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Integrated Framework for Managing Sustainable Supply Chain Practices

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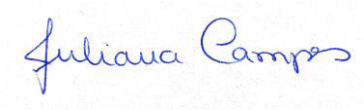
Berlin, September 9th, 2015



Abstract

The pressure on companies towards sustainable development is changing the way they are dealing with their supply chain network. Practices are not limited to the company level. They are involving suppliers, customers, government, society and other stakeholders that impact and are impacted by the actions to improve economic, environmental and social responsibility. This book presents a framework which can be used in practice and research for managing practices, possible to be implemented in different industries worldwide, and which intends to add value to the customers. It is composed by three clusters, seven groups and 21 sub-groups of practices. It was built with data colleted from a systematic literature review with more than 2000 documents analyzed and refined with workshops and interviews with academics and practitioners. The framework offers a holistic view of practices for improving supply chain sustainability and the integration between them. It has proven to be a valuable instrument for supporting decision planning.

Zusammenfassung

Die Herausforderungen nachhaltigen Handelns beeinflussen in Unternehmen in besonderem Maße das Management und den Aufbau von Supply-Chain Netzwerken. Derartige Veränderungen beschränken sich dabei nicht nur auf das jeweilige Unternehmen, sondern beeinflussen alle Akteure im Netzwerk, bspw. Lieferanten und Partner, sowie die Kunden, die Gesellschaft und den Staat. Diese zahlreichen Stakeholder sollten durch Ansätze nachhaltigen Handels in der Art beeinflusst werden, dass eine zunehmende ökologische und soziale Verantwortung auch zu verbesserten ökonomischen Ergebnissen führt. Dieses Buch stellt einen Ordnungsrahmen nachhaltigen Handels vor, welcher weltweit in Praxis und Forschung in unterschiedlichen Branchen realisiert werden kann und darauf abzielt den Mehrwert für die Kunden zu erhöhen. Der Ordnungsrahmen setzt sich dabei aus drei Bereichen zusammen, welche sich wiederum in sieben Gruppen und 21 Untergruppen unterteilen lassen. Die für die Entwicklung des Ordnungsrahmens relevanten Daten wurden dabei durch eine systematischen Literaturrecherche erhoben und geordnet, in deren Verlauf mehr als 2000 Dokumente analysiert wurden. Zwischenergebnisse wurden dabei in Workshops mit Praktikern und Wissenschaftlern bewertet, weiterentwickelt und zusätzlich durch Experteninterviews validiert. Der Ordnungsrahmen zur Nachhaltigkeit in Supply-Chain Netzwerken bietet eine ganzheitliche Sicht auf Verfahren zur Verbesserung der ökonomischen, ökologischen und sozialen Nachhaltigkeit sowie auf die Integration der einzelnen Bereiche und hat sich als wertvolles Instrumente zur Unterstützung von unternehmerischen Entscheidungen erwiesen.

Contents

List of figures

List of tables

1. Introduction

Sustainability is a heavily discussed topic worldwide. Researchers have been trying to measure the impact of different strategies on companies' performance. Governments are seeking to understand their role in this global movement, in an attempt to regulate companies' actions and therefore contribute to sustainable development. At the same time, organizations are struggling to reduce their negative environmental and social impacts while responding to consumers' pressures for supply chain transparency and ecologically-efficient products/services. Nevertheless, although the focus on sustainability actions has been increased, recent surveys show that a structured model for managing sustainable supply chain practices is still missing.

The present research is part of a limited group that offers a holistic research view about the topic. In an attempt to fill these gaps, a framework composed by three clusters, seven groups and 21 sub-groups of practices, embracing not only internal supply chain management but also supplier and customer relationship management was built. This process consisted of three stages. First, a systematic literature review was conducted and more than 2000 documents analyzed. Some international recognized models from other research fields were incorporated.

All collected practices were then clustered in a structured framework and validated in workshops and interviews with supply chain experts. It offers an integrated and broader view of sustainable supply chain management and is unique due to its structured format and methodological rigor. It provides supply chain managers and governance bodies from different fields a concrete guidance about the vast opportunities for increasing sustainability in supply chain context. It can be used as a structured management tool, supporting planning and decision making process.

Due to its supply chain complete view, it allows identifying synergies between members of a network, turning it into a more sustainable one. In

the research field, it suits as a background structure during the design phase and allows comparative works based on a same common model. The present framework may enable and motivate collaboration between supply chain's members, company's functional areas and formal institutions such as governments and Non-Governmental Organizations (NGOs), providing outstanding results to all involved parts.

2. Current Literature about Sustainable Supply Chain practices

The first phase of this research consisted of a systematic Literature Review was conducted. This is a method widely used in medical science researches and transferred to management science (Denyer and Tranfield, 2009). It differs from the traditional literature review in some aspects: starts from a systematic planning process, uses objective methods of literature selection (published or not), demand from the researchers the preparation of a review protocol describing details about criteria that were used. This makes easier the exact reproduction of the original research, for instance using data from other country. A comparative analysis between results also turns to be more appropriate and conclusions more scientific valuable. Systematic literature review is a method that offers an efficient procedure with a high quality level on the identification and extensive evaluation of literature databases (Tranfield, Denyer and Smart, 2003; Denyer and Neely, 2004). Thus, it is characterized as a transparent, reproducible and structured method for conducting a literature review (Briner and Denyer, 2012). In order to maintain the review focus, a formal protocol describing every steps of the process was designed. This document is very important for keeping the research transparent and reproducible. According to (Durach, Wieland and Kembro, 2014), six steps are recommended when using the systematic literature review method: Determination of Focus of Review, Preparation for the Literature Search, Search for literature, Selection of pertinent literature, Analysis and synthesis of literature and Reporting and using the review results.

2.1 Determination of Focus of Review

The main research question for the review aimed to understand the state-of-the-art of SSC practices research and was stated as "What is known from the existing literature about sustainable practices in supply chain?"

2.2 Preparation for the literature search

The process identifying and describing the inclusion and exclusion criteria considering the research question helps to establish a limitation for the literature search. Six selection criteria were used. First, the literature should focus on activities directly related to supply chain management. It envolves the management of activities that starts in sourcing and procurement, and includes all logistics management activities such as warehousing and transport. It includes, additionally, coordination and collaboration with channel partners, such as suppliers, intermediaries, service providers, and customers (Council of Supply Chain Management Professionals, 2015).

Literature must cite or describe practices, projects, actions and strategies. It must also consider at least environmental or social aspects. Studies about one specific company (case studies), industry or country were accepted. Practices from literature reviews about the topic were not considered, as this would incur in duplication of results. Therefore when a material contained only a literature review, it was discarded. Finally, the text must be in English or Portuguese so both reviewers could analyze without the need of a translating service. No limitation on the type of publication was included. Thus, reports from industries, governments and consultancy companies, project reports, books, articles published in journal of any kind or in conferences, working papers, technical/logistics magazine, among others.

2.3 Search for literature

Aware of the importance of choosing an appropriate method for literature search, three sources were used: two online databases, references cross check and literature recommendations from SSC researchers. The use of multiple methods is appropriate to reduce the risk of missing out on important literature and must be transparently reported upon (Durach, Wieland and Kembro, 2014).

Source one: Online databases

Defining Keywords:

For searching in electronic databases, authors should define the keywords, which help to build the search strings. Some authors suggest involving academicians/colleagues (Fawcett and Waller, 2011), from different countries (e.g., developed versus emerging markets) and with different research focus within the SCM field (Durach, Wieland and Kembro, 2014). These may offer a broader perspective and increase the theoretical contributions. Following these instructions, seven supply chain experts from academic community in four different countries – Germany, France, United Kingdom (UK) and Brazil, were consulted for contributing with relevant keywords related to the main research question.

Identifying databases and constructing search strings:

After defining the appropriate keywords which refine the research question, a librarian from business science and economics was consulted as suggested by Duff (1996). He assisted on identifying appropriate databases and refining the search strings (table 1) after being instructed about the research question and the expected kind of results. According to his recommendations, Web of Science (WoS) (using the Science Citation Index Expanded) and Business Source Complete were defined as databases which contain a large amount of leading scientific and technical journals across hundreds of disciplines, reports and magazines.

Literature on this subject was searched with no restriction on publication years or publication types, and without any privilege for quality ratings journals. The language was filtered to English or Portuguese as both of the reviewers could read only these languages. Due to the large quantity of results on Web of Science database that were not related to the current research topic, some restrictions had to be made. Only references from the following areas of studies were collected: Management, environmental sciences, business, operations research management science, engineering environmental, engineering manufacturing, engineering industrial, environmental studies, ecology, social work, ethics, economics, planning development, energy fuels, engineering civil, transportation, transportation science technology, urban studies, engineering chemical, engineering electrical electronic, engineering mechanical, public administration and water resources.

The search was conducted on August 2013 and prompted on 1935 pieces of literature on the subject matter: 880 from Web of Science and 1055 from Business Source Complete (BSC) using EBSCO Search Engine. After the exclusion of duplicates, 1628 were considered for the next step.

Dababase	Search string
Web of Science	Title=((Sustainab* OR Green* OR Ecologic* OR Social*) AND (Supply chain* OR Logistic*) AND (Practice* OR Practice* OR Action*)) OR Topic=((Sustainab* OR Green* OR Ecologic* OR Social*) AND (Supply chain* OR Logistic*) AND (Practice* OR Practice* OR Action*)) Timespan=All years. Databases=SCI-EXPANDED, SSCI.
BSC	AB ((Sustainab* OR Green* OR Ecologic* OR Social*) AND (Supply chain* OR Logistic*) AND (Practice* OR Practice* OR Action*)) OR TI ((Sustainab* OR Green* OR Ecologic* OR Social*) AND (Supply chain* OR Logistic*) AND (Practice* OR Practice* OR Action*))

Table 1: Search strings

2.4 Selection of pertinent literature

Applying selection criteria to select pertinent literature

In order to refine the selection criteria, 50 random literature was analyzed by two independent researchers. After the proper evaluation process, they discussed the results and adjusted the selection criteria in such a manner which makes them better understandable. The need for reading not only the title but the abstract was also evident after this process. Some titles were too broad and some were so specific that it was not clear the research scope.

After all the adjustments were made, the same researchers individually and blindly read all of the abstracts/titles. This process is recommended to be done by at least two reviewers as well as the calculation of the Cohen's κ indices (Cohen, 1968) aiming to reduce researcher bias and establish inter-rater reliability (Durach, Wieland and Kembro, 2014). It is important to highlight that the reviewers only had access only to limited information about the reference (title and abstract), in a way that information such as author and journal did not influence on reviewer decision on selecting the literature. If the relevance of a study was unclear just by reading the abstract, the decision should favor the inclusion for full reading. After each individual completed the screening, the findings were crosschecked. The Cohen's kappa statistics was calculated (0.85) and showed that the raters agreed on most of their classifications. A Cohen's kappa of "1" means 100% agreement. For the disagreements, the reviewers discussed until a final common decision or in case of not final agreement, they were automatically included for full reading. A total of 429 pieces of literature from online databases were selected.

Appraising literature quality or validity

After the pre-selection through titles and abstract reading (step 4), copies of the full article were obtained for those studies that appeared to help

answerting the research question, and two researches in a blind view process read all full articles and selected those that contained information that could help answering the research question. During this process, only considering sources from online databases, 429 pieces of literature were read and 79 pre-selected for the framework development process. In order to complement the amount of relevant references, two other sources were consulted: References sections from these pre-selected papers and recommendations from the authors of these papers.

Source two: References Cross check

As suggested on literature about systematic literature review (Durach, Wieland and Kembro, 2014), the reference sections of papers and books may contain interesting material to be added for full reading. Hence, sections of the 79 pre-selected literature from online databases were examined and according to the titles and its conformance with the research interest, included for full reading. A total of four additional literature were added.

Source three: Extra literature

Another strategy tested on this review was contacting some authors of some of the selected articles/books. Customized emails were sent to 76 authors (from the 79 selected literature from online databases). In this email, authors were asked to send recommendations of extra literature that could help answering the research question. A total of 29 authors answered and they suggested 117 literature. After excluding the duplicates and applying the selection criteria, 16 articles, books and companies reports were added. They also suggested contacts with other researchers and some specific research centers. A summary of the search and selection process is available on table 2 and as shown from 2052 documents, 99 were selected for building the framework of sustainable supply chain practices.

Source	Initial list	Selected after title/abstract reading	Selected after full reading text
Web of Science	880	279	52
Business Source Complete	1055	150	27
References section from 79 selected papers (WoS and BSC)	-	42	4
Author´s recommendation	117	77	16
Total	2052	548	99

Table 2: Summary of the results/source

2.5 Analysis and synthesis of literature

The profile of the selected 99 documents, resulted from the systematic literature, is presented hereinafter, and the detailed synthesis of the literature on topic.

Year of publication

When the selected literature are analyzed according to the publication year, it is spread over the years since Joseph Sarkis published "Evaluating environmentally conscious business practices" in European Journal of Operational Research in 1998. In 1999, the same author published an internal article at the Clark University "How Green is the Supply Chain? Practice and Research" about practices related to green supply chain. In the same year, Bjarne E. Ytterhus and researches from the Norwegian School of Management published in Eco-Management & Auditing Journal the paper "Environmental practices in the retailing sector: an analysis of supply chain pressures and partnerships" exposing since that time the transaction from Total Quality Management to Total Quality Environmental Management. The focus on environmental/green aspect is as well clear.

As shown in figure 1, the amount of materials focused on practices towards a sustainable supply chain has been increasing, especially after 2005. Selected literature from 2006-2013 represents 84% of the total. On the same time span of 8 years (1998-2005) only 16% of the total was published. Other authors that researched publications in the area of green supply chain management identified papers from 1992 and reaching more than 200 references in 2012 (Fahimnia, Sarkis and Davarzani, 2015)

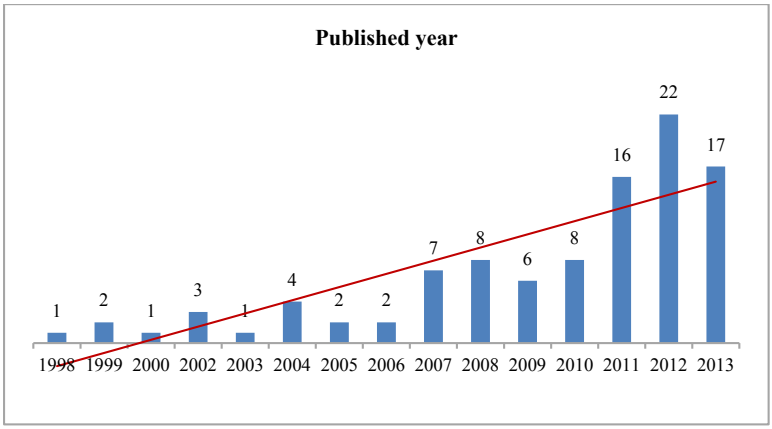


Figure 1: Publications per year in the area of sustainable supply chain practices (Source: own author)

On the other hand, figure 2 shows some interesting results from google trends. The red line represents the amount of searches for the term "green supply chain" while the blue line of searches for "sustainable supply chain" on google website. Firstly, it is clear the continuous and steady amount of searches related to these topics from 2007, with a stronger emphasis on green aspect. Secondly, while the trend for online searches for these terms is somehow stagnant, discussions and publications about practices (figure 1) are clearly increasing. It is, though a natural movement of a new topic, when its concepts need at first to be deeply studied and understood, and then applied in real cases. The topic sustainable supply chain practices is, therefore, a relevant subject and calls for applied researches.

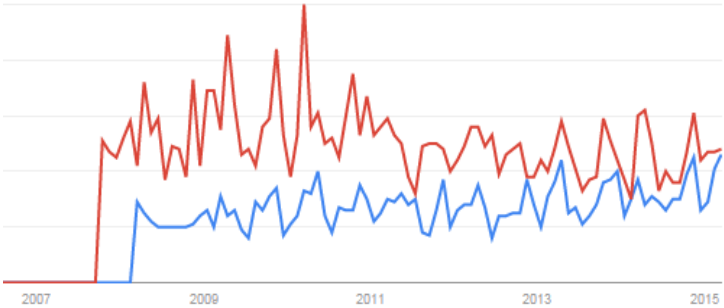


Figure 2: Search for "green supply chain" (red) and "sustainable supply chain" (blue) (Source: google trends)

Sources

As shown in table 3, pieces of literature about sustainable supply chain practices are published in a large variety of sources. The 99 references were available in 59 different journals, magazines, books, reports and conference proceedings. It proves its interdisciplinary comprehensiveness, from economics, operations and environmental management, to ethics and data management. The International Journal of Production Economics published 11 (11%) of the selected materials even though there is no large predominant source.

Journal	Freq.
International Journal of Production Economics	11
International Journal of Operations & Production Management	5
Supply Chain Management-An International Journal	5
Journal of Cleaner Production	5
Resources Conservation And Recycling	4
International Journal of Production Research	3
Business Strategy And The Environment	3
Benchmarking: An International Journal	3
Journal of Commerce	3
Books	3
Reports	3
Proceedings to conferences	3
International Journal of Physical Distribution & Logistics Management	2
Book: The Chartered Institute Of Logistics And Transport (UK)	2
IEEE Transactions on Engineering Management	2
Transportation Research Part E-Logistics And Transportation Review	2
European Journal of Operational Research	2
Journal of Business Ethics	2
Industrial Management & Data Systems	2
Others	35

Table 3: Publications/source

3. Framework building process

Within the selected literature, beyond sustainable supply chain practices, researchers also searched for a framework, with a holistic network view and that could be used to organize the collected material.

The need of an organizational framework for to spur green was stated in an international survey from ForberInsight with 308 C-level executives at large global enterprises (Forbes Insights, 2011) (figure 3). To fill this gap and understand the logic when building a framework, some well-recognized models from strategy and supply chain field were studied. In the end, workshops with experts were conducted in an attempt to initiate the development process and personal interviews with company's and research leaders confirmed its importance, clear logic and applicability.

Figure 3: Companies need an organizational framework to spur green (Source: Forbes Insights, 2011)

3.1 Well-recognized models

Value Chain Model

The term 'Value Chain' was first used in 1985 by Michael Porter in "Competitive Advantage: Creating and sustaining superior Performance" (Porter, 1985). According to this author, a value chain consists of the activities executed by a company that create and build value to its customers. Hence, an organization is considered more than just structure, people and flows of information, goods and services. In order to create value and produce what customers are willing to pay, companies should rearrange these components and manage the connections between them. It also

generates opportunities for creating competitive advantage. Porter separates the value chain in primary and support activities. Primary are those responsible directly for the development and delivery of the company's core product or service. These are: inbound logistics, manufacturing, outbound, marketing/sales and service. Support activities, on other hand, are those that enable the company to execute the primary activities, for instance, infrastructure, Human Resource Management, Information Technology, and others.

The three supply chain sub-systems

The model from Sunil Chopra and Peter Meindl organize Supply Chain in three macro processes: Supplier Relationship Management (SRM), Internal Supply Chain Management (ISCM), and Customer Relationship Management (CRM) (Chopra and Meindl, 2004). According to the authors, these processes manage the flow of information, goods and funds required to generate, receive and fulfill a customer request. SRM aims to manage supply sources for various goods and services. ISCM include planning production and storage capacity, preparation of demands and supply plans, and internal fulfillment of orders. CRM include managing the call center taking orders and providing services to clients/customers. For a successful supply chain it is crucial that the three macro processes are well integrated. Therefore, firms should ensure manage the interactions between each player from the network, both internal and external ones.

3.2 Workshops and interviews with experts

To build the framework for managing sustainable supply chain practices, all relevant information from the selected papers were reduced by repeated reading and the study data extracted according to the research question. Next, all cited practices from the selected articles were adjusted according to the similarity of the sentences/names/concepts (e.g. "green

purchasing" and "eco-procurement" were merged into "green procurement"). In case of doubts, practices were not merged. The findings of the systematic literature review provided an interesting but unstructured amount of data. Clustering is a useful technique in text mining for discovering interesting data distribution and patterns from unorganized data (Pons-Porrata, Berlanga-Llavori and Ruiz-Shulcloper, 2007). For clustering qualitative data and framework building, the Q-methodology and the "Cutting and Sorting" technique showed to be very useful. The literature suggests that after identifying quotes or expressions that seem to be relevant, each quote should be printed on a small sheet of paper and independent reviewers should arrange them into similar piles (Lincoln, 1985). For the present research, two workshops with different groups of researchers and practitioners were carried out. Individual interviews were also necessary.

The first workshop was carried with five supply chain experts - four independent researchers and one practitioner. They were invited to cluster 101 cited practices, printed in sheers of papers and asked to organize them in a structured and logic way. Results varied and each participant could present their results. After this "clustering" workshop, a first version of the framework was developed and discussed in a second workshop with different researchers, part of the sustainability group of the chair of Logistics and Production Management of the Berlin University of Technology. Their feedback were considered and the framework was then discussed in individual interviews with professors from universities worldwide and practitioners from two well-recognized companies in Germany as very active on sustainability forums – BASF and DHL. Their considerations were aligned with the results of an international survey (Forbes Insights, 2011) which showed the need of an organizational framework to spur green business practices. The interviewees' positive feedback were: the structure is clear and logic, it includes a broader definition of suppliers (which includes subcontractors), it is aligned with international collaborative platforms such as Green Freight Europe pro-

gram (independent voluntary program for improving environmental performance of road freight transport in Europe). They suggested some adjustments regarding the detail level of each sub-practice to better understand its content, and suggested some future researches to evaluate its suitability for different industries, including service sector.

4. Integrated Framework for Managing Sustainable Supply Chain Practices

The proposed framework intends in a first sight to represent a holistic view of a supply chain network and its macro processes: Supplier Relationship Management (SRM), Internal Supply Chain Management (ISCM), and Customer Relationship Management (CRM) (Chopra and Meindl, 2004). Those three subsystems fit each other perfectly representing the integrated and efficient flow of goods, services and related information from the point of origin to the point of consumption in order to offer value to the customers. In the sustainability context, offer value means developing social-environmental responsible products and services, implement business processes that require less resources and emit less waste, collaborate with suppliers and customers in order to reduce overall carbon footprint in the whole supply chain, among others. Therefore, all activities and practices should somehow offer value to the customers through the balance of the three aspects of the TBL.

The "Integrated framework for managing sustainable supply chain practices" (Figure 4) is composed by three clusters, 7 groups and 21 subgroups of practices. The first cluster, Supplier Relationship Management (SRM) consists of the Supplier Relationship sub-group, which includes practices that focus on the interaction between the company and its suppliers (Chopra and Meindl, 2004). The Internal Supply Chain Management (ISCM) cluster consists of five groups, related to the company's internal supply chain activities: governance, procurement, production, distribution and waste management. Similar to Porter's approach (1985) of support activities, Governance group contains practices that enables the other groups to be successful. It involves the definition of formal policies towards corporate sustainability, the control and alignment of these instructions and values with employees, investors, but also with external

stakeholders such as governments, NGOs and other companies. Therefore, Governance group is purposely in the framework designed in a way that exceed the corporate limits (ISCM cluster), being inserted into the SRM and CRM clusters. Another characteristic of this group is its format. Different than the other groups from ISC, Governance does not intend to represent the actions' flow, but the continuity of supportive actions. Procurement, which is directly linked with suppliers, is the sub-group of ISCM responsible for obtaining all necessary materials and services used during production (e.g. sustainable materials) and support materials for distribution (e.g. reusable pallets, recyclable packaging). Production Management group is not observed with a traditional departmental view, normally represented between procurement and distribution. The logic of this group is represent a broader collection of practices that since the design of a new product together with suppliers (SRM), produce solutions with an efficient resources use and distribute them. The final value delivered to customers (CRM) includes a combination of sustainable goods, services, technologies and processes. To enable this, similar to Governance, Production Management group is integrated visually with SRM and CRM clusters, and additionally support all other groups from ISCM. The Distribution group consists of practices related to the delivery of the final good or service and all the logistics network involved to make this happen in a more economic, social and environmentally way. The last group in ISCM is Waste Management, representing the reverse flow of overall waste generated by the company and its network, practices to reduce the disposable waste and capturing the value from it (reusing, remanufacturing, and recycling). It also considers pollution waste and overall emissions derived from the supply chain. The Customer Relationship Management (CRM) cluster consists of the Customer Relationship group, which includes practices to be implemented together with the customers, in order to involve them into the supply chain responsibility.

The Appendix 7.1 - Percentage of practices identified in the systematic literature review, shows that literature about this topic concentrates on supplier relationship (76,8%) and governance (73,7%) groups. Among the

99 selected literature, 51,5% cited practices about supplier selection, 49,5% about supplier assessment and 58,6% about supplier collaboration. These were the most cited sub-groups of practices, followed by business alignment with 47,5%. On the other hand, only 38,4% cited practices related to customer relationship, especially searching for customers' demands on sustainable solutions (11,1%). Waste disposal (14,1%) was also another sub-group with very less initiatives described or cited on the selected literature. The details of this analysis will be presented in the following pages.

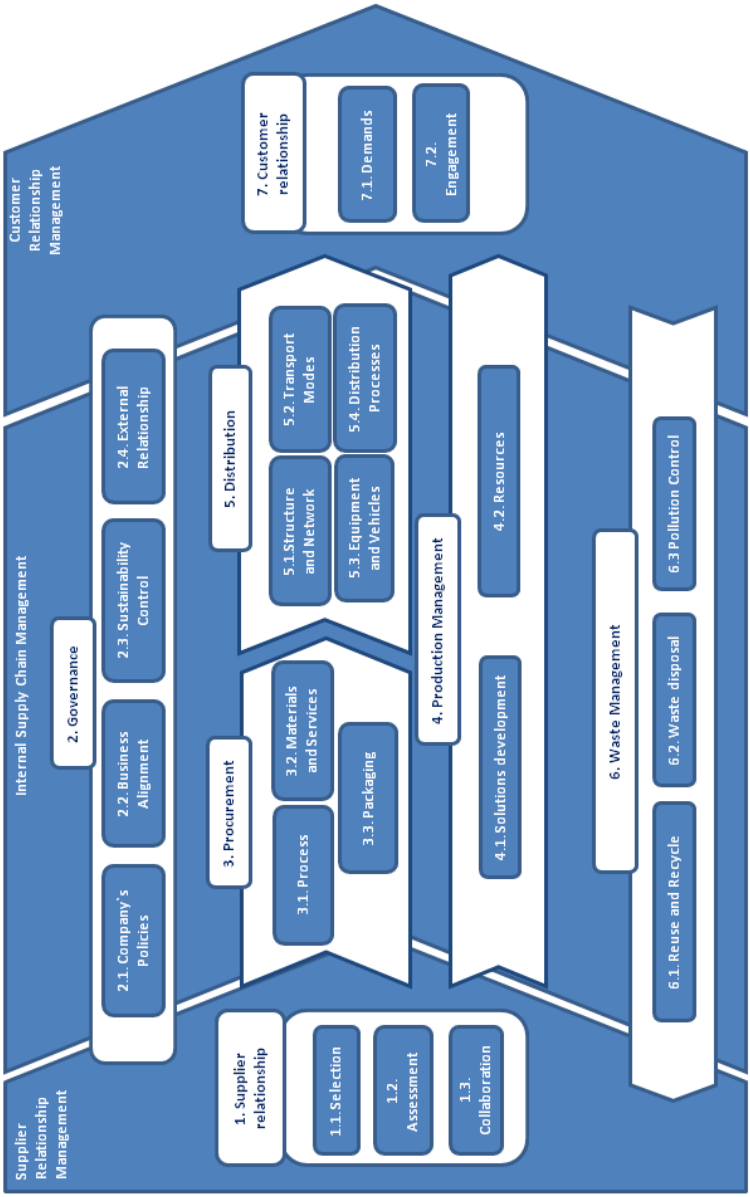


Figure 4: Integrated framework for managing sustainable supply chain practices

On table 4, it is possible to check the top five contributing pieces of references. As explained before, each selected reference was analyzed and practices collected. After designing the framework, it was possible to check which of the 99 references approached the largest amount of sub-groups (quantitatively). In other words, the references listed below might have used a more holistic perception of sustainable supply chain practices, and similar to the framework one.

The top five contributing references are in different types of publications (paper, book, report) and all published from 2010 on. It might be considered an evidence that sustainable supply chain practices with a holistic approach are being recently intensively discussed. Grant et al. (2013) was the reference with the largest amount of practices sub-groups found while still extending only 38% of all considered on the framework.

Authors	Year	Publication type	% of sub-groups
Grant, D.B.; Trautrims, A.; Wong, C.Y.	2013	Book	38,0%
Schönberger, H.; Galvez-Martos, JL.; Styles, D.	2013	Report	29,5%
Colicchia, C; Melacini, M; Perotti, S.	2011	Paper	26,7%
Cetinkaya, B., Cuthbertson, R., Ewer, G., Klaas-Wissing, T., Piotrowicz, W., &Tyssen, C.	2011	Book	26,7%
Perotti, S; Zorzini, M; Cagno, E; Micheli, GJL	2010	Paper	23,8%

Table 4: Top five contributing references

In the following pages, the content in details of each sub-group of practices from the framework will be presented.

Supplier Relationship Management

Supplier Relationship Management (SRM), cluster focus on the interaction between the enterprise and its suppliers (Chopra and Meindl, 2004). Suppliers include those that supply materials, components, parts, but as well service providers such as for distribution, maintenance, and others. When the aim of a network is add value to the customers, suppliers play an important role and therefore the most critical practice that might contribute to increase supply chain sustainability is supplier relationship.

4.1 Supplier Relationship

Involving and supporting supply chain partners is crucial to a successful sustainable supplier management program, even though formal tools and models are still limited (Fu, Zhu and Sarkis, 2012). This group includes practices that focus on the interaction between company and its suppliers that are upstream in the supply chain (Chopra and Meindl, 2004). Within the selected literature, Supplier relationship was the most cited group – 76,8% attesting its importance. It is separated into three subgroups: supplier selection, supplier assessment and supplier collaboration.

4.1.1 Supplier selection

Supplier selection is one of the most important aspects to reduce risk and increase the chances of a company's long-term viability. It has a crucial role within supply chain management (Kermani, Navidi and Alborzi, 2012; Genovese, Lenny Koh, Bruno and Esposito, 2013; Wu, Liao and Yang, 2013) although the identification of viable suppliers can be challenging and time/cost consuming. Price, quality and flexibility had been the main criteria in the supplier selection process. However, with companies' strategies incorporating sustainability aspects, the triple bottom line approach with its additional dimensions environmental and social has added more considerations in identifying the right suppliers (Öztürk and Özçelik,

2014). Therefore, sourcing from environmentally sound suppliers (Carter and Jennings, 2002; MacCarthy and Jayarathne, 2012; Styles, Schoenberger and Galvez-Martos, 2012a; Pagell and Wu, 2009; Liu et al., 2012; Azevedo, Carvalho, Duarte and Cruz-Machado, 2012) is one of the major issues faced by operations and purchasing managers in order to stay in a strategically competitive position (Chen et al., 2006). From all selected literature, 51,5% cited practices related to supplier selection (table 5).

Practices	Authors
Use of local supplies[1]	(Adetunji, Price and Fleming, 2008; Spence and Bourlakis, 2009; Wiederkehr, Gilbert, Crist and Caïd, 2004; Preuss, 2009; Styles, Schoenberger and Galvez-Martos, 2012a; Brammer et al., 2007; Grant, Trautrims and Wong, 2013; Gross et al., 2013; Carter and Jennings, 2002; Fulton and Lee, 2013; Kosansky and Schaefer, 2009)
Use minority-owned suppliers	(Carter and Jennings, 2002; Brammer et al., 2007),
Contract from social enterprises and the voluntary sector	(Preuss, 2009)

Table 5: Supplier Selection practices

[1] This practice is aligned with the trend of "near shoring" - outsourcing work to a supplier located in an adjacent country. Compared to offshore outsourcing, the benefits include less travel costs, less time zone differences, and closer cultural compatibility (Lacity, Willcocks and Rottman, 2008). It may also increase traceability, flexibility as well as reduce risks, delivery times and transportation costs. The evaluation of a fully on-shoring vs. off-shoring should take into account the fully supply chain impact both in terms of costs and environmental impact (Kosansky and Schaefer, 2009). Social issues may also be considered during decision-making. According to The Chartered Institute of Procurement & Supply, using local suppliers may demonstrates investment in the community, local suppliers would place considerable value on serving their local community and the benefits associated with it, the local knowledge of local suppliers means that they are well-placed to appreciate and satisfy local preferences (CIPS, 2015).

The definition of selection criteria considering environmental and social aspects (Rao, 2007; Nunes and Bennett, 2010; Vachon and Klassen, 2006; Lu, Lee and Cheng, 2012; Vachon, 2007; Koplin, Seuring and Mesterharm, 2007; Lau, 2011; Laosirihongthong, Adebanjo and Tan, 2013; Colby and Fertal, 2007; Eltayeb and Zailani, 2009; The vital links, 2007; Panapanaan, Karvonen and Phan, 2003; Schönberger, Galvez-Martos and Styles, 2013) were well cited and the detailed list is presented on table 6.

Among the listed criteria, compliance with governmental regulations is the most basic one, although not necessarily simple depending on the regulations' requirements. Compliance with company's guidelines such as code of conduct is also a present practice that shows the extension of supply chain responsibility. The implemetation of an Environmental Management System (EMS) might be included or not into some certification processes. ISO 14000, for instance, considers an EMS as one of its requirements. Other authors cited the requirememement of certifications but did not specify any (Pagell and Wu, 2009; Fu, Zhu and Sarkis, 2012; Dargusch and Ward, 2010; Lu, Lee and Cheng, 2012; Colicchia, Melacini and Perotti, 2011; Diabat and Govindan, 2011; Schönberger, Galvez-Martos and Styles, 2013; Caniato, Caridi and Moretto, 2011; Vachon, 2007; Sarkis, 1999)

Specific criteria	Authors
Compliance with company's and governmental environmental regulations	(Kumar, Teichman and Timpernagel, 2012; Vachon, 2007; Klerkx, Villalobos and Engler, 2012; Panapanaan, Karvonen and Phan, 2003; Schönberger, Galvez-Martos and Styles, 2013)
Compliance with specific guidelines/Statement	(Azevedo et al., 2012; Styles, Schoenberger and Galvez-Martos, 2012a; Spence and Bourlakis, 2009; Hsu and Hu, 2008)

Extension of company's code of conduct	(Caniato et al., 2013; Panapanaan, Karvonen and Phan, 2003; Grant, Trautrims and Wong, 2013; Kumar, Teichman and Timpernagel, 2012)
Certified EMS	(Eltayeb and Zailani, 2009; Ofori, 2000; Azevedo et al., 2012)
ISO 14000	(Carbone and Moatti, 2008; Gopalakrishnan et al., 2012; Liu et al., 2012; Adetunji, Price and Fleming, 2008; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu, Geng, Sarkis and Lai, 2011; Zhu, Sarkis and Lai, 2013; Wu, Ding and Chen, 2012; Perotti, Zorzini, Cagno and Micheli, 2012; Preuss, 2007; Lai, Lun, Wong and Cheng, 2011; Vachon, 2007; Khairani, 2012; Koplin, Seuring and Mesterharm, 2007; Laosirihongthong, Adebanjo and Tan, 2013; Tachizawa, Gimenez and Montes-Sancho, 2012; Ofori, 2000; Panapanaan, Karvonen and Phan, 2003; Azevedo et al., 2012)
A list of specific criteria can be found in Caniato et al. (2013) and Genovese et al. (2013)	

Table 6: Criteria for supplier selection

4.1.2 Supplier assessment

Supplier assessment refers to the process of gathering and processing information in order to evaluate and approve suppliers or potential supplier's performance and to mitigate by associated risks (Klassen and Vachon, 2003). Many evaluative activities are based on pre-established performance standards for: the quality of the materials, delivery reliability, speed, and customer service that are driven by priorities of downstream supply chain members (Leenders and Fearon, 1997). The goal of supplier assessment is to ensure suppliers' performance, for reducing cost, risk, leading to continuous improvement or even sustainability. Good supply chain practices also take in consideration the importance of supplier awards and feedback (Krause, Scannell and Calantone, 2000). Therefore, the supplier assessment process should be continuous (Ciliberti, Pontrandolfo and Scozzi, 2008; Liu et al., 2012; Sarkis, 1999; Holt, 2004; Holt and Ghobadian, 2009; Yang, Lin, Chan and Sheu, 2010; Lu, Lee and Cheng, 2012; Tachizawa, Gimenez and Montes-Sancho, 2012; Klerkx, Villalobos and Engler, 2012; Caniato et al., 2013). From all selected literature, 49,5% practices were related to supplier assessment, proving its importance in supplier relationship (table 7).

The first and very important practice of this sub-group is to communicate the requirements and expectations in a clear way. This avoids missunderstandings and future relationship conflicts. The monitoring process of the pre-established requirements may follow a formal audit format, use self-questionnaires or even inspections of suppliers' plants. Some authors cited some particularities on dealing with high-risk companies and the importance of a development approach. This is also considered when a company sets key performance indicators (kpi) and targets to its suppliers, motivating improvements and competitions between suppliers. The evaluation of indirect suppliers is a topic considered by some authors and increasingly discussed in company's reality. Practices regarding, sactions and rejection of those who lacks environmental concerns were not much cited although they are expected to be given more attention in the future.

Practices	Authors
Establish and communication of sustainability standards/expectations	(Caniato, Caridi and Moretto, 2011; Sarkis, 1999; Hsu and Hu, 2008; Rao, 2002; Rao and Holt, 2005; Sarkis, Zhu and Lai, 2011; Styles, Schoenberger and Galvez-Martos, 2012b; Liu et al., 2012; Lu, Lee and Cheng, 2012; Vachon, 2007; Colby and Fertal, 2007; Koplin, Seuring and Mesterharm, 2007; The vital links, 2007; Klerkx, Villalobos and Engler, 2012; Azevedo, Carvalho and Cruz Machado, 2011; Khairani, 2012)
Monitor their compliance with social and environmental standards along the supply chain[2]	(Adetunji, Price and Fleming, 2008; Leppelt, Foerstl, Reuter and Hartmann, 2013; Fulton and Lee, 2013; Okongwu, Morimoto and Lauras, 2013; Azevedo et al., 2012; Khairani, 2012)
Implement formal audits[3]	(Sarkis, 1999; Ciliberti, Pontrandolfo and Scozzi, 2008; Murphy and Poist, 2002; Liu et al., 2012; Rao, 2002; Gopalakrishnan et al., 2012; Fu, Zhu and Sarkis, 2012; Johnson, 2004; Leppelt et al.,

[2] Some of the benefits of monitoring suppliers' compliance are increase transparency (Eltayeb and Zailani, 2009) and ensure that their processes and products are environmentally and socially responsible (Carter and Jennings, 2002; Brammer et al., 2007)

[3] A recent research (Kumar, Teichman and Timpernagel, 2012) highlighted that Apple aligns its supply chain through routine audits, and training programs created to help suppliers comply with the standards. Audits are also used for material traceability. IKEA Forestry Standard, for instance, includes requirements to implement wood traceability, to avoid illegal deforestation, and to protect virgin and high nature value forests. In 2009, 10% of wood was audited. Carrefour Brazil works with other retailers to audit meat products and ensure they do not originate from deforested areas (Styles, Schoenberger and Galvez-Martos, 2012a). Nike, in the early 2000s, also developed a global factory database to help Nike's head office track its global supply chain and to enable head office access to the various audits being conducted in the field, which were now entered into the database by field staff on a regular basis (Doorey, 2011). Waitrose, a leading UK food retailer, for example, uses a "Suppliers ethical data interchange" (SEDEX) where audit data on individual suppliers is shared and all Waitrose's supplier audit information is managed through SEDEX. The Board is responsible for ensuring that SEDEX is commercially astute and ethically guided (Spence and Bourlakis, 2009).

	2013; The vital links, 2007; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu, Sarkis and Lai, 2013; Perotti et al., 2012; Preuss, 2007; Wu, Ding and Chen, 2012; Doorey, 2011; Lai et al., 2011; Lu, Lee and Cheng, 2012; Brammer et al., 2007; Khairani, 2012; Tachizawa, Gimenez and Montes-Sancho, 2012; Ofori, 2000; Panapanaan, Karvonen and Phan, 2003; Schönberger, Galvez-Martos and Styles, 2013; Kumar, Teichman and Timpernagel, 2012)
Use of self-assessment questionnaires	(Hsu and Hu, 2008; Sarkis, 1999; Preuss, 2009; Eltayeb and Zailani, 2009; Koplin, Seuring and Mesterharm, 2007; Spence and Bourlakis, 2009)
Inspect suppliers' plants	(Caniato et al., 2013; Rao, 2002; Styles, Schoenberger and Galvez-Martos, 2012a)
High risk organizations are not de-listed in an initial non-compliance, corrective action is agreed and monitored	(Spence and Bourlakis, 2009; Azevedo, Carvalho and Cruz Machado, 2011).
Set of key performance indicators and targets	(Carbone and Moatti, 2008; Fu, Zhu and Sarkis, 2012; Colby and Fertal, 2007; Styles, Schoenberger and Galvez-Martos, 2012b)
Create a "sustainable rating" system	(Caniato, Caridi and Moretto, 2011)
Award/reward the ones with better results	(Preuss, 2009; The vital links, 2007; Azevedo, Carvalho and Cruz Machado, 2011)

Evaluate indirect ones such as second-tier suppliers	(Eltayeb and Zailani, 2009; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu et al., 2011; Zhu, Sarkis and Lai, 2013; Wu, Ding and Chen, 2012; Perotti et al., 2012; Lai et al., 2011; Azevedo, Carvalho and Cruz Machado, 2011)
Direct controls on sub-contractors	(Caniato, Caridi, Crippa and Moretto, 2012; Johnson, 2004; Leppelt et al., 2013; Klerkx, Villalobos and Engler, 2012)
Press suppliers to take environmental actions	(Rao, 2002, 2007; Rao and Holt, 2005; Brammer et al., 2007; Ofori, 2000; Panapanaan, Karvonen and Phan, 2003; Tachizawa, Gimenez and Montes-Sancho, 2012)
Implement sanctions for suppliers	(Ciliberti, Pontrandolfo and Scozzi, 2008)
Change business order quantity according to the evaluation results	(Lu, Lee and Cheng, 2012)
Reject those who lacks environmental con-cerns	(Murphy and Poist, 2002; Doorey, 2011; Carbone and Moatti, 2008)

Table 7: Supplier Assessment practices

4.1.3 Supplier collaboration

A recent international study (Handfield, Straube, Pfohl and Wieland, 2013) showed one of the most important trend for logistics is Networked Economy, in other words: companies should learn how to build sustainable networks and collaborate with international partners setting win-win relationships. They are expected to have extreme levels of flexibility and robustness to react to market demand or supply chain disruptions, since product design until its recovery after its end of use. For this, they need to establish healthy and transparent relationships with its supply chain players, especially with its materials, products or service suppliers.

Specific about environmental collaboration, it can be defined as planning jointly environmental management and environmental solutions between company and its suppliers and customers (Vachon and Klassen, 2008). This concept can be also extended to collaborative social responsibility. Collaboration differs from other forms of interaction, such as monitoring, once it involves a pro-active relationship with two-way engagement and exchange of inter-organizational processes and information between supply chain actors (Vachon and Klassen, 2006). The focus is less on immediate outcomes of the supplier environmental efforts (e.g., compliance to existing regulations) and more on long term and sustainable gains, requiring specific resources investment in cooperative activities that address environmental issues in the supply chain (Vachon, 2007). Cooperative initiatives were also cited and differ from collaboration as the last aim the achievement of a common goal, while the former intends shared goals (Munson, Rosenblatt and Rosenblatt, 1999).

Collaborative initiatives with suppliers showed to be a well-researched topic as it had the largest percentage of citations within the selected literature: 58,6%. They can be focused on some specific practices such as the ones listed on table 8.

Practices	Authors
Collaborate with suppliers[4]	(Pagell and Wu, 2009; Caniato, Caridi and Moretto, 2011; Perotti et al., 2012; Wu, Ding and Chen, 2012; Lai et al., 2011; Vachon, 2007; Colicchia, Melacini and Perotti, 2011; Ashby, Leat and Hudson-Smith, 2012; Diabat and Govindan, 2011; Azevedo, Carvalho and Cruz Machado, 2011; Schönberger, Galvez-Martos and Styles, 2013)
Cooperate with suppliers[5]	(Hsu and Hu, 2008; Zhu and Sarkis, 2006; Zhu, Sarkis and Geng, 2005; Zhu et al., 2011; Sarkis, 1999; McKinnon, Browne and Whiteing, 2010; Zhu, Sarkis and Lai, 2013; Khairani, 2012; Ashby, Leat and Hudson-Smith, 2012)
Integrate processes and information	(Brito, Carbone and Blanquart, 2008; Vachon and Klassen, 2006)
Improve Information traceability	(Caniato et al., 2012; Pagell and Wu, 2009; Doorey, 2011; Caniato, Caridi and Moretto, 2011; Cetinkaya et al., 2011)

[4] Collaboration help ensuring environmentally sustainable processes and products (Ciliberti, Pontrandolfo and Scozzi, 2008; Laosirihongthong, Adebanjo and Tan, 2013; Eltayeb and Zailani, 2009; Tachizawa, Gimenez and Montes-Sancho, 2012) and building long term relationships (Nunes and Bennett, 2010; Wu, Ding and Chen, 2012). Coca-Cola, for example, after identifying water usage as one major impact areas, led a collaboration effort with its supplier to recycle and store wastewater so that it can be re-used in the factory and irrigated to other local farmers, saving the need of drawing reserves of groundwater (Kumar, Teichman and Timpernagel, 2012).

[5] The current situation of cooperation with Tier one (35%), Tier two (47%) and LSPs (34%) still has opportunities to be improved (Handfield et al., 2013).

Electronic data interchange (EDI)[6]	(Azevedo, Carvalho and Cruz Machado, 2011; Closs, Speier and Meacham, 2011)
Appropriate data collection for designing new solutions considering the life cycle	(Sarkis, 1999)
Offer incentives to reduce/share suppliers risks	(Dües, Tan and Lim, 2013; Goodman, 2000; Fu, Zhu and Sarkis, 2012)
Financial support	(Rao, 2002; Caniato et al., 2013; Spence and Bourlakis, 2009)
Jointly develop green technology/processes[7]	(Sarkis, 1999; Fu, Zhu and Sarkis, 2012)
Invest in supplier's development	(Delai and Takahashi, 2013; Pagell and Wu, 2009; Caniato et al., 2013, 2012; Lu, Lee and Cheng, 2012)
Compromise allocating company's personnel in regular visits in suppliers site to help it improve ethical performance	(Lu, Lee and Cheng, 2012)
Offer technical and environmental information for:[8]	(Caniato et al., 2012; Sarkis, 1999; Liu et al., 2012; Caniato et al., 2013; Holt and

[6] The integrated use of technology may provide total supply chain traceability for its products including showing consumers the origin of the product at the time of purchase and the ability to trace a product back to origin in the event of a product recall (Closs, Speier and Meacham, 2011)

[7] Phillips' eco-design practice includes a roadmap for improving product design and environmental performance by working closely with its suppliers (Young and Kielkiewicz-Young, 2001).

[8] According to a research in 2007, thanks to the increasing trend of outsourcing transportation and other supply chain tasks to a third-party logistics provider (3PL), up to 75% of a company's carbon footprint may come from transportation and logistics. As such, collaboration amongst logistics users, providers, suppliers, and even between competitors is nec-

	Ghobadian, 2009; Fu, Zhu and Sarkis, 2012; ECR, 2008; Lu, Lee and Cheng, 2012; Sarkis, 1998; Khairani, 2012; Koplin, Seuring and Mesterharm, 2007; Laosirihongthong, Adebanjo and Tan, 2013; Dües, Tan and Lim, 2013; Ofori, 2000; The vital links, 2007; Panapanaan, Karvonen and Phan, 2003)
Implement environmental management system (EMS)	(Carbone and Moatti, 2008; Rao, 2007, 2002; Rao and Holt, 2005)
Achieve third party certification	(Styles, Schoenberger and Galvez-Martos, 2012b)
Reduce their environmental impacts and defining goals	(Zailani, Jeyaraman, Vengadasan and Premkumar, 2012; Ciliberti, Pontrandolfo and Scozzi, 2008; Closs, Speier and Meacham, 2011; Tachizawa, Gimenez and Montes-Sancho, 2012; Ofori, 2000; Azevedo, Carvalho and Cruz Machado, 2011)
Promote awareness seminars for suppliers/subcontractors	(Carbone and Moatti, 2008; Holt, 2004; Holt and Ghobadian, 2009; Lieb and Lieb, 2010)
Bring together same industry suppliers to share their own know-how[9]	(Rao, 2002)

essary. Around 25% of the participants in a survey have or plan to partner with their transportation carriers and/or 3PLs to help them green their processes and an additional 27% are actively exploring the possibility of adding a logistics partner to help move environmental projects forward (O'Reilly, 2007)

[9] A supply "club" enables suppliers to for collaborate with each other (Sarkis, 1999), getting results on green, social and economic aspects.

Exchange information, ideas and advices	(Hsu and Hu, 2008; Fu, Zhu and Sarkis, 2012)
Disseminate best practices	(Styles, Schoenberger and Galvez-Martos, 2012a; b; The vital links, 2007; Schönberger, Galvez-Martos and Styles, 2013)
Share information about business ethical conducts and environmental criteria	(Holt, 2004; Holt and Ghobadian, 2009; Gopalakrishnan et al., 2012)
Making clear for suppliers corporate environmental concerns	(Hsu and Hu, 2008; Koplin, Seuring and Mesterharm, 2007)
Exchanging expectations and feedback	(Ciliberti, Pontrandolfo and Scozzi, 2008; Fu, Zhu and Sarkis, 2012; Tachizawa, Gimenez and Montes-Sancho, 2012; Lu, Lee and Cheng, 2012; Preuss, 2009; Spence and Bourlakis, 2009)
Bring together company's and suppliers' culture	(Golicic, Boerstler and Ellram, 2010)
Implement product steward-ship programs[10]	(Ofori, 2000; Ashby, Leat and Hudson-Smith, 2012; Grant, Trautrims and Wong, 2013)
Involve them through Water Efficiency Guides	(MacCarthy and Jayarathne, 2012)

Table 8: Supplier Collaboration practices

[10] Product stewardship is a product-centered approach which calls on those in the product lifecycle to share responsibility for reducing the environmental impacts of products (EPA, 2014).

Internal Supply Chain Management

Internal Supply Chain Management includes practices that even though influence other players from the supply chain, are mainly implemented internally by the company. It includes all processes involved in planning for and fulfilling a customer order (Chopra and Meindl, 2004). It consists of five groups: governance, procurement, production management, distribution and waste management, which are mutually integrated and also connected with groups from SRM and CRM cluster.

4.2 Governance

Governance refers to "all processes of governing, whether undertaken by a government, market or network, whether over a family, tribe, formal or informal organization or territory and whether through laws, norms, power or language“ (Bevir, 2012). In the proposed framework, the governance group contains practices that enable integrating company’s major business functions, processes and partners such as suppliers and customers. Using a similar approach to Porter’s supporting activities (Porter, 1985), it offer some corporate mechanism that permit practices from other groups to be implemented successfully. The visual format of the group shows that different from all the other groups from ISCM, Governance does not intend to represent actions’ flow to generate value to the customers. It represents, on the other hand, the continuity of supportive actions since the relationship with suppliers until relationship with customers. From all selected literature, 73,7% are included in this group - the second most cited one, behind only supplier relationship.

4.2.1 Company's Policies

Policies are usually linked with corporate goals, strategies, vision, mission and plan. After defining the corporate goals a number of long-term strategies, policies are developed. They define what management has to accomplish and how this is achieved (Wies, 1994). Company's policies was the sub-group of practices with inputs from 33,3% of all literature (table 9) and consists of a large variety of policies, normally specific on a subject such as energy water, product, expected businenss conduct. Policies are also used to align current regulation with internal strategies and some well established standards from NGOs or international programs are normally incorporated.

Practices	Authors
Develop Policies such as:	
Environmental, Corporate Social Responsibility, Recycling, Energy Reduction	(Keating, Quazi, Kriz and Coltman, 2008; Yang et al., 2010; Lu, Lee and Cheng, 2012; Sarkis, 1998; Doorey, 2011; Lai et al., 2011; Okongwu, Morimoto and Lauras, 2013; Khairani, 2012; Klerkx, Villalobos and Engler, 2012)
Green Logistics/transport	(Holt and Ghobadian, 2009; Azevedo, Carvalho and Cruz Machado, 2011)
Water Efficient Guides	(MacCarthy and Jayarathne, 2012)
Industry agreements/policies[11]	(Computer Makers Endorse Code for Treatment of Workers, 2004; Grant, Trautrims and Wong, 2013)

[11] Computer manufacturers Hewlett-Packard (HP), IBM, and Dell that have agreed on a "code of conduct" for the treatment of workers and the environment. The three companies and their contract-manufacturing partners have developed the Electronics Industry Code of Conduct to promote industry standards for socially responsible business practices across

Green Products Standards	(Khairani, 2012)
Recovery Policies for end products	(Ciliberti, Pontrandolfo and Scozzi, 2008)
Green Responsible Principles for purchasing	(Ciliberti, Pontrandolfo and Scozzi, 2008; Preuss, 2007; Spence and Bourlakis, 2009; Preuss, 2009; Panapanaan, Karvonen and Phan, 2003; Azevedo, Carvalho and Cruz Machado, 2011)
Code of Ethics/Conduct	(Murphy and Poist, 2002; Closs, Speier and Meacham, 2011; Adetunji, Price and Fleming, 2008; Delai and Takahashi, 2013; Caniato et al., 2012, 2013; Doorey, 2011; Leppelt et al., 2013; Dargusch and Ward, 2010; Holt and Ghobadian, 2009; Holt, 2004; Caniato, Caridi and Moretto, 2011; Styles, Schoenberger and Galvez-Martos, 2012a; Panapanaan, Karvonen and Phan, 2003; Grant, Trautrims and Wong, 2013)
Use International Environmental Programs/NGOs as a standard[12]	(This and Ch, 2008; Azevedo et al., 2012; Khairani, 2012)
Align with current regulation requirements	(Colby and Fertal, 2007; Lau, 2011; Panapanaan, Karvonen and Phan, 2003; Johnson, 2004)

Table 9: Company's Policies practices

their global supply chains. It encourages participants to go beyond legal compliance, drawing upon internationally recognized standards, in order to advance social and environmental responsibility (Computer Makers Endorse Code for Treatment of Workers, 2004).

[12] The flagship of Responsible Sourcing at Waitrose, a leading retailer in UK, was launched in 1999 and covers social aspects such as working hours, wage, equality of treatment, health, safety and hygiene, the employment of children or forced labor, among others. The code draws particularly on the International Labor Organization Standards. It also covers environmental protection and animal welfare issues (Spence and Bourlakis, 2009).

4.2.2 Business Alignment

Business alignment is considered one of the enablers for implementating an internal proactive environmental management (Liu et al., 2012). It consists of a sub-group of practices that support implementing sustainability inside companies in a sucessfully manner. The alignment of sustainability goals into corporate strategy and day-to-day supply chain management (Pagell and Wu, 2009; Lieb and Lieb, 2010; Lu, Lee and Cheng, 2012; Styles, Schoenberger and Galvez-Martos, 2012b) can be stimulated by increasing communication with internal stakeholders. Some companies decide for a specific department, responsible for issues such as manage company's environmental impact (Sarkis, 1999), enhance compliance with social and environmental standards along the entire supply chain (Ciliberti, Pontrandolfo and Scozzi, 2008), collect and disseminate best practices, provide advice, consolidate R&D activities (Cetinkaya et al., 2011), among others. Other companies build cross functional teams as in their understanding sustainability should be a transversal theme and incorporated into each department.

In both situations the commitment of of senior and mid-level managers with the topic is considered as a critical success factor that enables the alignment of strategies and actions. These actors are responsible for involving the company's employees in improving supply chain responsibility. Practices may start in the hiring process, consider financial issues and continue with trainnings and educational campaigns to promote heath, safety, environment and motivate people involved direct or indirectly in generating value to the customers. Being responsible for Internal stakeholders is a basic point when improving supply chain responsibility. This sub-group of practices had inputs from 47,5% of all literature and the list of practices are presented in table 10.

Practices	Authors
Increase communication efforts with internal stakeholders	(Ciliberti, Pontrandolfo and Scozzi, 2008; Carbone and Moatti, 2008; The vital links, 2007; Lu, Lee and Cheng, 2012; Wu, Ding and Chen, 2012; Okongwu, Morimoto and Lauras, 2013; Koplin, Seuring and Mesterharm, 2007; Khairani, 2012; Klerkx, Villalobos and Engler, 2012; Schönberger, Galvez-Martos and Styles, 2013)
Especially with investors[13]	(Biederman, 2011; Lu, Lee and Cheng, 2012; Leach, 2010)
High-level unit/department with responsibility for sustainability management to:[14]	(Ciliberti, Pontrandolfo and Scozzi, 2008; Carbone and Moatti, 2008; Lieb and Lieb, 2010; Lu, Lee and Cheng, 2012; Doorey, 2011; Spence and Bourlakis, 2009; Wu, Ding and Chen, 2012; Leppelt et al., 2013; Styles, Schoenberger and Galvez-Martos, 2012b; Colby and Fertal, 2007; Koplin, Seuring and Mesterharm, 2007; Cetinkaya et al., 2011; Schönberger, Galvez-Martos and Styles, 2013)
Create cross-functional teams (ecological experts, economists, lawyers, etc.)	(Brito, Carbone and Blanquart, 2008; Lu, Lee and Cheng, 2012)

[13] Provide investors with full and accurate financial information about the organization, incorporate the interests of investors in business decisions, inform investors of changes in corporate policy, provide all investors with a competitive return on investment, seek the input of major investors regarding strategic decisions (Lu, Lee and Cheng, 2012).

[14] Some other authors, nonetheless, understand and defend that sustainability should not be a formal department inside companies, because it might be understood as the one carrying all the responsibility. Better when sustainability gets embedded in all the roles in the company (Ladd, 2010).

Encourage the commitment from senior managers, support from mid-level managers with sustainability issues	(Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu, Sarkis and Lai, 2013; Perotti et al., 2012; Wu, Ding and Chen, 2012; Fu, Zhu and Sarkis, 2012; Hsu and Hu, 2008)
Practices related to Human resource (HR) management: Hire and promote more environmental conscious/diverse personnel, without discrimination Employee education/training in sustainability	 (Carter and Jennings, 2002; Klerkx, Villalobos and Engler, 2012; Panapanaan, Karvonen and Phan, 2003; Caniato et al., 2013; Murphy and Poist, 2002) (Murphy and Poist, 2002; Pagell and Wu, 2009; Liu et al., 2012; Delai and Takahashi, 2013; Holt, 2004; Holt and Ghobadian, 2009; Lieb and Lieb, 2010; Leppelt et al., 2013; Yang et al., 2010; Oberhofer and Fürst, 2012; Zhu, Sarkis and Lai, 2013; Golicic, Boerstler and Ellram, 2010; Lu, Lee and Cheng, 2012; Preuss, 2009; Vachon, 2007; Dües, Tan and Lim, 2013; Khairani, 2012; Klerkx, Villalobos and Engler, 2012; Caniato et al., 2013; Cetinkaya et al., 2011; Schönberger, Galvez-Martos and Styles, 2013; Sarkis, 1998, 1999)

Specific training for logistics employees[15]	(Vachon, 2007; Carter and Jennings, 2002; Golicic, Boerstler and Ellram, 2010; Liimatainen, Stenholm, Tapio and McKinnon, 2012; Cetinkaya et al., 2011; Schönberger, Galvez-Martos and Styles, 2013)
Practices related to employee's health, safety and motivation:	(Delai and Takahashi, 2013; Murphy and Poist, 2002; Lu, Lee and Cheng, 2012; Carter and Jennings, 2002; Okongwu, Morimoto and Lauras, 2013; Klerkx, Villalobos and Engler, 2012; Panapanaan, Karvonen and Phan, 2003; Caniato et al., 2013; Cetinkaya et al., 2011)
Monitor the use of safety equipment and procedures	(Carter and Jennings, 2002)
Ergonomic workplace design	(Grant, Trautrims and Wong, 2013)
Guaranteeing no child or forced labor	(Panapanaan, Karvonen and Phan, 2003; Grant, Trautrims and Wong, 2013)
Attention to the quality of life of the employees	(Carter and Jennings, 2002; Caniato et al., 2013)
Variety of working activities	(Caniato et al., 2013)
Plan operating schedules that allow drivers adequate time	(Panapanaan, Karvonen and Phan, 2003; Caniato et al., 2013)

[15] It includes certification of use of equipment (Carter and Jennings, 2002) and improving driving skills (McKinnon, Browne and Whiteing, 2010; Golicic, Boerstler and Ellram, 2010; Liimatainen et al., 2012; Colicchia, Melacini and Perotti, 2011; This and Ch, 2008; Grant, Trautrims and Wong, 2013; Carter and Jennings, 2002; Schönberger, Galvez-Martos and Styles, 2013). Migros developed a driver training scheme that is also extended to third party drivers, and offers incentives for drivers to save fuel (Schönberger et al., 2013)

at home, offer flexibility in work arrangements	
Help finding retirement facilities	(Klerkx, Villalobos and Engler, 2012)
Support employees who want to pursue further education	(Lu, Lee and Cheng, 2012; Klerkx, Villalobos and Engler, 2012; Panapanaan, Karvonen and Phan, 2003)
Possibility of participation in firm management	(Klerkx, Villalobos and Engler, 2012; Panapanaan, Karvonen and Phan, 2003)
Practices related to financial issues:	
Offer adequate wages, salaries and benefits.	(Carter and Jennings, 2002; Lu, Lee and Cheng, 2012; Panapanaan, Karvonen and Phan, 2003; Caniato et al., 2013)
Financial support for sustainability actions	(Wu, Ding and Chen, 2012; Lu, Lee and Cheng, 2012)
Include environmental criteria on decision making… for instance in transport decisions	(Rao, 2007)(Holt and Ghobadian, 2009)
Associated risks and investments start to be considered in projects that promote a continued ability to obtain resources	(Closs, Speier and Meacham, 2011)
- establish a link between performance/reward systems and sustainability/environmental factors	(Pagell and Wu, 2009; Zhu, Sarkis and Lai, 2013; Cetinkaya et al., 2011)

Table 10: Business Alignment practices

4.2.3 Sustainability Control

Sustainability Control sub-group determines the appropriate management systems, processes and procedures in order to: plan, measure, control and correct actions to improve its environmental, economic and social sustainability performance.

According to some authors, the implementation of formal procedures to anticipate future requirements and the management of appropriate responses are vital for companies nowadays (Lieb and Lieb, 2010; Klerkx, Villalobos and Engler, 2012). The implementation of an Environmental Management System (EMS) enables an organization to reach better results in reducing its environmental impacts and increase its operating efficiency (EPA, 2014). These may be complemented by other management systems and incorporated into certifications' requirement (e.g. ISO 14001). Through a controlling system, companies are able to measure the performance on greenhouse-gas (GHG) emissions (Lu, Lee and Cheng, 2012; Sarkis, 1998; Golicic, Boerstler and Ellram, 2010; Okongwu, Morimoto and Lauras, 2013; Klerkx, Villalobos and Engler, 2012; Grant, Trautrims and Wong, 2013; The vital links, 2007) and products' carbon footprint considering the entire supply chain (Lee and Cheong, 2011; Cetinkaya et al., 2011). In the last, collaboration with suppliers for data sharing is essencial and challenging as well. The systems support companies on setting targets[16] and allowing the defined public to monitor their achievement (This and Ch, 2008). Actions to improve communication increase employee's and business parters' motivation to achieve the targets (Epstein and Roy, 2001). Practices from this sub-group were found in 34,3% of all selected literature and are listed on table 11.

[16] Targets help reducing carbon footprint (Lieb and Lieb, 2010; Keating et al., 2008; Ageron, Gunasekaran and Spalanzani, 2012) and meeting safety requirements (Carter and Jennings, 2002)

Practices	Authors
Implement an Environmental management system (EMS)	(Keating et al., 2008; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Vachon, 2007; Wu, Ding and Chen, 2012; Doorey, 2011; Sarkis, 1999; Perotti et al., 2012; Ashby, Leat and Hudson-Smith, 2012; Dües, Tan and Lim, 2013; Colicchia, Melacini and Perotti, 2011; Klerkx, Villalobos and Engler, 2012; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Azevedo, Carvalho and Cruz Machado, 2011)
Production Resource System	(Dües, Tan and Lim, 2013; Ageron, Gunasekaran and Spalanzani, 2012)
Risk and Safety management system	(Keating et al., 2008; Lee and Cheong, 2011; Preuss, 2009; Azevedo, Carvalho and Cruz Machado, 2011; Grant, Trautrims and Wong, 2013; Carter and Jennings, 2002)
Combine programs and standards with current standards or certifications such as ISO 14001, FLA Code and SA 8000.	(Oberhofer and Fürst, 2012; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu, Sarkis and Lai, 2013; Perotti et al., 2012; Preuss, 2007, 2009; Vachon, 2007; Spence and Bourlakis, 2009; Dües, Tan and Lim, 2013; Ageron, Gunasekaran and Spalanzani, 2012; Diabat and Govindan, 2011; Dargusch and Ward, 2010; Khairani, 2012; Okongwu, Morimoto and Lauras, 2013; Schönberger, Galvez-Martos and Styles, 2013; Azevedo, Carvalho and Cruz Machado, 2011; Grant, Trautrims and Wong, 2013)
Establish Environmental Protection Program	(Lun, 2011; Cetinkaya et al., 2011)

Total Quality Environmental Management Program Internal and external auditing programs	(Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Lun, 2011; Sarkis, 1998; Diabat and Govindan, 2011; Ageron, Gunasekaran and Spalanzani, 2012; Azevedo, Carvalho and Cruz Machado, 2011) (Perotti et al., 2012; This and Ch, 2008)
Green information technology (IT)	(Perotti et al., 2012; Vachon, 2007; Preuss, 2009; Grant, Trautrims and Wong, 2013)

Table 11: Sustainability Control practices

4.2.4 External Relationship

The importance of taking into account the legitimate interests of those who can affect (or be affected by) company's activities is one of the main reflections in the Stakeholder theory (Freeman, 1994), that considers all kind of stakeholders, both external and internal. This sub-group, with inputs from 40,4% (table 12) of all references, consists of the relationship with some specific external stakeholders which are not commercially involved with the company. These are: society/community, NGOs, governments, companies from the same industry, universities and research centers. Other companies which might be interested in cooperative projects and do not have any commercial agreement, are also considered as well as companies' efforts to publish their sustainability results and practices (e.g. reports, awards).

Practices	Authors
Relationship with society:	(Wu, Ding and Chen, 2012; Spence and Bourlakis, 2009; Lau, 2011; Klerkx, Villalobos and Engler, 2012; Cetinkaya et al., 2011)
Register complaints of the community and take measures to resolve them	(Klerkx, Villalobos and Engler, 2012)
Evaluates investment in social	(Klerkx, Villalobos and Engler, 2012; Caniato et al., 2013)
Invest in infrastructure development projects	(Panapanaan, Karvonen and Phan, 2003; Cetinkaya et al., 2011)
Implement public educational campaigns	(Carter and Jennings, 2002; Wiederkehr et al., 2004; Delai and Takahashi, 2013)
Do voluntary work	(Brammer et al., 2007; Caniato et al., 2013)

Donates to community projects	(Brammer et al., 2007; Fu, Zhu and Sarkis, 2012; Klerkx, Villalobos and Engler, 2012; Panapanaan, Karvonen and Phan, 2003; Caniato et al., 2013)
Cooperate with local authorities	(Panapanaan, Karvonen and Phan, 2003)
Keep a good relationship with NGOs[17] helps accessing updated market information and manage image risk	(Styles, Schoenberger and Galvez-Martos, 2012a; Comas Martí and Seifert, 2013; Cetinkaya et al., 2011; Doorey, 2011)
Relationship with government in attempt to influence legislation related to social/environmental issues[18]	(Hsu and Hu, 2008; Murphy and Poist, 2002; Delai and Takahashi, 2013; Wu, Ding and Chen, 2012; Preuss, 2009; Biederman, 2011, 2012; Cetinkaya et al., 2011)

[17]Adopting a more collaborative approach with NGOs, they may support industry by becoming sources of best practices and partners for develop new technologies (Cetinkaya et al., 2011). CERES, an environmental sustainability NGO encourages companies like Nike to publish report using the Global Reporting Practice and engage external stakeholders on environmental issues. Levis in early 1998 got involved in a pilot project which consisted of working together with NGOs in Dominican Republic to improve its guidelines and monitoring processes at that country. The NGOs were permitted to interview the workers, check their working conditions and alignment with the company's guidelines and labor laws. The result of this project was that few were aware of the guidelines or their legal employment rights. Levis made this report public and also the new monitoring model that includes an ''independent monitoring'' (Doorey, 2011). Other companies, like retailers, use information from independent experts, such as Greenpeace and Marine Stewardship Council (MSC), to identify sustainable (but not necessarily certified) fish sources. Preserves endangered fish species, maintains marine fishery ecosystem integrity and biodiversity (Styles, Schoenberger and Galvez-Martos, 2012a; Comas Martí and Seifert, 2013). Coca-Cola collaborates with NGOs such as the World Wildlife Fund to develop the Bonsucro Production Standard to procure certified sustainable sugar for beverage production (Kumar, Teichman and Timpernagel, 2012).

[18]A survey "Product Sustainability: The Dos, Don'ts and Business Benefits" published in 2013 by Verdantix, a U.K.-based sustainable investment research firm showed that companies may be involved with governmental projects and discussions about new regulations in attempt to anticipate them and get competitive advantage (Verdantix, 2013). An interesting example is the National Clean Fleets Partnership, a public-private partnership that helps

Industry cooperative efforts:[19]	(Murphy and Poist, 2002; Lieb and Lieb, 2010; Sowinski, 2013; Perotti et al., 2012; Lai et al., 2011; Vachon, 2007; Doorey, 2011; Davies, 2008; Biederman, 2012; Colby and Fertal, 2007; Azevedo, Carvalho and Cruz Machado, 2011)
Share best practices	(Holt, 2004; Dargusch and Ward, 2010)
Build a stronger network and influence legislation	(Sarkis, 1999; Holt, 2004)
Develop industry standards	(Styles, Schoenberger and Galvez-Martos, 2012b)
Cooperate with universities and research centers	(Panapanaan, Karvonen and Phan, 2003)

large companies reduce diesel and gasoline consumption. Companies such as UPS, FedEx, AT&T, Pepsi-Frito and Staples re some of the members (Biederman, 2011). Working with the U.S. Environmental Protection Agency and the Coalition for Responsible Transportation, a national coalition of major shippers and carriers, the EDF helped launch the EPA SmartWay Drayage Program to reduce emissions at the nation's ports. Under the program, carriers commit to specific emissions-reduction targets and to the use newer, cleaner trucks. Shipper members are committed to using SmartWay carriers. (Biederman, 2012). Benefits in CO2, NOx and particulate matter reductions are confirmed by Sharp Electronics Corporation (Cetinkaya et al., 2011)

[19]A good example is the consortium founded by Wal-Mart in 2009 that work collaboratively on research and development of standards and IT tools for measuring and reporting environmental impacts across product lifecycles (Biederman, 2011). Other is the Clean Cargo Working Group which involves carriers and shippers in the shipping industry dedicated to sustainable product transportation by ocean (Lai et al., 2011). Coopetition in inter-modal part-load transport between three competing road haulage contractors in Switzerland showed to be a very profit solution (Cetinkaya et al., 2011). Improvement of processes through horizontal collaboration such as merge of logistics operations and vehicle deliveries may bring interesting results for all parts – estimation of 15-20% reduction in combined transportation costs (Newing, 2008). In one project, ECR UK brought together 20 retailers and suppliers in a series of collaborative distribution sessions. Companies' data and routes were examined and the potential mileage reduction was around two million vehicle miles per year. A second project called Shared Deliveries to Far Flung Places projected that closer collaboration on transport and distribution networks in northern Scotland between five companies could reduce 40 per cent of vehicle miles (Davies, 2008). Another great benefit of collaboration is the reduction on duplication of monitoring (Doorey, 2011).

Publish sustainability orCorporate Social Responsibility (CSR) reports for internal and external evaluation [20]	(Keating et al., 2008; Leppelt et al., 2013; Oberhofer and Fürst, 2012; Zhu, Sarkis and Lai, 2013; Dargusch and Ward, 2010; Okongwu, Morimoto and Lauras, 2013; Klerkx, Villalobos and Engler, 2012; Schönberger, Galvez-Martos and Styles, 2013)
Be audited by outside companies or third parties are also being used to manage social and environmental issues.	(Murphy and Poist, 2002; Pagell and Wu, 2009; Doorey, 2011; Dargusch and Ward, 2010; Leach, 2010)

Table 12: External Relationships practices

[20] The use of sustainability/CSR reports for internal and external evaluation is becoming a trend, and according to a KPMG survey in 2013, around 93% of the 250 largest companies in the world (G250) report their corporate responsibility (CR) activities (KPMG International, 2013).

4.3 Procurement

On the present framework, Procurement is a group directly linked with suppliers. Traditional procurement tries to keep a distance to suppliers, especially those of commodities, to gain leverage. By inverting this principle and keeping close relationships with their suppliers, procurement managers can increase the sustainability in their supply chain (Pagell and Wu, 2009). This is reflected in the increased importance of single-sourcing strategies, where concentration on core competences is central. Nevertheless outsourcing as a strategy is predicted to be widely used in the near future (Flotzinger, Hofmann-Prokopczyk and Starkl, 2008). In the framework, Procurement is the first core process of ISCM and contains practices related to make the procurement process itself and the materials and services to be purchased in a more social and environmentally responsible way. The role of procurement in driving forward the corporate sustainability agenda is critical as it may influence suppliers (Green, Morton and New, 1996) and favor those that rate highly on sustainability (Meehan and Bryde, 2011) for instance. From all selected literature, 59,6% are included in this group, separated in Procurement process, Materials and Services and Packaging.

4.3.1 Procurement Process

Sustainable procurement is an important topic, with more than 10% of Fortune 500 companies reporting practices in that field (Wu, Dunn and Forman, 2012). This sub-group considers practices related to improving the procurement process. They were cited in 42,4% of the selected references and are listed in table 13.

Practices	Authors
Implement e-Procurement[21]	(Lai et al., 2011)
Buy on total cost and not only on price	(Pagell and Wu, 2009)
Create a "sustainable product index"/database of products for classifying products according to their level of sustainability friendliness	(Biederman, 2011) (Hsu and Hu, 2008)
Use clear contractual terms	(Ciliberti, Pontrandolfo and Scozzi, 2008; Carter and Jennings, 2002)
Use long-term contracts with environmental dimensions	(Fu, Zhu and Sarkis, 2012)
Develop a special purchasing policy for the community	(Caniato et al., 2013)
Avoid non-ethical behavior[22]	(Carter and Jennings, 2002)

Table 13: Procurement process practices

[21] In the case of the Hong Kong International Terminals (HIT) operated by Hutchison Port Holding (HPH), the world's largest container terminal operator, it reduces the use of more than 250,000 sheets of paper a year. As a result, HIT cut paper consumption by 21% in 2007 (Lun, 2011).

[22] The authors cite the following: misleading a salesperson during a negotiation, inventing (making up) a second source of supply to gain competitive advantage, exaggerating the seriousness of a problem to gain concessions, giving preference to suppliers preferred by top management, writing specifications that favor a particular supplier, blaming suppliers for mistakes made by purchasing, sharing information about suppliers with their competitors, overestimating demand to gain volume discounts, avoiding bribes and kickbacks associated with carrier selection, mafia involvement and bribes offered to port officials to expedite shipments. They also suggest auctioning or donating gifts received from suppliers.

4.3.2 Materials and Services

The level of information sharing among supply chain members about procured materials and services is increasing as companies are trying to minimize overall risks and improve sustainability performance. Procurement is, therefore, a crucial process to ensure that the purchased inputs meet the buying firm's standards (Pagell and Wu, 2009). The purchase sustainable products and services is a practice cited by a large numbers of authors (Colicchia, Melacini and Perotti, 2011; Dües, Tan and Lim, 2013; Koplin, Seuring and Mesterharm, 2007; Laosirihongthong, Adebanjo and Tan, 2013; Ashby, Leat and Hudson-Smith, 2012; Fulton and Lee, 2013; Colby and Fertal, 2007; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Azevedo, Carvalho and Cruz Machado, 2011; Schönberger, Galvez-Martos and Styles, 2013). This may reduce cost, improve re-usability and minimize consumption of non-renewable resources (Carbone and Moatti, 2008; Rao, 2007; Styles, Schoenberger and Galvez-Martos, 2012b; Kosansky and Schaefer, 2009; Azevedo, Carvalho and Cruz Machado, 2011).

One possibility is purchase eco and social-labeled products and materials, which inform consumers about the impacts of the production, consumption and waste phases on the environment (Galarraga Gallastegui, 2002). Social labelling is a newer topic but increasingly being used for communicating about 'ethical trade'. Some have focused particularly on labor standards in global supply chains and highlighted issues such as child labor (Zadek, Lingayah & Forstater, 1998). European Union (EU) Ecolabel, for instance, is a voluntary label promoting environmental excellence. It identifies products and services with reduced environmental impact throughout their life cycle (EU Ecolabel, 2015). Besides, companies might also prefer using reusable or less polluting materials, which reduce the product footprint and the overall waste generated in the end of its life cycle. Practices related to the materials, components, products or services to be purchased, could be found in 37,4% of the references and are listed on table 14.

Practices	Authors
Eco and Social-labeled products (including fair trade and certified products)[23]	(Closs, Speier and Meacham, 2011; Rao, 2007; Rao and Holt, 2005; Rao, 2002; Styles, Schoenberger and Galvez-Martos, 2012b; Delai and Takahashi, 2013; Zhu, Sarkis and Lai, 2013; Zhu and Sarkis, 2006; Lai et al., 2011; Wu, Ding and Chen, 2012; Colicchia, Melacini and Perotti, 2011; Azevedo, Carvalho and Cruz Machado, 2011)
Prefer recyclable, reusable or recycled materials Or remanufactured products	(Sarkis, 1999; Murphy and Poist, 2002; Rao and Holt, 2005; Adetunji, Price and Fleming, 2008; Kotzab, Munch, Faultrier and Teller, 2011; Ciliberti, Pontrandolfo and Scozzi, 2008; Preuss, 2009; Carter and Jennings, 2002; Dües, Tan and Lim, 2013; Lau, 2011; Eltayeb and Zailani, 2009; Laosirihongthong, Adebanjo and Tan, 2013; Fulton and Lee, 2013; Ofori, 2000; Caniato et al., 2012; Lai, Wu and Wong, 2013; Azevedo, Carvalho and Cruz Machado, 2011; Schönberger, Galvez-Martos and Styles, 2013) (Preuss, 2009; Dües, Tan and Lim, 2013; Laosirihongthong, Adebanjo and Tan, 2013; Eltayeb and Zailani, 2009)
Use less polluting materials such as biodegradable or without hazardous substances[24]	(MacCarthy and Jayarathne, 2012; Rao and Holt, 2005; Caniato, Caridi and Moretto, 2011; Styles, Schoenberger and Galvez-Martos, 2012a; Eltayeb and Zailani, 2009; Carbone and Moatti, 2008; Perotti et al., 2012; Preuss, 2007; Vachon, 2007; Srivastava, 2007; Lau, 2011; Comas Martí and Seifert, 2013; Laosirihongthong, Adebanjo and Tan, 2013; Ofori, 2000; Lai et al., 2011)

Table 14: Materials and Services practices

[23] Coca-Cola developed a standard to procure certified sustainable sugar for beverage production (Kumar, Teichman and Timpernagel, 2012). Labels may also be reusable. Toyota Canada for instance uses reusable shipping container labels that are laminated for durability (Penny, 2009).

[24] As many refrigerated containers use chlorofluorocarbon (CFC), which contributes to the worsening of global warming, Maersk has replaced it with more environmentally friendly materials such as bamboo to develop container flooring (Lai et al., 2011).

4.3.3 Packaging

Packaging has become the second greatest cost component for manufacturing companies (Handfield et al., 2013) and due to smaller and more frequent shipments, encouraged by ecommerce, increasing order fulfillment costs are driving companies towards lighter weight and more efficient packaging and transportation methods (Penny, 2009). The topic is also target of regulation agencies when imposing new sustainability requirements. A good example is the UK's packaging waste directive (94/62/EC) that requires packaging to be minimized and designed for recovery and reuse. It encourages companies to meet waste recovery targets and establish restrictions on use of heavy metals in packaging.

Some countries have specific empty space and layer limitations of types of packaging (such as Taiwan and South Korea). Others entirely ban or restrict certain materials in some, or all, types of packaging. Examples are polyvinyl chloride (PVC) restrictions in South Korea and expanded polystyrene (EPS) bans in the United States (US) On the other hand, Japan instituted a recycling tax for all packaging at the source on a per kilo basis. The heavier the packaging (e.g. more plastic in the bottle), the higher the tax (Harrington, 2014).

Considering sustainability aspects in packaging are cited in a large amount of references (Dekker, Bloemhof and Mallidis, 2012; Rao and Holt, 2005; Caniato et al., 2012; Carbone and Moatti, 2008; Fulton and Lee, 2013; Ageron, Gunasekaran and Spalanzani, 2012; Grant, Trautrims and Wong, 2013; Carter and Jennings, 2002) and starts with the reduction of the amount of packaging material. It is then followed by the development of packaging innovations that might influence the weigh and volume or the type of material used to produce the packaging. Incentives to use sustainable packaging migh be extended to suppliers through collaborative initiatives or specific requirements. The attention to the proper packaging and labeling of hazardous materials is also included in this sub-group, which represented only 41,4% of the selected literature. The detailed practices and references are shown in table 15.

Practices	Authors
Reduce the amount of packaging material[25]	(Sarkis, 1999; Carter and Jennings, 2002; Ciliberti, Pontrandolfo and Scozzi, 2008; MacCarthy and Jayarathne, 2012; Oberhofer and Fürst, 2012; Kotzab et al., 2011; Brammer et al., 2007; Colicchia, Melacini and Perotti, 2011)
Implement packaging innovation[26]	(Closs, Speier and Meacham, 2011; Cetinkaya et al., 2011; Schönberger, Galvez-Martos and Styles, 2013; Grant, Trautrims and Wong, 2013)
Reduce weight and volume[27]	(Dekker, Bloemhof and Mallidis, 2012; Murphy and Poist, 2002; Carter and Jennings, 2002; Perotti et al., 2012; Preuss, 2007; Azevedo et al., 2012; Dües, Tan and Lim, 2013; Laosirihongthong, Adebanjo and Tan, 2013; Khairani, 2012; Lau, 2011; Azevedo, Carvalho and Cruz Machado, 2011)
Develop environmental responsible packaging - reusable and recyclable	(Ciliberti, Pontrandolfo and Scozzi, 2008; Zailani et al., 2012; Closs, Speier and Meacham, 2011)
Use less materials especially hazardous ones	(Eltayeb and Zailani, 2009; Laosirihongthong, Adebanjo and Tan, 2013)

[25] Reducing the amount of packaging material doesn`t mean increasing the probability of product damage during its movement across the supply chain (McKinnon, Browne and Whiteing, 2010).

[26] Are preferably implemented during design phase (Perotti et al., 2012; Sarkis, 1998)

[27] Reduction in volume promotes improvement in "space-efficiency", such as though replacing round cans with square ones to cut space requirements by 20% in vehicles, warehouses and shops (Sonneveld, 2000). Kumar et al. (2012) researched some practices from Apple: the package for the fourth generation iPod Nano is 32% lighter and has 54% less volume compared to the first generation.

Use alternative materials such as recycled and reusable[28]	(Carbone and Moatti, 2008; Zailani et al., 2012; Ciliberti, Pontrandolfo and Scozzi, 2008; Colicchia, Melacini and Perotti, 2011; Diabat and Govindan, 2011; Eltayeb and Zailani, 2009; Lau, 2011; Grant, Trautrims and Wong, 2013)
Use remanufactured From sustainable sources	(Carbone and Moatti, 2008) (Preuss, 2007)
Collaborate with suppliers for sustainable packaging[29] Set requirements for supplier to use environmental packaging	(Caniato et al., 2013; Kaplan, 2013) (Zhu et al., 2011; Zhu, Sarkis and Lai, 2013)
Use proper packaging and labeling of hazardous materials	(Carter and Jennings, 2002)

Table 15: Packaging practices

[28] Weber Logistics, a player in the U.S. West Coast logistics market, has purchased machinery that recycles dunnage into packing material to be used as protective filler during shipping, which greatly reduces the use of plastic filler (Sowinski, 2013). Toyota Canada is using coroplast, a durable, reusable plastic packaging instead of cardboard used for small parts shipments. Reusable absorbent pads are also used in place of newsprint when packing coroplast containers (Penny, 2009). Coca-Cola, a leader in packaging, has ninety-eight percent of their product delivered in bottles that are recyclable, or reusable (Kumar, Teichman and Timpernagel, 2012). The company targets to reach a 100 percent plant-based packaging by the year of 2020. Sugar cane and sugar cane waste material from Brazil and India is being used. Rice waste from India, and corn waste cornhusks from the United States and China are also being researched.

[29] Tetra Pak signed an agreement with Braskem, the largest thermoplastic resins producer in the Americas, for the supply of low-density polyethylene (LDPE) made from sugar cane to its packaging material factories in Brazil (Kaplan, 2013).

4.4 Production Management

Production Management group should not be observed with a traditional process view located between procurement and distribution. It is represented in the framework with a broader approach, as a link between suppliers and customers, crossing through internal company's processes. Production practices enable designing and delivering solutions according to customer's demands of high level of eco-efficiency and social responsibility. The integration of all three clusters (SRM, ISCM and CRM) and their collection of practices guarantee the success of this outcome. Its closeness with suppliers allow collaborative projects to be conducted. As most of companies' waste of resources are related to production processes, in this group stands large opportunities for efficiency improvements, especially when considering the product life cycle approach. Production Management is located in parallel with all ISCM as it supports their practices, in special, stimulating integration with logistics traditional responsibilities. A total of 64,6% of the researched literature considers practices from this group.

4.4.1 Solutions development

A good percentage of references (46,5%) cited practices related to the development of sustainable solutions in company's core products and services portfolio, and its production processes improvements. This is an area with a large potential for increasing sustainability in the supply chain. It connects inbound (suppliers and procured materials) with customers (through outbound logistics) offering value in solutions that transform sourced materials into customers' demands. Considering the product life cycle approach, companies aims to design products that have the lowest possible environmental impact throughout their entire life cycle (van Hemel, 1998), respecting environmental, health and safety aspects over the full product and process life cycle (Casper and Stevels, 2000). This includes designing social responsible products as well (Caniato, Caridi and Moretto, 2011). Therefore, a first step for reducing the overall product

footprint is taking environmental aspects into consideration when designing a solution (Carbone and Moatti, 2008; Liu et al., 2012; Pagell and Wu, 2009; Brito, Carbone and Blanquart, 2008; Rao, 2007; Delai and Takahashi, 2013; Hsu and Hu, 2008; Ageron, Gunasekaran and Spalanzani, 2012; Diabat and Govindan, 2011; Dües, Tan and Lim, 2013; Khairani, 2012; Laosirihongthong, Adebanjo and Tan, 2013; Perotti et al., 2012; Styles, Schoenberger and Galvez-Martos, 2012b). Some approaches regarding the product design are listed table 16. Another similar approach is designing products that help reducing customers' footprint (e.g. consume less energy). Most of these approaches require the management of product life cycles, where the whole impact of the product and its components is calculated and minimized. Collaboration with suppliers, once more, is critical for data collection and to work together especially in the design phase.

Practices	Authors
Design for:	
- Environment - DfE	(Sarkis, 1999; Caniato, Caridi and Moretto, 2011; Nunes and Bennett, 2010; Ashby, Leat and Hudson-Smith, 2012; Khairani, 2012; Azevedo, Carvalho and Cruz Machado, 2011; Grant, Trautrims and Wong, 2013)
- Sustainable Supply Chain Management Concept	(Cetinkaya et al., 2011)

- Consume less materials, especially hazardous ones[30]	(Wu, Ding and Chen, 2012; Zhu, Sarkis and Geng, 2005; Zhu, Sarkis and Lai, 2013; Zhu and Sarkis, 2006; Colicchia, Melacini and Perotti, 2011; Khairani, 2012; Eltayeb and Zailani, 2009; Azevedo, Carvalho and Cruz Machado, 2011; Grant, Trautrims and Wong, 2013; Kumar, Teichman and Timpernagel, 2012)
- Reuse/recycle	(Zhu, Sarkis and Lai, 2013; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Lai et al., 2011; Sarkis, 1998; Wu, Ding and Chen, 2012; Carter and Jennings, 2002; Kotzab et al., 2011; Colicchia, Melacini and Perotti, 2011)
- Disassembly[31]	(Zailani et al., 2012; Ciliberti, Pontrandolfo and Scozzi, 2008; Srivastava, 2007; Sarkis, 1998; Brammer et al., 2007; Wu, Ding and Chen, 2012; Colicchia, Melacini and Perotti, 2011; Azevedo, Carvalho and Cruz Machado, 2011; Grant, Trautrims and Wong, 2013; Zhu and Sarkis, 2006; Zhu, Sarkis and Geng, 2005; Zhu, Sarkis and Lai, 2013; Ytterhus, Arnestad and Lothe, 1999)

[30] Apple, electronics manufacturer, that decided recently to design its product line completely free (iPod product line) or nearly free of toxic components (laptop product line) (Kumar, Teichman and Timpernagel, 2012).

[31] Many cars and computers are designed to allow for future component and material recovery. It can reduce resource depletion, energy use and pollution production, and additionally offer significant effects on social and human health issues (Crowther, 1999). Additionally, this approach emphasizes the use of standardized materials and adoption of modular design (Lai, Wu and Wong, 2013; Azevedo, Carvalho and Cruz Machado, 2011).

Design solutions that help reducing customers' footprint (e.g. consume less energy)[32]	(Kotzab et al., 2011; Colicchia, Melacini and Perotti, 2011; Eltayeb and Zailani, 2009; Zhu and Sarkis, 2006; Wu, Ding and Chen, 2012; Zhu, Sarkis and Lai, 2013; Grant, Trautrims and Wong, 2013; Kumar, Teichman and Timpernagel, 2012).
Measure and analyze product life cycle[33]	(Zailani et al., 2012; Carter and Jennings, 2002; Gopalakrishnan et al., 2012; Pagell and Wu, 2009; Eltayeb and Zailani, 2009; Sarkis, 1998; Srivastava, 2007; Lai et al., 2011; Ageron, Gunasekaran and Spalanzani, 2012; Dües, Tan and Lim, 2013; Laosirihongthong, Adebanjo and Tan, 2013; Okongwu, Morimoto and Lauras, 2013; Ashby, Leat and Hudson-Smith, 2012; Brammer et al., 2007; The vital links, 2007; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013; Preuss, 2007).
Involve suppliers in the attempt of developing cleaner products providing them green design specification for purchasing	(Holt, 2004; Holt and Ghobadian, 2009; Styles, Schoenberger and Galvez-Martos, 2012b; Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu et al., 2011; Zhu, Sarkis and Lai, 2013; Perotti et al., 2012)

Table 16: Solutions development practices

[32] Apple decreased the energy usage in iMacs by 93% through increased hardware efficiency from the first to the current generation. They also designs its products with energy efficiency in mind, typically exceeding the Energy Star requirements (Kumar, Teichman and Timpernagel, 2012).

[33] According to Sarkis (1998), Life Cycle Assessment (LCA) can be used to identify opportunities to reduce the environmental impacts associated with a specific product, process, or activity. In Life-Cycle Costing, all costs are identified for a product throughout its lifetime, from raw materials acquisition to disposal, considering, therefore the cradle-to-grave approach. This is also called "design for whole-life costs" (Adetunji, Price and Fleming, 2008). The collection of scientific information on environmental hotspots for core product supply chains offers opportunity for defining priority improvement options (Styles, Schoenberger and Galvez-Martos, 2012b).

4.4.2 Resources

Practices related to resources' management, especially: energy, water and paper, are not only related to production but to all internal processes. Its location into the Production Management group is due to the majority of consumption and improvement opportunities being located into the core product/service production phase. Among the 99 selected references, 40,4% considered practices (table 17) focused on a better resource use and the reduction of general consumption[34] (Murphy and Poist, 2002; Rao, 2007; Carbone and Moatti, 2008; Adetunji, Price and Fleming, 2008; Nunes and Bennett, 2010; MacCarthy and Jayarathne, 2012; Closs, Speier and Meacham, 2011; Liu et al., 2012; Caniato et al., 2013; Delai and Takahashi, 2013; Zhu, Sarkis and Lai, 2013; Oberhofer and Fürst, 2012; Lun, 2011; Perotti et al., 2012; Biederman, 2011; Colicchia, Melacini and Perotti, 2011; Diabat and Govindan, 2011; Klerkx, Villalobos and Engler, 2012; Grant, Trautrims and Wong, 2013). Energy efficiency was well cited and its importance was also emphasized in a report from 2007 where it was considered the most common green supply chain practice in the United States (U.S.) (O'Reilly, 2007). Initiatives related to use of renewable energy sources are also considered into this sub-group.

Practices	Authors
Promote paperless program[35]	(Lieb and Lieb, 2010; Lai et al., 2011; Schönberger, Galvez-Martos and Styles, 2013; Lun, 2011)

[34] According to some authors (Lieb and Lieb, 2010; Schönberger, Galvez-Martos and Styles, 2013), large results are reached with the use of third parties to identify potential lighting upgrades to reduce kilowatt hour consumption, utility costs, and GHG emissions within all company facilities; development of an eco-consumption program focusing on management of the purchase, consumption, reuse, and recycling of office supplies and packaging materials; implementation of high-efficiency lighting projects at DCs; tracking of gas and electricity use at company-operated warehouses and DCs; establishment of pilot programs to substantially reduce energy consumption in company warehouses.

[35] In Maersk, to reduce the use of paper and simplify the shipping processes, an "End-to-End EDI Solutions" was developed to automatically synchronize the sharing of data across its customers and business partners, significantly cutting down paperwork, reducing processing speed, and decreasing the possibility of errors by transferring data without manual

Promote energy efficiency	(Adetunji, Price and Fleming, 2008; Caniato et al., 2013, 2012; Carbone and Moatti, 2008; Delai and Takahashi, 2013; Eltayeb and Zailani, 2009; Murphy and Poist, 2002; Holt and Ghobadian, 2009; Murphy and Poist, 2003; Lieb and Lieb, 2010; Ciliberti, Pontrandolfo and Scozzi, 2008; MacCarthy and Jayarathne, 2012; McKinnon, Browne and Whiteing, 2010; Kotzab et al., 2011; Lun, 2011; Perotti et al., 2012; Colicchia, Melacini and Perotti, 2011; This and Ch, 2008; Diabat and Govindan, 2011; Schönberger, Galvez-Martos and Styles, 2013; Azevedo, Carvalho and Cruz Machado, 2011; Grant, Trautrims and Wong, 2013)
Cogeneration	(Colicchia, Melacini and Perotti, 2011)
Develop/use of renewable energy sources[36]	(Kotzab et al., 2011; Perotti et al., 2012; Preuss, 2009; Comas Martí and Seifert, 2013; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; McKinnon, Browne and Whiteing, 2010; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013; Lun, 2011; Oberhofer and Fürst, 2012)

intervention (Lai et al., 2011). This also happened in Hong Kong International Terminals (HIT) operated by Hutchison Port Holding (HPH), the world's largest container terminal operator, container where shipping documents are converted into electronic form to improve operational efficiency and reduce the use of paper (Lun, 2011).

[36] According to Grant et al. (2013) and McKinnon et al. (2010) electricity bought in from energy suppliers can also be sourced from "greener" form of electricity generation. Energy, in warehouse site, can also be generated from biomass or low-carbon fuels, wind turbines, solar panels, recovered waste energy, kinetic energy and thermal-exchange units.

Water management:	(Carbone and Moatti, 2008; Adetunji, Price and Fleming, 2008; Caniato et al., 2013; Delai and Takahashi, 2013; Rao, 2007; Perotti et al., 2012; Colicchia, Melacini and Perotti, 2011; Fu, Zhu and Sarkis, 2012; Khairani, 2012; Comas Martí and Seifert, 2013; Schönberger, Galvez-Martos and Styles, 2013; Grant, Trautrims and Wong, 2013; Kumar, Teichman and Timpernagel, 2012)
Minimize water waste through cleaner technology processes	(Rao and Holt, 2005)
Collect rainwater and reuse	(Schönberger, Galvez-Martos and Styles, 2013; Grant, Trautrims and Wong, 2013)

Table 17: Resources consumption practices

4.5 Distribution

The distribution of goods impairs local air quality, generates noise and vibration, causes accidents and makes a significant contribution to global warming. In UK in 2004, transport accounted for 23% of total energy related carbon dioxide (CO2) emissions, with worldwide freight transport corresponding to 8% (McKinnon, 2007). When analyzing the direct global greenhouse-gas emissions in 2010 in terms of CO2-eq, transport accounts for 17,5% (Edenhofer et al., 2014). Additionally it is expected to more than double in the period to 2050 (Stern, 2007), making it the second-fastest growing sector after power. Specific buildings dedicated to warehousing and goods handling share between 2-3% (Kahn Ribeiro et al., 2007). Due to ecommerce increase, globalization and customers' demands, freight transport is increasing substantially and actions on the distribution group offer strategic opportunities to decrease companies' impacts on the environment and on people, while decreasing costs. The inputs from the selected literature corresponded to 54,5% although as shown in the following, these references are decentralized into the four sub-groups of practices: structure and network, transport modes, equipment and vehicles and distribution processes.

4.5.1 Structure and Network

Practices to improve supply chain sustainability may start in the planning of new logistics structures, such as warehouses, production plants or distribution channels. Sustainable requirements for construction methods and materials combined with discussions with the local community may offer long-term benefits to the company and its supply chain. During the network design plan, taking into consideration environmental and social aspects characterizes a balanced operation. Merging and opportunities for shortening the distances between company and its customers or suppliers may be identified. Moreover, optimizations in fleet use and consolidation of freight flows are also some of the cited practices. Although

there is no consensus on whether is more sustainable to centralize or decentralize the distribution, the authors from the selected references cited only the benefits of centralizing and using intermediate simple facilities and processes such as multi-drop, multi-pick, cross-docking. None of the pieces of literature considered descentralization. As shown in table 18, from all selected references, only 34,3% considered practices related to structure and network.

Practices	Authors
Use efficient land when considering the location for building a warehouse/production plant/store	(Murphy and Poist, 2003; Delai and Takahashi, 2013; Grant, Trautrims and Wong, 2013)
Avoid deforestation, protecting sensitive ecosystems	(Styles, Schoenberger and Galvez-Martos, 2012a)
Require environmental impact statements when selecting manufacturing and distribution sites for new constructions	(Kosansky and Schaefer, 2009)
Implement “green” practices during the construction phase, attention to:	(Nunes and Bennett, 2010; Lieb and Lieb, 2010; Kosansky and Schaefer, 2009; Preuss, 2009; Adetunji, Price and Fleming, 2008; Grant, Trautrims and Wong, 2013)
- Materials	(Perotti et al., 2012; Preuss, 2009; Colicchia, Melacini and Perotti, 2011; Fulton and Lee, 2013; Grant, Trautrims and Wong, 2013)
- Methods and waste… used for diminishing the impact to visual surrounding, air quality, water supply, and nature habitats	(Adetunji, Price and Fleming, 2008; Grant, Trautrims and Wong, 2013; Closs, Speier and Meacham, 2011)

- Facilities layouts - Low energy consumption facilities[37], also with green building certification such as Leadership in Energy & Environmental Design (LEED) and Building Research Establishment Environmental Assessment Method (BREEAM)	(Sarkis, 1999; Grant, Trautrims and Wong, 2013) (Caniato et al., 2012; MacCarthy and Jayarathne, 2012; Dekker, Bloemhof and Mallidis, 2012; Perotti et al., 2012; Sowinski, 2013; Preuss, 2009; This and Ch, 2008; Colicchia, Melacini and Perotti, 2011; Fulton and Lee, 2013; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013)
During the building planning phase, consider: warehouse temperature (temp, humidity/Insulation during construction), warehouse lighting, mechanical handling equipment and harness green energy	(Oberhofer and Fürst, 2012; Lun, 2011; Perotti et al., 2012; Colicchia, Melacini and Perotti, 2011; Schönberger, Galvez-Martos and Styles, 2013; Grant, Trautrims and Wong, 2013; Mckinnon, 2012)

[37] The Duke Realty in Waco, Texas implemented for Caterpillar a 750,000-square-foot "green" distribution center with reflective roof and parking lot to block sunlight, and energy saving controls for its air conditioning. Furthermore, they used recyclable materials in the construction and native grasses to landscape the site (Hoffman, 2008).

Redesign the logistic network and its components considering also the total emissions[38]	(Murphy and Poist, 2002; Perotti et al., 2012; Golicic, Boerstler and Ellram, 2010; This and Ch, 2008; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; Gross et al., 2013; Schönberger, Galvez-Martos and Styles, 2013; Ageron, Gunasekaran and Spalanzani, 2012; Dües, Tan and Lim, 2013; Kosansky and Schaefer, 2009; Kotzab et al., 2011; ECR, 2008)
Merge networks	(Gross et al., 2013)
Shorter networks between company and its customers	(Dekker, Bloemhof and Mallidis, 2012)
Shorter networks between company and its suppliers	(Caniato et al., 2012; This and Ch, 2008; Grant, Trautrims and Wong, 2013)
Use "cluster" suppliers[39]	(Cetinkaya et al., 2011)
Use centralized distribution systems[40]	(Caniato, Caridi and Moretto, 2011; Dekker, Bloemhof and Mallidis, 2012; Azevedo et al., 2012; Schönberger, Galvez-Martos and Styles, 2013; Grant, Trautrims and Wong, 2013)

[38] Some authors reinforce the importance of mapping the set-up of distribution channels from an environmental viewpoint in order to save transport kilometers and minimize both costs and emissions in addition to assessing the transport from an environmental perspective (Kotzab et al., 2011; Kosansky and Schaefer, 2009; Ageron, Gunasekaran and Spalanzani, 2012; Dües, Tan and Lim, 2013).

[39] IKEA implemented this concept where a major supplier takes responsibility for storing goods from the other suppliers for later consolidation with its own goods when orders are dispatched (Cetinkaya et al., 2011).

[40] Moving from decentralized to centralized distribution systems provide opportunities to of shipment consolidation, change of transportation mode and reduction of emergency deliveries (Aronsson and Brodin, 2006). Tesco started with this strategy of building larger and centralized warehouses. These changes have been saving around 2.186 million miles and 2 951 tons of CO2 per year (Schönberger, Galvez-Martos and Styles, 2013).

Use of intermediate simple facilities/processes such as multi-drop, multi-pick, cross-docking	(Brito, Carbone and Blanquart, 2008; Caniato, Caridi and Moretto, 2011)
Consolidation of freight flows[41]	(Sarkis, 1999; Dekker, Bloemhof and Mallidis, 2012; Lieb and Lieb, 2010; Kosansky and Schaefer, 2009; Perotti et al., 2012; This and Ch, 2008; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; Gross et al., 2013; Schönberger, Galvez-Martos and Styles, 2013; Grant, Trautrims and Wong, 2013)
Fleet optimization	(This and Ch, 2008; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; Golicic and Smith, 2013)
Reduction in vehicle fleet[42]	(Ciliberti, Pontrandolfo and Scozzi, 2008; Kosansky and Schaefer, 2009)

Table 18: Structure and Network practices

[41] Consolidation of freight flows occurs when different shipments are grouped into larger shipments, in order to better utilize a transport vehicle's capacity. This strategy reduces costs and pollutants emissions such as GHG, but may also increase the delivery lead time and consequently affect customer satisfaction. Carrefour implemented in 2010 a consolidated platform strategy where suppliers deliver to a single consolidation warehouse, from which Carrefour arranges goods transport to DCs and stores in optimally-filled trucks (Schönberger, Galvez-Martos and Styles, 2013).

[42] Toyota Canada, for instance, introduced load sharing with Honda and Chrysler when delivering customer parts orders to similar geographic areas. Load sharing is estimated to save approximately 680 tons of GHG and 9 tons of smog-forming contaminants per year (Penny, 2009).

4.5.2 Transport modes

Emission efficiency differs according to the transport mode implemented. Air transport is according to researches the most pollutant mode in CO2e kg/tonne-km. On the other hand, water and rail are considered the cleanest modes (World Economic Forum, 2009; Stern, 2007). Road, the mostly used mode worldwide, accounts for three-quarters of the global GHG emissions from transport (Stern, 2007). It emits, besides CO2, other dangerous pollutants for human health such as mono-nitrogen (NOx) and particulate matter (PM), most of them coming from the exhausts of heavy goods vehicles (HGVs). When these and other pollutants such as sulphur oxides (SOx) are additionally considered, the impact of each transport mode may change. Water transport, for instance, considered an environmentally-sound transport mode due to its low energy consumption per unit of freight, emits much higher rate of these pollutants per unit of energy consumed than any other transport mode (McKinnon, Browne and Whiteing, 2010).

Discussions about the impact of each mode of transport have been increasing due to the representation of transport emissions. However, practices to motivate changing the transport mode of company's distribution to less polluting ones (Carter and Jennings, 2002; Rao and Holt, 2005; Rao, 2007; Lieb and Lieb, 2010; Oberhofer and Fürst, 2012; Kosansky and Schaefer, 2009; Perotti et al., 2012; Golicic, Boerstler and Ellram, 2010; Azevedo, Carvalho and Cruz Machado, 2011) or/and encouraging intermodal strategies (Sarkis, 1999; Carbone and Moatti, 2008; Ciliberti, Pontrandolfo and Scozzi, 2008; Brito, Carbone and Blanquart, 2008; Dekker, Bloemhof and Mallidis, 2012; Caniato et al., 2013; Wiederkehr et al., 2004; Cetinkaya et al., 2011; Gross et al., 2013) were found in only 24,2% of all selected practices (table 19). Some authors also considered the use of alternative transport means (i.e.bike/car sharing), which is a reality nowadays (Ciliberti, Pontrandolfo and Scozzi, 2008). Some specific benefits of modal switch can be found in a report published by Efficient Consumer Response – Europe (ECR, 2008).

Practices	Authors
Prefer rail[43]	(Preuss, 2007; Wiederkehr et al., 2004; Carter and Jennings, 2002; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013)
Prefer sea and inland	(Wiederkehr et al., 2004; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013)
Avoid air-freight[44] and air-travel[45]	(Styles, Schoenberger and Galvez-Martos, 2012a; Wiederkehr et al., 2004)
Collaborating with suppliers to decide best modes of transportation based on cost and service needs	(Closs, Speier and Meacham, 2011)

Table 19: Transport modes practices

[43] In late 2008, Coop began a partnership with Green Cargo, moving goods transport within Sweden from roads to rail, saving 120 truck consignments per working day between Helsingborg and Umeå. This modal shift estimates to save 8000 t CO2 per year (10%) (Schönberger, Galvez-Martos and Styles, 2013). Mercadona reduced their environmental impact (7% in transport energy) changing one part of their operation from the east coast Spain to southern Spain. Every year, 220000 tonnes are transported on 416 trains. Good results were not only in CO2 reduction but also in delivery punctuality and goods damage. Cost savings of EUR 13.1 million have been achieved. (Cetinkaya et al., 2011)

[44] Although the Advisory Council for Aeronautical Research in Europe (ACARE) had set targets for aviation by 2020, the impact of this transport mode tends to increase due to globalization and popularization of e-commerce. The formal targets are, even so, to reduce fuel consumption and CO2 emissions by 50% (per passenger/tone carried) and NOx by 80% and perceived external noise by 50% (Sustainable Aviation, 2015).

[45] Participants of Toyota Canada's employee trip reduction program are estimated to have saved 2000 vehicle trips, 40,000 kilometres, 12 tonnes of GHG emissions and $20,000 in annual vehicle maintenance and operating costs per year (Penny, 2009).

4.5.3 Equipment and Vehicles

One of the most balanced strategy to combine economic, social and environmental benefits is through investing in equipment and vehicles. As shown in details in table 20, some factors related to equipment and vehicles may influence directly on sustainability improvements: Fuel type, vehicle's energy efficiency, body type, presence of aerodynamic accessories and supporting technologies and the maintenance policy. However, from all selected references, only 32,3% considered practices related to this sub-group.

Practices	Authors
Changes in fuel type Use alternative fuels[46]	(Lieb and Lieb, 2010; Oberhofer and Fürst, 2012; Lun, 2011; Ciliberti, Pontrandolfo and Scozzi, 2008; Dekker, Bloemhof and Mallidis, 2012; Holt and Ghobadian, 2009; Rao, 2007; Perotti et al., 2012; Biederman, 2011, 2012; Davies, 2008; Golicic, Boerstler and Ellram, 2010; Wiederkehr et al., 2004; Preuss, 2009; This and Ch, 2008; Colicchia, Melacini and Perotti, 2011; Fu, Zhu and Sarkis, 2012; Comas Martí and Seifert, 2013; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013)

[46] Discussions about the environmental and social trade-off of using alternative fuels are vast. According to some researches, vans with diesel engines emit less CO2 and HC but relatively more NOx and PM those with petrol engines (McKinnon, Browne and Whiteing, 2010). Among the most cited alternative fuels are Biofuel, such as biodiesel and bioethanol, use of hydroges, gas and electricity instead of petroleum. An example of company that invests on alternative fuels is UPS that has been using heavy tractor trucks equipped to run on liquefied natural gas. The vehicles reduce GHG emissions by about 25 percent and use 95 percent less diesel fuel than the older trucks they are replacing (Biederman, 2011).

Use hybrid technology in local deliveries operations	(Colicchia, Melacini and Perotti, 2011)
Use battery electric vehicles	(McKinnon, Browne and Whiteing, 2010; Cetinkaya et al., 2011; Schönberger, Galvez-Martos and Styles, 2013)
Use electric machinery and equipment used for warehousing processes	(Dekker, Bloemhof and Mallidis, 2012; Gopalakrishnan et al., 2012; Lun, 2011; Sowinski, 2013; Perotti et al., 2012; Lau, 2011; Grant, Trautrims and Wong, 2013)
Energy efficient vehicles such as:[47]	(Golicic, Boerstler and Ellram, 2010; Liimatainen et al., 2012; Wiederkehr et al., 2004; Colicchia, Melacini and Perotti, 2011; Lau, 2011; Grant, Trautrims and Wong, 2013)
Ships and aircraft	(Biederman, 2011; Leach, 2010)(Wiederkehr et al., 2004)
EURO emission standard vehicles	(Oberhofer and Fürst, 2012; McKinnon, Browne and Whiteing, 2010; Davies, 2008; Sowinski, 2013; Cetinkaya et al., 2011; Schönberger, Galvez-Martos and Styles, 2013)
With reduction of truck idle time	(Golicic, Boerstler and Ellram, 2010; Liimatainen et al., 2012; Grant, Trautrims and Wong, 2013)

[47] The United States department for energy expects that two-thirds of future fuel efficiency gains will come from improvements to engine and exhaust systems (McKinnon, Browne and Whiteing, 2010). These authors also enforce that regenerative braking is increasingly being adopted, as well as electric traction where electricity can be fed back either into the power supply system for use by other trains or returned to the National Grid to be used elsewhere. When analyzing aircraft's performance, over the past 40 years, the average fuel efficiency of commercial aircraft has risen by 70%, while aircraft coming into service today are around 75% quieter than their predecessors of 20 years ago (ICAO, 2007).

With turbocharging (recycling heat from exhaust gases), energy efficiency of auxiliary equipment (pumps, fans, air compressor, heating…), use of variable frequency drive HVAC	(Colicchia, Melacini and Perotti, 2011)
With "next generation tires"[48]	(McKinnon, Browne and Whiteing, 2010; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013)
With automatic pressure-monitoring and inflation of tires	(Oberhofer and Fürst, 2012)
Change the body type[49]:	
Double deck trailer	(Liimatainen et al., 2012)
Longer combination vehicles (LCV) and "Gigaliners"[50]	(Gross et al., 2013; Grant, Trautrims and Wong, 2013)

[48] The so called "next generation tires" can also raise fuel efficiency by 3.5-8% by reducing rolling resistance and thus increasing fuel consumption and reducing emissions (McKinnon, Browne and Whiteing, 2010; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013). FedEx, Johnson & Johnson and Walmart are now using wider tires on their trucks and Tyson Food uses aluminum wheels on their trucks are some of the examples in this topic (Golicic, Boerstler and Ellram, 2010).

[49] The use of less dense material in the chassis like aluminum may cut around 3000kgs of the tare/empty weight of the truck. It is a good solution when the problem is weight rather than space, and results are especially more fuel savings and consequently reductions on the amount of carbon emissions (McKinnon, Browne and Whiteing, 2010). Efficient Consumer Response – Europe (ECR, 2008) presented case studies of results from increase on vehicle capacity.

[50] The use of "Gigaliners", vehicles with 25,25 meters and a capacity of 44 tones are being tested in Germany and expected to save up to 20% of CO2 compared to usual HGVs, in spite of the fear of damage to the infrastructure, additional congestion and increased risk of accidents (Grant, Trautrims and Wong, 2013).

Use of less dense material	(Liimatainen et al., 2012)
Inclusion of aerodynamic accessories	(Liimatainen et al., 2012; McKinnon, Browne and Whiteing, 2010; This and Ch, 2008; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013; Oberhofer and Fürst, 2012)
Changes in logistics equipment such as using eco-friendly/recyclable containers and pallets	(Lieb and Lieb, 2010; Lai et al., 2011; Holt and Ghobadian, 2009; Holt, 2004; Azevedo, Carvalho and Cruz Machado, 2011)
Implementation of maintenance and renewal policies[51]	(Ciliberti, Pontrandolfo and Scozzi, 2008; Colicchia, Melacini and Perotti, 2011; This and Ch, 2008)

Table 20: Equipment and Vehicles practices

[51] It reduces the risks of leaking fluids, i.e. oil…(Carter and Jennings, 2002; Liimatainen et al., 2012; Perotti et al., 2012; Leach, 2010).

4.5.4 Distribution Processes

When analyzing practices related to the way logistics processes are implemented, a wide variety of improvement options are available focused on warehouse and transport management. The aim of these practices are improving optimization and reducing overall risks and costs. Economic-focused actions can generate positive results in the other two aspects of sustainability. Besides the opportunities, of all references, only 20,2% considered practices related to warehouse or transport management processes (table 21).

Practices	Authors
Warehouse management:	
Minimize inventory and its management (green scheduling and production planning, inventory management system with real-time inventory visibility)[52]	(This and Ch, 2008; Dües, Tan and Lim, 2013; Grant, Trautrims and Wong, 2013; Sarkis, 1998)
Storage, pack, label and transport properly hazardous materials	(Murphy and Poist, 2002; Carter and Jennings, 2002)
Find revenue-generating uses or donating obsolete inventory in warehouse	(Carter and Jennings, 2002)

[52] The implementation of an inventory management system may control and prevent environmental degradation. Integration of real-time inventory visibility has the potential to cut down unnecessary trips and wasteful inventory obsolescence by: improving the accuracy of inventory levels and creating a closed-loop system for reporting and reconciling inventory levels with front-office (This and Ch, 2008). Choosing a replenishment system and IT support, adjusting safety-stock levels based on supplier risk profiles may also contribute to reducing inventory and carbon emissions (Grant, Trautrims and Wong, 2013)

Transport management:	
Optimize freight loads and routes	(Caniato, Caridi and Moretto, 2011; Golicic, Boerstler and Ellram, 2010; Wiederkehr et al., 2004; Perotti et al., 2012; Liimatainen et al., 2012; This and Ch, 2008; Lau, 2011; Khairani, 2012; Caniato et al., 2013; Colicchia, Melacini and Perotti, 2011; Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Azevedo et al., 2012; Schönberger, Galvez-Martos and Styles, 2013)
Efficient Load Fill and Deliveries	(ECR, 2008)
Align inbound and outbound shipments[53]	(Colicchia, Melacini and Perotti, 2011; Lau, 2011)
Reduce the replenishment frequency	(Dües, Tan and Lim, 2013)
Negotiate with clients for amplifying delivery window	(Dekker, Bloemhof and Mallidis, 2012; Kosansky and Schaefer, 2009; Golicic, Boerstler and Ellram, 2010; Gross et al., 2013)
Change operation hours[54]	(Carter and Jennings, 2002; Lau, 2011)

[53]The alignment of inbound and outbound shipments (Colicchia, Melacini and Perotti, 2011; Lau, 2011) has the potential to reduce carbon emissions by connecting customers to synchronize returns with maximized fleet use (backhauls) and coordinating supplier shipments to consolidate freight costs and negotiate better rates (This and Ch, 2008).

[54] Carrefour, e.g. has installed special delivery areas to accept deliveries outside store opening hours at 39 hypermarkets and 1200 supermarkets/convenience stores (Schönberger, Galvez-Martos and Styles, 2013). Aware of the impact of transport activities in to society, they also installed low-noise handling equipment and use 'silent' trucks. These actions reduce noise pollution and traffic.

Use of telecommunications systems such as:	(Golicic, Boerstler and Ellram, 2010; Wiederkehr et al., 2004; This and Ch, 2008)
Use telematics[55]	(Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013)
Use Integrated Transport Management System[56]	(Schönberger, Galvez-Martos and Styles, 2013)
Low speed – low fuel consumption strategy	(Dekker, Bloemhof and Mallidis, 2012; Lieb and Lieb, 2010; Biederman, 2011; Liimatainen et al., 2012; Gross et al., 2013; Grant, Trautrims and Wong, 2013)

[55] Telematics-based solutions (Cetinkaya et al., 2011; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013) uses web-based fleet data to recognize opportunities for increased efficiencies and to monitor for excess speed, braking, fuel usage, and idling (This and Ch, 2008). The retailer Casino saved 8.5 million km and avoided 8 000 t CO2 emissions in one year by optimizing routes with tracking software (Schönberger, Galvez-Martos and Styles, 2013). Telecommunication systems bring interesting opportunities not only for reducing CO2 emissions but also supports managing traffic conditions – congestion and weather (McKinnon, Browne and Whiteing, 2010; Dekker, Bloemhof and Mallidis, 2012; Murphy and Poist, 2003) and reducing empty runs (McKinnon, Browne and Whiteing, 2010; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013). According to researches, approximately 25% of trucks km in EU countries is run empty (Eurostat, 2007) but reduction can be achieved through synergies with other companies and optimizing daily plans (Davies, 2008).

[56] Sainsbury implemented an Integrated Transport Management System and transport products from suppliers to DCs when returning from making store deliveries, and vice versa. CO2 reduced by 6.4% in the first year and a total of 1174 046 vehicle kilometers were avoided. Tesco also operate a load-sharing arrangement with suppliers which results of 55432 supplier back-loads saving yearly around 2.6 million road miles. Their fleet also did not grow despite significant retail growth (Schönberger, Galvez-Martos and Styles, 2013).

Improve drivers' skills	(McKinnon, Browne and Whiteing, 2010; Golicic, Boerstler and Ellram, 2010; Liimatainen et al., 2012; Colicchia, Melacini and Perotti, 2011; This and Ch, 2008; Grant, Trautrims and Wong, 2013; Carter and Jennings, 2002)

Table 21: Distribution Processes practices

4.6 Waste Management

The Waste Management is the last group in the ISCM cluster, representing the reverse flow of waste from all the core processes back to the suppliers or to its origin. Reuse, Recycle proper waste disposal, especially of hazardous materials, as well as pollution control are important collection of practices to reduce overall impact of waste in supply chain's carbon footprint. Waste includes materials and product's parts that might be brought back to the suppliers or to intermediate treatment centers to be disassembled, separated and properly managed. Waste also consists of direct emissions by the company or indirect ones. These may be done by suppliers during the product components' production, or by customers during product use phase. From all researched literature, 52,5% considered practices from this group, decentralized into sub-groups.

4.6.1 Reuse and Recycle

The Reuse and Recycle sub-group is directly linked with production management as when a product is designed considering sustainability aspects, it also generates in the end less waste, or at least less non-valuable waste. A recently developed definition for waste management considers not only the 3Rs (reduce, reuse, and recycle) but additional 3Rs (recover, redesign, and remanufacture) (Badurdeen et al., 2009). As shown in table 22, literature that considered these practices accounted for only 35,4% of the total selected.

Practices	Authors
Recover company's end of life products	(Murphy and Poist, 2002; Rao, 2007; Carbone and Moatti, 2008; Hsu and Hu, 2008; Nunes and Bennett, 2010; Caniato et al., 2012; Lieb and Lieb, 2010; Caniato, Caridi and Moretto, 2011; Kosansky and Schaefer, 2009; Caniato et al., 2013; Lai, Wu and Wong, 2013).

Implement reverse logistics: - for cleaner production - focusing on disposal Collect back used packaging or pallet systems and motive suppliers to the same	(Sarkis, 1998; Srivastava, 2007; Zhu, Sarkis and Lai, 2013; Eltayeb and Zailani, 2009) (Lai, Wu and Wong, 2013) (Grant, Trautrims and Wong, 2013) (Holt, 2004; Holt and Ghobadian, 2009; Rao, 2007; Eltayeb and Zailani, 2009; Laosirihongthong, Adebanjo and Tan, 2013)
Create closed loops	(Pagell and Wu, 2009; Grant, Trautrims and Wong, 2013)
Reuse Sell the waste in secondary markets	(Sarkis, 1999; Murphy and Poist, 2002; Carbone and Moatti, 2008; Eltayeb and Zailani, 2009; Nunes and Bennett, 2010; MacCarthy and Jayarathne, 2012; Gopalakrishnan et al., 2012; Liu et al., 2012; Colicchia, Melacini and Perotti, 2011; Ashby, Leat and Hudson-Smith, 2012; Comas Martí and Seifert, 2013; Lai, Wu and Wong, 2013; Azevedo et al., 2012; Carter and Jennings, 2002) (Closs, Speier and Meacham, 2011; Azevedo et al., 2012)
Remanufacture Include disassembly manual	(Holt, 2004; Rao, 2007; Carbone and Moatti, 2008; Ciliberti, Pontrandolfo and Scozzi, 2008; Holt and Ghobadian, 2009; Eltayeb and Zailani, 2009; Nunes and Bennett, 2010; Ashby, Leat and Hudson-Smith, 2012; Dües, Tan and Lim, 2013; Lai, Wu and Wong, 2013) (Hsu and Hu, 2008)

Recycle[57]	(Caniato et al., 2012; Murphy and Poist, 2002; Rao and Holt, 2005; Rao, 2007; Carbone and Moatti, 2008; Brito, Carbone and Blanquart, 2008; Hsu and Hu, 2008; Eltayeb and Zailani, 2009; Nunes and Bennett, 2010; Closs, Speier and Meacham, 2011; MacCarthy and Jayarathne, 2012; Delai and Takahashi, 2013; Gopalakrishnan et al., 2012; Lieb and Lieb, 2010; Oberhofer and Fürst, 2012; Biederman, 2011; Preuss, 2007; Lai, Wu and Wong, 2013; Ashby, Leat and Hudson-Smith, 2012; Colicchia, Melacini and Perotti, 2011; Comas Martí and Seifert, 2013; Laosirihongthong, Adebanjo and Tan, 2013; Grant, Trautrims and Wong, 2013; Azevedo et al., 2012)
Transform waste into energy	(Colicchia, Melacini and Perotti, 2011)

Table 22: Reuse and Recycle practices

[57] Maersk has a company policy on vessel recycling that requires a vessel to be rigorously checked before it is delivered to a recycling yard. It ensures that they are free from oil spillage, toxic water discharge, and harms generated from the disposal of all the shipping materials. The procedures involve conducting a radiation survey and auditing hazardous materials with the aim of minimizing the environmental impacts caused by vessel recycling (Lai et al., 2011).Coca-Cola developed six recycling plants around the United States that have made it easier to recycle all plastics. Apple uses a ratio of weight recycled as percentage of past sales to formulate goals and demonstrate an increasing development of taking back sold electronics (Kumar, Teichman and Timpernagel, 2012).

4.6.2 Waste Disposal

According to Wagner (2011), changes in waste management strategy may raise sustainability. The impacts are related to value capture, environmental impacts reductions and communities support. Combined actions with stakeholders are as well important since each player in the supply chain has its responsibility in the waste generation. Although some publications focus on this topic, they are rare compared to other sub-groups, representing only 14,1% of the total selected references. Some findings are are shown in table 23.

Practices	Authors
Waste disposal	
Hazardous waste disposal awareness	(Murphy and Poist, 2002, 2003; Carbone and Moatti, 2008; Delai and Takahashi, 2013; Lieb and Lieb, 2010; Comas Martí and Seifert, 2013; Colicchia, Melacini and Perotti, 2011; Khairani, 2012; Lai, Wu and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013; Eltayeb and Zailani, 2009)
Not to ship e-waste overseas	(Kumar, Teichman and Timpernagel, 2012)
Send the waste to a licensed waste suppliers to manage different types of wastes as a measure for pollution control	(Khairani, 2012)

Table 23: Waste Disposal practices

4.6.3 Pollution Control

Complementary to sustainability control, the pollution control sub-group represents the control of all emissions that a company or supply chain discharges (Azevedo, Carvalho and Cruz Machado, 2011). Programs for pollution prevention (Lun, 2011; Zhu et al., 2011; Cetinkaya et al., 2011; Zhu, Sarkis and Lai, 2013) are diectly linked with other sub-groups from governance, such as policies, education compaigns and relationship with external stakeholders. Practices intends to avoid not only air and noise emissions but odor and visual pollutions as well.

Practices about pollution control and management were found in only 24,2% of all selected literature, as shown in table 24, a sign that research in this topic related to supply chain is not yet much explored.

Practices	Authors
Pollution management	
Air pollution	(Rao, 2007; Delai and Takahashi, 2013; Rao and Holt, 2005; Murphy and Poist, 2003; MacCarthy and Jayarathne, 2012; Oberhofer and Fürst, 2012; McKinnon, Browne and Whiteing, 2010; Comas Martí and Seifert, 2013; Colicchia, Melacini and Perotti, 2011)
Noise pollution	(Adetunji, Price and Fleming, 2008; Rao and Holt, 2005; Murphy and Poist, 2003; MacCarthy and Jayarathne, 2012; Oberhofer and Fürst, 2012; Cetinkaya et al., 2011)
Visual and odor pollution	(Murphy and Poist, 2003)
Compensating programs	(Oberhofer and Fürst, 2012; Biederman, 2011; Cetinkaya et al., 2011)

Table 24: Pollution Control practices

Customer Relationship Management

Customer Relationship Management (CRM) cluster connects companies and their customers. The result derived from all interactions with suppliers, internal and external stakeholders, should be combined with customers' demands and engagement in order to offer a sustainable value for the customers.

4.7 Customer Relationship

According to the Carbon Disclosure Project (CDP) Supply Chain Report 2013–2014, 56% of the surveyed companies identified consumer behavior as the biggest driver of change toward expanding sustainability effort (Harrington, 2014). Practices related to this topic, separated in demands and engagement, however, were considered by only 38,4% of all selected literature.

4.7.1 Demand

Practices to manage customer's demands (Delai and Takahashi, 2013; Vachon and Klassen, 2006; Lai, Wu and Wong, 2013; Lau, 2011; Fu, Zhu and Sarkis, 2012; Okongwu, Morimoto and Lauras, 2013; Klerkx, Villalobos and Engler, 2012) and their demands are not much cited, representing only 11,1% of all selected literature. Those can be understood as "one-way" practices that companies implement independently of customer's reactions or change of behavior. The objective of such practices is to collect data, register information and monitor current customers or potential ones in order to improve company's performance towards the market. Some of the few examples of practices related to this specific topic are shown in table 25.

Practices	Authors
Track and evaluate waste and recycling habits	(Closs, Speier and Meacham, 2011)
Understand customer behavior and demands	(Sarkis, 1999)
Identify opportunities for market generation - managing and creating innovations	(Nunes and Bennett, 2010)

Table 25: Customer's demand practices

4.7.2 Engagement

Practices related to engagement differentiate from the previous sub-group as they require customer's involvement and reactions towards the company. It aims to change purchasing behavior, product's usage habits, and encourage a closer relationship with customers. Cooperation (Pagell and Wu, 2009; Vachon and Klassen, 2006; Diabat and Govindan, 2011; Dües, Tan and Lim, 2013; Khairani, 2012; Cetinkaya et al., 2011) can be implemented, for instance, in order to develop new solutions or to motivate the take back of products after its end of life. Specific programs for changing the customer's behavior can be complemented by education programs and collaborative approach. Practices regarding this sub-group were found in 32,3% the overall literature and are exemplified in table 26)

Practices	Authors
Cooperate with customers for:	
Eco-design, green packaging, cleaner production	(Zhu, Sarkis and Geng, 2005; Zhu and Sarkis, 2006; Zhu, Sarkis and Lai, 2013; Khairani, 2012; Zhu et al., 2011)
Reverse logistics relationships after products' end of life or for safe refill	(Eltayeb and Zailani, 2009; Delai and Takahashi, 2013; Zhu et al., 2011; Zhu, Sarkis and Lai, 2013; Carter and Jennings, 2002; Ageron, Gunasekaran and Spalanzani, 2012; Ashby, Leat and Hudson-Smith, 2012; Diabat and Govindan, 2011; Laosirihongthong, Adebanjo and Tan, 2013; Lau, 2011; Grant, Trautrims and Wong, 2013; Schönberger, Galvez-Martos and Styles, 2013)

Involve customers in programs[58] for:	
Recycling, vehicle idling, packing waste collection, using green packing materials	(Lai et al., 2011; Azevedo et al., 2012)
Use zero one-use bag	(Schönberger, Galvez-Martos and Styles, 2013)
Implement education programs[59]	(Delai and Takahashi, 2013; Rao and Holt, 2005; Liu et al., 2012; Rao, 2007; Ciliberti, Pontrandolfo and Scozzi, 2008; MacCarthy and Jayarathne, 2012)
Develop of a web site/carbon footprint calculator for each particular solution chosen[60]	(Lieb and Lieb, 2010)
Collaborate with customers for:	
Use less energy during product transportation	(Zhu et al., 2011; Zhu, Sarkis and Lai, 2013; Zhu and Sarkis, 2006)

[58] Solutions that need customer engagement such as in an attempt to increase success delivery rates, includes the use of reception boxes and offers carriers much greater control over the delivery schedule, improving the efficiency of vehicle loading and routing while virtually eliminating the risk of failed delivery (McKinnon, Browne and Whiteing, 2010). According to a research in Helsinki this may cut transport costs, delivery distances and related externalities by as much as 40% (Punakivi, Yrjölä and HolmstroÈm, 2001).

[59] Education programs provides information to consumers on environment-friendly products and/or production methods (Delai and Takahashi, 2013; Rao and Holt, 2005; Liu et al., 2012; Rao, 2007; Ciliberti, Pontrandolfo and Scozzi, 2008; MacCarthy and Jayarathne, 2012) raising sustainability awareness (Lieb and Lieb, 2010; Klerkx, Villalobos and Engler, 2012) and supporting integration between company and its customers (Vachon and Klassen, 2006) and helping them to being green (Dües, Tan and Lim, 2013). This practice considers customers capacity to learn and change their behavior, supports customer efforts to reduce their carbon footprints, helping them comply with various industry certification programs and expanding sustainability through collaborative partnerships (Lieb and Lieb, 2010).

[60] Maersk introduced a monthly customer scorecard called “CO2 Dial”, where each customer can access its footprint when making business with Maersk Line versus with other companies (Leach, 2010).

Develop renewable energy sources, especially at customer facilities Implement paperless programs/electronic communications to link with its customers and business partners	(Lieb and Lieb, 2010) (Lun, 2011).
Map activities that are carried out in order to encourage customers to consume more environmentally safe products or efforts to reduce and eventually reuse materials	(Kotzab et al., 2011)

Table 26: Customer engagement practices

5. Conclusions

Considerable discussionabout supply chain sustainability are being held by many different players worldwide, including companies from different industries, policy makers, non-governmental organizations and civil society. Moreover, the impact of supply chains' activities and the call for collaboration is continuously increasing, together with the need of management models to support the planning process and decision making in a new way of doing business. The presented research, thus, worked for the last years in developing a framework for managing sustainable supply chain practices, consisted of three integrated clusters, 7 groups and 21 sub-groups. It presents in a transparent way each of the building processes starting in an extensive systematic literature review, passing through the qualitative methods used to validate the model until the current version.

The systematic literature review, conducted between 2013 and 2014, was presented into details in order to enable future reproducibility, comparative analysis and additional improvements. The selection criteria were clear described on the text as well its focus on searching for practices, initiatives, strategies, in other words, actions that companies may implement to improve their supply chain sustainability. The publications on this specific topic of "sustainable supply chain practices" showed to be in an increasing rate since 2006. The sources included books; papers from top ranked journals; papers from not so well known journals; business reports from consultancies, agencies, research centers and companies; and also business magazines. The diversity was also identified as these documents were published in different research fields, such as Operations, Innovation, Resources, Management, Business Ethics, and others. The complete list of the 99 selected references is available in the Appendix and might be a good start for future researchers interested in this topic. In addition to the traditional systematic literature review process, the research offered 22 tables, each with specific practices identified from the literature

and their related-authors. These may support researchers in studies regarding particular types of supply chain sustainability practices.

The second step of this research involved the framework building process. Its complete description includes the explanation of the models considered as background and the qualitative methodologies used to develop and confirm its suitability to what especially companies' need. As already explained, workshops with diverse groups of supply chain experts, practitioners and researchers, were conducted as well as interviews with experts from two German companies considered as benchmarks in sustainable development.

The current version of the framework for managing sustainable supply chain practices is not expected to be a final version. Sustainability and especially practices to improve it are still in their first phase. Future adjustments will contribute to keep it updated according to the world's new demands. This version is a first step of future research, as well as what we know about sustainability nowadays. The idea of the framework is to offer a holistic and integrated view of areas where supply chain sustainability can be assessed and improved. First, it considers the traditional logistics functions such as Procurement and Distribution, combined with Production Management. The perception, although, of Production Management is different than the basic-process approach. It is located, on the framework, as a parallel cluster which might influence and receive influenced by all other others.

This new approach highlights the role of solutions development and resource management under all company's processes, as well as with its suppliers and customers. Commonly supportive functions had also their importance reinforced: Governance showed to be a prerequisite for building company's sustainability and Waste Management emphasized the crucial responsibility of logistics towards a closed-loop supply chain. The framework holistic view considers, nonetheless, not only internal supply chain management but also the company's vital relationship with

its stakeholders. The expected and proper fit between suppliers, company and its customers is well represented and complemented by other major stakeholders such as society, government, other companies, NGOs and Universities.

Additionally, this research makes available, under request, a visual basic tool, developed by the students that worked as volunteers for the chair of logistics. The tool uses the framework for managing sustainable supply chain practices as a backgroud. It may be employed for support data collection and information arrangement for future analysis. Companies might use it to structure their current practices/projects in a standard format, perform comparative studies with benchmarks or other companies, identify lack of investments in some specific areas, and improving their strategies in order to increase sustainability.

Among the wide variety of applicability of this work, one of the most important one is the identification of areas where research has been more intensively done and especially those where there are lack of research regarding sustainable supply chain practices. Studies involving supplier relationship and governance were found in more than 70% of the selected literature. Supplier selection, assessment and collaboration were discussed in 50% of the references. On the other hand, only 38,4% of them cited initiatives to strengthen customers' relationship, especially by detecting their behavior and demands in order to develop more sustainable solutions (11,1%). While international research (Handfield et al., 2013) shows that customers are the main drivers for implementing sustainability, in practice, literature have not been giving the appropriate importance to the topic. Or is it consequence of companies' level of importance?

Another topic that seems to be less researched is Waste disposal (14,1%). This lack might be filled in the near future as policy makers and regulation agencies are increasing the pressure on companies' attitudes towards waste reduction, its appropriate disposal and offset. The distribution group, which consist of traditional logistics activities, were in average 27%

cited, a considerable low value when compared to their criticality on the supply chain network and their impact on sustainability. Additional research is needed to understand if this represents the market reality, which are the barriers for implementing practices regarding this group specifically, and collect examples of overcoming strategies that may have been used by companies worldwide.

Other future research questions that emerged during this work are listed below:

- What is the relationship between each group and sub-groups of practices from the framework?
- Are there differences in the research level of each sub-group and companies' implementation level?
- What are the patterns and differences between industries? Or countries?
- Is the framework also applicable to the service sector? Which adjustments should be made?
- What is the importance of each sub-group for companies? What are the necessary efforts (financial, human resource, and others) for implementing practices from each of the sub-groups in the framework?

Limitations of the present research include those related to the systematic literature review method and also to the qualitative methods applied during the framework building process. Although the systematic literature review was conducted by two independent reviewers and the selection criteria previously defined, the process is subjective and therefore dependable on the understanding of each reviewer.

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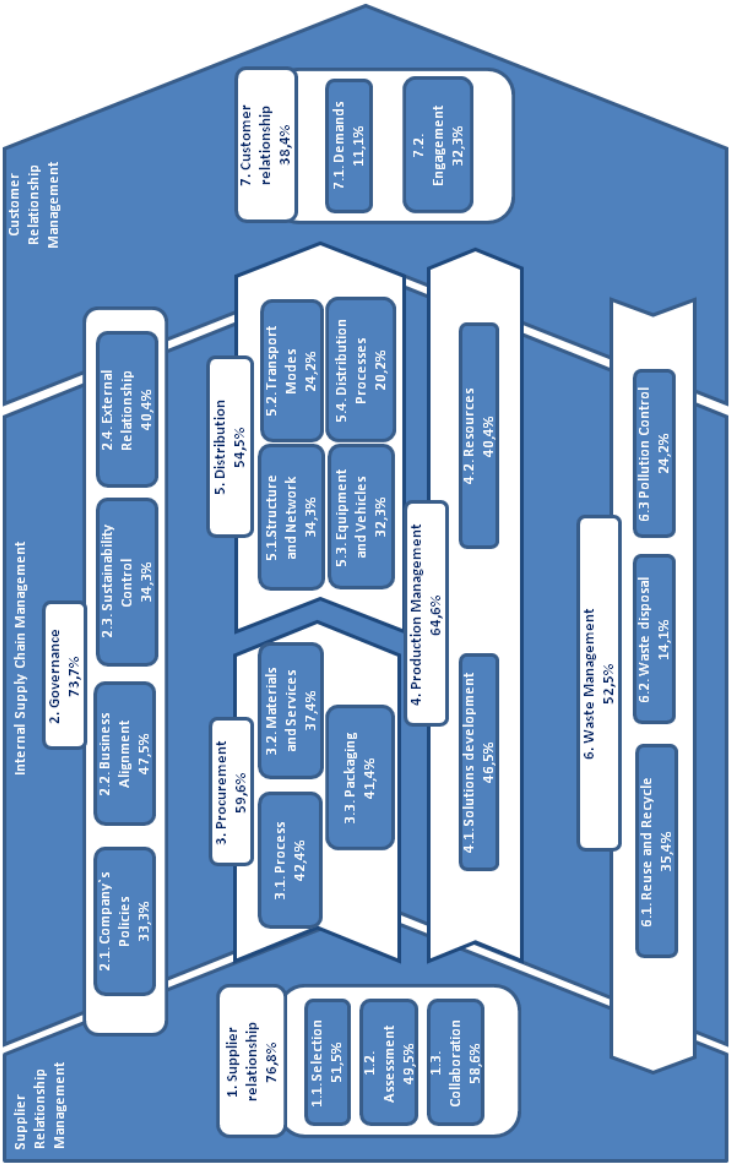
7. Appendix

7.1 Percentage of practices identified in the systematic literature review


Supplier Relationship Management
Internal Supply Chain Management
Customer Relationship Management
1. Supplier relationship 76,8%
1.1. Selection 51,5%
1.2. Assessment 49,5%
1.3. Collaboration 58,6%
2. Governance 73,7%
2.1. Company's Policies 33,3%
2.2. Business Alignment 47,5%
2.3. Sustainability Control 34,3%
2.4. External Relationship 40,4%
3. Procurement 59,6%
3.1. Process 42,4%
3.2. Materials and Services 37,4%
3.3. Packaging 41,4%
4. Production Management 64,6%
4.1. Solutions development 46,5%
4.2. Resources 40,4%
5. Distribution 54,5%
5.1. Structure and Network 34,3%
5.2. Transport Modes 24,2%
5.3. Equipment and Vehicles 32,3%
5.4. Distribution Processes 20,2%
6. Waste Management 52,5%
6.1. Reuse and Recycle 35,4%
6.2. Waste disposal 14,1%
6.3. Pollution Control 24,2%
7. Customer relationship 38,4%
7.1. Demands 11,1%
7.2. Engagement 32,3%

7.2 Selected references on the systematic literature review

Code	Source where the reference was taken
WoS	Web of Science
EB	Ebsco
CR	Reference sections of some pre-selected papers
REC	Recommendation from authors of the pre-selected papers

Source	Author	Title	Published by	Year
EB		Computer Makers Endorse Code for Treatment of Workers	Business & The Environment With ISO 14000 Updates (Scenario)	2004
EB		The vital links	Building Design	2007
EB		Green initiatives: Strategies for greening supply chain processes	Refrigerated Transporter (This &Ch)	2008
WoS	Adetunji, I; Price, A.D.F; Fleming, P.	Achieving sustainability in the construction supply chain	Proceedings Of The Institution Of Civil Engineers-Engineering Sustainability	2008
WoS	Ageron, B; Gunasekaran, A; Spalanzani, A.	Sustainable supply management: An empirical study	International Journal Of Production Economics	2012
WoS	Ashby, A; Leat, M; Hudson-Smith, M.	Making connections: a review of supply chain management and sustainability literature	Supply Chain Management-An International Journal	2012
WoS	Azevedo, S.G; Carvalho, H; Machado, V.C.	The influence of green practices on supply chain performance: A case study approach	Transportation Research Part E-Logistics And Transportation Review	2011

WoS	Azevedo, S.G; Carvalho, H; Duarte, S; Machado, V.C.	Influence of Green and Lean Upstream Supply Chain Management Practices on Business Sustainability	IEEE Transactions On Engineering Management	2012
EB	Biederman, D.	Calculated savings	Journal Of Commerce	2011
EB	Biederman, D.	Defending the turf	Journal Of Commerce	2012
WoS	Brammer, S; Walker, H.	Sustainable procurement in the public sector: an international comparative study	International Journal Of Operations & Production Management	2011
WoS	Caniato, F; Caridi, M; Crippa, L; Moretto, A.	Environmental sustainability in fashion supply chains: An exploratory case based research	International Journal Of Production Economics	2012
REC	Caniato, F; Arena, M; Cagliano, R; Caridi, M; Conte, A; Longoni, A; Moretto, A.	Sustainable supply chain in the food industry - Drivers and practices	Euroma Conference 2013	2013
REC	Caniato, F.; Caridi, M.; Moretto, A.	Sustainability in the Italian meat supply chain - The adoption of supply chain practices to improve sustainability performance	20 Annual IPSERA Conference, Maastricht University.	2011
WoS	Carbone, V; Moatti, V.	Towards greener supply chains: an institutional perspective	International Journal Of Logistics-Research And Applications	2011
CR	Carter, C.R.; Jennings, M. M.	Logistics social responsibility: an integrative framework	Journal of Business Logistics	2002
REC	Cetinkaya, B., Cuthbertson, R., Ewer, G., Klaas-Wissing, T., Piotrowicz, W., &Tyssen, C.	Sustainable supply chain management: practical ideas for moving towards best practice.	Book: Springer	2011

WoS	Ciliberti, F; Pontrando-lfo, P; Scozzi, B.	Logistics social responsi-bility: Standard adoption and practices in Italian companies	International Journal Of Production Eco-nomics	2008
WoS	Closs, DJ; Speier, C; Meacham, N.	Sustainability to support end-to-end value chains: the role of supply chain management	Journal Of The Acad-emy Of Marketing Science	2011
EB	Colby, K.; Fertal, D.	Greening your Supply Chain	Supply & Demand Chain Executive	2007
EB	Colicchia, C; Melacini, M; Perotti, S.	Benchmarking supply chain sustainability: in-sights from a field study	Benchmarking: An International Journal	2011
EB	Comas Martí, J. M.; Seifert, R. W.	Assessing the Compre-hensiveness of Supply Chain Environmental Strategies	Business Strategy And The Environ-ment	2013
EB	Dargusch, P; Ward, A.	Understanding Corpo-rate Social Responsibility with the integration of Supply Chain Manage-ment in Outdoor Apparel Manufacturers in North America and Australia	International Journal Of Business & Man-agement Science	2010
EB	Davies, M.	Time for a bit of net-working	Logistics Manager	2008
REC	de Brito, M. P; Carbone, V;Blanquart, C. M.	Towards a sustainable fashion retail supply chain in Europe: Organi-sation and performance	International Journal Of Production Eco-nomics	2008
WoS	Dekker, R; Bloemhof, J; Mallidis, I.	Operations Research for green logistics - An over-view of aspects, issues, contributions and chal-lenges	European Journal Of Operational Re-search	2012
WoS	Delai, I; Takahashi, S.	Corporate sustainability in emerging markets: in-sights from the practices reported by the Brazilian retailers	Journal Of Cleaner Production	2013
WoS	Diabat, A; Govindan, K.	An analysis of the drivers affecting the implemen-tation of green supply chain management	Resources Conserva-tion And Recycling	2011
WoS	Doorey, D.J.	The Transparent Supply Chain: from Resistance to Implementation at Nike and Levi-Strauss	Journal Of Business Ethics	2011

WoS	Dues, C.M; Tan, K.H; Lim, M.	Green as the new Lean: how to use Lean practices as a catalyst to greening your supply chain	Journal Of Cleaner Production	2013
REC	ECR Europe	ECR sustainable transport project	Report	2008
REC	Eltayeb, T.K;Zailani, S.	Going green through green supply chain initiatives towards environmental sustainability	Journal Of Operations And Supply Chain Management	2009
WoS	Fu, X.Y; Zhu, Q.H; Sarkis, J.	Evaluating green supplier development programs at a telecommunications systems provider	International Journal Of Production Economics	2012
EB	Fulton, K; Lee, S.	Assessing sustainable initiatives of apparel retailers on the internet	Journal Of Fashion Marketing & Management	2013
WoS	Genovese, A; Koh, SCL; Bruno, G; Esposito, E.	Greener supplier selection: state of the art and some empirical evidence	International Journal Of Production Research	2013
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WoS	Gopalakrishnan, K; Yusuf, YY; Musa, A; Abubakar, T; Ambursa, H.M.	Sustainable supply chain management: A case study of British Aerospace (BAE) Systems	International Journal Of Production Economics	2012
REC	Grant, D.B.; Trautrims, A.; Wong, C.Y.	Sustainable Logistics and Supply Chain Management – Principles and practices for sustainable operations and management	Book: The Chartered Institute Of Logistics And Transport (UK)	2013
REC	Gross, W., Zesch, F., Gelau, T., Hayden, C., Bötel, M., & Brock, M.	Costs and benefits of green logistics	4flow Supply Chain Management Study 2013	2013

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WoS	Hsu, CW; Hu, AH	Green supply chain management in the electronic industry	International Journal Of Environmental Science And Technology	2008
EB	Johnson, M.	Marks & spencer implements an ethical sourcing program for its global supply chain	Journal Of Organizational Excellence	2004
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WoS	Klerkx, L; Villalobos, P; Engler, A.	Variation In Implementation Of Corporate Social Responsibility Practices In Emerging Economies' Firms: A Survey Of Chilean Fruit Exporters	Natural resources forum	2012
WoS	Koplin, J; Seuring, S; Mesterharm, M.	Incorporating sustainability into supply management in the automotive industry - the case of the Volkswagen AG	Journal Of Cleaner Production	2007
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EB	Lau, K.H	Benchmarking green logistics performance with a composite index	Benchmarking: An International Journal	2011
EB	Leach, P.T.	Making green by going green	Journal Of Commerce	2010
WoS	Lee, KH; Cheong, IM	Measuring a carbon footprint and environmental practice: the case of Hyundai Motors Co. (HMC)	Industrial Management & Data Systems	2011
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WoS	Lieb, K.J; Lieb, R.C.	Environmental sustainability in the third-party logistics (3PL) industry	International Journal Of Physical Distribution & Logistics Management	2010
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EB	Liu, X; Yang, J; Qu, S; Wang, L;	Sustainable Production: Practices and Determinant Factors of Green	Business Strategy And The Environment	2012

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CR	Murphy, P.R; Poist, R.F.	Socially responsible logistics: an exploratory study	Transportation Journal	2002
REC	Nunes, B.; Bennett, D.	Green operations initiatives in the automotive industry: An environmental reports analysis and benchmarking study	Benchmarking: An International Journal	2010
REC	Oberhofer, P.; Fürst, E.	Sustainable Development in the Transport Sector: Influencing Environmental Behaviour and Performance	Business Strategy And The Environment	2012
CR	Ofori, G.	Greening The Construction Supply Chain In Singapore	European Journal of Purchasing & Supply Management	2000
EB	Okongwu, U; Morimoto, R.; Lauras, M.	The maturity of supply chain sustainability disclosure from a continuous improvement perspective	International Journal Of Productivity & Performance Management	2013
WoS	Pagell, M; Wu, Z.H.	Building a more complete theory of sustaina-	Journal Of Supply Chain Management	2009

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EB	Preuss, L. (a)	Contribution of purchasing and supply management to ecological innovation	International Journal Of Innovation Management	2007
WoS	Rao, P.	Greening the supply chain: a new initiative in South East Asia	International Journal Of Operations & Production Management	2002
REC	Rao, P.	Greening of the Supply Chain: An Empirical Study for SMES in The Philippine Context	Journal Of Asia Business Studies	2007
WoS	Rao, P; Holt, D.	Do green supply chains lead to competitiveness and economic performance?	International Journal Of Operations & Production Management	2005
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WoS	Yang, CL; Lin, SP; Chan, YH; Sheu, C.	Mediated effect of environmental management on manufacturing competitiveness: An empirical study	International Journal Of Production Economics	2010

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