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Review

A literature review on green supply chain management: Trends and future challenges

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ABSTRACT

This study aims to review the literature in green supply chain management (GSCM) published from 1998 to 2017 and presenting insights and directions for future research. The study collects data from Scopus and ISI Web of Science databases and objectively selects 880 papers and conducts metadata analysis. In addtion, 236 papers from ISI Web of Science is analyzed to present the insights along with the classifications of the literatures based on content analyses, which comprises of conceptual development, drivers and barriers, collaboration with supply chain partners, mathematical and other optimization models, and assessment of green supply chain management practices and performance. The study finds that research on drivers or barriers analysis of green supply chain management reveals a declining trend while there is a growing trend of applying mathematical optimization models for enhancing decision making in pursuit of environmental performance. Moreover, the study finds a consistent growth in the evaluation of green supply chain management practices and performance. Though, the concept of green supply chain management started gaining popularity among academicians from the beginning of the 20th century, this study finds a sharp growth of publications on the topic after 2010 until now. This study identifies influential authors, top journals, top contributing countries, top contributing institutions and contribution by disciplines. This study presents a comprehensive but straightforward conceptual model of green supply chain management. The findings and future research directions of the study offers a new avenue for further exploration and contribution to this discipline.

1. Introduction

The rise of global warming and changing biodiversity has brought the world's sustainability towards imminent danger. People from different areas including researchers, academicians, practitioners, and scientists got together to propose ways to maintain environmental sustainability. It is often claimed that unplanned and irresponsible actions by industries are potential threats to sustainability (King and Lenox, 2000). Consequently, establishing sustainable industries is one of the main goals of contemporary organizations. To achieve greater sustainable objectives, organizations need to play a vital role and need to be concerned about the external environment, which is often referred to as 'going green' mission (Bansal and Roth, 2000). The 'green' concept is referred to as 'doing actions while integrating environmental or ecological concern.' The supply chain is an important branch of operations management, and it has a significant impact on the environment including emissions, pollutions, the health hazard of community, etc. Organizations are now trying to minimize environmental impact by integrating environmental concern into their supply chain operations. The integration of environmental concerns into supply chain management practices is referred to as 'green supply chain management' (GSCM) (Sarkis, 2012). GSCM has been established as an important discipline in the academic world and a separate branch of sustainability. The research on GSCM has been proliferating for the last two decades and still needs further insights for future studies.

There are several literature reviews on GSCM done by previous researchers (Soda et al., 2016). Few of the papers focus on the methodology section of GSCM (Govindan et al., 2015b); (Soda et al., 2016), while others focus on specific aspects and practices (Islam et al., 2018); (Igarashi et al., 2013). Moreover, few authors look into the intersection of

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'green' supply chain with 'sustainable' supply chain in reviewing GSCM literature (Fahimnia et al., 2015), and few authors try to address broader aspects of GSCM literature (Srivastava, 2007); (Malviya and Kant, 2015). Nonetheless, prior studies have shortlistedthe papers using a subjective approach for review and insights, which potentially may lead lead to bias. Thus, there is a need to collect the data by the objective approach. GSCM literature is increasing exponentially (see Fig. 2), justifying the need to present new insights and research directions based on the latest development in the existing body of knowledge. The research questions the study addresses are: who are the influential authors? What is the trend of publication? What are the key journals? What are the top contributing countries, institutions and subject areas? Moreover, what are the key themes that can be derived by which the extant GSCM literature can be classified, and finally how to draw a simple framework to understand the concept of GSCM? Therefore, the objective of this paper is to review the existing literature review on GSCM and present insights for understanding the current phenomenon and for future research directions.

The data has been derived from the Scopus and ISI Web of Science databases from 1998 to December 2017. In order to present metadata analysis, the study analyzes 880 papers which have been derived objectively from the Scopus database. This metadata presents descriptive statistics of influential authors, popular journals, institutions, subject areas, influential papers, and the list of countries contributing papers in the GSCM literature. Into the bargain, the study also presents some insights which should provide an important avenue for future research. The contributions of this paper are manifold. First, the paper presents an integrated definition of GSCM. Second, the study reveals some findngs which are different from prior studies. Third, couple of categories in the classification of literature are scarce in the literature which helps readers understanding and viewing the literature from different dimensions. Finally, the study presents a new, simple, and easy to understand, but a comprehensive conceptual framework of GSCM. Academicians and researchers find this paper useful from the insights and future research direction for understanding the concept as well as further exploration in GSCM. The rest of the paper begins with the definition of green supply chain management in Section 2. followed by the detailed methodology in Section 3. Section 4 presents the observations, insights, and recommendations, and Section 5 discusses the conclusion, limitations, and direction for future research.

2. Green supply chain management

Academicians and practitioners are proposing the concept of GSCM as a potential solution for improving environmental performance. Although the concept of GSCM can be found in the early 1990s, the trend in growth of academic publications shows that it gained popularity after 2000 (Fahimnia et al., 2015; Seuring and Müller, 2008); (Srivastava, 2007). Moreover, Sarkis et al. (2011) maintain that the concept of GSCM can be traced back to the 1960s as environmental management movement. About that, Seuring and Müller (2008) narrated that the GSCM concept found its formal shape as a new discipline after the 1990s.

The concept of green supply chain management has been evolving for years. Handfield et al. (1997) mention the application of environmental management principles to the entire set of activities across the whole customer order cycle. Sarkis et al. (2011) defined GSCM as integrating environmental concerns into the inter-organizational practices of sustainable supply chain management, including reverse logistics. In general, it can be said that the concept of GSCM is broad, and there is no clear, holistic definition available to describe it. Since the concept is defined differently by researchers, it is difficult to describe GSCM by a single definition (Ahi and Searcy, 2013). Although there are differences among the definitions, there are clear usage of several common terms (Sarkis et al., 2011) such as 'supply chain environmental management' (Sharfman et al., 2009), 'green purchasing and procurement' (Min and Galle, 1997), 'green logistics and environmental logistics' (Murphy and Poist, 2000), and 'sustainable supply network management' (Young and Kielkiewicz-Young, 2001). To conclude, all of the possible definitions underlined by these researchers are summarized in (Table A1 in Appendix A).

3. Method

This study followed a systematic process of retrieving data from reliable sources. Saunders (2011) maintain that a systematic literature review begins with the definition of appropriate keywords which are being used in searching and retrieving the literature from databases as well as presents the analysis of the literature. Tranfield et al. (2003) argue that the aim of a literature review is to identify gaps in the literature as well as the knowledge limitations. Additionally, literature review summarizes and classifies existing studies based on key themes and suggestions for future works (Seuring et al., 2005). Following these notions, the current study employs a systematic method to retrieve data and classify the literature based on content analysis and direction for future research. In short, the study adopted a four-step method (see Fig. 1) in a similar approach including identifying the data, screening initial data, determining the eligibility and finally the inclusion of the data. The aim of collecting this data is to present insights and directions for the future research. The study collected data from Scopus (for metadata analysis) and ISI Web of Science (for classifications and insights) databases. Scopus database has been considered a reliable database by many scholars (Fahimnia et al., 2015; Malviya and Kant, 2015; Seuring and Müller, 2008). Moreover, ISI Web of Science database has been admired by the academicians for indexing high-quality contents, and many prior studies used this database as a reliable and high-quality data source (Apriliyanti and Alon, 2017; Tian et al., 2018).

3.1. Identification of the data

The data were collected from Scopus integrated databases, including all major publishers such as Emerald, Taylor and Francis, Springer, and Willey. The search covers the papers published between 1994 to December 2017. In the beginning, the study uses keywords like ‘green supply chain,' 'supply chain,' 'environmental,' and 'GSCM. The initial search keywords were limited to the title of the paper, and the keywords. At first 4000 papers were derived using three combinations of keywords. Table 1 presents the result of the initial search of Scopus database.

3.2. Screening initial data

The initial search result retrieves conference papers, books, and book chapters along with the articles but later was excluded except the articles. Accordingly, the search was limited to 'article titles' and 'keywords' only to remove books, conference proceedings, and magazines from the pile. As a result, 993 papers remained as articles after initial refinement, as presented in Table 2. In the end, after removing duplicates, 880 papers were finally chosen for the meta data analysis purpose.

3.3. Determining eligibility

To present the insights, the study objectively selected 236 papers from ISI Web of Science by merely doing a keyword search on the title. The keyword used in the search was “green supply chain” and limited to article title only. Again, the study included published papers from 1994 to December 2017. It is worth mentioning that all the paper appears in ISI Web of Science are also included in the 880 papers derived from Scopus databases. Many past studies also used ISI Web of Science to present insights (Coronado et al. (2011); Fetscherin and Heinrich (2015); Apriliyanti and Alon (2017).

3.4. The inclusion of the data

The study included 880 papers from the Scopus database for

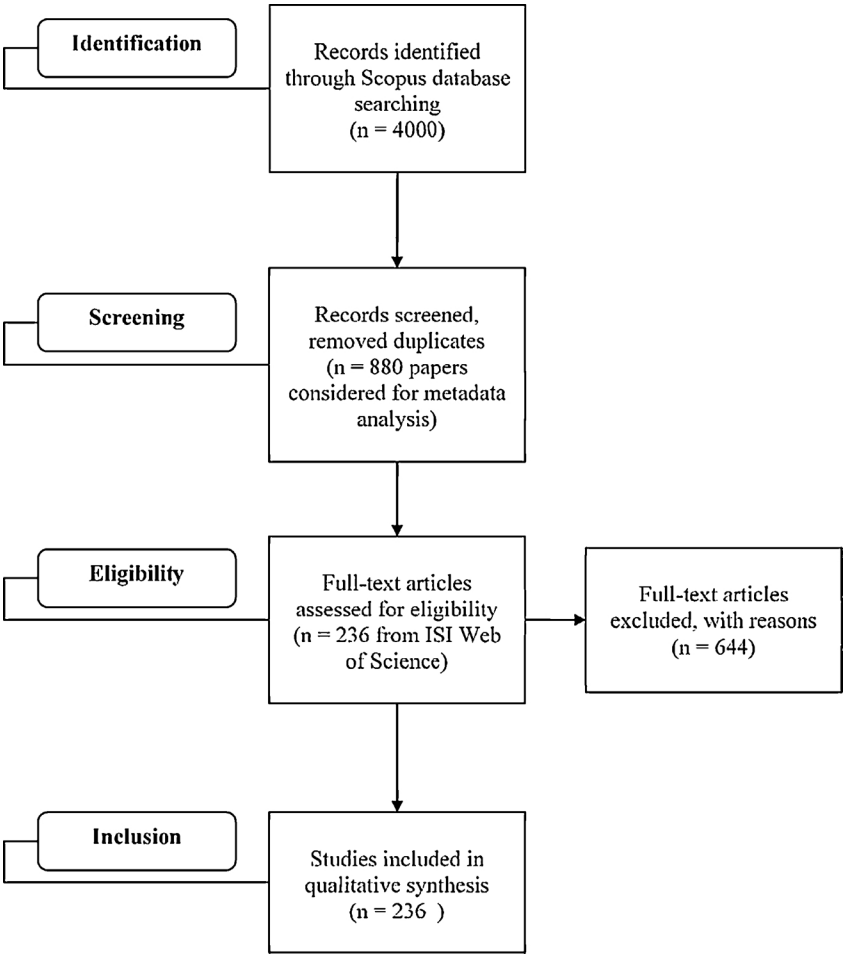

Fig. 1. Flowchart of the method used in this study (Moher et al., 2009).

metadata analysis, as well as 236 papers from ISI Web of Science for presenting insights and future directions. Thus, the study confirms that the data are derived from reliable sources. Moreover, these databases areare suitable for generalizability purpose since it index journals from other major databases such as Elsevier, Science Direct, Emerald, PLOS, Taylor and Francis, Wiley, Springer, IGI global and many more. On the other hand, to present the insights and future directions, the data should come from an even more reliable source. Many prior studies shortlisted the data for presenting the insights by subjective judgment (Fahimnia et al., 2015; Malviya and Kant, 2015). However, the current study objectively selected 236 papers from influential journals and

Table 1
Initial search result and number of papers appeared.

Keywords	Results (no. of articles)	Limit to
Green Supply Chain	3358	Article title, keywords
Environmental AND Supply Chain	471	Article title
GSCM	171	Keywords
Total	4000	–

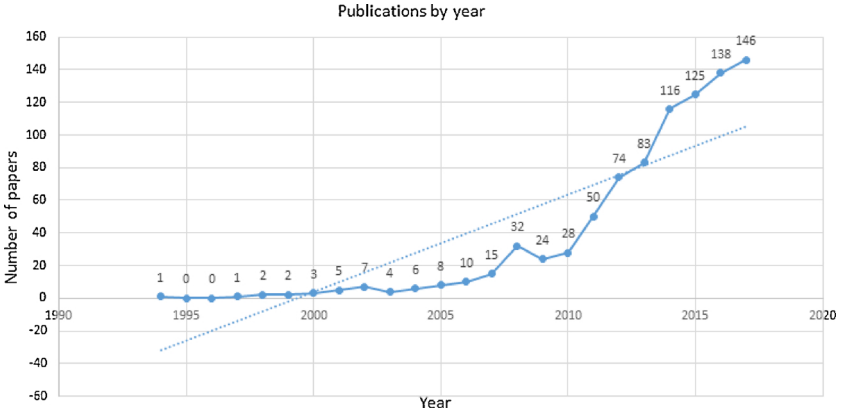

Fig. 2. Publications on GSCM by year.

Table 2
The result after refining the initial search.

Keywords	Results (no. of articles)	Limit to
Green Supply Chain	608	Article title
Environmental AND Supply Chain	297	Article title
GSCM AND Green Supply Chain	88	Keywords
Total	993	–

authors. For instance, Fahimnia et al. (2015) conducted a literature review on GSCM and found that all influential journals are indexed in the ISI Web of Science. Therefore, to ensure that the data are coming from a rich data source and to maintain unbias notion of the study, data were strictly collected from ISI Web of Science through keywords search. It is worth mentioning that papers that appear in ISI Web of Science search engine are also included in Scopus.

4. Observations and recommendations

The following section presents the metadata analysis and insights. Metadata analysis has been done based on 880 papers, and the insights have been presented based on content analysis of 236 papers.

4.1. Metadata analysis

This section presents the descriptive statistics based on the metadata of 880 papers. The metadata analysis contained publication of 880 papers by years, journals, authors, countries, citations, subject area, and institutions. In doing metadata analysis, one paper is counted for multiple times if the paper has multiple authors. For example, if a paper is coauthored by Dr. Sarkis and Dr. Zhu, both of them earn one publication credit. Similarly, both of their countries, and institutes earn one publication credit as well. In some cases, this studydoes not present the statistics in full list, but rather in a summarized format to increase readability.

4.1.1. Publications by year

Fig. 2 shows that the emergence of publications on GSCM started in 1990, followed by steady growth up until 2010. From 2010 onwards, it is clear from the figure that there is exponential growth until today. Moreover, the trend line also indicates an increasing pattern, which implies that the literature on GSCM is still growing. In the year 2017, 146 papers were published, which is significantly the highest number of papers as compared to previous years. This concludes that there is increasing concerns and interests on the GSCM topic, parallel with rising issues of environmental sustainability, industrial and domestic pollution, and concerns on social responsibility by both government and corporate bodies.

4.1.2. Publications by journals

Fig. 3 showed Journal of Cleaner Production published the highest number of papers (80), which is around 9 percent of the total 880 papers. Moreover, this is the same journal that shows the highest impact factor (5.7). Thus, Journal of Cleaner Production can be ranked as the number one journal due to its impact and popularity. The second most popular journal is the International Journal of Production Economics, which published around 5 percent of total papers on GSCM, and it has a decent impact factor (3.49) as well. Although the Journal of Supply Chain Management produced only 18 papers from the total lot, the impact factor of 4.07 (Table 3) is among the highest, thus placing the journal as among the best for this topic.

4.1.3. Publications by authors

Fig. 4 showed that Joseph Sarkis published the highest number of papers on GSCM (26 out of 880), which is around 3% of the total. The 2nd and 3rd author with the most papers published is Qinghua Zhu and Kannan Govindan respectively. The current study makes a comparison of authors' work between Scopus and ISI Web of Science databases to get a better idea on the top ten authors by comparing the number of papers published. Table 4 presents the rank of top 10 authors who appear in both Scopus and ISI Web of Science. Both of the lists shows a slight difference in the numbers of papers published. The rank of authors remains the same up until number 8 in both databases. Ming-Lang Tseng appears at number 9 in ISI Web of Science, whereas his name did not appear in Scopus top ten list. Mathiyazhagan appeared at number 10 in ISI list but ranked at number 9 in Scopus. Sheu appears at number 10 in Scopus, however disappears in the top ten list in ISI.

4.1.4. Publications by citations

In gathering information and ideas on influential authors of GSCM, the study takes the citation of papers into consideration. Table 5 below represents the top ten most cited papers in the Scopus databases report, which has been generated in December 2017. By that notion, this citation may slightly differ with the ones in Google Scholar and ISI Web of Science. From Table 5, it can be seen that in 2004, the paper published by Zhu and Sarkis got the highest number of citations (846), followed by the paper by Sarkis (654) in 2003. All of the authors in Table 5 had jointly published and cited between 309–846 times. Thus, it is safe to say that all the authors in Table 5 are the leading authors of GSCM literature.

4.1.5. Publications by countries

Fig. 5 indicated China published the highest number of papers in GSCM literature followed by the United States. The former shared 18.6%, while the latter produced 18.2% of total articles published. Following that, the United Kingdom and India, both share 11.5% and 11.3% from total published papers, respectively. Malaysia stands at the 10th position, withholding the share of 3.8% from total published articles. It has become clear that Asia, America, and Europe dominate the GSCM literature. Also, it is interesting to see that both China and America published a combined 37% of total published papers This might be due to the increase of awareness in sustainable environmental practices in these countries, because these countries produce much of the world's pollution as well as consumption of large share of fuel-based and coal-based energy during the last few decades.

4.1.6. Most common words used in the title

By using wordart.com (a free open-source online software to conduct text search and word cloud), the most common word used in GSCM publications was determined. Referring to Table 6, It is found that most common words used in the title are 'chain' and 'supply' which is 906 times, followed by 'green,' 'manage,' 'environmental,' and so on. Fig. 6 represented the word cloud which is derived from the software, highlighting the most common words in bigger and bold fonts, while other relatively less common words appear in smaller fonts. This word cloud is an easy approach to identifying the common words in a complex environment (Birko et al., 2015), and thus it can be used to identify the most common theme and keywords used in publications.

4.1.7. Publications by institutions

Fig. 7 illustrates GSCM publications by authors' affiliations. The figure shows that Dalian University of Technology, China, published the highest number of papers in the GSCM literature. This institution alone publishes 30 papers, which are approximately 3.7% of the total papers published. In contrast, this finding differs with the study by Fahimnia et al. (2015), which stated that the Clark University of United States ranked as number one regarding the highest publications in GSCM. As a comparison, this study finds that Clark University currently positioned at 5th in the list (Fig. 7). The subjectivity may have caused the differences in both studies in sorting the data, as well as the tendency to merge green SCM with sustainable SCM. Returning to the current list, the second institution with most papers published is Syddansk Universitet of Denmark, followed by Hong Kong Polytechnic University.

It is interesting to see from the Figs. 5 and 7 that Denmark stands at

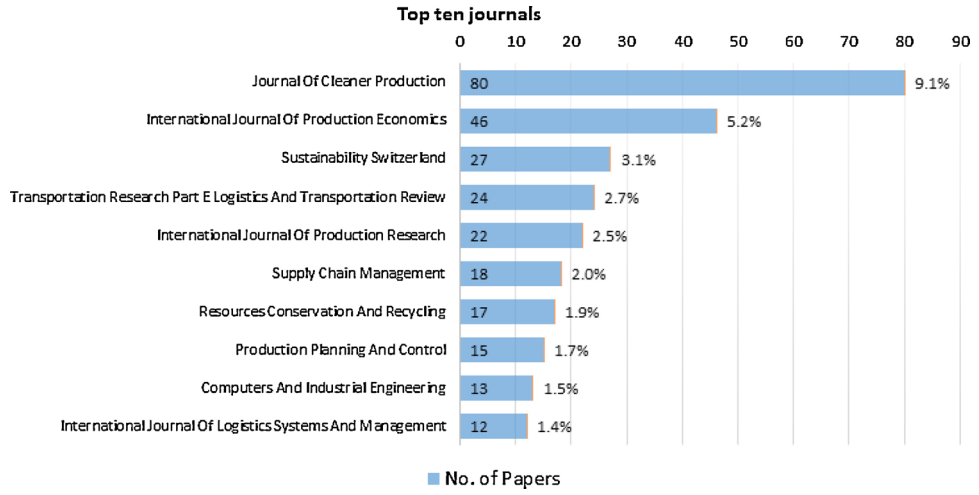

Fig. 3. Publications by Journals.

Table 3
Influential journals on GSCM.

Journals	Impact factor (2016)	No. of papers
Journal Of Cleaner Production	5.71	80
Supply Chain Management	4.07	18
International Journal Of Production Economics	3.49	46
Resources Conservation And Recycling	3.31	17
Transportation Research Part E Logistics And Transportation Review	2.97	24
Computers And Industrial Engineering	2.62	13
Production Planning And Control	2.36	15
International Journal Of Production Research	2.32	22
Sustainability Switzerland	1.79	27

Table 4
Top ten GSCM authors appeared in Scopus and ISI Web of Science.

Rank	Scopus	No. of Papers	ISI Web of Science	No. of Papers
1	Sarkis, J.	26	SARKIS J	22
2	Zhu, Q.	24	ZHU QH	19
3	Govindan, K.	20	GOVINDAN K	13
4	De Sousa Jabbour, A.B.L.	15	JABBOUR ABLD	12
5	Jabbour, C.J.C.	12	JABBOUR CJC	12
6	Lai, K.h.	9	LAI KH	11
7	Geng, Y.	9	GENG Y	8
8	Diabat, A.	9	DIABAT A	7
9	Mathiyazhagan, K.	9	TSENG ML	7
10	Sheu, J.B.	8	MATHIYAZHAGAN K	6

11th position in the top fifteen list of countries whereas one of the institutes of this country occupies the second position in the top ten list of institutions. The obvious reason would be that most of the papers from Denmark are concentrated to a handful of authors. For example, K. Govindan occupies the third position in the top ten list of authors by publishing 20 papers (see Fig. 4) out of 28 papers from Denmark (see Fig. 5) and he is affiliated to Syddansk Universitet (as shown in the Scopus database). Since the institutes are credited by the authors' work thus a particular institute may climb the top position if its staff publishes more papers. Similarly, Dalian University of Technology, China is also credited for its staff Q. Zhu who occupies the second position in the list of top ten authors. Even though J. Sarkis occupies the first position in the top ten authors and he is affiliated to Cark university however, his institute appears at four. It seems that the papers in America are quite dispersed as compared to Denmark and China

4.1.8. Contribution by subject area

Different disciplines being applied in the GSCM literature demonstrate its importance and acceptance in the academic arena. Looking at Fig. 8, it can be seen that the highest number of papers was contributed by the areas of business, management and accounting discipline, which covers 23% of the total GSCM literature. Following that, engineering ranked as the second highest area, which scored 17%, followed by environmental science with 13%. Although the business management area dominates in GSCM literature, there are also other disciplines on the rise,

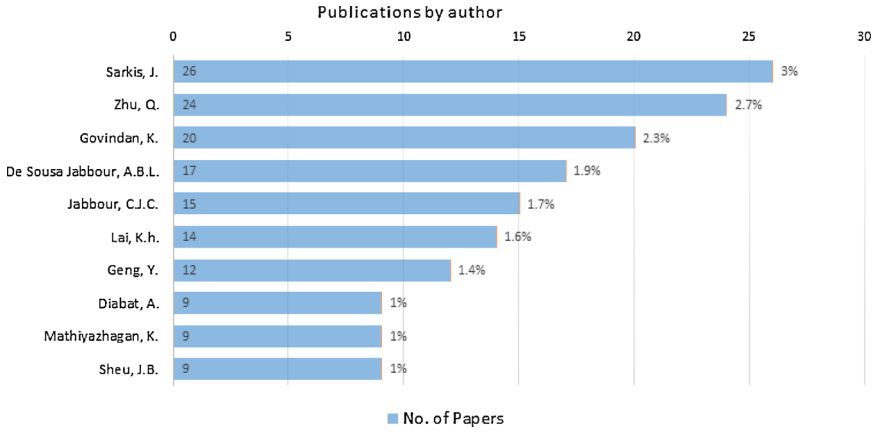

Fig. 4. Top ten authors in GSCM.

Table 5
Top ten cited papers in the GSCM literature.

Authors	Title	Year	Citations
Zhu Q., Sarkis J.	Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises	2004	846
Sarkis J.	A strategic decision framework for green supply chain management	2003	654
Hervani A.A., Helms M.M., Sarkis J.	Performance measurement for green supply chain management	2005	528
Vachon S., Klassen R.D.	Extending green practices across the supply chain: The impact of upstream and downstream integration	2006	527
Sarkis J., Zhu Q., Lai K.-H.	An organizational theoretic review of green supply chain management literature	2011	508
Zhu Q., Sarkis J., Geng Y.	Green supply chain management in China: Pressures, practices and performance	2005	463
Zhu Q., Sarkis J., Lai K.-H.	Confirmation of a measurement model for green supply chain management practices implementation	2008	412
Zhu Q., Sarkis J., Lai K.-h.	Green supply chain management: pressures, practices and performance within the Chinese automobile industry	2007	375
Zhu Q., Sarkis J.	An inter-sectoral comparison of green supply chain management in China: Drivers and practices	2006	365
Zhu Q., Sarkis J.	The moderating effects of institutional pressures on emergent green supply chain practices and performance	2007	309

Note: Citations presented here are based on the papers cited by Scopus indexed journal only.(as of December 2017).

showing interest on the topic. This might owe to the issue of environmental degradation, which matters a lot in today's contemporary business (Tseng and Chiu, 2013). Due to environmental degradation, firms are facing acute regulatory pressure from the government as well as pressure from environmentally conscious buyers and suppliers (Islam et al., 2018). Since GSCM improves environmental performance (Zhu and Sarkis, 2004), as a consequence, different disciplines also contributed to GSCM literature and created a varying topic of interests.

Table 6
Most common words used in the title.

Words	Numbers	Words	Numbers
Chain	906	Performance	155
Supply	906	Practice	117
Green	639	Industry	103
Manage	345	Model	99
Environmental	321	Sustained	81

4.2. Insights of GSCM

This section presents the insights based on the 236 papers objectively selected from ISI Web of Science database. The following sections present the classifications of the papers according to six major categories in GSCM literature, followed by the development of a conceptual framework based on the understanding of the existing literature. The literature has been classified as; (i) conceptual and theory development, (ii) drivers and barriers, (iii) collaboration with supply chain partners, (iv) presentation of mathematical and other optimization models, and (v) assessment/evaluation of GSCM practices and performances.

4.2.1. Conceptual and theory development

This sub-section classifies the papers related to the development of the concept of GSCM. Additionally, the papers which contribute to the development of theories in GSCM are also included. Beginning with the exploration of definitions given by different studies in the extant literature, this sub-section moves forward on the development of a integrated definition of GSCM. Firstly, to thoroughly review the past definitions, the study adopts the list of 22 definitions summarized by Ahi and Searcy (2013). This is to explore the common words and themes used in the past defining GSCM. To achieve this aim, the study used NVivo 10 software to identify the most common words and then perform a text search using the most common word to identify the placement of common word in the construction of sentences. The result of these search can be viewed in Table 7 and Fig. 9 below.

The search finds that the most frequent word is 'environmental,' which has been used 16 times out of 22 definitions. To explore the central theme of the concept, the study then performs a text search using the word 'environmental.' The software produces a 'word tree' based on the particular word, as illustrated in Fig. 9. This figure presents the 'word tree' with the most common word used in past

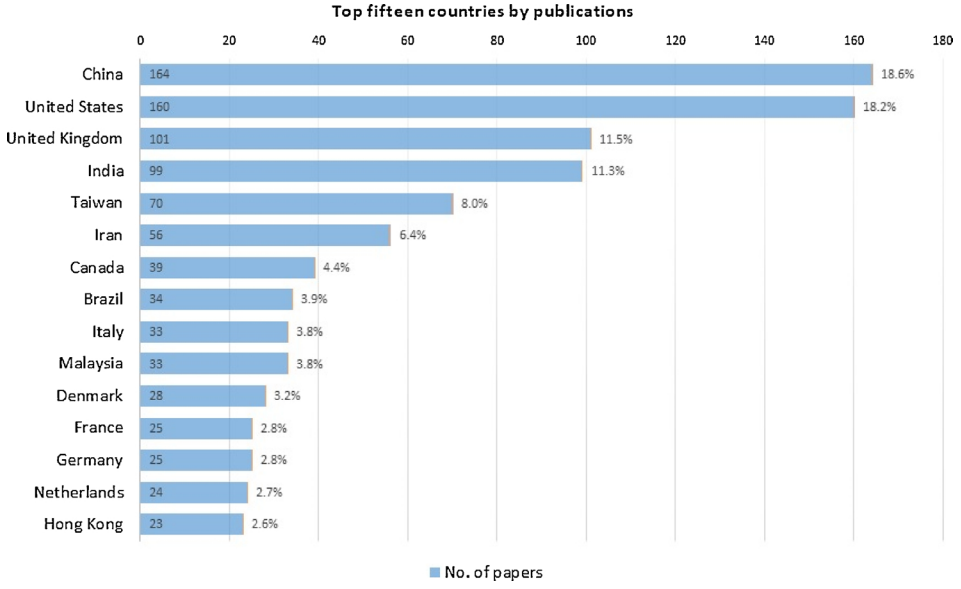

Fig. 5. Top fifteen countries that contributed to GSCM literature.

Fig. 6. Word cloud for most common words in GSCM publications.

definitions. Fig. 9 shows how the word 'environment' placed in the construction of sentences while defining GSCM. Some examples of these phrases are 'integration of sound environmental concern,' 'integrating environmental dimension of sustainability,', ' 'the integration of environmental issues,' and so on. Thus, it is clear from the word tree and frequency analysis that most of the prior definitions focused on environmental concern while referring to GSCM.

Moreover, Zhu et al. (2008b) maintain that the network of GSCM encompassing suppliers through manufacturers, and then to customers, would finally closing the loop (reverse logistics) by the logistics service provider with the help of a customer. In the supply chain network, GSCM suppliers are one of the influential players in the upstream integration of the supply chain and play a vital role. On the other side, customers are also a vital player in the downstream integration of GSCM network and can collaborate with the companies for minimizing the adverse environmental effect. Additionally, Tseng et al. (2017) argued that there is a need to view the supply chain practices from the associated partners of supply chain network such as customers, suppliers, logistics service providers, and manufacturers in order to pursue environmental performance. Therefore, based on the discussion above and keeping the central theme into consideration, “GSCM can be defined as the integration of environmental management system into the supply chain process including collaboration with customers, suppliers, and logistics service providers to share information and knowledge with an aim to improve environmental performance.” The definition presented here integrates supply chain partners such as suppliers, customers, and logistics service providers with the focal firms. Additionally, this definition emphasize that manufacturers should collaborate with the suppliers, customers, and logistics service providers to share information and knowledge to improve environmental performance.

As part of the evolution of GSCM concept, prior studies discussed the relationship of 'supply chain' and 'environmental issues.' For example, Hill (1997) discussed how firms could face environmental pressure by integrating environmental issues into a supply chain network. After that, several studies refer to that concept as GSCM. The central idea is the same –integrating environmental issues into a supply chain network. Sarkis (2003) developed a strategic decision framework incorporating components and elements of GSCM to show how the framework acts as a foundation for the strategic decision. As a result, Klassen and Vachon (2003) came up with the idea of collaboration with

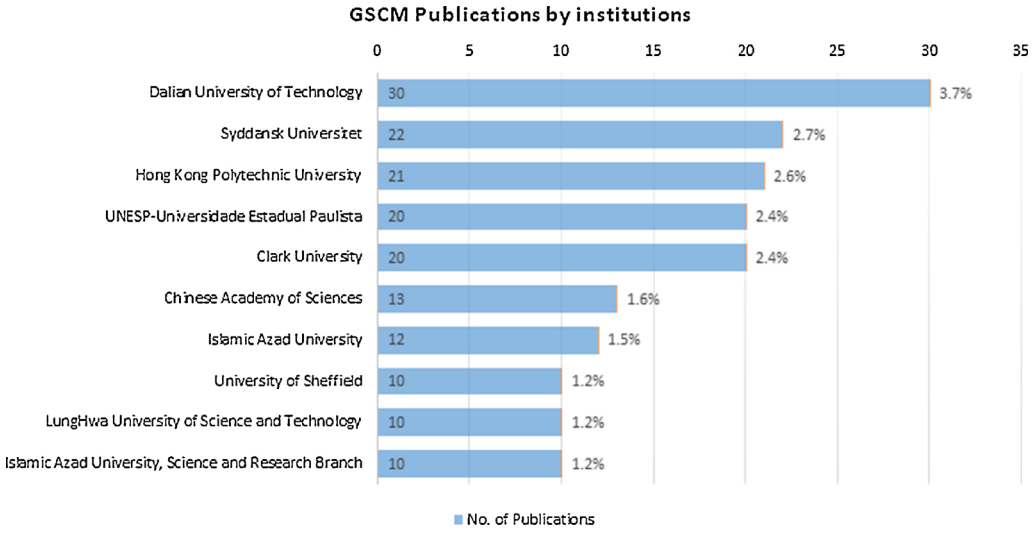

Fig. 7. Top ten institutions by publications.

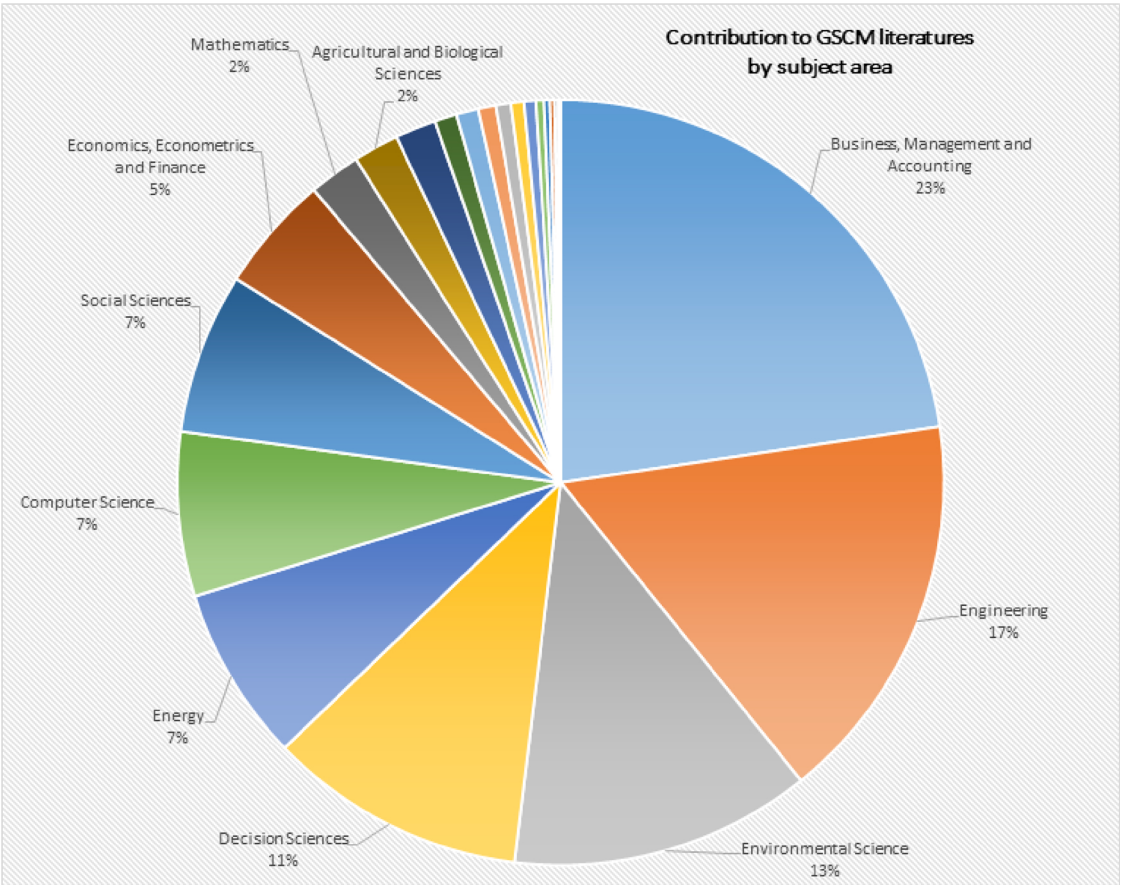

Fig. 8. Contributions of GSCM papers by subject area.

Table 7
The most frequent words used in the definition.
Source: Author own research.

Words	Numbers	Words	Numbers
Environmental	16	Green	8
Product	16	Material	7
Management	14	Integrate	7
Chain	13	Manufacturing	6
Supply	12	Life	6

customers to prevent pollution aspect in the supply chain network.

Following that, Zhu et al. (2007) study the pressure, practices, and performance, and the study finds that there is a positive relationship between pressure and practices as well as a positive relationship with practices and environmental performance. Moreover, Sarkis et al. (2011) further explain the existing literature under different organizational theories to show how the concept of GSCM can be explained with established theories and how the existing body of knowledge could be extended further. Rajabian Tabesh et al. (2016) then develops a framework to show how innovations affect GSCM performance. Finally,

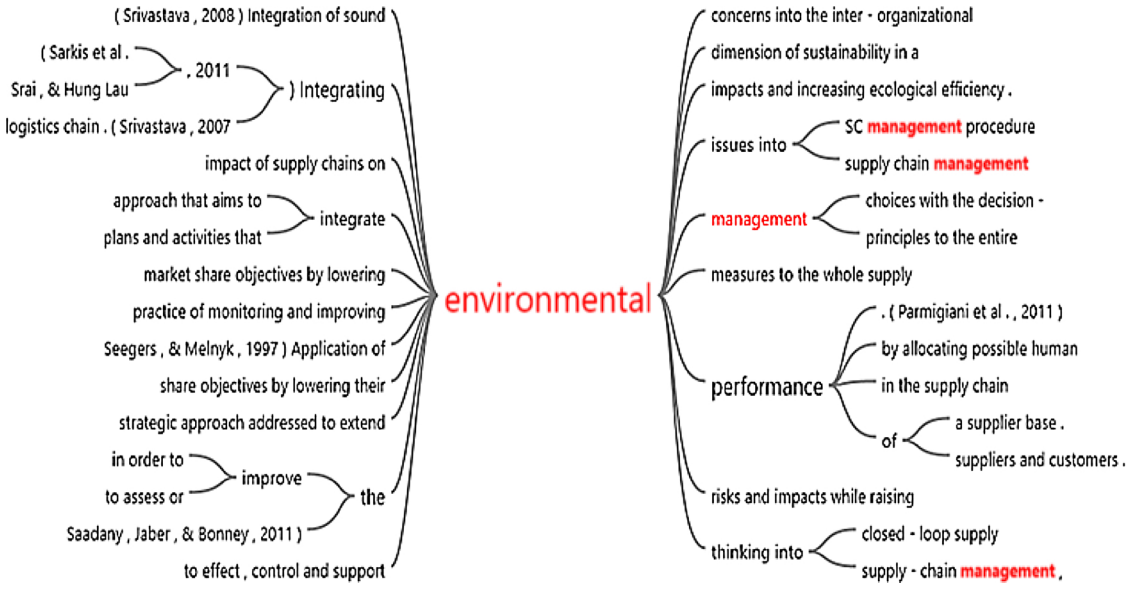

Fig. 9. The placement of the word "environment" in the definitions.

Roehrich et al. (2017) contribute to the GSCM literature to consider the importance of the first-tier-second-tier relationship which is different from the traditional concept of buyer-supplier relationships. Thus, it can be concluded that the evolution of the conceptual development of GSCM literature has incorporated many past contributors, and the studies related to the conceptual development of GSCM are growing. Table 8 reveals a consistent growing in this area which indicates that new sub-disciplines or branches of GSCM are still emerging.

4.2.2. Drivers and barriers

This section classifies the papers which are related to drivers and barriers in the implementation process of GSCM. Drivers or pressures are the factors whose existence drives firms implementing GSCM practices, such as regulatory pressure and stakeholders pressure. On the other hand, barriers are the factors whose existence hampers implementing the GSCM such as high cost, risk, complexities and many more. Successful implementation of GSCM is strongly motivated by drivers (Diabat and Govindan, 2011). Zhu and Sarkis (2007) find that the presence of driving forces including regulative and market pressure influence firms to adopt GSCM in pursuit of environmental performance. Meanwhile, Walker et al. (2008) identify several internal and external drivers including organizational factors, suppliers' environmental compliance requirements, regulation, customers, competitors, and society that drives SME in the adoption of GSCM. S. Moreover, Huang et al. (2017) study define the internal and external factors stimulating firms to adopt GSCM in Taiwan and found that institutional pressures including regulatory, customer awareness and competitive pressure (GSCM adoption by competitors) drive firms adopting GSCM.

In contrast, there are some barriers that hinder the implementation process of GSCM. Dube and Gawande (2016) studies the barrier analysis in GSCM and found that the lack of top management commitment and support, lack of training in GSCM, resistance to adoption of advanced technology, and financial constraints, are some of the important barriers that hinder successful implementation of GSCM. Srivastava (2007) narrates that lack of government support does not influence firms in adopting GSCM. Additionally, Walker et al. (2008) find that several internal and external barriers are hindering the implementation of GSCM. The internal organizational barriers include cost and lack of legitimacy, while external barriers cover poor supplier commitment, regulation, and industry-specific barriers. In another study, Govindan et al. (2014) identify 47 barriers in the Indian context, and among them are technological, outsourcing, financial, knowledge, and support from the stakeholders, which found to be the most influential barriers. In short, successful implementation of GSCM, is motivated, as well as hindered, by several internal and external drivers and barriers. Table 8 presents that the number of studies related to the drivers and barriers in GSCM has been declining which indicates drivers and barriers analysis is seemed to reach its maturity stage. Nevertheless, new drivers and barriers still are under researched in new contexts. Moreover, this area still occupies a significant number of papers in the extant literature.

Table 8
Classification of the 236 papers based on five categories.

Year	Concept	Drivers/ Barriers	Collaboration	Math. Model	Assessment	Total
2017	11	5	8	14	9	**47**
2016	8	7	10	8	7	**40**
2015	7	6	5	7	6	**31**
2014	5	4	5	5	7	**26**
2013	5	5	5	4	7	**26**
2012	5	4	5	5	7	**26**
2011	2	3	2	1	4	**12**
2010	1	2	1	0	2	**6**
2009	1	1	0	1	0	**3**
2008	3	1	0	1	2	**7**
2007	1	1	1	0	2	**5**
2006	0	1	0	0	1	**2**
2005	0	0	0	1	1	**2**
2004	1	1	0	0	0	**2**
2003	1	0	0	0	0	**1**
Total	**51**	**42**	**41**	**47**	**55**	**236**

4.2.3. Collaboration with supply chain partners

Many papers in the GSCM literatures discusses the improvement of environmental performance through the collaboration of supply chain partners, which includes suppliers (Bai and Sarkis, 2010; Rostamzadeh et al., 2015; Tseng, 2011), customers (Chavez et al., 2016; de Sousa Jabbour et al., 2017; Zhu et al., 2017), and logistics service providers (Ameknassi et al., 2016; Entezaminia et al., 2017; Sheu et al., 2005). This section classifies the papers which address the importance of collaboration with supply chain partners, as well as the selection process of partners while considering environmental criteria.

Tseng (2011) explains that the selection of suitable suppliers according to GSCM criteria is crucial for the firms in combating pollution and environmental pressure. Rostamzadeh et al. (2015) evaluated the

performance of GSCM and presented a hierarchical model to select the best partners based on GSCM criteria. Bai and Sarkis (2010) argue that suitable supplier selection plays a crucial role in GSCM while presenting a decision support tool in selecting best suppliers according to environmental criteria. Thus, it can be said that according to many researchers, collaboration with suppliers plays a crucial role in the successful implementation of GSCM.

In the meantime, de Sousa Jabbour et al. (2017) finds that cooperation with the customer has superior economic and environmental performance as compared to green purchasing. Zhu et al. (2017) also say that cooperation with the customer is necessary to improve economic and environmental performance. Additionally, Chavez et al. (2016) emphasize on the cooperation with customers to enhance environmental performance. Thus, collaboration with the customer also has a significant positive impact on the improvement of economic and environmental performance.

Finally, logistics service providers play crucial roles in both upstream and downstream in the supply chain management. Logistics build the tie between suppliers and focal firms as well as between customers and focal firms. Thus, the efficiency of GSCM largely depends on the actions of logistics companies. Sheu et al. (2005) argue that an integrated logistics systems help firms achieve superior performance. Ameknassi et al. (2016) emphasizes on logistics operation in GSCM and found that cooperation with logistics companies can improve environmental performance through minimizing Green House Gas (GHG) emissions. Entezaminia et al. (2017) find that waste management and greenhouse gas emissions can be monitored effectively using reverse logistics system.

Table 8 presents that the studies related to the collaboration with supply chain partners seems to be increasing. The papers related to the collaboration emphasize the improved relationship with the suppliers, customers, and logistics service providers so that they can mutually achieve environmental goals. Thus, the successful implementation of GSCM by the focal firms is also dependent on the successful integration and collaboration with supply chain partners. In summary, the existing literature has given tremendous importance on the collaboration with supply chain partners to improve environmental and economic performance.

4.2.4. Presentation of mathematical and other optimization models

Many studies in the GSCM literature proposes different models to identify problems, monitor phenomenon, and prescribe solutions. Fazli-Khalaf et al. (2017) present a scenario-based stochastic programming approach to control emission and pollution aspect of the firms effectively. Hariga et al. (2017) propose mathematical models which can minimize carbon emission, minimize operational cost and minimize environmental pollution aspect. Jindal and Sangwan (2017) offer a mathematical model for improving economic and environmental performance which works under fuzzy environment and can handle multi-objectives. Nurjanni et al. (2017) present a multi-objective optimization mathematical model to reduce cost and minimize environmental pollution through a trade-off between financial and environmental issues.

It is interesting to see from the Table 8 that the papers related to mathematical and other optimization model seemed to be increasing exponentially. Much of these papers emphasize on improving environmental and economic performance through strategic decision-making process based on mathematical models. Since the GSCM discipline is growing and the practitioners adopted the GSCP, more and more complicated relationship exists among supply chain partners. Therefore, optimization models emerged as part of helping practitioners solving real-life problems related to supply chain network and it hasbecome an integral part of GSCM literature.

4.2.5. Assessment/Evaluation of GSCM practices and performance

This section classifies the papers which address identifications and assessment of green supply chain practices (GSCP), as well as an assessment of performance. Additionally, the papers which discuss the relationship between practices and performance are also included in this subsection. The literature suggests that the practices of GSCM help firms achieve superior performance. Zhu and Sarkis (2004) find that several GSCM practices including eco-design, internal management support, collaboration with suppliers and customers positively influence the environmental performance of the firm. Moreover, Tseng et al. (2015) state that implementation of GSCM help firms reduces hazardous material thereby improve environmental performance. Additionally, Rao and Holt (2005) find that the adoption of GSCM practices comprised of reverse logistics, product recovery and reuse of the product, collaboration with suppliers and customers, and green purchasing and green design, would have a significant impact on the environmental and economic performance.

Huang et al. (2017) classif the performance, achieved as a result of adopting GSCM, into three categories, which includes environmental performance, economic performance, operational performance, and competitiveness. Several items can measure economic performance, including cost saving, new market opportunities, and profitability (Green et al., 2012; Zhao et al., 2016). On the other hand, environmental performance is measured by pollution prevention, waste minimization or by merely measuring environmental performance items (Tseng and Chiu, 2013; Zhu et al., 2012). Finally, operational performance and competitiveness are measured by efficiency, quality, productivity, etc. (Chavez et al., 2016; Green et al., 2012). The indicators for these performances are further detailed out in Table 9.

Different methodologies have been used in the literature to evaluate these performances (Dubey et al., 2015; Govindan et al., 2015b). Examples of these methods are; the fuzzy set theory, fuzzy DEMATEL (decision-making trial and evaluation laboratory), fuzzy AHP (Analytic hierarchy process), fuzzy ANP (analytic network process), SEM (structural equation modeling), ANOVA (analysis of variance), GRA (grey relational analysis), TOPSIS (technique for order preference by similarity ideal solution), interpretive structural modelling (ISM), and VIKOR(Vlsekriterijumska Optimizacija I Kompromisno Resenje). Table 8 reveals that the papers related to the evaluation or assessment of GSCM practices and GSCM performance GSCM outnumbered other categories. Moreover, it shows that number of papers are also growing in each year which indicate that the assessment of GSCM practices and performance become essential to pursue environmental performance.

Table 8 presents the classifications of 236 papers along with the year of publications. Table 8 shows that the papers are almost equally distributed to all categories and each year number of publications is increasing. When studies related to assessment/evaluation of GSCM practices and performance is dominating on the other hand studies related to the development of mathematical optimization models are increasing exponentially. Moreover, mathematical modeling and collaboration got more attention after 2010. Overall, the literature on GSCM is still growing consistently as observed from the literature.

4.2.5.1. Green supply chain practices (GSCP). Thoughts vs. actions: GSCM is the concept, whereas GSCP is the action. These actions translate the thoughts into practices. There are many GSCP that can be found in the literature. For example, Tseng et al. (2015) narrate that GSCP involves collaboration with suppliers to reduce hazardous materials. Zhu and Sarkis (2004) maintain that GSCP includes internal management support, collaboration with customers and suppliers, eco-design and investment recovery. Rao and Holt (2005) maintain that collaboration with suppliers and customers, reverse logistics, green purchasing, green design, and product recovery and reuse of used products represent as GSCP. Hence, GSCP is defined as diversely in the literature, and many of them are industry-specific. Nevertheless, it can be performed through various initiatives and actions (Rao and Holt, 2005); (Srivastava, 2007). Many studies discuss GSCP based on aspects such as green design, green manufacturing, and green purchasing (Kusi-Sarpong et al., 2016; Rostamzadeh et al., 2015; Tseng et al., 2013). Thus, the list of GSCP can be presented based on aspects and practices together. The

Table 9
List of drivers, practices and performance indicators.

Drivers	Barriers	Practices	Performances	Collaboration
INTERNAL	INTERNAL	Recycle and reuse	ECONOMIC	Internal and external collaboration is essential to adopt following GSCP
Branding of firms' green image	Lack of Environmental Knowledge	Reverse logistics	Cost saving	INTERNAL
Presence of ethical leadership	Lack of awareness	Industrial symbiosis (a mutual collaboration between firms within industries)	New market opportunities	Having environment friendly mission statement
ISO 14000 compliance requirement	Cost of switching to a new system	Eco-innovation practices	Profit margin	Pursue environmental award systems
Environmental awareness among members of the organization	The cost associated with eco-design	Green information technology and systems	Increased sales	Environmental compliance auditing
Resource efficiency through reducing cost, waste, water use as well as recycling	Financial constraints	Green design or eco-design	Market share	Pursue in ISO 14001 certification
EXTERNAL	Lack of involvement of top management	Carbon management	Net income	Share waste treatment plants
Regulatory pressure from the government, and other local and international environmental groups and agencies	Lack of Inter-departmental co-operation	Environmental collaboration with supplier	Positive economic performance	Recycle waste
Increased awareness of supply chain partners including buyers, suppliers, and logistics service providers	Lack of control on partners' operations.	Environmental collaboration with the customer	Cost of goods sold (COGS)	Avoid hazardous materials
Competitive pressure due to the adoption of GSCP by competitors	Fear of failure	Environmental collaboration with logistics service providers	Overall business performance	Generating minimum waste
EMS's requirements by supply chain partners	Lack of eco-technology	Adoption of EMS including ISO 14001 certification	Low cost to the customer	Design for recycling water
	EXTERNAL	Internal management	ENVIRONMENTAL	Returnable, reused, and recyclable packaging
	Lack of government support	Green purchasing/ procurement	Environmental performance	Use of energy efficient hardware and data center
	Lack of proper training/reward for suppliers	Green manufacturing	Waste minimization	Use of eco-labeling of information technology hardware
	Lack of awareness among supply chain partners	Green packaging	Pollution prevention	Buying environmentally-friendly raw materials
	Market competition and uncertainty	Green warehousing	OPERATIONAL	EXTERNAL
	Poor commitment from partners		Improved efficiency	Share environmental knowledge with suppliers
	Lack of support and guidance from regulatory authorities		Quality improvement	Choosing green suppliers
			Productivity improvement	Suppliers avoid hazardous elements
			Delivery	Suppliers save energy and minimize waste
			Flexibility	Suppliers use eco-friendly transportation
			Operational performance	Suppliers have eco-friendly mission
			Lead time	Suppliers control carbon emissions
				Monitor environmental compliance status of supplier's operations
				Working with customers for eco innovations
				Build network with customers for reverse logistics
				Share voluntary environmental information with customers
				Cooperate with logistics to minimize environmental impact
				Proper logistics integration to take back end-of-life items from customers
				Ensure community health and safety concerns in logistics
				Logistics use green fuels to minimize emission

comprehensive lists of GSCM aspects and green practices can be viewed in (Table B1 in Appendix B).

Many prior studies evaluate the GSCM performance based of GSCP attributes/criteria. For example, Kusi-Sarpong et al. (2016) evaluate environmental performance using GSCP criteria in the mining industry of Ghana and found that there is a positive association between the supplier collaborations and firms' sustainable objectives. Rostamzadeh et al. (2015) use Fuzzy VIKOR method to assess GSCP in laptop manufacturer in Malaysia to identify the best green supplier. Additionally, Stephan and Robert, (2006) evaluate GSCP and found that technology integration is necessary to collaborate with customers and suppliers to minimize environmental impact efficiently. Rostamzadeh et al. (2015) present the list of GSCP criteria used in prior studies. Based on this list of criteria, the study intends to explore further insights on the GSCP criteria. The study uses Nvivo 10 software to identify the most frequent words (limited to first 50 words) in the GSCP criteria used in past studies. The current study conducted word cluster (see Fig. 10) analysis and reveals that the word 'green' is the most frequent word, followed by the words 'environmental' then 'management' and so on. Therefore, based on this analysis, the central idea of assessing GSCP and performance had to be around 'green' and 'environmental' concern.

4.2.6. A conceptual framework for GSCM

Fig. 11 presents the comprehensive framework which encompasses drivers, practices, and performance. Drivers are the stimulator that motivates or sometimes forces focal firms to adopt the GSCP. Lee (2008) finds that the government's regulations are one of the driving factors motivating firms to adopt GSCP. Similarly, other drivers mentioned in Table 9 positively influence the firms to adopt GSCP. A stronger presence of the drivers results in a quicker adoption of GSCP because the inability to respond to the driving force timely might result in a threat to the existence of the firms. In contrast, there are barriers that exist which hinder the implementation process of GSCM. It can be concluded that the stronger the presence of these barriers, the poorer the implementation level of GSCM.

The GSCP is the action firms perform on a daily basis as part of the adherence of GSCM. To practice these GSCP successfully, firms need to collaborate with supply chain partners including suppliers, customers, and logistics service providers. Suppliers play a vital role in the upstream supply chain and contribute to achieving firm's environmental goal. Thus, the firm needs to collaborate with the supply chain partners for a successful implementation of GSCP. On the other hand, customers also play a significant role in the downstream supply chain, and a firm's profitability is largely dependent on their customers. However, firms need to collaborate with their customers and share environmental information to minimize environmental degradation.

Between suppliers and customers, there are logistics service providers that also plays a crucial role in maintaining the supply chain network from upstream to downstream. The actions and behavior of the logistics firms may have adverse consequences on the environment. Thus, there is a need to collaborate with logistics service partners in successfully implementing GSCP. Finally, once the firms successfully implement GSCP, it can expect superior performance. The performance can be seen as improved environmental performance, improved economic performance, improved operational performance and improved competitiveness.

Fig. 11 shows that drivers are influencing the focal firms to adopt GSCP. Green arrows represent the positive relationship between drivers and GSCP. Similarly, the successful implementation of GSCP leading to firms' improved performance that is indicated by another green arrow. The orange lightening symbol indicates the adverse impact of barriers to the implementation of GSCP. The smaller arrows represent the integrated network of upstream and downstream partners with focal firms. The dashed lines indicate the necessity of internal and external collaboration to help firms adopting GSCP (Zhu et al., 2008a). Internal collaboration is necessary within firm's departments and functional areas as well as external collaboration is also required among supply chain partners. Although there are multiple layers may exist in reality besides logistics alone in the upstream and downstream network. For example, multiple suppliers may exist (first tire, second tire, etc.) in the upstream supply chain network besides logistics alone. Similarly, multiple distributors may also exist besides logistics in the downstream network as well. In order to keep the framework simple, the study limits the network to logistics.

Moreover, the study does not incorporate all the items into this framework for the same purpose.However, Table 9 presents the accumulated lists of drivers, barriers, aspects of practices and performance measurement indicators being used in the framework. All of the GSCP had been discussed based on different aspects of the literature. Thus, for further clarification, the lists of aspects and their relevant practices along with the references can be refered to (Table B1 in Appendix B). Thus, this framework is also a contribution to the GSCM literature.

5. Conclusions and future research potentials

Due to the rise of global warming and change in biodiversity, there is an increased pressure on firms to improve environmental performance. Moreover, there is an increased environmental awareness among the stakeholders which stimulates the firms to minimize negative environmental impact of firms' operations. Much of the environmental degradation happens through the supply chain network of the firms. Thus, attention should be given to supply chain network to combat environmental degradation. GSCM is an emerging concept which integrates environmental issues into the supply chain activities of the firms. Although the idea of responding to environmental issues by

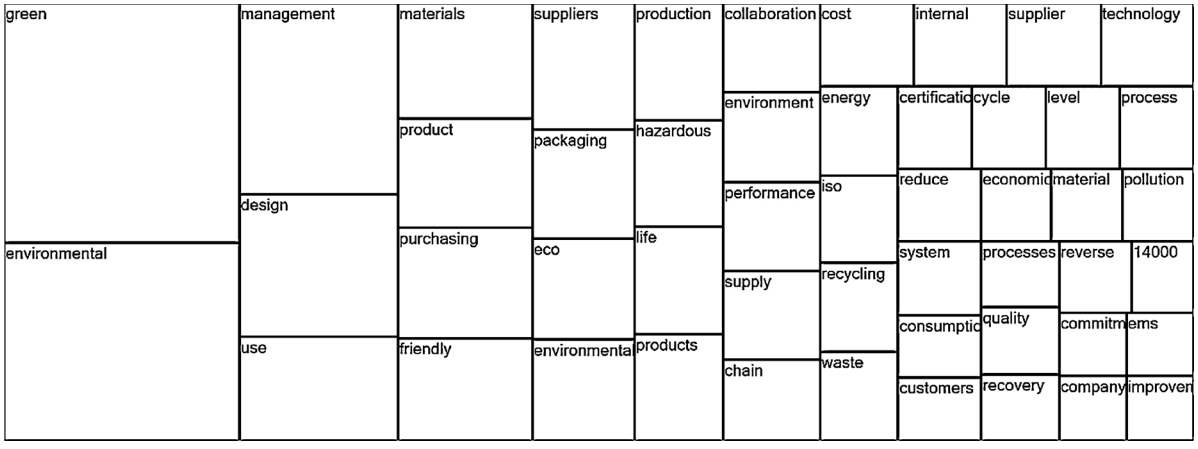

Fig. 10. The word cluster presenting the most frequently used words in the past GSCP.

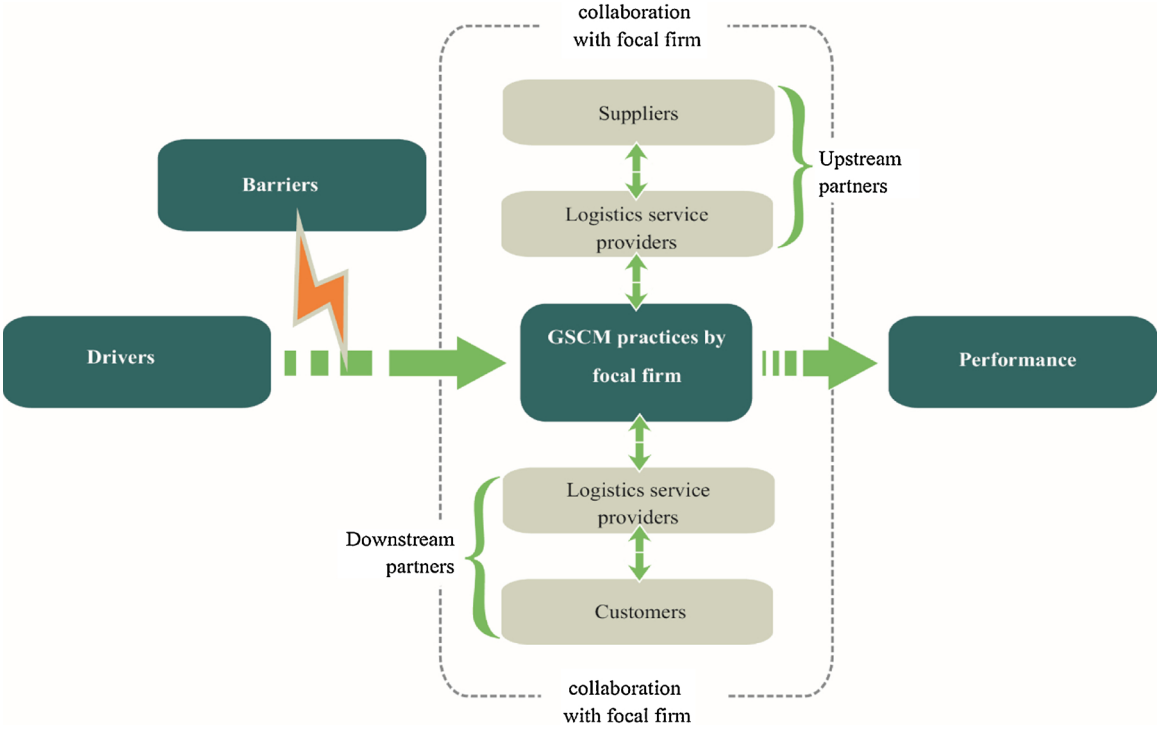

Fig. 11. A GSCM framework.

the firms is not new, however, the concept of GSCM had been gaining popularity from the beginning of the 20th Century. In line with this notion, this study finds that the GSCM discipline is still growing rapidly.

The paper begins with the concept of GSCM followed by the methodology in reviewing the extant literature. This paper reviews the literature of GSCM systematically and presents descriptive analysis based on metadata analysis as well as presents insights based on content analysis. The data has been collected from reliable databases. Metadata analysis reveals influential authors, popular journals, publications by year, top contributing countries, institutions, and disciplines. This study reveals that Sarkis and Zhu are the most influential authors in GSCM area about a number of publications and citations. Moreover, Journal of Cleaner Production found to be the most popular journals regarding its: impact and number of papers it publishes in this area. The study also reveals that both China and America are dominating this discipline in terms of their impact and number of publications. Additionally, the study finds that the business management discipline is holding a large share in the literature of GSCM.

Next, the study presents insights based on shortlisted papers derived from ISI Web of Science. The insights have been presented based on content analysis. The content analysis comprises the classifications of five categories under which all shortlisted papers have been categorized. The categories consist of conceptual and theory development, drivers and barriers, collaboration with supply chain partners, presentation of mathematical and other optimization models, and assessment/evaluation of GSCM practices and performances. The content analysis reveals that papers related to the conceptual development are still rising which indicates that authors are still developing the concept of GSCM and more and more sub-disciplines or branches are emerging. In contrast, papers related to drivers and barriers shows that the number of papers is not increasing as compar with other categories which indicates the study on the drivers and barriers in GSCM has reached to a maturity level.

The study further reveals that the importance of collaboration with supply chain partners to improve environmental performance has gathered much attention by contemporary researchers. Studies maintain that collaboration with suppliers, customers and logistics service providers is necessary to share environmental information, minimize pollution aspects and mutually achieve environmental goals. Moreover, the study reveals that there is an increasing number of papers in recent years on various mathematical optimization models to enhance decision making in pursuit of GSCM. Since new sub disciplines and branches are emerging thus, firms are facing new challenges. Application of mathematical models is most likely focusing on solving emerging challenges. Additionally, consistent work had been observed through the time frame on the assessment of GSCP and GSCM performance. Finally, the paper presents a comprehensive but straightforward conceptual framework based on the content analysis.

The paper has many contributions. First, it maintains an objective or unbiased approach in collecting the data. Thus a significant difference is being observed in the result between the current study and prior studies. In the metadata analysis, the top ten authors, top ten institutions of the current study is quite different from the result presented by Fahimnia et al. (2015). For example, K. Govindan could find a room in the top ten list of authors, nor his institution appeared in the top ten list. These differences might be due to the definitional differences or due to the adoption of different methodological approaches by prior studies. Moreover, a couple of categories in the classification of the literature are different from prior studies that offer readers the new avenues of looking at the literature to view and study. Second, the study presents an integrated definition of GSCM in Section 4.2.1. Third, the study presents a comprehensive conceptual framework of GSCM.

The study has some limitations. Firstly, since the study collected its data from Scopus and ISI Web of Science databases, these databases do not include all of the journals. Thus, many papers have been excluded which may potentially raise the concern of generalizability. Secondly, the study collected its data from the objective point of view through keyword search and did not go through a subjective overview for screening and shorlisting. Although screening the data by subjective judgment sometimes are usefulhowever, this approach may potentially lead to biasresults. Finally, the study confines itself to metadata analysis and content analysis to make it easy to understand for the general readers. Future studies may employ different citations and network analytic software to perform further analysis.

As for direction for future research, few papers in the literature explains the GSCM based on the upstream and downstream supply chain, while others study the GSCM based on the inbound and outbound supply chain. However, there is a lack of studies in the literature that investigates GSCM based on the viewpoint of partners associated with a supply chain network, which include suppliers, customers, logistics and manufacturer point of view. In the literature Tseng et al. (2017) also emphasizes on the assessment and evaluation of GSCP and GSCM performance based on the viewpoint of supply chain partners. There is also a lack of research on big data. Only a few papers consider big data for evaluating GSCM performance. Additionally, a vast number of papers in the literature collects data from respondents using perceptions, either in quantitative (Likert scales) or qualitative scale (Fuzzy). Comparatively, not so many studies employ real-life data, which would be an exciting piece of work if it gets published.

There were few studies attempting to conduct the inter-sectoral comparative study. For example, Zhu and Sarkis (2006) conduct the study on the electrical vs. automotive industry, with results suggesting a need to do more such work in the future in other countries. Additionally, intercontinental or comparative studies between countries are also scarce in the literature. Even though few studies collect data from different countries, the presentation of the comparative result was lacking (Rao and Holt, 2005). This sparks the potential for future research; to study the relationship between GSCP and performance in different countries and present a comparative picture.

Few papers try to address the theoretical underpinnings of GSCP and performance. Nevertheless, a significant number of influential papers in the GSCP literature lacks sound theoretical support when it comes to the assessment of the relationship between drivers, practices, and performance. When the framework is designed to study the relationship between GSCP and performance using SEM or other tools, it is suggested to support the research model by established theories (Seuring and Müller, 2008). Even so, it would be interesting to see such a contribution in the future works.

Moreover, most of the studies consider big firms as sample pool to collect their data. It is true that in the beginning, we need to make sure big firms adopt the GSCP firsthand so that smaller firms will start to follow. There is a notion that smaller firms follow the standards of big firms. As the concept of GSCM is growing and big firms already adopt GSCP, it is now necessary to see the impact of implementation on small firms. Smaller firms must be considered and jointly engaged in environmental protection so that they can be motivated and contribute to greater sustainability process.

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Appendix A

Table A1
List of GSCM Definitions.
Source: Ahi and Searcy (2013)

Sources	Definition
Handfield et al. (1997)	Application of environmental management principles to the entire set of activities across the whole customer order cycle, including design, procurement, manufacturing and assembly, packaging, logistics, and distribution.
Zhu et al. (2005)	An important new archetype for enterprises to achieve profit and market share objectives by lowering their environmental risks and impacts while raising their ecological efficiency.
Hervani et al. (2005)	Green Purchasing + Green Manufacturing/Materials Management + Green Distribution/Marketing + Reverse Logistics
Sheu et al. (2005)	Combination of both the product manufacturing supply chain and used-product reverse logistics chain.
Srivastava (2007)	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 end-of-life management of the product after its useful life.
H'Mida and Lakhal, (2007)	The practice of monitoring and improving environmental performance in the supply chain during a product's life cycle.
Y. Lakhal et al. (2007)	Olympic green supply chain characterized by five-circled flag of the Olympics as zero emissions, zero waste in activities, zero waste of resources, zero use of toxic substances, zero waste in product life-cycle, in addition to green inputs and green outputs.
Srivastava (2008)	Integration of sound environmental management choices with the decision-makingprocess for the conversion of resources into usable products.
Lee and Klassen (2008)	A buying organization's plans and activities that integrate environmental issues into supply chain management in order to improve the environmental performance of suppliers and customers.
Albino et al. (2009)	A strategic approach addressed to extend environmental measures to the whole supply chain.
Wee et al. (2011)	Integration of environment considerations into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the greening products.
Gavronski et al. (2011)	The complex of mechanisms implemented at the corporate and plant level to assess or improve the environmental performance of a supplier base.
Lorentz et al. (2011)	Integrating environmental thinking into closed-loop supply chain management.
El Saadany et al. (2011)	Reducing energy and virgin raw material usage and waste generation, and increasing product recovery options. Greening usually refers to the forward supply chain functions such as production, purchasing, materials management, warehousing and inventory control, distribution, shipping, and transport logistics.
Guiffrida et al. (2011)	The environmental dimension of sustainability in a supply chain context.
Wu and Pagell (2011)	An approach that aims to integrate environmental issues into SC management procedure starting from product design, and continuing through material sourcing and selection, manufacturing processes, the final product delivery and end-of-life management.
Yeh and Chuang (2011)	Management between suppliers, their products and environment, that is to say, the environment protection principle is brought into suppliers' management system. Its purpose is to add environment protection consciousness into original products and to improve competitive capacity in markets.
Bansal and Roth (2000) and Sarkis et al. (2011)	Integrating environmental concerns into the inter-organizational practices of SCM including reverse logistics.
Kim et al. (2011)	A set of practices intended to effect, control and support environmental performance by allocating possible human material resources and redefining organizational responsibilities and procedures.
Parmigiani et al. (2011)	The impact of supply chains on environmental performance.
Parmigiani et al. (2011)	A way for firms to achieve profit and market share objectives by lowering environmental impacts and increasing ecological efficiency.
Andiç et al. (2012)	Minimizing and preferably eliminating the negative effects of the supply chain on the environment.

Appendix B

Table B1
Summary Table for Aspects and Practices.
Source: (Islam et al., 2017)

GSCM aspects	Practices	Sources
Reverse Logistics	Recovery of the company's end-of-life items. Resale or reuse of used parts or components. Old/obsolete items being used or replaced. Recondition and refurbishing of used parts or components.	Büyüközkan and Çifçi (2012); Govindan et al. (2015a); Tseng and Chiu (2013), 2012
Industrial Symbiosis	Sharing waste treatment plants. Helping suppliers to establish their own environmental management system(EMS). Use of waste of other companies.	Puente et al. (2015); Mahmood et al. (2013); Tseng and Chiu (2012); Berlina et al. (2016); Tseng and Bui (2016), (Albu, 2017)
Eco-Innovation Practices	Substituting toxic inputs with environmentally friendly ones. Switching from "dirty" to cleaner technologies. Internal recycling of wastes.	(Crum et al. (2011); Rao and Holt (2005)
Green **Information Technology and Systems**	Use of energy efficient hardware and data centers. Consolidating servers using virtualization software. Reducing waste associated with obsolete equipment. Tele-presence systems. Collaborative group software. Eco-labeling of IT products.	Boudreau et al. (2008); Jenkin et al. (2011); Setterstrom (2008); Standing et al. (2008); Uddin and Rahman (2012)
Green Design	Design of products for reduced consumption of materials/energy. Intend to reduce products' negative effects on the environment during its entire life cycle. Design of products for reuse, recycle, recovery of materials, component parts. Design the products to be easily set up for the users in the most energy saving ways. Design for reduction of environmentally hazardous substances, design for recycling waste and design for remanufacturing aimed at returning it to a better condition.	Arena et al. (2003); Beamon (1999); Zhu et al. (2007); Eltayeb et al. (2011); Lin (2013); Sarkis (1998); Tseng and Chiu (2012); Fiksel and Fiksel (1996); Gungor and Gupta (1999)
Carbon Management	Carbon reduction targets. Training related to carbon management. Emphasized supplier engagement to announce greenhouse gas emissions and set up reduction objects to manage their carbon emissions.	Govindan et al. (2015a); Hsu et al. (2013); Lee (2011)
Supplier Environmental Collaboration	Collaborate with suppliers to build programs to reduce or eliminate waste. Share environmental management techniques and knowledge. Monitor environmental compliance status and practices of supplier's operations. Collaborate with suppliers to manage reverse flows of materials and packaging. Communicate goals of sustainability to suppliers.	Vachon and Klassen (2006), 2008; Gunasekaran et al. (2008)
Customer Environmental Collaboration	Collaborate with customer to develop environmental management solutions. Collaborate with customer to manage reverse flows of materials and packaging.	Lin (2013); Azevedo et al. (2011)
ISO 14001 Certification	Participating in environmental certification such as ISO 14001 certificate.	Nawrocka et al. (2009); Robèrt (2000); ISO (2010); Prajogo et al. (2012)
Internal Management	Environmental compliance monitoring and auditing. Total quality environment management. Pollution prevention plans. Environmental manager and training for employees. Employee incentive programs for environmental suggestions.	Olugu et al. (2011); Rao and Holt (2005); Tsoulfas and Pappis (2008); Zhu and Sarkis (2004)
Green Purchasing	Choice of suppliers by considering the environmental criteria. Buying environment-friendly raw materials. Pressuring supplier(s) to take environmental actions.	Carter and Ellram (1998); Yang et al. (2013); Kannan et al. (2014)
Green Manufacturing	Generate minimum waste, and reduce environmental pollution. Re-manufacturing and lean production. Cleaner production. Improved capacity utilization. Lower raw material costs, gain production efficiency, and improve their corporate image. Increase amount of goods delivered on time. Does not use hazardous or restricted materials during manufacturing and minimize waste during production.	Van Hoek (1999); Tseng and Chiu (2012), 2013; Zhu and Sarkis (2007)
Green Packaging	Environmentally friendly packaging (Eco-packaging). Returnable packaging, reused packaging, recyclable packaging.	González-Torre et al. (2004); Wu and Dunn (1995)

(*continued on next page*)

Table B1 (*continued*)

GSCM aspects	Practices	Sources
Green Logistics	Environmentally friendly transportation. Environment-friendly distribution. Using green fuels such as low sulfur content and alternative fuels such as liquid natural gas. Community/environmental, employee health and safety concerns while transportation.	Enarsson (1998); Salimifard et al. (2012); Murphy and Poist (2000)
Green Outsourcing	Care environmental responsibility in global outsourcing. Display environmental-friendly culture to all outsourcing stakeholders.	Babin and Nicholson (2011); Brown (2008); Tseng et al. (2011).
Green Warehousing	Decrease inventory levels. Investment recovery (IR) (sale) of excess inventories/materials. Sale of excess capital equipment.	Zhu et al. (2008b)

Note: Few scholars highlighted recycle and reuse as another aspect, but it has correlation with green production and reverse logistics. Therefore, the two aspects were rather included in green practices. Additionally, “green transportation” was merged with "green logistics", and “end of life practices” merged with "reverse logistics" for the same reason.

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