Green Supply Chain Management: Evolution of the Concept, Practices and Trends

J. Martínez and K. Mathiyazhagan

Abstract Companies are increasingly addressed toward sustainability, due to internal agents as senior management and employees and external stakeholders, such as national and international regulations, society and the market, to mitigate and/or eliminate impacts to the environment. To do this, companies establishing control strategies and mitigation of environmental impact and cleaner production, as green procurement or green supply chain management. The latter is a management approach that integrates the design stages, manufacturing, purchasing, distribution and logistics through practices that involve the entire supply chain, seeking to achieve the TBL (triple bottom line) to maximize the environmental, economic and social benefit. A literature review was proposed in Scopus bibliographic manager and Springer Link, from Boolean operators to analyze the evolution of the concept, practices that compose and trends on the field. It was found that even the concept of GSCM is under construction and there are altogether 231 articles that raise various trends and approaches GSCM, most of them focused on the automotive and construction.

Keywords Green supply chain management · Trends · Concept · Practices · Bibliometric analysis

1 Introduction

In this environment of globalization, companies have been integrated in stages based on a single set of products and/or services, increasing the system reliability, decreasing the delivery time and additional costs for the end customer are eliminated. The integration of these stages is known as supply chain. According to the Council of

J. Martínez
EAM University Institution, Armenia, Colombia
e-mail: jpmartinez@eam.edu.co

K. Mathiyazhagan (✉)
Department of Mechanical Engineering, Amity School of Engineering & Technology, Amity University, Sector 125, Noida, Uttar Pradesh, India
e-mail: madii1984@yahoo.com

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Supply Chain Management [1], a supply chain integrates many companies, starting with the acquisition of raw materials, followed by the manufacturing process and ending with the final distribution to the consumer, including the intermediate stages as transport and warehouse [2].

All providers of goods and services and all clients are interconnected by the consumer demand for finished products as well as materials and the logistics process, from procurement of raw materials to delivery of finished products to the end user [3]. However, supply chains even with their new environmental efforts continue to generate environmental problems such as pollution, emissions and discharges. These emissions have a high cost to the supply chain as well as an impact on the welfare of society and, at the same time, increase the loss in productivity and propose a bad image for the organizations [3].

To increase the competitiveness of supply chains and to minimize the impact on health and the environment, several mitigation mechanisms emerge as the list of ISO 14000 standards, TQEM (Total Quality and Environment Management), industrial ecology, green engineering, cleaner production and closed supply chain and among others [3]. Among all these trends, green supply chain management (GSCM) has been achieved attention between entrepreneurs and researchers [4].

Martinez Giraldo says the GSCM approach emerges as a way of integrating environmental management in organizations and respond to internal and external pressures, as well as part of the adoption of policies of corporate social responsibility [4]. The GSCM approach includes environmental considerations in all stages of the supply chain, from product design, purchasing processes to manufacturing operations, distribution, system information, sales and product management after completing its life cycle [5].

The goal of this article was to analyze research trends in green supply chain management, in order to determine how it has been developing this concept, the practices that include GSCM and potential fields of work.

2 Review Background

Delivery, quality, service, innovation, flexibility are used as strategies to achieve to draw attention to their customers. These strategies are seen as competing priorities [6]. Sarache et al. [7] define competitive priorities as the dimensions of business competition, which involves giving special treatment to this dimension on the other.

The competitive market and emerging priorities are relative. In the last decade, given the changing market requirements and pressure from the government, other requirements of internal and external customers have emerged. Thus, they have arisen the environment and after-sales service as new competitive priorities [8]. Showing that, customers increasingly consider the environment as a decision variable at the time of purchase, resulting in increased pressure on organizations.

In order to meet these customer needs, companies ensure a good relationship with suppliers, achieving national and international standards, devise strategies recirculation water, waste recovery and packaging from recycled material and a reverse logistics to return the material once its life cycle ends. To meet all requirements, companies have implemented practices reagent type, such as mitigation and waste treatment, recycling programs, reuse [9]. Also, there are proactive strategies that seek to control emissions and waste from the source establishing strategies such as green design or industrial ecology.

2.1 Review Result

Green Supply Chain Management Concept Definition

Green supply chain management (GSCM) is defined as the integration of environment thinking through the supply chain, including design, selection of raw materials, manufacturing processes, product delivery and product handling after its life cycle [10]. Another concept is proposed by Sarkis [11] in which the GSCM is a strategic approach aimed at increased environmental measures to the entire supply chain. Thus, GSCM is transverse to the supply chain and includes all stakeholders, the internal and external clients, the government and all the society.

Currently, there is no consensus on the GSCM concept. On the contrary, it was found that this varies depending on the approach of each researcher [12]. Some of the definitions detected in the state of the art that each author has incorporated over time within the scope of the GSCM concept are summarized in Table 1.

Table 1 Evolution of the GSCM concept

Author	Definition
Green et al. [42]	Integration between innovation and shopping can be considered to the environmental context
Min and Galle [43]	Build a product environmentally sustainable, developing reusable packaging, energy conservation, waste reduction, recycling and the creation of an environmentally sensitive organizational culture
[44]	Handling material and information flows as well as the cooperation of companies along the supply chain, aiming at sustainable, economic and social development
Sarkiset al. [45]	Integrating green practices throughout the supply chain, including functional areas such as purchasing, production and sales, from strategic, tactical and operational
Andic et al. [40]	Eliminating or mitigating the negative effects of the supply chain on the environment

Table 2 Equations search for bibliographic analysis

Keyword	Operator	Keyword
Green supply	AND	Definition
Green supply	AND	Concept
Green supply	AND	Innovation
Green supply	AND	Practices
Green supply	AND	Trends

3 Problem Description

For the literature review, keywords were established in UNESCO thesauri. After the keywords have obtained, the search with structure equations was conducted. They are presented in Table 2.

These equations were validated in search databases internationally renowned: Science Direct, JSTOR and Emerald. Scopus was employed as bibliographic gestor. The relevance of this manager and tools is based on the impact factor of the journals that comprise [13].

4 Solution Approach

The total papers obtained according to the keywords are presented in Tables 3 and 4. Preliminary work as presented by Ahí and Searcy (2014), they state that there is a correlation between the concepts of GSCM and sustainable supply chain management (SSCM). SSCM is defined as the involvement of the planning and management of supply activities, acquisition, conversion and logistics involved during the phases of pre-fabrication, manufacture, use and post-use in the life cycle in closed loop through multiple life cycleswith perfect shared information about the entire product life cycles between companies explicitly considering the social and environmental implications to achieve a shared vision. Meanwhile, Wolf [14] raises a related definition of mitigation strategies, i.e., the ability of the company to plan, mitigate, detect, respond to and recover from potential global risks. These risks involve substantial considerations of

Table 3 Results obtained with equations search

Keyword	Keyword	Articles
Green supply	Definition	142
Green supply	Concept	49
Green supply	Innovation	6
Green supply	Practices	32
Green supply	Trends	2
Total		231

Table 4 Evolution of GSCM practices

Source	Practices detected
Green et al. [42]	Shopping regulation compliance for profit, encourage excellence among suppliers, collaborative process substitution
Sheu [16]	Design of reusable products, customer–company collaboration for the return of the product, integration of reverse logistics in the supply chain
Srivastrava [17]	Adoption of the 6 Rs (reuse, reuse, recycle, refurbished, remanufacture, reverse logistics). Source reduction, pollution control, planning to reduce overproduction, environmentally sustainable design, disassembly process scheduling
Parmigiani et al. [46]	Carbon footprint reduction, pollution prevention, ISO 14001 environmentally safe manufacturing, disposal of hazardous materials, substitution of raw materials, life cycle assessment, effective partnerships
Büyüközkan et al. [47]	Social responsibility as a criterion for selecting suppliers, green image as a marketing strategy, use of environmentally friendly technologies and materials, compliance with environmental policies, participation in environmental projects, environmental certifications, pollution control

Source Compiled from Martinez (2015) and Fahimnia et al. [48]

marketing and supply chain as product development, channel selection, market decisions, sourcing, manufacturing complexity, transportation, government and industry regulation, availability of resources, talent management platforms, alternative energy and security.

As shown in Table 3, the biggest trend of GSCM research, still it is based on the concept as proposed to define the approach. Also, when a concept arises, the need arises to establish its components; hence, the practices are the second set of keywords.

Even Table 3 shows 231 papers as a result of the search, only 61 were read, because some of them are in two or three categories as green supply chain definition and also are included in green supply chain concept.

5 Results and Discussions

Among the definitions referred to excel proposed by Liu and Chang [15], who argue that the management GSCM is an important strategy for companies to improve their environmental and economic performance at the same time by reducing environmental risks and increasing their ecological efficiency. However, although proactive organizations such as Dell, HP and Sony have adopted initiatives, GSCM in its operational process [16] is still a new concept and has not been widely adopted,

particularly by small and medium-sized enterprises [17]. For example, global manufacturers of manufactured products, most manufacturing enterprises in China [18] appear to be still in the first stage of learning environmental practices (Martinez 2015). Even the early adopters under GSCM practices are merely in the initial stages of implementation [7]. They propose that a connection between the closed cycle and strategic orientation based on the processes and implementation practices GSCM is necessary.

Weather research GSCM in the period between 1990 and 2019 states the first publications whereas it relates to the supply chain, given in 2000 with four items, reaching its maximum output of 339 items in 2018. These contributions are mainly due to author's review documents such as Sarkis 61 where GSCM methodology relates to strategies decreased carbon footprint [7, 14, 19–22], resilience strategies [15, 18, 23–25], circular economy [26–28], all items have in common that the relationship that wins between the environment and economic developments is confirmed. Researchers also excel as Zhu, Govindan, Jabbour and Cruz Machado, who are among the five most cited and are part of the trends presented.

5.1 Processes Compose GSCM

Regarding the practices that make up the GSCM, Al-Aomar et al. propose a list of practices GSCM as relations with suppliers of material, reuse, recycling, implementation of HACCP standards, reducing water and energy, either sunlight or LED, among others that apply in the hospitality sector [29] These practices are minimization of materials and include worker safety, but few minimization strategies from design.

Another set of practices are proposed by Rosangela et al., who validate the hypothesis that adopting GSCM practices has a positive impact on the operating, economic and environmental performance of suppliers of Brazilian automotive supply chain [30]. They also state that the main pressures that influence the performance of companies are declaring companies, advances provider in developing products that respect the environment, the environmental partnership with suppliers and the cost of ecological packaging. As for the relationship between these practices and performance, the results show that adoption has a positive effect only in the economic and environmental performance of the companies studied [31].

Noor et al. [27] discussed the relationship between the GSCM concept and the concept of innovation [32]. This article validates the hypothesis that although several empirical studies described in the literature implicit GSCM has a significant bearing on green innovation, it is not provided the sufficient evidence to support that relationship in the development of new green product. All GSCM practices should be considered when investigating its relation to eco-innovation. Then, it is believed that manufacturers quite see how these practices may involve GSCM green innovation together in the process of product life cycle management.

The GSCM does not have processes that make it a standard. And, the concept is relatively new practices that make up the GSCM, obey the focus of research styles search and what it considers as relevant.

Green design focuses on creating products with (non-toxic materials and simultaneously meets the modular design [33]. On the other hand, industrial ecology proposes an analogy between natural ecological systems and the "community" of industrial plants. At the same way in a biological ecosystem, the industrial ecosystem should be viewed as an interrelated part of a larger system where the outcome of one of the organizations becomes an important raw material for another [34]. Industrial ecology explores new possibilities for interaction between companies, as a result of a rethinking of industrial activities, changing the waste concept and completing the understanding of its environmental impacts and its interrelation [35].

Other practices detected include remanufacturing, which plays a central role in efforts ecological efficiency, responsibility extended to the producer and the environment [36]. Recent days, researchers are focused to integrate the traditional manufacturing with green manufacturing [37]. Others are focused in terms of waste, refurbished, reuse, remanufacturing, as well as the use of energy [38]. Kristianto and Helo [25] are investigating the integration between: (i) product design and manufacturing processes and ecology and social principles, life cycle assessment, extension of product life cycle management and reuseand (ii) the design of supply chain networks and programming production lines and products.

According to Govindan et al., green thinking is important role for supplier selection [39]. Zhu et al. [31] establish the importance of measuring the performance of GSCM practices that have been developed for the use of performance indicators. These trends are also related to the proposals by Giraldo and Paulin [40, 41], who identifies the creation of new practices such as human resources management and green innovation as starting points for integrating more links in the supply chain.

6 Conclusions and Recommendations

The main quantity of papers related to green supply chain management is focused on building its concept, with a total of 142 articles. These papers have in common the inclusion of green practices on each stage of the supply chain, including all the hierarchical levels since the top management with the inclusion until the minor operational level. Also, these GSCM concept papers are based on the presentation and delimitation of this management approach. Thus, the integration of GSCM concept with other concepts are better and ensure the more sustainable environment.

As it was defined in Table 1, the innovations and trends in GSCM are a new research topic with just eight papers that contain these words into the title. However, several papers apply the concept and include practices and trends of GSCM. Some of these found in the literature are: the economic implications of the GSCM, implementation of GSCM in economic sectors such as automotive, the inclusion of the GSCM

in senior management, the development of new products with environmental considerations the positioning of the corporate environmental image, the reuse of waste and the creation of closed production cycles and the use of cleaner technologies such as LED panels.

Finally, after this review some questions associated with GSCM have emerged. Some questions are related with the appropriate way to measure green practices impacts, by building environmental performance indicators, as well as validation and relationship with other green trends emerged. Others are associated with the role among internal and external clients to implement GSCM.

6.1 Research Implication and Limitation

This study helps to identify the evolution of GSCM concept and several trends in the field. This review paper shows that the green supply chain is still under construction and the boundary definition has changed to include other emerged theories as cleaner production, closed supply chain, sustainable supply chain among others. The GSCM concept will be continue evolving to incorporate some practices that led communicate the supply chain stages. The principal limitation of this study was the quantity of paper analyzed in comparison with other review papers; this situation is due to access different sources of papers and bibliographic gestors.

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