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Green Supply Chain Management: the state-of-the-art literature review on production, logistics and operations international journals

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ABSTRACT

Today, environmental issues challenge companies in face of the increasing scarcity of resources, consumer awareness, environmental laws and visibility of the environmental impacts caused by the supply chains operations (VACHON, KLASSEN, 2006; SRIVASTAVA, 2007). Therefore, environmental management in the supply chain has been receiving increasing attention among researchers and managers, through the Green Supply Chain Management. It covers product design, supply and material selection, manufacturing processes, final product delivery to consumers and management of the product at the end of its useful life (SRIVASTAVA, 2007). This paper carried out a desk research to know the studies on this theme, based on Srivastava's review (2007), among important international journals in the area of management, logistics and operations. The result is a frame of reference of the theme through time, to show the scarcity of studies and the lack of an integrated view of the theme, and to drive future researches.

Keywords: Supply Chain Management, Sustainability, Environmental Management, Green Purchasing, Environmental Purchasing

1. INTRODUCTION

The sustainable management has shown growing interest among academics and managers working in the supply chain (Van Hoek, 1999), presenting itself as a critical issue for the future of the area of operations.

References to the terms "sustainability" and "sustainable development" in the literature related to economics, management and administration is evident. In 1990 the frequency of these terms was 3 / 1000. In 2005, this indicator rose to 15/1000 (LINTON, et al 2007). Pilkington and Fitzgerald (2006), in an analysis of the most researched themes in an important international journal of operations (the International Journal of Operations and Production Management) between 1994 and 2003 showed that the term sustainability was in the ninth place in the period between 1999 and 2003. It was among the studies that addressed the capacity constraints due to natural resources scarcity. However, the term was not among the ten topics most covered in the previous period of study (1994 to 1998). This fact indicates the emergence of a new research agenda for the area.

Among the various existing definitions, sustainability is the "*quantitative and qualitative conservation of environmental resources inventory, and the use of resources without damaging its sources or limit future supply, so that both the present needs and those of the future can also be met* " (AFONSO, 2006, p.11).

But what does the term sustainability in the supply chains mean? It means that the supply chain downstream and upstream form a close loop when they are administered in a coordinated manner toward the common goals of maximizing profit from the standpoint of the triple bottom line, integrating profits, society and planet, in the inter-organizational culture, strategies and operations (SRIVASTAVA, 2007). In this context, the background is the concept of cradle to cradle as a strategy to achieve sustainability in its broader meaning (McDONOUGH and BRAUNGART, 2002). Than surges the concept of the Sustainable

Supply Chain Management (SSCM). It is defined as "*a clear strategic and integrated thinking to achieve economic, social and environmental objectives in a systemic inter-companies processes coordination from the supply chain perspective"* (SEURING; MULLER, 2008; SRIVASTAVA, 2007).

For operations, the importance of SSCM is due to environmental deterioration, especially in relation to the scarcity of natural resources, the landfills saturation and the increased levels of pollution. In the business world, this approach has occurred not only because it is an environmentally friendly procedure, but it has generated good business and high profitability (SRIVASTAVA, 2007), not any more only as a center of operational costs (KLEINDORFER et al. 2005).

Focusing than in the environmental pillar of sustainability, the concept of Green Supply Chain Management (GSCM) appears. To Srivastava (2007), author of an extensive literature review of environment and supply chain management, the definition of GSCM is: *"the integration of environmental thinking in managing the supply chain, including product design, source and material selection, manufacturing processes, final product delivery to consumers and management of the product at the end of its life"* (SRIVASTAVA, 2007).

In this sense, investing in the "greening" of the supply chain can save resources, eliminate waste and increase productivity, as suggested by the Porter's hypothesis (PORTER and VAN DER LINDE, 1995). This approach assumes that the imposition of environmental standards encourages the search for technological innovations to better use (and reuse) the inputs such as raw materials, energy and labor (KITZMANN and ASMUS, 2006). Considering that green (or greening) refers to everything that is ecologically thought (SVENSSON, 2007).

The scope of the GSCM has expanded. It moves from reactive environmental management programs to more proactive practices (SRIVASTAVA, 2007), relating to the

issues that go beyond the administration of a closed loop supply chain and referring to product design practices. The new direction seeks to minimize the environmental impact after its useful life, to forecast the product life extension, to give correct destinations to wasts, among other practices (KLEINDORFER et al., 2005). But in general studies revisited showed a limited perspective, not adequately covering all the aspects the SSCM.

This article aims therefore to provide a broad frame of reference, helping future research to provide intra and inter-organizational integration based on the aspects of sustainability related to the supply chain management. The frame highlights the research trends in the international fields and the key areas for future research.

To achieve this, some relevant terms that appeared during the evolution of this field of study were selected, considering especially the theoretical framework developed by Srivastava (2007). Than a desk research was conducted to find the publications with these terms among title, abstract and key-words. Leading journals of management, logistics and operations were selected.

The importance and relevance of this study are justified because it supports respectively enterprise, government and civil society actions in, (1) decision-making for product development and management of reverse flows, (2) the development of public policies; (3) directing educational programs concerning the habits of consumption and disposal of products and packaging, the attention to the sources of raw materials and to the forests devastation, among other critical issues that need to be equated .

To fulfill these aims, firstly the aspects of the field of study (GSCM) is discussed, then the methodological procedures used to conduct the research is presented. The evolution of the studies found is presented in section four, when the lack of studies within the theme of sustainability in the supply chain in the international literature is shown. In the conclusions

potential issues and opportunities within the area of GSCM for future research were pointed out.

2. AN OVERVIEW OF THE CONCEPTS OF GSCM

Green Supply Chain Management has its roots in the literature on environmental and supply chain management, and deals with the influence and relationships between these two areas of study. In the literature revisited the definition and scope of sustainability in the supply chain is large. It covers the concept of green purchasing, sustainability integration along the supply chain (Carter, Ellram, 1998; SRIVASTAVA, 2007), including supplier, producer, consumer, reverse logistics (Zhu, Sarkis, 2004) and supply chain closed closed loop (GUIDE, WASSENHOVE, 2006a, 2006b), among others.

There is literature on the various aspects of GSCM, which includes green design (Chen, 2001 and Zhang et al., 1997), production planning and control for remanufacturing (GUIDE, WASSENHOVE, 2001), green issues in manufacturing and product recovery (GUIDE et al., 1996), reverse logistics (Carter, Ellram 1998; FLEISCHMANN et al., 2001) and design of the logistics network (Jayaraman et al., 2003). Additionally, Bloemhof-Ruwaard et al. (1995) study the interactions between operational research and environmental management.

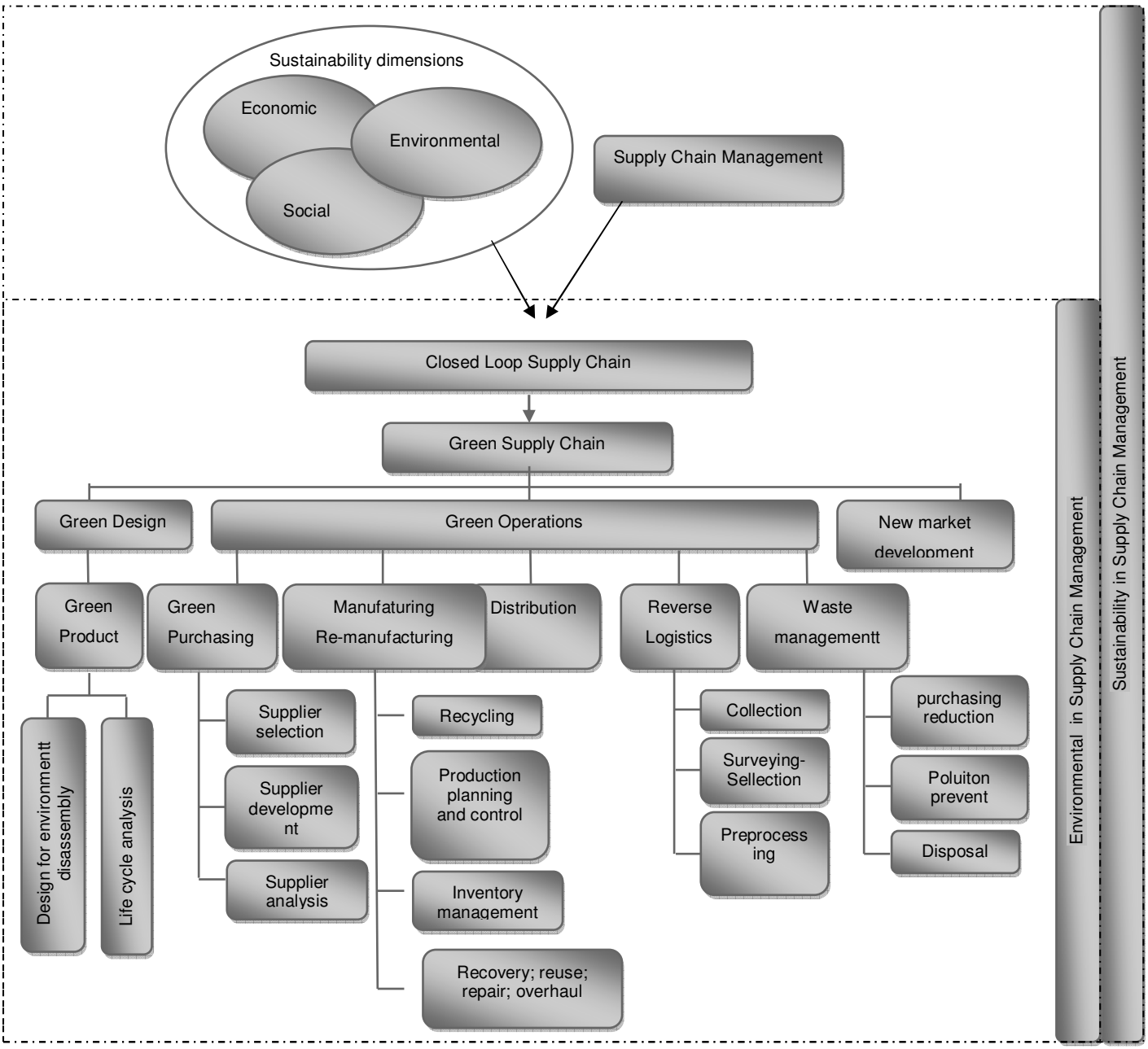
There is also extensive literature in areas related to green purchasing (Zhu, Geng 2001), industrial ecology and industrial ecosystems (MIN and GALLE, 2001; van HOEK, 1999; ZHANG et al. 1997; ZHU and SARKIS, 2004). Exhibition 1 seeks to organize the key concepts that define the field of study in GSCM, which is theoretical framework for this article.

This expanded perspective raises strategic and operational issues, such as the following basic activities (SRIVASTAVA, 2007):

i. Green design - includes design for the environment / for disassembly and product life cycle assessment, to consider environmental aspects in the products design. The product life cycle assessment is described as a process of analyzing and evaluating the consequences of material and energy flows of a product in relation to the environment in all phases of its life: extraction and processing of raw materials, production, transport and distribution, use, re-manufacturing, recycling and final disposal.

ii. Green Operation - refers to all strategic and operational aspects related to green procurement, reverse logistics, manufacturing / re-manufacturing of products, use, handling, logistics management and waste management.

iii. Market Development for Re-manufactured products - includes marketing activities, coordination and choice of channels. Such practices are aligned with the operations environmental concerns, and are added to the initiatives of green design, serving as a basis for construction and management of sustainability in the supply chain.



Exhibition 1: Classification of issues involved in the study of SSCM
Source: adaptation of Srivastava (2007)

2.1 Motivation for inclusion the of sustainability in the supply chain management

There are several reasons for this expansion and concern. There are companies that are responsive to external pressures, and others that are proactive, seeking to add value to its product and its business through these practices. The perspective changes when sustainability

is no longer seen as a source of costs but as a potential source of competitive advantage (GUIDE et al., 2003; van Hoek, 1999).

A literature review shows that regulatory forces have received more attention as drivers of sustainability, due to its greater influence in the businesses reverse channel structuring, being directly affected by one or multi-stakeholders: customers, suppliers, competitors and government (Frame 1).

Stakeholders	Authors
Government	Caincross, 1992; Corbett, Kleindorfer, 2001; Kleindorfer et al., 2005; Kopicki et al., 1993; Matos, Hall, 2007; Murphy et al., 1996; Srivastava, 2007; Stock, 1992
Suppliers	Carter, Ellran, 1998; Stock, 1992; Zhu, Sarkis, 2004
Customers	Corbett, Kleindorfer, 2001; Kopicki et al., 1993; Stock, 1992; Zhu, Geng, 2001; Zhu, Sarkis, 2004
Competitors	Guide et al., 2003; Kleindorfer et al., 2005; Porter, Van Der Linde, 1995; Stock, 1992; Van Hoek, 1999
Community	Kleindorfer et al., 2005; Snir, 2001
NGOs	Carter, Ellran, 1998; Kleindorfer et al., 2005

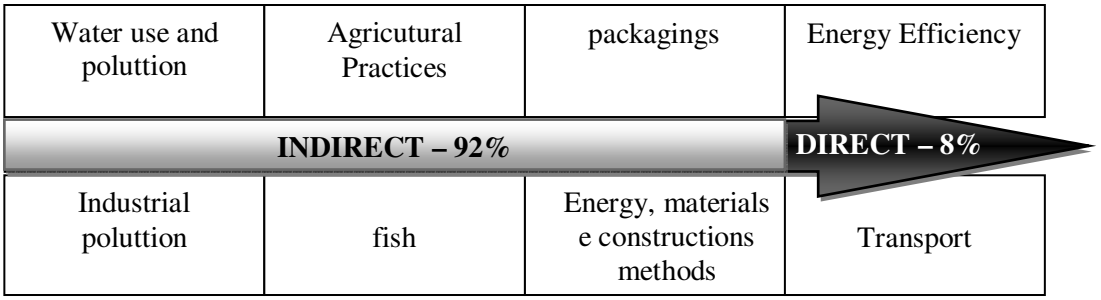
Frame 1: Identification of the stakeholders that affect the structure of the supply chains
Source: own elaboration

The strength of the institutional regulation consists of government, besides consumers, NGOs and lobbying groups that influence government and regulators. It appears that companies are more willing to improve their performance when public pressure results in strong regulations (SNIR, 2001).

Sometimes, the company itself pushes the creation of regulations if it has developed an environmentally friendly technology and believes that the rules requiring this technology would give it a competitive advantage (Kleindorfer et al., 2005). While before the companies were stimulated mainly by governments, now a vast number of different codes of conduct,

administrative standards, certification schemes, eco-labels and systems of global governance are being generated by private unilateral commitments.

Most of these forms of private regulation affects the big transnational corporations, but in many cases they affect smaller companies that are part of the production chain (CONROY, 2007). For example, the fact that the supermarket Wal-Mart has incorporated sustainability leadership as its strategy (CYRILLO, 2008), it may generate millions in economic savings and influence 60,000 suppliers - resulting in the incorporation of sustainable practices on a scale unseen in the business world (ROSENBURG, 2006). Exhibition 2, for example, represents the potential contributions of retail management towards sustainability in the supply chain.



Exhibition 2: Contributions towards the retail sustainable supply chain management
Source: Cyrillo (2008)

Bartley (2007) notes that the production chains globalization and the lack of regulatory capacity of states outside its borders, have led to new forms of "global governance". In this context, the institutional pressures of consumer and regulatory requirements, may represent profitability for business and consequent impacts on the practices of the supply chain, for various reasons (SRIVASTAVA, 2007).

Among them, the scarcity of natural resources already faced nowadays, and its intensification in the future, will strengthen the need to search the values of the waste. Another motivator is the price of non-renewable resources that will increase as increases its

scarcity. This will put these resources increasingly on the business agenda (Svensson, 2007). In this context, a rapid increase of investments in sustainable technologies, operations and supply chains by the forces of the institutional environment listed by Kleindorfer et al. (2005) is expected:

(i) Materials and energy cost – will continue to grow as the global economy expands. Countries like China and India, that are being industrialized, are making strong demands on these resources;

(ii) Public pressure regarding environment, health and safety - is likely to remain strong, leading to the strengthening of property rights, additional regulations, international agreements on the control of negative externalities and resource conservation, and the reduction of subsidies;

(iii) Increased awareness of the triple bottom line issues - can increase consumer demand for products from companies involved in such practices;

(i) (iv) Increased anti-globalization movement - is leading to the strong movement of activities of nongovernmental organizations (NGOs) concerning the company's environmental performance.

When these forces are presented, it is clear that the supply chain management towards sustainability is a process that involves several actors and factors, such as those related to the development of the organizational field, institutionalization and legitimacy of functional and

strategic aspects for the organization. Linton et al. (2007) point to the need of strategies, concerning sustainability, to integrate problems and flows along the supply chain, besides the management of product design, the residues manufacturing, the product life extension, the end of product life, and recovery procedures.

In this sense, GSCM goes beyond the closed loop supply chain (KLEINDORFER et al., 2005) and introduces new practices as well as changes existing ones, to create a new system of production and consumption (LINTON et al., 2007). It happens through different attitudes towards the expansion of this concern, along the chain, ranging from reactive monitoring practices to more proactive environmental programs implemented through various R's: reduce, reuse, rework, refurbishing, recollection, recycling, re-manufacturing, among others (SRIVASTAVA, 2007).

3. METHODOLOGY

This is a theoretical paper whose methodological procedure adopted is the desk research, based on the analysis of six major international journals in the area of management, logistics and operations, available in the electronic portals of EBSCOhost Electronic Journals Service and PROQUEST until 2009 (Frame 2). They are: Journal of Business Logistics, Production and Operations Management Journal, Journal of Operations Management, International Journal of Logistics Management, International Journal of Operations and Production Management, and Management Science.

	Journal	Research source	Date
Journals	Journal of Business Logistics (JBL)	Ebsco e ProQuest	from 1987 to 2009
	Production and Operations Management Journal (POM)	Ebsco e ProQuest	from 1999 to 2009
	Journal of Operations Management (JOM)	Ebsco e ProQuest	from 1980 to 2009
	International Journal of Logistics Management (IJLM)	Ebsco e ProQuest	from 1998 to 2009
	International Journal of Operations and Production Management (IJOPM)	Ebsco e ProQuest	from 1980 to 2009
	Management Science (MS)	Ebsco e ProQuest	from 1954 to 2009

Frame 2: Select Internationals Journals
Source: own elaboration

Based on the theoretical framework developed by Srivastava (2007), shown in Figure 1, the following concepts were investigated in the title, abstract and keywords of the articles: green/environmental purchasing, green product, green/environmental logistics, reverse logistics, reverse chain, closed-loop supply chain, green supply chain, and sustainable supply chain.

The goal of the search was to investigate: a) the history and trends of the researched theme, b) the theoretical and empirical gaps to suggest and guide future research. The process of the articles identification and selection resulted in a reference list of 56 publications between 1995 and 2009.

4. RESULTS

Based on the classification of the scope of the problem, an evolutionary timeline has been prepared. Frame 3 shows that from 1995 to 1997, the themes green product (THIERRY et al., 1995), green logistics (Murphy et al., 1996) and reverse logistics (CHANDRASHEKAR, DOUGLESS, 1996; CLENDENIN, 1997) began to appear in journals

in the area of operations. In 1997 came the first mention of "close the loop of the chain" (Clendenin, 1997), although this concept was not clearly defined until 2001 (FLEISCHMENN et al., 2001). However, it is only since 2003 that this concept is being studied systematically in the subsequent years.

Between 2001 and 2002, studies in reverse logistics gained even more force, but it is perceived that the researches began to expand through the themes within GSCM, with studies in reverse chain (FLEISCHMANN et al., 2001) and green supply chain (RAO, 2002). It was between 2003 and 2005 that there has been a great impetus to the issue, when studies focus on green product (KLEINDORFER et al., 2005), reverse supply chain and closed loop supply chain with great emphasis, green supply chain and mainly reverse logistics.

Finally, since 2006, much focus was given to the subject in general, with the presence of studies in green product, to return to green logistics, continuity of attention to reverse logistics, but with the growing number of studies in reverse chain, closed loop supply chain and green supply chain, indicating the expansion of the approach to a more systemic and comprehensive view.

Thematic			Years			
			1995	96	97	98
Sustainable Supply Cahin Management (SSCM)	**Green Design**	**Green product**	Thierry et al (1995)			
	Green Supply Chain Management (GSCM)	**Green operation**				
		Green/ sustainable purshing				
		Green/ sustainable logistics		Murphy, Poist e Braunschweig (1996)		
		Reverse logistics		Chandrashekar e Dougless (1996)	Clendenin (1997)	Carter e Ellram (1998)
		Reverse chain				
		Closet loop supply chain			Clendenin (1997)	
		Green supply chain				
	Sustainable supply chain					
Total			**1**	**2**	**1**	**1**

Frame 3: Evolution of the theme of SSCM in selected international journals (Continued)

Source: Research Data

Thematics			Years			
			99	00	01	02
Sustainable Supply Cahin Management (SSCM)	Green Design	**Green product**			Chen (2001)	
	Green Supply Chain Management (GSCM)	**Green operations**				
		Green/sustainable purchasing			Min e Galle (2001)	
		Green/sustainable logistics				
		Reverse logistics	Blumberg (1999)		Rogers e Tibben-Lembke (2001); Daugherty, Autry e Ellinger (2001); Majumder e Groenevelt (2001); Fleischmann et al (2001)	Rogers et al. (2002); Daugherty, Myers e Richey (2002); Souza, Ketzenberg e Guide (2002)
		Reverse chain			Fleischmann et al (2001)	
		Closed loop supply chain			Fleischmann et al (2001)	
		Green supply chain				Rao (2002)
	Sustainable supply chain					
Total			**1**	**0**	**6**	**4**

Frame 3: Evolution of the theme of SSCM in selected international journals (Continued)

Source: Research Data

Thematic			Years			
			03	04	05	06
Sustainable Supply Cahin Management (SSCM)	**Green Design**	**Green product**			Kleindorfer, Singhal e Wassenhove (2005)	
	Green Supply Chain Management (GSCM)	**Green operations**				
		Green / sustainable purchasing		Carter e Jennings (2004)		
		Green / sustainable logistics				Aronsson e Brodin (2006)
		Reverse logistics	Daugherty et al (2003)	Richey et al. (2004); Kulp, Lee e Ofek (2004); Savaskan, Bhattacharya e Wassenhove (2004)	Mukhopadhya y e Setoputro (2005); DeCroix e Zipkin (2005)	Tan e Kumar (2006); Savaskan e Wassenhove (2006); Tang e Teunter (2006); Aras, Vertere Boyaci (2006); Vorasayan e Ryan (2006)
		Reverse Chain				Guide et al (2006); Atasu e Cetinkaya (2006); Bakal e Akcali (2006)
		Closed loop supply chain	Guide, Jayaraman e Linton (2003)	Savaskan, Bhattacharya e Wassenhove (2004)	Kleindorfer, Singhal e Wassenhove (2005)	French e LaForge (2006); Guide et al (2006); Guide e Wassenhove (2006a); Guide e Wassenhove (2006b); Debo, Toktay e Wassenhove (2006); Georgiadis, Vlachos e Tagaras (2006); Ketzemberg, Laan e Teunter (2006); Rajamani, Geismar e Sriskandarajah (2006)
		Green supply chain		Zhu e Sarkis (2004)	Rao e Holt (2005); Zhu, Sarkis e Geng (2005)	Vachon e Klassen (2006)
	Sustainable supply chain					
Total			**2**	**5**	**5**	**18**

Frame 3: Evolution of the theme of SSCM in selected international journals (Continued)

Source: Research Data

Thematics			Years			Total of citations
			07	08	09	
Sustainable Supply Cahin Management (SSCM)	**Green Design**	**Green product**				**3**
	Green Supply Chain Management (GSCM)	**Green operations**				**0**
		Green / Sustainable purchasing				**2**
		Green / Sustainable logistics				**2**
		Reverse logistics	Webster e Mitra (2007)	Hanafi, Kara e Kaebernick (2008)	Stock e Mulki (2009)	**26**
		Reverse Chain	Kocabasoglu, Prahinski e Klassen (2007)	WiknereTang (2008)		**6**
		Closed Loop supply chain	Matos e Hall (2007); Webster e Mitra (2007)	WiknereTang (2008); Atasu, Guide e Van Wassenhove (2008)		**16**
		Green supply chain	Simpson, Power e Samson (2007)	Lee e Klassen (2008)		**7**
	Sustainable supply chain		Linton, Klassen e Jayaraman (2007)			**1**
Total			**5**	**4**	**1**	**56 63**

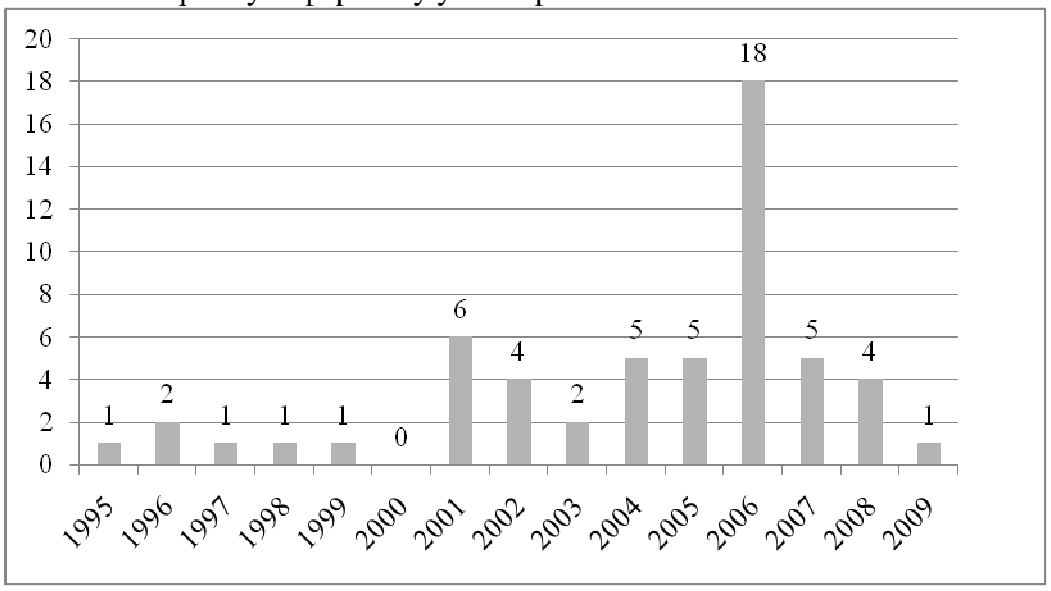
Frame 3: Evolution of the theme of SSCM in selected international journals
Source: Research Data

The sustainability management concept in the supply chain appeared in theses international journals only in 2007 (LINTON et al., 2007), which shows the relevance of the topic, although this is only the union of all the issues studied separately, in a systemic view of the entire supply chain and its components.

The years of greatest international publication, 2001 and 2006, represent special issues of two journals (Chart 1). In 2001, the International Journal of Operations and Production Management (IJOPM) published in its 21st volume, the number 12 on the subject of Sustainability. While the Journal of Production and Operations Management (POM) published in its 10th volume a sequence of two special issues: Environmental Management and Operations Management: Introduction to Part 1 (Manufacturing and Eco-Logistics) and Environmental Management and Operations: Introduction to Part 2 (Integrating Operations and Environmental Management Systems). In 2006, the same journal published another sequence of special issues in its 15th volume: the number 3 on the theme Closed-Loop Supply Chains (Part 1), and the number 4 named Closed-Loop Supply Chains (Part 2).

The results show that 50% of the work involving the main concepts in that define the theme of GSCM appeared in the last three years (2005 to 2008), which indicates the need for maturation, suggesting a field with great scope for future studies.

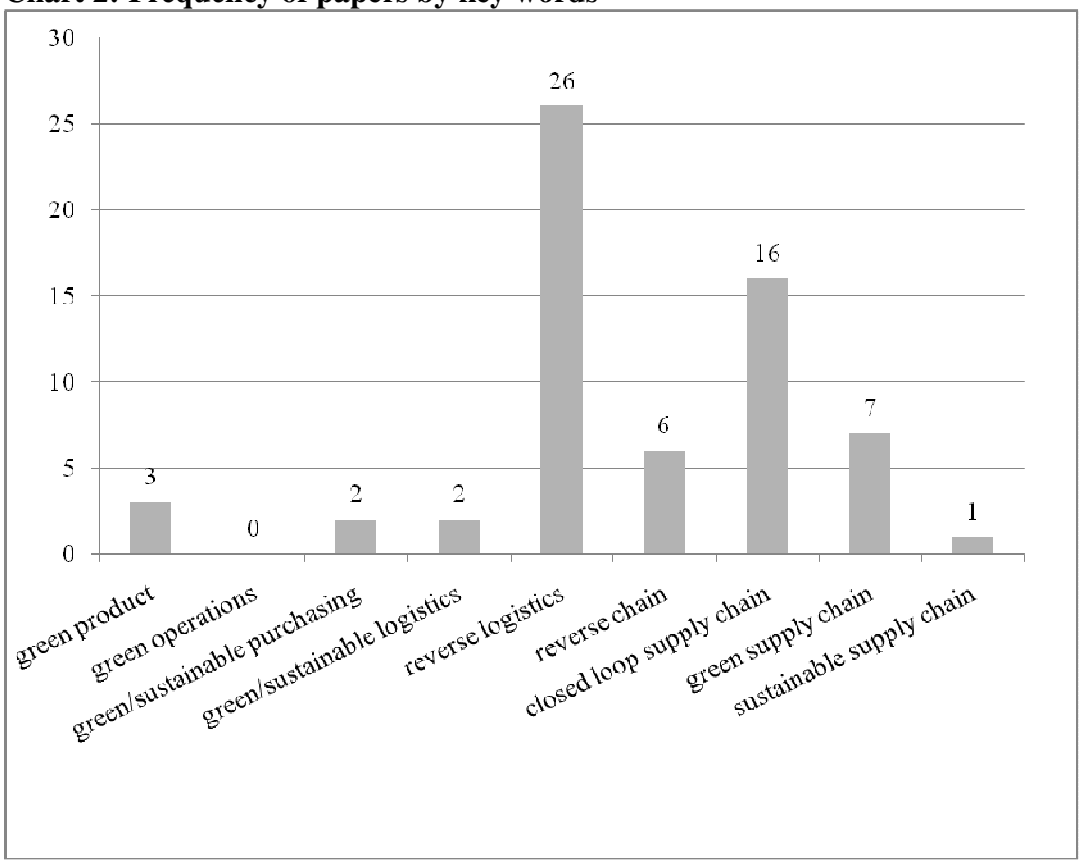
Chart 1: Frequency of papers by year of publication



Source: research data

When analyzing the keywords most frequently cited (Chart 2), we observe that it deals with the concept of reverse logistics (46%), followed by the concept of closed loop supply chain (29%).

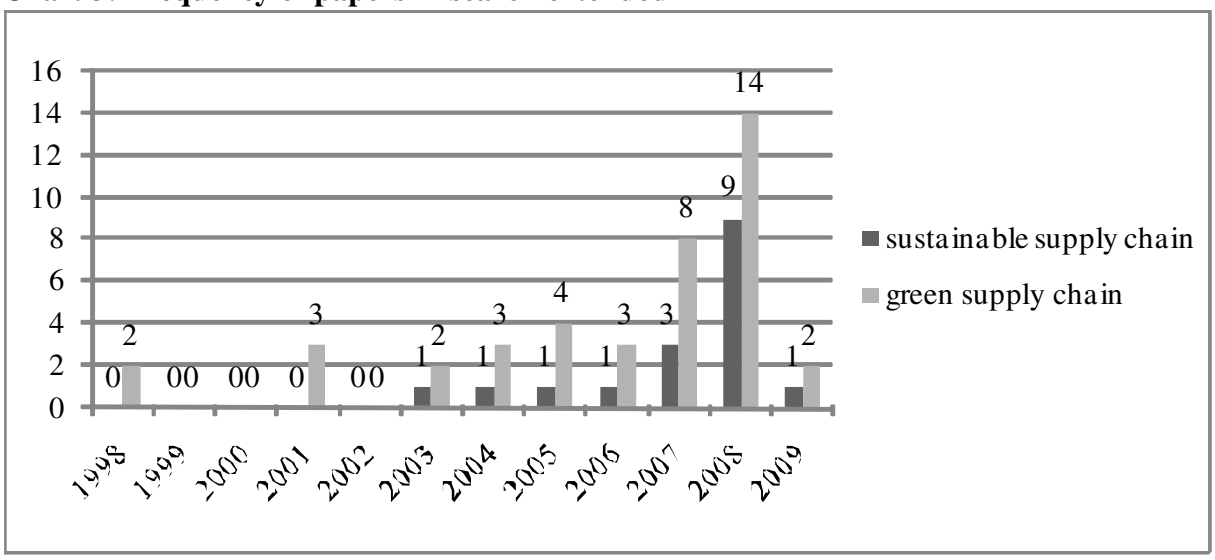
Chart 2: Frequency of papers by key words



Source: Research data

The results show that the international research covered eight of these nine concepts, demonstrating the expansion of research on the subject. However, only one article addressed the term sustainable supply chain (LINTON et al., 2007), showing that even the international mainstream of the area of operations have not yet incorporated the SSCM theme. This finding was corroborated by the extended search of this term in the EBSCOhost Electronic Journals Service portal, that showed 17 articles on SSCM. Even so, although the first mention of the term dated in 2003, 70% of the results were from 2007. The same result repeated when searching the term green supply chain, that appeared in 60% of the results also from 2007 on (Chart 3).

Chart 3: Frequency of papers in search extended



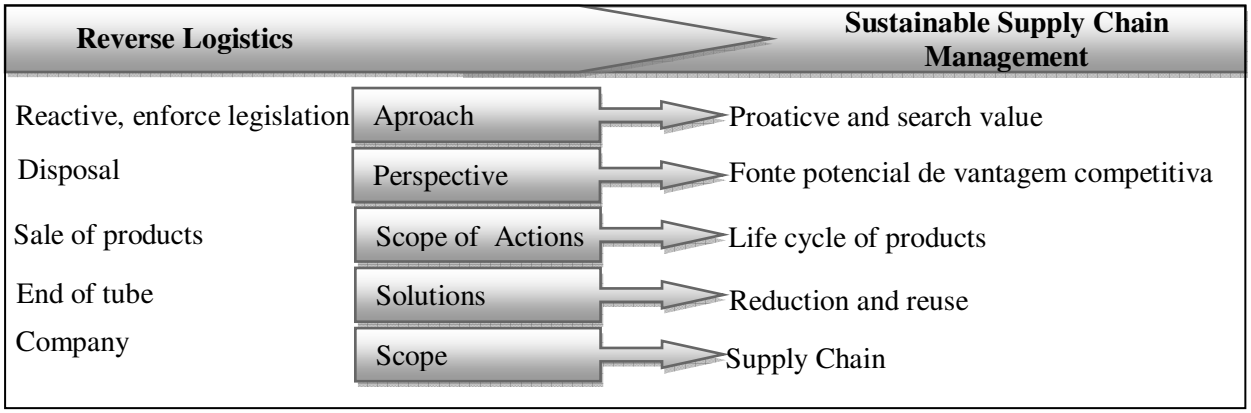
Source: research data

Considering the prevalence of studies addressing the concept of reverse logistics it is important to consider that, despite some initial advances, the literature on reverse logistics has provided a limited approach to classify the relationship between the organization and its natural environment, failing to address the conditions and factors that must be observed for a company to structure itself towards sustainability (HANDFIELD et al., 1997). The studies of reverse logistics are concentrated in the

inner space of business organizations and in their ability to implement policies for reuse and recycling of waste and / or products and services aggregated factors of an organization (VAN HOEK, 1999).

Research initiatives are needed to cover this gap. Specifically, research should move from reverse logistics in the direction of the development of sustainability management in supply chains. Thus, the inclusion of the supply chain approach represents a systemic perspective to achieve the initiatives more connected with the perspective of sustainability (van Hoek, 1999), as outlined in Figure 2.

Exibition 2: From Reverse logistics to Sustainable Supply Chain Management



Source: Van Hoek (1999, p.132)

In accordance with the proposal of Van Hoek (1999) it was considered in this paper that the reverse logistics alone is not enough for an integrated supply chain view, although it is a topic of great importance within the whole issue. But the approach of sustainability throughout the supply chain is more relevant to the understanding of the relationship between business and the environment.

5. CONCLUSIONS

The analysis of the theme from historical periods in important international journals in the area of operations provides a broad framework that directs concepts development, and future research based on aspects of sustainability within the supply chain.

In general, it is observed that the subject is growing in international publications. However, the study of sustainability requires interdisciplinary, and the analysis of other areas can complement the understanding of the state of the art of research on the subject.

Specifically, this article points out the need for more complete studies with the integration of the issues of sustainability and supply chain management, treating them in a systemic way. GSCM can reduce the environmental impact of industrial activity without sacrificing quality, cost, reliability, performance or efficiency of energy use. The subject launches a number of challenges for managers, academics and researchers. GSCM involves a paradigm shift in which the issue of sustainability is no longer seen as a source of costs, representing a potential source of competitive advantage for companies (GUIDE et al., 2003; VAN HOEK, 1999), as proposes the Porter's hypothesis.

This expanded perspective raises both strategic and operational issues and, therefore, opportunities for research. Such issues are also obstacles to the consolidation of the literature and practice of sustainability in the supply chain. Among them are: (1) the uncertainty regarding the quality, quantity and time of return of goods, containers, pallets and packages; (2) the costs to collect and transport them; (3) the existence of

potential profit for companies wishing to develop skills in GSCM and reverse supply chains; (4) the value recovery in the return flows of products; (5) the influence of governmental regulators in competitiveness; (6) and the uncertainties that influence the relationships within the GSCM.

Moreover, the inherent complexity of the environmental issue - its multiple stakeholders, uncertain implications for competitiveness and international importance - present significant challenges for researchers. Research is very important to support the development of business in order to turn the entire supply chain green.

Another point to be more fully explained is that GSCM research so far can be considered ad hoc, fragmented and partial. Therefore, more integrative contributions are needed in the long term, including dissemination of best practices, transfer of green technology and measure environmental performance within and between companies along the chain.

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