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Juliana Kucht Campos

A methodology for planning sustainable supply chain initiatives

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Berlin, September 2016

Juliana Kucht Campos

“Walk as if you are kissing the Earth with your feet.”

— Thich Nhat Hanh

Abstract

Pressure towards sustainable development from customers and regulators is changing the way companies deal with their supply chain network. Sustainability practices are not limited to the company level. They now involve suppliers, customers, government, society and other stakeholders that impact and are impacted by firms' actions to improve economic, environmental and social responsibility. Corporations, however, seem not to be fully prepared for planning their initiatives from a holistic perspective, which integrates all value-chain players. There is a need for practical managerial frameworks, tools and analysis that support decision making. This doctoral thesis presents a methodology for planning sustainable supply chain initiatives consisting of three scopes, each with its appropriate mechanism and background theory. The first scope called "Acting In" aims to structure organizational practices and help identify opportunities for internal collaboration among corporate business units and departments. The "Framework for Managing Sustainable Supply Chain Practices" is applicable to different industries worldwide and comprises 21 categories of practices. It was developed using data from a systematic literature review, refined with practitioners' insights. "Acting Out", the second scope of the methodology aims to compare practices from 32 recognized sustainability leaders from five different industries: basic materials and energy, industrial materials, automotive and commercial vehicles, consumer goods and transportation and logistics services. For these purposes, a "Benchmarks Practices Bank" was built which supported four comparative analyses for identifying industry collaboration opportunities: by groups of practices; by industry using a qualitative approach: by industry using a quantitative statistical approach; and by country. The third scope of the methodology "Acting Beyond" aims to support the definition and management of a portfolio of sustainable supply chain practices for use during collaboration between partners from a shared value chain. The "Practices Portfolio Planning Matrix" consists of the axes "efforts" and "impacts", while the size of the

bubbles corresponds to the level of the initiatives' implementation. Each of the four quadrants of the matrix has its own specific characteristics and initiatives are recommended to be implemented: through intra-corporate collaboration; through shared-value-chain collaboration; in combination with others and after a specific analysis as they require high efforts but offer low impacts to the company. Results from the tests in Brazil validated the matrix and allowed the identification of interesting learning opportunities from the perspective of national culture. Furthermore, based on findings from scope two and three of the methodology, categories of initiatives which have a high potential for collaborations are presented and discussed further. The proposed methodology in the current dissertation significantly supports supply chain practitioners and researchers interested in sustainability practices. The mechanisms developed support decision makers in planning sustainability initiatives and visualizing collaboration opportunities within the corporation, the industry and through the shared value chain. As companies become more global, supply chain becomes more complex and risks, costs and social-environmental impacts become higher. A systematic and holistic approach to supply chain relations provide insights for developing more sustainable solutions according to each partner's strength and improvement areas. The contribution of this work support organizations in addressing current challenges. Some of the findings presented in this document have already been reviewed and published in international conferences and journals.

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 Kunden, Gesellschaft und 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. Die Unternehmen ergreifen jedoch meist Einzelmaßnahmen. Ein ganzheitlicher Ansatz, d. h. ein Ansatz, der die gesamte Wertschöpfungskette umfasst, fehlt dagegen. Dringend benötigt werden Frameworks, Tools und eine systematische Analyse der Daten aus holistischer Sicht. In der vorliegenden Doktorarbeit wird eine Methodik zur Planung von Nachhaltigkeitsinitiativen in der Supply Chain entwickelt. Dabei werden drei Handlungsfelder unterschieden und der jeweilige theoretische Hintergrund sowie geeignete Mechanismen aufgezeigt. Das erste Handlungsfeld wird mit „Acting In“ bezeichnet und zielt darauf ab, unternehmensinterne Möglichkeiten der Zusammenarbeit zu identifizieren und zu strukturieren (Geschäftseinheiten, Abteilungen). Dieses „Framework for Managing Sustainable Supply Chain Practices“, das weltweit in unterschiedlichen Branchen realisiert werden kann, besteht aus 21 Kategorien von Maßnahmen. Es wurde anhand einer systematischen Literaturrecherche entwickelt und mit Hilfe von Praktikern überprüft und präzisiert. Das zweite Handlungsfeld wird mit „Acting Out“ bezeichnet. Hier wurden die Maßnahmen bzw. Vorgehensweisen von 32 Unternehmen untersucht, die in den fünf Industriezweigen „Rohstoffe und Energie“, „Werkstoffe“, „Personen- und Nutzfahrzeuge“, „Konsumgüter“ und „Transport und Logistik“ allgemein als führend im Hinblick auf Nachhaltigkeit eingestuft werden. Zur Selektion wurde eine „Benchmark Practices Bank“ mit 42 Unternehmen angelegt,

mit deren Hilfe vier vergleichende Analysen vorgenommen wurden, um Möglichkeiten der Zusammenarbeit zwischen Unternehmen der gleichen Wertschöpfungsstufe und Branche zu identifizieren. Anschließend wurden die Daten mit Hilfe von vier verschiedenen Rastern analysiert: ergriffene Maßnahmen (branchenübergreifend); branchenspezifische qualitative Analyse; branchenspezifische quantitative Analyse; nach Ländern. Das dritte Handlungsfeld wird mit „Acting Beyond" bezeichnet. Hier wurde zunächst eine Matrix entwickelt, mit deren Hilfe ein Portfolio mit Maßnahmenkategorien zusammengestellt werden kann, die Initiativen entlang der Wertschöpfungskette umfasst. Diese „Practices Portfolio Planning Matrix" besteht aus drei Inhalten: „Input", „Output" und Implementierungsniveau. Jeder der vier Quadranten hat spezifische Charakteristika, und es werden jeweils Handlungsempfehlungen ausgesprochen: unternehmensinterne Zusammenarbeit; Zusammenarbeit mit der Wettschöpfungskette; kombinierte Maßnahmen; und Maßnahmen, die einer weitergehenden Analyse bedürfen, weil sie einen hohen Input, aber nur einen geringen Output für das Unternehmen darstellen.

Aus den Ergebnissen der Modellentwicklung und dem Testfeld ‚Brasilien' konnten einerseits Validierungen gewonnen werden und andererseits interessante Lerneffekte verschiedener national-kultureller Aspekte für des Erreichen von Nachhaltigkeitszielen abgeleitet werden.

Außerdem wurden anhand der in den Handlungsfeldern 2 und 3 gefundenen Erkenntnisse Kategorien von besonders erfolgversprechenden Nachhaltigskeitsinitiativen diskutiert, von denen einige in Zusammenarbeit mit deutschen Organisationen umgesetzt werden sollen. Die in der vorliegenden Dissertation vorgeschlagene Methodik ist sowohl für die Forschung als auch für die Praxis von großer Bedeutung. Die hier entwickelten Mechanismen unterstützen die Entscheider in den Unternehmen bei der Planung von Nachhaltigskeitsinitiativen in Supply Chain und visualisieren Kooperationsmöglichkeiten auf den verschiedenen Ebenen: innerbetrieblich; auf derselben Wertschöpfungsstufe und über die gesamte Wertschöpfungskette hinweg. Da die Unternehmen immer globaler agieren, wird die Supply Chain immer komplexer und birgt immer größere Risiken verbunden mit steigenden Kosten und sozialen sowie ökologischen Auswirkungen. Ein systematischer und ganzheitlicher, d.h. die gesamte Wertschöpfungskette übergreifender Ansatz liefert Einsichten und nachhaltige Lösungen für alle Beteiligten, indem ihre Stärken genutzt und die noch verbesserungswürdigen Bereiche identifiziert und entsprechend entwickelt werden. Der vorgenannte in der Arbeit entwickelte Ansatz hilft, diese Herausforderungen in einen abgegrenzten Rahmen zu adressieren. Einige der Untersuchungsergebnisse wurden schon auf internationalen Kongressen vorgestellt und in Wissenschaftlerfachzeitschriften (double blind review) publiziert.

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List of Abbreviations

A&CV	Automobiles & Commercial Vehicles Manufacturers
BCG	Boston Consulting Group
BM&E	Basic Materials and Energy
CG	Consumer Goods
CO2	Carbon Dioxide
CRM	Customer Relationship Management
CSR	Corporate Social Responsibility
DHL	Deutsche Post DHL Group
EIL	Efforts Impact Implementation level
EMS	Environmental Management System
ERbV	Extended Resource-based View
EU	European Union
GHG	Greenhouse-Gas
IM	Industrial Materials
ISCM	Internal Supply Chain Management
KPIs	Key Performance Indicators
LCA	Life Cycle Assessment
LSPs	Logistics Service Providers
NGOs	Non-Governmental Organizations
NS	Norfolk Southern Railway

RbV	Resource-based View
RDT	Resource Dependence theory
SC	Supply Chain
SCM	Supply Chain Management
SRM	Supplier Relationship Management
SSCM	Sustainable Supply Chain Management
TBL	Triple Bottom Line
T&LS	Transport & Logistics Services
UK	United Kingdom
US	United States
WoS	Web of Science

1 Introduction

1.1 Research Topic and Relevancy

On April 22, 2016, at the United Nations (UN) in New York, 195 countries signed the formal Paris Climate Agreement to limit global warning and greenhouse-gas emissions. Although targets are considered not enough to keep warming below 2°C until 2030, this meeting is an official declaration of the criticality of balancing economic and social-environmental issues for world prosperity (United Nations, 2016). Besides, this agreement also made clear the need for joint engagement and collaboration. In order to turn the agreement into reality, developed countries have the duty to mobilize $100 billion a year from public and private sources by 2020 for supporting developing countries in implementing climate mitigation (The World Bank, 2015). Meanwhile, national plans provide the directive for achieving the defined targets and aim to reproduce the international agreement among internal ministries, companies and population.

Aside from governments, customers are also one of the main drivers for improving sustainability (Carbone, Moatti and Wood, 2012; Seuring and Müller, 2008a). They are increasingly demanding more responsibility and transparency in the way goods are sourced, produced, distributed and sold (Mckinsey, 2008) and willing to pay more for products and services provided by companies committed to sustainability. In 2011, these customers represented only 22 % while in 2014 they were 55 % - more than 62 % in Asia-Pacific and Latin America.

According to Szekely & Knirsch (2005):

> "Building a society in which a proper balance is created between economic, social, and ecological aims. For businesses, this involves sustaining and expanding economic growth, shareholder value, prestige, corporate reputation, customer

> relationships, and the quality of products and services. It also means adopting and pursuing ethical business practices, creating sustainable jobs, building value for all of the company's stakeholders, and attending to the needs of the underserved (p. 628)"

Businesses are, thus changing the way strategies are planned including social and environmental aspects (Ageron et al., 2012; Seuring and Müller, 2008a) and struggling to reduce their impacts and risks, improve transparency and comply with stakeholders' demands. The main barrier for general corporate sustainability is, however, in supply chain management (SCM) (UN Global Compact, 2013) which explains the gaps between what is desirable and what is implemented in practice (Bowen et al., 2001). According to Vachon & Mao (2008) "all industries will be challenged to reorganize their supply chains" (p. 1552) in an attempt to overcome challenges in extending sustainability through supply chain (SC) networks. Examples of failures are constantly in the news e.g. garment factory fires in Bangladesh, horsemeat scandal, recalls from automotive companies. In a complex worldwide production/distribution network, sustainable development does not involve only focal corporations but the entire network. Therefore, an integrated perspective is needed when planning (re)actions, which consider the overall SC impact on financial results, natural resources, and stakeholders. Although this approch is increasingly being focused on sustainable supply chain management (SSCM) literature (Gimenez and Tachizawa, 2012; Sarkis et al., 2011; Seuring and Müller, 2008a), an organizational framework to spur sustainable business practices is still missing (Forbes Insights, 2011). The lack of a comprehensive structure and supply chain perspective results in superficial solutions with low impacts in supply chain sustainability – commonly called "greenwashing" (Ramus and Montiel, 2005). There is a need for collaborative engagements (Seuring and Müller, 2008a; Vachon and Klassen, 2008) that cross corporate boundaries and promote shared-responsibility of social-environmental issues (Koplin et al., 2007).

Even though companies have been reporting corporate social responsibility (CSR) in a standardized format (Global Reporting Initiative, 2015), the portfolio of initiatives by industry show to differ (Halme and Huse, 1997; Waddock and Graves, 1997) and little attention has been paid to it (Simpson and Kohers, 2002), particularly among Transport and Logistics Service (T&LS) sector (Colicchia et al., 2013).

1.2 Research Objective, Questions and Scope

It is notable from the previous introduction the challenges faced by companies to extend their sustainability efforts to supply chain as well as the importance of collaboration engagements between supply chain partners. This dissertation aims, thus, to support companies in better planning their SSC practices in order to improve sustainability within their shared value chain. The developed “Methodology for planning sustainable supply chain initiatives” consists of three scopes and goes beyond the dependency between companies stated in the Resource Dependence theory (RDT) (Pfeffer and Salancik, 1978). It focus on benefits from collaborations – internal, industry and value chain ones in an attempt to improve overall supply chain sustainability.

The first scope answer the question “How can SC initiatives be structured in order to support sustainability management?” presents a “Framework for Managing Sustainable Supply Chain Practices” with a holistic view of the potential sustainability efforts a company can implement. It helps filling the gap of recent calls for a broader perspective (Straube and Doch, 2010) which integrates the 3BL aspects in SC research (Carter and Rogers, 2008; Hoejmose et al., 2012). The second scope answers the question “Which are the industry patterns regarding sustainable supply chain practices?” based on the tendency of companies copying the behavior of leading firms when seeking for legitimacy (Carbone and Moatti, 2008a; Meyer et al., 1991). Therefore, a “Benchmark Practices Bank” was built in an attempt to identify and discuss particularities in specific industries such as Industrial materials and Transport and logistics services. The third scope of the methodology answers "How should companies build and manage a portfolio of sustainability initiatives to improve their overall SC performance?" providing a "Practices Portfolio Planning Matrix" to support decision makers building and managing a portfolio of SSC practices together with shared value chain partners.

Finally, the fourth question "Where stands collaboration opportunities between German and Brazilian companies in order to improve sustainability in their supply chains?" complements the main purpose of this dissertation by providing an example of the matrix's applicationconsidering the demand for collaboration between developed and developing countries. Apart from promoting cross-country collaboration between companies, the results are also valid for governments and industry associations. The scope of this dissertation is presented in figure 1.

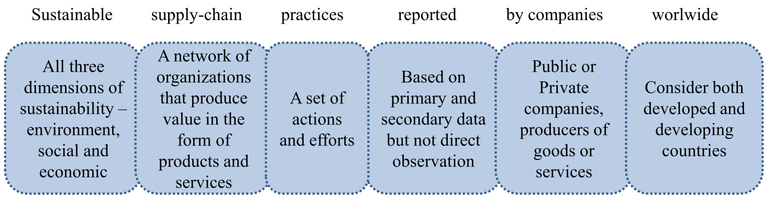


Figure 1. Scope of the dissertation (own author)

1.3 Outline of the Dissertation

The current dissertation is structured as visualized in Figure 2. In the following Section 2 the dissertation is contextualized with important definitions regarding sustainable supply chain and collaboration, the theoretical foundations of the "Methodology for planning sustainable supply chain initiatives" and the systematic literature review which provided data for building the "Framework for Managing Sustainable Supply Chain Practices". Chapter 3 presents details about the framework already published in details in Campos (2015). Chapter 4 provide details about the scope 2 of the methodology, the methodology used to build the " Benchmark Practices Bank" and four further analysis based on sustainability leading multinationals. Chapter 5 explains the structure of the "Practices Portfolio Planning Matrix" and results from workshops and interviews carried out in Brazil. Chapter 6 exemplify the use of the matrix for the purpose of identifying collaboration areas between Germany and Brazil in the context of sustainable supply chain. Finally, chapter 7 presents a short summary of the main research findings, limitations and suggestions for further studies.

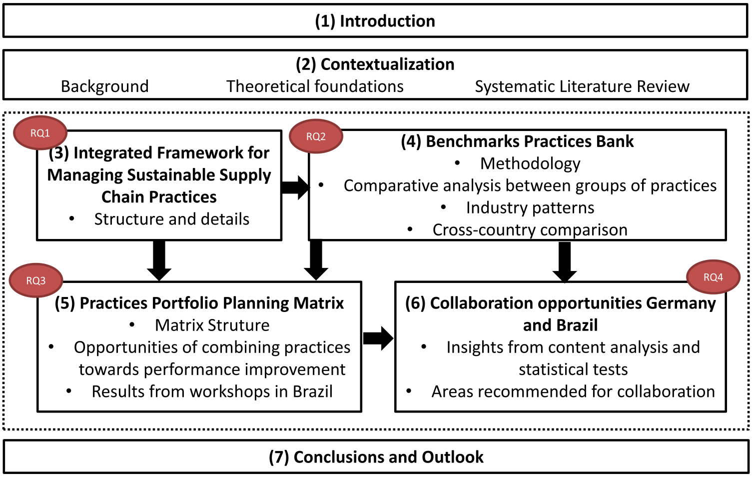


Figure 2. Outline of the dissertation (own author)

2 Contextualization and Theoretical Background

The present chapter is separated into three sections. The first one intends to contextualize this dissertation and presents important definitions regarding supply chain and sustainability, especially the link between them, as well as collaboration. The second section provides the theoretical foundations of the "Methodology for planning sustainable supply chain initiatives" explaining how traditional theories such as the Resource Dependence theory (RDT) (Pfeffer and Salancik, 1978) contribute for explaining the logic behind each of the scopes of the methodology. The last section presents the systematic literature review in details, which provided data for building the "Framework for Managing Sustainable Supply Chain Practices" (chapter 3).

2.1 Important Definitions

2.1.1 Sustainable Supply Chain

Sustainability is an increasing discussed topic among policy makers, academic researchers and practitioners worldwide. The most adopted and quoted definition comes from "Our Common Future", known as the Brundtland Report of the World Commission on Environment and Development that says: "development should meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). Some years later, Elkington coined the term triple bottom line (TBL) stating that "it is not possible to achieve a desired level of ecological or social or economic sustainability (separately), without achieving at least a basic level of all three forms of sustainability, simultaneously" (Elkington, 1999, p. 75). Another interesting definition highlights the value of human basic needs: "transforming our ways of living to maximize the chances that environmental and social conditions will indefinitely support human security, well-being and health" (McMichael et al., 2003, p. 679).

The practical implementation of the sustainability concept is visible among companies worldwide. More than two-thirds of companies have placed sustainability permanently on their management agenda and consider as necessary to keep competitiveness nowadays (Kiron et al., 2012). In this context, it can be defined as "sustaining and expanding economic growth, shareholder value, prestige, corporate reputation, customer relationships, and the quality of products and services. It also means adopting and pursuing ethical business practices, creating sustainable jobs, building value for all of the company's stakeholders, and attending to the needs of the underserved" (Szekely and Knirsch, 2005, p. 628). Among the potential benefits are "reducing long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management" (Shrivastava, 1995, p. 955).

Although the concept reinforce the need for balancing the three dimensions, as observed from the previous definitions, the economic benefits of sustainability seem to be mandatory. This is reflected also in the literature with a large amount of articles focusing on the economic dimension (87.2 %) although in the last 20 years the largest focus on environmental dimension (94.6 %). The social dimension is less represented in this sample (34.9 %) however been gaining attention just in the last years (Beske-Janssen et al., 2015).

In corporate business environment, some managers still have the idea of sustainability as investments without returns (Walley and Whitehead, 1994). Nonetheless, the broader is their approach, the more they visualize opportunities for improving corporate sustainability, in other words: "keeping businesses alive and profitable so that they can continue to deliver the goods and services that society needs and wants" (Hardisty, 2010, p. 6). Businesses that depend on a resource that will be scarce in some decades are, for instance, not sustainable as well as others that do not guarantee safe and healthy working conditions. In both examples, companies' behavior are responsible for "killing" the resources they depend on. The Resource Dependence theory (Pfeffer and Salancik, 1978), which fundaments this dissertation, states that companies are resource insufficient and rely on external stakeholders to obtain the necessary resources to survive. A general approach of sustainability developed by the author of this dissertation is "planning and acting for surviving in a long-term, even sacrificing short term benefits".

According to Shrivastava (1995), when long-term issues are systematically analyzed early, companies can better manage risks that threaten business sustainability, e.g. scarcity in natural resources. The challenges in improving sustainability are, then, the balance and alignment of the three TBL dimensions (Winter and Knemeyer, 2013). A holistic approach is, therefore, needed to build a system that encourage minimizing consumption, where nothing is wasted or discarded into the environment, that focuses on experiences and services rather than product ownership, that promote sharing and collaboration instead of competitive advantage, that balance human well-being, respect to the environment and our truly needs (Jackson, 2011). A system where value creation to stakeholders is a requirement and firms are demanded to take responsibilities and commitments to them (Mathur and Kenyon, 1997). One of the consequences of this new systemic point of view is the heavily engagement of logistics function in taking sustainability measures (Carbone and Moatti, 2008b). This is explained by the broader scope of logistics activities which includes purchasing from suppliers, in-bound logistics, production, distribution to final customers (outbound logistics), and reverse logistics (Sarkis, 1999).

In recent surveys Chief Executive Officers of global companies mentioned supply chain as an area of specific importance in their sustainability strategy (Accenture, 2012; Handfield et al., 2013) but also the top barrier for improving corporate sustainability (UN Global Compact, 2013). Global sourcing causes increase in SC complexity characterized by less transparency and control over suppliers, more transport emissions (Flotzinger et al., 2008) and increasing reliability on suppliers and subsuppliers (Welford, 2002). Sustainable development involves, thus not only corporations but also their networks (Carbone and Moatti, 2008b). The current challenge is making supply chains sustainable (Kleindorfer et al., 2005). Supply chain/SC management can be defined as:

(…) a network of organizations that are linked through upstream and downstream relationships in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer (Christopher, 1998).

(…) the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across business within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole (Mentzer et al., 2001).

(…) planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies (Council of Supply Chain Management Professionals, n.d.).

As observed from the presented definitions, some of the fundamental aspects of sustainability are already included in these traditional concepts such as the requirement of producing value, long-term perspective, SC as a network, which needs integration and collaboration within members. Aligned with Pagell and Shevchenko (2014), SCM is considered, in this dissertation, by nature as responsible for improving truly sustainability. According to these authors, the distortion between SCM and SSCM research should not exist. Krause et al. (2009 p. 18) points that a company "is no more sustainable than its supply chain". The challenge is, thus, reinforce the values, practices and sustainability goals into what SCM has currently become (Pagell and Wu, 2009). As observed in the following definitions of SSCM, the TBL dimensions are now emphasized.

(…) the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements (Seuring and Müller, 2008a, p. 1700)

(…) the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains(Carter and Rogers, 2008, p. 368). In addition, the authors provided four supporting facets or facilitators of SSCM:

– Risk management includes contingency planning and consideration of future SC disruptions;
– Transparency of both company's operations to stakeholders as for improving traceability and visibility of suppliers processes;
– Strategy for guaranteeing sustainability is part of daily business;
– Organizational culture includes building high ethical standards and managing stakeholders' expectations with social-environmental responsibility.

The movement toward SSC is understood by this dissertation's author as a natural evolution of lean supply chains that traditionally searched for enhancing operational efficiency and minimizing waste (Dües et al., 2013). The purpose, by that time, was only economic reasons. Nowadays, concerns regarding climate change, emissions and scarce resources are pressuring business to change their behaviors and strategies to keep "alive for a longer time". Long-term perspective and highly collaborative strategies are being more frequently adopted by supply chain members in order to reach a sustainable competitive advantage (Cox et al., 2007). The increasing SC complexity and length, associated with additional emissions and lack of transparency, turned traditional lean practices difficult to be implemented (Mollenkopf et al., 2010). Some of the most influential drivers and barriers for a firm to engage in SSCM are summarized by Walker et al. (2008) in table 1.

Table 1. Drivers and barriers for SSCM (Walker et al., 2008)

	Internal	External
Drivers	- top management commitment - supportive culture - implementation of an Environmental Management System (EMS)	- customers - governments and regulations - non-governmental organizations (NGOs) - investors
Barriers	- lack of supportive corporate structures - lack of management commitment - lack of training	- consumer desire for lower prices - competitive pressures - government regulations - suppliers' lack of commitment

Some authors identified regulation as the key driver for implementing environmental-related practices (Carbone and Moatti, 2008a; Holt and Ghobadian, 2009; Zhu et al., 2011; Zhu and Sarkis, 2006). Other drivers and details can be found in a vast amount of publications (Caniato et al., 2013; Diabat and Govindan, 2011; Giunipero et al., 2012; Lee, 2008; Murphy and Poist, 2003)

Among the main benefits of SSCM are: enhance firm competitiveness (Carter and Dresner, 2001; Zhu et al., 2005), strength brand names or differentiate their products (Klassen and McLaughlin, 1996; Mahler, 2007), help managing reputational and environmental risk (Teuscher et al., 2006), cost savings from reduced waste (Mollenkopf and Closs, 2005) and safer/better working conditions (Carter et al., 2007).

2.1.2 Collaboration

Collaboration with stakeholders is one of the most fundamental strategy to enhance sustainability (Sarkis et al., 2011; Seuring and Müller, 2007; Vachon and Klassen, 2007, 2008; Zhu and Sarkis, 2004). Cases of inter-firm alliances (Gulati, 2007) and partnerships have been increasing in the last decades together with challenges in dealing with SC members. Issues regarding communication and technological integration still have to be further discussed (Seuring, 2011). According to Inkpen and Currall (2004), information exchange may cause knowledge spillover and information asymmetry may create a power imbalance (Casciaro and Piskorski, 2005). Other barriers are: risk of one of the parties behave opportunistically (van Helden et al., 1999) or have different interests or values, the high coordination costs and risks of losing clients to competitors/partners, difficulty in calculating (monetary) benefits, unequal bargaining positions (Cruijssen et al., 2007).

Besides the difficulties, pressures from government regulations and market competitiveness (Limoubpratum et al., 2015) have been increasingly driving firms to engage in collaboration projects (Walker and Jones, 2012). Among the most cited incentives are: enhance competitive advantage of a supply network (Gold et al., 2010), better SC transparency and risks reductions (Seuring and Müller, 2008a; Vachon and Klassen, 2008), shared-responsibility of purchased goods (Koplin et al., 2007), cost savings (Carter and Rogers, 2008), innovation development (European Comission, 2001) and pool of resources to create economies of scale. Additionally, according to the "value of collaboration in the supply chain comes from the possibility of inter-organizational learning". It allows firms to improve their management skills and fill the lack of expertise in a specific topic with a partner that reveal idiosyncratic attributes. The jointly developed capabilities can be hard to replicate and, thus, be considered source of competitive advantage (Beske, 2012) however the generation of value depends on company's ability to identify and assimilate external knowledge derived from such experience (Gulati et al., 2009).

Brockhaus et al.(2013) point out that collaborative sustainability efforts are preferable to mandated implementation and the use of power over other SC members tends to benefit only the focal firm. According to Spekman et al. (2016) "true" collaboration "occurs when the process is open and transparent, and when firms share compatible goals and work jointly to achieve results that each could not easily obtain alone", with all members given. Cruijssen et al. (2007) consider Cooperation, Collaboration, Alliances and Partnerships as ambiguous concepts due to the vague boundary between them. For the purpose of this work collaboration is understood as one step further than the other concepts (Vachon and Klassen, 2008), long-term oriented based on similar goals (Vachon and Klassen, 2006) and where trust between the participants is essential (Walker et al., 2008). In order to measure the "true" benefits of collaborations, a holistic and SC approach is needed. When a firm understands their dependencies as opportunities of reinforcing its sustainability, the point of view move from corporate oriented to shared value chain.

2.2 Theoretical Foundations of the Proposed Methodology

The "Methodology for planning sustainable supply chain initiatives" aims to support companies in better planning their SSC practices in order to improve sustainability within their shared value chain. It support decision makers in improving supply chain sustainability through the focus on collaborative approaches. According to the Resource Dependence theory (RDT) (Pfeffer and Salancik, 1978) companies are open systems, resource-insufficient and dependent on external stakeholders. They tend, thus, to set internal and external coalitions in order to share needed resources, especially with supplier and customer relationships (Carter and Rogers, 2008). As observed from figure 3, the methodology consists of three scopes where SC sustainability can be improved.

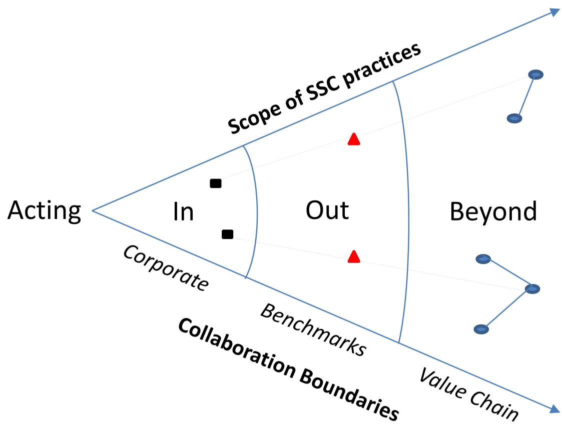


Figure 3. Sustainability point of view and scopes of SSC actions (own author)

The first one is corporate focused, with firms looking and "Acting in", structuring their SSC initiatives according to a formal standard mechanism. The second scope consists of industry-focused measures identified when looking outside the corporate boundaries and comparing their behavior with sustainability benchmarks. The use of a same structure (developed in the previous scope) allows better comparison and design of specific strategies for "Acting out" together with other companies. Finally, companies are able to "Act beyond" the firm or industry's boundaries and implement SSC practices in collaboration with the shared value chain.

The methodology goes beyond the dependency between companies stated in the RDT and focus on benefits from collaborations – internal, industry and value chain ones, through sharing assets, risks and knowledge in an attempt to improve overall supply chain sustainability. Figure 4 illustrates the methodology into more details presenting its three scopes, each with a main objective, the specific mechanism to support SSC practices management, collaboration opportunity and supporting theories. A detailed explanation of each of the scopes is presented in the following pages. Although traditionally applied to identify improvements and collaboration opportunities for one specific company, the methodology can also be conducted with groups of companies. Examples of how this methodology can provide insights on collaboration opportunities towards sustainability improvements between firms in Germany and Brazil are presented on chapter 6.

	Objective	**Mechanism**	**Collaboration Opportunity**	**Theoretical Background**
Scope 1: Acting In	Structure practices	Framework for managing SSC practices	Corporate	Stakeholder theory
Scope 2: Acting Out	Compare with leaders	Benchmarks practices bank	Industry	Institutional theory
Scope 3: Acting Beyond	Build a practices portfolio	Practices portfolio planning matrix	Shared value chain	Relational view and Extended resource-based view

Figure 4. Methodology for planning sustainable supply chain initiatives (own author)

2.2.1 Scope 1: Acting In

Sustainable supply chain management requires a systemic view of the SC components and its interfaces with each other (Svensson, 2007). Through an integrative perspective, it is possible to improve supply chain sustainability (Wolf, 2011). Nevertheless, broader and multidisciplinary approaches are still missing in SC research (Pagell and Shevchenko, 2014).

The "Framework for Managing Sustainable Supply Chain Practices" was developed based on this holistic view and aims to support structuring corporate practices, which also includes building a strong relationship with stakeholders. These are defined, in a wide sense, as "any group or individual who can affect or is affected by the achievement of the firm's objectives" (Freeman and Reed, 1983, p. 91), such as investors, employees, customers, suppliers, societies and the environment. According to the Stakeholder Theory, "managers must develop relationships, inspire their stakeholders, and create communities where everyone strives to give their best to deliver the value the firm promises" (Freeman, 1984; Freeman et al., 2004, p. 364). The commitment of SC partners is, thus, a vital strategy to reduce uncertainty surrounding the environment (Carter and Rogers, 2008) and legitimize stakeholders' interests. The firm's dependence on external and internal stakeholders is one of the several similarities between this theory and RDT with the first focusing on the stakeholders per se while the second highlighting the power and relationships. Within the framework, the commitment with different stakeholders (Mathur and Kenyon, 1997) are highlighted in Supplier Relationship Management and Customer Relationship Management, as well within the Internal Supply Chain Management - Governance dimension. In the latter, initiatives for improving the relationship with employees, governments, universities, society and other companies are considered vital for creating sustainable value. The concept behind the framework is that all initiatives implemented by a firm should somehow offer value to its stakeholders. Therefore, additionally to the Stakeholder theory, the Value Chain model (Porter, 1985) and the the three supply chain subsystems (Chopra and Meindl, 2004) were also considered during the framework building process, as detailed in section 3.1.

According to some authors, very few organizations achieved complete internal integration (Fawcett and Magnan, 2002). By structuring corporate practices according to the framework for managing SSC practices, the first collaboration opportunities arises from the articulation of internal stakeholders, their alignment and balanced efforts to enhance corporation sustainability. The promotion of an exchange culture (knowledge, resources and risks) among employees, teams, departments, business units of a company, allows cross-functional points of view, development of holistic solutions and more efficient management.

2.2.2 Scope 2: Acting Out

Stakeholders are important players in the Institutional Theory (DiMaggio and Powell, 1983) once they pressure firms to take actions towards more environmentally responsible behavior (Delmas and Toffel, 2004; Sarkis et al., 2011). According to Meyer, Rowan, Powell and DiMaggio (1991) companies tend to answer these pressures by copying the behavior of others and converging the way they operate both internally and externally (Carbone and Moatti, 2008b) when seeking for legitimacy. The authors explain that firms imitate whom they dependent, in an attempt to seem alike and, thus, increase the ir perceived value. Through the integration of RDT and Institutional Theory, institutional forces can be analyzed as sources of uncertainty and dependency, produced by three processes: coercive isomorphism, normative pressures and mimetic processes (DiMaggio and Powell, 1983):

Coercive isomorphism: externally codified rules, norms, or laws assign legitimacy to new management practices. Some examples are pressures from formal regulations, codes of conduct issued by UN, environmental standards and other mechanisms that requires companies to adopt SSC practices (Matten and Moon, 2008). A coercive pressure might also be originated by companies with powerful positions in the supply chain (Glover et al., 2014) that promote environmental management initiatives (Kilbourne et al., 2002) .

Normative pressures: standards and values promoted by professional networks, industry associations, and academic institutions (Rivera, 2004). These can also be internal corporate departments aiming to integrate new rules and legitimate practices (Glover et al., 2014) or managers that employ social rules from previous professional experience (Tate et al., 2010)

Mimetic processes: learning from “best practices” of benchmarks or companies considered particularly innovative, legitimate or visionary in SSC practices. Also called mimicry, this movement starts when leading companies disseminate information about their sustainability initiatives, promoting other players to copy their behavior (Halme and Huse, 1997). It might be structured as business coalitions (e.g. SmartWay, Together for Sustainability).

The focus of scope 2 of the methodology is on mimetic processes based on sustainability leaders which support companies planning their own sustainability actions. The “Benchmark Practices Bank”, developed using the Integrated Framework for Managing SSC practices (chapter 3) as a background, goes beyond corporate boundaries and promotes collaboration between same-industry firms with the intention of strengthen the industry, building specific standards for suppliers, sharing best practices, discussing particular challenges and solutions regarding this group of firms. In practice, they are also called horizontal colaboration once it is established between companies operating at the same level(s) in the market (European Comission, 2001). The structure varies: specific country (“Brazilian Association of Hygiene, Cosmetics and Perfumery Industries”, independent group of companies for a specific purpose (“Together for sustainability” - improve sustainability sourcing practices by chemical companies) or single projects between pairs of companies (“Nestle-PepsiCo” in consumer goods industry). Initiatives taken by one specific industry can, however, spillover across industry boundaries, leading in most of the cases to increase in sustainable behavior (Kovács, 2008).

Apart from analyzing industry patterns and identifying potential same-industry collaboration opportunities, the database encourage innovation and inspire an “out of the box” perspective (Brown, 2002) through the study of good practices from other businesses/industries. The second scope of the methodology supports firms in identifying innovative practices and revolutionary changes for create truly sustainable supply chains (Pagell and Shevchenko, 2014), different from previous researches that suggested copying practices from similar characteristics such as size or age, membership in the same industry, or geographic region (Guler et al., 2002).

2.2.3 Scope 3: Acting Beyond

The third scope of the methodology aims to support defining a SSC practices portfolio together with supply chain partners in an attempt to improve the shared value chain sustainability. The concept of "shared value chain" in this methodology combines concepts of "shared value" and "supply chain". According to Porter and Kramer (2011), shared value consists of initiatives that enhance competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates. In the context of the current methodology, it means offering a complete portfolio of value-added practices that balance social, environmental and economic responsibility. The "Practices Portfolio Planning Matrix" was developed based on contributions from Extended Resource-based Views (ERbV) (Eisenhardt and Schoonhoven, 1996; Lavie, 2006) and the relational view (RV) (Dyer and Singh, 1998). These approaches are evolutions of the traditional Resource-based View (RbV) (Barney, 1991; Wernerfelt, 1984) that argues that to achieve and sustain competitive advantage, firms must possess and control their valuable, rare, imperfectly imitable, and non-substitutable resources – e.g. technical know-how, management skills, capital, and reputation (Eisenhardt and Schoonhoven, 1996).

Instead of focusing on value-creating resources owned and controlled by a firm itself, Dyer and Singh (1998) suggest firms to span firm boundaries and focus on inter-organizational resources, capabilities and competences, which are sources of competitive advantage. According to Lavie (2006), ownership of resources is not a necessary condition for competitive advantage. Through vertical coordination (Carter and Rogers, 2008), partnerships and strategic alliances (Ellram and Cooper, 1990), companies are able to integrate social and environmental resources and knowledge among supply chain members in order to improve performance, balance power and reduce economic hazards. Exchange/share of resources, co-development of products, services, or technologies are some of the initiatives to be implemented in cooperation with partners to improve supply chain performance (Gulati and Singh, 1998).

In order to transform supply chain into a sustainable value chain, it is fundamental the involvement of all parts (Clarke and Roome, 1999) for changing dominant mindsets and single-company goals (Harris and Crane, 2002). The relational view pays special attention to the connection, tangible or intangible, between partners, individuals, departments, companies or entire networks. Eisenhardt and Schoonhoven (1996) states that “people cooperate when the payoff for cooperation exceeds that of proceeding alone”, a similar approach to the relational rent of Dyer and Singh (1998), an extra gain only possible to be created from shared resources among partners (Lavie, 2006). Moreover, alliances improve the strategic position of firms in competitive markets and enable them to share costs and risks. Therefore, when in difficult market conditions, companies tend to seek for alliance formations (Eisenhardt and Schoonhoven, 1996).

Integrating RDT with the ERbV and Relational View theories allow an internally focused perspective of how organizations manage their dependencies on critical resources and an externally focused perspective of how they can profit from partnerships. Network-related theories and extended versions of the RbV contribute to the analysis of interfirm relationship structures, the impact of network-level cooperation on firm's performance (Eisenhardt and Schoonhoven, 1996) and additional gains obtained from collaborative engagements. Supply chain is already a network of resource insufficient companies that depend on each other. One contribution of companies towards a more sustainable world is strengthing the existing SC bonds and creation of new win-win relationships that promote alliances, sharing resources strategies and collaboration.

The third and broader scope of the methodology cover supply chain relationships and encourage collaboration between shared value chain members, which could be part of the same SC or not yet. In a globalized world, vertical collaboration initiatives between buyers and sellers (Bengtsson and Kock, 1999) from all around the world are some of the possible applications for this scope, as described in chapter 6.

2.3 Systematic Literature Review on Sustainable Supply Chain Practices

In order to identify the current available literature about SSC practices, 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 (Denyer and Neely, 2004; Tranfield et al., 2003). 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 (2016), 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.

2.3.1 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?”

2.3.2 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 involves 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, n.d.).

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.

2.3.3 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, 2016).

<u>Source one: Online databases</u>

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, 2016). 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 2) 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.

Table 2. Search strings

Database	Search strings
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*))

2.3.4 Selection of Pertinent Literature

Applying selection criteria to select pertinent literature

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

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, 2016). 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 answering 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 it. 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.

Source two: References cross check

As suggested on literature about systematic literature review (Durach, 2016), 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 3 and as shown from 2052 documents, 99 were selected for building the framework of sustainable supply chain practices.

Table 3. Summary of the results/source

Source	**Initial list**	**After title/abstract reading**	**After full reading text**
Web of Science	880	279	52
Business Source Complete	1055	150	27
References section	-	42	4
Author´s recommendation	117	77	16
Total	**2052**	**548**	**99**

2.3.5 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 5, 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 et al., 2015)

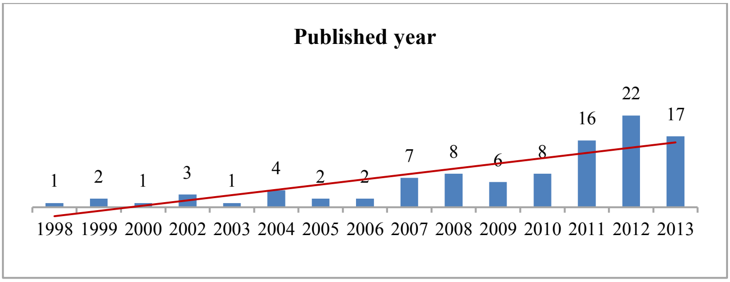


Figure 5. Publications per year in the area of SSC practices (own author)

On the other hand, figure 6 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 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.

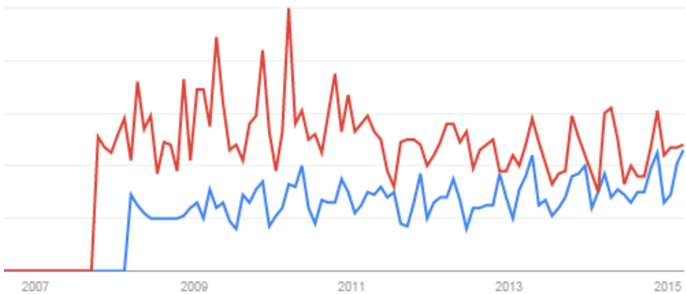


Figure 6. Search for “green supply chain” (red) and “sustainable supply chain” (blue) (GoogleTrends/https://www.google.com/trends/)

Sources

As shown in table 4, 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.

Table 4. Publications/source

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

3 Integrated Framework for Managing Sustainable Supply Chain Practices[1]

The present chapter answers the first research questions underlying this dissertation “How can SC initiatives be structured in order to support sustainability management?” and explain the scope 1 of the “Methodology for planning sustainable supply chain initiatives”. It is separated into ten sections. The first one presents the theoretical models and methodologies which supported developuing the “Framework for Managing Sustainable Supply Chain Practices” followed by a short description of the logic behind the framework and its structure. The next sections describe in details each of the 21 categories of the framework and the last section conclude the chapter. The content of this chapter was already published in Campos (2015).

3.1 Methodology for Framework Building

The Integrated Framework for Managing Sustainable Supply Chain Practices was build in order to answer the first research question “How can SC initiatives be structured in order to support sustainability management?” It is based on the results from the systematic literature review (Denyer and Tranfield, 2009) described in the previous section (2.3). This method differs from the traditional literature review due to its transparency, reproducibility and structure (Briner and Denyer, 2012). Furthermore, 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 with 308 C-level executives at large global enterprises (Forbes Insights, 2011) (figure 7). To fill this gap and understand the logic when building a framework, some well-recognized models from strategy

[1] A complete version of this chapter was published in Campos (2015)

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.

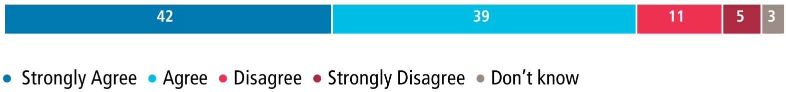


Figure 7. Companies need an organizational framework to spur green (Forbes Insights, 2011)

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.

Workshops and interviews with experts

To build the framework for managing sustainable supply chain practices, all relevant information from the selected references were reduced by repeated reading and the study data extracted. 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 et al., 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 program (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.

3.2 Description of the Framework

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 fewer 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 8) is composed by three clusters, 7 groups and 21 subgroups of practices. The first cluster, Supplier Relationship Management (SRM) and its single group Supplier Relationship 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: 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 successfully implemented. 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 designed in a way that exceed the corporate limits (ISCM cluster), reaching the SRM and CRM clusters. Aditionally, Governance does not intend to represent the actions’ flow, but the continuity of supportive actions, therefore its horizontal shape. 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 packaging) and support materials for distribution (e.g. reusable pallets). 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 to customers.

The final value delivered to customers (CRM) includes a combination of sustainable goods, services, technologies and processes. To expose this idea, Production Management group is designed horizontally and similarly to Governance, reaching SRM and CRM clusters. The Distribution group consists of practices related to the delivery of the final good or service in a more economic, social and environmentally way. Waste Management, represents the reverse flow of overall waste generated by the company and its network, includes practices to reduce the disposable waste and capturing the value from it (by reusing, remanufacturing, and recycling). It also involves pollution waste and the overall SC emissions. Lastly, considered th core of all businesses and the framework, is Customer Relationship Management (CRM) cluster with its single Customer Relationship group, which includes practices to be implemented together with the customers, in order to involve them into the supply chain responsibility.

The percentage of practices identified in each of the categories are represented on Appendix 1 and informed in the following sections where details are presented.

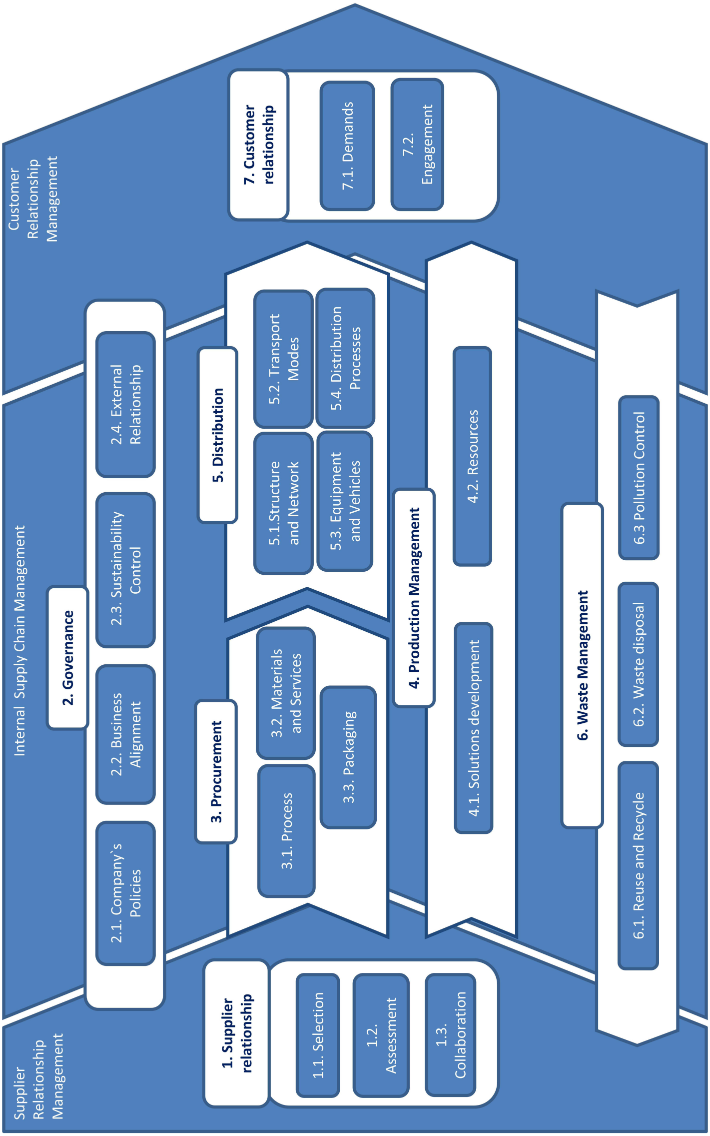


Figure 8. Integrated framework for managing sustainable supply chain practices (own author)

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.

3.3 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 et al., 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 sub-groups: supplier selection, supplier assessment and supplier collaboration.

3.3.1 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 (Genovese et al., 2013; Kermani et al., 2012; Wu et al., 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 (Azevedo et al., 2012; Carter and Jennings, 2002; Liu et al., 2012; MacCarthy and Jayarathne, 2012; Pagell and Wu, 2009; Styles et al., 2012a) 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).

Table 5. Practices regarding supplier selection

Practices	Authors
Use of local supplies	(Adetunji et al., 2008; Brammer et al., 2007; Carter and Jennings, 2002; Fulton and Lee, 2013; Grant et al., 2013; Gross et al., 2013; Kosansky and Schaefer, 2009; Preuss, 2009; Spence and Bourlakis, 2009; Styles et al., 2012a; Wiederkehr et al., 2004)
Use minority-owned suppliers	(Brammer et al., 2007; Carter and Jennings, 2002),
Contract from social enterprises and the voluntary sector	(Preuss, 2009)

The definition of selection criteria considering environmental and social aspects (*Building Design*, 2007; Colby and Fertal, 2007; Eltayeb and Zailani, 2009a; Koplin et al., 2007; Laosirihongthong et al., 2013; Lau, 2011; Lu et al., 2012; Nunes and Bennett, 2010; Panapanaan et al., 2003; Rao, 2007; Schönberger et al., 2013; Vachon, 2007; Vachon and Klassen, 2006) 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 implementation 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 requirement of certifications but did not specify any (Caniato et al., 2011; Colicchia et al., 2011; Dargusch and Ward, 2010; Diabat and Govindan, 2011; Fu et al., 2012; Lu et al., 2012; Pagell and Wu, 2009; Sarkis, 1999; Schönberger et al., 2013; Vachon, 2007).

Table 6. Criteria for supplier selection

Specific criteria	Authors
Compliance with company's and governmental environmental regulations	(Klerkx et al., 2012; Kumar et al., 2012; Panapanaan et al., 2003; Schönberger et al., 2013; Vachon, 2007)
Compliance with specific guidelines/Statement	(Azevedo et al., 2012; Hsu and Hu, 2008; Spence and Bourlakis, 2009; Styles et al., 2012a)
Extension of company's code of conduct	(Caniato et al., 2013; Grant et al., 2013; Kumar et al., 2012; Panapanaan et al., 2003)
Certified EMS	(Azevedo et al., 2012; Eltayeb and Zailani, 2009a; Ofori, 2000)
ISO 14000	(Adetunji et al., 2008; Azevedo et al., 2012; Carbone and Moatti, 2008b; Gopalakrishnan et al., 2012; Khairani, 2012; Koplin et al., 2007; Lai et al., 2011; Laosirihongthong et al., 2013; Liu et al., 2012; Ofori, 2000; Panapanaan et al., 2003; Perotti et al., 2012; Preuss, 2007; Tachizawa et al., 2012; Vachon, 2007; Wu, Ding, et al., 2012; Zhu et al., 2005, 2011, 2013; Zhu and Sarkis, 2006)
A list of specific criteria can be found in Caniato et al. (2013) and Genovese et al. (2013)	

3.3.2 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 et al., 2000). Therefore, the supplier assessment process should be continuous (Caniato et al., 2013; Ciliberti et al., 2008; Holt, 2004; Holt and Ghobadian, 2009; Klerkx et al., 2012; Liu et al., 2012; Lu et al., 2012; Sarkis, 1999; Tachizawa et al., 2012; Yang et al., 2010). 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 (KPIs) 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.

Table 7. Practices regarding supplier assessment

Practices	Authors
Establish and communication of sustainability standards/expectations	(Azevedo et al., 2011; *Building Design*, 2007; Caniato et al., 2011; Colby and Fertal, 2007; Hsu and Hu, 2008; Khairani, 2012; Klerkx et al., 2012; Koplin et al., 2007; Liu et al., 2012; Lu et al., 2012; Rao, 2002; Rao and Holt, 2005; Sarkis, 1999; Sarkis et al., 2011; Styles et al., 2012b; Vachon, 2007)
Monitor their compliance with social and environmental standards along the supply chain	(Adetunji et al., 2008; Azevedo et al., 2012; Fulton and Lee, 2013; Khairani, 2012; Leppelt et al., 2013; Okongwu et al., 2013)
Implement formal audits	(Brammer et al., 2007; *Building Design*, 2007; Ciliberti et al., 2008; Doorey, 2011; Fu et al., 2012; Gopalakrishnan et al., 2012; Johnson, 2004; Khairani, 2012; Kumar et al., 2012; Lai et al., 2011; Leppelt et al., 2013; Liu et al., 2012; Lu et al., 2012; Murphy and Poist, 2002; Ofori, 2000; Panapanaan et al., 2003; Perotti et al., 2012; Preuss, 2007; Rao, 2002; Sarkis, 1999; Schönberger et al., 2013; Tachizawa et al., 2012; Wu, Ding, et al., 2012; Zhu et al., 2005, 2013; Zhu and Sarkis, 2006)
Use of self-assessment questionnaires	(Eltayeb and Zailani, 2009a; Hsu and Hu, 2008; Koplin et al., 2007; Preuss, 2009; Sarkis, 1999; Spence and Bourlakis, 2009)
Inspect suppliers' plants	(Caniato et al., 2013; Rao, 2002; Styles et al., 2012a)
High risk organizations are not de-listed in an initial non-compliance, corrective action is agreed and monitored	(Azevedo et al., 2011; Spence and Bourlakis, 2009).

Set of key performance indicators and targets	(Carbone and Moatti, 2008b; Colby and Fertal, 2007; Fu et al., 2012; Styles et al., 2012b)
Create a "sustainable rating" system	(Caniato et al., 2011)
Award/reward the ones with better results	(Azevedo et al., 2011; *Building Design*, 2007; Preuss, 2009)
Evaluate indirect ones such as second-tier suppliers	(Azevedo et al., 2011; Eltayeb and Zailani, 2009a; Lai et al., 2011; Perotti et al., 2012; Wu, Ding, et al., 2012; Zhu et al., 2005, 2011, 2013; Zhu and Sarkis, 2006)
Direct controls on subcontractors	(Caniato et al., 2012; Johnson, 2004; Klerkx et al., 2012; Leppelt et al., 2013)
Press suppliers to take environmental actions	(Brammer et al., 2007; Ofori, 2000; Panapanaan et al., 2003; Rao, 2002, 2007; Rao and Holt, 2005; Tachizawa et al., 2012)
Implement sanctions for suppliers	(Ciliberti et al., 2008)
Change business order quantity according to the evaluation results	(Lu et al., 2012)
Reject those who lacks environmental concerns	(Carbone and Moatti, 2008b; Doorey, 2011; Murphy and Poist, 2002)

3.3.3 Supplier Collaboration

A recent international study (Handfield et al., 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 et al., 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.

Table 8. Practices regarding supplier collaboration

Practices	Authors
Collaborate with suppliers	(Ashby et al., 2012; Azevedo et al., 2011; Caniato et al., 2011; Colicchia et al., 2011; Diabat and Govindan, 2011; Lai et al., 2011; Pagell and Wu, 2009; Perotti et al., 2012; Schönberger et al., 2013; Vachon, 2007; Wu, Ding, et al., 2012)

Cooperate with suppliers	(Ashby et al., 2012; Hsu and Hu, 2008; Khairani, 2012; McKinnon et al., 2010; Sarkis, 1999; Zhu et al., 2005, 2011, 2013; Zhu and Sarkis, 2006)
Integrate processes and information Improve Information traceability Electronic data interchange Appropriate data collection for designing new solutions considering the life cycle	(Brito et al., 2008; Vachon and Klassen, 2006) (Caniato et al., 2011, 2012; Cetinkaya et al., 2011; Doorey, 2011; Pagell and Wu, 2009) (Azevedo et al., 2011; Closs et al., 2011) (Sarkis, 1999)
Offer incentives to reduce/share suppliers risks Financial support Jointly develop green technology/processes	(Dües et al., 2013; Fu et al., 2012; Goodman, 2000) (Caniato et al., 2013; Rao, 2002; Spence and Bourlakis, 2009) (Fu et al., 2012; Sarkis, 1999)
Invest in supplier's development Compromise allocating company's personnel in regular visits in suppliers site to help it improve ethical performance Offer technical and environmental information for:	(Caniato et al., 2012, 2013; Delai and Takahashi, 2013; Lu et al., 2012; Pagell and Wu, 2009) (Lu et al., 2012) (*Building Design*, 2007; Caniato et al., 2012, 2013; Dües et al., 2013; ECR, 2008; Fu et al., 2012; Holt and Ghobadian, 2009; Khairani, 2012; Koplin et al., 2007; Laosirihongthong et al., 2013; Liu et al., 2012; Lu et al., 2012; Ofori, 2000;

	Panapanaan et al., 2003; Sarkis, 1998, 1999)
Implement EMS	(Carbone and Moatti, 2008b; Rao, 2002, 2007; Rao and Holt, 2005)
Achieve third party certification	(Styles et al., 2012b)
Reduce their environmental impacts and defining goals	(Azevedo et al., 2011; Ciliberti et al., 2008; Closs et al., 2011; Ofori, 2000; Tachizawa et al., 2012; Zailani et al., 2012)
Promote awareness seminars for suppliers/subcontractors	(Carbone and Moatti, 2008b; Holt, 2004; Holt and Ghobadian, 2009; Lieb and Lieb, 2010)
Bring together same industry suppliers to share their own know-how	(Rao, 2002)
Exchange information, ideas and advices	(Fu et al., 2012; Hsu and Hu, 2008)
Disseminate best practices	(*Building Design*, 2007; Schönberger et al., 2013; Styles et al., 2012a, 2012b)
Share information about business ethical conducts and environmental criteria	(Gopalakrishnan et al., 2012; Holt, 2004; Holt and Ghobadian, 2009)
Making clear for suppliers corporate environmental concerns	(Hsu and Hu, 2008; Koplin et al., 2007)
Exchanging expectations and feedback	(Ciliberti et al., 2008; Fu et al., 2012; Lu et al., 2012; Preuss, 2009; Spence and Bourlakis, 2009; Tachizawa et al., 2012)
Bring together company's and suppliers' culture	(Golicic et al., 2010)
Implement product stewardship programs	(Ashby et al., 2012; Grant et al., 2013; Ofori, 2000)

Involve them through Water Efficiency Guides	(MacCarthy and Jayarathne, 2012)

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 connected with groups from SRM and CRM cluster.

3.4 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, p. 1). 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.

3.4.1 Company's Policies

Policies are commonly 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 business 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.

Table 9. Practices regarding company's policies

Practices	Authors
Develop Policies such as:	(Doorey, 2011; Keating et al., 2008; Khairani, 2012; Klerkx et al., 2012; Lai et al., 2011; Lu et al., 2012; Okongwu et al., 2013; Sarkis, 1998; Yang et al., 2010)
Environmental, Corporate Social Responsibility, Recycling, Energy Reduction, Green Logistics/transport	(Azevedo et al., 2011; Holt and Ghobadian, 2009)
Water Efficient Guides	(MacCarthy and Jayarathne, 2012)
Industry agreements/policies	(*Business & the Environment with ISO 14000 Updates*, 2004; Grant et al., 2013)
Green Products Standards	(Khairani, 2012)
Recovery Policies for end products	(Ciliberti et al., 2008)
Green Responsible Principles for purchasing	(Azevedo et al., 2011; Ciliberti et al., 2008; Panapanaan et al., 2003;

	Preuss, 2007, 2009; Spence and Bourlakis, 2009)
Code of Ethics/Conduct	(Adetunji et al., 2008; Caniato et al., 2011, 2012, 2013; Closs et al., 2011; Dargusch and Ward, 2010; Delai and Takahashi, 2013; Doorey, 2011; Grant et al., 2013; Holt, 2004; Holt and Ghobadian, 2009; Leppelt et al., 2013; Murphy and Poist, 2002; Panapanaan et al., 2003; Styles et al., 2012a)
Use International Environmental Programs/NGOs as a standard	(Azevedo et al., 2012; Khairani, 2012; This and Ch, 2008)
Align with current regulation requirements	(Colby and Fertal, 2007; Johnson, 2004; Lau, 2011; Panapanaan et al., 2003)

3.4.2 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 (Lieb and Lieb, 2010; Lu et al., 2012; Pagell and Wu, 2009; Styles et al., 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 et al., 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.

Table 10. Practices regarding business alignment

Practices	Authors
Increase communication efforts with internal stakeholders Especially with investors	(*Building Design*, 2007; Carbone and Moatti, 2008b; Ciliberti et al., 2008; Khairani, 2012; Klerkx et al., 2012; Koplin et al., 2007; Lu et al., 2012; Okongwu et al., 2013; Schönberger et al., 2013; Wu, Ding, et al., 2012) (Biederman, 2011; Leach, 2010; Lu et al., 2012)
High-level unit/department with responsibility for sustainability management to:	(Carbone and Moatti, 2008b; Cetinkaya et al., 2011; Ciliberti et al., 2008; Colby and Fertal, 2007; Doorey, 2011; Koplin et al., 2007; Leppelt et al., 2013; Lieb and Lieb, 2010; Lu et al., 2012; Schönberger et al., 2013; Spence and Bourlakis, 2009; Styles et al., 2012b; Wu, Ding, et al., 2012)

Create cross-functional teams (ecological experts, economists, lawyers, etc.)	(Brito et al., 2008; Lu et al., 2012)
Encourage the commitment from senior managers, support from mid-level managers with sustainability issues	(Fu et al., 2012; Hsu and Hu, 2008; Perotti et al., 2012; Wu, Ding, et al., 2012; Zhu et al., 2005, 2013; Zhu and Sarkis, 2006)
Practices related to Human resource (HR) management: Hire and promote more environmental conscious/diverse personnel, without discrimination Employee education/training in sustainability Specific training for logistics employees	(Caniato et al., 2013; Carter and Jennings, 2002; Klerkx et al., 2012; Murphy and Poist, 2002; Panapanaan et al., 2003) (Caniato et al., 2013; Cetinkaya et al., 2011; Delai and Takahashi, 2013; Dües et al., 2013; Golicic et al., 2010; Holt, 2004; Holt and Ghobadian, 2009; Khairani, 2012; Klerkx et al., 2012; Leppelt et al., 2013; Lieb and Lieb, 2010; Liu et al., 2012; Lu et al., 2012; Murphy and Poist, 2002; Oberhofer and Fürst, 2012; Pagell and Wu, 2009; Preuss, 2009; Sarkis, 1998, 1999; Schönberger et al., 2013; Vachon, 2007; Yang et al., 2010; Zhu et al., 2013) (Carter and Jennings, 2002; Cetinkaya et al., 2011; Golicic et al., 2010; Liimatainen et al., 2012; Schönberger et al., 2013; Vachon, 2007)
Practices related to employee's health, safety and motivation:	(Caniato et al., 2013; Carter and Jennings, 2002; Cetinkaya et al., 2011; Delai and Takahashi, 2013; Klerkx et al., 2012; Lu et al., 2012; Murphy and Poist, 2002; Okongwu et al., 2013; Panapanaan et al., 2003)

Monitor the use of safety equipment and procedures	(Carter and Jennings, 2002)
Ergonomic workplace design	(Grant et al., 2013)
Guaranteeing no child or forced labor	(Grant et al., 2013; Panapanaan et al., 2003)
Attention to the quality of life of the employees	(Caniato et al., 2013; Carter and Jennings, 2002)
Variety of working activities	(Caniato et al., 2013)
Plan operating schedules that allow drivers adequate time at home, offer flexibility in work arrangements	(Caniato et al., 2013; Panapanaan et al., 2003)
Help finding retirement facilities	(Klerkx et al., 2012)
Support employees who want to pursue further education	(Klerkx et al., 2012; Lu et al., 2012; Panapanaan et al., 2003)
Possibility of participation in firm management	(Klerkx et al., 2012; Panapanaan et al., 2003)
Practices related to financial issues:	
Offer adequate wages, salaries and benefits.	(Caniato et al., 2013; Carter and Jennings, 2002; Lu et al., 2012; Panapanaan et al., 2003)
Financial support for sustainability actions	(Lu et al., 2012; Wu, Ding, et al., 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 et al., 2011)

- establish a link between performance/reward systems and sustainability/environmental factors	(Cetinkaya et al., 2011; Pagell and Wu, 2009; Zhu et al., 2013)

3.4.3 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 (Klerkx et al., 2012; Lieb and Lieb, 2010). The implementation of an Environmental Management System enables an organization to reach better results in reducing its environmental impacts and increase its operating efficiency ("EPA", n.d.). 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 (*Building Design*, 2007; Golicic et al., 2010; Grant et al., 2013; Klerkx et al., 2012; Lu et al., 2012; Okongwu et al., 2013; Sarkis, 1998) and products' carbon footprint considering the entire supply chain (Cetinkaya et al., 2011; Lee and Cheong, 2011). In the last, collaboration with suppliers for data sharing is essencial and challenging as well. The systems support companies on setting targets 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.

Table 11. Practices regarding sustainability control

Practices	Authors
Implement an Environmental management system (EMS)	(Ashby et al., 2012; Azevedo et al., 2011; Cetinkaya et al., 2011; Colicchia et al., 2011; Doorey, 2011; Dües et al., 2013; Grant et al., 2013; Keating et al., 2008; Klerkx et al., 2012; Perotti et al., 2012; Sarkis, 1999; Vachon, 2007; Wu, Ding, et al., 2012; Zhu et al., 2005; Zhu and Sarkis, 2006)
Production Resource System	(Ageron et al., 2012; Dües et al., 2013)
Risk and Safety management system	(Azevedo et al., 2011; Carter and Jennings, 2002; Grant et al., 2013; Keating et al., 2008; Lee and Cheong, 2011; Preuss, 2009)
Combine programs and standards with current standards or certifications such as ISO 14001, FLA Code and SA 8000.	(Ageron et al., 2012; Azevedo et al., 2011; Dargusch and Ward, 2010; Diabat and Govindan, 2011; Dües et al., 2013; Grant et al., 2013; Khairani, 2012; Oberhofer and Fürst, 2012; Okongwu et al., 2013; Perotti et al., 2012; Preuss, 2007, 2009; Schönberger et al., 2013; Spence and Bourlakis, 2009; Vachon, 2007; Zhu et al., 2005, 2013; Zhu and Sarkis, 2006)
Establish Environmental Protection Program	(Cetinkaya et al., 2011; Lun, 2011)
Total Quality Environmental Management Program	(Ageron et al., 2012; Azevedo et al., 2011; Diabat and Govindan, 2011; Lun, 2011; Sarkis, 1998; Zhu et al., 2005; Zhu and Sarkis, 2006)
Internal and external auditing programs	(Perotti et al., 2012; This and Ch, 2008)
Green information technology (IT)	(Grant et al., 2013; Perotti et al., 2012; Preuss, 2009; Vachon, 2007)

3.4.4 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).

Table 12. Practices regarding external relationships

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

Cooperate with local authorities	Panapanaan et al., 2003) (Panapanaan et al., 2003)
Keep a good relationship with NGOs helps accessing updated market information and manage image risk	(Cetinkaya et al., 2011; Comas Martí and Seifert, 2013; Doorey, 2011; Styles et al., 2012a)
Relationship with government in attempt to influence legislation related to social/environmental issues	(Biederman, 2011, 2012; Cetinkaya et al., 2011; Delai and Takahashi, 2013; Hsu and Hu, 2008; Murphy and Poist, 2002; Preuss, 2009; Wu, Ding, et al., 2012)
Industry cooperative efforts:	(Azevedo et al., 2011; Biederman, 2012; Colby and Fertal, 2007; Davies, 2008; Doorey, 2011; Lai et al., 2011; Lieb and Lieb, 2010; Murphy and Poist, 2002; Perotti et al., 2012; Sowinski, 2013; Vachon, 2007)
Share best practices	(Dargusch and Ward, 2010; Holt, 2004)
Build a stronger network and influence legislation	(Holt, 2004; Sarkis, 1999)
Develop industry standards	(Styles et al., 2012b)
Cooperate with universities and research centers	(Panapanaan et al., 2003)
Publish sustainability orCorporate Social Responsibility (CSR) reports for internal and external evaluation	(Dargusch and Ward, 2010; Keating et al., 2008; Klerkx et al., 2012; Leppelt et al., 2013; Oberhofer and Fürst, 2012; Okongwu et al., 2013; Schönberger et al., 2013; Zhu et al., 2013)
Be audited by outside companies or third parties are also being used to manage social and environmental issues.	(Dargusch and Ward, 2010; Doorey, 2011; Leach, 2010; Murphy and Poist, 2002; Pagell and Wu, 2009)

3.5 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 advantage. 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 et al., 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 et al., 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.

3.5.1 Procurement Process

Sustainable procurement is an important topic, with more than 10 % of Fortune 500 companies reporting practices in that field (Wu, Dunn, et al., 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.

Table 13. Practices regarding procurement process

Practices	Authors
Implement e-Procurement	(Lai et al., 2011)
Buy on total cost and not only on price	(Pagell and Wu, 2009)

Create a "sustainable product index"/database for classifying products by their levels of sustainability friendliness	(Biederman, 2011) (Hsu and Hu, 2008)
Use clear contractual terms	(Carter and Jennings, 2002; Ciliberti et al., 2008)
Use long-term contracts with environmental dimensions	(Fu et al., 2012)
Develop a special purchasing policy for the community	(Caniato et al., 2013)
Avoid non-ethical behavior	(Carter and Jennings, 2002)

3.5.2 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 (Ashby et al., 2012; Azevedo et al., 2011; Cetinkaya et al., 2011; Colby and Fertal, 2007; Colicchia et al., 2011; Dües et al., 2013; Fulton and Lee, 2013; Grant et al., 2013; Koplin et al., 2007; Laosirihongthong et al., 2013; Schönberger et al., 2013). This may reduce cost, improve re-usability and minimize consumption of non-renewable resources (Azevedo et al., 2011; Carbone and Moatti, 2008b; Kosansky and Schaefer, 2009; Rao, 2007; Styles et al., 2012b).

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", n.d.). 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.

Table 14. Practices regarding materials and services

Practices	Authors
Eco and Social-labeled products (including fair trade and certified products)	(Azevedo et al., 2011; Closs et al., 2011; Colicchia et al., 2011; Delai and Takahashi, 2013; Lai et al., 2011; Rao, 2002, 2007; Rao and Holt, 2005; Styles et al., 2012b; Wu, Ding, et al., 2012; Zhu et al., 2013; Zhu and Sarkis, 2006)
Prefer recyclable, reusable or recycled materials	(Adetunji et al., 2008; Azevedo et al., 2011; Caniato et al., 2012; Carter and Jennings, 2002; Ciliberti et al., 2008; Dües et al., 2013; Eltayeb and Zailani, 2009a; Fulton and Lee, 2013; Kotzab et al., 2011; Lai et al., 2013; Laosirihongthong et al., 2013; Lau, 2011; Murphy and Poist, 2002; Ofori, 2000; Preuss, 2009; Rao and Holt, 2005; Sarkis, 1999; Schönberger et al., 2013)
Or remanufactured products	(Dües et al., 2013; Eltayeb and Zailani, 2009a; Laosirihongthong et al., 2013; Preuss, 2009)
Use less polluting materials such as biodegradable or without hazardous substances	(Caniato et al., 2011; Carbone and Moatti, 2008b; Comas Martí and Seifert, 2013; Eltayeb and Zailani, 2009a; Lai et al., 2011; Laosirihongthong et al., 2013; Lau, 2011;

	MacCarthy and Jayarathne, 2012; Ofori, 2000; Perotti et al., 2012; Preuss, 2007; Rao and Holt, 2005; Srivastava, 2007; Styles et al., 2012a; Vachon, 2007)

3.5.3 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 restrictions in South Korea and expanded polystyrene 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 (Ageron et al., 2012; Caniato et al., 2012; Carbone and Moatti, 2008b; Carter and Jennings, 2002; Dekker et al., 2012; Fulton and Lee, 2013; Grant et al., 2013; Rao and Holt, 2005) 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.

Table 15. Practices regarding packaging

Practices	Authors
Reduce the amount of packaging material	(Brammer et al., 2007; Carter and Jennings, 2002; Ciliberti et al., 2008; Colicchia et al., 2011; Kotzab et al., 2011; MacCarthy and Jayarathne, 2012; Oberhofer and Fürst, 2012; Sarkis, 1999)
Implement packaging innovation	(Cetinkaya et al., 2011; Closs et al., 2011; Grant et al., 2013; Schönberger et al., 2013)
Reduce weight and volume	(Azevedo et al., 2011, 2012; Carter and Jennings, 2002; Dekker et al., 2012; Dües et al., 2013; Khairani, 2012; Laosirihongthong et al., 2013; Lau, 2011; Murphy and Poist, 2002; Perotti et al., 2012; Preuss, 2007)
Develop environmental responsible packaging - reusable and recyclable	(Ciliberti et al., 2008; Closs et al., 2011; Zailani et al., 2012)
Use less materials especially hazardous ones	(Eltayeb and Zailani, 2009a; Laosirihongthong et al., 2013)
Use alternative materials such as recycled and reusable	(Carbone and Moatti, 2008b; Ciliberti et al., 2008; Colicchia et al., 2011; Diabat and Govindan, 2011; Eltayeb and Zailani, 2009a; Grant et al., 2013; Lau, 2011; Zailani et al., 2012)
Use remanufactured	(Carbone and Moatti, 2008b)
From sustainable sources	(Preuss, 2007)

Collaborate with suppliers for sustainable packaging Set requirements for supplier to use environmental packaging	(Caniato et al., 2013; Kaplan, 2013) (Zhu et al., 2011, 2013)
Use proper packaging and labeling of hazardous materials	(Carter and Jennings, 2002)

3.6 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.

3.6.1 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 et al., 2011). Therefore, a first step for reducing the overall product footprint is taking environmental aspects into consideration when designing a solution (Ageron et al., 2012; Brito et al., 2008; Carbone and Moatti, 2008b; Delai and Takahashi, 2013; Diabat and Govindan, 2011; Dües et al., 2013; Hsu and Hu, 2008; Khairani, 2012; Laosirihongthong et al., 2013; Liu et al., 2012; Pagell and Wu, 2009; Perotti et al., 2012; Rao, 2007; Styles et al., 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.

Table 16. Practices regarding solutions development

Practices	Authors
Design for:	
- Environment - DfE	(Ashby et al., 2012; Azevedo et al., 2011; Caniato et al., 2011; Grant et al., 2013; Khairani, 2012; Nunes and Bennett, 2010; Sarkis, 1999)
- Sustainable Supply Chain Management Concept	(Cetinkaya et al., 2011)

- Consume less materials, especially hazardous ones - Reuse/recycle - Disassembly	(Azevedo et al., 2011; Colicchia et al., 2011; Eltayeb and Zailani, 2009a; Grant et al., 2013; Khairani, 2012; Kumar et al., 2012; Wu, Ding, et al., 2012; Zhu et al., 2005, 2013; Zhu and Sarkis, 2006) (Carter and Jennings, 2002; Colicchia et al., 2011; Kotzab et al., 2011; Lai et al., 2011; Sarkis, 1998; Wu, Ding, et al., 2012; Zhu et al., 2005, 2013; Zhu and Sarkis, 2006) (Azevedo et al., 2011; Brammer et al., 2007; Ciliberti et al., 2008; Colicchia et al., 2011; Grant et al., 2013; Sarkis, 1998; Srivastava, 2007; Wu, Ding, et al., 2012; Ytterhus et al., 1999; Zailani et al., 2012; Zhu et al., 2005, 2013; Zhu and Sarkis, 2006)
Design solutions that help reducing customers' footprint (e.g. consume less energy)	(Colicchia et al., 2011; Eltayeb and Zailani, 2009a; Grant et al., 2013; Kotzab et al., 2011; Kumar et al., 2012; Wu, Ding, et al., 2012; Zhu et al., 2013; Zhu and Sarkis, 2006).
Measure and analyze product life cycle	(Ageron et al., 2012; Ashby et al., 2012; Brammer et al., 2007; *Building Design*, 2007; Carter and Jennings, 2002; Dües et al., 2013; Eltayeb and Zailani, 2009a; Gopalakrishnan et al., 2012; Grant et al., 2013; Lai et al., 2011; Laosirihongthong et al., 2013; Okongwu et al., 2013; Pagell and Wu, 2009; Preuss, 2007; Sarkis, 1998; Schönberger et al., 2013; Srivastava, 2007; Zailani et al., 2012).
Involve suppliers in the attempt of developing cleaner products	(Holt, 2004; Holt and Ghobadian, 2009; Perotti et al., 2012; Styles et al., 2012b;

providing them green design specification for purchasing	Zhu et al., 2005, 2011, 2013; Zhu and Sarkis, 2006)

3.6.2 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 (Adetunji et al., 2008; Biederman, 2011; Caniato et al., 2013; Carbone and Moatti, 2008b; Closs et al., 2011; Colicchia et al., 2011; Delai and Takahashi, 2013; Diabat and Govindan, 2011; Grant et al., 2013; Klerkx et al., 2012; Liu et al., 2012; Lun, 2011; MacCarthy and Jayarathne, 2012; Murphy and Poist, 2002; Nunes and Bennett, 2010; Oberhofer and Fürst, 2012; Perotti et al., 2012; Rao, 2007; Zhu et al., 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.

Table 17. Practices regarding resources consumption

Practices	Authors
Promote paperless program	(Lai et al., 2011; Lieb and Lieb, 2010; Lun, 2011; Schönberger et al., 2013)
Promote energy efficiency	(Adetunji et al., 2008; Azevedo et al., 2011; Caniato et al., 2012, 2013; Carbone and Moatti, 2008b; Ciliberti et al., 2008; Colicchia et al., 2011; Delai and Takahashi, 2013; Diabat and Govindan, 2011; Eltayeb and Zailani, 2009a; Grant et al., 2013; Holt and Ghobadian, 2009; Kotzab et al., 2011; Lieb

Cogeneration	and Lieb, 2010; Lun, 2011; MacCarthy and Jayarathne, 2012; McKinnon et al., 2010; Murphy and Poist, 2002, 2003; Perotti et al., 2012; Schönberger et al., 2013; This and Ch, 2008) (Colicchia et al., 2011)
Develop/use of renewable energy sources	(Cetinkaya et al., 2011; Colicchia et al., 2011; Comas Martí and Seifert, 2013; Grant et al., 2013; Kotzab et al., 2011; Lun, 2011; McKinnon et al., 2010; Oberhofer and Fürst, 2012; Perotti et al., 2012; Preuss, 2009; Schönberger et al., 2013)
Water management: Minimize water waste through cleaner technology processes Collect rainwater and reuse	(Adetunji et al., 2008; Caniato et al., 2013; Carbone and Moatti, 2008b; Colicchia et al., 2011; Comas Martí and Seifert, 2013; Delai and Takahashi, 2013; Fu et al., 2012; Grant et al., 2013; Khairani, 2012; Kumar et al., 2012; Perotti et al., 2012; Rao, 2007; Schönberger et al., 2013) (Rao and Holt, 2005) (Grant et al., 2013; Schönberger et al., 2013)

3.7 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 (CO_2) emissions, with worldwide freight transport corresponding to 8 % (McKinnon, 2007). When analyzing the direct global greenhouse-gas emissions in 2010 in terms of CO_2-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.

3.7.1 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 descentralize 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.

Table 18. Practices regarding structure and network

Practices	Authors
Use efficient land when considering the location for building a warehouse/production plant/store Avoid deforestation, protecting sensitive ecosystems Require environmental impact statements when selecting manufacturing and distribution sites for new constructions	(Delai and Takahashi, 2013; Grant et al., 2013; Murphy and Poist, 2003) (Styles et al., 2012a) (Kosansky and Schaefer, 2009)
Implement "green" practices during the construction phase, attention to: - Materials - Methods and waste… used for diminishing the impact to visual surrounding, air quality, water supply, and nature habitats - Facilities layouts - Low energy consumption facilities, also with green building certification such as Leadership in Energy & Environmental Design and Building Research Establishment Environmental Assessment Method	(Adetunji et al., 2008; Grant et al., 2013; Kosansky and Schaefer, 2009; Lieb and Lieb, 2010; Nunes and Bennett, 2010; Preuss, 2009) (Colicchia et al., 2011; Fulton and Lee, 2013; Grant et al., 2013; Perotti et al., 2012; Preuss, 2009) (Adetunji et al., 2008; Closs et al., 2011; Grant et al., 2013) (Grant et al., 2013; Sarkis, 1999) (Caniato et al., 2012; Cetinkaya et al., 2011; Colicchia et al., 2011; Dekker et al., 2012; Fulton and Lee, 2013; Grant et al., 2013; MacCarthy and Jayarathne, 2012; Perotti et al., 2012; Preuss, 2009; Schönberger et al., 2013; Sowinski, 2013; This and Ch, 2008)
During the building planning phase, consider: warehouse temperature (temp, humidity/Insulation during	(Colicchia et al., 2011; Grant et al., 2013; Lun, 2011; Mckinnon, 2012;

construction), warehouse lighting, mechanical handling equipment and harness green energy	Oberhofer and Fürst, 2012; Perotti et al., 2012; Schönberger et al., 2013)
Redesign the logistic network and its components considering also the total emissions	(Ageron et al., 2012; Cetinkaya et al., 2011; Colicchia et al., 2011; Dües et al., 2013; ECR, 2008; Golicic et al., 2010; Gross et al., 2013; Kosansky and Schaefer, 2009; Kotzab et al., 2011; Murphy and Poist, 2002; Perotti et al., 2012; Schönberger et al., 2013; This and Ch, 2008)
Merge networks	(Gross et al., 2013)
Shorter networks between company and its customers	(Dekker et al., 2012)
Shorter networks between company and its suppliers	(Caniato et al., 2012; Grant et al., 2013; This and Ch, 2008)
Use "cluster" suppliers	(Cetinkaya et al., 2011)
Use centralized distribution systems	(Azevedo et al., 2012; Caniato et al., 2011; Dekker et al., 2012; Grant et al., 2013; Schönberger et al., 2013)
Use of intermediate simple facilities/processes such as multi-drop, multi-pick, cross-docking	(Brito et al., 2008; Caniato et al., 2011)
Consolidation of freight flows	(Cetinkaya et al., 2011; Colicchia et al., 2011; Dekker et al., 2012; Grant et al., 2013; Gross et al., 2013; Kosansky and Schaefer, 2009; Lieb and Lieb, 2010; Perotti et al., 2012; Sarkis, 1999; Schönberger et al., 2013; This and Ch, 2008)
Fleet optimization	(Cetinkaya et al., 2011; Colicchia et al., 2011; Golicic and Smith, 2013; This and Ch, 2008)

Reduction in vehicle fleet	(Ciliberti et al., 2008; Kosansky and Schaefer, 2009)

3.7.2 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 (Stern, 2007; World Economic Forum, 2009). 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, 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 et al., 2010).

Discussions about the impact of each mode of transport have been increasing due to the representation of transport emissions. Nonetheless, practices to motivate changing the transport mode of company’s distribution to less polluting ones (Azevedo et al., 2011; Carter and Jennings, 2002; Golicic et al., 2010; Kosansky and Schaefer, 2009; Lieb and Lieb, 2010; Oberhofer and Fürst, 2012; Perotti et al., 2012; Rao, 2007; Rao and Holt, 2005) or/and encouraging intermodal strategies (Brito et al., 2008; Caniato et al., 2013; Carbone and Moatti, 2008b; Cetinkaya et al., 2011; Ciliberti et al., 2008; Dekker et al., 2012; Gross et al., 2013; Sarkis, 1999; Wiederkehr et al., 2004) 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 et al., 2008). Some specific benefits of modal switch can be found in a report published by Efficient Consumer Response – Europe (ECR, 2008).

Table 19. Practices regarding transport modes

Practices	Authors
Prefer rail	(Carter and Jennings, 2002; Cetinkaya et al., 2011; Colicchia et al., 2011; Grant et al., 2013; Preuss, 2007; Wiederkehr et al., 2004)
Prefer sea and inland	(Cetinkaya et al., 2011; Colicchia et al., 2011; Grant et al., 2013; Schönberger et al., 2013; Wiederkehr et al., 2004)
Avoid air-freight and air-travel	(Styles et al., 2012a; Wiederkehr et al., 2004)
Collaborating with suppliers to decide best modes of transportation based on cost and service needs	(Closs et al., 2011)

3.7.3 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.

Table 20. Practices regarding equipment and vehicles

Practices	Authors
Changes in fuel type	
Use alternative fuels	(Biederman, 2011, 2012; Cetinkaya et al., 2011; Ciliberti et al., 2008; Colicchia et al., 2011; Comas Martí and Seifert, 2013; Davies, 2008; Dekker et al., 2012; Fu et al., 2012; Golicic et al., 2010; Grant et al., 2013; Holt and Ghobadian, 2009; Lieb and Lieb, 2010; Lun, 2011; Oberhofer and Fürst, 2012; Perotti et al., 2012; Preuss, 2009; Rao, 2007; Schönberger et al., 2013; This and Ch, 2008; Wiederkehr et al., 2004)
Use hybrid technology in local deliveries operations	(Colicchia et al., 2011)
Use battery electric vehicles	(Cetinkaya et al., 2011; McKinnon et al., 2010; Schönberger et al., 2013)
Use electric machinery and equipment used for warehousing processes	(Dekker et al., 2012; Gopalakrishnan et al., 2012; Grant et al., 2013; Lau, 2011; Lun, 2011; Perotti et al., 2012; Sowinski, 2013)
Energy efficient vehicles such as:	(Colicchia et al., 2011; Golicic et al., 2010; Grant et al., 2013; Lau, 2011; Liimatainen et al., 2012; Wiederkehr et al., 2004)
Ships and aircraft	(Biederman, 2011; Leach, 2010)(Wiederkehr et al., 2004)
EURO emission standard vehicles	(Cetinkaya et al., 2011; Davies, 2008; McKinnon et al., 2010; Oberhofer and Fürst, 2012; Schönberger et al., 2013; Sowinski, 2013)
With reduction of truck idle time	(Golicic et al., 2010; Grant et al., 2013; Liimatainen et al., 2012)

With turbocharging (recycling heat from exhaust gases), energy efficiency of auxiliary equipment (pumps, fans, air compressor, heating…), and others	(Colicchia et al., 2011)
With "next generation tires"	(Grant et al., 2013; McKinnon et al., 2010; Schönberger et al., 2013)
With automatic pressure-monitoring and inflation of tires	(Oberhofer and Fürst, 2012)
Change the body type:	
Double deck trailer	(Liimatainen et al., 2012)
Longer combination vehicles and "Gigaliners"	(Grant et al., 2013; Gross et al., 2013)
Use of less dense material	(Liimatainen et al., 2012)
Inclusion of aerodynamic accessories	(Grant et al., 2013; Liimatainen et al., 2012; McKinnon et al., 2010; Oberhofer and Fürst, 2012; Schönberger et al., 2013; This and Ch, 2008)
Changes in logistics equipment such as using eco-friendly/recyclable containers and pallets	(Azevedo et al., 2011; Holt, 2004; Holt and Ghobadian, 2009; Lai et al., 2011; Lieb and Lieb, 2010)
Implementation of maintenance and renewal policies	(Ciliberti et al., 2008; Colicchia et al., 2011; This and Ch, 2008)

3.7.4 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).

Table 21. Practices regarding distribution processes

Practices	Authors
Warehouse management:	
Minimize inventory and its management (green scheduling and production planning, inventory management system with real-time inventory visibility)	(Dües et al., 2013; Grant et al., 2013; Sarkis, 1998; This and Ch, 2008)
Storage, pack, label and transport properly hazardous materials	(Carter and Jennings, 2002; Murphy and Poist, 2002)
Find revenue-generating uses or donating obsolete inventory in warehouse	(Carter and Jennings, 2002)
Transport management:	
Optimize freight loads and routes	(Azevedo et al., 2012; Caniato et al., 2011, 2013; Cetinkaya et al., 2011; Colicchia et al., 2011; Golicic et al., 2010; Grant et al., 2013; Khairani, 2012; Lau, 2011; Liimatainen et al., 2012; Perotti et al., 2012; Schönberger et al., 2013; This and Ch, 2008; Wiederkehr et al., 2004)
Efficient Load Fill and Deliveries	(ECR, 2008)
Align inbound and outbound shipments	(Colicchia et al., 2011; Lau, 2011)
Reduce the replenishment frequency	(Dües et al., 2013)

Negotiate with clients for amplifying delivery window	(Dekker et al., 2012; Golicic et al., 2010; Gross et al., 2013; Kosansky and Schaefer, 2009)
Change operation hours	(Carter and Jennings, 2002; Lau, 2011) (Golicic et al., 2010; This and Ch, 2008; Wiederkehr et al., 2004)
Use of telecommunications systems such as: - telematics	(Cetinkaya et al., 2011; Grant et al., 2013; Schönberger et al., 2013)
Integrated Transport Management System	(Schönberger et al., 2013)
Low speed – low fuel consumption strategy	(Biederman, 2011; Dekker et al., 2012; Grant et al., 2013; Gross et al., 2013; Lieb and Lieb, 2010; Liimatainen et al., 2012)
Improve drivers' skills	(Carter and Jennings, 2002; Colicchia et al., 2011; Golicic et al., 2010; Grant et al., 2013; Liimatainen et al., 2012; McKinnon et al., 2010; This and Ch, 2008)

3.8 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.

3.8.1 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.

Table 22. Practices regarding reuse and recycle

Practices	Authors
Recover company's end of life products	(Caniato et al., 2011, 2012, 2013; Carbone and Moatti, 2008b; Hsu and Hu, 2008; Kosansky and Schaefer, 2009; Lai et al., 2013; Lieb and Lieb, 2010; Murphy and Poist, 2002; Nunes and Bennett, 2010; Rao, 2007).
Implement reverse logistics: - for cleaner production - focusing on disposal Collect back used packaging or pallet systems and motive suppliers to the same	(Eltayeb and Zailani, 2009a; Sarkis, 1998; Srivastava, 2007; Zhu et al., 2013) (Lai et al., 2013) (Grant et al., 2013) (Eltayeb and Zailani, 2009a; Holt, 2004; Holt and Ghobadian, 2009; Laosirihongthong et al., 2013; Rao, 2007)
Create closed loops	(Grant et al., 2013; Pagell and Wu, 2009)
Reuse	(Ashby et al., 2012; Azevedo et al., 2012; Carbone and Moatti, 2008b; Carter and Jennings, 2002; Colicchia et al., 2011; Comas Martí and Seifert, 2013; Eltayeb and Zailani,

Sell the waste in secondary markets	2009a; Gopalakrishnan et al., 2012; Lai et al., 2013; Liu et al., 2012; MacCarthy and Jayarathne, 2012; Murphy and Poist, 2002; Nunes and Bennett, 2010; Sarkis, 1999) (Azevedo et al., 2012; Closs et al., 2011)
Remanufacture Include disassembly manual	(Ashby et al., 2012; Carbone and Moatti, 2008b; Ciliberti et al., 2008; Dües et al., 2013; Eltayeb and Zailani, 2009a; Holt, 2004; Holt and Ghobadian, 2009; Lai et al., 2013; Nunes and Bennett, 2010; Rao, 2007) (Hsu and Hu, 2008)
Recycle Transform waste into energy	(Ashby et al., 2012; Azevedo et al., 2012; Biederman, 2011; Brito et al., 2008; Caniato et al., 2012; Carbone and Moatti, 2008b; Closs et al., 2011; Colicchia et al., 2011; Comas Martí and Seifert, 2013; Delai and Takahashi, 2013; Eltayeb and Zailani, 2009a; Gopalakrishnan et al., 2012; Grant et al., 2013; Hsu and Hu, 2008; Lai et al., 2013; Laosirihongthong et al., 2013; Lieb and Lieb, 2010; MacCarthy and Jayarathne, 2012; Murphy and Poist, 2002; Nunes and Bennett, 2010; Oberhofer and Fürst, 2012; Preuss, 2007; Rao, 2007; Rao and Holt, 2005) (Colicchia et al., 2011)

3.8.2 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.

Table 23. Practices regarding waste disposal

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

3.8.3 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 et al., 2011). Programs for pollution prevention (Cetinkaya et al., 2011; Lun, 2011; Zhu et al., 2011, 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.

Table 24. Practices regarding pollution control

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

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.

3.9 Customer Relationship

According to the Carbon Disclosure Project 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.

3.9.1 Demand

Practices to manage customer's demands (Delai and Takahashi, 2013; Fu et al., 2012; Klerkx et al., 2012; Lai et al., 2013; Lau, 2011; Okongwu et al., 2013; Vachon and Klassen, 2006) 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.

Table 25. Practices regarding customer's demand

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

3.9.2 Engagement

Practices related to engagement differentiate from the previous subgroup 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 (Cetinkaya et al., 2011; Diabat and Govindan, 2011; Dües et al., 2013; Khairani, 2012; Pagell and Wu, 2009; Vachon and Klassen, 2006) 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)

Table 26. Practices regarding customer engagement

Practices	Authors
Cooperate with customers for: Eco-design, green packaging, cleaner production Reverse logistics relationships after products' end of life or for safe refill	 (Khairani, 2012; Zhu et al., 2005, 2011, 2013; Zhu and Sarkis, 2006) (Ageron et al., 2012; Ashby et al., 2012; Carter and Jennings, 2002; Delai and Takahashi, 2013; Diabat and Govindan, 2011; Eltayeb and Zailani, 2009a; Grant et al., 2013; Laosirihongthong et al., 2013; Lau, 2011; Schönberger et al., 2013; Zhu et al., 2011, 2013)
Involve customers in programs for: Recycling, vehicle idling, packing waste collection, using green packing materials Use zero one-use bag	 (Azevedo et al., 2012; Lai et al., 2011) (Schönberger et al., 2013)
Implement education programs	(Ciliberti et al., 2008; Delai and Takahashi, 2013; Liu et al., 2012; MacCarthy and Jayarathne, 2012; Rao, 2007; Rao and Holt, 2005)

Develop of a web site/carbon footprint calculator for each particular solution chosen	(Lieb and Lieb, 2010)
Collaborate with customers for: Use less energy during product transportation Develop renewable energy sources, especially at customer facilities Implement paperless programs/electronic communications to link with its customers and business partners	 (Zhu et al., 2011, 2013; Zhu and Sarkis, 2006) (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)

3.10 Conclusions

Considerable discussion about 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 present chapter, thus, presents 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 which started with 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 and 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 2 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. It is composed by 7 dimensions, 21 categories and 91 practices. It considers the traditional logistics functions such as Procurement and Distribution, combined with Production Management. The latter, different from the traditional perspective, 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 in cooperation with volunteer students and researchers. The tool uses the framework for managing sustainable supply chain practices as a background and can be employed in the data collection process 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. Some screenshots of the tool are available in Appendix 6.

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. Would be a reflection of the reality among companies' initiatives?

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 offsetting strategies. 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?
- 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 two independent reviewers conducted the systematic literature review and the selection criteria previously defined, the process is subjective and therefore dependable on the understanding of each reviewer.

4 Benchmarks Practices Bank

The present chapter answers the second research questions underlying this dissertation "Which are the industry patterns regarding sustainable supply chain practices?" and explain the scope 2 of the "Methodology for planning sustainable supply chain initiatives". The chapter is separated into six sections. The first one offer a detailed description of the applied methodology for developing the Benchmark Practices Bank, making the data collection and analysis is transparent and replicable (Kolbe and Burnett, 1991). The logic behind building this database is making SSC practices reported by leading companies publicly available for encouraging and inspiring other organizations.

The following sections presents the results of four comparative analysis that supports filling the gap of research in identifying industry patterns (Brockhaus et al., 2013; Tate et al., 2010; Wu, Dunn, et al., 2012). The results allow firms to better plan collaborations between companies from the same sector and also between others with similar issues regarding SSCM. The second section describes the results according to the groups of practices in order to allow comparison between literature (chapter 3) and data from multinational leading companies. The third presents a qualitative approach with details about each industry's patterns, which derived a paper presented at the EurOMA Sustainability Forum 2016. The fourth section shows the results of a quantitative analysis using non-parametric statistics tests, used to identify statistic significant differences between each industry in each of the 21 groups of practices. Derived from these results, a sub-section focusing in particularities from T&LS when compared with producers was published and presented at the EurOMA Conference 2016. The last analytical section evidences statistically significant differences between companies from Brazil and Germany in implementing SSC practices for further presenting a cross-country collaboration framework, also accepted for presentation at the 14th Global Conference on Sustainable Manufacturing (GSCM) in South Africa – October, 2016 and publication in the Procedia Manufacturing journal.

The final section aggregate the preliminary conclusions of each of the previous sections.

4.1 Methodological Approach

Supply chain management research has being based on the analysis of primary data however using secondary data in empirical studies offer several advantages. According to Hakim (1982 p. 489) “One advantage of secondary analysis is that it forces the researcher to think more closely about the theoretical aims and substantive issues of the study rather than the practical and methodological problems of collecting new data. The time and effort involved in obtaining funds for and organizing a new survey can be devoted instead to the analysis and interpretation of results”. It requires less money, less time and less personnel since data is publicly available, it is mostly free from contamination of respondent perceptions (Calantone and Vickery, 2010; Cowton, 1998). The extra effort to transform the available data, build constructs and find a way of fitting the data into the research needs must, nonetheless, compensate those necessary when working with primary data.

One of the most currently used methodology is content analysis: “a research technique for the objective, systematic and quantitative description of the manifest content of communication” (Berelson, 1952, p. 489). It aim to interpret subjectively the content of text data through the systematic classification of coding, identifying patterns (Neuendorf, 2002). It enables researchers to analyze “sources of texts in a more scientific, systematic, and, sometimes, quantitative way” (Rabinovich and Cheon, 2011, p. 306), enabling to make further replicable and valid conclusions (Cavanagh, 1997). It has been successfully applied in recent SCM researches (Colicchia et al., 2011; Piecyk and Björklund, 2015; Tate et al., 2010; Wu, Dunn, et al., 2012). The unit of assessment may be any published documents such as academic papers and CSR reports.

According to specialists in this methodology (Eisenhardt, 1989; Mayring, 2008), data can be derived deductively or inductively. For the purpose of this research, the deductive approach was used which means employing an existing theory or framework as a background for data collection. The steps suggested by Mayring (2008) (figure 9) were employed and the "Framework for Managing SSC practices" employed as a background of categories and coding scheme (Appendix 3). Two reviewers were trained in each of the 91 practices from the framework and results discussed until consensus, as suggested by Milne and Adler (1999) for increasing reliability.

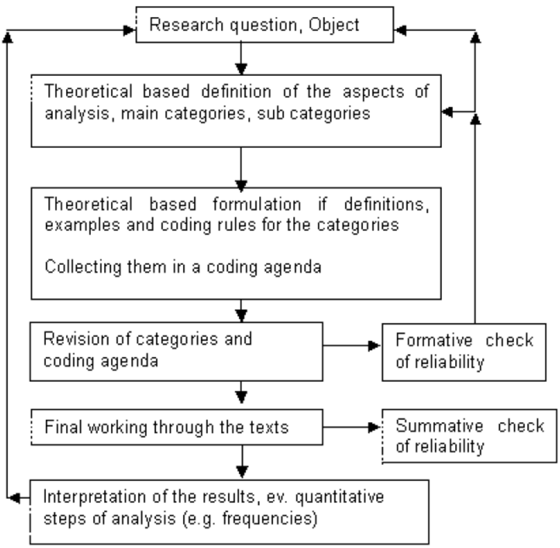


Figure 9. Step model of deductive category application (Mayring, 2008)

4.1.1 Sources of Data – CSR Reports

In order to analyze SSC practices implemented by worldwide leaders, Corporate Sustainability Reports (CSR) were employed as sources of data. Researches using sustainability reports is commonly being used (Comas Martí and Seifert, 2013; Piecyk and Björklund, 2015; Tate et al., 2010; Wu, Dunn, et al., 2012). It is defined by the Global Reporting Initiative as “a report published by a company or organization about the economic, environmental and social impacts caused by its everyday activities” and can help “to measure, understand and communicate” sustainable performance (Global Reporting Initiative, 2015). They contribute to transparency and offer an important platform for the communication of positive and negative impact of sustainable behaviour, as well as for the continual recording of information that can affect company’s policy, strategy and activities. Information should be based on evidences which improves the perception of their trustworthiness (Higgins and Walker, 2012). Nonetheless it is unclear when a company is reporting implemented practices or only what stakeholders want to read (Kolk, 2003) since they are not likely to report facts that may damage their reputation.

According to KPMG International (2013), the current rate of corporate reporting among the 250 largest companies in the world is over 90 %. Nevertheless, differences among countries and industries (Chen and Bouvain, 2009; Roca and Searcy, 2012) is characterized by least reporting in US and Asia Pacific. Around 20 % of large companies in high carbon sectors such as chemicals, mining, industrials, metals & manufacturing and construction & materials does not report on carbon. Furthermore, oil and gas firms score lowest in the reports’ quality. Lacks in publishing targets and considering a broader supply chain scope evidences vast opportunities for improving the quality of corporate sustainability reports.

Some authors found that the content of the CSR reports in emerging markets can be affected by the corporation’s country of origin (Wanderley et al., 2008). Piecyk and Björklund (2015), however, did not identified this difference when analyzing logistics service providers (LSPs), except for the number of environmental indicators – more in China than in Europe and US. Aware of the limitations of using content analysis of companies’ reports, the actions to minimize them are showed on table 27.

Table 27. Actions taken to minimize research limitations

Limitations	Action taken
Risk of bias – deliberate or unintentional (Cowton, 1998) Multiple judgments (Brewerton and Millward, 2001)	Involving several researchers into content analysis, validity and reliability of (literature) sampling and data analysis may be broadly enhanced (Duriau et al., 2007)
Need to manipulate the data into a suitable form (Cowton, 1998)	Use of a framework with detailed description of each practice (Mayring, 2008) Use a structured tool to organize the collected data
Self-published reports which might be used for commercial purposes (Calantone and Vickery, 2010)	Choose top ranked companies
Not much details about the practices	Selected a sample of large companies which publish more details Searched in at least 3 public sources (e.g. sustainability reports, annual reports and websites).

4.1.2 Sample of Companies

The aim of building a benchmark bank is to consider practices being implemented by leading international companies worldwide that represents benchmarks of SSC practices. In order to conduct the researches for the current section, 32 companies were selected according to the following criteria (table 28):

Table 28. Criteria for sample selection

Criteria	**Rationale**
Large companies	Are more likely to engage in SSCM (Min and Galle, 2001; Murphy and Poist, 2000; Pagell, 2004) since they experience the greatest pressure from societal and legislative drivers (Holt and Ghobadian, 2009) Publish sustainability or integrated annual reports
Benchmarks in sustainable initiatives	Listed in The Newsweek Green Ranking 2012 or 2014 as a strategy to use reliable information and not green-washing (Parguel et al., 2011), hey were acknowledged as being leaders in Sustainability, thus, exemplars for other companies in their respective industries.
Companies from Brazil, Germany and some exceptions from the US[2]	Intentions to compare developing and developed countries

The Newsweek Green ranking is an established annual assessment of corporate environmental performance of the world's 500 largest publicly traded companies. These are scored based on their performance in eight indicators (2015): combined energy productivity, combined greenhouse gas productivity, combined water productivity, combined waste productivity, green revenue score, green pay link, sustainability board committee, and audited environmental metrics. An overall final score,

[2] The author made use of a collaborative database that focused on these two countries. However, within T&LS sector, only two German companies (and none Brazilian) were identified, turning out to be necessary the inclusion of more firms. Thus, The 75 Green Supply Chain Partners list from Inbound Logistics magazine has been reviewed and five companies from the United States that also fit to the previous two criteria have been added.

which is a weighted average of the indicators leads to a sorted list in descending order with the placements of the companies (Newsweek, 2015). The leading firms were then clustered into five groups according to their products (table 29). Their position in this ranking is presented on Appendix 4.

Table 29. Selected industries and companies

Industry	**Characteristics**	**Companies**
Basic Materials and Energy (BM&E)	Combination of companies from Oil&Gas and some from Materials sector (those more directly related to raw materials). Some examples are below: – Oil & Gas Producers: Companies engaged in the exploration for and drilling, production, refining and supply of oil and gas products (Industry Classification Benchmark, n.d.). – Alternative Energy: Companies that develop or manufacture renewable energy equipment utilizing sources such as solar, wind, tidal, geothermal, hydro and waves (Industry Classification Benchmark, n.d.). – Manufacturers of industrial gases (MSCI, n.d.). – Manufacturers of construction materials including sand, clay, gypsum, lime, aggregates, cement, concrete and bricks (MSCI, n.d.). – Companies involved with the discovery, development and processing of raw materials (e.g. industrial gases, oil, iron ore, nickel) and primary ones (e.g. electricity, cement).	HeidelbergCement AG Vale S.A. Linde AG Petrobras S.A. RWE Energiedienstleistungen GmbH

Industrial Materials (IM)	Consists of some manufacturers from Industrials (Auto Parts & Equipment) and some from Materials sector (steel and chemicals) (Industry Classification Benchmark, n.d.). Some examples are below: – Iron & Steel: Manufacturers and stockholders of primary iron and steel products such as pipes, wires, sheets and bars, encompassing all processes from smelting in blast furnaces to rolling mills and foundries. Includes companies that primarily mine iron ores. – Chemicals: Producers and distributors of simple chemical products that are primarily used to formulate more complex chemicals or products, including plastics and rubber in their raw form, fiberglass and synthetic fibers. – Building Materials & Fixtures: Producers of materials used in the construction and refurbishment of buildings and structures, including cement and other aggregates, wooden beams and frames, paint, glass, roofing and flooring materials other than carpets. – Electronic Equipment: Manufacturers and distributors of electronic products used in different industries. Includes makers of lasers, smart cards, bar scanners, fingerprinting equipment and other electronic factory equipment.	BASF SE ThyssenKrupp AG Siemens AG Continental AG Gerdau S.A. Merck KGaA
Automobiles & Commercial Vehicles	Combination of companies from Automobile and Commercial Vehicles manufacturers (Industry Classification	Daimler AG Bayerische Motoren Werke AG

Manufacturers (A&CV)	Benchmark, n.d.). Some examples are below: – Automobiles: Makers of motorcycles and passenger vehicles, including cars, sport utility vehicles and light trucks. – Commercial Vehicles & Trucks: Manufacturers and distributors of commercial vehicles and heavy agricultural and construction machinery, including rail cars, tractors, bulldozers, cranes, buses and industrial lawn mowers.	MAN SE Volkswagen AG Porsche AG Audi AG
Consumer goods (CG) except for A&CV[3]	Combination of manufactures of consumer staples (Food, Beverage and Tobacco; Household & Personal Products), Textiles, Apparel & Luxury Goods and Pharmaceuticals, Biotechnology & Life Sciences (MSCI, n.d.). Some examples are below: – Producers of alcoholic and non-alcoholic beverages including bier, liquors, distillers, mineral waters. – Producers of agricultural products, Meat, Poultry & Fish, packaged foods including dairy products, fruit juices, meats, poultry, fish and pet foods. – Manufacturers of cigarettes and other tobacco products. – Producers of non-durable household products, personal and beauty care products, including cosmetics and perfumes. – Manufacturers of apparel, accessories & luxury goods, footwear and textile.	Adidas AG Beiersdorf AG Bayer AG Henkel AG & Co. KGaA BRF S.A. (former Brasil Foods) Natura S.A. Companhia de Bebidas das Américas (Ambev S.A.) JBS S.A.

[3] The traditional consumer goods industry (defined by the industry classification benchmark) includes also A&CV.

	– Companies engaged in research into and development of biological substances for the purposes of drug discovery and diagnostic development.	
Transport & Logistics Services (T&LS)	Transportation sector (MSCI, n.d.). Some examples are below: – Companies providing air freight transportation, courier and logistics services, including package and mail delivery and customs agents. – Companies providing primarily passenger air transportation; goods or passenger maritime transportation; goods and passenger rail transportation and goods and passenger land transportation.	Deutsche Post DHL Group (DHL) United Parcel Service of America, Inc. (UPS) FedEx Corporation CSX Corporation Union Pacific Railroad Company Norfolk Southern Railway (NS) Deutsche Lufthansa AG

The use of only large companies, identified as sustainability leaders may provide results that do not represent the reality however it shows benchmarking practices that may be followed by other companies interested in improving their sustainability. Moreover, although the selected companies were from Germany and Brazil (some exceptions from the US), they are multinational firms, which means that operations are spread all over the world. More details about each company and the public documents used for content analysis are presented on Appendix 5. Figure 10 summarizes the 32 selected firms for further analysis in this dissertation.

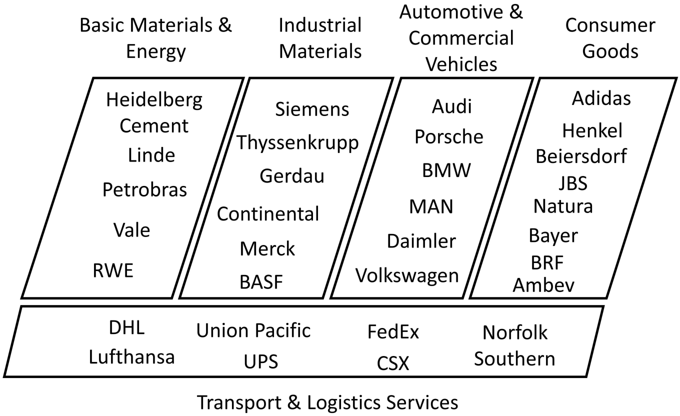


Figure 10. Sample of companies from the Benchmarks Practices Bank (own author)

Since the database is collaborative, filled and used by independent researchers, each has its own criteria for sample selection. However, all should follow two important rules: only public recognized benchmarks are included and all practices have to be organized according to the framework for managing SSC practices. In June 2016, 47 companies are included in the benchmarks database.

4.1.3 Categorization Process

The framework for managing sustainable supply chain practices (Campos, 2015), used as a background and coding scheme, consists of seven clusters, 21 groups and 91 specific practices. Data were collected from public documents – annual and sustainability reports (Tate et al., 2010). Complementary, due to the impression that companies have been increasingly using alternative reporting media to publish details on their sustainability initiatives, press releases and company websites were also analyzed. Important is that firm's commitment level is described, although it difficult to determine whether information are implemented or just reported to appease stakeholders (Kolk, 2003). Due to time constraints, data was not coded individually as suggested by Pagell and Wu (2009), but coded by one trained researcher and revised by the main one (author of this dissertation). The changes and likely doubts were discussed together between them. This process ended for each company when the coders reached a consensus on each of the 91 practices of the framework.

It is important to highlight that the textual content of each of the 91 cells is considered as "one" practice in the quantitative analysis. Even though, it is common that more than one action is reported per cell. E.g. Practice "Relationship with government" might include "… lobby with politicians…", "…participate in projects with governmental agencies". Therefore, the quantitative and qualitative approach complemented each other.

4.1.4 Tool Developed for Data Collection

Additionally to making a "Benchmarking Practices Bank" available for future studies, this research makes available, under request, a visual basic tool, developed by a group of volunteer researchers from the chair of logistics - Technische Universität Berlin. The tool uses the framework for managing sustainable supply chain practices as a background. 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.

The tool consists of two visible sheets and one hidden sheet. The first visible sheet "GI" contains the information about the researched company such as name, main products and markets, environmental, economic and social indicators. The second visible sheet "Framework" contains the Framework for Managing Sustainable Supply Chain Practices, already described in details on Chapter 3. A short description of each category and practices are also visible to support the users. For each practice, the user might insert other important information such as source and year of publication. The hidden sheet "Main sheet" contains the consolidation of all inserted information, and it is suggested to keep it hidden during the data collection phase for data security. During the analysis phase, this sheet can be turned into "visible" using the button "Alt-F11" – Password "Tub". Another interesting feature of the tool is the "doubt button". In case of any doubt regarding the appropriate information location, the "doubt" button can be pressed. The field background changes its colors "calling" attention of the user/reviewer. In case of solving the doubt, the "doubt clear" button can be pressed. There is an option of including "the most used source" for future analysis, as well the report year (if only one is used), information page and link when available on company's websites. Some of the screens of the tool are available on Appendix 6.

4.1.5 Statistical Tests

For statistical analysis, each of the database's cells (91 practices x 32 companies) were coded 1 in case of at least one practice reported and 0 in case of absence of practice reported. The sample was then divided in five groups according to the products' characteristics: BM&E (Basic materials and energy) represents companies that extract raw materials (e.g. gas, oil, iron ore) or produce basic ones (e.g. energy, cement). These companies act as traditional suppliers of other industries. IM (Industrial materials) group produces steel, chemicals, vehicle's parts or electronic systems. The traditional consumer goods industry (Industry Classification Benchmark, n.d.) is divided into A&CV (Automotive and commercial vehicles), which are vehicles' manufacturers and other consumer goods (CG) such as pharmaceuticals, cosmetics, personal goods, apparel/textiles, food and beverages. Lastly, T&LS group includes only logistics service providers (LSPs).

After collecting companies' SSC practices, coding and adjusting for statistical analysis, descriptive statistics and complementary tests were used to investigate the existence of differences between the groups. Since variables were qualitative and expected value higher than 5, chi-square (Bollen, 1989) was run using frequency data. The difference is confirmed as being statistically significant if p-value are less than 0,05. In addition, two nonparametric tests were applied. The first one was Fisher's exact test, recommended for small sample (Levine et al., 2005), was applied to identify where stands the differences between two groups. Furthermore, the Mann-Whitney U test was used to verify the significance of the implementation percentages of specific practices considering the company's industries. These tests were similarly used in Callado, Callado, & Chaves (2015) when investigating patterns of non-financial performance indicators.

4.2 Comparative Analysis between Groups of Practices

4.2.1 Overview

An overview of the comparative analysis between practices reported by companies from five industries and organized according to the seven clusters of the framework is summarized on figure 11. It is important to make clear that the percentages informed in the following figures do not represent the percentage of companies that reported certain category. Each category (as observed in Appendix 3) is composed by specific practices, therefore, the total percentage of each category is, thus, the average of the values from the specific practices. The table with the percentages of each specific practice and the total ones are available in Appendix 7.

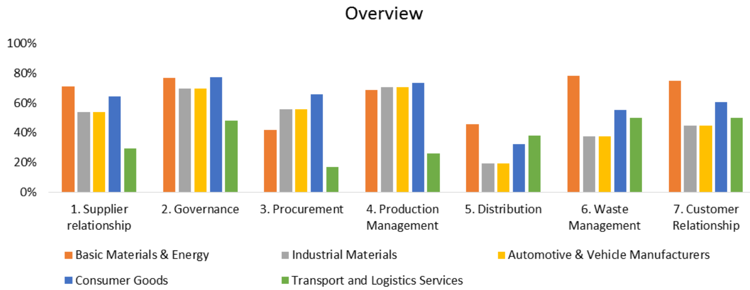


Figure 11. Overview of SSC practices by type/industry (own author)

First, it calls attention that companies in general have been focusing on internally-focused initiatives (Eltayeb and Zailani, 2009b) such as governance and production management practices. Table 30 shows that internal practices among producers and T&LS firms are more reported than external ones – with supplier, LSPs, customers and other external stakeholders, similarly to findings from (Winter and Knemeyer, 2013).

Table 30. External and Internal practices by source

	Literature	BM&E	IM	A&CV	CG	T&LS
EXTERNAL	40,6%	76,3%	52,4%	68,1%	67,3%	42,2%
INTERNAL	33,9%	59,6%	47,5%	55,9%	57,5%	35,4%
difference	6,7%	16,7%	4,8%	12,2%	9,8%	6,8%

It is also visible that BM&E firms report more than the other industries in both internal and external relationships while T&LS report less. T&LS industry seems to behave differently from the others, with a traditionally lower level of reported SSC practices. The statistically significant significances and more details about each category of practice are presented in the following sections of this chapter. Furthermore, the lack in reporting from LSPs might be one of the reasons why distribution initiatives are scant in all groups. According to previous studies, this industry seems not to recognize the importance of CSR (Colicchia et al., 2011; Piecyk and Björklund, 2015). Even those companies that do implement SSC initiatives, they find difficult to report them using the traditional reporting systems (Colicchia et al., 2011). Producers, on the other hand, seem to consider outsourced activities as not in the scope of their CSR reports, especially distribution. This narrow perspective of reporting is not aligned with the current holistic-sustainabilit demands. The trend is supply chain integration evidenced through the publication of SSC practices conducted by all responsible for sharing value, which will require more visibility, integration and collaboration.

4.2.2 Supplier Relationship

Aligned with results from a Delphi study from Seuring and Müller (2008a), figure 12 shows that the focus of producers have been in supplier selection and assessment with fewer differences regarding industries, which will be detailed in section 4.3 and 4.4. Except for T&LS, all others seem to set specific criteria for supplier selection considering social-environmental aspects and the majority seem to require suppliers to comply with code of conducts or guidelines. In contrast with other findings (Comas Martí and Seifert, 2013), supplier relationship is not concentrated in consumer goods industry, but showed to be slightly more reported by BM&E firms. In general, companies seem to monitor and audit suppliers, including through on-site inspections, which is a response for the increasing demand for more shared responsibility among SC members, transparency and pressure for improvements on buyers-supplier relationship. Although the high importance of sourcing from environmentally sound suppliers and monitoring them (Carbone and Moatti, 2008b; Seuring and Müller, 2008a), differences may occur when dealing with LSPs. Global companies seem to understand suppliers as those that supplies goods and not also the ones that supplies services. It is unclear, thus, how the relation with transport providers takes place (Wolf and Seuring, 2010) as well inside T&LS industry.

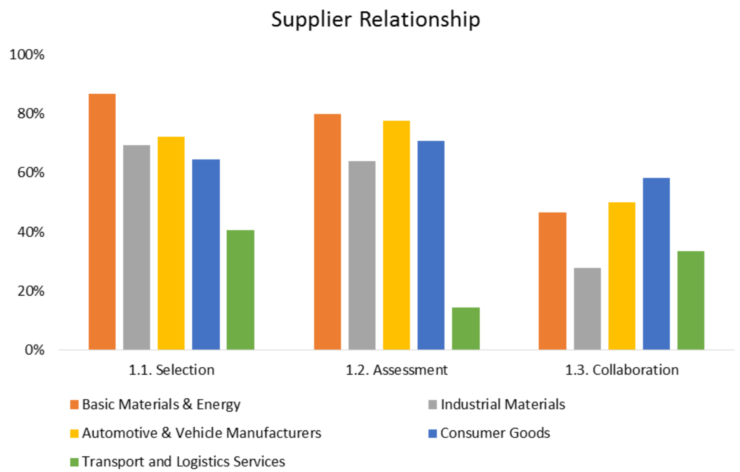


Figure 12. Comparative analysis regarding supplier relationship (own author)

The same figure shows the lower efforts in supplier collaboration, similarly to previous findings (Brockhaus et al., 2013). This practice is well researched in academia (58,6 % of the selected references) (Campos, 2015) and with a high level of importance for practitioners, researchers and NGOs (Koplin et al., 2007; Seuring and Müller, 2008b). Nonetheless, in the present sample, this topic showed to be concentrated in educating/offering technical support for suppliers' sustainability improvements. Although the majority of the researched companies stated the importance of collaboration, description of initiatives taken with suppliers, customers and other stakeholders were scant. It is unclear if companies do not invest in collaboration or if they just do not publish about it because of any specific reason. This absence sign with any doubt the challenges in managing this initiative.

4.2.3 Governance

Governance practices are among the most cited ones, in literature and practice. As observed from figure 13, except for T&LS, all other industries showed the importance of business alignment initiatives such as: training their corporate human resources, guarantee their commitment to sustainability, health and career perspective, and other practices related to social internal sustainability. According to Mckinsey&Company (2014) the maintenance of good relationships with society and other companies is cited by more than 87 % of their researched firms, similarly to the present findings (average of 79 %). Relationship with government were more commonly identified in BM&E and A&CV and can be explained by the higher regulation constraints faced by these industries. In contrast, IM firms reported less in this regard, as well as relations with universities and NGOs. Additionally, most of these companies have social and environmental policies and besides some visual differences by industry, mostly set a sustainability measurement system with appropriate KPIs and responsible for managing risks ad safety.

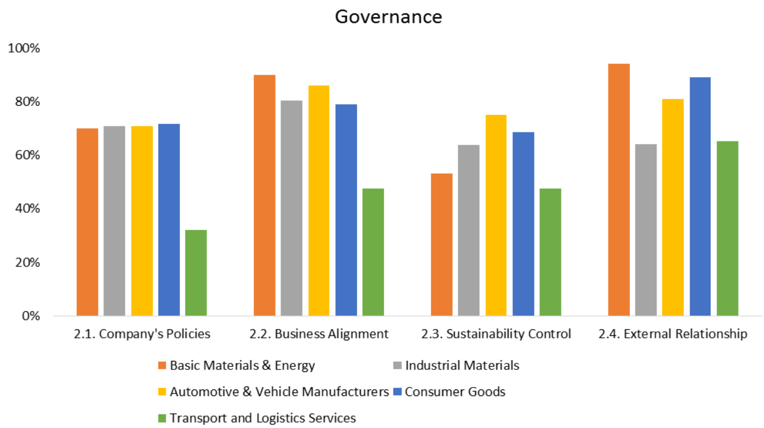


Figure 13. Comparative analysis regarding governance (own author)

4.2.4 Procurement

Procurement practices are not much cited neither in literature nor in companies' reports. As observed from figure 14, they are more concentrated in purchasing more sustainable materials and components, especially recycled and reusable ones (Carbone and Moatti, 2008b). Initiatives to improve the procurement process, e.g. building long-term contracts and using e-procurement platforms, are observed mostly among producers (less in BM&E). On the other hand, there is a lack in initiatives towards reducing packaging or improving it (similar to Colicchia, Melacini and Perotti, 2011) as well as for using eco-labels. Furthermore, different than the results from Thun and Müller (2010) when analyzing the German automotive industry, suppliers' involvement in packaging developing were rarely cited. As observed from the figure, packaging intiatives increase as closer the industry is from end customers. E.g. Consumer goods firms seem to invest more in improvements towards more sustainable packaging. This is expected once they sell directly to the final customers to whom packaging is fundmental.

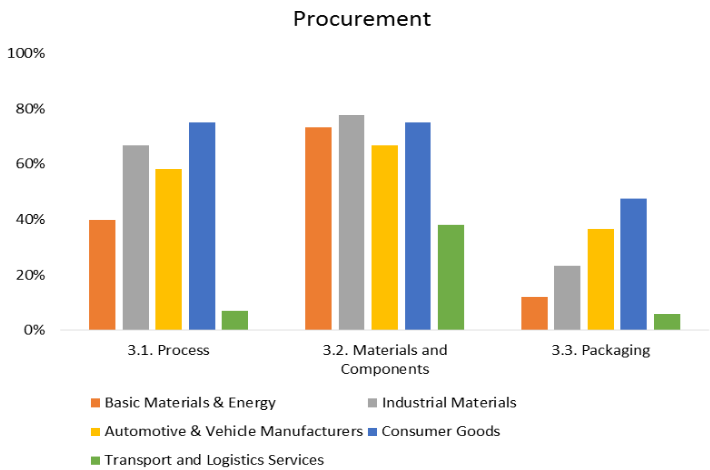


Figure 14. Comparative analysis regarding procurement (own author)

4.2.5 Production Management

Production management practices were relatively well identified in literature and in practice, however focused on resource management rather than sustainable solutions development category. Except for T&LS, citations from reports focused on the reduction of energy - similar to findings from Colicchia, Melacini and Perotti (2011), water management and in investing in alternative energy sources. Besides the majority of the T&LS companies that invest in reducing energy consumption, additional efforts related to resource management within this industry were scant.

Larger companies have higher level of eco-design (Caniato et al., 2012; Carbone and Moatti, 2008b; Eltayeb and Zailani, 2009b), which was confirmed in this research where development of environmental and social responsible solutions were cited by 96 % of the producers, commonly complemented by product life cycle management. In general, half of the companies also reported initiatives to develop solutions that help clients to reduce their own carbon footprint. The total percentage in the solutions development category, as verified in figure 15, turns to be lower due to lacks in involving suppliers in design and production as well in fewer companies offering online services that contribute ro reducing emissions. Moreover, the lack of "green services" within LSPs was confirmed in this research as identified by Rossi et al. (2013).

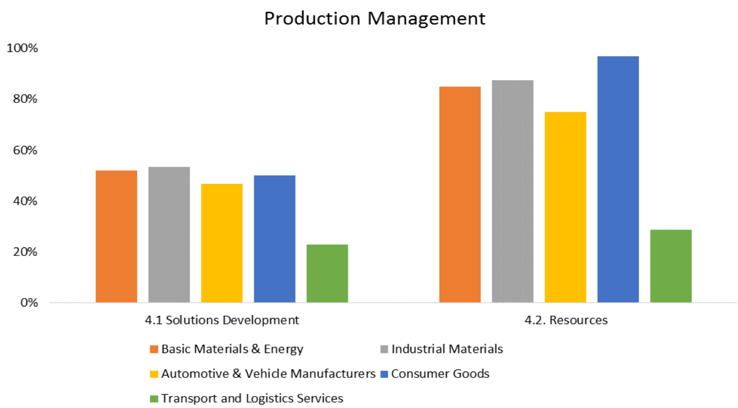


Figure 15. Comparative analysis regarding production management (own author)

4.2.6 Distribution

Distribution practices had low rate in literature and the lowest in practice. In general, practices regarding distribution were very limited. According to previous researches with similar results (Colicchia et al., 2011), there is a lack of visibility regarding outsourced activities. As observed from Figure 16, they are more concentrated in distribution processes (except IM firms). T&LS companies showed to differ from producers in employing more eco-efficient, renewable fuels and cleaner technologies in equipments and vehicles. Some assumptions of industry patterns were build and will be tested in section 4.4, e.g. A&CV investing in less polluting modes such as rail.

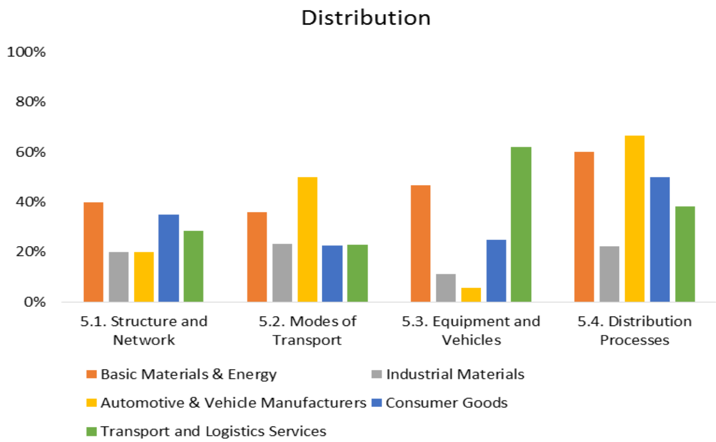


Figure 16. Comparative analysis regarding distribution (own author)

4.2.7 Waste Management

Within waste management practices, it is visible from figure 17 that they are mainly focused on waste disposal and pollution control (Comas Martí and Seifert, 2013), which are high regulated topics. Moreover, it is evident that BM&E distinguish from the other industries in these categories due to the nature of the business from this group of companies

(Sweeney and Coughlan, 2008). IM also calls attention in the lack of involvement especially in waste disposal practices, a surprise when considering steel, chemical and high-tech firms. These firms are demanded by legislation the appropriate disposal of their waste nevertheless most of them do not report about these issues. Additionally, it seems that even multinationals face challenges in implementing reusing and recycle systems, and its disalignment with the vastly reported eco-design practices. It seems that although the product design considers social-environmental issues, they are mostly not developed to be reused or easily recycled.

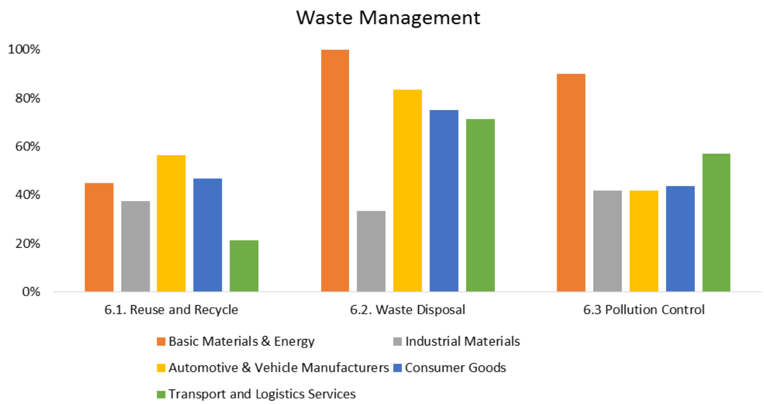


Figure 17. Comparative analysis regarding waste management (own author)

When analyzing data in details, it sems that BM&E firms are particularly investing in reusing programs while CG in recycling which can be explained by the products' characteristics. Basic materials are more similar/closer to raw materials, enabling reuse for other purposes. In contrast, those produced for final customers, in particular CG, are already customized and consist of a combination of different types of materials, which turn the reuse process more complicated. Therefore, the focus of this industry is in recycling.

4.2.1 Customer Relationship

Articles relating to customer relationship management are inexistent in findings from Winter and Knemeyer (2013) and few in the current literature content analysis conducted on chapter 3 (38,4 %). As described in previous researches, involvement with upstream SC players are more common than with downstream ones – e.g customers (Carbone and Moatti, 2008b). It is also clear from figure 18 that one-way efforts such as understand customer demands for more sustainable solutions and informing them about sustainability issues, are more commonly reported than engaging customers in collaboration initiatives.

BM&E firms, due to their products' characteristics, seem to invest more in involving customers on risk and safety programs and offering complementary services (Chan et al., 2015). One example is the tool developed that allows customers to manage their energy consumption according to the brands and design of specific household appliances and set reduction targets.

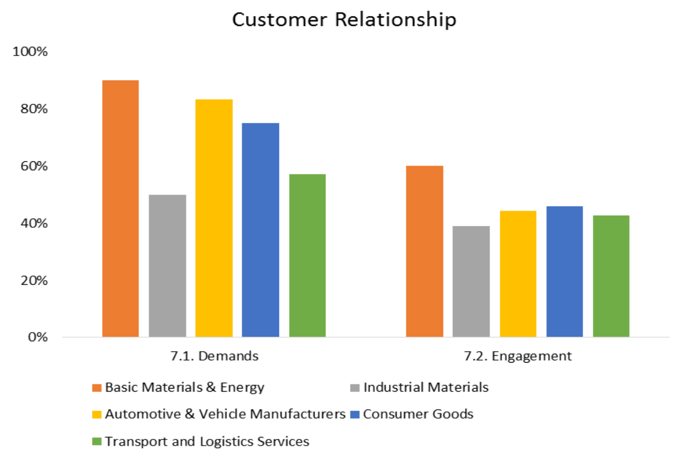


Figure 18. Comparative analysis regarding customer relationship (own author)

4.2.2 Preliminary Conclusions

This first general analysis of SSC practices implemented by four groups of companies evidences the imbalance in dimensions, categories and industries. Leading companies in general have been focusing on internally-focused initiatives (Eltayeb and Zailani, 2009b) and although high levels of supplier relationship are identified, collaborative initiatives, also with customers, showed to be scarce. This confirms the opportunity for conducting deeper studies on "how suppliers can engage their customers on sustainability initiatives" (Winter and Knemeyer, 2013, p. 35). Similarly is the lack of reported information regarding distribution and transport activities traditionally carried out by external partners. This gives the impression of an inexistent SC integration despite the current demand for a holistic approach and for measuring the impact in terms of the whole supply chain (Colicchia et al., 2011).

4.3 Industry Patterns Regarding Sustainable Supply Chain Practices[4]

4.3.1 Overview

In literature, the amount of publications regarding the topic has continuously increased in the last decade and showed to be a cross-field subject, discussed in operations management, SCM and in business ethics journals (Carter and Easton, 2011; Touboulic and Walker, 2015a). The focus is still more on environmental results since they are easier to measure and implement (Seuring and Müller, 2008a), nevertheless some changes have been observed. The representation of both publications and companies' practices focused on SSC is arising (Beske et al., 2014; Campos, 2015). It is defined as 'the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business

[4] Some of the results of this section were presented in the EurOMA Sustainability Forum, which took place in Lancaster in April 2016.

processes for improving the long-term economic performance of the individual company and its SC (Carter and Rogers, 2008). Government and society are among the main drivers (Carbone, Moatti and Wood, 2012; Seuring and Müller, 2008a) although initiatives still lack a comprehensive SC perspective (Baumgartner and Ebner, 2010). The result is corporate-focused solutions without an integrated approach and individual gains that in most cases does not justify the necessary investments. When strategies are implemented together with supply chain partners, additional benefits are possible to be obtained. The challenge of building SSC is, however, the complexity of relying on others that are not directly controlled. An incentive to set collaborations with suppliers for improving SC transparency and reducing risks (Seuring and Müller, 2008a; Vachon and Klassen, 2008) is the shared-responsibility of sourcing problems regarding social-environmental issues (Koplin et al., 2007). Large corporations such as Nestlé have been leading global initiatives towards more responsible sourcing. The world's largest food maker admitted to find slave labor in the production of a cat food brand. Although it is known that the seafood industry in Thailand is involved in forced labor and human trafficking, Nestlé's admission according to some NGOs can trigger a new behavior from businesses (The Guardian, 2016a).

According to previous researches (Chen and Bouvain, 2009; KPMG International, 2013; Roca and Searcy, 2012; Sarkis, 1999; UN Global Compact, 2013), sustainability plays different role according to the industry and further research is called since a long time. Although sustainability is very important for 61 % of the researched Utilities companies, oil and gas firms score lowest in the reports' quality. While, the automotive sector reached some of the highest levels of sustainable reporting (77 %), the importance of sustainability for their suppliers of industrial materials it is just 38 %. More details, nevertheless, are not given in this study nor in any others that focuses on differences between industries regarding SSC practices (Sweeney and Coughlan, 2008; Wanderley et al., 2008). This section aims to fill this gap and the call for more details about differences between industries (Wu, Dunn, et al., 2012). Due to each industry's characteristics, some specific investments are expected.

Since Basic Materials & Energy (BM&E), in general, is characterized by a high impact on the environment (nature and surrounding communities), measures are expected to be concentrated in upstream processes (Sweeney and Coughlan, 2008). Almost all companies in Industrial Materials (IM) group are energy intensive and from a heavy polluting sector. As energy accounts for about two-thirds of emissions (Stern, 2007) and improvements towards its consumption are clearly demanded by stakeholders, energy intensive industries are expected to invest considerably in resource and waste management. Heavy polluting sectors such as chemicals, utilities, pulp and paper, and metals (WCED, 1987) are also under public scrutiny (Carbone, Moatti and Vinzi, 2012). Similarly happens to Automobile & Commercial Vehicles (A&CV), that according to Sweeney and Coughlan (2008), focus primary on the environment and secondary on customers. The opposite is expected within other Consumer Goods (CG) companies, where customers' pressures are higher and initiatives that promotes companies' image expected.

In Appendix 7 the amount/percentage of all practices per industry are displayed and signed by colors to ease the viausalization of the differences between the five groups (red cell= maximum of 1 company, green cell = minimum of total amount of companies – 1, yellow cell = more than one company and less than the total amount of companies -1). In Appendix 8 a summary of the industry patterns.

4.3.2 Basic Materials and Energy

In Table 31 the practices that are more (and less) likely to be implemented by Basic materials and Energy producers are displayed. It calls attention the link between BM&E group which produces basic materials and the use of local suppliers, certifications and stakeholders relationship. The findings are aligned with other researches that identified external-stakeholder relationship, external reporting/transparency, economic investments in communities and employee volunteering as top reputation-management activities that extractive services companies are persuading (Mckinsey&Company, 2014) and building materials (Comas Martí and Seifert, 2013). Investments in resource management and renewable sources of energy evidence the importance of the topic for this group. According to Marimon et al. (2012) e Halme and Huse (1997) sectors that are the most harmful to the environment, such as BM&E, are the earlier and more comprehensive adopters of sustainable practices.

Table 31. Practices from basic materials and energy producers

Supplier relation-ship	- Supplier selection and assessment practices. - Suppliers required to obtain certifications such as ISO 14001, OHSAS 18001 and SA 8000. - High rate of local suppliers (50-70 %) among all companies from this group except the energy one. - Clear communication with suppliers about the required standards and penalizations in case of lack of compliance . - Indirect suppliers are also assessed. - Educational and collaboration programs in an attempt to improve suppliers' processes into more sustainable ones. - Collaboration towards integration and data sharing is, though, reported by only one company.
Govern-ance	- Formal organizational department or cross-functional committee. - Communication with employees. - External relationships is very important issue for this industry. All invest in relationships with society, government, non-governmental organizations (NGOs), other companies and universities. - All audited by third parties such as consultancy firms.
Procure-ment	- Procurement initiatives are clearly concentrated in <u>what</u> rather than in <u>how</u> materials are purchased. - Only one firm reports efforts of introducing e-procurement despite customer's tradition to use fax - represented 80 % of the orders in 2012.
Produc-tion Man-agement	- All invest in developing more sustainable solutions and the majority apply the product life cycle assessment (LCA), although suppliers' involvement in the design phase is present in only three companies' documents. - Offer online platforms that helps improving transparency, such as offering the ship position, e-commerce website and online assessments. - All invest in renewable sources of energy and resource management practices.

Distribution	- ISO 14001 certified sites, noise-reduction measures, air purification filters, and biodiversity protection programs. - Almost all firms report using eco-efficient vehicles and equipment, setting maintenance and renewal practices, and driving training programs, enabled by the short distances between sites. - The use of alternative fuels, identified in previous researches (Comas Martí and Seifert, 2013), were also cited by three out of five companies.
Waste Management	- Material reuse, e.g. employment of CO2 to produce algae, which created new biomass for use in a variety of ways, such as for bio-energy. - All focus on reducing the impact of waste disposal, besides pollution, on the environment.
Customer relationship	- Customer engagement with training programs for responsible handling of their products. The energy company also engage customers in sending videos with ideas for saving energy and using a web-tool for minimizing consumption.

4.3.3 Industrial Materials

In Table 32 the practices that are more (and less) likely to be implemented by Industrial Materials manufacturers are displayed.

Table 32. Practices from industrial materials' manufacturers

Supplier relationship	- All require compliance with specific sustainability guidelines such as from UN Global Compact. - Half declare to use local or minority owned suppliers although their percentage from the total is unclear. - Collaboration with suppliers, by the majority of the companies, means investing in technical support and other strategies to improve suppliers' sustainability. - Only one company reports collaboration towards integration and data sharing.
Governance	- Almost all complement the traditional measures with financial incentives to employees. - Although relationships with society and with other companies are cited by the majority, only half of them reported relationship with government, universities and NGOs. - Only two seem to be audited by third parties.

Procure-ment	- Have specific procurement policy or principles to ensure processes are aligned with corporate responsibility standards. - The most cited principles are "fair dealing" with customers, suppliers, and distributors, and "antitrust and competition law compliance". - Use online trading platform to increase transparency in the process. - Only the chemical firm cite improvements towards more sustainable packaging and use of eco-labels.
Production Manage-ment	- All describe initiatives to optimize energy and water consumption while only one did not report developing more sustainable solutions and using product LCA.
Distribution	- Few and limited to half of the firms investing in building green construction sites.
Waste Man-agement	- Concentrated in pollution prevention. - Only one third describe appropriate waste disposal procedures. - Half reuse or recycle materials.
Customer relationship	- Half invest in customer demand management and offer sustainability information/educational programs.

Since most of the distribution processes are outsourced, leading companies seem not to consider initiatives implemented by their logistics service providers in their reports/websites. This shows evidence that companies focus on their own corporate responsible practices, where they can fully control, and not on network joint actions (Gualandris et al., 2015). Would be a sign of lack in requiring LSPs to implement sustainability measures?

4.3.4 Automobile and Commercial Vehicles

In Table 33 the practices that are more (and less) likely to be implemented by Automobile and Commercial Vehicles manufacturers are displayed. Although case studies (Thun and Müller, 2010) promoting new technologies developed through partnerships between manufacturers and suppliers are available, they are scant in their reports. Since projects are conducted by both companies, why information is not published in corporate sustainability media? Is this a strategy to control dependency risk? Practices related to the governance group were vast and compliance with regulations is present in almost all firms' publications.

Table 33. Practices from automotive and commercial vehicles' manufacturers

Supplier relationship	- Companies use internationally accepted standards as criteria for supplier selection. As found by Thun and Müller (2010), using environmental criteria when selecting suppliers and not certification requirements is a common within this industry. - The use of local or minority-owners suppliers was cited by four of six. - Particular are educational programs for training suppliers and collaboration toward integration and information sharing. Some use digital learning module (e-learning) which gives information about social-environmental standards and enable a self-check. - The monitoring process includes, for almost all, the evaluation of indirect suppliers and punishment for those that lack compliance. This was unexpected statement since most of the companies assume not to have enough visibility after Tier 1 supplier (KPMG International & The Economist Intelligence Unit, 2013). - Although case studies (Thun and Müller, 2010) promoting new technologies developed through partnerships between manufacturers and suppliers are available, they are scant in their reports.
Governance	- Large investments to strength relationships particularly with regulatory agencies and governments.
Procurement	- Besides procuring more sustainable materials, the majority report long-term contracts with clear clauses and improvements towards packaging. - Suppliers' involvement in packaging developing were scant, different than the results from Thun and Müller (2010) when analyzing the same industry.
Production Management	- None of the firms seems to use online services in order to add value to their products; e.g. augmented reality owner's manual app (Hyundai, 2016). - Almost all companies seem to use LCA aligned with supplier's information and invest in reducing the emissions in the product use phase (Comas Martí and Seifert, 2013).

	- Although companies use hazardous substances, none of them reported initiatives regarding the use of special packaging and label for them. - Investments in energy consumption and renewable sources are fully implemented and results aligned with previous researches (Comas Martí and Seifert, 2013). - The only two manufacturers in the whole sample that did not report water management practices are in this group.
Distribution	- Less polluting modes, especially rail, and not using alternative fuels as already observed in other researches (Comas Martí and Seifert, 2013).
Waste Management	- Remanufacturing is reported by almost all companies and complemented by resale of tested and certified used parts, reuse containers and carbon fibers. - Additionally, almost all seem to work in a closed, mandatory system for workshop waste disposal, in accordance with the laws, which means that dealers and dealerships must take part in the disposal system.
Customer relationship	- Understanding customers' demands, informing and educating them in sustainability issues is a common practice within A&CV companies, different from collaboration programs, which was found in only one case. - This finding is interesting since within this industry customer is the most important driver of green SCM (Thun and Müller, 2010).

As observed from table 33 the importance of regulatory agencies and governments can also be identified in large investments to strength relationships particularly with these stakeholders. According to Thun and Müller (2010), different environmental acts are the main barriers for implementing green SCM while some also found practices such as policies, integration of functional areas and eco-oriented training of employees are the most cited organizational requirements. It is as well unclear why some companies in this group does not report water management practices once this resource is critical during production.

4.3.5 Consumer Goods

In Table 34 the practices that are more (and less) likely to be implemented by Consumer Goods manufacturers.

Table 34. Practices from consumer goods' manufacturers

Supplier relationship	- Half declare to use local or minority owned suppliers even though their representation within all is not informed. - In the apparel supply chain, few companies seem to use local manufacturing (Fulton and Lee, 2013) and different from other manufacturers, the requirement of management system for suppliers (Zimmer et al., 2015) is cited by only one company. - The majority reported monitoring some indirect suppliers and penalizing those that lack with compliance. It is unclear, nonetheless, how tier 2, 3… suppliers are assessed since visibility is generally limited to tier 1 (KPMG International & The Economist Intelligence Unit, 2013) and consequently the environmental actions taken (Comas Martí and Seifert, 2013). - Collaborations are vast, especially focusing on educational programs and providing technical information for improving supplier's processes. Collaboration for developing new technologies is present in two CG companies - 40 % of all findings among the 32 companies.
Governance	- Cross-functional team or department to manage sustainability and financial incentives to motivate reaching the goals. Attention to fair trade and human rights were as well observed (Carbone, Moatti and Vinzi, 2012; Fulton and Lee, 2013). - Almost all are internationally certified and audited by third party institutions, particularities from this industry. Similar findings were described in other researches that highlighted external reporting and communicating company's sustainability activities as the most reputation-management activity implemented by manufacturers (Mckinsey&Company, 2014). - External relationships are also important in this industry.
Procurement	- Investments in packaging improvements - Besides procuring more sustainable materials, e.g. organic ones (Fulton and Lee, 2013), the majority highlights efforts to improve procurement sustainability, e.g. setting long-term contracts and clear clauses.
Production Management	- Due to the products' characteristics, only the pharmaceutical company highlights attention to packaging and label for hazardous substances, which is enforced by the current industry regulation.

	- All report to reduce overall consumption (materials…) apart from energy and water. Other researches had already identified clothing and food manufacturers as very much involved in water issues (Comas Martí and Seifert, 2013).
Distribution	- Except for investing in green constructions and transport optimization, other distribution initiatives are scant (Fulton and Lee, 2013).
Waste Management	- Concentrated on recycling (pattern from this industry) and lack of investments in other initiatives such as remanufacture, is justified by the products aspects.
Customer relationship	- Different from Fulton and Lee (2013)'s findings, companies seem to profit from customer collaboration programs and from informing them about sustainability issues. Once a large amount of the carbon footprint, especially energy and water consumption, stands in the use-phase, these efforts enable reductions for both companies and customers.

It is important to highlight that according to Huang, Tan and Ding (2012), inside CG industry, differences between sectors may occur - food and drink manufacturers tend to implement more SSC practices than clothing, textile and tannery ones.

4.3.6 Transport and Logistics Services

In Table 35 the practices that are more (and less) likely to be implemented by Transport and Logistics Services providers. T&LS industry is the most particular one. This can be explained, at first, since it offer services and not goods like the other industries. Second, due to the maturity level of sustainability, confirmed with the low percentage of companies within this sector that discuss its SC impacts (KPMG International, 2013).

Table 35. Practices from transport and logistics service

Supplier relationship	- T&LS firms reported sourcing from environmentally responsible suppliers however only two reported clear criteria for selecting them. - They expect compliance with company's own social and environmental guidelines. - Few declare to monitor direct suppliers and none indirect ones.

	- Supplier collaboration, although well cited in previous researches (Colicchia et al., 2013), seems to be concentrated in a few examples that aims to develop new technologies. - Few complement with educational/technical information programs in the field of sustainability.
Governance	- Have a formal environmental sustainability statement for the company, nonetheless this seem not mean environmental and social policies. - It is also the only industry where only the minority of the companies make explicit compliance with regulations.
Procurement	- Although half of the companies declare to procure sustainable materials (57 %) including recycled and reusable ones (43 %), they represent a low percentage when compared to the other industries, with 92 % and 79 % respectively.
Production Management	- Only two seem to understand the opportunities for offering more sustainable services regarding logistics activities. - None reported using LCA (Rossi et al., 2013). - Low investments in resources management.
Distribution	- Invest in alternative and greener fuels, more efficient vehicles and equipment and have transport optimization systems (Colicchia et al., 2013; Rossi et al., 2013). - The majority use rail transport, set maintenance and renewal policies.
Waste Management	- Few seem to reuse and recycle (Chiarini, 2014), which is aligned with Colicchia et al. (2013).
Customer relationship	- Important to build efficient relationships with customers - Offer of complementary services such as "Carbon Dashboard" which allow them to analyze their greenhouse gas emissions generated by the transport of their freight. - Further collaborative efforts are neglected (Perotti et al., 2012).

For LSPs, reductions of energy consumption and air emissions are some of the results expected when implementing SSC practices (Perotti et al., 2012), nevertheless resource management practices are missing. In particular, water management and investments in alternative energy sources (both 14 %) are considerably lower than the average of the other industries (87 % and 88 % respectively). Only one isolated case of use solar electricity in its facility is reported, different from Colicchia, Marchet, Melacini and Perotti (2013).

4.3.7 Preliminary Conclusions

Sustainable supply chain management can offer companies great improvements opportunities through the implementation of practices that might vary according to the industry (Waddock and Graves, 1997). The aim of this section is to present some of the patterns of five industries, considering public information about 32 leading companies.

The first conclusion is that T&LS firms have a particular behavior towards sustainability, with lack in fundamental practices related to governance and production management. Although some distribution practices were identified within this industry, they were less than expected. Since their core values are in transport and warehousing, leading companies are expected to offer best practices in these fields. Despite the high emissions in the transport sector – 14 % (Stern, 2007), profit margins in their market are low, thus only limited resources may be available to support the CSR initiatives (Piecyk and Björklund, 2015). Opportunities for reducing their impact on the environment and society might arise, thus, from collaborations (Touboulic and Walker, 2015b) although they seem to be absent in companies' realities. During the analysis of companies' reports it was clear that many companies call collaboration the simple relationship between companies. As defined on section 2.1.2, to be considered as "true" collaboration, initiatives should be not mandatories and both companies should have similar goals and benefits.

The second conclusion of this section is the lack of integration between SC partners reflected by the absence of of reported practices regarding distribution, among all researched industries. Other researches also identified few sustainability efforts regarding outbound SC and warehousing, due to the inability of companies having full visibility on these processes (Colicchia et al., 2011). Consequently, focal companies do not integrate initiatives implemented by their partners within their own corporate reports. It is unclear if they just do not report or if they do not implement them, losing chances for cost reductions combined with minimizing their impacts on the society and environment. Additionally, governance, procurement and production management practices are well implemented, efforts to involve suppliers e.g. in the product design or packaging improvements are rare. The focus on internal descriptive activities rather than proactive external engagement processes were identified in previous studies within manufacturers in the United Kingdom (Holt and Ghobadian, 2009). It seems that more than five years later, the scope of sustainable supply chain practices are still concentrated inside “companies’ walls”. Since a large percentage of product’s carbon footprint comes from suppliers (Accenture, 2012), companies should build integration platforms with suppliers in order to better manage their overall emissions.

The third conclusion and contribution of this section is the details of particular practices per industry (figure 19). Some can be explained by the products characteristics but others can be understood as potential improvement for same-industry companies or insights for sustainable development through inter-industry analysis.

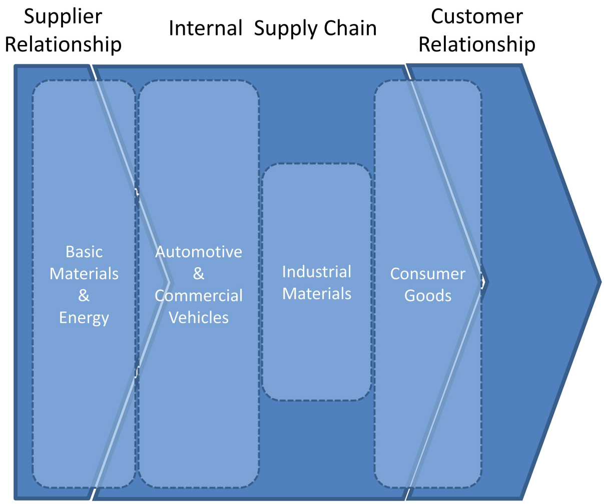


Figure 19. Summary of patterns per industry – visual representation (own author)

Basic Materials & Eenergy: Invest considerably more in waste management and supplier relationships, including with LSPs, although this does not mean setting collaboration projects.

Automotive & Commercial Vehicles: focus on high-regulated issues and improving transparency with suppliers.

Industrial Materials: particular obstacles in managing waste and collaborating with external stakeholders - governments, suppliers and customers. Would be due to their position in the SC where they are neither directly influenced by final customers' pressures nor by strict regulators in these issues?

Consumer Goods: initiatives for improving procurement, recycling rates and setting collaboration with customers for reducing scope 3 emissions.

The overall conclusion is that leading companies seem to have overcame the first challenge of organizing their corporate internal environment, each industry with its particular portfolio of practices. The current step is building long-term relationships with other companies, normally through industry associations and collaborative platforms. This step is essential for extending sustainability towards supply chain. The present research, despite the limitations of using companies from selected countries and few amount per industry, contributes for practitioners in implementing SSC measures. Results from this qualitative research can also be used as hypothesis for further quantitative studies.

4.4 Differences between Industries' Practices[5]

4.4.1 Overview

Sustainable supply chain (SSC) issues have received an increased attention during the last years. Pressures from governments and customers have been changing the way companies plan their strategies. This has been particularly important especially those organizations with significant impact on the environment and society (Ageron et al., 2012; Seuring and Müller, 2008a). Even though the way companies CSR report is becoming standardized (Global Reporting Initiative, 2015), the portfolio of initiatives implemented in each industry is, in fact, different (Halme and Huse, 1997; Waddock and Graves, 1997). Sweeney & Coughlan (2008) demonstrated that industries such as automobile, oil and gas, and pharmaceutical (the health and beauty part) focus on environmental issues, justified by to the nature of their businesses. Mitnick (2000), on the other hand, points out that the higher the negative impact in one area of CSR (e.g environment), the less likely is a firm to report on this issue. Common conclusion prevalent in the literature, is that little attention has been paid to understanding differences among industries' behavior towards SSC (Simpson and Kohers, 2002), most particularly among Transport and Logistics Service (T&LS) sector (Colicchia et al., 2013).

This sector is one of those strongly affected by this movement and stakeholders expect eco-efficient measures in an attempt to reduce their im-

[5] The content of this section was presented at the EurOMA Conference.

pact on environment and society, especially with neutralization or minimization of air pollution and noise. The sector accounts for around 13 % of all greenhouse gas emissions, 27 % of final energy use (Intergovernmental Panel on Climate Change, 2014) and transportation is considered the main source for mono-nitrogen (NOx), sulphur Oxides (SOx), and PM (particulate matter or fine dust) (McKinnon and Piecyk, 2010). The future scenario is even more critical since world road and rail freight volumes are expected to grow between 230 % and 420 % until 2050 (OECD and ITF, 2015).

The most important players in T&LS sector are the logistics service providers (LSPs) that offer transportation, warehousing, cross-docking, inventory management, packaging, and freight forwarding (Council of Supply Chain Management Professionals, n.d.) to other companies – e.g. manufacturers. According to recent research, all parties understand the importance of environmental performance (World Bank, 2012). Opportunities for improving sustainability such as switch to cleaner fuels; use of less energy and improvement of energy efficiency of vehicles across all modes are recommended in combination with managerial initiatives including: improvement of environmental performance and energy efficiency and reduction of negative impact on the environment and key natural assets (European Comission, 2011). Recently, calls for research focusing specifically on the third party logistics (3PL) market (Evangelista et al., 2011; Perotti et al., 2012) and a more holistic approach within LSPs' emissions reduction programs (Lieb and Lieb, 2010) reinforce the importance of a deeper understanding of the sector.

Although practices are vastly reported on literature, on practice, sustainability practices seem to be misaligned with the call for action within T&LS sector. Pressure from customers may be the major driver for improving sustainability (Zhu et al., 2007) but T&LS firms are still not being strongly forced to improve their social and environmental performance (Evangelista et al., 2011). The consequences are, then, reluctances to implement initiatives (Seuring and Müller, 2008b) and perceived dissatisfaction on the performance improvements gained with environmental investments (Perotti et al., 2012). In this sector, only 17 % of the largest T&LS companies discuss in details the sustainability impacts of their supply chain (KPMG International, 2013) and there is a clear need to change culture and mind-set towards sustainability among all the stakeholders (Colicchia et al., 2013), including focal companies, thus, LSPs' clients.

Focal companies are those that govern the SC (Handfield and Nichols, 1999) and highly influence how multiple tiers of the supply chain perform. The increase in SC complexity and consequently lack of transparency make their role as SC orchestrators (Rossi et al., 2013) even more critical. Therefore, some worldwide leaders have been including requirements for LSPs to improve their environmental performance, and consequently reduce costs, in their contracts (Wolf and Seuring, 2010). This pressure might change the short-term perspective of LSPs, that in general focus on meeting customers' immediate quality requirements (Evangelista et al., 2011). The necessary decarbonization, nevertheless, is limited as alternative vehicle technologies fuels are still expected to be costly in the next decades (Creutzig et al., 2015). Companies need, thus, to enhance strategic collaborations among network partners in order to build hard-to-replicate capabilities (Beske, 2012) and improve their values through improving supply chain sustainability. Among the reasons are characteristics of this sector, which consist of small companies, often family-owned (Cruijssen, 2006) with low profit margins and under strict service level requirements, thus , with limited resources to invest in SSC initiatives (Piecyk and Björklund, 2015; Rossi et al., 2013).

4.4.2 Objectives and Complementary Methods

Within this context of potential opportunities, the present research aim to identify differences between industries regarding SSC practices and, in particular, between T&LS and producers. Besides content analysis, used for sampling and categorization data from the 32 leading companies (as described on section 4.1), complementary non-parametric tests were run to support identifying if and where stands differences between industries. For statistical analysis, each of the database's cells (91 practices x 32 companies) were coded 1 in case of at least one practice reported and 0 in case of absence of practice reported. The sample considered five industries as previously described: BM&E (Basic materials and energy), IM (Industrial materials), A&CV (Automotive and commercial vehicles), CG (Consumer goods) and T&LS (Transport and Logistics Services).

After collecting companies' SSC practices, coding and adjusting for analysis, descriptive statistics tests were used to investigate differences between industries regarding SSC practices and, in particular, between T&LS and producers. The chi-square was applied for a broader industry-analysis while the Fisher exact test, recommended for small sample (Levine et al., 2005) and the Mann-Whitney U test were used to verify where stands the differences and if the percentages of reported practices are significantly different, respectively. These tests were similarly used in Callado, Callado, & Chaves (2015) when investigating patterns of non-financial performance indicators.

4.4.3 Statistically Significant Differences between Industries

In an attempt to identify differences among industries in implementing SSC practices, two tests were conducted. The detailed and complete results are displayed in Appendix 9. According to Table 36, the chi-square test showed that IM and T&LS are statistically significant different from BM&E, A&CV and CG industries (p-value less than 0,05). Therefore these three similar industries were clustered into one group called BM&E/A&CV/CG for further tests.

Table 36. Differences between industries – results from the chi square test

	IM	A&CV	CG	T&LS
BM&E	0,000026	0,063	0,41	0,00000000000000007
IM		0,016	0,00014	0,00003
A&CV			0,24	0,00000000002
CG				0,00000000000000002

When analyzing differences between IM and the other producers, results from Fisher exact tests showed p-value less than 0,05 in three categories of practices: Supplier collaboration (p=0,034); External relationship (p=0,0011) and Waste disposal (p=0,032).

As for supplier collaboration, except for investments in supplier education, other practices especially towards integration and developing new technologies were scant among IM companies. BASF was one of the few companies that reported collaborative efforts in order to improve integration and transparency: “ELEMICA is the electronic hub for chemical goods dedicated to transmitting business data including vendor managed inventory messages”. The company, together with Merck and other chemical partners are active members of "Together for Sustainability" initiative that aims to develop a global standard of supplier evaluations and auditing. The multinational was the only to report, moreover, cooperation with their suppliers for assessing risk along the entire value chain. Closer relationship with governments, NGOs and Universities were, as well missing, in half of the companies. Although regulatory pressures are higher in BM&E and A&CV, the maintenance of a good relationship with these stakeholders can be beneficial to IM companies especially iron & steel and electronic equipment manufacturers. According to BASF, government should create favorable conditions for business activities and political lobbying is a duty of “Citizen BASF”. Merck highlighted its importance for successful introduction of products that are based on new technologies. ThyssenKrupp is engaged in "Econsense", an association of 35 multinational companies that work together within the German Federation of Industries and the World Steel Association on sustainability issues. All three companies are also committed to the United Nations Global Compact.

Reporting initiatives related to an environmentally responsible waste disposal process were scant among IM with only BASF and Continental out of six companies reporting versus 100 % of the BM&E ones. The chemical company reported to regularly carry out audits to inspect external waste management plants however from the 1.31 million metric tons classified as hazardous, only 0.33 million metric tons of hazardous waste away for professional disposal. Continental declared not to export any waste. They reported setting contracts with certified, professional waste recyclers who collect it and correctly recycle or dispose of it. Nothing was found regarding waste disposal in Merck, Siemens, Thyssenkrupp and Gerdau except for some essential measures for improving reusing and recycling rates.

These first results shows that IM companies are very much internally focused and seems not to be pressured by stakeholders. Although their clients are being forced to change due to regulations and demands from customers, among this group in particular the sustainability demand did not spillover across industry boundaries (Kovács, 2008).

4.4.4 Particularities from Transport and Logistics Sector regarding Sustainable Supply Chain Practices

The second part of this section intends to investigate where stands differences between T&LS sector and producers. Firstly, the Mann-Whitney U test was run and showed statistically significant differences (BM&E – T&LS p= 0,00013812; IM- LS p=0,052228718, A&CV-T&LS p=0,000942287 and CG-T&LS p=0,000392144). Secondly, the Fisher exact test was run in each of the 21 categories of practices to identify where stands these differences. Summarized results with p-values lower than 0,05 are displayed in the following tables (37-41), showing differences in eight groups of practices: supplier selection; supplier assessment; companies policies; business alignment initiatives; procurement process; solutions development; resources management and investments in equipment and vehicles.

Although five out of seven companies reported sourcing from environmentally sound suppliers, only two seem to have specific selection criteria, which considers social-environmental criteria. Suppliers must compliance with company’s own guidelines while requirement of certifications or a management system are neglected. Additionally, after selected, suppliers seem not to be further assessed, audited on site or pressured to improve their performances. Only Lufthansa highlighted the right to terminate contracts in the event of lack compliance while evaluation of sub-contractors was not found in any T&LS company. One can conclude that supplier relationship towards selecting and monitoring suppliers' performance are, in fact, not yet a reality in this sector. Similar results were identified in previous research when comparing manufacturers with merchandisers (Murphy and Poist, 2000).

Table 37. Particularities in T&LS – Supplier relationship

1.Supplier Relationship	IM x T&LS	BM&E/A&CV/CG x T&LS
1.1. Selection	0,013	0,00025
1.2. Assessment	0,000007	0,000000000020

In previous research (Colicchia et al., 2013), LSPs reported developing a formal environmental sustainability statement for the company, however this initiative does not include necessarily setting environmental and social policies. The establishment of formal policies is directly related with the implementation of SSC practices (Murphy and Poist, 2000).Whereas all producers reported setting these guidelines, among T&LS companies they were considered by less than half. DHL cited an environmental policy, one specific for the procurement and selection of paper products, a corruption policy and guiding principle "Respect & Results" aligned with standards from the International Labor Organization. CSX has cited just a principle of transport goods in a manner that minimizes community and environmental impacts, and a code of ethics that includes guidance on social media, retaliation, and fraud and theft protection. Union Pacific's environmental policy outlines three primary commitments: pollution prevention, regulatory compliance and continuous improvement. The company also adopted a Code of Ethics for the chief executive officer and senior financial officers, a Statement of Policy Concerning Business Conduct and Ethics for employees and a Code of Business Conduct and Ethics for Directors. Lufthansa, through its Integrity Compliance module, focuses on social issues such as law-abiding conduct in business relationships, employment policy to guarantee appropriate working environment conditions and appropriate salaries. Furthermore, none of the T&LS firms reported clear quality policies, which should be a foundation for multinational businesses and relationships. The lack of well-defined policies makes it difficult for daily operations and customer's demands to be aligned. Moreover, without a holistic approach with a similar basis, mismatched actions are taken and potential results lost.

Even though the majority of the firms reported setting a formal structure to manage sustainability and invest in human resources communication, training and social programs, the percentage is still lower when compared with producers, similarly to Murphy & Poist (2000) when analyzing merchandisers (versus manufacturers). Only at Lufthansa managers receives financial primes based on the achievement of sustainability targets, versus 71 % on average of the producers. The importance of logistics social responsibility is, although, a topic with increasing awareness (Carter and Jennings, 2002; Piecyk and Björklund, 2015).

Table 38. Particularities in T&LS – Governance

2. Governance	IM x T&LS	BM&E/A&CV/CG x T&LS
2.1. Company's Policies	0,012	0,00027
2.2. Business Alignment	0,0044	0,000018

A statistically significant difference was also identified in T&LS procurement with only CSX highlighting sustainability measures during this process - supplier contracts uphold all laws and regulations, respect human rights and maintain corporate policies that support diversity and non-discrimination. Opportunities for using e-procurement platforms, building clear contractual clauses and promoting long term-relationships are missing among T&LS companies which might be an evidence of lack in customer's pressures towards sustainability since these initiatives are traditionally promoted by focal companies, rather than the service provider. Besides, since LSPs procure basically packaging materials and service, the criticality of their procurement process might be lower than the producers'. Nevertheless, initiatives regarding packaging were expected to be higher despite previous studies where they were also absent (Colicchia et al., 2013).

Table 39. Particularities in T&LS – Procurement

3. Procurement	IM x T&LS	BM&E/A&CV/CG x T&LS
3.1. Process	0,026	0,00057

In production management practices, the sector, different from the others, reported few initiatives towards developing more sustainable solutions and none of the companies seem to considering the life cycle approach when designing new services. One explanation might be that T&LS customers are not willing to pay a premium price for more eco-efficient logistics services (Rossi et al., 2013). Nonetheless, companies invest considerably in offering online services that help clients to reduce and offset greenhouse gas emissions (e.g. E-Postbrief from DP-DHL; eCargo, eCockpit from Lufthansa and FedEx® Electronic Trade Documents), a sign of value creation generated by the service providers. Despite previous researches (Perotti et al., 2012) identified that, for LSPs, reductions of energy consumption and air emissions are some of the results expected when implementing SSC practices, investments in resource management are still scarce. Few companies reported reducing non-hazardous waste, paper and water consumption (Carbone and Moatti, 2008b) and only cited continuous employing solar facilities, despite previous studies (Colicchia et al., 2013).

Table 40. Particularities in T&LS – Production Management

4. Production Management	IM x T&LS	BM&E/A&CV/CG x T&LS
4.1 Solutions Development	0,020	0,009
4.2. Resources	0,000021	0,000000010

On the other hand, T&LS companies showed to invest considerably more in improving equipment and vehicles' performance (Lieb and Lieb, 2010). Among the most cited practices and similar to (Rossi et al., 2013) are: use of alternative fuels such as liquefied natural gas (LNG), biofuel, hydrogen, synthetic and renewable diesel; battery-powered electric; double-stack trains; more eco-efficient vehicles with stop-start technology, wheels with low-torque roller bearings, low friction bearing seals, aerodynamic "teardrop" trailers. Previous research, however, did not identified the use of alternative fuels as a particularly common practice among LSPs (Colicchia et al., 2013) which might be a sign of recent investments. Different from Perotti, Zorzini, Cagno, & Micheli (2012)'s findings, other initiatives such as reverse logistics, warehousing and transportation strategies, could not be considered as more frequently implemented by T&LS companies (Colicchia et al., 2011). More details can be found in Campos & Schoeder (2015).

Table 41. Particularities in T&LS – Distribution

5. Distribution	IM x T&LS	BM&E/A&CV/CG x T&LS
5.3. Equipment and Vehicles	0,000000013	0,00000010

4.4.5 Preliminary Conclusions

The objective of this section is to investigate differences among industries in implementing SSC practices and particularities among T&LS when compared to producers. The results showed that BM&E, A&CV and CG have no statistically significant difference whereas some patterns were found among IM and T&LS companies' behaviors. After a deeper analysis on practices reported by IM industry, it is clear the lack of supplier collaboration, especially towards information sharing. Relationships with governments, NGOs and Universities are as well lower than those reported by producers. Even though strategic relations can benefit companies especially iron & steel and electronic equipment manufacturers, few examples could be identified in companies' reports and websites. Furthermore, only two IM companies reported initiatives related to an environmentally responsible waste disposal process versus 100 % of the BM&E ones.

When analyzing particularities in T&LS sector, results showed higher statistically significant investments only in equipment and vehicles, and particularly lower percentages of practices reported in supplier selection, supplier assessment, companies' policies, business alignment, procurement process, solutions development and resources management. Elementary strategies such as publishing policy on eco-efficiency remain scant among T&LS companies as well as operational measures such as packaging reduction/improvement, transport optimization and recycling, expected to be found among LSPs (Rossi et al., 2013). The explanation, according to these authors might stand in the lack of capabilities and tools to deploy eco-efficiency strategies as well as a reporting system specifically for measuring the environmental impact of 3PL activities (Colicchia et al., 2011). Further explanations for why LSPs in general do not recognize the importance of CSR practices are still unclear (Piecyk and Björklund, 2015).

As opposed to other sectors that have overcame the first challenge of organizing their corporate internal environment, T&LS firms are still lacking pressure and investments for overcoming this preliminary phase (Colicchia et al., 2013). Fundamental policies are the basis for implementing SSC practices (Murphy and Poist, 2000) although still missing in LSPs realities. The same happens regarding collaboration with customers and suppliers, highly discussed and demanded in literature (Perotti et al., 2012) although with few effective actions. Instead, companies have been mainly investing in individual economic goals (Colicchia et al., 2011) and attending just whats is demanded by regulators e.g. vehicle requirements.

Considering the previous conclusions with another point of view, makes us think that T&LS firms might be facing a great opportunity. The fact that T&LS are not yet being strongly pressured to take actions that combine social-environmental objectives, in contrast with their clients, shows the chance of these companies improving their value to the market. The same way emissions from logistics processes are continuously increasing, potential mitigation strategies are also surging, which does not include only expensive and complex technological instruments. With a holistic view, it is possible to identify basic and eco-efficient approaches that match with the worldwide demand for building a more sustainable supply chain. According to Straube & Doch (2010), sustainability is a driving force for a more cooperative business environment. Logistics could be, thus, the “missing link” between producers and customers in improving supply chain sustainability (Wu, Dunn, et al., 2012). Transforming a pollutant and “commodity-deliver” industry into an innovative and value creator one is the chance of moving LSPs to a strategic position in the SC (Wolf and Seuring, 2010).

This study offers both theoretical and practical implications especially for LSPs and their clients. As for theoretical implications, the research contributes to those that investigates SSC practices and most particularly those that focuses on the 3PL market (Colicchia et al., 2013; Evangelista et al., 2011; Piecyk and Björklund, 2015; Rossi et al., 2013). From a practical point of view, the study provide information about the current state of both producers and LSPs, highlighting differences between them. The results may provide, thus, insights for potential innovation, differentiation and collaborations towards a more sustainable network.

4.5 Creating Value by Sustainable Manufacturing and SCM Practices – a Cross-country Comparison[6]

4.5.1 Overview

Sustainable supply chain (SSC) management and sustainable manufacturing have received increased attention during the last years by companies and literature (Beske-Janssen et al., 2015). The need for changing the way people, companies, and governments behave is evident. Supply chain managers are being observed as catalysts for corporate transformation (Halady and Rao, 2010) and customers as drivers towards more sustainable business practices of companies. Industry is one of the main source of greenhouse gas emissions and multinational enterprises have the power of promoting long-term and collaborative solutions that contribute to reducing emission from the entire supply chain. Due to particular characteristics and demands from regulations, market and customer (Tate et al., 2010), companies react differently. Previous researches found differences according to the industry (Waddock and Graves, 1997) and country (Gunasekaran et al., 2014; Roca and Searcy, 2012), nevertheless studies about differences in practices implemented by developed and developing countries for further map of collaboration opportunities are still missing.

For the present research, companies from Germany and Brazil represent the two analyzed groups. Germany is internationally recognized as one of the leaders in sustainable development due to its investments in eco-efficient technologies, renewable energy and measures for achieving the emissions targets (Halme and Huse, 1997). Companies are pressured by taxes and regulations to act more sustainable – e.g. EU's Renewable Energy Directive which aims to increase the share of renewable energy to

[6] The content of this section is planned to be presented at the 14th Global Conference on Sustainable Manufacturing (GSCM) in South Africa – October, 2016 and published in the Procedia Manufacturing journal. It was already reviewed.

20 % by 2020. Brazil is a leading emerging country in environmental challenges (Gunasekaran et al., 2014) and has been increasingly investing in deforestation control measures and reverse logistics processes and solutions (Jabbour, Azevedo, et al., 2013a). The logic of studying initiatives implemented by companies from these two countries is that global problems such as climate change require worldwide collaboration in order to get the so-called relational rents: ‘‘a supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners’’ (Dyer and Singh, 1998). Instead of just analyzing how multinational companies react regarding SSC initiatives, the present research goes beyond and presents a framework based on companies’ reality. In addition, by using a holistic model as research background, inter-multidisciplinary research is promoted with a global collaborative perspective.

4.5.2 Materials and Methods

In order to develop the proposed framework, the authors conducted a content analysis with 18 sustainability benchmarks, where text data is systematic classified and patterns identified (Neuendorf, 2002). The sample consisted of large leading multinationals which are more likely to engage in SSCM (Pagell, 2004), benchmarks in sustainable initiatives (listed in “The Newsweek Green Ranking” 2012 or 2014), from four different industries and with headquarters in either Germany or Brazil (table 42).

The coding scheme followed the framework for managing sustainable supply chain practices (Campos, 2015), which consists of three areas, seven dimensions, 21 categories and 91 types of practices. It starts with initiatives related to supplier relationship management (categories selection, assessment and collaboration), followed by those related to the internal supply chain management (governance, procurement, production, distribution and waste management dimensions) and finalizing in the target of all initiatives – customers.

Table 42. Sample of companies – Germany x Brazil

	Germany	Brazil
Consumer Goods	Bayer; Adidas; Beiersdorf; Henkel	BRF; Natura; Ambev; JBS
Basic Materials	Linde; BASF; Heidelberg Cement	Petrobras; Vale
Industrial Materials	Thyssenkrupp; Siemens	Gerdau
Retail	Metro	GPA

The source of data was public available documents – annual and sustainability reports (Tate et al., 2010) from 2012 until 2015. These are powerful instruments to inform partners, investors and society about firm's commitment level with sustainability, although it is difficult to determine whether described measures and initiatives are in fact implemented or just reported to appease stakeholders (Kolk, 2003). On the other hand, not all measures and set targets are published in the reports. For the quantitative statistical analysis, each of the database's cells (91 practices x 32 firms) were coded 1 in case of at least one practice reported and 0 in case of absence of practices reported. The Fisher's exact test was used to identify which types of practices were statistically significant different (p-value less than 0,05 or less than 0,10) between the countries.

4.5.3 A Comparative Study of Materials Sector Benchmarks in Brazil and Germany[7]

A preliminary study comparing two companies – BASF and Vale, both from material sector was previously published (Campos et al., 2015). A translated summary is presented in the following paragraphs. It was possible to identify similarities and differences in their behaviors, some explained in the next section.

[7] The content of this section was published in Business Management Review V4. N8. March 2015 (Campos, Straube and Cardoso, 2015)

Both companies require their suppliers to comply with current regulations and to implement an Environmental Management System. Since Vale, the Brazilian company, works with raw materials extraction, local suppliers are more commonly employed while the German one, BASF, due to its large variety of products offered and global approach, uses risk classification to assess their suppliers around the world (Azevedo et al., 2011). Both use questionnaires to evaluate suppliers and BASF complements it with audits, conducted by itself or third parties. The results collected by Vale are used to build an index for awarding suppliers with better performance, an initiative seem not implemented by German companies (Thun and Müller, 2010). Although both cited penalizations in case of lack of compliance, none set improvement targets to suppliers (Carbone and Moatti, 2008b). In contrast, collaboration projects are identified in both companies, with complementary financial credit lines for Vale's suppliers invest in improving their operations (Caniato et al., 2013; Rao, 2002; Spence and Bourlakis, 2009). Evaluation of indirect suppliers are vastly cited on the literature (Eltayeb and Zailani, 2009a; Perotti et al., 2012; Zhu et al., 2013) and BASF deals with this issue demanding their suppliers to make clear in their proposals which subcontractors they intend to use and applying the product shared-responsibility principle (Grant et al., 2013) among SC members.

One difference regarding these two companies is the intensity of technology use. Although Vale highly invests in technologies and implements interesting reuse solutions, probably due to its traditional processes and limited products' portfolio, these are relatively few when compared with BASF. The German company employs information technology solutions for optimizing the purchasing process (e.g. e-procurement) and establishing a more efficient relationship with customers and suppliers (Azevedo et al., 2011; Caniato et al., 2012; Cetinkaya et al., 2011; Closs et al., 2011; Pagell and Wu, 2009). Both companies invest in developing new and more sustainable technologies to the market. Even Vale that sells commodities has been trying to add value to its products and implement improvements in its production processes. At BASF, through the use of eco-efficiency and risk analysis, solutions to support customers in saving energy are offered, some made from renewable materials or containing eco-labels (Azevedo et al., 2011; Closs et al., 2011; Rao and Holt, 2005).

High investments in partnerships between BASF and governments, research institutes and other companies, including competitors, are another particular difference from Vale. The german company contributes for developing new chemical industry standards and new products, motivates facilities sharing and participate in social projects, which results in environmental, economic and social gains. Moreover, the "Verbund" principle connects all production units and find processes synergies and optimization opportunities. A similar initiative, although in a smaller scale, is also present in Vale. The Brazilian company has been investing considerable in programs to reduce its impact on the biodiversity, emissions control, water reuse, non-fossil fuels employment and energy auto generation, partly from renewable energies (Cetinkaya et al., 2011; Delai and Takahashi, 2013; Grant et al., 2013; Murphy and Poist, 2003; Perotti et al., 2012). BASF, on the other hand, despite some tests with using renewable energy, still reports barriers for massive use. The company focuses on technologies to improve eco-efficiency and reuse in order to reach the 70 % reduction target in GHG emissions. Both companies use intermodal transport although Vale invests more in infrastructure, especially in Brazil and Asia, in an attempt to increase maritime and rail transport. BASF promotes sharing facilities with other companies and probably due to its high outsourcing level does not publish any information regarding distribution processes. Nevertheless, both have rigorous standards to be followed by transportation companies.

Waste management is clearly driven by regulations although each company have different strategy to deal with it. Vale reported building partnerships for reusing their waste while BASF owns a recycling plant and audits external facilities to where non-reusable materials are sent.

The relationship between both companies with their clients happens though call centers and face-to-face meetings. Due to the products criticality, BASF makes available product instruction manuals and 24 hour a day service for emergency cases. The company reported the importance of customers' collaboration (Delai and Takahashi, 2013; Rao, 2007; Rao and Holt, 2005) and educational programs for guaranteeing the right use of their products (Cetinkaya et al., 2011; Pagell and Wu, 2009; Vachon and Klassen, 2006). For them, these are opportunities of improving SC sustainability, in an economic, environmental and social manner.

Both Vale and BASF, international benchmarks of sustainability, invest massively in strategies to reduce their impacts, especially in the environment. Although classified in the same sector, basic materials, differences regarding their operations, structure and offered products/solutions evidenced some of the differences within their SSC initiatives. One can conclude, nonetheless, that the Brazilian company invest considerably more in infrastructure and process improvements while the German more in technology and strategic partnerships.

A quantitative research showing the statistically significant differences regarding companies from both countries is presented in the following section.

4.5.4 Content analysis with German and Brazilian Companies

Findings show that the two groups differ significantly in four of the 21 analyzed categories of initiatives: external relationship, packaging, structure and network and customers' demands. The complete table with results from the Fisher exact test are displayed on Appendix 15.

The first identified category is external relationship (p-value=0,083) which shows a higher importance of governments and regulatory agencies for Brazilian companies. Relationships are reported similarly to collaboration with public institutions to get health and security trainings, support spreading education on how to combine business and biodiversity conservation, to measure climate issues using a public satellite system, to build sectoral agreements regarding packaging, durable household goods, lighting, batteries and medications, to build a public list of companies fined for human rights violations or joint sustainable plans for developing the Amazonia region, to improve urban mobility conditions.

Investments in improvements towards sustainable packaging are cited by the majority of companies from both countries, however, some particularities were identified (p-value=0,078) regarding the behavior of the German ones. Within this group, more companies reported awareness in hazardous materials management – e.g. implementation of the Globally Harmonized System, explained by the strict level in European regulations. Although in Brazil there are laws for this issue, none of the companies highlighted specific initiatives in their reports. The same is observed in involving suppliers in packaging optimization programs. Although the link between these investments and benefits in terms of weight and volume during transportation, Brazilian companies seem not to be open enough to collaborate with suppliers. On the other hand, Germans profit from extending the product life cycle perspective to develop sustainable manufacturing solutions. They use these relationships to avoid emissions and costs through reduced package volume, use of less and recycled sources of fiber materials and opting for packaging that can be used for both transport and in-store presentation.

The third statistically significant difference is regarding structure and network initiatives (p-value=0,045). Investments in efficient land use and green construction as well as specific strategies in the logistics network for reducing emissions are considerably higher among the German companies. They identify the value of building certified sites e.g. ISO 14001, Leadership in Energy and Environmental Design and one even designed a specific manual with mandatory environmental measures for architects when building their stores. The development of automation systems and modern technologies support improvements in resources efficiency and are aligned with investments for generating renewable energy on-site. Regarding network design and optimization, e.g. the location of new warehouses and distribution centers, German companies more often emphasis ecological advantages like reduced fuel consumption and transport related emissions in their reports Initiatives to shorten distances with suppliers are for instance positioning them "wall to wall" to the production site. This approach can not only support a more flexible and stable production but also help to reduce transport related emissions . Another clear characteristic of these companies is the sharing culture, between business units and also with other companies (Campos et al., 2015). The use of pooling systems with firms with similar product categories is vastly reported among the German firms. They highlight the advantages of increasing the percentage of fully loaded trucks, reducing the number of empty runs and consequently emissions. Brazilian companies, on the other hand, report large investments in their own infrastructure to overcome restrictions of the public one, e.g. floating cross docking stations, necessary when delivering in shallow ports.

The last identified difference relates to managing customers' demands (p-value=0,096), which is more intensively reported by Brazilian companies. An explanation might be due to the need of frequent and closer contact between customers and enterprises in the Brazilian market. Apart from periodic satisfaction surveys, social media and press publications, they reported technical visits, co-creation platforms, specific portals e.g. "I love makeup", blogs, magazines, TV shows and short message service to update clients about their order status. According to some companies, even among international customers, there is a clear demand for adjusting products to a "local taste" and for giving instructions in different languages about health, safety and environmental issues. Initiatives that aim to change customers' behaviors are also identified – e.g. program for responsible consumption of alcoholic beverages or reduction of the use of plastic bags by customers.

4.5.5 Cross-country Collaboration Framework

Based on the content analysis of companies' reports and statistical tests, the framework represented on figure 20 was built. It aims to support the comparison of countries SSC practices for further identification of value creation opportunities through collaboration projects. It evidences the pressures from regulations, market and companies, which influence the market behavior differently according to the country or sector where it is set. In Germany, EU requirements are among the strongest drivers for improving SC sustainability as well as the increase in market competitiveness. Brazilian companies, on the other hand, are strongly pressured by customers, especially multinational companies that require higher sustainability standards. Under the influence of these forces, the supply chain network is motivated to change towards the development of sustainable solutions and collaborations. Therefore, overall relationships play an important role in this process. Relationship with government is directly influenced by regulatory pressures, but also oriented by culture and structural needs.

In Brazil, despite the existence of regulations regarding environmental and social responsibility, relationships with governmental institutions are intensively employed for obtaining appropriate infrastructure and for developing the workforce/population in general. Two fundamental and critical requirements for reaching more efficient processes – infrastructure and people. Additionally, due to the lack of appropriate resources, companies from developing countries, consequently, invest more in relationship with society in an attempt to extend the sustainable behavior beyond corporate boundaries, establishing a cultural sustainability value.

In Germany, once infrastructure and people have a more mature sustainability level, companies seem to find answers for these same demands through collaborative projects with other companies, including SC members for sustainable manufacturing and more efficient SC processes. The exaggerated competitive culture in Brazil and lack of trust between companies hamper similar initiatives, thus, the relational focus is on customers that demand a closer contact.

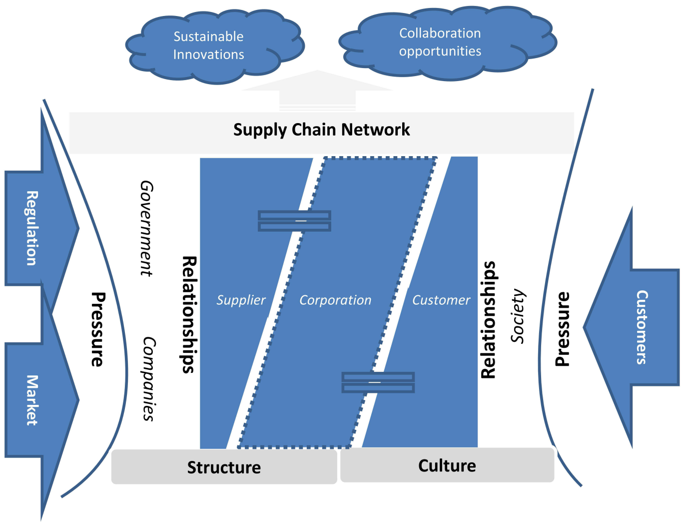


Figure 20. Cross-country collaboration framework (own author)

4.5.6 Preliminary Conclusions

Effective actions in extending SC sustainability are still missing in overall companies' actions (Touboulic and Walker, 2015b), as well as SSC research in developing countries (Pagell and Shevchenko, 2014). The combination of these two gaps evidences collaboration opportunities between different countries, answering the global need for improving sustainability. This section aims to contribute to this discussion and the authors believe that solutions should involve global implementation however respecting each country's particularities. The presented framework supports analyzing specific variables that influence SC performance and identifying opportunities for value creation through cross-country collaborations. Moreover, it evidences the benefits of designing projects together with stakeholders for improving sustainable innovation in manufacturing and logistics, as well for removing barriers that influence the completely global value chain. In developing countries, the lack of infrastructure and sustainability knowledge can be overcome by contributions from the maturity of developed ones. On the other hand, the closer relationship with customers and partnership with government among developing countries provides insights for future manufacturing technologies by the other group.

4.6 Conclusions

The “Benchmark Practices Bank” was developed based on the Institutional Theory assumptions, especially the tendency of companies copying “best practices”. Nonetheless, it goes beyond from previous approaches that found mimetic behavior between firms with similar characteristics (Guler et al., 2002). It aims to support identifying innovative practices, revolutionary changes for create truly sustainable supply chains (Pagell and Shevchenko, 2014) and “out of the box” (Brown, 2002) solutions. Based on this mechanism, specific analyses were conducted and interesting findings discussed.

The first conclusion of this chapter is the imbalance in dimensions, categories and industries with leading companies still focusing on internally-focused initiatives (Eltayeb and Zailani, 2009b), few collaborative initiatives with suppliers and customers, as well as lack in integration with LSPs in order to promote and report SSC practices in distribution processes.

Secondly, altough differences between industries were previously observed (Waddock and Graves, 1997), the identification of where they stand was unclear in the literature. This study contributes in presenting details about each of the five analyzed industries - producers and logistics service providers through statistically testing in section 4.4 some of the assumptions in sections 4.2 and 4.3. Statistically significant differences were identified in IM and T&LS group of companies. Despite the high emissions in the transport sector, there seems to be a lack in initiatives (Rossi et al., 2013) among LSPs towards sustainability. The explanation, according to these authors might stand in the lack of capabilities and tools to deploy eco-efficiency strategies. It is unclear, however, if they do not implement or do not report. In both cases, information is not available for stakeholders, including clients. CSR reports from manufacturers and energy producers do not include information about distribution intiatives which might be due to this lack of visibility of LSPs strategies or consequence of the challenges in measuring impacts and integrating the whole supply chain (Colicchia et al., 2011). Even though a large percentage of product's carbon footprint comes from suppliers (Accenture, 2012), clear collaboration projects are not commonly reported.

When analyzing actions taken by companies from developed and developing countries such as Germany and Brazil respectively, results showed that multinationals are behaving similarly. From all 21 categories, only four presented statistically significant differences. Nevertheless, coercive pressures (DiMaggio and Powell, 1983) seem to drive countries and companies differently according to their cultural background and specific characteristics. Solutions should be globally planned and implemented, but respect each country's particularities. The framework presented in section 4.5 supports analyzing cross-country variables that influence SC performance and identifying opportunities for value creation through collaboration between companies from different regions.

Among the limitations of this chapter's research, the more critical one is the use of self-reported reports which might contain few details about the practices or even greenwashing. Data from reports and corporate websites are not audited on-site to confirm its contents although by researching top-ranked companies it is less likely that companies state information that are not according to their reality due to the high reputational risk (Jose and Lee, 2007). Aware of the limitations of using content analysis of companies' reports, a list of actions were previously taken (section 4.1). The sample size for the statistical tests applied to each of the 21 categories is also a limitation enabling only the run of non-parametric tests. Even though, the complementation of qualitative data provided insights for further specific analysis by companies.

As for section 4.5, although the results reflect the context in Brazil and Germany, they provide valuable insights to other developed and developing country. A cross-country study with a larger sample size, e.g. comparing Asians and Latin American countries, is recommended. The focus of this chapter is to present benchmarks in SSC practices based on well-known rankings although further research might obtain interesting results when considering other selection criteria (e.g. the largest, most innovative, beloved by customers, small and medium ones…).

5 Practices Portfolio Planning Matrix

The present chapter explains in details the scope 3 of the "Methodology for planning sustainable supply chain initiatives" and help answering the third research questions underlying this dissertation "How should companies build and manage a portfolio of sustainability initiatives to improve their overall SC performance?" The chapter is separated into five sections. The first one describes the structure and functionality of the "Practices Portfolio Planning Matrix" consisted of specific measures of efforts, impacts and implementation level of SSC practices. The second section presents the methodology used for building the matrix based on data collected from companies in Brazil. It is followed by an exemplification of how initiatives can be combined with others (quadrant 3) in an attempt to generate extra benefits, similar to the "1+1=3" concept. Further, the results from workshops and interviews conducted in Brazil in September/October 2015 are explained. At last, a final section aggregates preliminary conclusions of each of the previous sections.

5.1 Matrix Structure and Applicability

The demand for tools to support managers in the selection of the proper sustainable initiatives was previously identified during contacts with companies as well confirmed by other authors (Colicchia et al., 2011). Moreover, according to Zhu, Sarkis e Lai (2012a), the right sequence for implementing of SSC practices offer additional social, environmental and economic benefits. The third scope of the "Methodology for planning sustainable supply chain initiatives" aims to support decision makers in building and managing a portfolio of SSC practices to be implemented, also together with other supply chain partners. The "Practices Portfolio Planning Matrix" has some similarities with the "Boston Consulting Group (BCG) "Growth-Share matrix", developed by one of the company's founder (Henderson, 1970). According to the author, a successful company should have a portfolio of products with different growth rates and different market shares, as visualized on Figure 21.

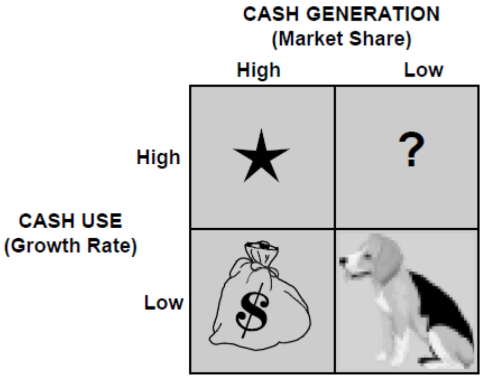


Figure 21. BCG matrix (Henderson, 1973)

Stars (quadrant 1) use large amounts of cash due to their high growth rate and generate large amount of cash to the company (in the case of this matrix, higher market share). *Cash Cows* (quadrant 3) grow slowly, thus, demand low amount of cash. However, since they consist of mature products with high market share, they also generate high amount of cash. *Dogs* are products that, according to the author, are worthless (Henderson, 1973). Nevertheless, recent analysis from other BCG authors (Reeves et al., 2014) highlighted the important role of this kind of product in today's competitiveness. They found evidence of successful companies that capture failure signals from these products to better plan future experiments. According to them, today's market circumstances change more rapidly and unpredictably, requiring companies to constantly renew their strategies. Finally, the *Question Marks* products are the ones that can require heavy cash investments although the cash generation is still low since their market share is low. If they do not acquire leading market position, they become "big dogs".

Similarities can be observed between the BCG Matrix and the one presented in details in this chapter. The "Practices Portfolio Planning Matrix", also called EIL Matrix due to its three variables (further explained) - Efforts, Impacts and Level of implementation, intends to support companies in building a balanced and diversified portfolio of SSC practices to improve value chain sustainability. The first two variables can be slightly compared with cash use (efforts) and cash generation (impacts) from the BCG Matrix nonetheless its scope is broader rather than only financial. Another difference is the approach towards partnerships with other companies. By the time the BCG Matrix was developed, the concept of competitive advantage followed the traditional Resource.based View (Barney, 1991; Wernerfelt, 1984). This theory defend possession and control over sharing and co-development. Nowadays, vertical coordination (Carter and Rogers, 2008), partnerships and strategic alliances (Ellram and Cooper, 1990) between supply chain members are seen as great opportunities for achieving success. Supply chain sustainability instead of companies' competitiveness is also a recent concept that, as observed in the previous chapters, remains a challenge. The EIL matrix encourages resources sharing and co-operations as critical strategies for obtaining high levels of sustainability. Although internal and industry-collaborations were discussed in the previous chapters, partnerships specifically with shared value chain members were still not yet focused. According to the Extended Resource-based View (Lavie, 2006), SC integration results in extra gains only possible to be created from shared resources among partners. Each of its variables is further explained:

5.1.1 X-axis - Effort

The perceived necessary effort to implement certain initiative is represented in the X-axis and consists of four categories (table 43).

Table 43. Categories of efforts

Categories	Example of efforts
Financial	Financial capital for obtaining the necessary structure and physical assets such as technological equipment.
Human	Employees' hours (including new hires)
Relational	Relationships with strategic contacts and partners
Time	Span of time

5.1.2 Y-axis - Impact

The perceived necessary impact of certain initiative in the company is represented in the Y-axis and consists of three categories (table 44).

Table 44. Categories of impacts

Categories	Example of impacts
Financial	Cost reductions and/or extra revenues
Sustainability targets	Support achieving sustainability targets
Company's image	Brand/company image for stakeholders

Different from studies that consider only financial impact, this matrix make sure social and environmental targets are also included in the analysis.

5.1.3 Bubble size - Current Level

The current implementation level is represented by the size of the bubbles. The larger is the bubble, higher is the implementation level. This data is based on practitioners' experience in the researched company. If the bubble is too small this means that certain category is not even planned.

5.1.4 Matrix as a Decision Making Tool

The matrix is represented in a bubble chart which displays the relationship between three dimensions of data. It is important to make clear that it does not intend to work as a Six Sigma prioritization matrix (Aveta Business Institute, n.d.). Categories of practices from all four quadrants can be turned into projects that may start at the same time however; each should be managed differently according to its own characteristics. In Figure 22 it is an example of the EIL Matrix.

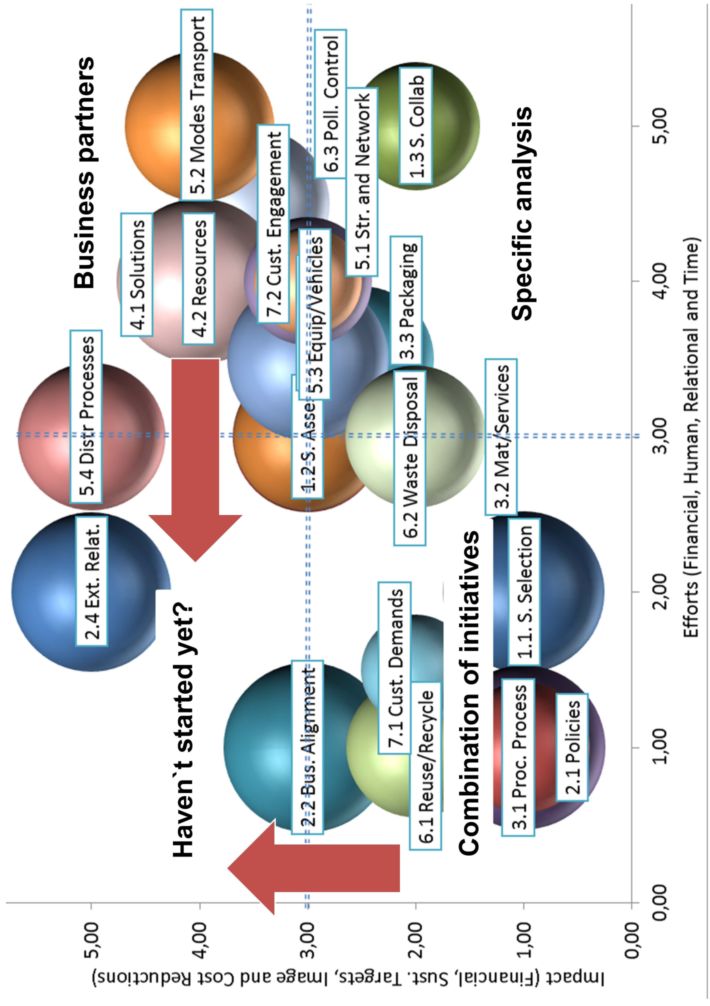


Figure 22. Practices Portfolio Planning Matrix (illustrative example) (own author)

Quadrant 1: “haven’t started yet?”

In this quadrant are included categories of practices that demand low efforts, e.g. capital investments, and offer high impact to the company. These are initiatives that should have higher implementation levels (large bubbles) or that should be basic-requirements due to their characteristics. They are similar to the “*Cash cows*” from the BCG matrix. Improvememets may arise from internal collaboration in exchanging knowledge, resources, risks, between employees, teams, departments, business units of the same company. Once few organizations achieved complete internal integration (Fawcett and Magnan, 2002), corporate leaders should encourage information sharing, cross-functional work, holistic solutions and a more efficient systemic management among corporate teams.

Quadrant 2: “business partners”

In this quadrant are categories of practices that offer high impacts to the company however, it requires high efforts to be implemented (similar to the “*Stars*” from the BCG matrix). Therefore, it is suggested to build partnerships in order to reduce efforts - structures, assets, people, relational network and time. According to Gulati and Singh (1998), exchange or share resources, co-development of products, services, or technologies are suggested to be implemented together with partners to improve supply chain sustainability and thus, reduce the needed efforts.

Practices in this quadrant with high implementation levels are recommended to be strongly monitored due to their higher efforts. Since capabilities and consequently power are most probably concentrated in this firm, partnerships with supply chain members offer additional opportunities of developing innovative approaches (Pagell and Shevchenko, 2014) that were not considered previously with a single-company mind-set.

Quadrant 3: "combination of initiatives"

In quadrant 3 are located categories of practices that even though require low efforts to be implemented, outcomes are also perceived as low in financial, image and social-environmental performance. Similar to the "*Dogs*" of the BCG Matrix however not worthless, initiatives located in this quadrant should have their value or impact maximized (Reeves et al., 2014). Therefore, through the combination of practices from quadrant 1, extra benefits might be generated, similar to the relational rents (Dyer and Singh, 1998). For this combinatory analysis, quantitative methods to find pair of practices with high correlations can be used as exemplified in section 5.3. can be conducted in additional to qualitative perceptions from company's experts.

Quadrant 4: "specific analysis"

In quadrant 4, categories of practices with high efforts and low impacts can be found. These are similar to the "*Question Marks*" of the BGC Matrix. In the case of the EIL matrix, it is recommended to have a particular attention to these practices since they might be mandatory for the business, e.g. current or future industry regulations. Therefore, categories in this quadrant should be carefully analyzed, in an attempt to map all other variables that might affect positively and negatively their implementation.

5.2 Methodological Approach

5.2.1 Questionnaires Testing

In order to collect the necessary data to build the matrix, several workshops and interviews were carried out. At first, in October 2014, during the seminar "NetloP-Vertiefungsseminar 2014„Nachhaltigkeit und Standardisierung in der Logistik", a workshop with practitioners from German companies from Materials, Energy, Chemical, Vehicles, Consumer Goods, Retailing, Logistics and Transportation, Consultancy and

Automation sectors (list of participant companies appendix 10) was organized. The aim was to test the questionnaires and discuss about the benefits of using this mechanism for supporting decision making.

5.2.2 Final Version of the Questionnaires

In Brazil, during five workshops and 3 interview, details about the framework, its purpose and structurete (dimensions, categories and practices) were presented and discussed. Complementarily, a list with the definition/key-words of all practices were available for consultation during the questionnaire filling process. Participants were aggrouped according to the industries' similarities for discussing the topics. Two questionnaires in Portuguese (Appendix 11) were used for data collection. The *first one* aims to identify the company implementation level of several SSC practices and general information about the company (no name was required). The following 5-point scale was used to measure the implementation level:

1. Not interested in implementing
2. Planned
3. Initial implementation phase
4. Partially implemented
5. Completely implemented

NA. Not applicable

The list of 91 initiatives were based on the framework for managing sustainable supply chain practices (chapter 3) and additional specific practice. For instance, 1.1.1 asks if the company selects suppliers considering, besides, economic aspects, also social-environmental ones. After answering it, the participant was asked if they require suppliers any external certification such as ISO. The reason for including these specific questions are the specific patterns identified per industry in section 4.3. These specific practices will not be considered in this dissertation, but might be used in further research.

The *second* questionnaire aims to identify the perceived efforts and impacts of implementing certain SSC practices for companies in Brazil.

Based on the framework and the results from chapter 4, a list of 25 practices were defined. Each group of participants had to evaluate efforts and impacts each based on the following scale:

1. Extremely low/inexistent
2. Low
3. Medium
4. High
5. Extremely high

NA. Not applicable

5.2.3 Data Collection Process and Descriptive Analysis

During two weeks in September and October 2015, workshops "Challenges and opportunities for implementing sustainable supply chain practices in Brazil" and interviews to collect data were conducted in Brazil (table 45). The list of the companies that participated are informed on the appendix 12.

Table 45. Sources of data – companies in Brazil

Workshops/Interview	Number of participants	Number of groups
Workshop during the ILOS Conference in Rio de Janeiro (diverse group)	29	3
Workshop FGV/Mmurad (diverse group)	50	9
Workshop ES em Acao (diverse group)	18	4
Workshop Vale (mining)	6	1
Workshop Usiminas (steel)	4	1
Interview Arcelor Mittal Tubarao (steel)	1	1
Interview Marca Ambiental (solid waste management)	1	1
Interview Cenibra (paper and pulp)	1	1
Total of participants	***110***	
Total of companies (questionnaire 1)	***67***	
Total of groups (questionnaire 2)	***22***	

Although there were no restrictions regarding the participation of multinational companies, the participants were from firms originally from Brazil (73 %), 64 % large companies (more than 500 employees) and from different industries, but especially T&LS (34 %) as observed from table 46.

Table 46. Industry of the researched companies

Sector	Absolute	%
Logistics	23	34 %
Health/Pharmaceutical	6	9 %
Energy/Chemical	6	9 %
Basic Materials	4	6 %
Industrial Materials	4	6 %
Retail	2	3 %
Others/not informed	22	33 %
Total	67	100 %

5.3 Opportunities of Combining Sustainable Supply Chain Management Practices towards Performance Improvement[8]

5.3.1 Overview and Methodological Approach

Considerable efforts for research on SSCM have become evident in the past years (Winter and Knemeyer, 2013). Besides conceptual studies and quantitative models, empirical research is vital to examine SSCM practices that positively influence SSCM performance. Thus, scholars and practitioners started focusing on specific practices and initiatives to successfully reduce socio-environmental impacts of companies' operations. The systematic combination of practices is, however, not yet approached in literature. We believe that a combination of practices can result in an extra benefit for companies similarly to the concept of relational rent:

> ''a supernormal profit jointly generated in an exchange relationship that cannot

[8] The content of this section was sent on 16.03.2016 to call for book chapters for the edited springer book. Title: Social and Environmental Dimensions of Organizations and Supply Chains – Tradeoffs and Synergies. Series: Greening of Industry Networks Studies.

> be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners'' (Dyer and Singh, 1998)

To systematize existing SSCM practices and examine the opportunities of their combination to improve corporate and supply chain performance, this section presents results derived from the systematic literature review presented in the previous chapter which produced an integrated framework for managing sustainable supply chain practices (Campos, 2015). Based on the conceptual framework, a sample of 99 publications that deal with SSCM practices is analyzed to identify dominating and underrepresented initiatives. Quantitative analysis of the results of the literature review involves counting the frequencies of occurrence for each category, i.e. SSCM practices, and calculating relative frequencies to point out the relevance of each framework element. In this way, highly relevant SSCM practices, but also underrepresented ones, can be pointed out. Furthermore, contingency analysis is employed to identify correlations of occurrence between pairs of analytic categories and thus reveal combinations of SSCM practices that are more often linked than expected. Contingency analysis is carried out using SPSS® 22.0 where the phi (φ) coefficient is calculated (Backhaus et al., 2013). If the phi coefficient exceeds 0.300, a positive correlation between the occurrences of the analyzed pair of categories can be assumed, i.e. the two categories appear unexpectedly often together in the same reference. Contingency analysis is one possible method for quantitative assessment of findings gained during content analysis of large paper samples and has been used in similar research approaches (Wolf, 2008; Gold et al. 2010a,b).

After identifying some hypotheses from the contingency analysis, corporate reports from five German automotive manufacturers are examined in order to exemplify how companies might improve their sustainability performance through practice combinations. The automotive industry is identified as having a "greener supply chain", with many implemented practices (Perotti et al., 2012) As this section examines the realm of and relationships between SSC practices, the selection of ranked companies leaders is supposed to contribute to comprehensive results. Thus, according to the Newsweek Green Ranking 2014 and 2015, a number of German automobile companies are identified. Moreover, the analysis undertaken benefits from the availability of data for German automotive companies from previous research projects. More information about the chosen companies are on table 47.

Table 47. Sample of automotive companies

Company	Main products	Public documents used
Audi	Cars	Corporate Responsibility 2012 and 2014
BMW	Cars, Motorcycles	Sustainable Value Report 2012 and 2013
Daimler	Cars, Commercial Vehicles	Sustainability Report 2014
Porsche	Cars	Annual Report 2013 and 2014
Volkswagen (VW)	Cars, Commercial Vehicles	Sustainability Report 2014

5.3.2 Results and Discussions from Contingency Analysis

The framework used for content analysis consists of seven structural dimensions and for each dimension several analytic categories were defined. The dominant dimensions of SSCM practices are supplier relationship and governance. In contrast, customer relationship, although relevant was cited in only 38.4 % of the sample papers. The frequencies of the analytic categories in each structural dimension are displayed in Appendix 14.

This section informs about the results from applying contingency analysis to identify highly correlated SSCM practices. Even though, it is important to note that those relationships that do not exceed the threshold of being regarded as significant contingency are equally important for SSCM. This is reflected in the cross-functional perspective of SCM, which necessitates the integration of all the framework dimensions. Before looking at the detailed analytic categories, the aggregate structural dimensions are analyzed. Figure 23 gives overview of the pairs of structural dimensions with phi efficient of 0.300 or above and can thus be considered as significantly correlated dimensions.

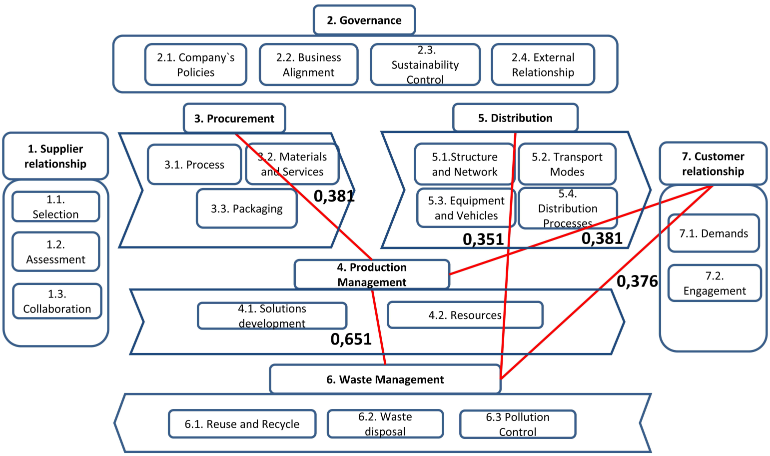


Figure 23. Correlations between structural dimensions (own author)

From the results in Figure 23, it is concluded that production management and waste management are central dimensions of SSCM with strong correlations with each other and with customers. In addition, production is strongly correlated with procurement while waste with distribution. On the other hand, corporate governance, being on a strategic level, seems to be decoupled from the other (often tactical and operational) dimensions. It refers to the foundation for building corporate sustainability such as policies and guidelines, human resources management, sustainability control and external stakeholders' relationships.

Although supplier relationship dimension was considered in the largest amount of literature references (76,8 %), no relationship was found with the other dimensions which might be a sign that, in general, practices in this groups are normally not implemented together with practices from other groups. Exceptions were found in supplier collaboration category, as further described. After looking at the inter-dimensional correlations, the categories of each dimension are related to the categories of the other dimension in order to identify important pairs of SSC practices. As a result, seventeen category combinations are identified (Figure 24) and further described.

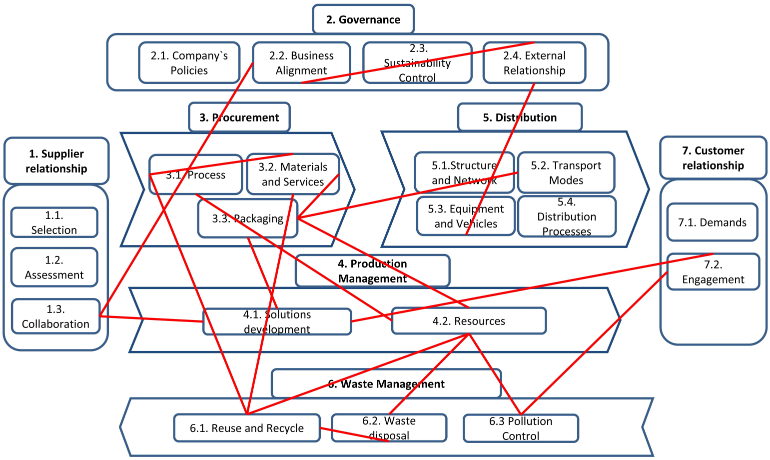


Figure 24. Correlations between categories of practices (own author)

5.3.3 Results and Discussions from Content Analysis of Companies' Reports

Supplier Collaboration (1.3) related with Business Alignment (2.2) (phi=0,329) and Solutions Development (4.1) (phi=0,354)

The relationship between these categories can be explained when analyzing some of the reasons for companies to collaborate with suppliers:

a) Ensure compliance to sustainability standards

The set of quality, environmental and social standards for the purchased products is a common initiative by companies worldwide. In BMW it is common to have a sustainability and environmental protection department responsible for monitoring water, waste, energy, emissions, and for the training and environmental management system. Porsche highlights the importance of consisting of a cross-functional team with different departments while VW reinforces its necessary link with the management board. Moreover, Daimler makes clear that those suppliers who are unable to meet environmental and social requirements should not be immediately delisted from the supplier pool. It is more efficient to support supplier development, which improves collaboration and enhances mutual trust between the two parties. Supplier development programs in VW and Porsche consist of digital learning module (e-learning) and for Audi involve internal departments such as Human Resource, Health and Safety, Procurement and Quality. By the end of 2014 in VW, for instance, 14,457 suppliers had completed the E-Learning module, which equates to 71 % of procurement expenditures. The tool is made available to the supplier's workforce as well as to employees of Volkswagen AG procurement for qualification purposes.

The development of suppliers and employees in a common platform showed to be one success factor for improving supply chain sustainability. It supports extending company's values to its business partners.

b) Improve transparency

International initiatives such as Supply Chain Program of the Carbon Disclosure Project are used by BMW to improve supply chain transparency. There, suppliers can record their resource consumption on a generally accepted platform and identify business opportunities and cost savings. The vehicle manufacturer analyzes and evaluate their potential for improvement in Supplier Performance Review meetings. VW promotes meeting, suppliers and manufacturers discussed challenges and collaborative solutions to improve sustainability along the supply chain. This event in 2014 spotlighted social rights and more than 900 suppliers participated.

Information sharing is also very critical for life cycle-wide resource management. VW consider the environmental impacts of their products, particularly CO_2 emissions, at every stage of their life cycle. Collaboration with their suppliers plays, thus, an important role for achieving target reductions in products' environmental footprint.

c) Development of new solutions

Another benefit from LCA is the opportunity to develop more sustainable solutions. Once all data are collected, components and processes that contribute to the overall product footprint can be identified. This enables companies to set new requirements to their suppliers or collaborate with them for developing more sustainable solutions. An example is BMW Group Research and Innovation Centre in Munich that encourages suppliers to present best-practice case studies on innovative and sustainable products, materials and production processes during specific monthly forums.

Business Alignment (2.2) and External Relationship (2.4) (phi=0,371)

The cross functional group responsible for managing sustainability must also set stakeholder dialogues, not only in group and suppliers' level, but also with government, other companies, universities, and NGOs. The relationship with external stakeholders support current and future law compliance, development of industry standards and collaborative platforms that promotes the better use of resources, cost reductions and more power to deal with them. BMW, for instance, organizes stakeholder forums with representatives from all groups of interest and cooperation with universities are used to support employees and suppliers' development.

On the one hand, a company might be interested in exposing their know-how to governments, companies and NGOs, in an attempt to support development of new regulations or standards. This initiative brings a competitive advantage to the company that supports the development of new requirements and become a benchmark in the topic. On the other hand, pressures from the environment influence firms' performance and strategies. The continuous update regarding stakeholders' demands is crucial for maintaining compliance with laws, taking advantages from industry cooperation and monitoring environmental and social questions raised by NGOs.

External relationships and Equipment and Vehicles (5.3) (phi=0,311)

Relationship with stakeholders such as government, universities and industry associations are clearly focused on the development of more sustainable solutions for improving equipment and vehicle's performance. The focus at this moment is intensified in electric mobility, alternative fuels and vehicle's production process optimization.

Sustainable Mobility 2.0 is a project from the World Business Council for Sustainable Development of which most of the automotive companies are members. They collaborate with other companies from different industries to develop solutions for sustainable future urban mobility (VW). BMW Group is also part of the National Platform for Electric Mobility, a German government advisory committee on electromobility. The company launched a Roundtable with students in Berlin where they discussed the topics of greenwashing vs. credibility, electromobility and transformation of the German energy industry. Daimler designed a LivingLab BWe, where business, science, and public authorities cooperate to study different approaches to electric mobility and the technologies they involve.

Discussions regarding alternative fuels are conducted by Daimler in the "Automotive Fuel Cell Cooperation", a joint venture by this company (50.1 %), Ford (30 %), and Ballard (19.9 %) founded in 2008. Another example is Audi that in early 2014 entered into a strategic partnership with the French biotech company Global Bioenergies.

In order to improve the production process, VW participates in the "Innovation Alliance Green Carbody Technologies". Together with Siemens and Fraunhofer Institute, they developed a simulation model to improve energy-efficieny in the trajectories of production robots. Audi is active in the Aluminium Stewardship Initiative, which aims to develop a global standard for sustainable aluminum, with environmental and social criteria for all stages of raw material extraction, production and processing.

Procurement Process (3.1) and Materials/Services (3.2) (phi=0,900), Reuse and Recycle (6.1) (phi=0,306)

The sustainable procurement process starts with the reduction of the demanded materials which is directly linked with reusing and recycling initiatives (Min and Galle, 1997). An example is the Original Parts Center of VW, the largest of its kind in Europe that remanufactures used engines and gearboxes. Since 1994, it has saved more than 351000 tons of steel and 49000 tons of aluminum. Audi has been researching new concepts and techniques for reusing carbon fibers and reconditioning of components such as starters and alternators from used vehicles. Their Ingolstadt plant saved roughly 500 metric tons of steel, 48 tons of copper and 76 tons of aluminum in one year of operation.

The procurement process also involves demand more sustainable materials, components, products or services, with lower impact in the environment and society. This influences waste elimination strategies during and in the end of the product life cycle. According to Min & Galle (1997), the potential liability and costs of disposal of hazardous materials are the most important factors when choosing suppliers. An example are the use of renewable materials in new models from VW (Polo 5, Sharan N F, Golf 6, Golf 7, Passat 8) and Daimler. One of the main drivers for improving the materials which compound a vehicle is the directive 2000/53/EC of the European Parliament and of the Council. It says that, in January 2015, the reuse and recovery shall be increased to a minimum of 95 % and recycling to a minimum of 85 % by an average weight per vehicle and year. Therefore, a higher percentage of the procured components are now more sustainable ones, thus, easier to be further reused or recycled.

Besides how much and what is procured, it is also essential for a sustainable procurement process understand how they are purchased. It consists of building the contract with clear clauses and requirements, as well as including the shared responsibility principle. Consequently, long-term collaborative relationships and joint efforts are promoted in order to reduce the impacts of their business in the environment and on society. VW, for instance, supports the European Commission in suppressing the funding of armed conflicts through the raw materials trade. Another practice is encouraging the use of e-procurement, which saves paper, time and increase transparency between buyer and suppliers.

Materials and Services (3.2) and Reuse and Recycle (6.1) (phi=0,302)

As explained in the previous section, the procurement of more sustainable materials, components, products and services is directly related with waste management. The increase in the purchase of these kind of materials brings more opportunities for reusing the parts, remanufacturing, refurbishing, or facilitating the recycling process. One example comes from BMW that uses the “Design for Recycling” principle since the design phase, when materials and components are defined. The objective is to use components that can largely be reused or recycled. Audi`s “MAI recycling” research project involves industrial partners in an attempt to find new concepts and techniques for reusing carbon fibers in volume production, therefore, reducing the need for raw ones. The company aims to develop the “Munich–Augsburg–Ingolstadt region” into a European center of excellence for carbon fiber–reinforced polymer lightweight construction.

Packaging (3.3) and Materials/Services (3.2) (phi=0,368), Solutions Development (4.1) (phi=0,368), Resources (4.2) (phi=0,352), Transport Modes (5.2) (phi=0,338)

When companies decide to invest on procuring more sustainable materials and services, they include in this range the avoidance of using disposable packaging (including containers) or non-recyclable packaging materials. In order to minimize any negative impact on the environment as well as additional financial charges caused by disposable packaging, VW invests in reusable packaging and containers in a larger extent. BMW established a packaging manual, which is integrated into the purchasing terms and conditions. This document makes clear their requirements, focused on the avoidance of packaging, on encouraging the use of reusable packaging and materials that can be recycled after its life cycle ends.

Besides reducing the product footprint, packaging innovations enable complementary efficiency gains that benefit the environment and society. BMW and Porsche use packaging design as opportunity for identifying the ideal density for protecting the product as well as the optimal use of space during transport loading. In an attempt to reduce overall materials consumption, Daimler dispense the paint-protection film used in their vehicles resulting in saving approximately 40000 square meters (430000 square feet) of the material in a year. Moreover, the use of bumper pads was discontinued for the entire fleet of exported passenger cars, a total annual volume that could fill 10 large shipping containers. BMW also reduces transport volume, and thus, resource consumption, by optimizing packaging on inbound distributions. Additional initiatives to improve packaging in transport management is in literature correlated with the transport mode employed. All automotive manufacturers reported using preferably rail transport - Audi has 60 % of your vehicles distributed using this mode and some though the Eco Plus, the CO_2-neutral rail transport by DB Schenker. The link, nevertheless, between the chosen mode and the use of sustainable packaging is not evident in companies' reports. The packaging redesign, use of less or lighter materials, as well as reusable ones might depend on the transport mode's restrictions. The same might happen for their reverse flow.

Solutions Development (4.1) and Customer Engagement (7.2) (phi=0,309)

The design of more sustainable products, processes and services is an excellent opportunity for encouraging changes in customer behaviors. Several examples are available of improvements by the automotive industry in order to increase eco-efficiency and reduce the amount of emissions, including noise, which affects directly the society. Companies have settled targets to reduce CO_2 emissions in the European new vehicle fleet, aligned with the EU requirements, which generates large investments in new technologies. Beyond the development of hybrid and electric vehicles, other considerable improvements in vehicle's performance are visible. More efficient engines, optimized aerodynamics, intelligent energy management, lightweight design (with carbon fiber reinforced plastic), downsizing, forward looking drive control, the "Auto Start Stop" function, brake energy regeneration, tires with reduced rolling resistance or air flap control, are some of the innovations that automotive manufacturers are implementing to improve sustainability of their cars. VW offers, for both commercial and personal vehicles, an additional driver assistance system that enhance road safety by reducing driver errors. The company centralizes the development of fuel-saving and low-carbon technologies in the "Complete Vehicle Architecture" unit. Initiatives to improve overall traffic flow, which are combined with reductions in energy consumption, are also being tested by companies and customers. Audi highlights the active lane assist, which warns drivers if they leave their lane, adaptive cruise control (ACC) with "Stop & Go", which automatically maintains the distance from other cars, and the night-vision assistant that detects people and animals in the dark.

Solutions that provide economic gains (e.g. less fuel consumption) combined with environmental (e.g. less emissions) and social benefits (e.g. more safety) show to be accepted by the customers. Local governments have also being investing in more sustainable solutions, e.g. Stuttgart testing the Citaro G BlueTec hybrid buses (manufactured by Daimler) for public transport.

In addition, engaging customers for more sustainable products includes informing them about aspects such as fuel or electricity consumption, annual fuel costs, CO_2 emissions and the amount of tax payable considering the amount of pollutants emitted. Since December, 2011 in Germany, it is mandatory that new cars present a label with these information and a summary range from A+ (very efficient) to G (inefficient).

Resources (4.2) and Reuse and Recycle (6.1) (phi=0,338), Waste Disposal (6.2) (phi=0,375) and Pollution Control (6.3) (phi=0,447)

One of the strategies used to optimize overall consumption of materials is to reuse them. It can be incorporated in remanufactured and refurbished products or even into new products after being reprocessed. Automotive companies employ reused, recycled and renewable materials in order to improve the environmental footprint of their vehicles. New models from VW showed that such content correspond to approximately one-third of their weight. Daimler also invests in more recycled materials and less weight ones which provide gains in energy consumption and overall emissions.

Product development considering environmental and social aspects bring additionally interesting results regarding the amount of non-useful waste, which is finally disposed. When the attention to sustainability aspects is taken since the design phase, the amount of this kind of waste in the end of the life cycle is minimum. An example is VW and Audi, that follows the ISO 22628 standards for recyclability and recoverability of road vehicles, and which vehicles are at least 85 % recyclable, and 95 % overall recoverable. At the same time, BMW Group Recycling and Dismantling Centre has been researching new solutions for increasing the vehicle recycling rate, reducing consequently the amount of waste disposed, e.g. regarding batteries from hybrid and electric models, which can be used to produce photovoltaic systems.

Finally, by managing resources more efficiently, overall emissions and the amount of energy, materials and waste disposed are further reduced. According to VW using resources efficiently reduces not only the environmental impacts but also manufacturing costs. Savings in energy consumption affect directly energy-related emissions. Porsche, for instance switches off all the machines and lighting during the morning brakes, resulting in less energy, costs and waste, including noise ones. The use of renewable energy, e.g. solar panels by the company in Leipzig allowed an annual reduction of 11,637 t of CO_2 emissions. According to their report “The biggest savings will come from the use of waste heat from the nearby woodchip- fired heating plant, which will provide almost 80 % carbon- neutral heating at the location and result in cost savings of approximately €360000 per annum.” Audi factory in Gyo˝r (Hungary) is also building a geothermal heat plant which is expected to meet approximately 60 % of the plant’s total heat requirements, and reducing in company’s CO_2 emissions by a further 23000 t.

Reuse and Recycle (6.1) and Waste Disposal (6.2) (phi=0,306)

The more a company reuses and recycles its waste, the less disposed waste is generated. VW states that at the planning stage of production technologies, the company must manage the waste generated in each process, including derived from harmful materials. Solutions for separating waste in an effective way promotes reductions in disposal expenses and allows capturing the its value though recycling systems. Waste reduction is also an important focus at VW’s locations in China. In April 2014, a project was launched in two locations, which aimed to increase the recycling ratio to 80 %. In Germany, BMW operates a closed, mandatory system for waste disposal. All dealers and dealerships are responsible for returning the listed materials to the BMW system for recycling and raw material recovery. Waste from service, maintenance and repair (e.g. bumpers, batteries, trim) should be inserted into this reverse logistics flow. Daimler, Audi and VW has been investing in projects for developing innovative solutions for recycling waste from electric vehicles (Lithium Battery Recycling Initiative). Audi is also involved in the Aluminium End-of-Life (Aleol) project, which aims to develop a recycling process chain, for testing the effectiveness of the latest sorting technologies, among others. Moreover, Daimler search for alternatives for reusing wastewater from the production plant. All initiatives will result, thus, in less waste disposed to the environment.

Pollution Control (6.3) and Customer Engagement (7.2) (phi=0,315)

Discussions about how to minimize emissions to the environment (air, water, visual, noise or odor) should consider the product life cycle, starting in the design phase with each materials to be used, until how customers use and dispose their products after the end of the use-phase.

This concept, thus, includes the customer responsibility in reducing the overall impact of a product and encourage them to set a more sustainable behavior. Additional services can also support this change, such as a Daimler’s tool to support decision making between each available alternatives for urban mobility and a car-sharing services, e.g. Car2go.

5.3.4 Preliminary Conclusions

Although the increase researches and companies’ efforts to implement sustainable supply chain practices, new approaches regarding the topic are necessary. In this section, the focus is given in the systematic combination of practices which can result in an “combination benefit” for companies similar to the concept of relational rent (Dyer and Singh, 1998). Answering the further research suggestion from chapter 3 “What is the relationship between each group and sub-groups of practices from the framework?”, this section presented interesting results.

First, it shows that among the seven structural dimensions of the framework for managing SSC practices (Campos, 2015), production and waste management are central with strong correlations with each other and with customers. Governance dimension, compound of fundamental initiatives for building corporate sustainability, confirms its strategic level while supplier relationship cluster dimension seems to be decoupled from the others.

Further, based on the correlations among the 21 categories, practices reported by five German vehicle manufacturers were analyzed and exemplify how companies have been combining initiatives in order to obtain extra benefits. It confirmed the central role of procurement, waste and production management and the crucial responsibility of logistics processes towards a closed-loop supply chain. The deeper analysis of the categories also provided insights about the disconnectedness of supplier relationship, distribution and customer relationship practices which might be a sign of lack in SC integration and loss in improvement opportunities

5.4 Results of the EIL Matrix Applicability

As described previously on section 5.1.4, the EIL Matrix is divided in four quadrants. Therefore, the results will be explained following each of the quadrants.

5.4.1 General Results

Results from the workshops and interviews conducted in Brazil provided interesting insights about the implementation level of SSC practices by companies in Brazil and the perceived effort and impact of each of the practices by decision makers. Complete results are displayed in Appendix 13. As observed from figure 25, all categories of practices are perceived by companies in Brazil as resulting in high impacts and requiring high efforts. With this outcome, some conclusions and questions arise:

- The low maturity level regarding SSCM among companies in Brazil contributes for the general evaluation of all categories of practices as hard to be implemented (demanding a considerable amount of investments)
- The high impact of all categories of practices reinforce the importance of the topic in the country.
- Since all categories are in quadrant 2 of the EIL Matrix, in theory, all of them might be object of future projects with partners. However, there is a need for futher analysis.

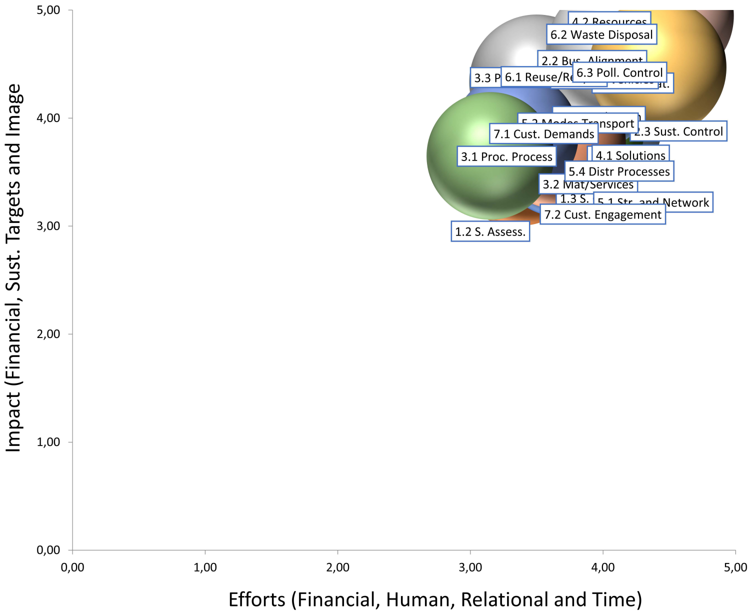


Figure 25. Results from the EIL matrix in Brazil (own author)

A detailed blick in quadrant 2 is displayed in figure 26.

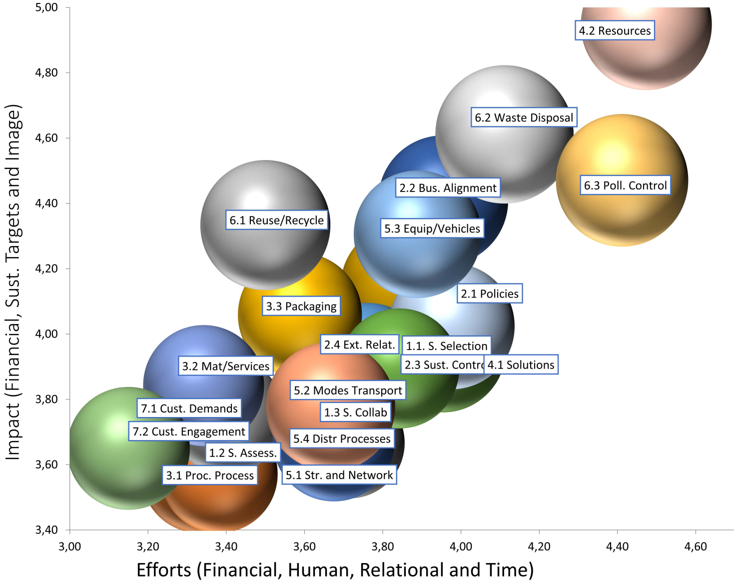


Figure 26. Results from the EIL matrix in Brazil (zoom in) (own author)

As for the implementation level, as shown in table 48, companies in Brazil seem to consider themselves high (more than 4/5) in “6.2. Waste disposal” measures and low (less than 3/5) in “1.2. Supplier Assessment”, “1.3. Supplier Collaboration”, “3.1. Procurement Processes”, “3.2. Materials and Services” and “5.2. Modes of Transport”. These categories will also be considered when identifying where stands collaboration opportunities between Germany and Brazil.

Table 48. Implementation levels of companies in Brazil

Practices	Implementation
1. Supplier Relationship	
1.1. Selection	3,17
1.2. Assessment	2,95
1.3. Collaboration	2,60
2. Governance	
2.1. Company's Policies	3,52
2.2. Business Alignment	3,57
2.3. Sustainability Control	3,37
2.4. External Relationship	3,27
3. Procurement	
3.1. Process	2,93
3.2. Materials and Components	2,89
3.3. Packaging	3,25
4. Production Management	
4.1 Solutions Development	3,34
4.2. Resources	3,62
5. Distribution	
5.1. Structure and Network	3,16
5.2. Transport Modes	3,04
5.3. Equipment and Vehicles	3,43
5.4. Distribution processes	3,52
6. Waste Management	
6.1. Reuse and Recycle	3,57
6.2. Waste Disposal	4,04
6.3. Pollution Control	3,70
7. Customer Relationship	
7.1 Demands	3,09
7.2 Engagement	3,18

5.4.2 Quadrant 1 “haven’t started yet?”

Categories of practices that demand low efforts and offer high impact to the company are suggested to be focused internally. The ones identified in this research were: 3.3 Packaging and 6.1 Reuse/Recycle. Their implementation levels are intermediary (3,25 and 3,57, respectively) which means the intensification of these initiatives might be easier rather than starting from the beginning. Brazilian companies can reduce the overall impact through internal collaboration engagements. These are critical as well for extending these initiatives to other supply chain members such as suppliers and customers. Since a large percentage of product’s carbon footprint comes from suppliers (Accenture, 2012), companies should search for solutions to sustainability challenges together with business partners. Additionally, collaboration with Germany might me profitable in identifying more sustainable packaging options, and on how automotive manufacturers involve their suppliers towards these improvements (Thun and Müller, 2010).

Regarding reuse/recycling, partnerships with customers for reverse logistics or awareness programs are fundamental for reducing the overall impact of whats is being produced/sold. The real success of these actions depend, as well, on how the products are built. Modular components or those without toxic substances (McKinsey&Company, 2015), for instance, allow companies to improve their reuse/recyclability rates. Further studies to comprehend how European countries such as Germany reach high recycling rates might also be useful for improving performances. As previously found, encouraging T&LS companies to reuse/recycle might be a big challenge since their maturity level in this issue is considerably low (Chiarini, 2014; Colicchia et al., 2013), however also a great opportunity for generating extra revenues and achieving sustainability targets.

5.4.3 Quadrant 2 “business partners”

Categories of practices with high efforts and high impacts in terms of financial performance, sustainability targets and brand image are suggested to be implemented together with business partners. The ones identified in this research are: 2.1 Company’s Policies; 2.2 Business Alignment; 4.2 Resources; 5.3 Equipment and Vehicles; 6.2 Waste Disposal and 6.3 Pollution Control.

Waste disposal is the categories with highest IL among companies in Brazil (4,04), thus on avarage “partially implemented”. It is recommended to be monitored (efforts and impacts) not to let it turns into a “question mark” in BCG Matrix que low impacts and still high efforts. Once the capabilities and consequently power are most probably concentrated in the firm, partnership with companies that are not mature in this category might not be profitable. Even though, a deeper analysis is needed and partnerships between supply chain members that owns complementary experience might support the development of innovative approaches (Pagell and Shevchenko, 2014). The other categories have IL between 3,4 and 3,7 and are recommended to be focus of collaboration projects with business partners in order to reduce their necessary efforts. As pointed by Gulati and Singh (1998), the exchange or share of resources, co-development of products, services, or technologies have greater chances for improving supply chain performance. Consequently, this partnership may promotes each participants’ performance. In the next chapter (6), a detailed study is presented in order to identify collaboration opportunities regarding these categories between government, associations and companies from Germany and Brazil.

5.4.4 Quadrant 3 “combination of initiatives”

Categories located in quadrant 3 are characterized by requiring low efforts and low impacts. Different from what Henderson suggested for the “dogs” in the BCG Matrix, these categories are not worthless. Managers have to find strategies to improve their outcomes such as through the combination of practices. The categories that fit to this quadrant in this research are: 1.2 Supplier Assessment, 1.3 Supplier Collaboration, 2.4 External. Relationships, 3.1 Procurement Processes, 3.2 Materials and Services, 5.1 Structure and Network, 5.2 Modes of Transport, 5.4 Distribution Processes, 7.1 Customer's Demands, 7.2 Customer Engagement. For a company-specific analysis, the identification of practices that offer a "relational rent" (Dyer and Singh, 1998) should be conducted according to the company results. Using the findings from a study based on literature about SSC practices (section 5.3), it is assumed that 3.1 Procurement Processes might generate larger impacts when implemented in combination of Reuse/recycle strategies (located in quadrant 1). The same might happened with 3.2 Materials and Services when implemented in combination with Packaging (also located in quadrant 1). Some of the others with high correlations with categories located in quadrant 2 (partnerships) can be incorporated in the scope of a project together with external partners. Example: Supplier collaboration and Business Alignment. The expansion of an internal corporate training program to its suppliers might improve the impacts of supplier collaboration with the company.

5.4.5 Quadrant 4 "specific analysis"

Categories that require high efforts, nevertheless offering low impacts, identified in this research are: 1.1. Supplier Selection, 2.3 Sustainability control and 4.1 Solutions development. They are recommended to be object of specific analyses in order to identify opportunities for improving their impacts and reducing the efforts. Since all of these categories have a low implementation level, companies in Brazil might be facing challenges in implementing those categories, e.g management systems and internal KPIs related to sustainability. If the requirements come from legislation or from the market, companies need to manage these practices in order to minimize the negative variables and increase the positive outcomes. The necessary efforts to implement it might be continuously reduced as long as the firm gets more experience in managing it. Additional benefits might also arise when the firm anticipate the demands from legislation with a pro-active approach.

One example is solutions development category that might be located in this quadrant due to the lack in customers' awareness and value in purchasing social-environmental responsible products and services. Consequences are low demand and perceived high impacts and costs. The trend is, however, that customers in Brazil will increasingly demand and give a higher value to sustainable solutions, which will enable companies to lower their efforts and improve their outcomes. Furthermore, collaborations with other supply chain partners might help reducing the necessary efforts to have these initiatives implemented, especially when it is a mandatory requirement. Supplier selection category, for instance, might have its efforts reduced with partnerships with industry collaborative projects aimed to develop industry-specific criteria for selecting suppliers and support their sustainable development, e.g. Together for Sustainability.

5.5 Conclusions

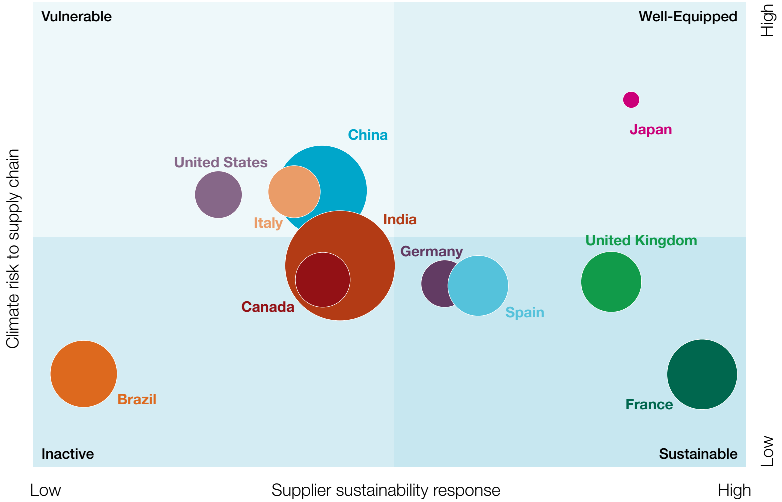
The third scope of the "Methodology for planning sustainable supply chain initiatives" has the aim to support decision making regarding the portfolio of practices to be implemented by a certain company, also together with other supply chain partners. Therefore the "Practices Portfolio Planning Matrix", called EIL matrix (efforts-impact-implementation level) was developed. Each of its quadrants contains specific characteristics based on the considered variables and suggestions for improving corporate and SC performance. Using this mechanism, the author collected data from companies in Brazil. General findings showed, on one hand, the low maturity level regarding SSCM among companies in Brazil and on the other hand the importance of the topic in the country (high impact). Practices from each of the quadrants were discussed calling attention for those more appropriate for implementation in combination with others with high impacts. The logic is to obtain extra benefits similar to the concept of "1+1=3" and the "relational rent" (Dyer and Singh, 1998). Procurement Processes for instance showed to potentially generate larger impacts when implemented in combination of Reuse/recycle strategies (located in quadrant 1). The same might happened with 3.2 Materials and Services when implemented in combination with Packaging (also located in quadrant 1). Moreover, practices from quadrant 4 (specific analysis) showed to be strongly related to requirements from legislation or from the market. Additional positive impacts may be improved when anticipating the demands from legislation with a pro-active approach. Finally, practices recommended to be implemented together with business partners are further discussed in details in the chapter 6.

6 Collaboration Opportunities Germany and Brazil

Emerging countries have been increasingly used as sustainability research object in the last years due to their large population, rapidly increasing per capita material consumption and limited citizens' environmental awareness (Wu et al., 2016). These countries seem to have also weaker corporate culture, knowledge and performance on sustainability management (Zhang, 1999) which evidence high challengesin improving sustainable development. The majority of the studies focus in Asian markets (Lee, 2012; Rao and Thamizhvanan, 2014; Zhu and Zhang, 2015) while few are conducted within the Brazilian context (De Sousa Jabbour, De Souza Azevedo, Arantezs, & Jabbour, 2013; Gunasekaran, Jabbour, & Jabbour, 2014; A. B. L. S. Jabbour & Jabbour, 2009). Recently, interest in analyzing sustainability initiatives carried out by companies from Brazil is arising (Gunasekaran et al., 2014; Jabbour, Jabbour, et al., 2013). For some researchers its cultural characteristics require more discussions regarding the adoption of SSC practices (Caldas and Wood, 1997; Jabbour et al., 2016; Mittal and Sangwan, 2014) once this is considered an implementation driver or barrier (Carter and Jennings, 2002). According to Holt & Ghobadian (2009), national identity may also influence how initiatives are operationalized in a different host country.

Calls for more research in developing countries are reinforced by Pagell & Shevchenko (2014) and Pallaro, Subramanian, Abdulrahman, & Liu (2015). Discussions are traditionally regarding the transfer of knowledge from developed to developing countries however recently a recently published book chapter by Touboulic & Ejodame (2016) called attention to learning opportunities from emerging countries regarding the three TBL objectives. This dissertation and the present chapter follow this movement and focus on exchange instead of transfer of knowledge in order to answer the last research question **“Where stands collaboration opportunities between German and Brazilian companies in order to improve sustainability in their supply chains?”**

The comparison of initiatives conducted by companies from developed and developing countries is important for understanding differences in their characteristics that affect supply chain performance. This is critical for overcoming the sustainability challenge in a global manner and through setting successful collaboration projects. Sharing best practices enable not only developing countries (Hsu et al., 2013; Jabbour, 2015; Wu et al., 2016) but also developed ones to manage their portfolios of practices in a more holistic way, considering efforts and impacts from/in the whole supply chain. Specifically regarding Germany and Brazil, despite the closer relationship between the two countries in international trade (Welford, 2005), SSC research considering both countries are still inexistent. Germany is one of the top five exporters of Brazil (MDIC, 2016) and more than 900 German companies are operating in Brazil with total investment of 19 billion euros (46 % of all Latin America). Among the most problematic factors for doing business with Brazil are: tax rates, restrictive labor regulations and corruption (Forster et al., 2015). Moreover, as observed from figure 27, different from Germany, Brazil has been facing challenges in involving suppliers in sustainability actions. In a globalized world where companies can trade with partners from anywhere, the level of responsiveness to SC disruptions makes a big difference when selecting supply partners.



vulnerable	Susceptible to risk due to poor risk mitigation
Inactive	Low risk exposure hence suppliers unconcerned
Well-Equipped	Aware of risk and steps taken
Sustainable	Extensive measures despite low risk exposure

Figure 27. Sustainability risk/response matrix (Accenture Strategy, 2014)

The first two sections of this chapter present relevant information about Germany and Brazil, especially in the context of sustainable development in order to show why these two countries were chosen as representants of developed and developing ones. The third section presents findings from a statistical and a content analysis, which shows the differences in SSC categories of practices between the two countries. Finally, based on these results and those obtained from the EIL Matrix with participants in Brazil (section 5.4), collaboration areas are presented and discussed. These can be taken in diverse formats such as by single companies, associations or through governmental agreements towards a more sustainable supply chain between the two countries.

6.1 Germany

Germany has a population of 80.97 million (2014), a Gross domestic product (GDP) of $3.686 trillion (2014) and a 8.9 metric tons per capita (2011) of CO_2 emissions (World Bank, 2015). The country is recognized as a leader in successfully aligning prosperous and sustainable growth, and capable of decoupling economic growth from its environmental footprint (Buehler et al., 2011). According to Rehman and Shrivastava (2011), the 'Green movement' started in Germany supported by one of the most stringent environmental legislation in the world. Environmental protection policies seem to be part of the economic activity and cultural background described as "green policy is merely good industrial policy" (Federal Ministry of Economics and Technology & Federal Ministry for the Environment, 2010).

Particularly in Germany, federal gasoline and sales taxes have been encouraging the demand for less polluting and smaller vehicles, in parallel with other initiatives such as shifting from road to rail, employing alternative fuel vehicles, creating a culture of change, driver training, encouraging use of public transport, promoting horizontal collaboration across supply chain, reducing consumption and recycling (Eyefortransport, 2007). Due to the established infrastructure which limit the options for modal shift, firms need to invest considerably in high technology (Intergovernmental Panel on Climate Change, 2014). Additionally, multinationals face challenges of adjusting their operations to requirements from different national regulations and environmental acts (Thun and Müller, 2010).

Although the European Union have implemented directives like waste electrical and electronic equipment (WEEE) and end of life vehicle (ELV), the main driver for ecological initiatives in Germany are customers' demand and market competition. The country is also characterized by well balancing cooperation and competition (Sachs and Loske, 2002) which was pointed in section 4.5. As observed from figure 28, German firms have been involving their suppliers in reducing emissions in a higher percentage (61 %) than the average of the participants from other countries (52 %) (Accenture, 2014). Except for water risk management, all other measures focused on this survey were higher among the Germany respondents.

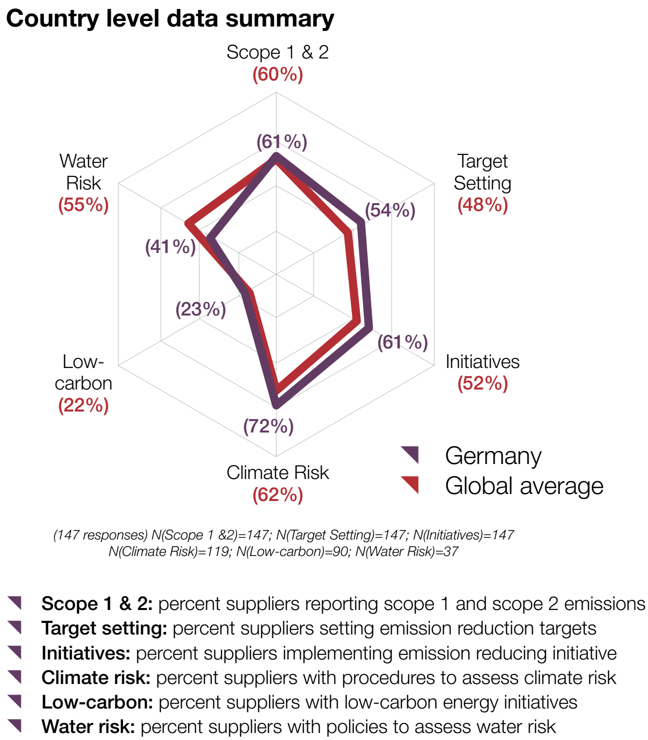


Figure 28. Country level data summary – Germany (Accenture Strategy, 2014)

Germany is also a leader in power generation by renewable energy which reached 30 % in 2015 (figure 29). By the year 2025, 40-45 % of electricity consumed in Germany is planned to be derived from renewables; by 2035 the target is 60 % (Federal Ministry for Economic Affairs and Energy, 2016).

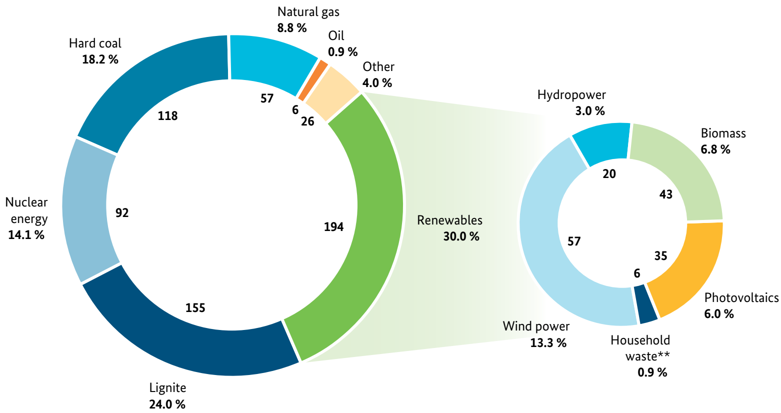


Figure 29. Gross electricity generation in Germany (Federal Ministry for Economic Affairs and Energy, 2016)

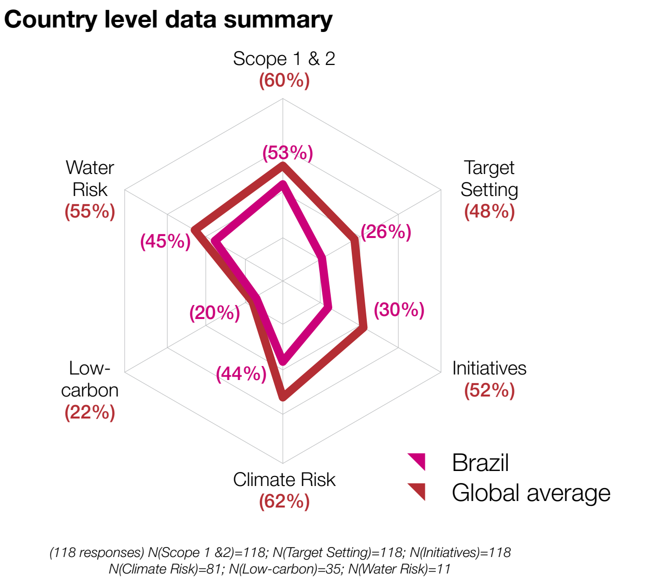
6.2 Brazil

Brazil is responsible for 30 % of the wealth generated in Latin America and member of the BRIC countries - Brazil, Russia, India, and China (Gunasekaran et al., 2014). Besides the current economic political crisis, it still have chances of becoming one of the top-10 economies by 2050 (PriceWaterCoopers, 2015). The country has a population of 206.1 million (2014), a GDP of $2.417 trillion in 2014 and a 2.2 metric tons per capita (2011) of CO_2 emissions (World Bank, 2015).

Despite the position of the world's seventh biggest greenhouse gas polluter, the country has lower the increase of its resource footprint (Wu et al., 2016) and implemented since 2010 governmental initiatives such as the New Policy for Solid Waste (NPSW). This policy gives the directives for building an integrated management system of solid waste, including hazardous ones, under the principles of the co-responsibility and through the promotion of cooperation agreements between economic sectors and public institutions (Brasil, 2010). Furthermore, in October

2015, Brazil was the first major developing country to set reduction targets in GHG emissions for the global pact against climate change: 37 % by 2025 from 2005 levels. The focus is on, until 2030, ending illegal deforestation and increasing the share of renewable sources in country's energy mix – target of 66 % from hydropower and 23 % from other renewable sources such as wind, solar and biomass (The Guardian, 2015). In the beginning of 2016, the government started to put in practice a 10-year energy plan released in 2014 which intends to generate 7 Gigawatts from solar projects by 2024, making up 3.3 % of Brazil's energy mix. According to the president of the Brazilian Solar Power Association (Absolar), if panels were installed on the rooftops of every house in the country, solar energy could supply more than double the Brazilian residential demand (The Guardian, 2016b).

Given the abundance of natural resources, the deployment of renewable energy should be more accessible than in Germany (Woerlen, 2010) nonetheless, their energy endowment and technologies limitations would limit the transfer from fossil fuel to clean energy sources (Wu et al., 2016). The population's lack of sustainability awareness and resistance are considered the strongest barrier for implementing SSC practices in emerging countries such as Brazil (Jabbour et al., 2016) and China (Zhu, Crotty, et al., 2008). A consequence is illustrated in figure 30: initiatives to manage climate exposures among Brazilian suppliers are lower than the average of countries in all measures utilized in this research (Accenture, 2014).



- **Scope 1 & 2:** percent suppliers reporting scope 1 and scope 2 emissions
- **Target setting:** percent suppliers setting emission reduction targets
- **Initiatives:** percent suppliers implementing emission reducing initiative
- **Climate risk:** percent suppliers with procedures to assess climate risk
- **Low-carbon:** percent suppliers with low-carbon energy initiatives
- **Water risk:** percent suppliers with policies to assess water risk

Figure 30. Country level data summary – Brazil (Accenture Strategy, 2014)

Other challenges are lack of infrastructure and high logistics costs (11,7 % of the GDP in 2014) in a country where 67,2 % of total transportation (in % of tons per kilometer cargo uni)) is done by road and only 18,3 % by rail (ILOS, 2015). The energy sector is as well critical in Brazil, representing nowadays the same amount of emissions than deforestation - 31 %. Due to the constant droughts in the country, reservoirs of hydropower plants are depleted, turning to be necessary to intensify the use of thermoelectric plants which are much more pollutant. Some researchers express also concern with the expansion in the agricultural sector by 1,8 % in 2015 and more particularly the rise in soy industry. The country is currently the major exporter of soy in the world, responsible for one-third of its global trade (Gaworecki, 2016). The agriculture sector, besides requiring high demands of energy and causing deforestation, accounts for around 61 % of the country's emissions (Garcia, 2015).

According to recent research (Rao and Thamizhvanan, 2014), decision makers in developing countries have been increasing their sustainability awareness although this does not mean willingness to support adaptation strategies. This study was conducted in India, however similar results were obtained in Pakistan (Jeswani et al., 2008) and Brazil. According to Jabbour et al. (2013) when researching high-tech companies in Brazil, the most adopted practices were: internal green management, investments recovery and reverse logistics. The authors also highlight that collaborative approaches with customers are still not evident and firms cannot be considered pro-active regarding SSC initiatives, especially due to the scarcity of structured actions e.g. eco-design. Some of the most cited practices are: comply with environmental legal requirements and implement audit programs (Jabbour, 2014). Similar results were found when analyzing the literature regarding sustainable supply chain published in Brazil, only three of the nine researched concepts were found: green logistics, reverse logistics and reverse chain (Dias et al., 2012). In emerging countries, regulations such as environmental ones (e.g. New National Solid Waste Policy) and international directives such as RoHS (Restriction of Certain Hazardous Substances), required by foreign customers (Christmann and Taylor, 2001; Jabbour, Azevedo, et al., 2013a) are the main driver for SSC practices. Similar results were observed in section 4.5. The lack of a systemic perspective approach is as well evident among this group and more research is needed to fill this gap (Dias et al., 2012).

6.3 Insights from Statistical Tests and Content Analysis

Based on the content analysis previously described on section 5.2 with 10 German and 8 Brazilian companies, the chi-square test for paired data (McNemar's test) was run in order to identify if the two groups of companies where statistically different. The results (table 49) show that no significant difference could be identified in the general amount of reported practices.

Table 49. Significant statistical differences between Germany and Brazil – general results

	Germany		Brazil	
	Implement	**Not implement**	**Implement**	**Not implement**
Practices (absolut)	510	400	408	320
Practices (%)	56,04 %		56,04 %	
McNemar chi-square test	p-value = 0,6766			

However, when analyzed each of the 21 categories of practices through the Fisher exact test, some specific differences could be verified (table 50). Although, they were already discussed in details in section 4.5, they are summarized in the following paragraphs for better understanding of the collaboration areas.The complete table with results from the Fisher exact test is displayed on Appendix 15.

Table 50. Significant statistical differences between Germany and Brazil – results per category

Practices	p-value[9]	Who implement more?
2. Governance		
2.4. External Relationship	0,083*	Brazil
3. Procurement		
3.3. Packaging	0,078*	Germany
5. Distribution		
5.1. Structure and Network	0,045**	Germany
7. Customer Relationship		
7.1. Demands	0,096*	Brazil

Brazilian companies report more initiatives than the Germans on strengthen relationship with governments and regulatory agencies. Previous studies in developing countries have identified the lack of partnership with government as one of the most relevant barriers for improving corporate sustainability (Ahmed and Ali, 2004). This might explain the need to minimize the lack of developmental support and barriers for industrial development in these countries (Schroeder and Gomes, 2014). Companies in Brazil also reported more initiatives related to managing customers' demands, which can be explained by their expectation of closer contact through different types of communication channels. These can also be due to international requirements from foreign customers and the need to adjust the products to a "local taste", for instance, or giving instructions in different languages about health, safety and environmental issues. Nevertheless, this findings does not mean more collaboration with customers (Jabbour, Azevedo, et al., 2013a), a common practice among chinese companies (Zhu, Crotty, et al., 2008). If implemented, these could support Brazilian companies in succeeding in

[9] Notes: * for p <= 0.1, ** p <= 0.05

reverse logistics (and for filling the PNRS), eco-design and clean production initiatives, as well for improving SC sustainability awareness (Arantes et al., 2013).

German companies, on the other hand, report more on improvements towards sustainable packaging aligned with the European Directive on Packaging and Packaging Waste amended in 2004. This directive is applied to all companies who sell products in European Union and aims reducing the use of raw materials and hazardous substances, promoting recovery standards in packaging components, and seting a concentration limit for heavy metals content (European Comission, 2015). In addition, German companies seem to involve suppliers in packaging optimization programs, differently from Brazilian ones that show resistance in collaborating especially suppliers and competitors. The use of pooling systems with other firms is also evident among the Germans and allow increasing the percentage of fully loaded trucks, reducing the number of empty runs and consequently emissions. Investments in efficient land use and green construction as well as specific strategies for reducing emissions are considerably higher among German companies. For them it is clear that building of environmental certification sites equipped with automation systems and modern technologies offer improvements in resources efficiency.

6.3.1 Implemented by Benchmarks from Both Countries

In order to analyze which initiatives are reported by companies from both countries, each of the 91 practices from the framework is positioned in table 51 according to the percentage of companies that cited it: low (<=35 %), medium (>35 %-65 %) and high (>65 %). The detailed list with the exact percentage of each practice per country is displayed in Appendix 16. Results show fundamental SSC practices that are vastly implemented, therefore, representing the ones that might be focused by those with still low sustainability level. As observed, most of them are located in the governance dimension, proved to be the basis for corporate sustainable development, such as environmental and social policies, an organizational structure to manage sustainability, internal communication and education, sustainability management as well as the set of relationships with society, NGOs and other companies. Furthermore, supplier relationship is based on statements of intentions to source from environmentally sound suppliers using specific selection criteria that consider the TBL, requirement of a compliance statement, conduction of frequent monitors and audits on-site. General collaboration statements are exemplified with supplier's educational programs however further collaboration engagements are not detailed reported. It is unclear if these are intentions, real actions or just greenwashing. Intentions are clearly reported regarding the purchase of sustainable materials such as recycled ones, which support the development of more sustainable solutions. Energy and water management programs, employment of cleaner energy sources and pollution control measures are also vastly highlighted. Strategies to strength customer relationship are presented in the majority of the researched companies which do not mean collaboration.

6.3.2 Not implemented by Benchmarks from Both Countries

When analyzing practices that were scant in both groups, calls attention that the majority is located in the distribution dimension. As described on chapter 4, this evidences the lack of SC integration. Since practices are traditionally implemented by LSPs, focal companies are not able to have full visibility on the implemented practices (Colicchia et al., 2011). Even when they do know what are the partner's approaches towards sustainability, they do not integrate these initiatives into their own CSR reports. Most probably, they do not conduct a deeper and detailed analysis on their partners' initiatives to search for synergies with their own operations. Chances of building collaboration projects and a truly sustainable supply chain (Pagell and Shevchenko, 2014) seem to be missing especially among producers.

As previously described (section 4.2.3) the lack in practices related to IT suggests that companies might not give enough attention to this topic or the benefits concerning energy and material consumption are too low to

be considered/reported. The same happens with collaboration with suppliers for developing new technologies, packaging improvements or for eco-design which were not much cited or implemented by benchmarks in both countries evidencing in practice the challenges in setting collaborations, even among multinationals, benchmarks in sustainability.
Surprisingly is the lack of citations about quality policies in sustainability reports. Some questions arise: “Is quality considered a standard of today’s business that does not need to be reinforced in company’s reports?” “Is quality not considered as a sustainability aspect?”. Moreover few CSR reports considered special package/label for hazardous material, recovery of end of life products and remanufacture/refurbishment. Would be a sign that issues under strict regulations in both countries are seen as mandatories for businesses, thus, turning to be compulsory to be informed in sustainability reports?
In the next section, initiatives placed as low by one country and medium or high by the other are considered for analyzing the most appropriate categories where Brazil (companies and government) should collaborate concerning SSC.

Table 51. Results from the content analysis – Germany x Brazil

		GERMANY		
		LOW (<=35 %)	**MEDIUM (>35 %-65 %)**	**HIGH (>65 %)**
BRAZIL	**LOW (<=35 %)**	1.3.3. Collaboration - New Technologies 2.1.3 General Policy - Quality standards 2.3.6. Practices related to IT 3.3.3. Suppliers' involvement on packaging issues	1.1.4. Management System by suppliers 3.3.1. Reduce amount of packaging 5.1.4. Specific strategies for reducing emissions 5.2.1. General – Intermodal 5.2.2. General - Less polluting modes 5.2.4. Specific - Rail	4.1.4. Product Life Cycle management

		3.3.4. Special package and label for hazardous material 4.1.2. Provide green specification for suppliers 5.1.2. Layouts/Shared 5.1.3. Network redesign 5.1.5. Vehicle fleet optimization 5.2.5. Avoid air 5.3.3. Rolling Resistance Reduction 5.3.4. Increase Capacity 5.3.5. Aerodynamic 6.1.1. Recovery end of life products /Reverse Logistics 6.1.3. Remanufacture and Refurbishment		
	MEDIUM (>35 %-65 %)	1.3.5. Financial support for sustainability and improving quality 4.1.3. Online Services 5.3.6 Maintenance and renewal 5.4.3.Transport – Optimization	1.1.3. Certifications for supplier 1.1.6. Prefer using local/ minority-owned/specific suppliers 1.2.1. Communication of sustainability standards 1.2.4. KPI's and improvement targets for suppliers	1.2.5. Evaluation to indirect suppliers and/or subcontractors 1.2.6. Supplier`s change/rejection/penalization 2.3.4. Establish KPI's and improvement targets/goals for company

		6.3.2. Compensating programs	1.3.2. Collaboration – Integration 2.2.1. Link - sustainability strategy and supply chain 2.3.3. Environmental, Social and Quality Programs 3.1.1. Sustainable Procurement process 3.2.3. Specific - Less hazardous materials 3.3.5. Eco-labels 4.1.5. Products that reduce customer's energy 5.2.3. Specific – Water 5.3.1 Type of fuel 5.3.2 New technology- eco-efficient 5.4.1. Inventory Management/Hazardous 5.4.2. Transport - Low speed and correct poor driving 6.1.4. Recycling 7.2.1. Educate customers on sustainability issues 7.2.2. Complementary services 7.2.3. Collaborate with customers	4.2.1. Reduce overall consumption (materials…) 5.1.1. Efficient land use and Green construction
	HIGH (>65 %)		1.3.4. Collaboration - Sustainable Processes 2.1.4. Compliance with Regulations 2.2.6. Financial issues	1.1.1. Sourcing from environm. sound suppliers 1.1.2. Criteria for supplier selection considering also en-

			2.3.2. Company's Certifications 2.4.2. Relationship - Government and regulatory agencies 2.4.3. Relationship University 2.4.6. Audit by third party companies 3.1.2. . Long-term and clear contracts with environmental dimensions 6.1.2. Reuse 6.2.1. Waste Disposal 7.1.2. Inform customers about sustainability issues	vironmental and social aspects 1.1.5. Compliance statement from suppliers/guidelines/CC extension 1.2.2. Monitor and audit suppliers' performance/.. 1.2.3. Audits using on-site inspections 1.3.1. General Collaboration/Cooperation 1.3.6. Educate/offer technical env.information 2.1.1. General Policy - Environmental standards 2.1.2. General Policy - Social standards/Code of conduct 2.2.2. Structure - Cross function/Sust. Department 2.2.3. Communication with stakeholders 2.2.4. Human Resources - Training/Education 2.2.5. Human Resources - Social issues 2.3.1. Measurement system/ Sust. Management 2.3.5. Risk and Safety Management 2.4.1. Relationship - Society/Biodiversity

				2.4.4. Relationship - NGOs 2.4.5. Relationship - other companies 2.4.7. Publicize efforts 3.2.1. General Sustainable Materials and Services 3.2.2. Specific - Recycled and reusable materials 3.3.2. Improvements towards sust. packaging 4.1.1. Envir. social aspects in solutions develop. 4.2.2. Reduce consumption of energy 4.2.3. Energy Source 4.2.4. Water Management 6.3.1. Prevent, Reduce and Manage pollution 7.1.1. Customer Relationship Management

6.4 Collaboration Opportunities - Workshops

Based on the results from workshops and interviews in Brazil, categories from quadrant 2 were identified as more suitable for collaborative projects (highlighted on figure 31). These are characterized as with potential to provide high impact in companies although high efforts are needed. Collaboration with shared value chain parts contribute for reducing the required financial, human, relational and time efforts. Further, each of these categories are analyzed based on the results from previous sections in an attempt to recommend actions and a stronger partnership between Brazil and Germany (table 52).

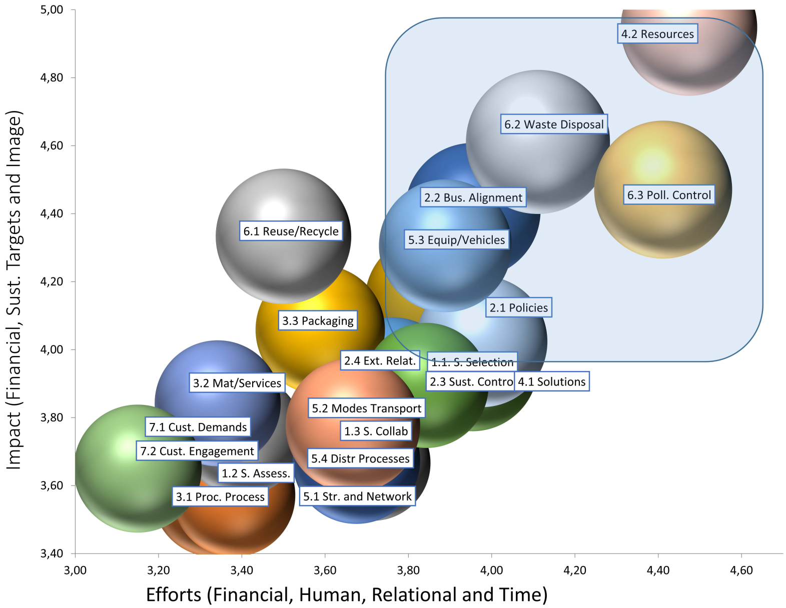


Figure 31. Quadrant 2 of the EIL matrix – collaboration opportunities (own author)

Table 52. Potential collaboration areas based on the perceived efforts/impacts of practices' implementation

High Efforts and Impacts	Conclusions	Collaboration areas/ objectives	Scope of action
2.1 Company's Policies	a) Benchmarks from both countries seem to have well defined social-environmental	a) Exchange of practices between Brazilian benchmarks and companies in the same country regarding policies and standards; e.g.	OUT

	policies. Learning opportunities exist between benchmarks and workshop participants (IL= 3,52/5).	codes of conduct. Effective policies enable communicating management's vision, which translates into strategic business plans (Hsu et al., 2013).	
	b) As previously observed, policies must be followed by the generation of knowledge between firms in order to greener the industrial context in Brazil (Jabbour, Azevedo, et al., 2013b)	b) Trainings on policies issues to promote the sustainability awareness among internal stakeholders (Arantes et al., 2013; Teixeira et al., 2012), suppliers, customers.	BEYOND
	c) Few companies from both countries reported about quality policies.	c) Further research to answer the questions: Is quality policy considered a current business standard that does not need to be reported? Are companies not considering quality as one important aspect of sustainability?	IN
	d) Due to the strict role of regulations in emerging countries (Jabbour et al., 2016), Brazilian companies seem to explicit the importance of complying with them in their reports. It is unclear whether these are national or from customer's country of origin. China, for instance, is impacted	d1) Instructions and discussions regarding regulations from main exporting markets (Germany and EU are among this group) to Brazilian companies.	BEYOND

	more strongly by EU regulations than their own regional ones (Zhu, Crotty, et al., 2008)	d2) Instructions and discussions regarding the Brazilian regulation to foreign companies.	BEYOND
2.2 Business Alignment	a) Benchmarks from both countries seem to have an organizational structure to manage sustainability and maintain a strong relationship with internal stakeholders. Learning opportunities exist between benchmarks and workshop participants (IL= 3,57/5).	a) Exchange of practices between Brazilian benchmarks and companies in the same country regarding sustainability department/cross functional team and relationship with this corporate public (Jabbour, Jabbour, et al., 2013)	OUT
	b) More German companies report the importance of linking sustainability strategy and supply chain.	b1) Reinforce the importance of this integration while building company's directives and strategies.	IN
		b2) Provide information about opportunities for improving business/SC performance through the implementation of SSC practices.	BEYOND
	c) Besides setting targets for improving environmental sustainability, certifications e.g. 14001 play an important role in promoting sustainability among Brazilian companies (Jabbour, Jabbour, et al., 2013). In a comparative study between UK and China this issue was found as a signifi-	c) Facilitate and give incentives for companies obtaining international environmental-social certifications or developing similar reliable certifications systems for those acting in the Brazilian market.	IN

	cant differences identified (Zhu, Crotty, et al., 2008)		
	d) For both countries, training programs are considered as very important strategy to improve corporate sustainability (Jabbour et al., 2016; Jabbour, Jabbour, et al., 2013; Thun and Müller, 2010). In developing countries, due to the lack of awareness or responsiveness from decision makers (Rao and Thamizhvanan, 2014), this is even more critical.	d1) Implementation of continuous trainings programs in order to promote benefits of a more sustainable behavior and changes in the national culture.	IN
		d2) Research how other emerging countries have been managing this issue, especially changing population's behavior, and learn from them.	OUT
4.2 Resources	a) Benchmarks from both countries seem to set energy and water management programs, as well as invest in renewable energy sources. Learning opportunities exist between benchmarks and workshop participants (IL= 3,62/5).	a1) Exchange of practices between Brazilian benchmarks and companies in the same country regarding resource management. Reduce water consumption is already target of companies in Brazil (Jabbour et al., 2016) nevertheless investments in renewable energy is already in its infancy.	OUT
		a2) Development of measurement standards and KPIs to be applied by all companies in Brazil when reporting resource consumption, optimization and emissions. This makes comparison easier.	IN
	b) German firms report more initiatives	b) Comprehensive campaigns in TV promotions,	OUT

	to reduce overall consumption, which also include materials such as paper… This might be reflected by the higher sustainability awareness level of this population.	newspapers, school education and regular workshops to disseminate about resource scarcity and the importance of its efficient management (Zhu et al., 2013). Awareness campaigns focusing on the energy and water scarcity in Brazil (Reuters, 2015) support the transition from a waste culture to a resource criticality culture.	
	c) German companies report considerably more initiatives related to the Product Life Cycle management.	c1) Design and discuss the implementation of an integrated product policy (Berkhout and Smith, 1999) for legitimizing life cycle assessment methods among Brazilian firms. If suitable, international standards might be applied. c2) Combine online services for customers with awareness programs in order to reduce overall emissions.	BEYOND
	d) Germans report considerably more in green buildings, and employment of automatization systems and high-technology to optimize resources consumption.	d1) Subsidize and foster investments in more sustainable sites, high-technology systems and resource management approaches.	OUT
		d2) Promote the transfer of knowledge and technologies with Germans regarding in this issue.	OUT
5.3 Equipment and Vehicles	a) Although firms from both countries reported similar (medium) levels of employment of more eco-efficient vehicles, Germany is well known as leader in	a1) Support the massive employment of these technologies in emerging countries like Brazil.	OUT
		a2) Transfer technology from Germany to Brazil concerning its maintenance	BEYOND

	greening the automotive industry.	and production of spare parts.	
	b) Few companies report distribution practices	b1) Discuss challenges in implementing and reporting practices by T&LS firms. Industry associations might support analyzing particularities in this industry. b2) Discuss challenges in extending SC efforts towards sustainability and reporting joint engagements by SC members.	OUT
	c) Besides benchmarks from both countries, workshop participants seem to have difficulties in improving sustainability of equipment and vehicles (IL= 3,43/5).	c) Foster the development of national technological improvements in equipment and vehicles.	IN
	d) Germany combine eco-efficient technologies with less-polluting modes of transport such as rail.	d) Enable and raise investments for rail and water transport infrastructure through PPPs, including foreign institutions. Industry associations may support this initiative.	OUT
	e) Brazilian companies report higher levels of maintenance and renewal programs than German ones. This can be explained by the higher operational costs due to poor infrastructure.	e) Structure public-private partnerships (PPP) in order to improve infrastructure, using the closer relationship firms have with governments (as identified previously). Industry associations may support this initiative.	OUT

	f)) German companies report more the use of network centralization strategy and direct shipping. This is possible and seem appropriate due to the country/region size. In Brazil, the country size, lack in infrastructure and high service level demanded by the customers favor decentralization.	f) Build pooling systems in intermediate sustainable logistics structures in order to reduce emissions with warehousing, enable higher rates of truck consolidation and promote (horizontal) collaboration. Industry associations may support this initiative. Additional social benefits such as less congestions and noise are expected.	OUT
	g) Brazilian firms report more in transport optimization initiatives which offer cost/emissions reduction opportunities and, thus, higher margins to the LSPs.	g1) Apply this knowledge to trigger the structure of associations among LSPs such as ABOL (Associação Brasileira de Operadores Logísticos) to promote their professionalization, dissemination of a culture of collaboration and trust.	OUT
		g2) Promote collaboration projects involving carriers and shippers that support costs and resources optimization similar to the Green Freight Europe Initiative.	BEYOND
6.2 Waste Disposal	a) After reducing consumption, the next strategy suggested to reduce waste disposal is the reuse (Wu et al., 2016). This is not common among German companies (McKinsey&Company, 2015) as it is among Brazilian ones. One example is the European Directive on	a) Exchange of knowledge about reducing x reusing practices with Germany in order to support improving the “reuse” culture in the European country and the reducing among the Latin American one.	OUT

	Packaging and Packaging Waste that makes clear that developing a package to be reused is optional.		
	b) The strict requirements from the PNRS have been driving reduction in solid waste and its appropriate disposal (Jabbour et al., 2016) which might explain why this issue is highly reported by Brazilian firms (including those in the workshops). Although in Europe, regulations are also strict and non-compliance costs high, companies do not commonly report about waste disposal initiatives.	b) Partnerships to discuss and implement projects regarding waste management regulations among companies in Brazil (through industry associations?). Regulation is an important driver for improving sustainability in developing countries (Jabbour et al., 2016).	OUT
6.3 Pollution Control	a) Benchmarks from both countries seem to conduct measures to control emissions, reported by all Brazilian companies (70 % from the Germans). Learning opportunities exist between benchmarks and workshop participants (IL= 3,70/5).	a) Exchange of practices between Brazilian benchmarks and companies in the same country regarding pollution management, focusing on emissions prevention.	OUT
	b) Few companies from both countries report prevention measures. The focus	b1) Conduct studies to understand differences in pollution management programs in each of the countries and the role of regulations as a driver.	OUT

	seem to be in controlling and corrective strategies.	b2) Encourage the employment of broader approaches such as the total cost in order to justify long-term investments, e.g. prevention.	BEYOND

The results from workshops and interviews in Brazil also allowed the identification of categories of practices with low implementation level[10]. Results are displayed in table 53.

Table 53. Potential collaboration areas based on the implementation level (low) by companies from the workshop

Low IL	Conclusions	Collaboration areas/ objectives	Scope
1.2. Supplier Assessment	a) Brazilian and German benchmarks reported high levels of monitoring and audit suppliers' sites while IL workshops companies = 2,95/5	a) Exchange of practices between Brazilian benchmarks and companies in the same country in improving monitoring and auditing on-site.	OUT
	b) More German companies reported demanding suppliers to have EMS that allow better control over emissions, resource consumptions, and visibility.	b1) Structure audit systems using collaborative platforms similar to "Together for Sustainability" for example, that support companies in monitoring their suppliers. According to Arantes et al., (2013) supplier assessment and partnerships are some of the elements to a successful supplier development.	OUT
		B2) Collaboration and information exchange through the support	BEYOND

[10] Low implementation level are those evaluated as less than 3 in the 5-point scale.

		them implementing management systems. The development of more accessible tools complemented with appropriate trainings may support suppliers in managing/exchanging their data.	
	c) Although companies from both countries declared that they punish suppliers that lack compliance, recent research stated that fewer than 30 % of the firms actually implement these measures. The reason might be the lack of available alternative supply options (Porteous, Rammohan, & Lee, 2015).	c1) Encourage suppliers to improve their performance and fit to the defined requirements/standards through the building of collaborative platform where they can also participate for building the assessment requirements and plans for monitor/audits.	OUT
		c2) Finance or facilitate the development of new sustainable suppliers or the improvement of the current ones (w.g. awards).	BEYOND
1.3. Supplier Collaboration	a) Both benchmarks groups reported high levels of collaboration with suppliers for turning their processes more sustainable and offering technical and environmental information while IL from workshops companies = 2,60/5	a) Exchange of practices between Brazilian benchmarks and other companies in the same country regarding supplier collaboration. Organize through industry associations of special training programs to support suppliers in turning their processes more sustainable/educational programs.	OUT

	b) Statements reinforcing the importance of general collaboration with suppliers are vastly reported by companies from both countries. The impact is positive on competitiveness and economic performance of the firm (Mitra & Datta, 2014) although detailed practices regarding the topic are still missing. This evidences challenges in conducting projects together with supply chain partners, particularly suppliers. An explanation might be the lack of trust, which might be a characteristic of emerging countries (Zhu et al., 2008a).	b) Build neutral collaboration platforms where supply chain members can exchange knowledge, problems and solutions. These can be structured by industry or multi-industries. Important to be leaded by a neutral, independent party, able to act as operator and facilitator of supply chain collaboration, e.g Tri-vizor.	BEYOND
	c) Financial support to suppliers are found only among some companies in Brazil (38 %). Specific studies showed that German managers do not agree in awarding suppliers for achieving environmental targets (Thun & Müller, 2010).	c1) Combine sustainability awareness, education and environmental information to suppliers (A. B. L. S. Jabbour & Jabbour, 2009) with incentives – financial and non-financial ones, e,g, public recognition environmental awards (Klassen & McLaughlin, 1996).	BEYOND
		c2) Understand which strategies do German companies motivate suppliers to improve sustainability awareness and initiatives among their suppliers.	OUT

	d) The reduction and employment of returnable/biodegradable packaging is currently being implemented by benchmarks although the extension of this practice to suppliers is not common among the companies in Brazil.	d) Promote shared responsibility among supply chain members and collaborations with packaging suppliers to support sustainability improvements.	BEYOND
	e) Neither German nor Brazilian companies report collaboration engagements towards developing new technologies. However, case studies evidence some examples.	e) Conduct studies to identify challenges or reasons not for reporting joint projects in CSR public documents.	IN
3.1. Procurement Process	a) Brazilian benchmarks reported high levels of long-term contracts and clear clauses while IL of workshops companies = 2,93/5.	a1) Promote exchange of practices between Brazilian benchmarks and companies in the same country about building long-term and clear contracts.	OUT
		a2) Verify how companies guarantee clear contracts. Do they build together with suppliers? Is there any standard of “fair basic contract” built by a neutral organization such as an NGO?	IN
	b) Brazilian benchmarks reported more initiatives than German ones regarding preferences for long-term and clear contracts. This issue seem to be critical in Brazil probably due to the fact that formal contracts ease the commitment of partners to	b) Conduct a more collaborative approach than just contract oriented. It is clear the importance of a clear contract for both parts however; the negotiation process should include a more holistic view over the performance measures.	BEYOND

	implement social-environmental initiatives (Lewis, Liu, & Song, 2015)		
3.2. Procurement - Materials and Components	a) Brazilian benchmarks reported high levels of sustainable materials and services purchase, e,g, recycled and reusable while IL of workshops companies = 2,89/5.	a1) Promote exchange of practices between Brazilian benchmarks and companies in the same country regarding sustainable materials.	IN
		a2) Build a sustainable materials/products public list/online purchasing platform where important information regarding sustainability are available based on same calculation methods. This makes comparison and purchasing easier. A neutral party should manage this platform.	BEYOND
	b) The development of more sustainable solutions and preference for green components (e.g. recycled materials) are vastly reported by benchmarks although not confirmed in Brazilian's reality (A. B. L. S. Jabbour & Jabbour, 2009). This can be explained by the sample of multinational companies that must attend requirements from foreign customers (De Sousa Jabbour et al., 2013).	b1) Promote eco-design practices which minimize resource consumption and waste generation, as well as reduce physical space during distribution (Arantes et al., 2013)	BEYOND
		b2) Design a national sustainable product award to encourage companies to develop these kind of solutions, improve visibility to the public and demand, and improve sustainability awareness.	BEYOND

	c) The consumption of hazardous/toxic materials in Brazil is an important topic (C. J. C. Jabbour et al., 2016) nevertheless few companies reported measures to minimize their use or find alternative substitutes. Moreover, the lower implementation level by companies researched during the workshops and interviews confirm the lack of actions regarding this issue.	c) Promote discussions and systemic approaches to deal with the topic, which should involve supply chain members, government, and especially companies that, must be encouraged to develop more sustainable solutions to substitute hazardous components. Some proposals and insights might arise from German chemical companies.	BEYOND

6.5 Conclusions

In a globalized world where multinational enterprises are involved in distinct environments, mimetic behavior and collaboration between firms from different countries are increasingly observed (Ferreira et al., 2014). According to Christmann and Taylor (2001), different cultures are becoming more similar due to environmental requirements from international trade and countries should learn from each other. One of the most successful strategies is using joint ventures that use technical knowledge from the parenting company and cultural knowledges from the local one. Despite this global movement, the role of culture and country specific characteristics showed to play an important role in the internationalization process. The results from this chapter reinforce the need of improving sustainability awareness among the world population, especially from developing countries. Learning opportunities exists in both countries based on the strengths and weakness of each, cultural background and particular current challenges.

The findings evidence improvement areas in each of the scopes of the "Methodology for planning sustainable supply chain initiatives". Those located in the first scope "ACTING IN" arise from differences in the behavior of workshop participants and benchmarks patterns. Although the two groups consist mainly of large Brazilian companies, differences in the implementation level were identified. They can be justified by the higher pressures and reputational risk once they are listed in a sustainability ranking. Some of the workshop participant companies, although also large companies might lack experience, management tools and skills to implement SSC initiatives (Zhu, Sarkis, et al., 2008). Together with differences are opportunities of exchanging knowledge, best practices and experiences in order to improve the overall sustainability level in Brazil.

The second scope "ACTING OUT" of the methodology provide collaboration areas in the industry point of view. Differences between Brazilian and German benchmarks can be turned into insights for local arrangements. Although previous studies have described the behavior of Brazilian companies as in an initial stage (Arantes et al., 2013; Dias et al., 2012; Jabbour et al., 2016), an interesting finding of this research is that no significant statistical differences was found in the variety of reported practices when compared with German ones. Moreover, when each category was analyzed, only four up to 21 showed differences which proves that collaboration opportunities exist in a two-way direction and the sharing knowledge approach is more appropriate.

The third scope "ACTING BEYOND" relates to collaboration areas among shared value chain members. They were found when comparing qualitative differences between the countries. German companies showed to be more experienced in involving business partners and even competitors in sharing knowledge and resources while Brazilian ones showed particular strategies in dealing with current infrastructural and political restrictions which are interesting for foreign companies understanding hidden challenges in making business in Brazil (Caldas and Wood, 1997).

The overall conclusion of this research is that although multinational enterprises are located worldwide, their origins and cultural background influence decisions regarding their sustainable supply chain portfolio of initiatives. The understanding of these particularities and limitations support firms in planning their operations. Collaboration with Germany showed to be beneficial for diminishing the lack of experience with sustainable development, the necessary technologies and management skills (Jabbour et al., 2016).

Some limitations to this study are already described in chapter 4.1. They are mostly related to the use of CSR self-published reports for content analysis, the researcher bias in the categorization process and use non-parametric statistical tests due to the small sample size (when analyzed differences in the level of category of practices). Additionally, regarding the workshops and interviews conducted in Brazil, they reflect the reality of companies located in only three of its 26 states – Sao Paulo, Rio de Janeiro and Espírito Santo. They are located in the southeast region (4 states) that represents 57 % of the national revenues (IBGE, 2013) nevertheless they do not represent the whole country and its different subcultures. Furthermore, data from the workshops and interviews are based on the participants' perception of efforts, impacts and implementation levels. Therefore, besides further studies already stated in tables 54 and 55, action researches are recommended for verification, measurement and quantification of the reported initiatives. In addition, would be intereresting for SSC field in emerging countries the comparison between the dispersion of practices by a large sample of companies in different countries. This information would support decision makers especially from government and industry associations in deciding wheather to conduct a broader program or a more focused approach. Further workshops in Germany could also provide more data for comparing the current situation of not-ranked firms from this country with the ones from Brazil.

7 Final Conclusions and Outlook

7.1 Main Research Findings

In view of the increasing efforts worldwide to improve business sustainability, this dissertation is dedicated to support companies in better planning their SSC practices in order to improve sustainability within their shared value chain. It provides a “Methodology for planning sustainable supply chain initiatives” presented on chapter 2 that goes beyond the concepts of the Resource Dependency Theory (Pfeffer and Salancik, 1978) and focus on benefits from collaborations – internal, industry and value chain ones, through sharing assets, risks and knowledge. It consists of three scopes, which are aligned with following secondary research questions:

(RQ1) How can SC initiatives be structured in order to support sustainability management?

Chapter 3 describes the “Framework for managing SSC practices” published in a detailed version in 2015 (Campos, 2015). It was developed from a systematic literature review of more than 2000 publications until 2013 and further workshops with practitioners. The framework provides a holistic perspective of dimensions and categories of practices that could be implemented by companies worldwide or used as a background for further research. It consists of 7 dimensions, 21 categories and 91 practices, which were explained in details once they were used in the following chapters.

(RQ2) Which are the industry patterns regarding sustainable supply chain practices?

Chapter 4 describes and uses the “Benchmarks practices bank” for research analysis. This database was developed in cooperation with independent researchers for joint use. It is filled with data from CSR reports of sustainability leaders and consists of an open-access dynamic database, currently with 42 companies, for those interested in studying SSC initiatives. Based on this mechanism, qualitative and quantitative analyses were conducted: per category of SSC practices, per industry and per country. Interesting conclusions could be taken from these analyses especially the particular behavior of T&LS companies that seem not to take SSC initiatives or report them to their stakeholders (Colicchia et al., 2013). The explanation, according to these authors might stand in the absence of capabilities and tools to deploy eco-efficiency strategies as well as a reporting system specifically for measuring the environmental impact of 3PL activities (Colicchia et al., 2011). The present study contributes to the investigation of the 3PL market particularly (Colicchia et al., 2013; Evangelista et al., 2011; Piecyk and Björklund, 2015; Rossi et al., 2013).

Furthermore, leading manufacturers seem to have overcame the first challenge of organizing their corporate internal environment, each industry with its particular portfolio of practices. One particular example are the harder challenges from IM firms in collaborating with external stakeholders - governments, suppliers and customers, probably explained by their position in the SC. The current step is exactly in building long-term relationships with other companies, normally through industry associations and collaborative platforms. This step is essential for extending sustainability towards supply chain. The findings also support the benefits of collaborations between developed and developing countries. The author believe that solutions for sustainability issues should involve global implementation however respecting each country's particularities. Therefore, a framework was developed to supports analyzing cross-country variables that influence SC performance and identifying opportunities for value creation through collaboration between companies from different regions.

(RQ3) How should companies build and manage a portfolio of sustainability initiatives to improve their overall SC performance?

Chapter 5 supports decision makers in extending sustainability efforts through corporate shared value chain. The "Practices Portfolio Planning

Matrix", also called EIL Matrix due to its three variables – Efforts, Impacts and Implementation level of SSC initiatives, has four quadrants:

Quadrant 1("haven't started yet?"): categories of practices that demand low efforts and offer high impact to the company should be implemented internally.

Quadrant 2 ("business partners"): categories of practices with high efforts and impacts in terms of financial performance, sustainability targets and brand image are suggested to be implemented together with business partners. As pointed by Gulati and Singh (1998), the exchange or share of resources, co-development of products, services, or technologies have greater chances for improving supply chain performance.

Quadrant 3 ("combination of initiatives"): categories characterized by requiring low efforts and low impacts are recommended to be implemented in combination with other practices with high impact. Different from what Henderson suggested for the "dogs" in the BCG Matrix, the combination strategy might improve their outcomes as presented in section 5.4. The logic is similar to the "relational rent" (Dyer and Singh, 1998) of "1+1=3"

Quadrant 4 ("specific analysis"): categories that require high efforts, nevertheless offering low impacts are recommended to be specificly analyzed in order to identify opportunities for improving their impacts and reducing the efforts.

The matrix was tested personally with 110 decision makers in Brazil that provided data that were further analyzed considering the four quadrants of the matrix and their implementation level. Results show the low maturity level regarding SSCM among companies in Brazil, the perceived correlation between impact and efforts, the importance of the topic in the country, and the vast area for collaboration with shared value chain partners.

(RQ4) Where stands collaboration opportunities between German and Brazilian companies in order to improve sustainability in their supply chains?

Based on the previous results, further quantitative and qualitative analysis were conducted for identifying collaboration areas for Brazilian companies especially with German ones. Two tables present the findings and improvement areas where governments, industry associations, independent groups of companies or single companies from Brazil can focus on. Those located in the first scope of the “Methodology for planning sustainable supply chain initiatives” “Acting In” arise from differences in the behavior of workshop participants and benchmarks patterns. Although the two groups consist of large Brazilian companies, differences in the implementation level were identified, which are opportunities or exchanging knowledge, best practices and experiences inside the country.

The second scope “Acting Out” of the methodology provide collaboration areas in the industry point of view. Specific differences between Brazilian and German were identified in only four out of the 21 categories of practices which proves that collaboration opportunities exist in a two-way direction and the sharing knowledge approach is more appropriate when dealing with these two countries.

The third scope “Acting Beyond” offers collaboration areas among shared value chain members. German companies showed to be more experienced in balancing cooperation and competition (Sachs and Loske, 2002) while Brazilian ones showed particular strategies in dealing with current infrastructural and political restrictions.

On a practical level, the current dissertation and the “Methodology for planning sustainable supply chain initiatives” strongly contribute to supply chain practitioners and researchers interested in sustainability practices. The developed mechanisms support decision makers in planning SC practices and visualizing collaboration opportunities – corporate, industry and through the shared value chain. As companies become more global, SC is getting more complex and risks, costs and social-environmental impacts higher. A systematic and holistic approach of the supply chain relations provide insights for developing more sustainable solutions according to each partner's strength and improvement areas, following the "plan globally and jointly, act locally" principle.

7.2 Limitations and Further Research

The present dissertation is subject to a number of limitations that were already exposed in chapters 3, 4, 5 and 6, nonetheless it is important to highlight some of them. First, regarding the data collection methods. Although two independent and trained reviewers conducted the systematic literature review and content analysis, the process is subjective and therefore dependable on the understanding of each reviewer. The use of clear inclusion criteria for the first process and the framework for managing SSC practices as a background for the second one, intended to minimize the research bias. For a deeper understanding of "how how to create supply chains that are sustainable" (Kleindorfer et al., 2005), participatory/action type research (Westbrook, 1995) are recommended for further studies.

The second limitation is related to the source of data. For the systematic literature review only two databases were used to search for publications. For the content analysis, self-published CSR reports were used which migh contain greenwashing or information that are not compatible with company's reality. In order to minimize the risks of these situations, only top ranked companies were chosen to be part of the sample in an attempt to include multinational firms with high reputational risks in case of publishing false information. CSR reports might also not contain enough details about company's initiatives, therefore, other public official sources such as websites, annual reports, code of conduct, were considered during data collection process. Even though, it is recommended, when possible, to use primary data from action research, where these can be verified through observations in business operations. Moreover, during the workshop/interview for building the EIL Matrix in Brazil, the participants them discussed the questions in groups. Although the name of the company was not required in the questionnaires, they were using "identification tags" permitting the identification of the company where they work. Therefore, there is a risk that the information regarding the implementation level (questionnaire 1) was rated higher than the reality once they might want to impress the other participants.

Furthermore, CSR reports reflect what a company focus in one specific period of time – normally annually. During this research, companies were analyzed once based on the available public documents at that specific time. Thus, it is recommended for further research a longitudinal study to understand the evolution (or not) of their initiatives, as well as the relationship between their reported practices and new legislations, brand scandals or their position in international rankings.

The third limitation relates to the <u>sample size and selection criteria</u> used for the industry (5-8 companies per industry) and country (8-10 companies per country) analysis. Due to this small sample, differences could only be tested in a category-level using non-parametric Fisher's exact test. A larger and representative sample size is recommended for future analysis. Furthermore, the fact of selecting only large companies (also among the workshops participants) and listed in the Green Sustainability ranking, are also strong limitations of this study. What if other ranking was used? What if small and medium companies were researched? Although large companies are more pressured by external forces (Holt and Ghobadian, 2009), small and medium companies, represent 99 % of companies worldwide (Walker and Preuss, 2008), and might be more interested in implementing "true" collaboration frameworks due to the similar relational power among the members. Interesting findings might also come from outliers from a statistical perspective but with high potencial of providing insights in this topic (Singhal and Singhal, 2012).

Lastly, it is recommended the qualitative measurement of each practice's maturity level using an appropriate framework such as the recently developed (Subramanian et al., 2016) that considers sustainable supply chain context.

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9 Appendices

Appendix 1. Percentage of Practices Identified in the Systematic Literature Review

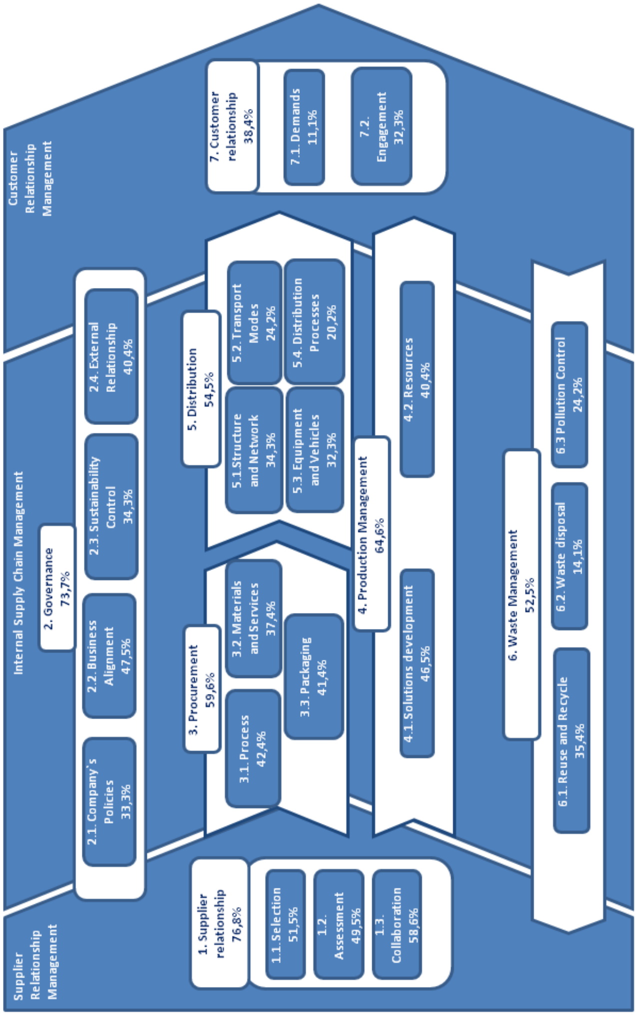

Figure 32. Percentage of practices (own author)

Appendix 2. Selected References in the Systematic Literature Review (99)

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; Pontrandolfo, P; Scozzi, B.	Logistics social responsibility: Standard adoption and practices in Italian companies	International Journal Of Production Economics	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 Academy 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: insights from a field study	Benchmarking: An International Journal	2011
EB	Comas Martí, J. M.; Seifert, R. W.	Assessing the Comprehensiveness of Supply Chain Environmental Strategies	Business Strategy And The Environment	2013
EB	Dargusch, P; Ward, A.	Understanding Corporate Social Responsibility with the integration of Supply Chain Management in Outdoor Apparel Manufacturers in North America and Australia	International Journal Of Business & Management Science	2010
EB	Davies, M.	Time for a bit of networking	Logistics Manager	2008
REC	de Brito, M. P; Carbone, V;Blanquart, C. M.	Towards a sustainable fashion retail supply chain in Europe: Organisation and performance	International Journal Of Production Economics	2008
WoS	Dekker, R; Bloemhof, J; Mallidis, I.	Operations Research for green logistics - An overview of aspects, issues, contributions and challenges	European Journal Of Operational Research	2012
WoS	Delai, I; Takahashi, S.	Corporate sustainability in emerging markets: insights 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 implementation of green supply chain management	Resources Conservation 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
WoS	Golicic, S.L; Boerstler, C.N; Ellram, L.M.	'Greening' Transportation in the Supply Chain	MIT Sloan Management Review	2010
WoS	Gopalakrishnan, K; Yusuf, YY; Musa, A; Abubakar, T;	Sustainable supply chain management: A case study of British	International Journal Of Production Economics	2012

	Ambursa, H.M.	Aerospace (BAE) Systems		
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
REC	Holt; D.	Managing the interface between suppliers and organizations for environmental responsibility – an exploration of current practices in the UK	Corporate Social Responsibility And Environmental Management	2004
REC	Holt, D.; Ghobadian, A.	An empirical study of green supply chain management practices amongst UK manufacturers	Journal Of Manufacturing Technology Management	2009
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
EB	Kaplan, A.	Planting for the Future	Beverage World	2013
WoS	Keating, B; Quazi, A; Kriz, A; Coltman, T.	In pursuit of a sustainable supply chain: insights from Westpac Banking Corporation	Supply Chain Management-An International Journal	2008
EB	Khairani, N.S; Rajamanoharan, I.D;	Green supply chain management practices: evidence from Malaysia	Malaysian Accounting Review	2012

	Thiru-manickam, N.			
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
EB	Kosansky, A; Schaefer, T. E.D.	You can go green	Manufacturing Today	2009
EB	Kotzab, H; Munch, H.M.; Faultrier, B; Teller, C.	Environmental retail supply chains: when global Goliaths become environmental Davids	International Journal Of Retail & Distribution Management	2011
WoS	Kumar, S; Teichman, S; Timpernagel, T.	A green supply chain is a requirement for profitability	International Journal Of Production Research	2012
EB	Lai, KH; Wu, Sarah J.; Wong, Christina W. Y.	Did reverse logistics practices hit the triple bottom line of Chinese manufacturers?	International Journal Of Production Economics	2013
WoS	Lai, KH; Lun, Y.H.V; Wong, C.W.Y; Cheng, T.C.E.	Green shipping practices in the shipping industry: Conceptualization, adoption, and implications	Resources Conservation And Recycling	2011
EB	Laosiri-hongthong, T; Adebanjo, D; Tan, K.C.	Green supply chain management practices and performance	Industrial Management & Data Systems	2013
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
EB	Leppelt, T; Foerstl, K; Reuter, C; Hartmann, E.	Sustainability management beyond organizational boundaries–sustainable supplier relationship management in the chemical industry	Journal Of Cleaner Production	2013
WoS	Lieb, K.J; Lieb, R.C.	Environmental sustainability in the third-party logistics (3PL) industry	International Journal Of Physical Distribution & Logistics Management	2010
WoS	Liimatainen, H; Stenholm, P; Tapio, P; McKinnon, A.	Energy efficiency practices among road freight hauliers	Energy Policy	2012
EB	Liu, X; Yang, J; Qu, S; Wang, L; Shishime, T; Bao, C.	Sustainable Production: Practices and Determinant Factors of Green Supply Chain Management of Chinese Companies	Business Strategy And The Environment	2012
WoS	Lu, R.X.A; Lee, P.K.C; Cheng, T.C.E.	Socially responsible supplier development: Construct development and measurement validation	International Journal Of Production Economics	2012
WoS	Lun, Y.H.V.	Green management practices and firm performance: A case of container terminal operations	Resources Conservation And Recycling	2011
WoS	MacCarthy, B.L; Jayarathne, P.G.S.A.	Sustainable collaborative supply networks in the international clothing industry: a comparative analysis of two retailers	Production Planning & Control	2012

REC	Mckinnon, A; Browne, M; Whiteing, A.	Green logistics: Improving the environmental sustainability of logistics.	Book: The Chartered Institute Of Logistics And Transport (UK)	2010
WoS	Murphy, P.R; Poist, R.F.	Green perspectives and practices: a "comparative logistics" study	Supply Chain Management-An International Journal	2003
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 sustainable supply chain management using case studies of 10 exemplars	Journal Of Supply Chain Management	2009
WoS	Panapanaan, V.M; Linnanen, L; Karvonen, M.M; Phan, V.T.	Roadmapping Corporate Social Responsibility In Finnish Companies	Journal of Business Ethics	2013
WoS	Perotti, S; Zorzini, M; Cagno, E; Micheli, G.J.L.	Green supply chain practices and company performance: the case of 3pls in Italy	International Journal Of Physical Distribution & Logistics Management	2012

WoS	Preuss, L. (b)	Addressing sustainable development through public procurement: the case of local government	Supply Chain Management-An International Journal	2009
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
WoS	Sarkis, J.	Evaluating environmentally conscious business practices	European Journal Of Operational Research	1998
CR	Sarkis, J.	How Green is the Supply Chain?: Practice and Research	Internal Publication	1999
REC	Schönberger, H.; Galvez-Martos, JL.; Styles, D.	Best Environmental Management Practice in the Retail Trade Sector	Report EUR 25998 EN	2013
EB	Sowinski, L.L.	Sustainability Drives Service Offerings at Weber Logistics. (cover story)	Food Logistics	2013
WoS	Spence, L; Bourlakis, M.	The evolution from corporate social responsibility to supply chain responsibility: the case of Waitrose	Supply Chain Management-An International Journal	2009
WoS	Srivastava, S.K.	Green supply-chain management: A state-	International Journal Of Management Reviews	2007

		of-the-art literature review		
WoS	Styles, D; Schoenberger, H; Galvez-Martos, J.L. (a)	Environmental improvement of product supply chains: A review of European retailers' performance	Resources Conservation And Recycling	2012
WoS	Styles, D; Schoenberger, H; Galvez-Martos, J.L. (b)	Environmental improvement of product supply chains: Proposed best practice techniques, quantitative indicators and benchmarks of excellence for retailers	Journal Of Environmental Management	2012
WoS	Tachizawa, E.M; Thomsen, C.G; Montes-Sancho, M.J.	Green Supply Management Strategies in Spanish Firms	IEEE Transactions On Engineering Management	2012
WoS	Vachon, S.	Green supply chain practices and the selection of environmental technologies	International Journal Of Production Research	2007
WoS	Vachon, S; Klassen, R.D.	Extending green practices across the supply chain - The impact of upstream and downstream integration	International Journal Of Operations & Production Management	2006
WoS	Wiederkehr, P., Gilbert, R., Crist, P., &Caïd, N.	Environmentally sustainable transport: concept, goal and strategy - the OECD's EST Project	European Journal Of Transport And Infrastructure Research	2004
EB	Wu, GC; Ding, JH; Chen, PS	The effects of GSCM drivers and institutional pressures on GSCM practices in Taiwan's textile and apparel industry	International Journal Of Production Economics	2012
WoS	Yang, CL; Lin, SP; Chan, YH; Sheu, C.	Mediated effect of environmental management on manufacturing	International Journal Of Production Economics	2010

		competitiveness: An empirical study		
EB	Ytterhus, B.E.; Arnestad, P; Lothe, S.	Environmental initiatives in the retailing sector: an analysis of supply chain pressures and partnerships	Eco-Management & Auditing	1999
WoS	Zailani, S; Jeyaraman, K; Vengadasan, G; Premkumar, R.	Sustainable supply chain management (SSCM) in Malaysia: A survey	International Journal Of Production Economics	2012
WoS	Zhu, QH; Geng, Y; Sarkis, J; Lai, KH.	Evaluating green supply chain management among Chinese manufacturers from the ecological modernization perspective	Transportation Research Part E-Logistics And Transportation Review	2011
WoS	Zhu, Q; Sarkis, J.	An inter-sectoral comparison of green supply chain management in China: Drivers and practices	Journal of Cleaner Production	2006
WoS	Zhu, Q; Sarkis, J; Geng, Y.	Green supply chain management in China: Pressures, practices and performance	International Journal Of Operations & Production Management	2005
REC	Zhu, Q; Sarkis, J; Lai, KH.	Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices	Journal of Purchasing & Supply Management	2013

Appendix 3. Descriptions of Dimensions, Categories and Practices

CATEGO-RIES/PRACTICES	DESCRIPTION
1. Supplier Devel-opment	**Implement practices related to suppliers' selection, assessment and collaboration to improve company's and suppliers' performance on environmental and so-cial outcomes**
1.1. Selection	**Include sustainability criteria during the supplier se-lection process (certifications, management systems, compliance with guidelines, code of conduct), prefer using specific group of suppliers that are more social-environmental responsible**
1.1.1. Sourcing from environmen-tally sound suppli-ers	Prefer suppliers that are recognized as more environ-mentally responsible
1.1.2. Criteria for suppliers selection considering also environmental and social aspects	Establish environmental and social criteria to select suppliers, expecting them to comply with proper re-quirements
1.1.3. Certifica-tions for supplier	Request suppliers to have certifications such as ISO or Independent Environmental Certification
1.1.4. Manage-ment System by suppliers	Request suppliers to implement a management system to monitor risk, environmental and social performance
1.1.5. Compliance statement from suppliers/guide-lines/CC extension	Require suppliers should comply with laws of local gov-ernment, guidelines/codes of conducts
1.1.6. Prefer using local/ minority-owned/specific suppliers	Prefer using local/ minority-owned suppliers or from some specific group
1.2. Assessment	**Communicate expectations, monitor suppliers' perfor-mance and ensure they meet the required objectives, using questionnaires/inspections. Evaluate indirect suppliers and penalize them in case of lack of compli-ance**

1.2.1. Communication of sustainability standards/expectations	Make clear that suppliers are communicated about company's standards, requirements and expectations
1.2.2. Monitor and audit suppliers' performance/ Use questionnaire/ High risk	Monitor suppliers' performance and ensure they meet the required objectives. Use (self-) questionnaires. Special assessment for high-risk suppliers. Provide Hotline for supplier's employees call in case of failures on sustainability compliance.
1.2.3. Audits using on-site inspections	Conduct audits (also implemented by third-parties) using inspections of suppliers' plants
1.2.4. KPI's and improvement targets for suppliers / Rating	Establish key performance indicators (KPI) and targets for suppliers. Implement a "suppliers' sustainability rating"
1.2.5. Evaluation to indirect suppliers and/or subcontractors	Evaluate not only first-tier suppliers (direct suppliers) but also second-tier suppliers and/or subcontractors
1.2.6. Supplier`s change/rejection/ penalization in case of lacking environmental/social requirements	Change suppliers to better cope with sustainable sourcing, rejecting or penalizing those who lack environmental and social concerns
1.3. Supplier collaboration	**Collaborate with suppliers to increase SC sustainability, promote integration and information sharing, financial support for sustainability**
1.3.1. General Collaboration/Cooperation	Implement collaborative/cooperative practices, projects or actions with suppliers in order to increase supply chain sustainability
1.3.2. Collaboration - Integration	Implement collaborative efforts for operations integration between suppliers and company in order to increase transparency and other benefits for SC sustainability
1.3.3. Collaboration - New Technologies	Jointly develop or implement technologies that support sustainable development, such as efficient vehicles/ solutions.
1.3.4. Collaboration - Sustainable Processes	Jointly develop of cleaner, more efficient and more social responsible processes. Support standardization of suppliers' processes.

1.3.5. Financial support for sustainability and improving quality	Offer financial support to suppliers adjust their operations in order to cope with sustainability standards and to reduce suppliers' risks from engaging in collaborative projects
1.3.6. Educate/offer technical and environmental information	Educating suppliers` employees in sustainability issues (manuals or seminars): for implementing EMS, achieving third party certification, defining waste reduction goals…
2. Governance	**Implement sustainability policies and management systems, align business operations with sustainability matters, and establish a good relationship with stakeholders**
2.1. Company's Policies	**Implement policies to motivate quality improvements combined with reduction of the impact on the environment and people. May include supply chain specific policies and compliance with current regulations**
2.1.1. General Policy Environmental standards	Implement policies/standards that aim to avoid/reduce impact on the environment, in favor of green procurement, green Logistics...
2.1.2. General Policy Social standards/Code of Conduct	Implement policies/standards that aim to avoid/reduce impact on the people (social) such as Code of conduct/Ethics, Anti-corruption Policy, Corporate Health Policy, Diversity-Culture
2.1.3 General Policy Quality standards	Implement policies/standards that aim to motivate quality improvements related to efficiency and effectiveness
2.1.4. Compliance with Regulations	Comply with current regulations
2.2. Business Alignment	**Promote alignment between company's strategies and sustainability issues, create formal departments/functions to manage this topic, stimulate internal communication and education.**
2.2.1. Link - sustainability strategy and supply chain	Establish a link between sustainability goals and corporate strategy/day-to-day supply chain management
2.2.2. Structure - Cross function/Sust. Department	Encourage cross-function integration and/or define a dedicated department in charge of sustainability issues.

2.2.3. Communication with shareholders and employees	Communicate goals/targets and improvements to shareholders and employees. Provide Hotline for employees call in case of failures on sustainability compliance.
2.2.4. Human Resources - Training/ Education	Train and educate employees for sustainability issues
2.2.5. Human Resources - Social issues	Guarantee managers and other employees' commitment with sustainability. Hire/promote more sustainability conscious and diverse personnel. Improve employee's health and career perspective.
2.2.6. Financial issues	Offer adequate wages. Establish a link between reward systems and sustainability factors for employees, managers and senior executives
2.3. Sustainability Control	**Implement management systems and internal KPIs related to sustainability; manage company's certifications and risk-safety-related issues.**
2.3.1. Measurement system/ Sustainability Management	Implement management systems to measure and monitor environmental and social issues inside the company. Establish a formal procedure to anticipate future scenarios and responses. Calculate carbon footprint and monitor company`s performance/ Conduct internal audits
2.3.2. Company's Certifications	Be certified on international quality, social and environmental standards
2.3.3. Environmental, Social and Quality Programs	Implement internal programs and audits schedule to increase quality and decrease the social and environmental impact
2.3.4. Establish KPI's and improvement targets/goals for company	Establish key performance indicators (KPI) and improvement targets/goals for the company
2.3.5. Risk and Safety Management	Manage company's risks considering not only financial risks but also environmental and social ones. Make sure that the basic safety requirements are being applied regarding employees.
2.3.6. Practices related to IT	Implement information technological (IT) practices to increase energy efficiency and reduce materials use

2.4. External Relationship	**Manage relationship with external stakeholders and publicize sustainability efforts.**
2.4.1. Relationship - Society/Biodiversity	Settle a good relationship/projects with communities, social society and biodiversity. Manage community's complaints, projects, educational campaigns, voluntary works, donations
2.4.2. Relationship - Government and regulatory agencies	Settle a good relationship/projects with government and regulatory agencies. May be used in order to change or antecipate future regulations.
2.4.3. Relationship University	Settle good relationship/projects with universities and relevant research centers
2.4.4. Relationship - NGOs	Settle good relationship/projects with NGOs
2.4.5. Relationship - other companies	Promote or participate in projects and cooperative efforts with other companies (e.g. same industry)
2.4.6. Audit by third party companies	Use an outside company or third parties to manage social-environmental issues and increase transparency
2.4.7. Publicize efforts	Make public sustainability efforts (publish sustainability/CSR reports and awards)
3. Procurement	**Improve sustainability through changes in the procurement process, materials and services (including packaging) that are purchased.**
3.1. Process	**Implement improvements on the procurement process, including on contracts, in order to make it more social-environmental responsible**
3.1.1. Sustainable procurement process	Improve the procurement process to reduce its environmental and social impact (e.g. e-procurement)
3.1.2 . Long-term and clear contracts with environmental dimensions	Prefer long term contracts in attempt to reduce suppliers risk and increase collaboration/ Make sure that contractual terms are clear for all parts
3.2. Materials and Services	**Purchase sustainable materials, components, products and services, including those that are certified (e.g Eco-Label)**

3.2.1. General Sustainable Materials and Services	Purchasing products, services (including fair trade products) and (raw) materials that respects social responsibility requirements and impacts less (or have zero impact) on the environment (e.g. eco-labeled ones)
3.2.2. Specific - Recycled and reusable materials	Prefer products that are manufactured with recycled components or that may be recycled in the end of its life
3.2.3. Specific - Less hazardous materials	Reduce/substitute the use of chemical/ hazardous substances
3.2.4. Eco-labels	Use eco labels, which certifies environmental/social responsibility, into the company's products
3.3. Packaging	**Use or design innovations on packaging in order to make them more sustainable**
3.3.1. Reduce amount of packaging	Reduce the general amount of packaging
3.3.2. Improvements towards sustainable packaging	Use packaging improvements such as those made from recycled and reusable materials, with reduced weight and volume
3.3.3. Suppliers' involvement on packaging issues	Collaborate with suppliers to develop sustainable packaging. Require them to use sustainable package(degradable and non-hazardous) and remanufacturing
3.3.4. Special package and label for hazardous material	Dedicated attention on hazardous materials to ensure proper package and label
4. Production Management	**Implement practices related to the development of new solutions and management of resources**
4.1. Solutions Development	**Design more sustainable products, processes and services, considering the product life cycle and resources consumption**
4.1.1. Environmental and social aspects in solutions development	Design products, services and processes considering environmental and social aspects, such as, designed to be recycled, use less material, energy, and harmful substances. Design for environment, reverse logistics… approaches
4.1.2. Provide green specification for suppliers	Provide special specifications related to sustainability to suppliers during the design phase

4.1.3. Online Services	Develop solutions that encourage clients to use online platforms
4.1.4. Product Life Cycle management	Implement a system to measure and analyze product life cycle and use data during design phase
4.1.5.Products that reduce the environmental/social impact during its use	Design products that reduce customer's energy consumption during its use, or bring benefits to the customers in reducing the environmental or social impact
4.2. Resources	**Manage resources (materials, energy, water) and invest on renewable sources**
4.2.1. Reduce overall consumption (materials…)	Implement efforts to reduce consumption (e.g. raw materials, paper, others) and waste
4.2.2. Reduce consumption of energy	Implement general energy conservation programs. Co-generation
4.2.3. Energy Source	Invest on renewable energy and use on company's operations
4.2.4. Water Management	Implement water conservation programs or practices (reuse systems, waste reduction)
5. Distribution	**Improve sustainability through adjustments in structure, network, modes of transport, new vehicles and equipments' technologies and distribution processes**
5.1. Structure and Network	**Implement adjustments during construction phase, facilities management, network structure and specific distribution strategies.**
5.1.1. Efficient land use and Green construction	Use lean concepts during construction phase: land use, environmental impact reports, less impact approach, avoid waste during construction
5.1.2. Layouts/Shared	Implement adjustments in warehouse layouts or workflow, share warehouses with other companies, with gains in carbon emissions
5.1.3. Network redesign	Redesign the logistical system (shorter networks, commercial disintermediation) in order to reduce carbon footprint

5.1.4. Specific strategies for reducing emissions	Implement specific strategies for reducing carbon footprint (Centralization, Use of intermediate simple facilities, use larger warehouses, direct distribution, encourage freight consolidation)
5.1.5. Vehicle fleet optimization	Optimize vehicles fleet, implement sharing resources projects
5.2. Modes of Transport	**Improve sustainability through switches on modes of transport.**
5.2.1. General - Intermodal	Combine various modes to transport, getting advantages related to carbon reductions from each mode
5.2.2. General - Less polluting modes	Prefer less polluting modes, including programs to motivate employees to use public transport, bikes…
5.2.3. Specific - Water	Take advantages on preferences on using water transport
5.2.4. Specific - Rail	Take advantages on preferences on using rail transport
5.2.5. Specific - Avoid air	Avoid using air freight & air travels for business purpose
5.3. Equipment and Vehicles	**Improve sustainability through adjustments on logistics equipment and vehicles (fuel, rolling resistance, body type, maintenance, others)**
5.3.1 Type of fuel	Use of vehicles with new sources of energy: electric or hybrid. Also for vans, rails, aircrafts and equipment/machinery used in warehouses.
5.3.2 New technology - eco-efficient	Develop or use eco efficient vehicles and equipment (e.g EURO V) and those that emit less noise. Reduction of truck idle time , turbocharging (recycling heat from exhaust gases), energy efficiency of auxiliary equipment (pumps, fans, air compressor, heating…), use of variable frequency drive HVAC. Also for vans, rails, aircrafts, containers and equipment/machinery used in warehouses.

5.3.3. New technology - Rolling Resistance Reduction	Use "Next generation tires” that enable raising fuel efficiency by reducing rolling resistance, automatic pressure-monitoring and inflation of tires
5.3.4. Body Type - Increase Capacity	Use vehicles that permit an increase on load capacity (double-deck trailers and trains, longer-combination vehicles, gigaliners)
5.3.5. Body Type - Aerodynamic	Adjust vehicles and equipment with aerodynamic devices/accessories. Use less dense materials
5.3.6 Maintenance and renewal	Implementation of maintenance and renewal policy
5.4. Distribution Processes	**Implement changes in the distribution process such as inventory management (particular attention to hazardous materials) and transport optimization, improve driving skills and use low speed driving**
5.4.1. Inventory Management/Hazardous	Manage inventory, avoiding waste, loss and excess of capacity. Proper storage, packaging and labeling of hazardous materials
5.4.2. Transport - Low speed and correct poor driving	Encourage strategies to save fuel (low speed, correct poor driving)
5.4.3.Transport - Optimization	Optimize routes and freight, reduce empty runs, and manage flows considering traffic and weather conditions. Telecommunications systems (Telematics, Integrated Transport Management System), Efficient Load Fill and Deliveries, Align inbound and outbound shipments, Changes in operation hours). Negotiate with clients for amplifying delivery window. Reduce the amount of business travels
6. Waste Management	**Manage waste and pollution in order to decrease environmental, economic and social impact**
6.1. Reuse and Recycle	**Encourage reuse practices, including remanufacture and recycling**
6.1.1. Recovery end of life products /Reverse Logistics	Recover company's products after their end of life (also send back to suppliers for recovery). Collect used package or pallet systems and motivating suppliers to the same
6.1.2. Reuse	Reuse of materials (also pallets) and waste (e.g. dust from production), sell waste in secondary markets

6.1.3. Remanufacture and Refurbishment	Remanufacture or/and refurbish (also for pallets) materials
6.1.4. Recycling	Recycle, manage recycling rates, send back to suppliers for recycling
6.2. Waste Disposal	**Implement practices for disposing (not selling) waste in a correct way.**
6.2.1. Waste Disposal	Implement practices for disposing (not selling) waste in a correct way, not ship e-waste overseas. Hazardous waste disposal awareness. Transform waste into energy. Create closed loops
6.3. Pollution Control	**Control, minimize and compensate pollution**
6.3.1. Prevent, Reduce and Manage pollution	Implement programs to prevent, reduce and manage pollution (air, water, visual, noise, odor).
6.3.2. Compensating programs (Offset)	Implement compensations to pollution (e.g. investments in reflorestation to compensate the company's emissions) such as Offset Programs
7. Customer Relationship	**Manage customer relationship identifying their demands and engaging them on sustainability issues**
7.1. Demands	**Collect information about customer demands/habits and react according to their necessities**
7.1.1. Customer Relationship Management	Manage customer relationship to monitor of customer satisfaction, product usage and its life cycle (reaction according to customer's demand). Identify opportunities for market generation - managing and creating innovations
7.1.2. Inform customers about sustainability issues	Provide customers with information about company's products and processes (one-way flow)
7.2. Engagement	**Engage customers actively on sustainability issues and encourage behavior changes**
7.2.1. Educate customers on sustainability issues	Educate customers (e.g. water efficiency programs), making them learn and change their behaviors towards a more sustainable life
7.2.2. Complementary services	Offer complementary services to support customers engagement with sustainability issues (e.g. carbon footprint calculator, bike or car-sharing)
7.2.3. Collaborate with customers	Collaborate with customers for eco-design, green packaging, product take back, reductions on overall carbon footprint

Appendix 4. Ranking Position of the Selected Companies (32)

	Company Name	Industry domain	Green 2012	Green 2014	Green 2015
BM&E	**HeidelbergCement**	Materials	416		
	Linde	Materials	356	148	248
	Petrobras Petroleo Brasileiro S.A.	Energy	309	275	239
	RWE	Utilities	398	237	
	Vale S.A.	Materials	315	171	41
IM	**BASF**	Materials	236	128	191
	Continental	Vehicles & Components	291	235	217
	Gerdau	Materials	450		
	Merck	Healthcare	256	198	142
	Siemens	Industrial Goods	66		13
	ThyssenKrupp	Materials	433		
A&CV	**AUDI**	Automob & Components		210	216
	BMW	Vehicles & Components	30	16	26
	Daimler	Vehicles & Components	95	39	73
	MAN	Industrial Goods	214		
	Porsche Automobil Holding	Automob & Components		387	423
	Volkswagen	Vehicles & Components	71	121	190
CG	**Adidas**	Textiles, Apparel & Luxury Goods	208	17	
	Ambev	Food, Beverage & Tobacco	390	484	401

	Bayer	Healthcare	156	360	301
	Beiersdorf	Household & Personal Products		70	
	BRF - Brasil Foods S.A.	Food Bever-age & To-bacco	403		
	Henkel	Consumer Goods	218	113	62
	JBS	Food, Bever-age & To-bacco	479		
	Natura Cosmeti-cos S.A.	Consumer Staples			
T&LS	**CSX**	Transport & Logistics	364	215	155
	Deutsche Post	Transport & Logistics	48	143	125
	FedEx	Transport & Logistics	231	333	254
	Lufthansa	Transport & Logistics	334		
	Norfolk Southern	Transport & Logistics	300	312	115
	Union Pacific	Transport & Logistics	358	241	187
	United Parcel Ser-vice	Transport & Logistics	163	117	159

Appendix 5. Selected Companies (32) and Documents Used for Data Collection

Basic materials and Energy

Company	Headquarter location	Main Products	Revenue in 2014 (millions)	Published documents used for the research	Reference
Heidelberg Cement	Germany	Cement	€ 12610	Sustainability Report 2013/2014	(Heidelberg Cement, 2015)
Linde	Germany	Industrial Gases & Healthcare	€ 17047	Corporate Responsibility Report 2014 Building Strengths/Annual Report 2014	(Linde, 2015a) (Linde, 2015b)
Petrobras	Brazil	Oil, Gas, Energy	R$ 304890	Sustainability Report 2013 Relatório de Sustentabilidade2014	(Petrobras, 2014) (Petrobras, 2015)
RWE	Germany	1. Electricity and Gas generation	€ 48468	Our Responsibility. Report 2013	(RWE, 2014)
Vale	Brazil	Iron ore, Nickel	$ 47820	Sustainability Report 2013	(Vale, 2014)

Industrial materials

Company	Headquarter location	Main Products	Revenue in 2014 (millions)	Published documents used for the research	Accessed in the link:
BASF	Germany	Chemicals, Plastics	€ 74326	BASF Report 2013	(BASF, 2014)
Continental	Germany	Tires, Brake System	€ 34505.7	GRI Report 2013 Code of Conduct 2012	(Continental, 2014) (Continental, 2012)
Gerdau	Brazil	Steel	R$ 42500	2014 Annual Report Gerdau Code of Ethics Relatório de Sustentabilidade 2013	(Gerdau, 2015) (Gerdau, n.d.) (Instituto Aco Brasil, 2014)
Merck	Germany	Chemicals, Pharmaceuticals	€11500	Corporate Responsibility Report 2012 Annual Report 2012	(Merck, 2013a) (Merck, 2013b)
Siemens	Germany	Drive Technology, Automation	€ 71920	Annual Report 2013	(Siemens, 2014)
Thyssenkrupp	Germany	Steel	€ 14128	2013_2014 Annual Report	(Thyssenkrupp, 2014)

Automotive and Commercial Vehicles Manufacturers

Com-pany	Head-quarter location	Main Products	Revenue in 2014 (million)	Published documents used for the research	Accessed in the link:
Audi	Ger-many	Luxury Ve-hicles	€ 53787	Corporate Responsibil-ity 2012 Corporate Responsibil-ity 2014	(Audi, 2013) (Audi, 2015)
BMW	Ger-many	Luxury Ve-hicles, Sports Cars, Mo-torcycles	€ 80401	Sustainabil-ity Value Report 2012 Working To-gether/Sus-tainable Value Re-port 2013	(BMW, 2013) (BMW, 2014)
Daimler	Ger-many	Luxury Ve-hicles, Commer-cial Vehi-cles	€ 129872	Sustainabil-ity Report 2014	(Daimler, 2015)
Porsche	Ger-many	Sport cars, SUV's	€ 17205	Annual Re-port 2013 Annual Re-port 2014	(Porsche, 2015) (Porsche, 2014)
MAN	Ger-many	Trucks, Buses	€ 14300	2012 Corpo-rate Re-sponsibility	(MAN, 2014)

				Report 2014 Annual Report	(MAN, 2015)
Volkswagen	Germany	Cars, Trucks	€ 202458	Sustainability Report 2014	(Volkswagen, 2015)

Consumer Goods

Company	Headquarter location	Main Products	Revenue in 2014 (million)	Published documents used for the research	Accessed in the link:
Adidas	Germany	Footwear, Sports apparels and equipment	€ 14534	Sustainability Progress Report 2013 Health & Safety Guidelines 2010 Guide to best environmental practices 2005	(Adidas Group, 2014) (Adidas Group, 2010) (Adidas Group, 2005)
Ambev	Brazil	Beverages	R$ 38079.8	Annual Report 2013	(Ambev, 2013)
Bayer	Germany	Health products, Veterinary Drugs	€ 42239	Integrated Annual Report 2014	(Bayer AG, 2015)

Beiersdorf	Germany	Cosmetics	€ 6285	Sustainability Review 2012 and 2013 Annual Report 2012 and 2013	(Beiersdorf, n.d.) (Beiersdorf, n.d.)
BRF	Brazil	Food and Beverages	R$ 31700	Annual and Sustainability Report 2014	(BRF, 2015)
Henkel	Germany	Beauty/cosmetics products	€ 16428	Sustainability Report 2014	(Henkel, 2015)
JBS	Brazil	Food and Beverages	R$ 120469	Annual and Sustainability Report 2013	(JBS, 2014)
Natura	Brazil	Cosmetics	R$ 7400	Report 2011 Annual report 2013	(Natura, 2012) (Natura, 2014)

Transport and Logistics Services

Com-pany	Head-quarter location	Main Products	Revenue in 2014 (million)	Published documents used for the research	Accessed in the link:
CSX	United States	Rail based transpor-tation ser-vices	$ 12700	Corporate So-cial Responsi-bility 2012	(CSX, 2013)
DHL	Ger-many	Express mail/cou-rier ser-vice	€ 56630	Corporate Re-sponsibility Report 2012	(Deutsche Post DHL, 2013)
FedEx	United States	Courier, freight services	$ 45570	2012 Report on Global Citi-zenship 2013 Report on Global Citi-zenship	(FedEx, 2013) (FedEx, 2014)
Lufthansa	Ger-many	Passenger and Cargo Airline	€ 22624 (Jan-Sept)	Sustainability Report 2013 Sustainability Report 2014 Annual Report 2012	(Lufthansa Group, 2014) (Lufthansa Group, 2015) (Lufthansa Group, 2013)
Nor-folk	United States	Railway transport	$ 11624	Sustainability Report 2013	(Norfolk Southern, 2013)

Union Pacific	United States	Freight service	$ 24000	2013 Sustain-ability and Cit-izenship Re-port	(Union Pacific, 2014)
UPS	United States	Courier, freight services	$ 58232	Corporate Sustainability Report 2012	(UPS, 2013)

Appendix 6. Tool Developed to Collect Data (own author)

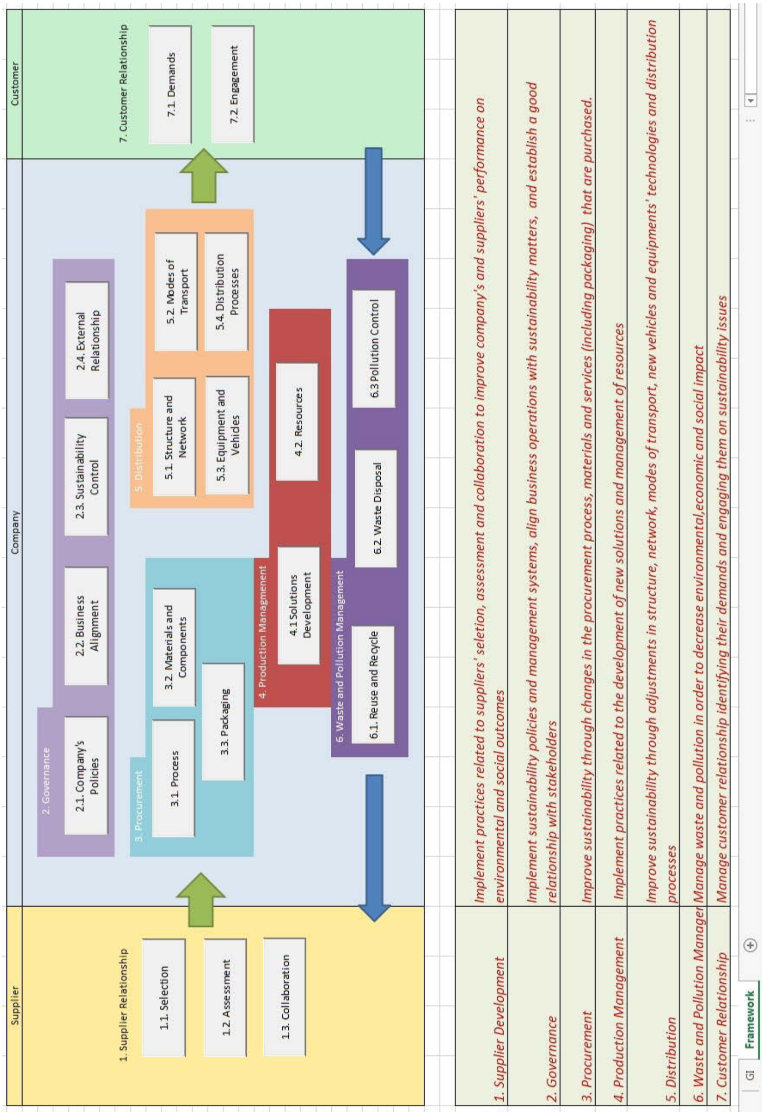

Figure 33. Screen 1 (tool to collect data)

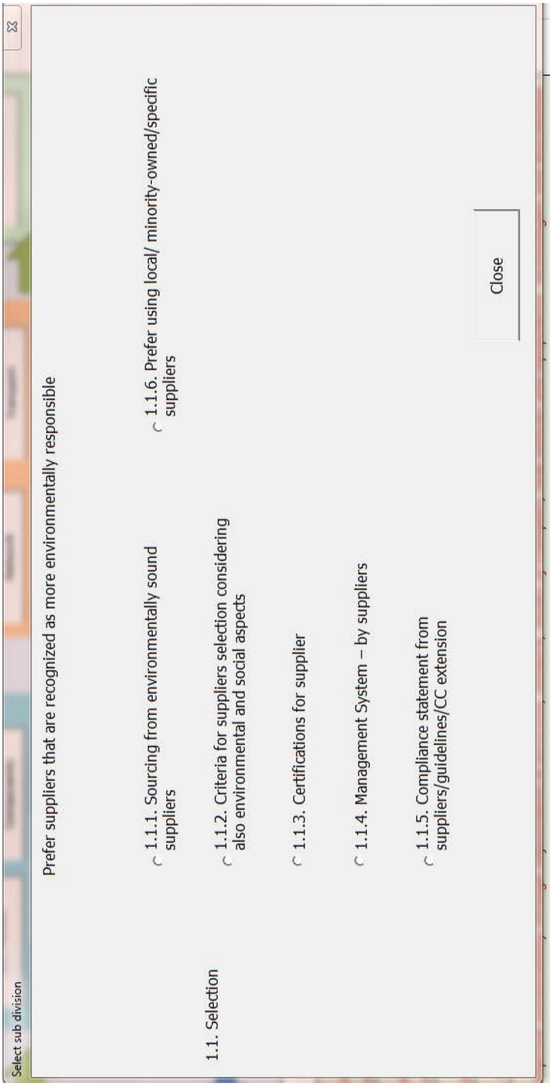

Figure 34. Screen 2 (tool to collect data)

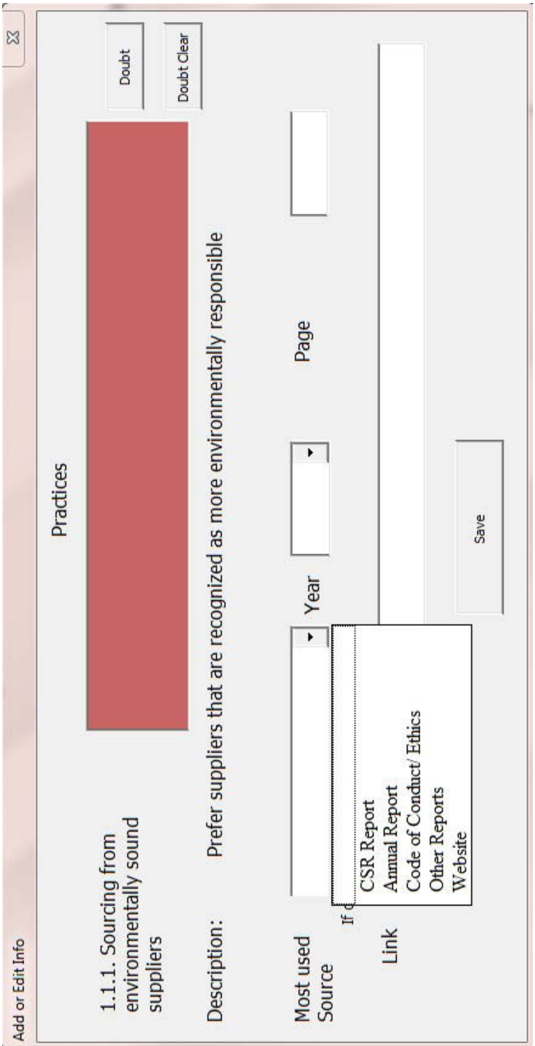

Figure 35. Screen 3 (tool to collect data)

Appendix 7. Amount of Practices by Industry

Categories	BM&E (5)		IM (6)		A&CV (6)		CG (8)		T&LS (7)	
1. Supplier relationship	71%		54 %		67 %		65 %		29 %	
1.1. Selection	87%		69 %		72 %		65 %		40 %	
1.1.1. Sourcing from environmentally sound suppliers	100 %		100 %		100 %		100 %		71 %	
1.1.2. Criteria for suppliers selection considering also environmental and social aspects	100 %		100 %		83 %		100 %		29 %	
1.1.3. Certifications for supplier	80%		33 %		33 %		38 %		29 %	
1.1.4. Management System – by suppliers	60%		50 %		50 %		13 %		14 %	
1.1.5. Compliance statement from suppliers/guidelines/CC extension	100 %		83 %		100 %		88 %		71 %	
1.1.6. Prefer using local/ minority-owned/specific suppliers	80%		50 %		67 %		50 %		29 %	
1.2. Assessment	80%		64 %		78 %		71 %		14 %	
1.2.1. Communication of sustainability standards/expectations	100 %		50 %		67 %		50 %		0 %	
1.2.2. Monitor and audit suppliers' performance/ Use questionnaire/ High risk	100 %		83 %		100 %		100 %		29 %	
1.2.3. Audits using on-site inspections	100 %		67 %		100 %		88 %		29 %	

1.2.4. KPI's and improvement targets for suppliers / Rating	20%		33 %		33 %		50 %		14 %	
1.2.5. Evaluation to indirect suppliers and/or subcontractors	60%		67 %		83 %		75 %		0 %	
1.2.6. Supplier`s change/rejection/ penalization in case of lacking environmental/social requirements	100 %		83 %		83 %		63 %		14 %	
1.3. Collaboration	47%		28 %		50 %		58 %		33 %	
1.3.1. General Collaboration/Cooperation	100 %		50 %		83 %		100 %		57 %	
1.3.2. Collaboration - Integration	20%		17 %		67 %		50 %		29 %	
1.3.3. Collaboration - New Technologies	0%		0%		0%		38 %		43 %	
1.3.4. Collaboration - Sustainable Processes	80%		50 %		33 %		75 %		43 %	
1.3.5. Financial support for sustainability and improving quality	20%		0%		17 %		25 %		0 %	
1.3.6. Educate/offer technical and environmental information	60%		50 %		100 %		63 %		29 %	
2. Governance	77%		70 %		78 %		77 %		48 %	
2.1. Company's Policies	70%		71 %		71 %		72 %		32 %	
2.1.1. General Policy - Environmental standards	100 %		100 %		100 %		100 %		43 %	
2.1.2. General Policy - Social standards/Code of Conduct	100 %		100 %		83 %		100 %		57 %	
2.1.3 General Policy - Quality standards	40%		33 %		33 %		25 %		0 %	

2.1.4. Compliance with Regulations	40%		50 %		67 %		63 %		29 %	
2.2. Business Alignment	90%		81 %		86 %		79 %		48 %	
2.2.1. Link - sustainability strategy and supply chain	80%		50 %		83 %		38 %		29 %	
2.2.2. Structure - Cross function/Sust. Department	100 %		67 %		83 %		100 %		57 %	
2.2.3. Communication with shareholders and employees	100 %		83 %		100 %		75 %		43 %	
2.2.4. Human Resources - Training/Education	100 %		100 %		100 %		88 %		86 %	
2.2.5. Human Resources - Social issues	100 %		100 %		83 %		100 %		57 %	
2.2.6. Financial issues	60%		83 %		67 %		75 %		14 %	
2.3. Sustainability Control	53%		64 %		75 %		69 %		48 %	
2.3.1. Measurement system/ Sustainability Management	80%		83 %		100 %		75 %		86 %	
2.3.2. Company's Certifications	40%		50 %		67 %		88 %		43 %	
2.3.3. Environmental, Social and Quality Programs	20%		50 %		50 %		63 %		0 %	
2.3.4. Establish KPI's and improvement targets/goals for company	100 %		83 %		100 %		75 %		86 %	
2.3.5. Risk and Safety Management	80%		100 %		100 %		88 %		71 %	
2.3.6. Practices related to IT	0%		17 %		33 %		25 %		0 %	
2.4. External Relationship	94%		64 %		81 %		89 %		65 %	
2.4.1. Relationship - Society/Biodiversity	100 %		100 %		83 %		75 %		100 %	

2.4.2. Relationship - Government and regulatory agencies	100%		50%		100%		75%		71%	
2.4.3. Relationship University	100%		50%		83%		75%		57%	
2.4.4. Relationship - NGOs	100%		50%		83%		100%		71%	
2.4.5. Relationship - other companies	100%		83%		83%		100%		71%	
2.4.6. Audit by third party companies	100%		33%		50%		100%		43%	
2.4.7. Publicize efforts	60%		83%		83%		100%		43%	
3. Procurement	42%		56%		54%		66%		17%	
3.1. Process	40%		67%		58%		75%		7%	
3.1.1. Sustainable Procurement process	20%		83%		50%		63%		0%	
3.1.2. Long-term and clear contracts with environmental dimensions	60%		50%		67%		88%		14%	
3.2. Materials and Components	73%		78%		67%		75%		38%	
3.2.1. General Sustainable Materials and Services	80%		100%		100%		88%		57%	
3.2.2. Specific - Recycled and reusable materials	80%		83%		67%		88%		43%	
3.2.3. Specific - Less hazardous materials	60%		50%		33%		50%		14%	
3.3. Packaging	12%		23%		37%		48%		6%	
3.3.1. Reduce amount of packaging	0%		17%		50%		50%		14%	
3.3.2. Improvements towards sustainable packaging	20%		33%		67%		100%		14%	
3.3.3. Suppliers' involvement on packaging issues	0%		0%		17%		25%		0%	

3.3.4. Special package and label for hazardous material	20%		33%		17%		13%		0%	
3.3.5. Eco-labels	20%		33%		33%		50%		0%	
4. Production Management	69%		70%		61%		73%		26%	
4.1 Solutions Development	52%		53%		47%		50%		23%	
4.1.1. Environmental and social aspects in solutions development	100%		83%		100%		100%		29%	
4.1.2. Provide green specification for suppliers	0%		17%		0%		25%		0%	
4.1.3. Online Services	60%		33%		0%		13%		43%	
4.1.4. Product Life Cycle management	60%		83%		83%		63%		0%	
4.1.5. Products that reduce customers energy	40%		50%		50%		50%		43%	
4.2. Resources	85%		88%		75%		97%		29%	
4.2.1. Reduce overall consumption (materials…)	80%		83%		67%		100%		29%	
4.2.2. Reduce consumption of energy	80%		100%		83%		100%		57%	
4.2.3. Energy Source	100%		67%		83%		100%		14%	
4.2.4. Water Management	80%		100%		67%		88%		14%	
5. Distribution	46%		19%		20%		32%		38%	
5.1. Structure and Network	40%		20%		20%		35%		29%	
5.1.1. Efficient land use and Green construction	80%		50%		83%		75%		86%	
5.1.2. Layouts/Shared	20%		0%		0%		13%		14%	

5.1.3. Network redesign	40%		17%		0%		25%		14%	
5.1.4. Specific strategies for reducing emissions	40%		33%		0%		38%		14%	
5.1.5. Vehicle fleet optimization	20%		0%		17%		25%		14%	
5.2. Modes of Transport	36%		23%		50%		23%		23%	
5.2.1. General - Intermodal	40%		17%		50%		25%		43%	
5.2.2. General - Less polluting modes	60%		33%		67%		25%		0%	
5.2.3. Specific - Water	60%		17%		33%		25%		14%	
5.2.4. Specific - Rail	20%		17%		83%		25%		57%	
5.2.5. Specific - Avoid air	0%		33%		17%		13%		0%	
5.3. Equipment and Vehicles	47%		11%		6%		25%		62%	
5.3.1 Type of fuel	60%		33%		0%		50%		86%	
5.3.2 New technology - eco-efficient	80%		33%		33%		50%		100%	
5.3.3. New technology - Rolling Resistance Reduction	20%		0%		0%		0%		43%	
5.3.4. Body Type - Increase Capacity	20%		0%		0%		13%		29%	
5.3.5. Body Type - Aerodynamic	20%		0%		0%		0%		43%	
5.3.6 Maintenance and renewal	80%		0%		0%		38%		71%	
5.4. Distribution Processes	60%		22%		6%		46%		38%	
5.4.1. Inventory Management/Hazardous	60%		33%		17%		50%		14%	
5.4.2. Transport - Low speed and correct poor driving	80%		17%		0%		25%		29%	

5.4.3.Transport - Optimization	40%		17 %		0%		63 %		71 %	
6. Waste Management	78%		38 %		61 %		55 %		50 %	
6.1. Reuse and Recycle	45%		38 %		57 %		47 %		21 %	
6.1.1. Recovery end of life products /Reverse Logistics	20%		33 %		50 %		38 %		0 %	
6.1.2. Reuse	100 %		50 %		67 %		63 %		43 %	
6.1.3. Remanufacture and Refurbishment	0%		17 %		67 %		0%		14 %	
6.1.4. Recycling	60%		50 %		43 %		88 %		29 %	
6.2. Waste Disposal	100 %		33 %		83 %		75 %		71 %	
6.2.1. Waste Disposal	100 %		33 %		83 %		75 %		71 %	
6.3 Pollution Control	90%		42 %		42 %		44 %		57 %	
6.3.1. Prevent, Reduce and Manage pollution	80%		83 %		67 %		75 %		71 %	
6.3.2. Offsetting programs	100 %		0%		17 %		13 %		43 %	
7. Customer Relationship	75%		44 %		64 %		60 %		50 %	
7.1. Demands	90%		50 %		83 %		75 %		57 %	
7.1.1. Customer Relationship Management	100 %		50 %		100 %		88 %		71 %	
7.1.2. Inform customers about sustainability issues	80%		50 %		67 %		63 %		43 %	
7.2. Engagement	60%		39 %		44 %		46 %		43 %	
7.2.1. Educate customers on sustainability issues	60%		50 %		67 %		50 %		29 %	
7.2.2. Complementary services	60%		33 %		50 %		38 %		57 %	
7.2.3. Collaborate with customers	60%		33 %		17 %		50 %		43 %	

Appendix 8. Summary of Industry Patterns

1. **SUPPLIER RELATIONSHIP**

SIMILARITIES

Positive

- Sourcing from environmentally sound suppliers
- Criteria for suppliers selection considering also environmental and social aspects
- Compliance statement from suppliers/guidelines
- Monitor and audit suppliers' performance/ Use questionnaire/ High risk
- Audits using on-site inspections
- Educate/offer technical support'

Negative

- Collaboration - New Technologies (16 %)
- Financial support for sustainability and improving quality (12 %)

DIFFERENCES

BM&E	IM	A&CV	CG	T&LS
Positive - Certifications for suppliers as a selection criteria - Communication of sustainability standards/expectations **Negative**	**Positive** None **Negative** - Educate/offer technical and environmental information	**Positive** - Collaboration for Integration - Educate/offer technical and environmental information **Negative** None	**Positive** - Collaboration - New Technologies (2 out of 5/32) **Negative** - Management System as selection criteria	**Positive** - Collaboration - New Technologies (3 out of 5/32) **Negative** - Criteria for suppliers selection considering also environmental and social aspects - Management System as selection criteria - Communication of sustainability

None				- Monitor/audit suppliers' performance - Audits using on-site inspections - Evaluation to indirect suppliers and/or sub-contractors - Supplier`s penalization in case of lacking env/social requirements - Educate/offer technical and environmental information

2. GOVERNANCE

SIMILARITIES

Positive

- General Policy - Env. standards[11]
- General Policy - Social standards/Code of Conduct[12]
- HR- Training/Education
- HR - Social issues[13]
- Measurement/Sust. Management
- Establish KPI's and improvement targets/goals for company
- Risk and Safety Management
- Relationship - Society/Biodiversity and other companies

Negative

- Practices related to IT (15 %)

DIFFERENCES

[11] Except T&LS
[12] Except T&LS
[13] Except T&LS

BM&E	IM	A&CV	CG	T&LS
Positive - Audit by third party companies (100 %) - Overall external relationship **Negative** - None	**Positive** - None **Negative** - Relationship with Government, University and NGOs	**Positive** - Relationship with government **Negative** - None	**Positive** - Company's Certifications - Audit by third party companies (100 %) **Negative** - None	**Positive** - None **Negative** - Environmental standards - Social standards/Code of Conduct - Structure - Cross function/Sust. Department - Communication with shareholders and employees - HR - Social issues - HR - Financial issues - Audit by third party companies - Publicize efforts

3. PROCUREMENT

SIMILARITIES

Positive

- Purchase Sust. Materials and Services

Negative

- Suppliers' involvement on packaging issues (8 %)

DIFFERENCES

BM&E	IM	A&CV	CG	T&LS
Positive - None **Negative** - Sustainable Procurement process - Improvements towards sust. packaging	**Positive** - None **Negative** - None	**Positive** - None **Negative** - Online Services	**Positive** - Improvements towards sustainable packaging **Negative** - None	**Positive** - None **Negative** - Sustainable Procurement process - Long-term and clear contracts - Purchase less hazardous materials - Improvements towards sustainable packaging - Eco-labels

4. PRODUCTION MANAGEMENT

SIMILARITIES

Positive

- Environmental and social aspects in solutions development
- Reduce consumption of energy
- Water Management
- Energy Source

Negative

- Provide green specification for suppliers (8 %)

DIFFERENCES

BM&E	IM	A&CV	CG	T&LS
Positive - Online Services (60 %) **Negative** - None	**Positive** - None **Negative** - None	**Positive** - None **Negative** - Water Management	**Positive** - Reduce overall consumption **Negative** - None	**Positive** - None **Negative** - Environmental and social aspects in solutions development - Product Life Cycle management - Reduce overall consumption (materials…) - Reduce consumption of energy - Energy Source - Water Management

5. DISTRIBUTION

SIMILARITIES

Positive

- Efficient land and green buildings

Negative

- Layouts/Shared (9 %)
- Vehicle fleet optimization (15 %)
- Avoid air (13 %)
- New technologies (Rolling Resistance Reduction, Increase Capacity, Aerodynamic (13 %)

DIFFERENCES

BM&E	IM	A&CV	CG	T&LS
Positive - New technology - eco-efficient equipment & vehicles - Maintenance and renewal - Transport - Low speed and correct poor driving **Negative** - None	**Positive** - None **Negative** - None	**Positive** - Use less polluting modes - Use of rail **Negative** - None	**Positive** - None **Negative** - None	**Positive** - Use of rail - Type of fuel - New technology - eco-efficient equipment & vehicles **Negative** - None

6. WASTE MANAGEMENT

SIMILARITIES

Positive

- Prevent, reduce and manage pollution

Negative

- None

DIFFERENCES

BM&E	IM	A&CV	CG	T&LS
Positive - Reuse **Negative** - None	**Positive** - None **Negative** - None	**Positive** - Remanufact. **Negative** - None	**Positive** - Recycling **Negative** - None	**Positive** - None **Negative** - None

7. CUSTOMER RELATIONSHIP

SIMILARITIES

Positive

- Customer engagement

Negative

- None

DIFFERENCES

BM&E	IM	A&CV	CG	T&LS
Positive - None **Negative** - None	**Positive** - None **Nega-tive** - None	**Positive** - None **Negative** - Collaborate with customers	**Positive** - None **Negative** - None	**Positive** - None **Negative** - None

Appendix 9. Statistically Significant Differences between T&LS and Manufacturers

Practices	IM x T&LS	BM&E/A&CV/CG x T&LS
1. Supplier Relationship		
1.1. Selection	0,013*	0,00025**
1.2. Assessment	0,000007**	0,000000000020**
2. Governance		
2.1. Company's Policies	0,012*	0,00027**
2.2. Business Alignment	0,0044**	0,000018**
2.3. Sustainability Control		0,037*
2.4. External Relationship		0,0010**
3. Procurement		
3.1. Process	0,026*	0,00057**
3.2. Materials and Components		0,0086**
3.3. Packaging		0,00036**
4. Production Management		
4.1 Solutions Development	0,020*	0,009**
4.2. Resources	0,000021**	0,000000010**
5. Distribution		
5.3. Equipment and Vehicles	0,000000013**	0,00000010**
6. Waste Management		
6.1. Reuse and Recycle		0,046*

Appendix 10. Participants in the Workshop in Germany

INDUSTRY	Firma
Materials	BASF Agro B.V.
Materials	BASF SE
Materials	HeidelbergCement AG
Materials	IVF Hartmann AG
Energy	Osram GmbH
Energy	Hilti Corporation
Chemical	Lehnkering GmbH
Chemical	Chemion Logistik GmbH
Vehicles	Volkswagen AG
Vehicles	Volkswagen Logistics GmbH
Consumer Goods	BSH Bosch und Siemens
Consumer Goods	Strellson AG
Consumer Goods	Philip Morris GmbH
Retailing	Tchibo GmbH
Retailing	Migros-Genossenschafts-Bund
Logistics	Migros Verteilzentrum Suhr AG
Logistics	Logistik Service GmbH
Logistics	SDV Geis GmbH
Logistics	Schmitz Cargobull AG
Logistics	Bertschi Global AG
Logistics	Duisburger Hafen AG
Transportation	Kühne + Nagel (AG & Co.) KG
Transportation	Kühne + Nagel Management AG
Transportation	Hapag-Lloyd AG
Transportation	DB Mobility Logistics AG
Transportation	Hamburg Süd
Transportation	Lufthansa Cargo AG
Transportation	Schenker Deutschland AG
Transportation	Swiss Int. Air Lines Ltd.
Consultancy	Integral logistics GmbH & Co. KG
Automation	Groz-Beckert KG

Appendix 11. Questionnaires for Building the Matrix (Original Version in Portuguese)

QUESTIONNAIRE 1 – IMPLEMENTATION LEVEL

Prezado participante deste workshop,

Pedimos por gentileza que dedique estes primeiros minutos para nos informar sua percepção quanto ao nível de implementação em sua empresa das práticas de sustentabilidade na cadeia de suprimentos abaixo listadas. Os dados serão utilizados apenas para fins acadêmicos e para orientar as discussões durante o workshop.

Setor: Automobilístico Energia/Químico Bens industriais Varejo Outros: ____	 Materiais Básicos Bens de consumo Saúde/Farmacêutico Serviços Logísticos
País de localização da matriz: _______________________________________	
Tamanho: <50 funcionários 250-500 funcionários	50-250 funcionários >500
Opcional **Nome:** ___________	**Função:**_______________________________

Nível de implementação:

1. Sem interesse em implementar 2. Planejado 3. Em fase inicial
4. Implementado parcialmente 5. Implementado completamente
NA. Não se aplica

Relacionamento com os fornecedores	**Nível de Implementação**
Selecionar fornecedores considerando além, dos aspectos econômicos, também os socioambientais	① ② ③ ④ ⑤ **NA**
- Requerer certificações externas (ex. ISO 14000, 9001, MSC...)	① ② ③ ④ ⑤ **NA**
Avaliar periodicamente os fornecedores considerando aspectos socioambientais	① ② ③ ④ ⑤ **NA**
- Uso de auditorias nas instalações dos fornecedores	① ② ③ ④ ⑤ **NA**

- Estabelecer metas socioambientais para os fornecedores	① ② ③ ④ ⑤ NA
- Implementar sanções ou encerrar contratos em virtude de não adequação as normas socioambientais	① ② ③ ④ ⑤ NA
Colaborar com os fornecedores através de metas compartilhadas relativas a sustentabilidade	① ② ③ ④ ⑤ NA
- visando o desenvolvimento de novas tecnologias (mais eficiência e menos impacto socioambiental)	① ② ③ ④ ⑤ NA
- visando processos mais sustentáveis (mais eficiência e menos impacto socioambiental)	① ② ③ ④ ⑤ NA
- visando o aumento da transparência na cadeia de suprimentos	① ② ③ ④ ⑤ NA
- Proporcionar incentivos financeiros para gerar ganhos de sustentabilidade	① ② ③ ④ ⑤ NA

Governança	**Nível de Implementação**
Implementar políticas ambientais e sociais	① ② ③ ④ ⑤ NA
Alinhar tais políticas com os colaboradores	① ② ③ ④ ⑤ NA
Gerir sustentabilidade através de um sistema formal de gestão	① ② ③ ④ ⑤ NA
- Utilizar indicadores de desempenho relacionados a questões ambientais e sociais	① ② ③ ④ ⑤ NA
Manter práticas de relacionamento com *stakeholders* externos a empresa	① ② ③ ④ ⑤ NA
- com a comunidade	① ② ③ ④ ⑤ NA
- com o governo	① ② ③ ④ ⑤ NA
- com outras empresas	① ② ③ ④ ⑤ NA

Compras	**Nível de Implementação**
Estabelecer contratos com cláusulas relativas a sustentabilidade que sejam claros e bem definidos	① ② ③ ④ ⑤ NA
Incluir critérios de sustentabilidade na escolha dos insumos a serem comprados	① ② ③ ④ ⑤ NA

- Usar insumos recicláveis	① ② ③ ④ ⑤ NA
Implementar ações de sustentabilidade em embalagens no intuito de reduzir a quantidade usada e/ou o uso de embalagens mais recicláveis	① ② ③ ④ ⑤ NA

Produção	**Nível de Implementação**
Gerar melhorias em aspectos socioambientais em serviços/produtos e processos	① ② ③ ④ ⑤ NA
- Envolver fornecedores na fase de desenvolvimento de novos produtos/serviços	① ② ③ ④ ⑤ NA
Analisar o Ciclo de Vida do produto para reduzir seu impacto ambiental	① ② ③ ④ ⑤ NA
Otimizar a utilização de recursos hídricos e energéticos	① ② ③ ④ ⑤ NA
- Investir em fontes renováveis de energia	① ② ③ ④ ⑤ NA

Distribuição	**Nível de Implementação**
Investir em construções mais sustentáveis	① ② ③ ④ ⑤ NA
Otimizar a rede de distribuição considerando a redução dos impactos socioambientais	① ② ③ ④ ⑤ NA
Utilizar modais de transporte com menores impactos socioambientais	① ② ③ ④ ⑤ NA
Investir em veículos e equipamentos mais eco eficientes	① ② ③ ④ ⑤ NA
Investir em manutenção e renovação da frota de veículos	① ② ③ ④ ⑤ NA
Implementar melhorias em processos de distribuição (otimização de transporte e armazenagem)	① ② ③ ④ ⑤ NA

Gestão de Resíduos e Poluição	**Nível de Implementação**
Promover iniciativas de Reuso e Reciclagem	① ② ③ ④ ⑤ NA

Descarte adequado dos resíduos sólidos	① ② ③ ④ ⑤ **NA**
Gestão da Poluição (inclusive prevenção)	① ② ③ ④ ⑤ **NA**

Relacionamento com Clientes/Consumidores	**Nível de Implementação**
Manter relacionamento com os clientes, informando-os acerca de questões socioambientais	① ② ③ ④ ⑤ **NA**
Incentivar os consumidores terem comportamento mais sustentável	① ② ③ ④ ⑤ **NA**
Estabelecer relações de cooperação com clientes	① ② ③ ④ ⑤ **NA**

QUESTIONNAIRE 2 – PERCEIVED EFFORTS AND IMPACTS

Pedimos por gentileza que nos informar sua percepção quanto aos esforços e impacto das práticas de sustentabilidade na cadeia de suprimentos abaixo listadas. Os dados serão utilizados apenas para fins acadêmicos e para orientar as discussões durante o workshop.

Setor: ☐ **Automobilístico** ☐ **Materiais Básicos**
☐ **Energia/Químico** ☐ **Bens de consumo** ☐ **Bens industriais**
☐ **Saúde/Farmacêutico** ☐ **Varejo** ☐ **Serviços Logísticos**
Outros: ____

Variáveis e Escala para mensuração

Esforços: Esforços (financeiros, humanos, relacionamento, tempo) para implementação da atividade

Impactos: Impacto da atividade na empresa (financeiros positivos, em metas de sustentabilidade, na imagem da empresa, redução de custos)

NA. Não se aplica 1. Extremamente baixo/Inexistente 2. 3. 4. 5. Extremamente alto

Relacionamento com os fornecedores	**Esforços**	**Impactos**
Selecionar fornecedores considerando além, dos aspectos econômicos, também os socioambientais	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Avaliar periodicamente os fornecedores considerando aspectos socioambientais	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Colaborar com os fornecedores através de metas compartilhadas relativas a sustentabilidade	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Governança	**Esforços**	**Impactos**
Implementar políticas ambientais e sociais	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Alinhar tais políticas com os colaboradores	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Gerir sustentabilidade através de um sistema formal de gestão	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Manter práticas de relacionamento com *stakeholders* externos a empresa	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA

Compras	Esforços	Impactos
Estabelecer contratos com cláusulas relativas a sustentabilidade que sejam claros e bem definidos	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Incluir critérios de sustentabilidade na escolha dos insumos a serem comprados	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Implementar ações de sustentabilidade em embalagens	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Produção	**Esforços**	**Impactos**
Gerar melhorias em aspectos socioambientais em serviços/produtos e processos	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Analisar o Ciclo de Vida do produto para reduzir seu impacto ambiental	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Otimizar a utilização de recursos hídricos e energéticos	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Distribuição	**Esforços**	**Impactos**
Investir em construções verdes	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Otimizar a rede de distribuição considerando a redução dos impactos socioambientais	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Utilizar modais de transporte com menores impactos socioambientais	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Investir em veículos e equipamentos mais eco eficientes	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Investir em manutenção e renovação da frota de veículos	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Implementar melhorias em processos de distribuição (otimização de transporte e armazenagem)	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Gestão de Resíduos e Poluição	**Esforços**	**Impactos**
Promover iniciativas de Reuso e Reciclagem	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA
Descarte adequado dos resíduos sólidos	① ② ③ ④ ⑤ NA	① ② ③ ④ ⑤ NA

Gestão da Poluição (inclusive prevenção)	① ② ③ ④ ⑤ **NA**	① ② ③ ④ ⑤ **NA**
Relacionamento com Clientes/Consumidores	**Esforços**	**Impactos**
Manter relacionamento com os clientes, informando-os acerca de questões socioambientais	① ② ③ ④ ⑤ **NA**	① ② ③ ④ ⑤ **NA**
Incentivar os consumidores terem comportamento mais sustentável	① ② ③ ④ ⑤ **NA**	① ② ③ ④ ⑤ **NA**
Estabelecer relações de cooperação com clientes	① ② ③ ④ ⑤ **NA**	① ② ③ ④ ⑤ **NA**

Appendix 12. Some of the Researched Companies in Workshops and Interviews in Brazil

Approach	Company
Workshop ILOS	Furnas
Workshop ILOS	CIELO
Workshop ILOS	ArcelorMittal Brasil
Workshop ILOS	SPDL - São Paulo Distribuição e Logistica
Workshop ILOS	Embraport
Workshop ILOS	Tegma Gestão Logística
Workshop ILOS	Comdesp Comércio Exterior
Workshop ILOS	Sermavil Locação
Workshop ILOS	Ksytar
Workshop ILOS	Syngenta Crop
Workshop ILOS	Ford Motor Company
Workshop ILOS	Terminal Portuario Cotegipe
Workshop ILOS	Hospital Moinhos de Vento
Workshop ILOS	Correios
Workshop ILOS	Natura
Workshop ILOS	Aché
Workshop ILOS	Libercon Engenharia
Workshop ILOS	Becton Dickinson Indústrias Cirúrgicas
Workshop ILOS	Smart Freight Centre
Workshop ILOS	SPDL - São Paulo Distribuição e Logistica
Workshop FGV/Mmurad	Vale
Workshop FGV/Mmurad	SBM Offshore
Workshop FGV/Mmurad	EBSERH
Workshop FGV/Mmurad	Imetame
Workshop FGV/Mmurad	Cesan
Workshop FGV/Mmurad	Ulihort
Workshop FGV/Mmurad	Stonenge
Workshop FGV/Mmurad	Servamil
Workshop FGV/Mmurad	Fortlev
Workshop FGV/Mmurad	Supermercado Perim
Workshop FGV/Mmurad	Busato Transportes
Workshop FGV/Mmurad	O&G
Workshop FGV/Mmurad	Technip
Workshop ES em Acao	Grupo Aguia Branca

Workshop ES em Acao	Vix Logistica
Workshop ES em Acao	LogIn
Workshop ES em Acao	Vale
Workshop ES em Acao	ArcelorMittal
Workshop ES em Acao	UCL
Workshop with logistics group	Vale – Sede ES
Interview	Arcelor Mittal Tubarao
Interview	Marca Ambiental
Interview	Cenibra
Interview	Usiminas

Appendix 13. Results of Data Collection - Companies in Brazil

	Implementation	Efforts	Impact
1.1 Select suppliers considering, besides financial aspects, also social-environmental ones	3,17	3,86	3,95
1.2 Periodically evaluate suppliers considering environmental aspects	2,95	3,33	3,57
1.3 Collaborate with suppliers through shared goals related to sustainability	2,60	3,71	3,67
2.1 Implement environmental and social policies	3,52	3,86	4,14
2.2 Align policies with employees	3,57	3,95	4,41
2.3 Manage sustainability through a formal management system	3,37	3,95	3,95
2.4 Maintain relationship and practices with external stakeholders	3,27	3,76	3,90
3.1 Establish contracts with clauses related to sustainability that are clear and well defined	2,93	3,38	3,57
3.2 Include sustainability criteria in the selection of raw materials to be purchased	2,89	3,40	3,75
3.3 Implement sustainable packaging initiatives in order to reduce the amount of and/or use more recyclable one	3,25	3,59	4,06

4.1 Implement social and environmental improvements in the products/services and processes	3,34	3,98	4,02
4.2 Optimize water and energy use	3,62	4,47	4,95
5.1 Invest in more sustainable buildings	3,16	3,68	3,68
5.2 Optimize the distribution network considering the reduction of environmental impacts	3,04	3,84	3,89
5.3 Use transport modes with lower environmental impacts	3,43	3,89	4,31
5.4 Invest in vehicles and more eco-efficient equipment	3,52	3,67	3,78
6.1 Promote initiatives Reuse and Recycling	3,57	3,50	4,33
6.2 Proper disposal of solid waste	4,04	4,11	4,61
6.3 Manage pollution (including prevention)	3,70	4,41	4,47
7.1 Maintain relationships with customers, informing them about environmental issues	3,09	3,34	3,84
7.2 Establish cooperative relations with customers	3,18	3,15	3,65

Appendix 14. Significant Correlations between Structural Dimensions and Analytic Categories

	S	G	P	Pm	D	W	C
S	-	0.107	0.132	0.244**	-0.118	0.148	0.188
G	-	-	0.023	0.183	0.193	0.122	0.046
P	-	-	-	0.381***	0.199*	0.289***	0.184
Pm	-	-	-	-	0.174	0.651***	0.366***
D	-	-	-	-	-	0.351***	0.095
W	-	-	-	-	-	-	0.376***
C	-	-	-	-	-	-	-

Notes: * p <= 0.050, ** p <= 0.015, and *** p <= 0.005

Acronyms	**Category combination**	**Phi co-eff./Signif.**
	Supplier Relationship	
SC*GBA	Supplier Collaboration (1.3)*Business Alignment (2.2)	0.329***
SC*PmS	Supplier Collaboration (1.3)*Solutions Development (4.1)	0.354***
	Governance	
GBA*GE	Business Alignment (2.2)*External Relationship (2.4)	0.371***
GE*DE	External Relationship (2.4)*Equipment and Vehicles (5.3)	0.311***
	Procurement	
PP*PMC	Procurement Process (3.1)*Materials/Services (3.2)	0.900***
PP*WPR	Procurement Process (3.1)*Reuse and Recycle (6.1)	0.306***
PMC*WPR	Materials/Services (3.2)*Reuse and Recycle (6.1)	0.302***
PPL*PMC	Packaging (3.3)*Materials/Services (3.2)	0.368***
PPL*PMS	Packaging (3.3)*Solutions Development (4.1)	0.368***
PPL*PME	Packaging (3.3)*Resources (4.2)	0.352***

PPL*DM	Packaging (3.3)*Transport Modes (5.2)	0.338***
Production Management		
PmS*CE	Solutions Development (4.1)*Customer engagement (7.2)	0.309***
PmE*WPR	Resources (4.2)*Reuse and Recycle (6.1)	0.338***
PmE*WPW	Resources (4.2)*Waste Disposal (6.2)	0.375***
PmE*WPP	Resources (4.2)* Pollution Control (6.3)	0.447*
Distribution (sub-categories already included under “Supplier Relationship” and “Governance”)		
Waste Management		
WPR*WPW	Reuse and Recycle (6.1)*Waste Disposal (6.2)	0.306***
WPP*CE	Pollution control (6.3)*Customer Engagement (7.2)	0.315***
Customer relationship (sub-categories already included under “Production Management” and “Waste Management”)		

Notes: * for p <= 0.050, ** p <= 0.015, and *** p <= 0.005

Appendix 15. Results of Fisher's Exact Test – Germany and Brazil

Practices	p-value
1. Supplier Relationship	
1.1. Selection	0,547
1.2. Assessment	0,320
1.3. Collaboration	0,439
2. Governance	
2.1. Company's Policies	0,616
2.2. Business Alignment	0,330
2.3. Sustainability Control	0,842
2.4. External Relationship	0,083*
3. Procurement	
3.1. Process	0,191
3.2. Materials and Components	0,765
3.3. Packaging	0,078*
4. Production Management	
4.1 Solutions Development	0,288
4.2. Resources	0,111
5. Distribution	
5.1. Structure and Network	0,045**
5.2. Modes of Transport	0,247
5.3. Equipment and Vehicles	0,208
5.4. Distribution Processes	0,268
6. Waste Management	
6.1. Reuse and Recycle	1,000

6.2. Waste Disposal	0,367
6.3 Pollution Control	0,315
7. Customer Relationship	
7.1. Demands	0,096*
7.2. Engagement	0,580

Notes: * for p <= 0.1, ** p <= 0.05

Appendix 16. Amount of Practices per Country – Germany and Brazil

Practices	GE	BR	diff (GE-BR)
1. Supplier Development			
1.1. Selection			
1.1.1. Sourcing from environm. sound suppliers	90 %	88 %	3 %
1.1.2. Criteria for suppliers selection considering also environmental and social aspects	90 %	88 %	3 %
1.1.3. Certifications for supplier	40 %	50 %	-10 %
1.1.4. Management System – by suppliers	40 %	13 %	28 %
1.1.5. Compliance statement from suppliers/guidelines/CC extension	90 %	88 %	3 %
1.1.6. Prefer using local/minority-owned/specific suppliers	60 %	50 %	10 %
1.2. Assessment			
1.2.1. Communication of sustainability standards/expectations	50 %	63 %	-13 %
1.2.2. Monitor and audit suppliers' performance/ Use questionnaire/ High risk	100 %	75 %	25 %
1.2.3. Audits using on-site inspections	80 %	75 %	5 %
1.2.4. KPI's and improvement targets for suppliers / Rating	40 %	38 %	3 %
1.2.5. Evaluation to indirect suppliers and/or subcontractors	70 %	63 %	8 %
1.2.6. Supplier`s change/rejection/ penalization in case of lacking environmental/social requirements	80 %	63 %	18 %
1.3. Collaboration			
1.3.1. General Collaboration/Cooperation	80 %	88 %	-8 %
1.3.2. Collaboration - Integration	40 %	38 %	3 %
1.3.3. Collaboration - New Technologies	30 %	13 %	18 %

1.3.4. Collaboration - Sustainable Processes	60 %	75 %	-15 %
1.3.5. Financial support for sust. and quality	0 %	38 %	-38 %
1.3.6. Educate/offer technical and env. information	70 %	75 %	-5 %
2. Governance			
2.1. Company's Policies			
2.1.1. General Policy - Environmental standards	100 %	100 %	0 %
2.1.2. General Policy - Social standards/Code of Conduct	100 %	100 %	0 %
2.1.3 General Policy - Quality standards	30 %	25 %	5 %
2.1.4. Compliance with Regulations	40 %	75 %	-35 %
2.2. Business Alignment			
2.2.1. Link - sustainability strategy and supply chain	60 %	38 %	23 %
2.2.2. Structure - Cross function/Sust. Department	80 %	100 %	-20 %
2.2.3. Communication with shareh. and employees	70 %	100 %	-30 %
2.2.4. Human Resources - Training/Education	90 %	100 %	-10 %
2.2.5. Human Resources - Social issues	100 %	100 %	0 %
2.2.6. Financial issues	60 %	75 %	-15 %
2.3. Sustainability Control			
2.3.1. Measurement system/ Sust. Management	80 %	88 %	-8 %
2.3.2. Company's Certifications	50 %	75 %	-25 %
2.3.3. Environmental, Social and Quality Programs	40 %	63 %	-23 %
2.3.4. Establish KPI's and improvement targets/goals for company	100 %	63 %	38 %
2.3.5. Risk and Safety Management	90 %	100 %	-10 %
2.3.6. Practices related to IT	20 %	0 %	20 %
2.4. External Relationship			
2.4.1. Relationship - Society/Biodiversity	80 %	100 %	-20 %

2.4.2. Relationship - Government and reg. agencies	60 %	88 %	-28 %
2.4.3. Relationship University	60 %	75 %	-15 %
2.4.4. Relationship - NGOs	80 %	100 %	-20 %
2.4.5. Relationship - other companies	90 %	100 %	-10 %
2.4.6. Audit by third party companies	60 %	88 %	-28 %
2.4.7. Publicize efforts	90 %	75 %	15 %
3. Procurement			
3.1. Process			
3.1.1. Sustainable Procurement process	50 %	50 %	0 %
3.1.2. . Long-term and clear contracts with environmental dimensions	50 %	88 %	-38 %
3.2. Materials and Components			
3.2.1. General Sustainable Materials and Services	100 %	88 %	13 %
3.2.2. Specific - Recycled and reusable materials	90 %	88 %	3 %
3.2.3. Specific - Less hazardous materials	60 %	38 %	23 %
3.3. Packaging			
3.3.1. Reduce amount of packaging	40 %	25 %	15 %
3.3.2. Improvements towards sust. packaging	70 %	75 %	-5 %
3.3.3. Suppliers' involvement on packaging issues	30 %	0 %	30 %
3.3.4. Special package and label for haz. material	30 %	0 %	30 %
3.3.5. Eco-labels	50 %	38 %	13 %
4. Production Management			
4.1 Solutions Development			
4.1.1. Env. and social aspects in solutions develop.	100 %	75 %	25 %
4.1.2. Provide green specification for suppliers	20 %	13 %	8 %
4.1.3. Online Services	20 %	50 %	-30 %
4.1.4. Product Life Cycle management	90 %	25 %	65 %

4.1.5. Products that reduce customers energy	40 %	38 %	3 %
4.2. Resources			
4.2.1. Reduce overall consumption (materials…)	100 %	63 %	38 %
4.2.2. Reduce consumption of energy	100 %	88 %	13 %
4.2.3. Energy Source	80 %	88 %	-8 %
4.2.4. Water Management	90 %	75 %	15 %
5. Distribution			
5.1. Structure and Network			
5.1.1. Efficient land use and Green construction	90 %	38 %	53 %
5.1.2. Layouts/Shared	10 %	13 %	-3 %
5.1.3. Network redesign	20 %	13 %	8 %
5.1.4. Specific strategies for reducing emissions	60 %	25 %	35 %
5.1.5. Vehicle fleet optimization	30 %	13 %	18 %
5.2. Modes of Transport			
5.2.1. General - Intermodal	40 %	13 %	28 %
5.2.2. General - Less polluting modes	40 %	25 %	15 %
5.2.3. Specific - Water	40 %	38 %	3 %
5.2.4. Specific - Rail	40 %	13 %	28 %
5.2.5. Specific - Avoid air	30 %	0 %	30 %
5.3. Equipment and Vehicles			
5.3.1 Type of fuel	60 %	38 %	23 %
5.3.2 New technology - eco-efficient	60 %	50 %	10 %
5.3.3. New technology - Rolling Resist. Reduction	10 %	13 %	-3 %
5.3.4. Body Type - Increase Capacity	0 %	25 %	-25 %
5.3.5. Body Type - Aerodynamic	0 %	0 %	0 %
5.3.6 Maintenance and renewal	10 %	63 %	-53 %
5.4. Distribution Processes			
5.4.1. Inventory Management/Hazardous	40 %	38 %	3 %
5.4.2. Transp. - Low speed and correct poor driving	40 %	50 %	-10 %
5.4.3.Transport - Optimization	20 %	63 %	-43 %

6. Waste and Pollution Management			
6.1. Reuse and Recycle			
6.1.1. Recovery end of life products /Rev. Logistics	30 %	25 %	5 %
6.1.2. Reuse	60 %	88 %	-28 %
6.1.3. Remanufacture and Refurbishment	20 %	0 %	20 %
6.1.4. Recycling	60 %	63 %	-3 %
6.2. Waste Disposal			
6.2.1. Waste Disposal	40 %	75 %	-35 %
6.3 Pollution Control			
6.3.1. Prevent, Reduce and Manage pollution	70 %	100 %	-30 %
6.3.2. Compensating programs	10 %	38 %	-28 %
7. Customer Relationship			
7.1. Demands			
7.1.1. Customer Relationship Management	70 %	88 %	-18 %
7.1.2. Inform customers about sustainability issues	50 %	75 %	-25 %
7.2. Engagement			
7.2.1. Educate customers on sustainability issues	50 %	63 %	-13 %
7.2.2. Complementary services	50 %	50 %	0 %
7.2.3. Collaborate with customers	40 %	63 %	-23 %

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