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REGIONAL CASE STUDY

Maturity levels of material cycles and waste management in a context of green supply chain management: an innovative framework and its application to Brazilian cases

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Abstract The objective of this study is to identify the relationship between the maturity of environmental management and the adoption of green supply chain management (GSCM) practices utilizing an integrative framework and evidence from multiple cases. To achieve this goal, a state of the art literature review on environmental management maturity was performed, and a typology of GSCM practices was created to produce an original integrative framework of GSCM maturity levels. To verify its applicability to real cases, five companies in supply chains with high levels of environmental impact were analyzed. Of the five companies, two were in the battery business, two in the pesticides business, and one in the automotive business. Adherence to the integrative framework was verified, and sensitivity to changes in maturity of environmental management and the adoption of GSCM practices were observed, achieving the research's objective. The following classification of GSCM maturity levels was obtained: (a) first, the reactive GSCM level with low adoption of GSCM practices, which is motivated by legal restrictions; (b) second, the preventive GSCM level with average adoption of GSCM practices, which is driven by cost reduction; (c) and third, the proactive GSCM level, which is driven by the pursuit of competitive advantages.

Keywords Sustainable supply chain · Sustainable operations management · Green supply chain management practices · Waste management · Brazil

Introduction

The adoption of green supply chain management (GSCM) practices and efficiency gains have been studied by many researchers [1–5], and there is a positive relationship between the adoption of GSCM practices and the maturity of environmental management [6]. Therefore, it is theoretically and logically possible to link environmental management maturity to GSCM practices to align environmental and economic results, as described by Zhu et al. [7] and Zhu et al. [8]. Classifying the maturity of environmental management is important for its development and effectiveness [9, 10].

Based on these assumptions, this study aims to identify the relationship between the maturity level of environmental management and the intensity of adoption of GSCM practices through an integrative framework and multiple cases.

The study is conducted in Brazil, which it is the largest Latin American economy and represents 30 % of regional Gross National Product (GNP). Brazil is also one of the BRIC countries (Brazil, Russia, India and China) and is the world's seventh largest economy [11].

The following productive chains were chosen: (a) the automotive supply chain, specifically the truck sector, which increased about 40 % in 2013; this is the main transportation mode in Brazil for cargo transportation and

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has high environmental impacts, as well as in the Chinese context [12]; (b) the pesticides supply chain. Brazil is one of the top food and agricultural players around the world [13]. This sector used to have a higher environmental impact because of its implications for the environment, ecosystems, and biodiversity [14]; (c) the batteries supply chain, which tends to have higher environmental impacts because it uses lead, which poses a risk both for humans and other species [15].

The analyzed chains are governed by restrictive environmental laws, which may increase the adoption of GSCM practices. Until now, neither conceptual nor practical discussions of the maturity levels of GSCM have occurred. This word adds new evidence about materials cycles, waste management, and green policy in developing economies [16].

This article is divided into a description of the methodological procedures, a bibliographic review of maturity in environmental management, and GSCM practices. An integrative framework, containing the model on which the objective of this work is based, is elaborated after this review. The final section discusses the results, concludes, and provides avenues for future research.

Research methodology

The variables utilized to build and validate the integrative framework were obtained through a bibliographic search of the existing literature on environmental management maturity and GSCM practices. The keywords environmental management maturity and GSCM practices were entered into the Web of Science and Scopus portals for journal publications, surveys, and reviews that contained these keywords in their titles. This search was updated until December, 2014. Of the articles collected, seven addressed environmental management maturity and 42 addressed GSCM practices. These articles were used to create an integrative framework of GSCM maturity levels.

Previous research was analyzed carefully to ensure internal validity, according to the recommendations made by Gibbert et al. [17] for multiple case studies.

Multiple case studies of Brazilian organizations with high potential for environmental impact were examined to test the proposed integrative framework. Due to the complexity and difficulty of obtaining data on environmental practices and issues, only companies that accepted to yield the necessary data, documents, and accessibility were selected in this research. In this context, e-mails were sent to 14 different organizations. Given the responses and accessibility, we selected three segments, chosen because of their high impacts on the environment. Five companies from those three different sectors (automotive, pesticides, and batteries) were selected. Two companies participated in the pesticide supply chain [a manufacturer (Company B) and a distributor (Company E)]; two participated in the battery supply chain [an automotive battery manufacturer (Company C) and a lead recycler (Company A)]; and one participated in the automotive supply chain [a truck trailer manufacturer (Company D)].

The information was collected through semi-structured interviews and direct observation, which produced a wide range of GSCM practices. Visible artifacts, such as photographs, plans, layouts, organization charts, and phrases that represented the phenomenon, were collected during the interviews. Finally, the results are presented in a spider web graph, since they are widely used to explain results GSCM [18].

For each researched firm, managers were interviewed for about 3 h each. Besides the interviews, contacts were made by telephone and e-mail with the respective respondents/interviewed managers to confirm data obtained in the interviews and to avoid any doubts about the GSCM practices adopted by the companies. All results were sent to companies for additional information and amendments.

Data processing was done using data triangulation principles (interviews, documents and direct observation), as proposed by Yin [19], to answer accurately the proposed research question and objective. The adopted procedures were (a) validity of constructs by using multiple sources of data (interviews, direct observations, internal reports and balance sheets); (b) comparison between practices found in the state-of-the-art literature on the practices used by the organizations that were the focus of this research; (c) external validity by comparing the state-of-the-art literature and the five different cases. Some examples from the interviews' scripts are (a) does your company adopt any GSCM practice?; (b) what is the main driver for spreading green issues across the supply chain? (c) explain the greening of organization and planning practices, operational practices, and communicational practices across the supply chain.

Conceptual background for framework development

Maturity levels in environmental management

The classification of organizations by maturity levels of environmental management increases the likelihood of their participation in a competitive environment because it suggests an evolutionary process [10, 20].

Jabbour's [9, 21] and Jabbour et al. [22] affirm that there is evidence that companies can be categorized by the maturity of their environmental management (that is, their

environmental management stage). The authors propose three environmental management maturity levels: reactive, preventive, and proactive.

To classify the maturity of environmental management as proposed by Jabbour's [9, 21] and Jabbour et al. [22], important organizational characteristics are considered, such as the support of top management, organizational structure, interface with other areas, environmental objectives, inclusion of environmental management strategies, and environmental focus [6].

GSCM practices

One of the main Brazilian regulations on the subject of environmental management with implications for GSCM is Law No. 12,305 [23], which established the National Policy on Solid Waste, covering guidelines for the development of national waste management plans, with implications for both companies and the government [24]. According to Sakai et al. [25], new environmental laws tend to create new opportunities and challenges for people involved in waste management. Thus, they can have potential synergistic effects between national 3R (Reduce, Reuse, Recycle) policies and strategies aimed at increasing the useful life of landfills, procurement of resources and reduction of emissions of greenhouse gases. Waste management is important for companies' profitability because it can help a company reduce its cost and avoid waste. A lot of methods can be used to manage and reduce waste, for example, GSCM principles [26].

Some schools of thought emphasize the application of management techniques integrating concepts of circular flows, namely, industrial ecology and circular economy. Industrial ecology is defined as a model based on the circular flow of materials, waste, and energy [27]. Circular economy is defined by Geng et al. [28] as an economic alternative that proposes the circular flow of materials, waste, and energy. The practices listed by Zhu et al. [29, 30] are related to those practices proposed by Zhu et al. [7, 8], denoting similarities and complementarities. GSCM has been widely studied over the last two decades [31]. However, an analysis of the most frequently cited articles on this subject using the Web of Science and Scopus databases reveals there is not a complete consensus among researchers about which practices can be attributed to GSCM.

After a literature review, it was concluded that Zhu and Sarkis [32] were the most aligned to this research's objectives, providing a set of GSCM practices relevant to the studied economic sectors analyzed herein.

Zhu and Sarkis [32] GCSM practices were reorganized following the main ideas of Zhu et al. [12], Azevedo et al. [33] and González-Benito and González-Benito [34, 35]. As a consequence, Fig. 1 presents the GSCM classification adopted by this work.

The highlighted GSCM practices in Fig. 1 are described as follows: Planning practices reflect the extent to which an environmental management system was developed and implemented. That is, they denote the measurement procedures that define a company's environmental policy; they are developed with the aim of establishing environmental objectives for the selection and implementation of environmental practices and to assess the results of such practices. Planning GSCM practices were further divided into external, investments recovery, internal environmental management, and storage and green building practices:

1. External GSCM practices pertain to downstream links and the extent of the focal company's supply chain.
2. Investment recovery GSCM practices intend to recover an investment.
3. Internal environmental management GSCM practices are initiatives related to inward initiatives.
4. Storage and green building GSCM practices are related to how companies store their products and raw materials and how they the support green building activity for this purpose.

The operating GSCM practices, in turn, can be classified into two groups: those relating to products and those related to processes. The first group includes practices focused on design and development of new environmentally conscious products. The second group includes practices focused on operational processes, focusing especially on the development and implementation of manufacturing

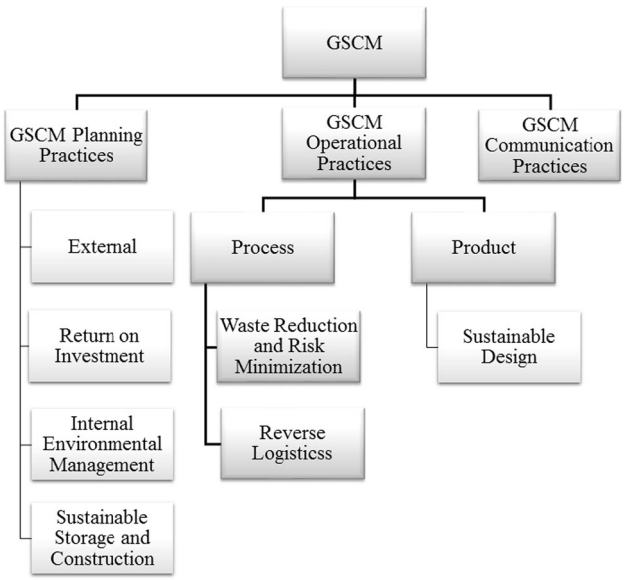

Fig. 1 GSCM practices. Source: based on Zhu et al. [12]; Azevedo et al. [33]; and González-Benito and González-Benito [34, 35]

processes and methods and environmentally conscious operational processes. These concepts are the basis for the following groups of operational GSCM practices:

5. Green design operational GSCM practices focus on environmental improvements in products' operations.
6. Waste reduction and risk reduction operational GSCM practices focus on practices that have at their core the production process and the search for waste reduction and the minimization of risks.
7. Reverse logistics operational GSCM practices focus on how logistics may help firms recover value and become greener.

Besides the two groups of previously listed practices, given the significant importance of green consumers [36], it is also necessary to consider that companies with a proactive level of environmental management practices tend to adopt green communication [37]. Since there is an opportunity to consider this communication dimension in the core of GSCM initiatives, this research also considered communication GSCM practices. Such practices aim to communicate the social and institutional environment of company actions taken in favor of the natural environment:

8. Communication GSCM practices aim to communicate to firms' stakeholders the main news and information about green management and initiatives, including actions taken in favor of the natural environment.

This set of communication GSCM practices consists of the communication practices described by González-Benito and González-Benito [35]), as follows:

- frequent environmental reporting;
- sponsorship of environmental events and/or collaboration with environmental organizations;
- environmental arguments in marketing;
- provision of regular and voluntary forms of information about environmental management for clients and institutions.

Based on the set of GSCM practices illustrated in Fig. 1, the 42 articles on GSCM practices identified through the Scopus and Web of Sciences portals are classified. Many GSCM practices are identified and detailed in Table 2 with their corresponding justifications.

Proposition of an integrative framework of maturity levels in GSCM

The authors propose that GSCM maturity is related to the intensity with which GSCM practices—including planning, operational and communication practices—are adopted. Thus, a model of organizational GSCM maturity is obtained. Organizations are classified according to top management support, organizational structure, interface with other areas, environmental objectives, inclusion of environmental management strategies, environmental focus, and main motivating factors [6, 9, 21, 38]. Once the organizations are classified by their motivating factor, they are classified according to the intensity of GSCM practice adoption, as González-Benito and González-Benito [34, 35] claim organizations vary with respect to the intensity of their adoption. Similarly, there is synergy and a logical order in the adoption of GSCM practices [8]. So, not only is the number of adopted GSCM practices relevant for classifying organizations, but the extent/variation to which the practices are adopted is also a major factor for their classification.

Figure 2 depicts the combination of environmental management maturity levels and GSCM practices used to classify organizations.

Applying the integrative framework of GSCM maturity levels to multiple case studies

The following section presents an analysis of multiple cases. A previous synthesis of environmental management maturity based on the classification provided by Jabbour's [9, 21], Jabbour et al. [22], and Jabbour et al. [6] is presented. Both these factors and adopted management practices [6] are summarized in Table 1.

In summary, companies A, B, and C were grouped into the proactive level of environmental management maturity, company D was classified as preventive, and company E was classified as reactive.

Once these companies were classified by their level of environmental management maturity, they must be classified by the intensity with which they have adopted GSCM

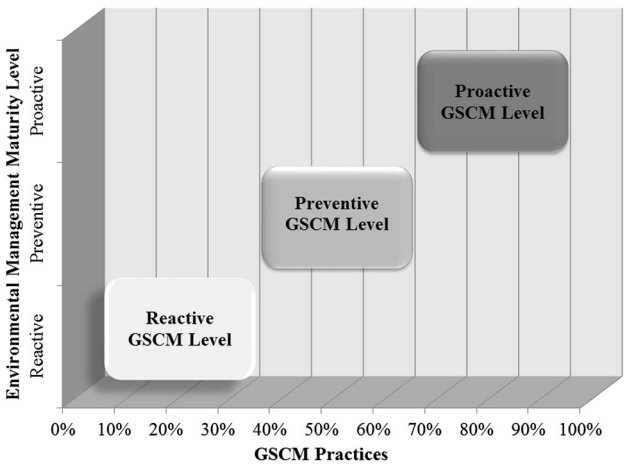

Fig. 2 An integrative framework of GSCM maturity levels. Source: the author

Table 1 Factors used to identify maturity level of environmental issues

Factors	Company A	Company B	Company C	Company D	Company E
Top management support	Yes, affirmation that sustainability principles guide the company	Yes, declaration of environmental values in company policies	Yes, declaration of environmental values in company policies	Yes, top management is mindful of environmental values	Yes, top management demonstrates commitment to the environment
Organizational structure	Yes, all company levels are involved in environmental management	Yes, all company levels are involved in environmental management	Yes, all company levels are involved in environmental management	Yes, top and middle management designate a person responsible for the area	No
Interface with other areas	Yes, the 5S group is the base of the interface	Yes, there is a 3R group and dissemination of the environmental policy throughout the organization	Yes, there is an incentive plan for environmental practices for which all employees are rewarded if the practice is adopted	No, the company designates only one employee who is responsible for environmental issues	No
Environmental objectives	Yes, acid reduction	Yes, develop lower toxicity products	Yes, reduce lead plates	Yes, cost reduction and return on investment through waste separation and sale	No
Inclusion of environmental management strategies	Yes, declaration in the company vision, mission and values	Yes, declaration of environmental values in company policy	Yes, declaration of environmental values in the company policy	No	No
Environmental focus	Competitive advantages	Competitive advantages	Competitive advantages	Cost reduction	Regulatory compliance
Environmental management maturity level	Proactive	Proactive	Proactive	Preventive	Reactive

Source: the author

practices. These GSCM practices were grouped according to Table 2 as follows.

Since groups of GSCM practices have a number of distinct practices with each other, it was necessary to carry out the parameterization of data based on the following mathematical procedures.

$$\mathrm{GPGSCM}_k = \frac{\sum_i^n \mathrm{PGSCMA}_{i,k}}{\sum_i^n \mathrm{PGSCMD}_{i,k}} \times 100,$$

where k represents the practices of GSCM, n represents the number of elements in each group of practices GSCM $i = (1, 2, \ldots, n)$.

$$\mathrm{TPGSCM}_k = \frac{\sum_i^m \mathrm{GPGSCM}_i}{m}, \text{ where } m = 8$$

Where:

$i = (1, 2, \ldots, m)$
GPGSCM = set/quantity of GSCM practices
PGSCMA = GSCM practices adopted
PGSCMD = described GSCM
TPGSCM = total GSCM.

Based on the outputs obtained from the calculation formula, it is possible to parameterize the relative importance of each set of GSCM practices on the whole, as each set has a different number of practices described in the literature; thus, one can evaluate the isonomic way each group of GSCM practices relates to the total level of adoption of GSCM practices by organizations.

Of the five companies, only company E operated at the reactive level of environmental management maturity. This organization has implemented few GSCM practices, that is, only 14 % of the listed practices. Most of the adopted practices are GSCM planning practices of the internal environmental management type and GSCM process operational practices of the waste reduction and risk minimization type. This pattern indicates that the company focuses on the adoption of mandatory GSCM practices. According to the company representative interview, "the company meets all legal requirements". This position indicates that the adopted GSCM practices are imposed by legislation.

Table 2 Range of GSCM practices

Group	GSCM practices	A	B	C	D	E
1	External planning practices					
	Provision of design specifications to suppliers that include environmental requirements	*	*	*	–	–
	Cooperation with suppliers to meet environmental objectives	*	–	*	*	–
	Environmental audit of internal supplier management	*	–	*	–	–
	ISO14001 certification of suppliers	–	–	–	–	–
	Evaluation of adoption of environmentally friendly practices by the second tier of suppliers	*	–	*	–	–
	Cooperation with customers for ecodesign	–	–	–	*	–
	Cooperation with customers for a cleaner manufacturing	*	*	*	–	*
	Cooperation with customers for the use of green packaging	–	–	–	–	*
	Participation in an eco-industrial Park	*	–	–	–	–
References	Arantes et al. [39], Govindan et al. [3]; Jabbour et al. [4, 22]; Liu et al. [40]; Mitra and Datta's [31]; Mohanty and Prakash [36]; Perotti et al. [41]; Zhu and Sarkis [32, 44, 45]; and Zhu et al. [1, 7, 8, 13, 42, 43]					
2	Return on investment planning practices					
	Return on investment (sale) of stocks/materials excess	*	*	*	*	–
	Sale of scrap and used materials	–	*	*	*	–
	Sale of underused equipment	*	–	*	*	–
References	Arantes et al. [39]; Liu et al. [40]; Govindan et al. [3]; Jabbour et al. [4, 22]; Zhu and Sarkis [32, 44, 45]; and Zhu et al. [1, 7, 8, 13, 42, 43]					
3	Internal environmental management planning practices					
	GSCM commitment of senior management	*	*	*	*	*
	GSCM support for middle management	*	*	*	*	–
	Multifunctional cooperation for environmental improvements	*	*	*	–	–
References	Arantes et al. [39]; Chien et al. [46]; Govindan et al. [3]; Green Junior et al. [47]; Jabbour et al. [4, 22]; Liu et al. [40]; Perotti et al. [41]; Zhu and Sarkis [32, 44, 45]; and Zhu et al. [1, 7, 8, 13, 42, 43]					
4	Sustainable storage and construction planning practices					
	Attention to construction materials (e.g., recycled concrete, steel, asphalt, etc.)	*	–	–	–	–
	Use of thermal insulation	*	*	*	–	–
	Use of natural illumination in distribution facilities	*	*	–	*	–
	Use of energy efficient illumination systems	*	–	–	*	–
	Use of energy efficient material handling equipment	*	*	–	*	–
	Use of alternative energy sources (e.g., solar or photovoltaic panels)	*	–	–	–	–
	Water conservation (e.g., plants and landscaping materials that minimize water waste and use of system gray water)	*	*	*	–	–
References	Perotti et al. [41]					
5	Sustainable design product operational practices					
	Design of products with low material/energy consumption	–	–	–	–	–
	Design of products for material and component reuse, recycling, and return	–	*	*	–	–
	Design of products to avoid or reduce hazardous substances in its composition and/or manufacturing process	–	*	–	–	–
References	Arantes et al. [39]; Chien et al. [46]; Govindan et al. [3]; Jabbour et al. [4, 22]; and Laosirihongthong et al. [48]; Liu et al. [40]; Zhu and Sarkis [32, 44, 45]; and Zhu et al. [1, 7, 8, 13, 42, 43]					
6	Waste reduction and risk minimization operational practices					
	Waste reduction	*	*	*	*	*
	Reduction of the consumption of hazardous and toxic materials	*	*	*	*	–
	Definition of a list of environmentally hazardous substances	*	*	*	–	*
	Profiles of raw materials with forbidden substances	*	*	*	–	*
	Green products homologation data	*	*	*	–	*
	Green manufacturing practices	*	*	–	–	–
	Manufacturing of green products	*	*	–	–	–
	Green products standards	*	*	*	–	–
	Use of recyclable products whenever possible	*	–	*	–	–
	Consumption reduction whenever possible	*	*	*	–	–
	Material reuse whenever possible	*	*	*	*	*
	Total environmental quality management	*	*	*	–	–
	Compliance with environmental legislation and auditing programs	*	*	*	–	–
	ISO 14001 certification	*	*	–	–	–
	Existence of an environmental management systems	*	*	*	–	–

Table 2 continued

Group	GSCM practices	A	B	C	D	E
References	Arantes et al. [39]; Azevedo et al. [33, 49]; Chien and Shih [50]; Chien et al. [46]; Espadinha-Curz et al. [51]; Govindan et al. [3]; Green Junior et al. [47]; Jabbour et al. [4, 22]; Liu et al. [40]; Mohanty and Prakash's [36]; Perotti et al. [41]; Zhu and Sarkis [32, 44, 45]; and Zhu et al. [1, 7, 8, 13, 42, 43]					
7	Reverse logistics operational practices					
	Reverse transport logistics and waste disposal	–	*	*	*	*
	Distribution, transport and execution strategies to redesign logistic system for higher environmental efficiency	*	–	–	–	–
	Environmentally friendly facility locations	*	–	–	–	*
	Use of alternative fuels	–	–	–	–	–
	Selection of logistics modals based on eco-friendly parameters	–	–	–	–	–
	Use of low-emission vehicles	*	–	–	–	–
	Consolidation and effective use of vehicle full load capacity	–	–	*	–	–
	Implementation of systems to minimize travel distances	–	–	*	–	–
	Vehicle maintenance and elimination	–	–	–	–	–
References	Arantes et al. [39]; Azevedo et al. [33, 49]; Chien and Shih [50]; Espadinha-Curz et al. [51]; Guide Junior and Li [52]; Jabbour et al. [22]; Mitra and Datta's [31]; and Perotti et al. [41]					
8	GSCM communication practices					
	Periodic environmental reporting	*	*	*	–	–
	Sponsorship of environmental events/collaboration with environmental organizations	*	*	*	–	–
	Use of environmental arguments in marketing	*	*	*	–	–
	Regular voluntary supply of environmental management information to customers and institutions	*	*	–	–	–
References	González-Benito and González-Benito's [34, 35]					
	Total (Parametrized level of adoption, after applying calculations)	71 %	65 %	63 %	33 %	14 %

Source: the author

* Adoption of the GSCM practice by the company

– Non-adoption of the GSCM practice by the company; A: Company A; B: Company B; C: Company C; D: Company D; E: Company E

Another surveyed organization that participates in the automotive chain, company D, exhibited a preventive level of environmental management maturity. This company adopts more GSCM practices (33 %) than company E does (reactive level). Most of the GSCM practices adopted by company D are focused on return on investment and green construction practices related to energy savings. The use of GSCM practices to meet legislative requirements was clear during the visit to the organization.

However, companies A, B, and C exhibited a proactive level of environmental management maturity. These companies recognize the strategic character of environmental management and value an environmentally friendly image. These three companies have in common the use of highly environmentally hazardous raw materials and belong to industries with restrictive environmental regulations. These regulations oblige companies to adopt a series of environmental practices, which could be considered externality costs. However, these companies internalize environmental management as a strategic element that is essential to their existence and increasing their market share.

Based on these characteristics, it can be affirmed that surveyed organizations with proactive environmental management use highly hazardous raw materials and are subject to restrictive environmental legislation. This result is also found in Jabbour et al. [4] where they affirm that the use of hazardous raw materials is positively correlated with the adoption of GSCM practices and in Zhu et al. [1] where they affirm that institutional pressures motivate companies to adopt GSCM practices.

Companies A, B, and C adopt more GSCM practices than companies D and E, which are preventive and reactive. The totals of adoption of GSCM practices by companies A, B, and C are 71, 65, and 63 %, respectively, compared to 33 and 14 % of companies D and E. Most significantly, companies A, B, and C exhibited the following GSCM practices: planning practices of the internal environmental management type; process operational practices of the waste reduction and risk minimization type, and communication practices.

Discussion: the applicability of the proposed framework

The analysis of environmental management maturity and adopted GSCM practices provides evidence of a relationship between these elements given that the environmental management of an organization can be classified by its maturity level [9, 10, 20, 21, 38] (Fig. 3). There is a strong relationship

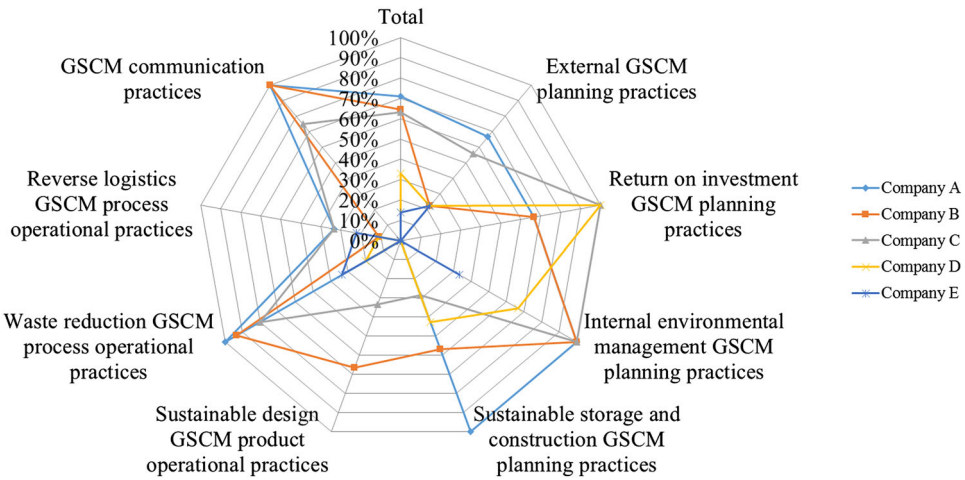

Fig. 3 Range of GSCM practices. Source: the author. *Asterisk* adoption of the GSCM practice by the company; *lines* non-adoption of the GSCM practice by the company; *filled diamond* Company (A), *filled square* Company (B), *filled triangle* Company (C), *cross mark* Company (D), *asterisk* Company (E)

between the adoption of environmental management practices and companies with proactive environmental management maturity [37]. Additionally, there is an evident relationship between the GSCM practices described and classified according to the model proposed in Fig. 1 (i.e., the set of GSCM practices based on Zhu et al. [13], Azevedo et al. [33], and González-Benito and González-Benito's [34, 35] and maturity of environmental management.

To collaborate in the classification in GSCM maturity and contribute to the gradual evolution of organizational environmental management, the following integrative framework of GSCM maturity is postulated:

- The reactive GSCM maturity level: few GSCM practices are implemented. The company reacts to environmental problems generated by the organization itself, such as complying with restrictive environmental legislation or the imposition of taxes, fines, and other penalties due to institutional pressure to adopt GSCM practices [1]. GSCM practices are considered externalities and legal problems.
- The preventive GSCM maturity level: more GSCM practices are adopted compared to the previous level. It is assumed that GSCM practices are cost-effective when pollution and environmental problems are prevented. Companies seek to reduce pollution at the source to avoid environmental damage rather than obtain strategic competitive advantages based on their environmental performance. Environmental issues are the responsibility of a few employees in the company or are considered non-strategic.
- The proactive GSCM maturity level: Many GSCM practices are adopted. GSCM practices are considered part of an organizational pillar that produces long-lasting competitive advantages. During this phase, GSCM practices have the status of organizational functions in which companies mobilize diverse environmental issues in their planning, strategic product development, manufacturing, and communication processes. The multifunctional involvement of organization members is also observed [6, 38]. Pressure from environmentally concerned consumers who influence the adoption of GSCM practices [36] is crucial to this level. These advanced GSCM characteristics are usually present in companies that have made considerable investments in corporate social responsibility.

Conclusion

This study filled a gap in the literature by proposing a new framework of GSCM maturity levels. The framework applicability to real cases was verified through a qualitative study of Brazilian companies. The following are the main conclusions of the study:

- The junction of the maturity of environmental management and GSCM practices obtained by this integrative GSCM maturity levels framework enabled the identification of a positive relationship between organization environmental management maturity level and the number of GSCM practices adopted.
- The framework proposes the following three levels of GSCM maturity: the reactive level of GSCM maturity, the preventive level of GSCM maturity, and the proactive level of GSCM maturity.
- Higher levels of GSCM were associated with the adoption of more GSCM practices.

The following are the implications of this study:

- For academics, a new GSCM evolutionary framework may be useful for further research to diagnose the maturity of GSCM initiatives worldwide.

- For practitioners and consultants, this framework provides an additional instrument for use in environmental management and GSCM consultancy.
- For organizational leaders responsible for implementing GSCM, this framework indicates the current and desired levels as well as the effort required to progress in the adoption of GSCM within their companies.

The main limitations of this study include the emphasis on highly polluting manufacturing industries, focus on Brazilian cases, and the qualitative approach. These limitations may be overcome by additional research on GSCM.

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