2012)	Correlated GSCM practices with organizations' performance.
Dues et al. (2013)	Lists the lean supply chain management practices with green chain management practices.
Shi et al. (2012)	Conceptualizes a structural model of green supply chain management based on natural resources.
Kannan et al. (2013)	Presents a mathematical model to helps supplier selection based on GSCM practices.
Hsu et al. (2013)	Addresses the relationship between carbon management and the selection of green suppliers.
Kannan et al. (2014)	Tested a supplier selection mathematical model in an electronic Brazilian industry.
Tseng et al. (2013)	Studies the supply chain green management practice in Asia, correlating to sustainability concepts.
Sarkis (2012)	Investigates the relationship among factors that influence the implementation and practice of green supply chain management.
Zhu et al. (2013)	Empirically tests a theoretical model that correlates types of pressures that companies are submitted in the implementation of GSCM practices.
De Giovanni and Vinzi (2012)	Uses statistical models to measure the performance of supply chains that adopt green practices.
Chan et al. (2012)	Empirically related environmental orientation, GSCM activities, and corporate performance.
Muduli et al. (2013)	Analyzes the green supply chain management in an Indian mining company.
Shen et al. (2012)	Developed a model to evaluate the performance of suppliers who adopt the GSCM practices.
Zhu et al. (2012)	Explores the relationship between innovation and adoption of green practices in the supply chain under an ecological perspective.
Mirhedayatian et al. (2014)	Correlates environmental performance with green supply chain management practices.
Wu et al. (2012)	Present pressures and motivators that companies in the Taiwan textile industry face in relation to GSCM.
Koh; Gunasekaram and Tseng (2012)	Correlates environmental impact issues with development and operations in an IT supply chain in Taiwan.
Cabral et al. (2012)	Developed a decision support model in supply chains that adopt green practices.
Bose and Pal (2012)	Correlated green initiatives with the impact on companies' inventory costs.
De Giovanni (2012)	Addressed the “triple bottom line ” sustainability concept to analyze the environmental management practices in green supplies chains.

Source: Authors

implementation, evaluation and maintenance, presenting, in general, a more proactive approach, which denotes acting in anticipation of any regulation issues and pressures. It can be noticed by the presence of research topics as balancing relations between internal and external GSCM practices, mathematical models for green supplier selection, carbon management, development of decision support system for supply chains adopting green practices, the concept of “triple bottom line” in GSCM, among others. However, business performance is a recurring agenda in the most cited articles, highlighting correlations between GSCM practices and environmental, economic and operational performance, as well as the empirical relationship between environmental orientation, GSCM activities and corporate performance. GSCM-adopted supplier performance is also analyzed, together with the relationship

Table 26
The 20% most cited articles in the period 2015–2016.

Article	Research description
Hashemi et al. (2015)	Presents a mathematical model considering economic and environmental criteria for green suppliers' selection.
Rostamzadeh et al. (2015)	Developed a quantitative evaluation model to measure uncertainties in GSCM activities.
Dubey et al. (2015)	Investigates the impacts of supplier relationship management and total quality management on environmental performance, in a rubber plant.
Kannan et al. (2015)	Developed a model to select green supplier for a plastic manufacturing company in Singapore.
Govindan et al. (2015)	Evaluate the main practices to improve environmental and economic performance.
Savino et al. (2015)	Studied a fresh chestnuts supply chain plant, evaluating simultaneously sustainability improvement and its economic impact.
Luthra; Garg and Haleem (2015a)	Analyzes the critical success factors for GSCM implementation of in Indian factories.
Hasani et al. (2015)	Proposes a model to maximize after tax profit in a medical device closed-loop global supply chain network under uncertainty.
Luthra; Garg and Haleem (2015b)	Analyzes the key success factors behind the successful achievement of environmental sustainability by automobile industry supply chains in India.
Li et al. (2016)	Studied the pricing policy of a company with green practices in supply chain.
Liou (2015)	Presents an evaluation system that allows companies to recognize relevant factors in carbon management and to develop carbon reduction strategies.
Rauer and Kaufmann (2015)	Analyzes GSCM implementation barriers.
Mathiyazhagan et al. (2015)	Investigate pressure for GSCM adoption in mining industry.
Ji et al. (2015)	Evaluates the relationship between the company and the supplier in a sustainable supply chain.
Lam and Dai (2015)	Proposes a method with systematic metrics for logistics service providers develop their environment sustainability performance in the context of GSCM.
Brandenburg (2015)	Suggests an objective programming approach to improve the supply chain configuration for a new consumer product, considering economic and environmental criteria.
Mangla et al. (2015)	Analyzes the relevant risks in the effective implementation of GSCM practices under the industrial point of view.
Jabbour and Jabbour (2016)	Proposes an integrative framework for the relationship between Human Resource Management and the management of green supply chain.
Wu and Chang (2015)	Identify the critical success factors for GSCM implementation.
Montoya-Torres et al. (2015)	Proposes a conceptual framework to measure and analyze the supply chain carbon footprint.
Kuei et al. (2015)	Identify the critical factors that influence the adoption of green supply chain practices in Chinese companies.
Freeman and Chen (2015)	Developed a mathematical model for green supplier selection.
Wong et al. (2015)	Developed a literature review on the integration of environmental management in supply chains.
Lee (2015)	Correlates the social capital accumulation by a company with green supply chain management practices.
Talaei et al. (2016)	Presents a mathematical model that assists the carbon management in the supply chain.
Laari et al. (2016)	Identify the direct and indirect relationships between the customer-oriented GSCM practices green supply and environmental and financial performance in a logistics company.
Gurtu et al. (2015)	Analyzes the keywords used in GSCM literature.

Source: Authors

between the adoption of green initiatives and inventory impacts.

Finally, the most cited articles referring to the last period (2015–2016) are seen in Table 26:

The 2015–2016 period resembles somehow the 2012–2014 triennium, since most of the authors addressed empirical studies and brought proactive solutions to the GSCM issues. Critical success factors in GSCM implementation are identified; mathematical models for green supplier selection and carbon management are developed, among others. Moreover, theoretical researches are also significant in this period, inferring the expansion of GSCM practices knowledge and the concerns with human factor within the context of green practices, as divulged by Jabbour and Jabbour (2016), who presents an integrative framework for the relationship between HRM and GSCM. However, as happened in the 2012–2014 period, concerns with business results still prevail, with authors proposing models to maximize after taxes profits, studies focused on pricing policy of green companies and the economic impact on companies that address the GSCM, as well as the social capital accumulation by companies adopting green practices.

When comparing the four periods, it can be noticed a significant increase in quantity of studies, corroborating with the trend identified in Fig. 3, section 4 – Research profile, inferring the spreading process of GSCM practices, both empirically and academically. Based on the top 20% articles, the 2006–2008 contains five researches, followed to eight in 2009–2011, and jumping up to 27 in 2012–2014. Coincidently, the 2015–2016 presented 27 items too, but considering it covers two years only, instead of a full triennium, it is expected to see the GSCM publication increase trend perceivable for the next years.

Assessing such trend, it is also expected that, from now on, authors will be addressing green practices innovation benchmarks, encompassing evolutionary processes, systems and technologies, towards effectively incorporating GSCM as a business strategy, with companies developing proactive approaches with standards of excellence in their practices throughout the chain and preparing themselves for new pressures and regulations, beyond legal compliance. Moreover, given the competitive and demanding scenario, as well as the observed trend, the unveillance of more researches about the GSCM theme will provide additional information and opportunities to expand its studies and applications. However, these factors depend on the reality of each context of technological advances, as well as resources availability.

6. Final considerations

For the achievement of this research objectives, we analyzed 339 publications on GSCM, searching “Web of Science”, “Scopus”, “Taylor & Francis” “Science Direct” and “Ingenta Connect” databases, selecting the terms “Green Supply Chain management” and “GSCM” in the title, abstract and keywords, applying the restriction of be published in English language journals between 2006 and 2016, as an extended sequel of Srivastava (2007) research.

For the construction of Systematic Literature Review, articles resulting from the research were read, studied and classified in categories related to methodological procedures, context, and area where the research took place. Such reading process of 339 articles was necessary to make feasible the literature analysis (research areas, authors, methods, etc.), seen in Tables 5–15

For the development of the Research Profiling, articles information was loaded to VantagePoint software and, after processing, they were organized in tables and graphs. Data was also processed by CitNetExplorer to identify Citation networks, and by CitEspace to generate research cluster figures.

In this sense, the article reached its goal to sort the items in the proposed classification, since: i) we featured a broad comprehensive study, ii) we presented the subject bibliometric profile within the analyzed period, iii) the developed research content can help academics and researchers to understand the concepts surrounding the green supply chain management in a wider perspective, iv) we divulged the main GSCM research areas through research clusters, and exhibited how researchers are positioned in the clusters; and v) upon classifying articles, the study enlightens and help evidencing knowledge gaps that can drive future GSCM researches.

In this step, it was noticed that only three articles were related to public administration, what drives to question why GSCM do not appear in the public area literature? There are no contributions in this area or they are not published? It is a subject to be explored in future researches. Other relevant area where GSCM practices were not identified in the literature was pharmaceutical industry, what brings concerns since drugs may be improperly disposed in landfill and/or sewerage systems (Heberer, 2002; Clara et al., 2005). Studies in USA (Benotti et al., 2009), Spain (Carballa et al., 2004), Switzerland (Bendz et al., 2005), Germany (HEBERER, 2002), and Brazil (Stumpf et al., 1999), reported chemical components found in sewage treatment plants, water supply network, rivers and lakes.

Apropos of the Research Profiling method, we purposed to answer the expanded questions: i) How is the evolution in the volume of publications per year? ii) Which were the institutions that publish most? iii) Who were the most productive authors? iv) Which countries have higher volume of publications? v) Who were the most cited authors? vi) What are the years in which there were more quotes? vii) What were the journals that publish most? viii) What were the most referenced journals? and ix) Which key words were most used?

The goals were reached, helping to develop a search profile in the field of GSCM. For example:

- Knowing that the most productive institution is the Dalian University of Technology, researchers can approach such institution, seeking partnerships and/or to develop researches on its premises;
- Knowing that the top publishing and, also, most cited journal is the Journal of Cleaner Production, researches interested in this subject should seek research material in their publications;
- Knowing that the most used keywords are “green supply chain management”, “supply chain management” and “Green Supply Chain” and that 96.7% of the articles published in the last 10 years are present in Web of Science and Scopus databases, researchers should start their searches using such information.

Results indicated that about 40% of the researches focused to the benefits of GSCM implementation, while about 10% were related to barriers to such implementation. Therefore, it can be inferred that studies that may contribute to reduce and/or overcome GSCM implementation barriers would be an avenue for future researches to be developed.

It was also noticed that most of the researches were empirical studies and use questionnaires for data collection. When using mathematical models, research on GSCM uses mainly Fuzzy Logic (36%).

We recommend that the term GSCM, despite being the acronym for Green Supply Chain Management, should not be used as a search term in databases, since several articles related to subjects other than Green Supply Chain Management are raised (about 15% of the total). In addition, it was also found that the use of such term in all search database fields generate as response a huge amount of items that not related to the studied subject.

The Research Profile also showed that the Web of Science database has the largest collection of publications on the subject, where the Journal of Cleaner Production has both the largest number of publications and the largest number of citations on the subject.

Besides that, it was identified that the GSCM research between 2006 and 2016 was segmented in eleven major clusters: global supply chain, environmental-oriented supply chain cooperation, paper recycling reverse logistics, supplier selection, logistics system, responsive sustainable supply chain network, bibliographic analysis, developing new product, environmental supply chain management, green practice adoption, and conscious technologies (see Fig. 9).

These conclusions were drawn mainly from the tables that were used to synthesize the results of the research (a total of 26), as well as figures and graphs (a total of 9). Many other aspects could be addressed here, but due to word-cont restrictions, the reader is encouraged to take a detailed look at these tables in order to prospect details about GSCM.

Also, as proposition for new studies, authors can analyze articles published after 2016, including more aspects in the literature review, such as research objectives, research results and proposals for new studies, as well as expanding the studies to SSCM, a broaden theme that adopts a triple bottom line (i.e., environment, economic, and social) approach to sustainability (Ahi and Searcy, 2013). GSCM deployment results in different countries can also be compared, aiming to correlate influence aspects, such as environmental local legislation and regulatory subjects, with such results.

In addition, this article is recommended to researchers and academics who intent to start their research in GSCM area, since the conceptual map developed by the SLR method, together with the bibliometric results, created a profile for that area of knowledge, assisting in the identification of future researches and opportunities for researchers to apply their theories.

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