

Supply chain environmental and social sustainability practice diffusion – bibliometrics, content analysis and conceptual framework

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Abstract

The purpose of this paper is to uncover how environmental and social sustainability practices are diffused across the supply chain tiers through supplier development initiatives. In particular, the work seeks to uncover the initiatives developed directly or indirectly by manufacturing firms and the factors that enhance them. A systematic literature review is used to examine the breadth of the sustainable supply chain literature. The papers obtained are screened and analysed using established procedures to produce bibliometric and thematic analyses. The findings show the evolution of this young field around key research groups with few papers looking beyond focal firms to immediate suppliers and even fewer examining multiple tiers. Whilst numerous organisational factors are identified, few works consider most of them together and none capture their interrelationships at such breadth. Within this field lacking in theory, the originality of the work is the assembly of environmental and social practices into an integrated framework for their diffusion across supply chain tiers in the design and implementation of supplier development initiatives. There is recognition of where in the supply chain these practices are applied. The implications of this research are a framework around which supply chain diffusion theory can be tested and subsequent potential for its deployment in business to guide sustainable practice adoption.

Keywords: sustainable supply chain management, supplier sustainability development, environmental and social sustainability practices, sustainable development, stakeholder engagement, diffusion.

1 INTRODUCTION

Buying manufacturing firms coerce suppliers to implement sustainability practices through transactional instruments, such as imposing requirements and standards during the selection process to avoid risk and uncertainty (e.g. reputation, image, disruption and dependency) (Ayuso et al., 2013; Lo, 2014). Consequently, suppliers are likely to meet the minimum requirements, perhaps without seeing the direct benefits and value (Caniëls et al., 2013). More positively, some manufacturing firms seek to build more committed relationships that might facilitate diffusion of environmental and social sustainability practices across the supplier base through supplier sustainability development (SSD) initiatives (Ağan et al., 2016; Beske and Seuring, 2014). Whilst literature covers SSD in a broad context of sustainable supply chain management (SSCM), there are gaps in the mechanisms and influential factors to achieve this.

Bai and Sarkis (2010) considered supplier development as a critical activity within supply chain management and also necessary for the effective green supply chain management. Sancha et al. (2015) extended this by considering social sustainability across the supply chain. Through supplier development initiatives, manufacturing firms can help suppliers to enhance behaviour, performance and capabilities related to sustainability (Bai and Satir, 2020; Lalwani et al., 2018). Indeed, a common aspect of SSD literature has been the direct or indirect effort from the buying firm to aid suppliers to achieve improvements related to sustainability performance or, at least assuring the acceptable performance standard, which is a crucial objective of supply chain management (Bubicz et al., 2019; Gold et al., 2010a). These improvements have been gained by integrating environmental and/or social sustainability practices with supply chain management activities (Beske and Seuring, 2014; Bubicz et al., 2019; Gimenez and Tachizawa, 2012; Seuring and Müller, 2008; Wong et al., 2015). The challenges here are that much research is about what practices are promoted from the perspective of the focal firm. There has been little research on how these practices are deployed, especially from the wider perspective of multiple tiers.

SSD is reported with traditional SSCM themes of supplier selection, monitoring, risk management (Silva et al., 2020), collaboration with suppliers (Chen et al., 2017). Even though significant research has been initiated and completed on SSD drivers, enablers (Sancha et al., 2015), barriers (Bai and Satir, 2020) and mechanism (Ağan et al., 2016; Bai and Sarkis, 2010), as well as outcomes (Ehrgott et al., 2013), studies into organisational factors that affect the diffusion of sustainability practices based on SSD initiatives are scant. Srivastava (2007) argued that more integrative contributions of organisational factors for the diffusion of best practices are needed but little has emerged since then.

There is some knowledge about factors that facilitate SSD initiatives, for instance, which suppliers need to be engaged, their position across the supplier bases, mechanisms to be adopted and purposes. Bai and Sarkis (2010), one of the

first papers that covered SSD initiatives, argued that there was a gap in the research on how buyers could effectively manage supplier development initiatives. A literature review by Noshad and Awasthi (2015) highlighted the importance of research to address the necessary ingredients for developing suppliers. Overall, the factors that affect the employment of SSD initiatives have been given limited coverage in the literature.

There is a need for research on SSD initiatives, examining practice diffusion knowledge, determining limitations in theory and proposing future directions. This paper addresses the gap in knowledge of how manufacturing firms diffuse environmental and social sustainability practices through SSD initiatives into supply tiers. These provide insight into how buying firms can address sustainability within supplier development initiatives holistically. To fill this gap, bibliometric and thematic analyses are conducted, demonstrating the evolution of SSD literature in terms of environmental and social practices diffused through SSD initiatives and the factors that enhance SSD initiatives.

2 RESEARCH APPROACH

A systematic review is an evidence-based process (Tranfield et al., 2003) to identify, appraise and synthesise all relevant studies. This replicable, transparent, and scientific method (Pilbeam et al., 2012) is well established in SSCM research (e.g. Bubicz et al., 2019; Chen et al., 2017; Silva et al., 2020). This SLR was conducted in line with Tranfield et al. (2003) and Denyer and Tranfield (2006, 2009) following a protocol made up of four steps: planning, searching, screening, and analysis, as described below.

2.1 Planning and Searching

This review is guided by an overall question of “how do manufacturing firms diffuse environmental and social sustainability practices through supplier development initiatives?” In order to be more precise in terms of the scope and focus of the research, the CIMO-logic was employed. This model describes the logical thinking of “if you want to achieve outcome O in context C, then use intervention type I” (Denyer and Tranfield, 2009, p. 395). Thus, it is assumed that sustainability supplier development initiative (I) may diffuse sustainability practices (O) based on different mechanisms (M) and affected by organisational factors (C). Consequently, this allowed deconstructing the above question into four research questions:

- [RQ1] What are the environmental and social sustainability practices diffused through supplier development initiatives?
- [RQ2] What are the mechanisms employed?
- [RQ3] What are the influential organisational factors in the supplier sustainability development for the diffusion of environmental and social sustainability practices?
- [RQ4] How are environmental and social sustainability practices diffused across the supplier base through development initiatives?

Many firms have sought to employ supplier development initiatives to disseminate environmental and social sustainability practices along the supplier base (Schmidt and Schwegler, 2008). It is assumed that practices are related to technology, employee development, and organisation management (including

philosophies, principles, and work organisation) (Bolden et al., 1997). Sustainability is a business objective and practices are used to further realisation (Elkington, 1997), promoting the preservation of natural resources and waste reduction, as well as the inducement of social behaviour (e.g. proper working conditions, fair wages, safety standards) (Hollos et al., 2012). Interestingly, organisational factors are the elements that facilitate internal actions of the buying firm and suppliers to coordinate the information exchanges, build and transfer knowledge, resource and technologies related to sustainability (Grimm et al., 2014; Sancha et al., 2015).

Taking into consideration the research questions, a protocol was designed providing an explicit description of the steps taken. Table 1 summarises the eligibility criteria adopted in this research, including the search strategy, and exclusion criteria (Moher et al., 2010). In order to encompass a specific topic that can be broadly addressed, Brandenburg et al. (2014) suggested identifying and testing some potential keywords before starting the searching process. Some relevant and well known and cited papers on sustainability supplier development were selected, such as Bai and Sarkis (2010), Seuring and Müller (2008) and Vachon and Klassen (2006). From these papers, keywords were identified and tested using the Scopus database. Recent publications found in the searching process were also considered to confirm the keywords (e.g. Bai and Satir, 2020; Lo et al., 2018; Yawar and Seuring, 2018). Moreover, to encompass a representative number of materials more closely related to the research question, two sets of keywords in line with environmental and social sustainability and supplier development (“sustainab*”, “environment*”, “social responsibility”, “supply chain”, collaborat*” and “supplier development”) were used to construct search strings.

Relevance criterion	Description
Research questions (CIMO-Logic)	<ul style="list-style-type: none"> - What are the environmental and social sustainability practices diffused through supplier development initiatives? - What are the mechanisms employed? - What are the influential organisational factors in the supplier sustainability development for the diffusion of environmental and social sustainability practices? - How are environmental and social sustainability practices diffused across the supplier base through development initiatives?
Keywords	The search strings used based on the key-words selected were: 1) “sustainab*” and “supply chain” and collaborat*” or “supplier development”; 2) “environment*” and “supply chain” and collaborat*” or “supplier development” & 3) “social responsibility” and “supply chain” and collaborat*” or “supplier development”.
Database	Scopus, Science Direct, Web of Science and Taylor & Francis online.
Time	1992-2020.
Type of documents and Language	Peer-reviewed scientific papers in English.
Type of papers	Academic conversation, including papers based on surveys, cases and conceptual models or theories and literature review.
Exclusion criteria	When papers do not provide evidence for the SSD initiative, mechanism, sustainability practices or factors (e.g. focused only on cost or quality) and when confined to general humanity issues (e.g. climate change, war, loss of jobs due to automation, risk of economic collapse, famine, and overpopulation, corruption).

Table 1: SLR Protocol.

Databases used were Scopus, Science Direct, Web of Science and Taylor & Francis online. The main criterion to choose those databases was that they were related to the field of manufacturing, sustainability and supply chain management and index well-rated journals.

The strings were then used to search peer-reviewed scientific papers published in English between the period 1992 to January 2020 in databases using the “all fields”. According to Seuring and Müller (2008) and Srivastava (2007), most research related to SSCM has been published after 1990. The search strategy was based on all possible combinations between those two groups of keywords to take into account papers more representative with the research question.

Denyer and Tranfield (2006) considered that inclusion and exclusion criteria should be based on the research question and be piloted to ensure that they can be reliably interpreted and that they classify studies correctly. Therefore, the inclusion criteria were papers were selected when they provided insights on supplier development initiatives developed directly or indirectly by manufacturing firms, sustainability practices diffused by the initiative, mechanisms adopted or organisational factors that influenced the initiative.

2.2 Screening

Using the protocol discussed above, a total of 2750 articles were originally identified. This was reduced to 93 for bibliometric and thematic analysis as a result of the following steps:

- Removal of duplicates for create pre-selection sample using Endnote (1265);
- Selection based on firstly reading the titles and abstracts (pre-selection). This initial step resulted in 112 papers;
- Reviewing in full of the 112 papers was done. In this step, the removal of those without discussion on which and how sustainability practices were diffused through supplier development initiatives on reading full article was performed. These screening processes, resulted in 93 papers included to the bibliometric and thematic analysis.

Overall, the most common reasons for the elimination of these papers were: 1) a strong focus on supply chain management activities without focused on supplier development activities (i.e. only supplier selection or supplier performance assessment without a link with supplier development); 2) lack of discussion on which and how sustainability practices were diffused through supplier development initiatives, and 3) sectors which did not relate to manufacturing.

2.3 Analysis

The content of the papers was analysed, taking into account the aspects presented in Table 2, which includes a bibliometric and thematic analysis. The content analysis uses a large amount of data and allows in-depth synthesis of the results from the studies (Easterby-Smith et al., 2012; Miles et al., 2014). The same approach was adopted by other papers that employ SLR, such as Ahi and Searcy (2013), Bubicz et al. (2019); da Silva et al. (2020); Gold et al. (2010) and Igarashi et

al. (2013).

Bibliometric analysis was conducted with the aid of the Bibliometrix R-package (<http://www.bibliometrix.org>) (Aria and Cuccurullo, 2017). The bibliometrix, written in the R language, offers a toolkit for quantitative research in bibliometrics. The content of the bibliometric map with the characteristics of publications drawn up is presented in Table 2.

In the thematic analysis, environmental and social sustainability practices, supplier development initiatives and organisational factors were identified and analysed. Categories were set based on the principles of consistency and clear distinction between categories (Fu et al., 2018). For instance, organisational factors were categorised according to whether they relate to the process of design or implementation of the supplier development initiative. The papers that support the factors were also examined in terms of their empirical rigour by employing methodology (e.g. conceptual papers – e.g. literature review and empirical papers – e.g. case study and survey), as well as noting the occurrences of the factors. It is important to note that the factors were not used as an exclusion criterion or to sort the level of importance of the factors (prioritisation).

Analysis	Content	Source
Bibliometric	Year, Journal, Country, University, Industrial sectors, Position in the supply chain, Sustainability dimension, Methodology employed, Most cited references, Most cited authors, Co-citation, Collaboration network, Evolution of author's keyword, Conceptual map and Keywords clusters.	Aria and Cuccurullo (2017) and Pilbeam et al. (2012)
Thematic	Environmental and social sustainability practices diffused, Supplier development mechanisms and purpose and organisational factors	Authors

Table 2: Content analysis

Therefore, the content analysis aimed to understand in detail the environmental and social practices diffused through supplier development initiatives. In addition, this analysis also identified research gaps and opportunities for future studies.

3 RESULTS AND DISCUSSION

In this section, the results of the SLR are presented and discussed in four sub-sections. First, the bibliometric analysis is provided. Second, the analysis of mechanisms and purpose of SSD initiatives is given (addressing RQ2), followed by environmental and social sustainability practices diffused through supplier development initiatives (RQ1). Then, the analysis of the organisational factors that affect the sustainability practices diffusion is provided (RQ3). Finally, a conceptual framework based on the organisational factors identified is proposed (RQ4).

3.1 Bibliometric Analysis

The motivation for this topic to understand this young field of literature on supplier environmental and social sustainability development; most literature is from

the last 10 years (73.1%) (Figure 1). By 1999, only three papers were found. All of them covered only environmental practices diffused through supplier development initiatives, including reverse logistics (Roy and Whelan, 1992), hazard substance use reduction (Walton et al., 1998) and cleaner production (Lippmann, 1999). Between 2000 and 2009, 22 papers were published placing both environmental and social sustainability practices. For instance, Nawrocka et al. (2009) reported training on decent working conditions and ISO 14001 to suppliers. The highest number of publications was observed in 2012. After that, a fluctuation is underlined. Interestingly, between 2015 and 2020 a significant interest in social sustainability practices was found (e.g. Bubicz et al., 2019; da Silva et al., 2020; Lalwani et al., 2018; Yawar and Seuring, 2017). Overall, the majority of the papers focused on environmental between 1992 and 2020 (66% of the sample). Papers on environmental and social practices or only social practices had the same proportion (17% each). Papers on pure economic practices (e.g. quality issues, cost analysis) are not included in this literature review.

Table 3 presents the most cited papers on Scopus, which were selected in this systematic review. In addition, the most cited references used by the papers selected (local) and the most cited author (local) are presented. Interestingly, Seuring and Müller (2008) is the most cited papers on Scopus and the most cited reference used by the papers selected. Seuring is also one of the most cited authors by the papers selected. A similar result was observed to Vachon and Klassen (2008) and Lee and Klassen (2008) as one of the most cited papers (global) and most cited reference (local), as well as Vachon, Klassen and Lee as the most cited authors (local). Some such as Rao and Holt (2005) and Zhu and Sarkis (2004) targeted supplier environmental performance assessment without insight into sustainable supplier development (SSD). Finally, Krause et al. (2000) did not cover sustainability practices even provided theoretical background and insights on supplier development.

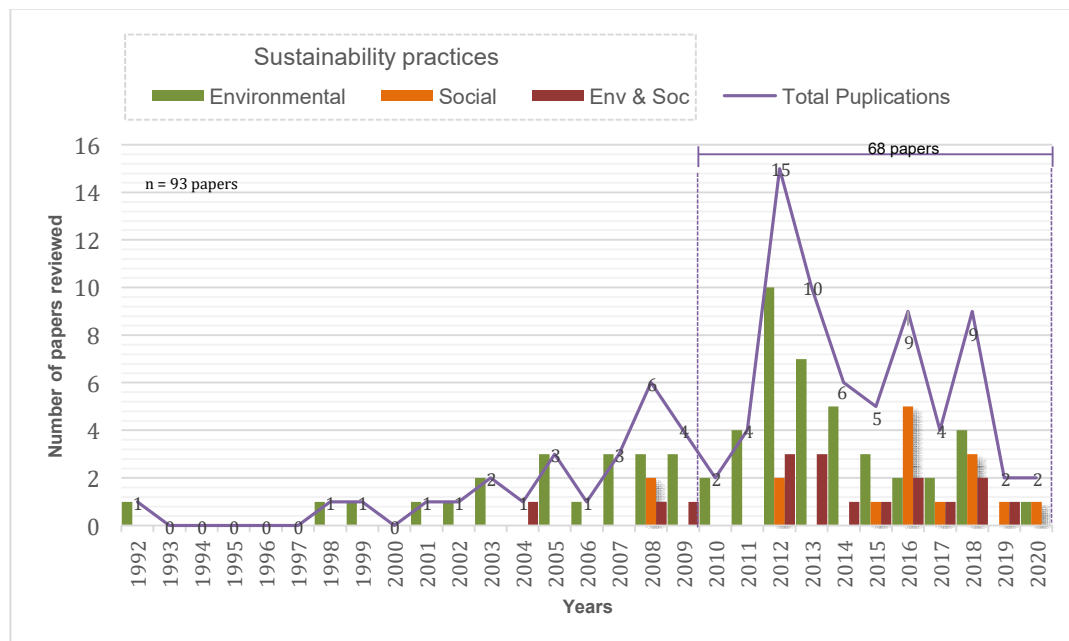


Figure 1: Distribution of the papers reviewed per year and sustainability practices observed.

In addition, the co-citation network and collaboration network were performed to visualise social networks. “Co-citation of two articles occurs when both are cited in a third article” (Aria and Cuccurullo, 2017, p. 969). Figure 2 shows four colour-coded co-citation clusters. It shows that the papers in this field have evolved around different works, namely Seuring and Müller (2008) (blue cluster), Carter and Rogers (2008) (purple cluster), Rao and Holt (2005) (green cluster) and Vachon and Klassen (2008) (red cluster). Figure 2 shows therefore how the local citations cluster into author groups. There are works that, whilst not necessarily the highest overall cited, are central across the works namely Seuring and Müller (2008) (Blue) and Zhu and Sarkis (2004) (Green). Together Table 3 and Figure 2 show the presence of distinct author and paper communities of this evolving field.

The collaboration network performed highlighted a scientific collaboration between Tachizawa, Sancha, Gimenez, Rodrigues, Pagell, Wong and Arenas as well as between Sarkis, Zhu, Lai, Bai and Dou.

Table 3: The 10 most cited papers, references and authors.

R*	Most cited papers (Scopus)	n*1	Most cited references (local)	n*1	Most cited author (local)	n*1
1	Seuring and Müller (2008)	2440	Seuring and Müller (2008)	54	Carter	147
2	Vachon and Klassen (2008)	843	Carter and Rogers (2008)	29	Zhu	129
3	Vachon and Klassen (2006)	787	Rao and Holt (2005)	28	Krause	97
4	Pagell and Wu (2009)	733	Vachon and Klassen (2008)	27	Vachon	91
5	Zhu et al. (2008)	682	Krause et al. (2000)	27	Seuring	84
6	Zhu et al. (2007)	592	Zhu and Sarkis (2004)	23	Lee	75
7	Gold et al. (2010)	414	Lee and Klassen (2008)	19	Sarkis	66
8	Klassen and Vachon (2003)	330	Klassen and Vachon (2003)	19	Klassen	65
9	Eltayeb et al. (2011)	328	Pagell and Wu (2009)	19	Handfield	60
10	Lee and Klassen (2008)	324	Bai and Sarkis (2010)	18	Pagell	54

* R – Rank;

*1 n – Occurrences

Distribution of papers by countries and universities was carried out and although not detailed in this paper the most prominent countries were UK then China, Germany and US covering more than 52% of the papers. The Chinese university, Dalian University of Technology, had the biggest frequency of papers published. The vast majority of the papers were published by researchers from management/business departments (83 papers), followed by engineering (e.g. industrial; environmental) (10 papers). Even sustainability is an interdisciplinary field; the management/business schools have prominence in the supplier sustainability development field. Interestingly, contributions were also found from practitioners, including managers, policy makers and authors from governmental agencies and NGOs.

Regarding the journals, 32 different journals were included, 72% from the field of supply chain management, manufacturing or operational management and 35% from sustainability fields. Journal of Cleaner Production took a dominant role with 21 papers. It was followed by “International Journal of Production Economics”, “Business Strategy and the Environment”, “Journal of Purchasing and Supply Management”, “Supply Chain Management: An International Journal”, “International Journal of Production Research” and “Corporate Social Responsibility and Environmental Management”.

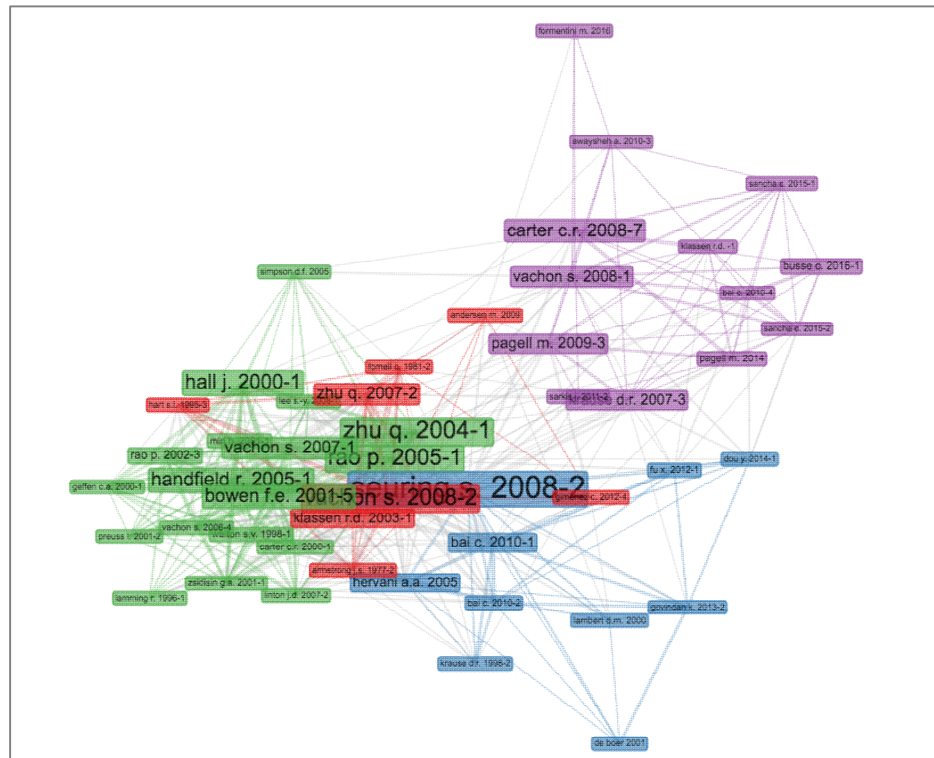


Figure 2: Co-citation analysis based on Clustering algorithm Louvain and 50 nodes.

Figure 3 illustrates the most used author keywords taking into account the minimum two occurrences of an author keyword (as distinct from the search keywords). Understanding the progression of most used author's keywords might represent research trend and potential gaps, as well as the main idea and methodologies employed in the topic (Saikia et al., 2020). A total of 165 keywords were found between 2000 and 2020. The papers published between 1992 and 1999 did not provide the author keywords. The most frequent keyword used was “supply chain management” (26) followed by “sustainability” (20). “Environmental management” (13), “corporate social responsibility” (6) and “ISO 14001” (2) were the most used sustainability practices. Some keywords emphasised sustainability supplier development, such as “green supplier development” (5) and “sustainable supplier development” (2). SSD is also associated with other supply chain management activities, including “supplier selection” (4), “supplier performance measurement” (2) and “supply chain integration” (2). Some keywords were also

related to the methodology employed, such as “case studies” (5), “literature review” (4) and “survey” (2). A trend of interested in social sustainability practices was also evidenced in the last 5 years. Even with only one occurrence a diversity of keywords related to social issues or practices was shown, for instance, “socially responsible supply chains”, “socially responsible supplier development”, “socially responsible practices”, “slavery”, “human rights” and “labour rights”.

Figure 4 presents a conceptual map by clustering common co-occurrence of keywords. It was constructed using the bibliometrix R-package performing multiple correspondence analysis. The smallest cluster brings “environmental supplier development” (key concept), “carbon management” (practice) and “dematel” (method). The biggest cluster is more related to environmental themes (e.g. “green supply chain”, “green supplier development” and “environmental issues”) and provides keywords regarding environmental practices (e.g. “environmental management”, “ISO 14001”, “lean production”) and supply chain management activities (e.g. “supplier selection”) and methods (e.g. “cluster analysis”, “vikor” and “literature review”). The blue cluster is more specific to sustainable supplier development. Finally, the green one does not cover a specific keyword related to supplier sustainability development. Differently, collaboration and “supply chain integration” are uncovered. These keywords capture collaborative approaches between buying firm and its suppliers for achieving a common purpose, mutual effort and shared benefits. Particularly, in this cluster social, sustainability and risk management appear likely the purposes.

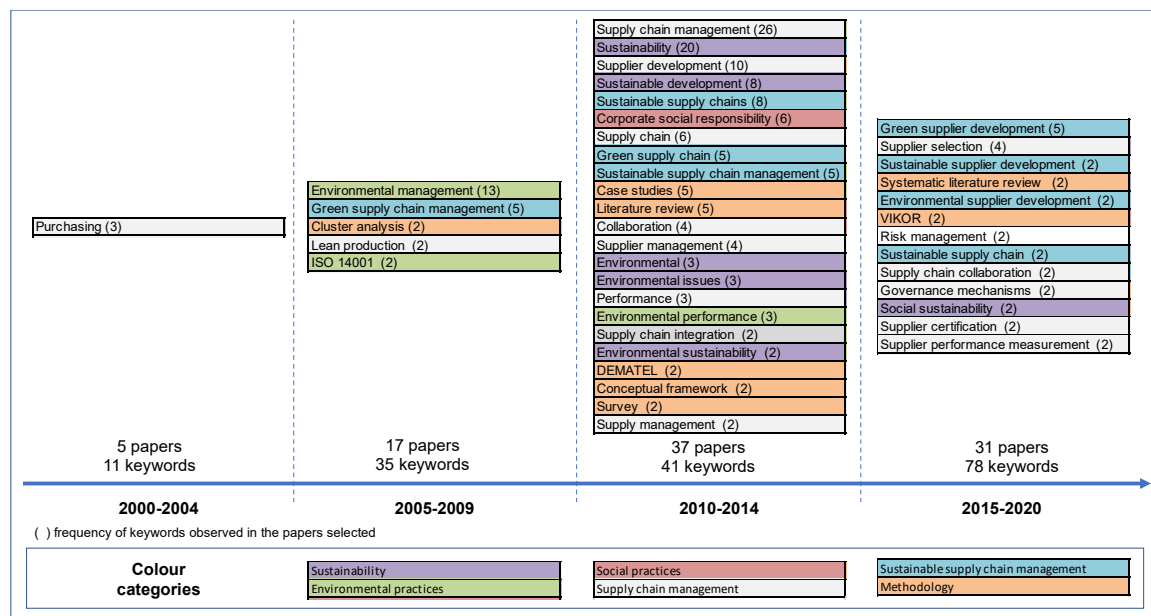


Figure 3: Evolution of author keywords with more than 2 occurrences.

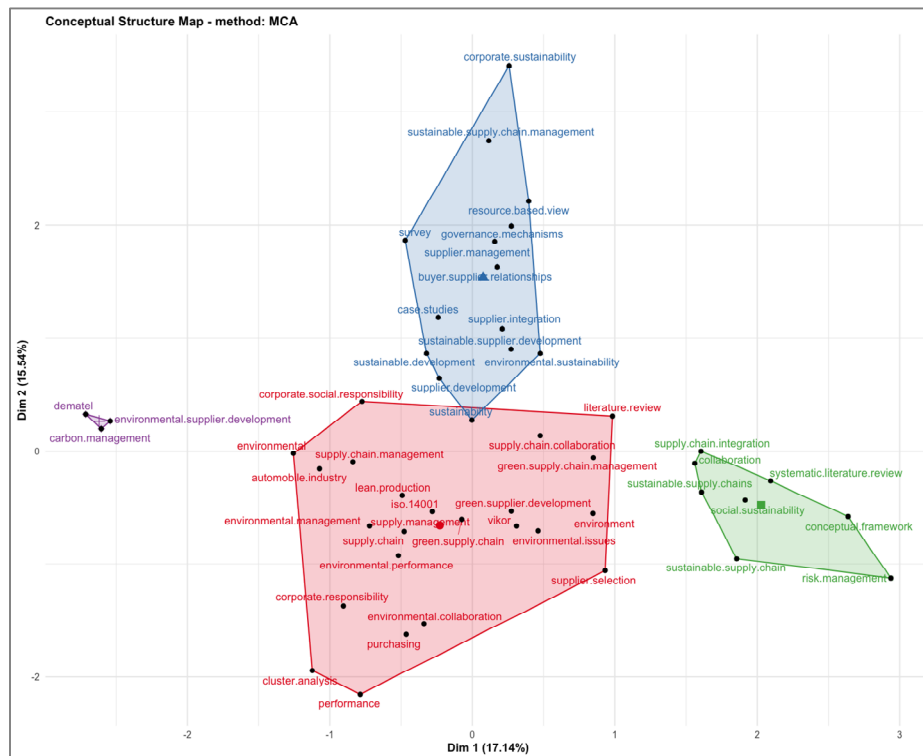


Figure 4: Conceptual map and author keywords clusters.

Most of the papers reviewed were based on empirical data (76%), including survey (32 papers) (e.g. Rogers et al., 2019; Tong et al., 2012), case studies (27 papers) (e.g. Karp, 2005; Yawar and Seuring, 2017), secondary data (public reports or databases) (3 papers) (e.g. Lalwani et al., 2018; Tate et al., 2012) and a mix of methodologies (e.g. survey and cases study and modelling and case study) (9 papers) (e.g. Bai and Satir, 2020; Zhu et al., 2007) (Table 4). Eighteen papers were based on literature reviews (19%). Most of them were conducted through a traditional way without a protocol for searching and analysing contributions (10 papers) (e.g. Gold et al., 2015; Lippmann, 1999). Eight review papers were based on a systematic literature protocol (e.g. Rogers et al., 2019; Wong et al., 2015). This suggests the reviews could have been conducted more robustly. However, this SLRs covered SSD with traditional SSCM themes (supplier selection, monitoring, collaboration, risk management). Papers based on modelling methodologies (Interpretive structural modelling, dematel and vikor) were also found (4%) (e.g. Govindan et al., 2013; Trapp and Sarkis, 2016).

Organisational theories have the power to explain a phenomenon and can drive the creation of knowledge (Boer et al., 2015). Various organisational theories were used here, however, most papers did not employ a theory as the lens of investigation, Table 4 lists those that did. Fifty-two papers used a background theory individually or more than one theory. A total of 28 theories were used in the papers. Resource base-view theory, transactional cost theory, Institutional theory and Stakeholder theory were the most employed individually. Noting their frequently of individual use were in low single figures. Overall, empirical studies dominated the field.

Table 4: Distribution of papers by the method employed and the use of background theories.

Method	n	Background Theories																			NE
		TT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	MT	
Survey	32	22	1	2	3	1	0	1	0	1	0	0	0	1	0	1	0	1	1	9	10
Case Study	27	10	1	1	0	1	0	0	0	1	0	1	0	0	1	0	0	0	0	4	17
Review	10	4	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	6
SLR	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	5
Modelling & Case Study	6	6	1	0	0	0	2	0	0	0	1	0	1	0	0	0	0	0	0	1	0
Modelling	4	4	0	0	0	0	1	0	2	0	0	0	0	0	0	0	1	0	0	0	0
Empirical study (reports)	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
Survey & Case Study	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	93	52	4	4	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1	18	41

n – Occurrences.

TT – Frequency of papers which employ theory (ies) as a lens of the investigation.

MT – More than one theory employed.

NE – Frequency of papers which NOT employ theory (ies) as a lens of the investigation.

Background theories: 1 – Resource-based view; 2 – Transaction cost; 3 – Institutional; 4 – Stakeholders; 5 – DEMATEL; 6 – Diffusion of innovation; 7 – Interpretive structural modelling; 8 – Resource dependence; 9 – Data envelopment analysis; 10 – Goal-setting; 11 – Grey ANP-based; 12 – Psychological distance; 13 – Relational; 14 – Resource advantage; 15 – Rough set; 16 – Social capital; 17 – Systems and MT – More than one theory employed: e.g. Agency & 2, Contingency & 4, Ecological modernization, 1 & 3; Signalling, 2, 4 & 8.

The scope of the supply chain focus was limited to the focal firm typically. Table 5 presents the frequency of papers related to the position of the members in the supply chain and the industrial sector studied. In terms of the position, this is regarding where the data were collected in the study, i.e. focal firms or focal firm and suppliers. The members of the supply chain were specified by 26 papers. Most of them focused on the focal firm initiatives for developing suppliers (17 papers) (e.g. Forman; Jorgensen, 2004; Zhang et al., 2017).

Focal firms and 1st tier suppliers (e.g. Graham, 2018; Simpson and Power, 2005) and focal firms, 1st tier suppliers and low-tier suppliers (Golini et al., 2017) were also found. The position of supplies was uncovered in 5 papers, 1st and 2nd tier suppliers (Lee and Kim, 2011) and low-tier suppliers (e.g. Rodríguez et al., 2016; Yawar and Kauppi, 2018). On the other hand, 11 papers focused on suppliers, however, it was not possible to identify the position in the supply chain (e.g. Thakker and Rane, 2018; Yadlapalli et al., 2018). In addition, 19 papers dedicated to focal firms and buying firms, without clear evidence on their position across the chain. Interestingly, most of them were based on surveys and covered a mix of industrial sectors (e.g. Formentini and Taticchi, 2016; Handfield et al., 2005). Similarly, six papers covered members located both in upstream, such as suppliers, and in downstream, such as logistics providers, waste management service providers, as well as, focal firms (e.g. Brockhaus et al., 2013; Sancha et al., 2015). However, they did not necessarily investigate the entire supply chain of the same industrial sector or the network, covering different members and industrial sectors. Finally, the position of the members was not provided by 31 papers. Overall, there is a surprising lack of focus or clarity of focus in published work beyond the focal firm.

Table 5: Distribution of papers by Method employed and the use of background theories.

Position in the supplier chain				n	Industrial Sector														NE	
Low-tier Suppliers	2 nd tier Suppliers	1 st tier Suppliers	Focal Firms		Total	1	2	3	4	5	6	7	8	9	10	11	12	13		14
-	-	-		17	17	4	1	3	1	0	0	1	1	0	1	0	0	1	4	0
-	-			3	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	-			1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
-			-	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	-	-	-	4	3	0	2	0	0	0	0	0	0	0	0	0	0	0	1	1
Focal firms and buying firms				19	18	1	0	0	0	1	0	0	0	0	0	0	0	0	16	1
Suppliers (Tier not clear)				11	11	4	0	1	1	0	1	0	0	0	0	0	1	3	0	0
Upstream and downstream (logistics provider)				6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
Position not clear				31	12	1	0	1	0	1	0	0	0	1	0	0	0	3	5	19
Total				93	66	11	6	5	2	2	1	1	1	1	1	1	1	7	32	21

n – Occurrences.

NE – Frequency of papers which NOT specified a sector.

Suppliers (Position not clear) – Data collected at the supplier level, but the position were not clear (e.g., 1st tier, 2nd tier or low-tier).

Industrial sectors: 1 – Automotive; 2 – Food & Beverage; 3 – Electrical & electronics; 4 – Apparel; 5 – Package printing; 6 – Chemicals; 7 – Furniture; 8 – Irrigation equipment; 9 – Machinery; 10 – Pharmaceutical; 11 – Semi-conductor; 12 – Telecommunication equipment; 13 – Manufacturing (sector not specified); 14 – Mix of industrial sectors: e.g. Manufacturing; Logistics; Communications; Electric; Gas; Sanitary services and Agriculture, forestry and fishing; Mining and quarrying; Manufacturing; Electricity; Gas; Steam; Air conditioning supply; Water collection; Sewerage; Waste management; Construction; Wholesale; Retail; Logistics.

Regarding the industrial sector, 40 papers targeted on a specific sector, 26 a mix of sectors and 27 papers did not specify (Table 5). The former finding can be justified considering the nature of the research, most of them were reviews papers or modelling. Considering both a specific sector and mix sectors, more than 100 sectors were found and sectors with greater representation were automotive, food, apparel, chemicals and electrical and electronics.

This section covered a bibliographic analysis. This descriptive analysis provided interesting observations in the development of the field and started to identify potential limitations in the scope of research. The thematic analysis next will focus in on how practices are deployed and where.

3.2 Thematic Analysis

3.2.1 Supplier development initiatives: purpose and mechanism

Figure 5 illustrates the distribution of the purpose of supplier sustainability development (SSD) identified in the literature. The vast majority of SSD publications concentrate on improving suppliers' sustainability performance (67%) and solving suppliers' problems (50%). With regard to the improvements in supplier's sustainability performance, this covers both environmental and social performance, including a broad range of themes, such as materials (e.g. Dou et al., 2014a), packaging (Blome et al., 2014b) and energy (e.g. Liu et al., 2018), carbon (e.g. Formentini and Taticchi, 2016) and working conditions (e.g. Golini et al., 2017). Harms et al. (2013) argued that SSD provides awareness-raising for sustainability

issues. For instance, Gold et al. (2015) found that training and education activities reduce vulnerability to slave labour and other exploitative practices.

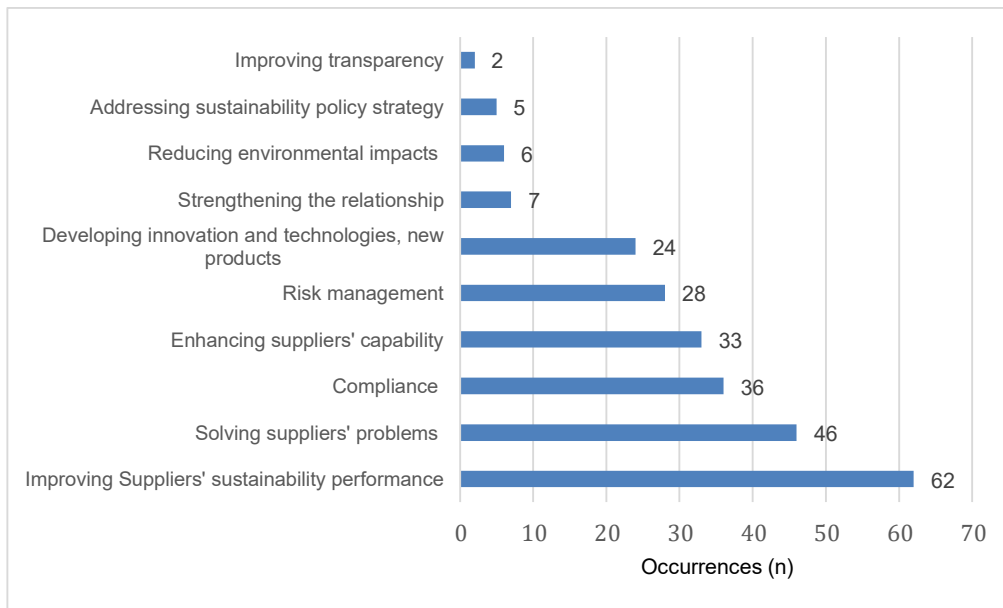


Fig. 5: Supplier sustainability development purpose.

SSD initiatives are oriented towards compliance with the sustainability requirements adopted in the supplier selection and applicable laws and regulation. Noshad and Awasthi (2015) argued that finding suppliers already organised to meet the requirements during the selection process is likely to be a challenge to buying firms. This can be overtaken by developing suppliers' capabilities. SSD is also driven by risk management (e.g. reputation, continuity) (e.g. Dou et al., 2014a; Srai et al., 2013) and developing innovation (e.g. technologies, new products) (e.g. Ağan et al., 2016; Sharfman et al., 2009). Finally, strengthening the relationship (e.g. Kogg and Mont, 2012; Wong et al., 2015), reducing environmental impact (e.g. Dou et al., 2014a; Handfield et al., 2005), addressing buying firm's sustainability policy (e.g. Harms et al., 2013; Wu, 2017) and improving transparency (Gold et al., 2015; Pagell and Wu, 2009) were also evidenced.

The definition of supplier development mechanisms is critical for the diffusion of sustainability practices; hence it is associated with the way that the buying firm develops its suppliers to achieve the development purpose. Bai and Sarkis (2010) categorised green supplier development mechanism into three groups, namely green knowledge transfer and communication; investment and resource transfer; management and organisational practices. The first category incorporated training, awareness and advisers regarding environmental issues for suppliers. Investments in supplier capability, process and alternatives for reducing environmental cost as well as integration between suppliers and focal firm's employees were included in the second category. Finally, management organisational practices were buying firms' internal capability, implementation of practices and integration with suppliers in the eco-design stage.

Several papers followed Bai and Sarkis' categorisation (Ağan et al., 2016; Ehrgott et al., 2013; Fu et al., 2012; Liu et al., 2018; Tate et al., 2012; Trapp and Sarkis, 2016). However, in the categorisation from Bai and Sarkis, some conditions or organisational factors (e.g. information sharing, ongoing communication) or supplier sustainability performance activities (e.g. strong formal environmental evaluation, auditing suppliers) are defined as supplier development mechanisms. In addition, other development mechanisms were found, which did not fit Bai and Sarkis' categorisation, for instance joint initiatives. Based on that, a new supplier sustainability development mechanisms classification is proposed in Table 6, covering five groups, namely: sharing knowledge; joint initiatives; technical support; incentives and investments.

It is important to note that in the sharing knowledge, technical support and investments categories, the major source of effort comes from the buying firm. In joint initiatives and incentives, there is a more symmetrical effort between the buying firm and its suppliers. For instance, a clear definition of responsibility and resources are considered. Moreover, both firms engaged provide resources, such as capabilities and information (Akamp and Müller, 2013). According to Rosen et al. (2001) this reciprocal effort is a success factor for a long-term relationship.

Table 6: Supplier sustainability development mechanism.

Category	Description	n
Sharing knowledge	It focuses on awareness-raising for sustainability issues and associated with educating (training), informal transferring knowledge (e.g. email exchanges), technical support and assistance and personal transfer (transferring employees – buyers to suppliers or vice versa).	49
Joint initiatives	Buying firm and suppliers work together to achieve sustainability objectives (e.g. carbon management), improve sustainability performance, design products/components, and developing innovation and technologies.	36
Technical support	Direct buying firm's effort or indirect (e.g. consultancy firms or universities) to help suppliers to solve technical problems.	23
Incentives	Suppliers are encouraged to improve their sustainability performance by using long-term contracts, increasing the volume of business, sharing profits and awards. The outcomes of the supplier performance assessment are critical for this category.	17
Investments	Direct capital invested in supplier's facilities, including equipment, technologies, standards and capabilities.	11
n - occurrences		

Prior literature has focused on the prioritisation of the development mechanism by using decision support tools (e.g. analytical hierarchy process) but without a clear connection with the supplier development purpose (Bai and Sarkis, 2010; Dou et al., 2014a; Fu et al., 2012). Furthermore, evidence provided across the literature is not sufficient to state the efficiency of a particular mechanism to achieve a specific purpose. Likewise, a link between the supplier development mechanisms and the development purpose is provided in Table 7. The Chi-Square test was used for all possible combinations (mechanisms versus purpose). The statistical test revealed a significative correlation ($p < 0.05$). The p-value test was also employed considering the development mechanisms' average and mean. The result revealed

a strong correlation. Therefore, based on both tests, a correlation between supplier development mechanisms and purpose was evidenced.

In addition, the level of influence of a mechanism to reach a particular purpose was assumed considering the occurrences (mechanisms and purpose) and the mechanisms' average and median. For instance, from 49 sharing knowledge initiatives occurrences, 36 were related to solving supplier sustainability problems (e.g. Gimenez and Tachizawa, 2012; Klassen and Vereecke, 2012) and 35 improving performance (e.g. Sarkis, 2012; Touboulic and Walker, 2015). Both of them are bigger than the average and median. In this case, it was inferred that sharing knowledge had a high influence to help suppliers to solve environmental and social issues. In the same way, joint initiatives are more effective for developing innovation and technologies (e.g. Beske and Seuring, 2014; Carbone et al., 2012) and enhancing supplier capabilities (e.g. Ciliberti et al., 2008; Rashidi and Saen, 2018). Indeed, according to Blome et al. (2014) joint initiatives are critical for developing sustainable products. Technical support contributes to compliance with regulation and requirements (e.g. Liu et al., 2018; Wong et al., 2015), as well as risk management (e.g. Ağan et al., 2016; Yawar and Seuring, 2018). On the other hand, a low influence from all supplier development mechanisms was found with a focus on strengthening the relationship, reducing environmental impact, addressing sustainability policy strategy and improving transparency.

In general, there is a broad range of mechanisms that can be employed in line with the development purpose. Conversely, not all the mechanisms might contribute achieving the purpose, or they may be less influential.

Table 7: Supplier sustainability development mechanisms vs. purpose.

Development Mechanisms	Purpose of supplier sustainability development										Average	Median	P-value Average	P-value Median
	PE	PR	CO	CA	RM	TE	RE	IM	ST	TR				
Sharing knowledge	35	36	23	22	16	17	5	5	3	2	16.4	17	0.000	0.000
Joint initiatives	26	25	14	12	9	16	5	2	2	1	11.2	11	0.000	0.000
Technical support	18	19	12	12	10	8	4	3	1	1	8.8	9	0.000	0.000
Incentives	16	10	8	8	8	7	4	1	1	1	6.4	8	0.000	0.000
Investments	10	7	6	4	6	5	2	1	-	1	4.7	5	0.006	0.002
PE – Improving performance, PR – Solving problem, CO – Compliance, CA – Enhancing supplier capability, RM – Risk management, TE – Developing innovation and technologies, RE – Strengthening the relationship, IM – Reducing environmental impact, ST – Addressing sustainability policy strategy and TR – Improving transparency Criteria High influence= <i>bigger than average and median</i> Medium influence= <i>equal to average or median</i> Low influence= <i>lower than average and median</i>														

3.2.2 Supplier development and environmental and social sustainability practices diffusion

Table 8 presents the environmental practices diffused through supplier development initiatives. Supporting suppliers to implement environmental performance measurement and improvements (45 occurrences) were the most common practices disseminated, followed by meeting legal and regulation

compliance (36). Interestingly, other practices related to the sustainability performance were also found. However, some authors were more precise, specifying the focus of the assessment or the improvement, such as carbon emission reduction (e.g. Dou et al., 2014a), energy efficiency (e.g. Formentini and Taticchi, 2016), using of less material (e.g. Awasthi and Kannan, 2016), packaging improvements (e.g. Bowen, 2001), reducing water consumption (e.g. Sancha et al., 2015), life cycle assessment (Bai and Sarkis, 2010) and lean manufacturing (Wong et al., 2015).

Similarly, reducing hazards releases (e.g. Akman, 2015; Bakker and Nijhof, 2002) and reverse logistics (e.g. Graham, 2018) were addressed in a reactive manner, i.e. compliance with the regulation. On the other hand, environmental practices in line with a proactive approach (e.g. new vision and strategies) (Walton et al., 1998) were also found. These include the design for environmental (e.g. Liu et al., 2018), improving suppliers' processes (e.g. environmental-friendly production/equipment) (e.g. Gimenez and Tachizawa, 2012), environmental management systems (e.g. Green Jr et al., 2012), environmental programme (e.g. Koplin et al., 2007) and eco-labelling (e.g. Trapp and Sarkis, 2016).

Sustainable agriculture practices were also evidenced, such as farm management (e.g. Zimmer et al., 2016), logistics integration (e.g. Busse et al., 2016), securing livelihood strategies (e.g. Golini et al., 2017), biotechnology (Rodríguez et al., 2016), seeds research and development (Lalwani et al., 2018) and soil management (Rodríguez et al., 2016).

In general, environmental practices diffused through SSD initiatives were related to performance, compliance, strategy and sustainable agriculture. These practices were diffused by all development initiatives, i.e. sharing knowledge, joint initiatives, technical support, incentives and investments. Interestingly, packaging improvements were diffused only through joint initiatives, whereas biotechnology (e.g. palm biotech development) was by incentives. In terms of the position in the supply chain tier, design for environmental and meeting regulation were practices diffused across both 1st tier, 2nd tier and low-tier suppliers. Interestingly, reducing hazardous releases on the environment and reverse logistics were more commonly disseminated to 1st tier and low-tier suppliers, whereas supplier process change was found in both 1st and 2nd tier suppliers. On the other hand, carbon emission reduction, energy efficiency and the use of less material were practices reported by papers, which focused on focal firms or buying firms without a clear position.

Table 8: Environmental practices diffused through supplier development.

Environmental practices diffused	n	Mechanism					Position in the supply chain			
		SK	JI	TS	INC	INV	Suppliers			FF or BF
							LT	1&2 T	1T	
Environmental performance measurement and improvements	45	Yes	Yes	Yes	Yes	Yes	Yes	NE	Yes	Yes
Meeting environmental legal and <i>regulation compliance</i>	36	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Design for environment	24	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Improving suppliers' processes - Environmental-friendly production/equipment	22	Yes	Yes	Yes	Yes	Yes	NE	Yes	Yes	Yes
Clean production & Pollution prevention	21	Yes	Yes	Yes	Yes	Yes	Yes	NE	Yes	Yes
Environmental Management Systems – ISO 14001	15	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Reducing hazards releases on the environment (hazard management, reduction of the consumption)	15	Yes	Yes	Yes	Yes	Yes	Yes	NE	Yes	Yes
Reverse Logistics (Recycling, remanufacturing or disposal) and Close loop supply chain	14	Yes	Yes	Yes	Yes	Yes	Yes	NE	Yes	Yes
Environmental management programmes	10	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Carbon emission reduction performance - direct or indirect carbon emission	8	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Energy efficiency	6	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Using of less materials	6	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Farm management	5	Yes	Yes	Yes	Yes	Yes	Yes	NE	NE	Yes
Logistics integration	4	Yes	Yes	Yes	Yes	Yes	Yes	NE	NE	Yes
Package improvements	4	NE	Yes	NE	NE	NE	NE	NE	NE	Yes
Reducing water consumption	3	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Securing livelihood strategies (e.g. Animal well being, animal reproduction)	3	NE	NE	Yes	Yes	NE	Yes	NE	NE	NE
Eco-labelling (e.g. Energy Star, Blue Angel)	2	Yes	Yes	NE	NE	NE	NE	NE	NE	NE
Biotechnology (e.g palm biotech development)	1	NE	NE	NE	Yes	NE	NE	NE	NE	Yes
LCA	1	Yes	Yes	Yes	Yes	Yes	NE	NE	NE	Yes
Lean manufacturing	1	Yes	Yes	Yes	Yes	NE	NE	NE	NE	Yes
Seeds control, research and development and certification	1	NE	NE	Yes	NE	NE	NE	NE	NE	Yes
Soil management (e.g. preparation and crop mgt)	1	NE	NE	Yes	NE	Yes	Yes	NE	NE	NE
n – occurrences NE – Not evidenced Mechanisms: SK – Sharing knowledge; JI – Joint initiatives; TS – Technical support; Inc – Incentives and Inv – Investments. Position in the supply chain: LT – Low-tier suppliers; 1&2T – 1 st and 2 nd tier suppliers; 1T – 1 st tier suppliers; 1T – 1 st tier suppliers; FF or BF – Focal or Buying firm (data collected at FF or BF's level).										

Typical social sustainability practices reported related to working conditions, health and safety, human rights, codes of conduct, corporate social responsibility (CSR) and community development (Table 9). These practices identified are typical of other collations from authors such as with Bubicz et al. (2019) and Lu et al. (2012). This review also identifies additional specific CSR practices such as assisting with ethical labour standards and behaviour (e.g. Gallear et al., 2012) and fair price principles (e.g. Yawar and Kauppi, 2018). However, Table 9 shows the instances these and many other practices to be a low frequency of citation.

Technical support was the most used initiative for disseminating social

practices, followed by sharing knowledge and incentives. Health and safety, human rights, community development, woman empowerment and fair price were social practices diffused by all supplier development initiatives. Interestingly, codes of conduct were diffused only through sharing knowledge initiatives (e.g. training). Yadlapalli et al. (2018) argued that training allows suppliers not only enhancing capabilities for understanding social responsibility but also complying with social standards.

Table 9: Social practices diffused through supplier development.

Social practices diffused	n	Mechanism					Position in the supply chain			
		SK	JI	TS	INC	INV	Suppliers			FF or BF
							LT	1&2 T	1T	
Working conditions	14	yes	yes	NE	yes	NE	NE	NE	NE	Yes
Health and safety (H&S)	12	yes	yes	yes	yes	yes	NE	NE	NE	Yes
Human rights	11	yes	yes	yes	yes	yes	yes	NE	NE	yes
Code of conduct	7	yes	NE	NE	NE	NE	NE	NE	NE	yes
Corporate social responsibility programme	7	yes	yes	NE	yes	NE	NE	NE	NE	yes
Community development	5	yes	yes	yes	yes	yes	yes	NE	NE	yes
Adult literacy	4	yes	yes	yes	yes	yes	yes	NE	NE	yes
Ethical labour standards and behaviour	4	yes	yes	yes	NE	NE	NE	NE	NE	yes
Meet H&S legal and regulation compliance	3	yes	yes	NE	NE	NE	yes	NE	yes	yes
Product responsibility	3	yes	yes	NE	NE	NE	NE	NE	NE	yes
SA 8000	3	yes	yes	NE	NE	NE	NE	NE	NE	yes
Women empowerment	3	yes	yes	yes	yes	yes	yes	NE	NE	yes
Fair price	2	yes	yes	yes	yes	yes	yes	NE	NE	NE
Gender issues	2	yes	NE	yes	yes	NE	yes	NE	NE	yes
Improved worker healthcare access	2	NE	NE	yes	yes	NE	yes	NE	NE	NE
Poverty alleviation	2	NE	NE	yes	yes	yes	yes	NE	NE	NE
Proper salaries and fairly reward	2	NE	NE	yes	NE	yes	yes	NE	NE	NE
Worker skills development	2	NE	NE	yes	yes	NE	yes	NE	yes	yes
Better worker education access	1	NE	NE	yes	yes	NE	yes	NE	NE	NE
Better worker nutritional status	1	NE	NE	yes	yes	NE	yes	NE	NE	NE
Employment stability	1	yes	NE	yes	NE	NE	NE	NE	NE	yes
Slavery issues	1	NE	NE	NE	NE	NE	NE	NE	NE	NE
Social performance management	1	NE	yes	yes	NE	NE	yes	NE	yes	NE
n – occurrences NE – Not evidenced Mechanisms: SK – Sharing knowledge; JI – Joint initiatives; TS – Technical support; INC – Incentives and INV – Investments. Position in the supply chain: LT – Low-tier suppliers; 1&2T – 1 st and 2 nd tier suppliers; 1T – 1 st tier suppliers; 1T – 1 st tier suppliers; FF or BF – Focal or Buying firm (data collected at FF or BF's level).										

Most of the papers did not focus on any specific position across the supply chain. They report only the focal firms or buying firms initiatives for diffusing social practices. Meeting H&S legal and regulatory compliance (Lee and Klassen, 2008), improving worker skills (Golini et al., 2017) and social performance management programme (Tachizawa and Wong, 2014) were uncovered across the 1st tier and low-tier suppliers diffusion. Most of the social practices identified were diffused across low-tier suppliers, including working conditions (e.g. adult literacy, better worker education access and nutritional status), human rights (e.g. women

empowerment, gender issues, poverty alleviation), corporate social responsibility (fair price) and community development (Rodríguez et al., 2016; Yawar and Kauppi, 2018; Yawar and Seuring, 2018).

3.2.3 Organizational factors influencing the diffusion of environmental and social practices across the supplier base through development initiatives

Previous tables list the practices that were extracted from the papers examined. This literature review sought to establish what influences their diffusion (RQ3). Through iteratively coding the 93 papers, 20 influences emerged in the analysis and were named organisational factors (OFs). A distinct split of 20 OFs that influence practice diffusion from the buyer to the supplier was apparent, namely whether they are applied to the design or the implementation of SSD initiative. This provides a foundation by which the diffusion of environmental and social sustainability practices occurs. This section therefore addresses the factors identified.

3.2.3.1 Design of supplier sustainability development

Considering the limited resources to employ in SSD initiatives, buying firms need to prioritise them by precisely defining the supplier development purpose (OF1) and defining the development mechanisms to be employed (OF2) (Bai and Sarkis, 2010). The full list of design OFs will be assembled in Table 10. The definition of suppliers to be engaged through supplier development is also critical (OF3). Trapp and Sarkis (2016) stated that not all suppliers would require the same level of supplier sustainability development. Ağan et al. (2016) suggested that buying firms need close involvement of long-lasting and strategic suppliers. Rodríguez et al. (2016) suggested suppliers in low tiers with property rights, updated tax IDs, or environmental licenses to mitigate certain transaction risk. Interestingly, Klassen and Vereecke (2012) reported a categorisation system to select suppliers to be engaged in development initiatives based on their risk (e.g. geographical location) and influence (long-lasting relationship).

Supplier sustainability development is a multi-faceted concept, hence it has a strong interaction with supplier performance assessment and supplier selection (Ağan et al., 2016). Nagel (2003) argued that the implementation of SSD initiatives could not take place without supplier performance assessment. Performance is a step toward supplier development (Krause, 1997) serving as a baseline for subsequent planning actions and improvements (Bai and Sarkis, 2010). Thus, supporting and transferring knowledge to help them to comply with the sustainability requirements adopted during the purchasing phase is SSD purpose (Ağan et al., 2016; Fu et al., 2012; Trapp and Sarkis, 2016). Supplier development also addresses the firms sustainability agenda (Dou et al., 2014a), including policy, strategies and values (e.g. Beske and Seuring, 2014; Lee and Cheong, 2011).

Uniquely, the design of the SSD initiative, including the purpose, mechanisms and suppliers to be developed, is a starting point for supplier development. These are critical factors for the design of SSD initiatives and might therefore take into consideration, the outcomes from the supplier sustainability performance assessment (OF4), the sustainability requirements (OF5) and the buyer

sustainability policy and strategies (OF6). These factors will be presented later in the design stage of a supplier sustainability development framework.

Pagell and Wu (2009) emphasised the importance of the integration and support from top managers as an organisational factor (OF7). Top managers can influence according to their expectation the SSD initiative (Ehrgott et al., 2013). Cross-functional integration (OF8), for instance between environmental management, research and development, production and procurement is also an important component for the designing of SSD initiatives (e.g. Lee and Cheong, 2011; Trapp and Sarkis, 2016). This can also produce a better knowledge about the products and components in terms of their environmental and social risk (Beske and Seuring, 2014; Lippmann, 1999) (OF9). Examples of risks are provided by Silva et al. (2020), including ecological issues (input-and output-related aspects, resources, energy and emissions) and working conditions and ethical business.

The internal implementation of sustainability practices by buying firms was influential for SSD design, considering the know-how and experience. This is a typical behaviour of manufacturers to diffuse environmental practices across the supplier base (Zhu et al., 2012). Deploying an environmental management system (ISO 14001) is one of the most frequent practices implemented, followed by design for environmental (Ashby et al., 2012; Diabat et al., 2014), recycling (e.g. Blome et al., 2014; Hajmohammad et al., 2013), code of conduct, corporate social responsibility initiatives (e.g. Beske and Seuring, 2014; Forman and Jorgensen, 2004) and social standards, e.g. BS 8000 (e.g. Ciliberti et al., 2008; Gold et al., 2015). The implementation of these practices by buyers facilitated the design of SSD initiatives (OF10).

Inter-organisational factors were also found as influential in the design of SSD initiatives. Sancha et al. (2015) stated that previous experience with a critical supplier through collaborative approaches affected the design of SSD initiatives (OF11). Of note from Noshad and Awasthi (2015) was the intensive sharing knowledge and involvement facilitated the design of new products. Shared sustainability values and a common understanding of sustainability (OF12) also enabled the engagement of suppliers in the SSD design (Gold et al., 2010b; Srai et al., 2013).

To sum up, influential factors related to the design of supplier sustainability development are presented in Table 10. Regarding these factors, buying firms can enhance the diffusion of environmental and social sustainability practices by planning the supplier development initiatives, especially taking into consideration the purpose, suppliers and mechanisms needed. There is, however, a gap in knowledge here of which factors should be used and when.

Table 10: Influential factors for considering environmental and social practices in the design of supplier development.

Organisational factors	Practices		Empirical rigour		Citation	Example references
	Env	Soc	Emp	Conc		
Definition of supplier development purpose (OF1)	X	X	Both	<i>Env</i>	5	(Dou et al., 2014a; Zimmer et al., 2016)
Definition of development mechanism (OF2)	X	X	Both	-	5	(Awasthi and Kannan, 2016; Rashidi and Saen, 2018)
Definition of suppliers to be engaged (OF3)	X	X	Both	<i>Env</i>	11	(Klassen and Vereecke, 2012; Thakker and Rane, 2018)
Outcomes of the supplier sustainability performance assessment (OF4)	X	X	Both	Both	29	(Lee and Cheong, 2011; Yawar and Seuring, 2018)
Sustainability requirements (OF5)	X	X	Both	<i>Env</i>	16	(Ağan et al., 2016; Formentini and Taticchi, 2016)
Buying firm's sustainability policy and strategy (OF6)	X	X	Both	<i>Env</i>	12	(Lee and Klassen, 2008; Lu et al., 2012)
Support of top and middle managers (OF7)	X	X	Both	Both	12	(Fu et al., 2012; Leppelt et al., 2013)
Cross-functional integration (OF8)	X	X	Both	<i>Env</i>	9	(Ehrgott et al., 2013; Govindan et al., 2013)
Products and/or components risk (OF9)	X	X	Both	<i>Env</i>	2	(Bai and Sarkis, 2010; Beske and Seuring, 2014)
Internal implementation of sustainability practices (OF10)	X	X	Both	<i>Soc</i>	22	(Holt and Ghobadian, 2009)
Collaborative approaches with suppliers (OF11)	X	X	Both	<i>Env</i>	16	(Chan, 2007; Tachizawa et al., 2012)
Sharing sustainability principles, value and goals (OF12)	X	X	Both	Both	9	(Paulraj, 2011; Srai et al., 2013)
Env – Environmental / Soc – Social / Empirical – empirical papers (case study, survey, etc.). / Concep.– Conceptual papers (literature review, SLR).						

3.2.3.2 Implementation of supplier sustainability development

Collaborative approaches with suppliers (OF11) were also frequently reported as an influential factor for the implementation of SSD initiatives. The full list of implementation OFs will be assembled in Table 11. These require interactions, trust and knowledge exchange to facilitate sustainable products and process and mutual benefits (Hollos et al., 2012; Touboullic and Walker, 2015). Collaborative approaches also provide joint learning for suppliers and buying firms by understanding of each other's responsibility and capability requested to the SSD initiative (Vachon and Klassen, 2008). It is important to emphasise that there is an evident overlap between collaboration and supplier development. For instance, it is common to find papers on sustainability collaboration, which took into consideration research constructs regarding supplier development (e.g. training on sustainability issues, technical assistance to implement sustainability practices) and papers on supplier development using collaboration constructs (e.g. joint plan, strengthened relationship, enhanced communication) (Ciliberti et al., 2008; Ehrgott et al., 2013; Gallear et al., 2012; Lee and Cheong, 2011). Moreover, they have similar

characteristics in their definitions, including shared responsibility, cooperative effort, information sharing.

In order to implement SSD initiatives, external stakeholders are frequently engaged (OF13). According to Liu et al. (2018) SSD implementation requires an extensive multi-stakeholder engagement. For instance, Gold et al. (2015) reported a protocol against child labour across the cocoa industry, which was designed and implemented based on the engagement of government, civil society and cocoa industry. NGOs are the most cited stakeholder engaged in the SSD implementation in the papers examined. Both NGO and buyer resources are integrated, protecting the value in the buyer–supplier relationship and enhancing a supply chain's social sustainability (Rodríguez et al., 2016b).

Leppelt et al. (2013) highlighted the need to assess the impact of the SSD initiative implemented. The authors focused on the effectiveness of actions plans to treat non-compliances through auditing suppliers. Zimmer et al. (2016) suggested evaluating supplier performance before and after the SSD implementation to promote improvements in supplier performance. Liu et al. (2018) also suggested that the review of the SSD effectiveness might include the impact and cost of the initiative and future strategies (e.g. initiatives, suppliers). Besides that, Bai and Sarkis (2010) recommended the establishment of a long term plan for improving supplier performance. Therefore, the assessment of the impact of the SSD initiative (OF14) is also an influential factor, especially in terms of the accomplishment of the SSD purpose.

The implementation of SSD initiatives involves an intensive commitment of resource (Ahmed and Hendry, 2012; Wong et al., 2015). Each resource can take the form of information (Wagner and Krause, 2009), personnel (Krause et al., 1998), structures and processes (Wagner, 2006) and funds (Sancha et al., 2016; Thakker and Rane, 2018). Therefore, internal capabilities are needed (OF15). Implicit support of top managers (OF7) (Dou et al., 2014a), additional employees involved and cross-functional integration were essential for the supplier environmental development implementation (OF8) (Ağan et al., 2016). This allows the exchange of information and knowledge beyond the usual business relationship (Ehrgott et al., 2013). Furthermore, Lippmann (1999) mentioned the need for training for buyer staff involved in the SSD initiative (OF16). According to Busse et al. (2016) this provides employees with an understanding of foreign perspectives.

The commitment of resources is also expected from suppliers. Both buyers and suppliers can better understand where and how to invest resources (Dou et al., 2014a). This is one way to represent a joint engagement between them (Krause and Ellram, 1997) and it is, therefore, an influential factor that affects the implementation of SSD initiatives. Ehrgott et al. (2013) found that understanding the supplier's capability (e.g. technological and managerial skills) allowed the buyer to evaluate the supplier's capacity to innovate and remain competitive (OF19). Moreover, the commitment of suppliers' top management for sustainability initiatives is identified as influential (Dou et al., 2014b; Fu et al., 2012; Klassen and Vachon, 2003) (OF20).

Table 11 presents the organisational factors for diffusing environmental and social sustainability practices through the implementation of SSD initiatives. Given collaborative approaches with suppliers was one of the most mentioned factors, it

does indicate that much research is confined to the relationship between the focal firm and immediate supply with little research reaching beyond the first tier as cited earlier.

Table 11: Influential factors for considering environmental and social practices in the implementation of supplier development.

Organisational factors	Practices		Empirical rigour		Citation	Example references
	Env	Soc	Emp	Conc		
Collaborative approaches with suppliers (OF11)	X	X	Both	Both	62	(Noshad and Awasthi, 2015; Rizzi et al., 2013)
Engagement of external stakeholders (OF13)	X	X	Both	Both	13	(Bubicz et al., 2019; Cramer, 2008)
Assessment of the impact of the supplier development initiative (OF14)	X	X	Both	Env	4	(Leppelt et al., 2013; Liu et al., 2018)
Internal capabilities (OF15)	X	X	Both	Env	21	(Touboulic and Walker, 2015; Zhu et al., 2012a)
Support of top and middle managers (OF7)	X	X	Both	-	12	(Blome et al., 2014a; Lo et al., 2018)
Cross-functional integration (OF8)	X	X	Both	Both	8	(Chen et al., 2017; Govindan et al., 2013)
Training purchasing staff on sustainability (OF16)	X	X	Both	Both	4	(Lippmann, 1999; Rodríguez et al., 2016a)
Enhanced communication with suppliers (OF17)	X	X	Both	Both	22	(Beske and Seuring, 2014; Lee and Kim, 2011)
Strengthened relationship (OF18)	X	X	Both	Both	32	(Formentini and Taticchi, 2016; Wu, 2017)
Understanding suppliers' capability (OF19)	X	X	Both	Env	11	(Busse et al., 2016; Harms et al., 2013)
Support of suppliers' top managers (OF20)	X	X	Both	-	4	(Fu et al., 2012; Liu et al., 2018)
Env – Environmental / Soc – Social / Empirical – empirical papers (case study, survey, etc.). / Concep.– Conceptual papers (literature review, SLR).						

3.3 Framework for supplier sustainability development

The preceding analysis has shown several deficiencies in supplier sustainability development (SSD). In particular, the conceptualisation of when which environmental and social sustainability factors need to be considered is absent. Additionally, few works consider the breadth of factors against the entire range identified in the papers analysed. Finally, much work considers the immediate supply chain interface of the focal firm and wider influence is not explicitly given and therefore assumed to be neglected. To address these deficiencies, this section presents a framework to bring these organisational factors (OFs) together.

Interestingly, "a conceptual framework covers, either graphically or in narrative form, the main things to be studied, including the key factors, variables, or constructs (Miles et al., 2014). Jabareen (2009) considered that conceptual framework provided an interpretative approach for reality, i.e. an understanding, instead of a casual/analytical setting, which might be designed through a process of qualitative analysis.

The proposed framework is designed by clustering 20 OFs identified in the 93 papers examined in the systematic literature review (Figure 6). The framework is proposed to develop a theory on supplier sustainability development diffusion. It captures the two clusters of design factors (from table 10) on the left and implementation factors (from table 11) on the right that align with the functional activities in supplier development. The framework displays the context of each organisational factor of definition, intra- company, external or inter- firm. The definition factors (OF1, OF2, OF3 and OF14) are linked in literature hence these are shown interconnected. They are foundational and are therefore shown larger to bring emphasis. The implementation area between OF3 and OF14 indicates that change is required to realise the impact of the supplier sustainability development (SSD) but it is not a factor uncovered in the literature analysis. A few of the factors (OF7, OF8 and OF11) are relevant to both design and implementation and therefore occupy both these respective areas. The framework is not represented as a hierarchy or nor is a strict sequencing defined in the literature, however, it is logical that many of the factors higher in the diagram would need to be initiated before the lower ones, e.g. requirements (OF5) and training (OF16) would need to start before engaging suppliers in (say) understanding supplier capability (OF19).

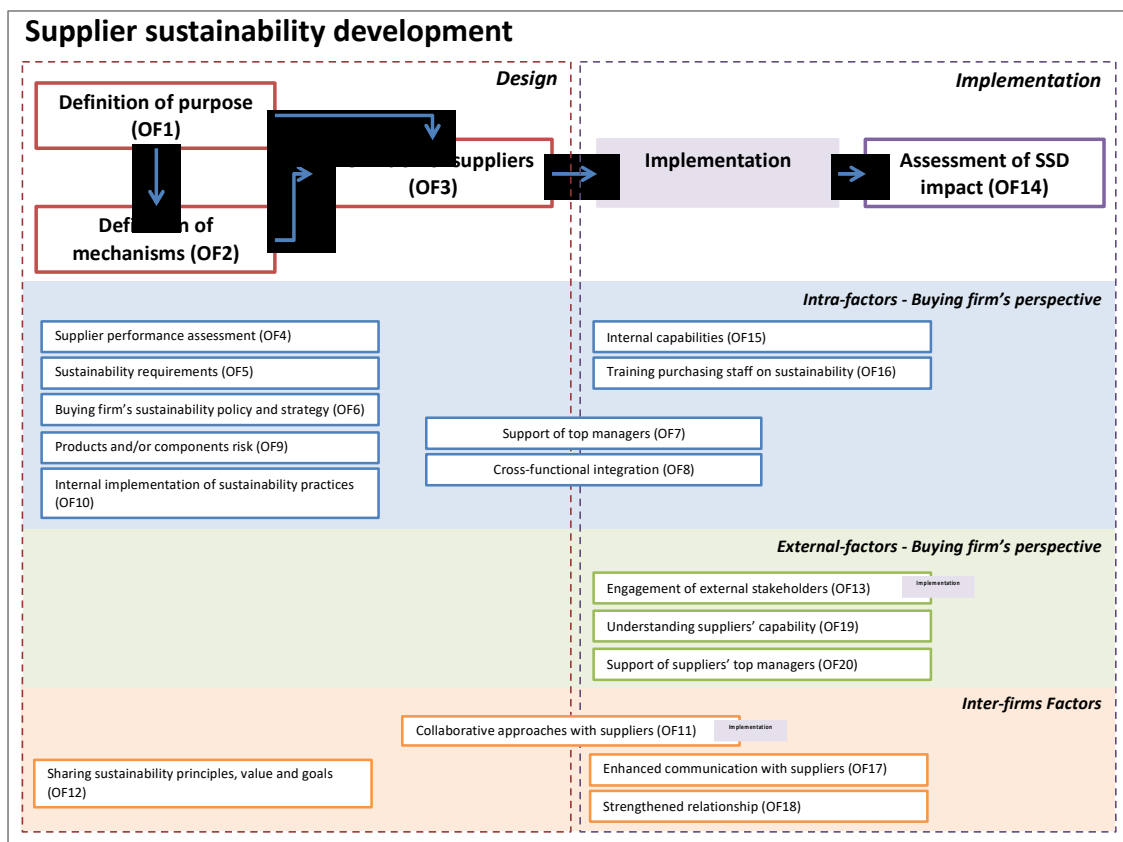


Fig. 6: Framework for supplier sustainability development.

Particularly for the design of the SSD initiative, the definition of purpose, mechanisms and suppliers to be engaged are influenced by most of intra-factors,

such as the outcomes of suppliers sustainability performance assessment (OF4), sustainability requirements used in the selection process (OF5), sustainability policy and strategy (OF6), products and/or components environmental and social risk (OF9) and the expertise gained by implementing sustainability practices (OF10).

Collaborative approaches with suppliers (OF11) and engagement of external stakeholders (OF13) during the implementation are also imperative. Furthermore, the assessment of SSD might impact supplier behaviour, capability and performance over time. This might help both buying firms and suppliers to move forward with more commitment to sustainability and long-term relationship.

Even though the proposed framework focuses on the role of buying manufacturing firms, understanding the influential factors related to the suppliers is also captured, such as understanding suppliers' capability (OF19) and support of suppliers' top managers (OF20). There are also common factors for both buyers and suppliers (inter-firm factors), namely, sharing sustainability principles, value and goals (OF12) (influential to SSD design) and enhanced communication with suppliers (OF17) and strengthened relationships (OF18).

The proposed framework depicts patterns of the factors and points out the most critical variables influencing the SSD. This provides a foundation by which the diffusion of environmental and social sustainability practices occurs through SSD initiatives. Each of these can be subdivided according to whether they relate to the process of design or the process of implementation.

The framework brings together the breadth of factors that have been dispersed across the literature into one place. Additionally, the context of their use across the supply chain is now explicit. This framework, therefore, represents a stage towards an integrative view of supply chain environmental and social practice diffusion and subsequent enhancement of theory. The framework requires empirical testing uncover its value and limitations to fully address the earlier authors calls for integrative contributions, i.e. Bai and Sarkis (2010), Noshad and Awasthi (2015b) and Srivastava (2007).

4. CONCLUSIONS

4.1 Academic and practical implications

This paper has examined research works related to the diffusion of environmental and social sustainability practices across the supply chain through supplier development initiatives. The body of literature analysed is still a young field and rapidly emerging, with nearly three-quarters of the papers studied having appeared in the last ten years. Interestingly, between 2015 and 2020 a significant interest in social sustainability practices was found, evidenced by the number of papers and keywords regarding social sustainability, such as "socially responsible supply chains" (Yadlapalli et al., 2018), "socially responsible supplier development" (Wu, 2017; Yawar and Kauppi, 2018), "slavery" and "labour rights" (Gold et al., 2015). These keywords were most often clustered with keywords related to risk management.

The literature has focused on data collected at the level of focal firms plus focal firms and buying firms. Most of the papers reviewed did not specify the position

of suppliers. This is surprising and indicates many papers labelled as supply chain management could be limited to suppliers rather than the supply chain. More detail regarding the data collection is needed in papers claiming to be about supply chains, therefore. It also suggests the need of research incorporating different tiers of the supply chain either from the perspective of the focal firms or more generally as supply chains or supply networks.

This paper extends previous research regarding the categories of SSD mechanisms (e.g. Bai and Sarkis, 2010) by providing a new SSD mechanisms category, which covers five groups, namely: sharing knowledge; joint initiatives; technical support; incentives and investments. The SSD initiatives have focused more on improving performance, solving problem, compliance, enhancing supplier capability. Other purposes were also identified, albeit with few occurrences, such as strengthening relationships, reducing environmental impact, addressing sustainability policy strategy and improving transparency. More research related to these purposes and the link between them and development mechanisms is needed.

In spite of the significant body of literature on SSCM, there is an absence of theory to explain how environmental as well as social sustainability practices diffuse in the supplier base as a result of supplier development initiatives. Driven by these gaps, a conceptual framework was proposed focusing on the role of the manufacturing buying firms in the diffusion of sustainability practices across their supplier base. The proposed framework extends prior research (Awasthi and Kannan, 2016; Bai and Satir, 2020; Busse et al., 2016; Rodríguez et al., 2016a; Rogers et al., 2019; Thakker and Rane, 2018; Wu, 2017; Yawar and Seuring, 2018; Zhang et al., 2017) by providing an analysis of the factors for how supplier development initiative might diffuse environmental and social practices.

The conceptual framework proposed has two novel features. Firstly, the integration of the design and implementation of SSD initiatives in order to enhance the diffusion of both environmental and social sustainability practices by capturing organisational factors that influence the diffusion. The second novelty is the extent of organisational factors, which aids the manufacturing buying firm to drive both environmental and social sustainability diffusion across their supplier base. As a result, the work provides clarity on the conditions required for addressing both environmental and social sustainability practices in the supplier development initiatives, providing an understanding of the diffusion across different tiers.

Two significant theoretical implications are presented here. Firstly, the evolutionary journey and intellectual structure of sustainable supplier development literature. Specifically, the comprehensive classification of organisational factors (OFs) into purpose, mechanism, practices diffused and conditions. Secondly, the OFs were then assembled into an SSD conceptual framework that captures the design and implementation phases covering the focal firm and the supply chain tiers.

Additionally, two significant practical implications arise out of the theoretical base. Firstly, the classification of the organisational factors for SSD initiatives into their purpose, the mechanisms to implement at different stages has the potential to support company focus where and when most effective. This link between purpose and mechanism is crucial for buying firms to separate the strategic positioning from the supporting operational advancement. Secondly, the framework has the potential

for integrating and contextualising common tools in use to ensure that best practice tools are prompted where they are most powerful for supporting the business advance.

4.2 Limitations and future research opportunities

Four limitations are noted in this research that in turn drive the need for further research. Firstly, there might be overlaps among the factors, practices and mechanisms presented in the framework. This limitation is the result of the theoretical, literature review methodology and prompts the need for empirical work to better understand interactions between the factors.

Secondly, many factors were not cited frequently. These included sustainability training for purchasing staff, impact assessment, suppliers' top management support and product risk. More work is needed to evaluate whether such factors are simply neglected by researchers or that they are not a significant influence on sustainability advancement.

Thirdly, in this work, few papers explicitly explore the multiple tiers of the focal company supply chains. Therefore, empirical work is needed to capture more data from higher-level tiers to detect any patterns in relationships resulting from influences such as tier position, sector type and geography.

Finally, there appears to be a skew in the use of environmental factors and social factors that warrant further research. Especially, the prevalence of environmental factors for supplier level and the absence of social risk consideration in the design of initiatives. Again, research is needed to understand whether this has been neglected by researchers or whether the equal consideration of environmental and social factors at design and implementation stages is not necessary.

In summary, the contribution of this paper is the depiction of factors influencing sustainability practices diffusion. This provided a foundation for conceptual framework development by which the diffusion of environmental and social sustainability practices can be promoted and enhanced.

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