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A Literature Review: *Drivers and Hinders of Sustainability and Interaction in Supply Networks*

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Summary: This report presents a literature review on what drives and hinders sustainable business practices across firm boundaries – i.e. in supply and business networks. The focus of this literature review is on the exchange and interaction processes taking place between firms (customers, suppliers, competitors etc.), and in relation to other types of actors (NGOs, authorities, etc.). Based on this inter-organizational and interactive perspective of the business landscape, the overall research question posed in this report is <i>what are the main drivers and hinders of achieving sustainability in supply networks</i> We investigate this inquiry by identifying and analysing which type of drivers and hinders are generally identified in relation to sustainability issues, and which actors (e.g. suppliers, customers, competitors, authorities, others) that are pointed to as hindering/driving forces in relation to sustainable supply networks. In addition, we investigate the potential connection between types of business relationships and the likely achievement of sustainability – i.e. the connection between level of supplier-buyer interaction and the engagement in sustainable innovation.	
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1. Introduction

This report presents a literature review on what drives and hinders sustainable business practices across firm boundaries – i.e. in supply and business networks. A nowadays-typical meaning of *sustainable* business solutions, whether technical or organizational, is that they are shaped in relation to economic, environmental and social considerations. This is referred to as *the triple bottom line* (Tate et al. 2010; Leppelt et al., 2013), and implies that companies should go beyond a business model purely based on economic profit maximizing by including an environmental and social agenda into their practices. In the aftermath of globalised production, firms are expected to have a *CSR strategy* (Corporate Social Responsibility) which has induced a wave of more or less successful attempts of implementing environmentally and socially responsible business practices (Kogg, 2009). Often it is more of an image than an actual practice implemented across the organisation and supply chain, which indicates that it is problematic to implement sustainability into the routines of everyday business life. One problematic issue is how to control what is happening in the entire supply chain of a product or service; it is one thing to organize particular practices *within* a firm, quite another to spread practices *externally across several firms*. In addition, implementing strategies and practices in relation to sustainability appear particularly problematic. A reasonable question is *why?*

Others have posed this question before us and done so in different ways depending on the analytical perspective applied; is there a lack of legitimacy for these issues and therefore the answer lie in stricter regulation and law enforcement? Is it the multinational corporations that should take the main responsibility and therefore top management within ‘focal’ firms need to take the initiative? Alternatively, is it a matter of identifying a ‘competitive advantage’ in relation to issues of sustainability and therefore each firm has to consider a CSR strategy in relation to its unique set of activities and resources? None of these perspectives, questions or answers are irrelevant. However, as the achievement of sustainability and ‘shared value’ (Porter and Kramer, 2006) lies in creating effects *in the interface between the focal firm and other actors* – individuals and organizations - our investigation applies a network perspective on the business landscape and industrial renewal (Håkansson et al., 2009).

Such a perspective views the firm as part of a network of interdependent actors, activities and resources that are interrelated across organizational boundaries. This implies that firms, their activities and resources are dependent on other firms and actors, their activities and resources in order to function and to create different kinds of benefits (revenues, learning, innovation etc.). In addition to the one mentioned above, there are two main reasons for why this approach seems suitable for an investigation of how to implement sustainability across firm boundaries. Firstly, it is based on a large number of empirical observations in several industries regarding business-to-business relationships and how they matter - and in several ways are essential - for the strategies and practices of the individual firm (e.g. Håkansson, 1982; Håkansson et al., 2009) as well as for innovation (Waluszewski & Håkansson, 2007). This seems highly useful for an investigation of how the individual firm can implement new solutions (i.e. sustainable) in relation to other firms and actors. Secondly, it specifically looks into the *content* of relationships in terms of the business practices that are applied in initiating, developing and

maintaining business relationships (Håkansson & Snehota 1995; Håkansson and Johanson, 2001). Business practices here refer to the adaptation processes that are involved in the forming, development and maintenance of relationships as firms relate their technical and organizational resources to each other as well as mutually relevant activities. In relation to our goal of investigating and better understanding the business practices of developing sustainable technical and organizational solutions across supply networks, this seems like a highly appropriate theoretical and methodological approach.

Consequently, the focus of this literature review is on the exchange and interaction processes taking place between firms (customers, suppliers, competitors etc.), and in relation to other types of actors (NGOs, authorities, etc.). Based on this inter-organizational and interactive perspective of the business landscape, the overall research question posed in this report is *what are the main drivers and hinders of achieving sustainability in supply networks?*

We investigate this inquiry by identifying and analysing which type of drivers and hinders are generally identified in relation to sustainability issues, and which actors (e.g. suppliers, customers, competitors, authorities, others) that are pointed to as hindering/driving forces in relation to sustainable supply networks. In addition, we investigate the potential connection between types of business relationships and the likely achievement of sustainability – i.e. the connection between level of supplier-buyer interaction and the engagement in sustainable innovation.

2. The theoretical framework – industrial network theory

The industrial network approach is based on the understanding that the ability of a firm to operate, to learn and to develop is based on its level of interaction with other firms (Håkansson, 1982; Håkansson & Snehota, 1995). Business relationships, and the interaction that takes place between actors through them, are therefore key for firms to learn about how their ‘internal’ resources can or is being used by others, how the resources of others can be combined and utilized, and how important activities can be mutually adjusted to increase the efficiency of particular operations. Through interaction with others, business relationships can also lead to innovation – the development, production and use of new solutions (Håkansson & Waluszewski, 2007). Thus, as business relationships not only enables economic exchanges but also learning, teaching as well as innovation as part of such exchanges, they are treated as key resources for firms.

In a network perspective, firms are embedded in network-like structures of activities and resources represented by other firms and actors (Håkansson & Snehota, 1995). This implies that at any given moment, the single company is involved in a number of operations (e.g. production, distribution, R&D) that depends on a specific set of resources, which in turn are controlled by and spans the organizational boundaries of a set of other firms. These firms, activities and resources are thus *interdependent* – each entity functions in a specific way due to the inclusion of the other entities (Håkansson & Waluszewski, 2002). As firms are highly dependent on other firms for gaining access to key resources (such as knowledge, technical components, skills and strategic operations), the boundary between the internal and external environment of the firm is blurry. This is due to the *bonds* (between actors), *links* (between activities) and *ties* (between resources) which have formed across firm boundaries through *interaction* and repeated investments over time in specific operations (Håkansson & Johanson, 1992). A great number of empirical studies have shown that usually firms form close bonds with a set of specific suppliers and customers, in addition to a selection of other types of relationships (Ford et al., 2003).

As a result, the single company is highly affected by its *network position*; the way in which the single firm can maintain and change the bonds, links and ties depends on how it is related to the other actors in the network. The position depends on the characteristics of the firm, its resources and through which types of relationships it is connected to the rest of the network, as well as which types of actors are part of the network. For instance, is the firm directly related to key actors and resources or does it depend on others to gain such access? How does the firm relate to how the operations and resources of the network are organized - are the other actors highly dependent on the resources of the firm, or is it the other way around? As it in many ways dictates the strategic options of the single firm, the network position defines how the firm can mobilize resources and engage in value creating processes. In the case of sustainability, the network position of the firm affects the ways in which it can mobilize resources across the network in the pursuit of creating mutual benefits from sustainable operations.

The way that firms are embedded in networks of interdependent activities and resources have direct consequences for the process of achieving innovation. Specific technological and organizational structures as well as investment patterns are formed as activities and resources are shaped in relation to each other across organizational boundaries over time (Håkansson & Waluszewski, 2007). If anything *new* is to create value for the actors forming this pattern, it has to fit into the existing structure of activities and resources. Otherwise, the entire activity/resource structure and investment pattern need to change, which naturally is highly costly for everybody involved. This changes the perspective of innovation as needing to be unique and groundbreaking. Rather, in order to create value for both producers and users new solutions need to be compatible with existing structures of technology and organization. In the case of developing sustainable products and processes, this implies that the sustainable solutions that can fit into existing operations, resource structures and business relationships of a supply network will be less costly to implement. Therefore, one of the key issues to achieving sustainable innovation lies in appreciating the fit between established network structures of actors, resources and activities, and new sustainable solutions.

The role that business relationships can play for learning and innovation depends on the level of interaction between the actors involved (Håkansson & Prekter, 2004; Cantillon, 2010). The classification scheme in *Figure 1* shows how the content (i.e. the level of interaction) of different types of relationships denotes what the actors can learn and develop/change in relation to each other. The different categories of interaction range from *pure exchange*, where there is no relationship and thus no knowledge exchange or development, to *networking*, which implies deep interaction among several parties that can learn and adapt collectively as a result. In a network perspective, networking is the most efficient way to learn and to innovate; by mutually adapting the resources and activities within the network as to create a better fit, there are good chances that these changes will actually create benefits for several parties (producers and users). In this investigation of the relation between sustainability and business interaction, we use this classification scheme to classify which type of relationships appear most common, driving and hindering in the development of sustainable supply networks.

	Actor bonds	Resources ties	Activity links
Pure exchange - no relationship or exchange of knowledge	-	-	-
Minor social exchange - repetitive exchanges, short time horizon, <i>single relationship</i>	Some social sentiments	Some degree of orientation in relation to the counterpart's resources. Can be both one/two-sided.	Some degree of orientation in relation the counterpart's activities. Can be both one/two-sided.
Technical exchange - short term or long term, <i>single relationship</i> , maintaining flexibility	Know how to work together in relation to a specific technology or activity	Minor changes in facilities and business units concerning specific technology and projects. Often one-sided.	Minor changes in related activities, often one-sided.
Cooperation - short term or long term, repetitive, <i>single relationship</i>	Know how to adapt to each other in relation to different types of technologies/activities	Mutual changes in several types of resources	Mutual changes in joint and related activities
Networking - long term, <i>involving third party -several relationships</i>	Know how to systematically relate to several parties in co-managing resources and activities (dyad<-> triad<-> network)	Mutual changes in relation to several parties in several types of resources	Mutual changes in relation to several parties in joint and related activities

Figure 1. *Interaction and adaptations/changes in bonds, ties and links. Developed from Cantillon (2010).*

3. Methodological considerations

The purpose of this study is to investigate primarily how firms handle their supply networks in relation to sustainability and specifically what it is that drives and hinders such processes. Therefore, the targeted literature in this review is that of peer-reviewed articles that address sustainability in combination with *supply chain management* (SCM). SCM is a term that since the beginning of the 1980s has developed from a phrase to an extensive body of literature addressing both theoretical and empirical issues in relation to the development and integration of supply chains in the flow of goods and services (Harland, 1996).

According to Harland (1996, p.64; 2004, p. 4), there are four analytical levels related to SCM: 1) the internal supply chain of the firm, 2) the dyadic relationship (first tier), 3) the external supply chain (multi-tier) and the supply network (the interrelated/collaborating businesses that provide the final product/service). Our investigation mainly falls under the last category, the network level, as we consider (interrelated) business relationships to be the one resource that enables the use, combination, and development of other resources across firm boundaries (e.g. knowledge, technical facilities, products). However, as there from an industrial network perspective are no strict boundaries between the internal and external resources of a firm in the traditional sense (which is the reason for why handling and developing resources is highly complex), the ‘external’ dyadic relationship, chain or network is seen as highly interconnected with the ‘internal’ resources of the firm. In that sense, our investigation and perspective stretch across all four analytical levels and concern the interplay between them; the ‘internal’ resources of the firm are interrelated with the ‘external’ supply network.

In practice, this means that when identifying drivers and hinders of implementing sustainability in supply networks we have included articles targeting all the respective analytical levels. In reviewing these articles we have focused on aspects concerning business relationships and the types of actors that the focal firm interacts with (or does not interact with), as well as how. However, we have also acknowledged drivers and hinders identified as mainly ‘internal’ resources and activities of the firm, in order to analyse how they might depend on or be part of resource constellations transcending firm boundaries. Thus, in reviewing the articles we have considered sustainability in relation to both internal and external resources and activities, as well as the connectivity between them.

We searched and selected the articles through a combination of a systematic and narrative literature review. The initial search started from a systematic search for articles addressing ‘sustainability’ and ‘green’ in combination with ‘supply chain’, ‘supply chain management’ and ‘supply network’. While ‘supply chain’ and ‘supply chain management’ were phrases that generated around 200 articles each, ‘supply network’ only generated 100 articles in one database (Business Source Premier) and a dozen in another (Scopus). While this certainly does not mean that these are the only articles that consider a broader network perspective, it does imply that this term is not as established, nor as investigated as dyads and chains, which is also recognized by others (e.g. Carter and Easton, 2011; Miemczyk et al., 2012).

Three different databases (ScienceDirect, Scopus, Business Source Premier) were used and the search was limited to peer-reviewed articles within the fields of ‘social sciences’, ‘business, management and accounting’ as well as ‘environmental sciences’. These articles represent literature reviews, case studies and quantitative surveys. As we are interested foremost in empirical and real-life studies as well as literature reviews related to such studies, articles based on any type of mathematical modelling were excluded. As we in addition are interested in management tools for how to obtain sustainable supply networks, we also performed a search for Life Cycle Assessment (LCA) and Life Cycle Management in relation to supply chain management (Scopus and ScienceDirect). This generated 72 articles. Articles presenting pure technical analyses or mathematical modelling were excluded. From this total search, 33 articles were handpicked based on their relevance to the theme of managing sustainability in supply networks, LCA and to their relevance for others within the research field (number of citations). Considering that issues of sustainability and CSR did not become part of the international political agenda until the 1990s, there is now an extensive body of literature on sustainability and supply chain management. In addition, this stockpile of literature has accelerated vastly during the last five years. As noted by Seuring (2011), in 2007-2011 no less than three extensive literature reviews on sustainable supply chain management were published, and since then at least five more (Carter & Easton, 2011; Miemczyk et al., 2012; Mollenkopf et al., 2012; Giunipero et al., 2012; Igarashi et al., 2013). This trend indicates an accelerating political awareness and relevance of these issues as well as an increased use of sustainable practices in business and society, which needs to be studied and analysed. It also further highlights the importance of studies targeting the drivers and hinders of sustainability in the interplay between different actors – both between firms, and between firms and other types of actors.

We analyse the literature by the use of the interactive and inter-organizational perspective of industrial network theory. In practice, this means that the unit of analysis has been the *interface* between firms, as well as other organisation in terms of how different types of relationships and interactions affect the implementation of sustainable products, processes and business relationships/networks. More specifically, in the literature we have targeted: 1) general drivers and hinders and how they relate to the internal and external network of the firm, 2) the role of different actors in relation to the focal firm – which actors are identified as driving and/or hindering the development of sustainability in supply networks, and finally, 3) the impact of types of business relationships – eventual connections between the degree of inter-organizational interaction and achievement of sustainable supply networks. In addition, we investigate LCA as a potentially enabling tool of sustainability and interaction. Finally, we use the concept of *network position* and the classification scheme for the impact of levels of interaction (Figure 1) to discuss how interaction in networks relates to sustainability.

4. Results

The results of the literature review provide us with several important insights in relation to how sustainability is or can become an embedded practice in business networks, and what drives and hinders such processes. These are outlined in the following four sections.

4.1 Drivers and hinders of sustainable supply networks – what motivates and demotivates the focal firm?

Through the reviewed articles, we have identified a number of different drivers and hinders for sustainable supply chains in the internal and external network of the firm, and in the interplay between the two. As sustainability by definition is concerned with the environmental and social effects of products and processes ‘outside’ of the focal firm, SCM literature addressing sustainable supply chains and networks (SSC and SSN) often takes the perspective of the dyad, chain or network, rather than just the focal/internal firm. However, there is some variation in relation to whether it is *the firm* that is considered the most important component in driving or complying to change or if it is the external network.

4.1.1 Drivers and hinders related to managing the internal network

Handfield et al. (2005) identifies *top management* as one of the most important drivers of implementing sustainable practices in the firm and throughout the supply chain. The initiatives are taken *within* the firm by the top management, which leads to new organizational practices and perspectives that subsequently can be imposed on others in the supply chain through relationships or through compliance to demands. Also Guinipero et al. (2012) identifies top management initiatives as an essential and central driver for sustainable practices, which then can be spread to others. Along with such initiatives, organizational values and culture (Hoejmose & Adrien-Kirby, 2012) as well as communication across the organization (Seuring & Müller, 2008) become essential drivers in the making of a sustainable business model. Here, only when the focal firm has a set business strategy for sustainability can it be spread to others. Dey et al. (2011) recommends this as an explicit strategy: to start out by establishing internal routines from a short-term perspective, and then extend these practices to the rest of the supply chain from a long-term perspective. In this regard, Mollenkopf et al. (2010) view the multinational corporation (MNC) as the type of firm with the potential of driving and spreading such strategies and practices across global supply chains. Its size, R&D capacity and coordination of international production networks make it capable of influencing others and enforcing new ways of working globally. The main hinder or problem then becomes first how to implement the new practices within the firm, and then how to implement it across the supply network. Seuring and Müller (2008) identify management systems (such as ISO) as an important driver for such a process.

A primary identified hinder and management problem in relation to the internal activities of the firm is *direct and indirect costs* related to changes and to uncertainties in the process of implementing a sustainable supply chain (e.g. Seuring & Müller, 2008; Walker et al., 2008; Guinipero et al., 2012). As for any innovation project, changing existing ways of working, as well as who you are working with (suppliers etc.), requires investments and there are always

uncertainties regarding if and when the return on investment will come. Such uncertainties can be reduced through the acquirement of appropriate knowledge, but due to the newness of sustainability (Mollenkopf et al., 2010) as well as its complexity (Seuring & Müller, 2008) this is a tricky issue.

A related identified hinder is the belief of there being a *trade-off between environmental and economic performance* (Handfield et al., 2005). It is often believed that in order for sustainability to become an implemented practice within the firm it has to be done at the expense of economic performance. This is partly connected to the *lack of appropriate measures for environmental performance* – how should environmental performance be evaluated in relation to economic performance (Ibid.)? More specifically, Handfield et al. (2005) point to the problem of aligning corporate environmental strategy with performance criteria at the commodity level. A main issue thus appears to lie in turning strategies into actual practices that can also be evaluated. This appears to be a problem of finding good methods to do so, as sustainability is a complex issue to measure, but also of gaining *legitimacy* for such aspects (Walker et al., 2008). In general, economic key performance indicators drive companies, as this is the way their owners and stockholders evaluate them. Therefore, it becomes difficult to legitimize the use of any other indicators and criteria to develop the business and to evaluate performance and success.

However, a too strict focus on costs (Hoejmose & Adrien-Kirby, 2012) and the fear of additional costs (Leppelt et al., 2013) can induce an aspiration to remain ignorant in relation to supplier misconduct. Firms that are *not willing to invest* in supplier development or *to face the legal consequences* of eventual supplier misconduct are also identified as a central hinder to the implementation of sustainability in supply chains (Handfield et al., 2005). Based on the results of seven case studies in the chemical industry, Leppelt et al. (2013) term such firms ‘sustainability followers’. This means that rather than developing their supplier relationships they choose to trust that they cultivate their own codes of conduct and sustainability standards, and thereby avoid the costs of co-development. In contrast, ‘sustainability leaders’ work closely with their suppliers, guide them in implementing sustainable practices, and perform audits to make sure that the mutually agreed codes of conduct are being practiced. These ‘leader firms’ have a strategy of how to handle sustainability *internally* (foundation, communication, guidance, outcome), which they then implement *externally* through their supplier relationships. By applying an innovation perspective on what denotes a sustainable firm, Bommel (2011) states a number of “innovation characteristics” which should drive sustainability: *transparency, internal cooperation, active learning and adapting*, and a clear *leadership*. Lack or weaknesses thereof, should thus hinder sustainable practices to spread within the firm.

4.1.2 Drivers and hinders related to managing the external network

In relation to managing sustainability in the external network, there are a number of identified issues that the firm needs to deal with. This is partly due to the general problems of managing supply networks, but often it has to do with issues specifically connected to sustainability. In general, it can be concluded that sustainability adds to the complexity of managing supply networks. As it involves environmental and social issues in relation to more and different actors

than ‘normally’ included in the supply chain, it broadens and lengthens the spectrum of issues that needs to be dealt with, as well as with whom (Seuring & Müller, 2008; Crespín-Mazet & Döntenwill, 2012). A common view is that while *customers* and *governmental policies* are identified as the main drivers (this will be further discussed in the next section), suppliers need to be “managed”. They can be supporters, but are seldom identified as drivers (Walker et al., 2008). In an investigation of what drives the participation of small- and medium-sized suppliers to participate in GSC programmes, Lee (2008, p. 186) offers an explanation as to why suppliers might have difficulty in driving these complex types of issues;

“SME suppliers usually lack the information, resources, or expertise to deal with environmental issues. They have little know-how in bringing into effect the technical and managerial changes that would enable them to meet emerging environmental and social standards.”

However, not only are suppliers not viewed as drivers, they are even viewed as direct hinders. Lee (2008, p.186) continues:

“As a result, SME suppliers can be a source of environmental risk and a bottle neck in pursuing the goal of a greener supply chain.”

The result of the study in the chemical industry show that what drives these small suppliers are their customers’ environmental requirements and regulations. Managing a supply network in which some actors might be *unwilling or unable to change* is of course a challenge, and therefore poor or lack of supplier commitment is a generally identified hinder (Walker et al., 2008). In relation to the supply network consisting of a variation of suppliers that are able/unable to support change, many of the same factors that are identified as hinders in the internal network of the firm are also identified in the external supply network. For instance, the *lack of legitimacy* for sustainability issues (Walker et al., 2008), *reluctance to invest* (among suppliers) due to high costs and risks (Højmosé & Adrien-Kirby, 2012), and *lack of transparency* (ibid.) and *communication* in the supply chain (Seuring & Müller, 2008). Thus, many of the issues that firms need to deal with internally are also challenges in the external supply network.

Walker et al. (2008) and Tate et al. (2010) also call attention to industry-specific drivers and barriers; depending on the industry’s particular characteristics in relation to for instance industrial organisation, level and type of regulation, suppliers of basic technologies, and type of customers, specific factors become more or less central in the development of sustainable supply chains. For instance, pharmaceutical companies can be concerned with cutting production costs to offer drugs to lower-income individuals, while financial firms might be interested in finding links between financial performance and the use of alternative energy sources (Tate et al., 2010). Which specific type of challenges that companies face in relation to their external network and how they can be met thus in some regard differ from industry to industry.

4.2 Drivers and hinders in relation to the different actors in the network

In our search we identified a number of actors in the network of the focal firm in terms of how they act as hindering or driving forces for sustainable supply chains and networks. Unquestionably, the most frequently identified external actors for driving sustainability issues in supply networks are *customers* and *governmental policy makers/legislators* (e.g. Seuring & Müller, 2008; Bommel, 2011; Hoejmosé & Adrien-Kirby, 2012). Due to legal, legitimacy and economic reasons, these stakeholders place particular pressure on the focal firm, which therefore may need to adapt its practices. Walker et al. (2008) identifies two types of customers that push the development of green SCM projects: large customers that use their power position to implement sustainable business practices across the supply chain (see also Mollenkopf et al. 2010), or end-consumers that demand new and sustainable products and services. Also Solér et al. (2010) classifies demands of the end-consumer as a central driver for sustainable practises. In addition, the authors state that the ‘closeness’ to the end-consumer and its environment affects the suppliers’ assessment of why and how to implement green values and practices; the closer the relationship to the end-consumer, the likelier the supplier is to change its practices in relation to those demands (ibid.).

As for policy makers, regulators and legislators, these play an important role in setting (legal/non-legal) standards that needs to be met by different companies and industries (e.g. ISO). While this is seen as a positive driver for enforcing sustainable measurements, indicators and accounting standards across a variety of firms, there is also the view of this not being as effective or efficient as other types of drivers. It is indicated that the standards that are implemented merely on the basis of regulatory pressure might not become as integrated within the firm or across the supply chain as when this is done from initiatives within the firm or in relation to customers (Walker et al., 2008). Thus, regulatory pressure can be a positive driving force for starting to implement green SCM. However, it might not be enough to enhance the environmental performance as it does not force the focal firm to embed it into its “*value chain processes as thoroughly as in companies which were initially motivated to do so*” (Handfield et al., 1997 p. 306, in Walker et al. 2008). There are even those that identify regulation as a hinder. One example is how rules of public procurement can constrain innovation and thus hamper the development of new sustainable products and processes (Porter & van de Linde, 1995). Another is how local policies related to specific products negatively affects the efficiency of environmental initiatives (Huttunen et al., 2014). Nonetheless, standards seem to have an important role in that they set the minimum requirements and guide those that want to push further than such requirements. According to Seuring (2011), the focal firm is completely dependent on regulators, customers and NGOs to set standards that they can both follow and go beyond.

In relation to external pressure and standards, *NGOs* is another actor that is identified as an important driver. One such organisation is the *International Organization for Standardisation* (ISO), which is labelled as an NGO but which through its great influence on national governments basically exert legal pressure on a global scale (Mollenkopf et al., 2010). MNCs often experience a higher level of pressure than other firms of implementing the ISO standards and in turn place pressure on their suppliers to do the same. Crespin-Mazet and Dontenwill

(2012) suggest that in turning to sustainable SCM practices, the individual firm will have to relate to actors which it ‘normally’ would not have to, such as NGOs and non-business actors. Not least to gain legitimacy for sustainability issues in relation to the rest of the supply network. On the topic of closed loops, Kumar (2006) also discusses how strategic alliances with non-business actors can allow the focal firm to concentrate on its core business instead of internalising sustainable operations, such as recycling and waste management. Other than business actors thus have an important part to play in the shaping of sustainable supply chains; regulators and NGOs play the role of driving standards as well as the legitimacy for such standards and sustainable SCM, and other non-business actors can take on complementary activities. Miemczyk et al. (2012) however also identify a hinder in needing to include or assign greater parts to non-business actors in purchasing and supply networks. It is generally a problem to develop and manage supply networks, and to do so by including non-business actors is identified as even more of a challenge due to the different logics of how to create value (economic vs. other).

From the perspective of sustainability potentially representing a competitive advantage, competitors are also identified as drivers for developing innovative ways of handling green issues in the supply chain (Linton et al., 2007; Walker et al., 2008). Differentiating the firm or entire supply chain by adapting products and processes towards sustainability may offer competitive opportunities. Hopkins (2009) also identify competitors as important collaborators as the growing importance of considering sustainability will change how firms need to organize internally and in relation to other actors.

4.3 Interaction and sustainability in supply networks

A common theme that is very apparent across the reviewed articles is the need for several types of inter-organizational collaboration in the implementation of network-wide sustainability. Several articles address the general need to interact across the wider network of different actors (firms, NGOs, authorities etc.), while some focus particularly on inter-firm collaboration and business-to-business relationships. While collaboration and relationships are seen as necessary, there are nuances in which types of relationships are identified as most fruitful.

Through a literature review, Rizzi et al. (2013) investigate collaborative strategies as a means to implement extended producer responsibility (EPR) in open-loop supply chains. They imply that in the pursuit of achieving EPR the responsibility of the producers will, to a greater extent than otherwise, stretch across organizational borders. As there is little knowledge of the full ‘system dynamics’ regarding such responsibility, this pursuit will enhance uncertainties and the need for risk sharing. Therefore, the authors conclude that the higher the openness to collaboration among the firms in the supply chain, the more effective the outcomes of EPR; more is gained by sharing risks and knowledge with others. Also, due to the newness, complexity and uncertainties of pursuing sustainable supply chains, the authors assign great value to trust-based relationships (ibid., p 569):

“Trust between partners gains particular importance when the levels of process manageability and outcome interpretability of firm relationships are low, which is the case

for many forms of proactive collaboration within SCs aiming simultaneously for various sustainability goals.”

Sustainability is thus identified as a special supply chain management problem; the scope and depth of the issues that need to be handled pose a great challenge to the individual firm and the network it is part of. Seuring (2011) states that it requires the “full” supply chain overview, which is normally not necessary when controlling costs and qualities of commodities. This in turn calls for supply chain strategies of a more encompassing type; it is not enough to optimize the operations of the single firm but a number of other firms (and actors) need to be included. Due to the inclusion of further aspects than costs and quality and the extended responsibilities, the strategic approach must be both ‘widened’ and ‘lengthened’ (Bommel, 2011). Sustainability aspects thus forces managers to (re-)consider inter-firm collaboration with their suppliers, either through selecting new suppliers to collaborate with, or developing existing supplier relationships towards new forms of cooperation – through ‘closer’ relationships (i.e. deeper interaction) and ‘wider’ relationships (i.e. interaction regarding new processes), as well as to consider information sharing further upstream and downstream (Vermeulen & Ras, 2006; Seuring & Müller, 2008; Mollenkopf et al., 2010).

While investments in close supplier relationships can be regarded cost demanding and therefore a hinder to achieving sustainability (Leppelt et al., 2013), there is also the view of long-term and trust-based relationships as cost reducing. Hoejmose and Adrien-Kirby (2012) support close business relationships as a way to share risks and gain additional knowledge, and as a result reducing the costs of entering into a more sustainable supply chain approach. They also see this as a way to audit suppliers; by engaging in close interaction with suppliers, it becomes less of an effort to sustain codes of conduct and ensure their efficiency (i.e. that they are being implemented properly).

Related to green supply chain management, there is an explicitly stated connection between green supply chains and cooperation as a means of gaining competitive advantage (e.g. Seuring, 2011; Gold et al., 2010). Or as stated by Solér et al. (2010, p. 14):

“Within the field of green supply chain management (GSCM), an interest in supply chain cooperation to create sustainable competitive advantage, i.e. the collaborative paradigm, has made researchers turn their attention to information related aspects of the supply chain.”

Thus, connections are drawn between sustainability, inter-firm collaboration, and information and knowledge sharing. This is also considered by Bommel (2011) who states that in addition to “innovation characteristics”, the firm needs a set of “cooperative characteristics”. These include: trust, reputation, joint programmes, and cooperative information systems throughout the supply network. This accentuates the need of an outward-looking focus of the firm in its pursuit of engaging in a sustainable supply network. It also assigns a special role to knowledge. The uncertainties connected to sustainability, in relation to what it means for the individual firm and supply chain to implement it, increases the need for knowledge and knowledge sharing. As

the required knowledge mainly has to do with how problems are solved across the chain and network, this in turn creates a need for interaction among firms. Furthermore, as identified in several earlier literature reviews, this interaction needs to be informal rather than formal, and deep rather than superficial or at arm's length (Kumar, 2006; Solér et al. 2010; Hoejmose & Adrien-Kirby, 2012; Rizzi et al., 2013). Lamming and Hampson (1996, p. 53) identified issues of collaboration and communication in relation to sustainable supply chains already in the 1990s:

“Supply chains often appear to suffer from poorly-organized information and too many barriers to communication. At present, this is the case with environmental issues. As the nature of environmental problems is uncertain in the future, and the focus of future legislation unclear, intra-value chain co-operation would appear to be a fundamental element of any environmental strategy.”

Additionally, the authors argue for the further mutual benefits that can be achieved through collaboration. It is not only about exchanging information, but also more importantly about learning and teaching, as well as developing *new* knowledge and ways of working based on interaction:

“If a collaborative approach is employed in purchasing, suppliers may be able to help customers understand the environmental effects and the causes in the supply chain. At the same time, customers may help suppliers to understand the related issues such as potential competitive advantage and the criteria used for evaluation and rating. Since each has vested interest in the other's success, this joint working should create the best results, giving more cost effective environmental solution and better market opportunities for the supplier to embed in the customer's value chain.” (Ibid. p.52)

As opposed to many other studies, Young and Kielkiewicz-Young (2001) take the supply network as an explicit focus in their investigation of *sustainable supply network management* (SSNM) in eight economic sectors in Europe and North America. They suggest that by collaborating closely across the network and learning from others, firms can develop sustainable practices more efficiently, and thereby achieve a competitive advantage:

“To achieve this [competitive advantage] depends on an organisation's ability to leverage sustainability advantages in its supply network. It means being open to, working with and even learning from the network, all of which requires trust.” (Ibid., p. 261)

They argue that while large customers often pose as the greatest driver of sustainability practices, even small suppliers have been known to influence their customers. Naturally, from the customer's perspective this requires an openness to learning from one's network. Another conclusion is that those firms that are most involved in SSNM also use the most sophisticated tools and strategies to succeed with internal cross-functional and inter-firm collaboration; those firms that are the most outward looking are also the most internally integrated.

Dealing with sustainability also forces managers to consider collaboration with other types of actors than firms. As has been discussed in previous sections, authorities, NGOs and other non-business actors have an important role to play and often act driving forces of sustainability issues in supply networks. What seems less investigated is the nature of the collaboration between firms and such actors, as they often are only addressed as actors placing external pressure on firms. Florence-Crespin and Dontenwill (2012) and Kumar (2006) make out two exceptions. Kumar (2006) uses the case of Nike shoes to illustrate the benefits of using a non-profit organization to achieve a more sustainable supply chain. By forming a strategic alliance with the National Recycling Coalition (NRC), Nike outsourced the logistics operations of re-collecting the shoes that were to be recycled as part of a green initiative. This alliance created mutual benefits for the two parties; it permitted Nike to gain access to the network of NRC as well as to use their services (for payment), and Nike shipped the shoes free of charge to its recycling facility and subsequently re-used the material in their manufacturing. Thus, through the alliance a closed-loop was formed which presented added value for both parties. While the example does not illustrate the level of interaction, it does illustrate the need for mutual benefits in the forming of collaborations. This can appear challenging in relationships between such different organizations, and is even identified as a clear hinder to sustainable supply chains (Miemczyk et al., 2012). However, the Nike case demonstrates the possibility of identifying and practicing sustainability through shared value creation with non-business actors. Florence-Crespin and Dontenwill (2012) investigate a case within gardening regarding the forming of “cooperative ties” with non-business actors as “*a key success factor to develop the firm’s resources and legitimacy in sustainable development*” (ibid., p. 208). They investigate how a gardening distribution company – Botanic – re-defines its strategy in terms of incorporating sustainable practices throughout several functions of the firm (purchasing, transportation etc.). In this process, the company becomes highly dependent on different types of non-business actors such as NGOs, certifiers, and independent experts for the provision of knowledge, certification, legitimacy, and connection to specific producers. The firm’s supply network after the process of becoming an ecological gardening provider was fundamentally different than the one before, which illustrates a definite ‘widening’ of the network needed for forming a sustainable supply chain, as well as the possibilities of identifying shared value with actors other than business.

4.4 LCA as a tool to implement sustainable supply chains and networks – how does it relate to interaction in supply networks?

So far, it has repeatedly been argued that lack of information and knowledge sharing in the supply chain is a clear hinder to achieving chain- or network-wide sustainability. More specifically, one aspect of this hinder is the lack of appropriate metrics and data to measure the performance of sustainable practices across (global) supply chains (Mollenkopf et al., 2010). One type of analysis that has grown in use and importance during the last two decades is life cycle assessment (LCA):

“Life Cycle Assessment (LCA), which quantifies the potential environmental impact of product systems within a defined system boundary (International organization for standardization ISO, 2006), is an important technique for identifying improvements during

the design of a product and production process as eco-design.” (Nakano & Hirao, 2011, p. 1189)

By targeting a specific product or process an LCA aims at identifying the most environmentally hazardous materials or activities in any specific supply chain. However, to map and analyse all the materials and activities in a supply chain is extremely costly and resources-demanding, if not impossible. There are two main problems; firstly, to actually consider all the materials and activities connected to even just one product, and secondly, to gain access to the required information about these activities as they take place both within and outside the boundaries of the single firm. Information retrieval is thus a main concern, which is why standardized tables for commonly used materials and production or transportation methods are often used. The result of an LCA shows the environmental impacts of selected items and activities, such as carbon dioxide emission (CO₂), energy consumption or methane emission. As such, it gives an indication to the involved firm(s) which parts of the supply chain causes the greatest environmental damage and which areas should be prioritized in the exercise of an environmental practice. Thus, the goal of an LCA is to work as a tool for decision-making and implementing new practices along the supply chain:

“Life cycle assessment (LCA) is a widely accepted methodology to support decision-making processes in which one compares alternatives, and that helps prevent shifting of environmental burdens along the value chain” (Fullana et al., 2011, p. 458).

While LCA is the most effective tool for environmental impact analysis (mainly through the ISO practice), there are however several identified issues with performing an LCA. Some has to do with the LCA itself. One is that it solely focuses on environmental factors (and not social) (Huttunen et al., 2014). Performing an LCA mainly has positive intentions and implications for green issues while it potentially can harm various social conditions (at the extreme). Thus, while social LCA is under development, a general LCA neglects these values. Hagelaar and van der Vorst (2002) also call attention to the use of standardised data as opposed to site-specific. They consider generic and aggregated data from average industrial conditions inadequate and even misleading for management decisions regarding the selection of a *“specific supplier for a specific company”* (ibid., p. 404). Furthermore, as with the use of any technology or tool, LCA is context-dependent and therefore it is difficult to standardise and convey best practice on how this tool should be used. Attention is therefore also drawn towards the problem of how to use the results of the LCA as a tool to make informed decisions and to make actual changes along the specific supply chain – i.e. how to turn LCA into effective life cycle management (LCM). As a first step towards performing a useful LCA, Fullana et al. (2011) suggest that the project resources of those executing it should be divided according to the “Three-Third Principle”. This implies that one third should be used on communicating mutual goals and targets early on with the client (the focal firm being assessed) so that when the assessment is done the results are actually something that the client understands and sees a use for. Another third should be put on helping the client to make use of the results in terms of turning them into actual practices, and finally one third should be used for the actual analysis.

However, for an LCA to be truly efficient in terms of environmental and economic performance several authors point to the need to collaborate in the supply chain in order to achieve *integrated*

chain management (e.g. Hagelaar & van der Vorst, 2002; Seuring, 2004; Nakano & Hirao, 2011). Here LCA represents the tool to produce information, and collaboration or integration the tool to improve the performance of that information. Through several case studies Nakano and Hirao (2011) notice that the *type of information shared* among business partners is related to *the type of relationship*; if there are strong cooperative ties or power relations (for instance due to the share of sales that a customer accounts for), then more extensive information sharing is made. The relationship thus functions as a channel for the information produced with an LCA; LCA is a way to produce data, but it is the type of inter-firm collaboration that determines the use and efficiency of that data in the restructuring of activities and resources in the supply network. As a result of their study, Nakano and Hirao (2011) suggest a type of assessment that also considers the economic impact of ‘material flows’ and enables cost reductions in relation to such flows (Material Flow Cost Accounting). While this extends the data needed for the analysis, by adding the economic dimension to environmental assessment making, they hope to contribute to corporate decision-makers that need to calculate both the economic and environmental opportunity cost of their choices.

The indication from the literature is that while there are many studies of the technical dimensions of an LCA, more management studies investigating the use and practice of this tool is certainly needed. These studies need to consider 1) the nature of the data (Hagelaar & van der Vorst, 2002), 2) how the data is perceived by the client (Fullana et al., 2011), 3) how it can be practiced to make informed management decisions (Nakano & Hiroa, 2011), and finally, 4) how it can function as an information sharing and communication tool in networks (Ibid.). In a recent publication in *Science*, the challenge of achieving an assessment framework that is effective *both* for assessing environmental impacts and re-shaping supply chains was expressed by Rourke (2014, p. 1127) in the following way:

“There is a real opportunity to connect global measurement systems, with targeted monitoring, comparative ratings, and reporting. Even as LCA scientists work through technical challenges rooted in the complex ecologies of supply chains, they must simultaneously integrate recent lessons from the behavioural sciences related to effective sustainability communication and behaviour change in order to design tools that have any chance of being useful for decision-making. Better data, decision support tools, and incentives are needed to move from policing supply chains to predicting and preventing unsustainable practices.”

5. Concluding discussion

In this review of how sustainability relates to interaction in supply and business networks there are several findings that strongly support both the timeliness and relevance of this inquiry. As the awareness and knowledge of sustainability increases so do the ways of approaching it as a collective problem. Several literature reviews point to the lack of studies of sustainable SCM on the network level, but also encouragingly report that there is a growing awareness and interest of this issue (Walker et al., 2008; Hoejmose & Adrien-Kirby, 2012). What seems clear is that the pursuit of sustainable supply chains adds complexity to the *interfaces* between actors, business and other. It is a dimension that relates to other values than primarily economic and therefore requires operations and changes motivated by other goals. In turn, this requires particular knowledge and practices, as well as relationships. One main finding from our review is that a number of scholars basing their conclusions on extensive literature reviews, on case studies and large-scale surveys *explicitly* state that *long-term* and *trust-based relationships* are essential for the implementation of sustainable supply chains and networks (Seuring & Müller, 2008; Mollenkopf et al., 2010; Bommel, 2011; Seuring, 2011; Hoejmose & Adrien-Kirby, 2012). We can also conclude that the *type of actors* included in sustainable supply networks are different from ‘non-sustainable’ supply networks (Kumar, 2006; Seuring & Müller, 2008; Florence-Crespin & Dontenwill, 2012). Thus, firms need to interact with a different set of actors than ‘normally’ if they are to engage in sustainable SCM practices. Consequently, there are several managerial challenges connected to achieving sustainable supply networks.

Another very interesting observation is that several of the identified hinders of achieving sustainable supply chains are also the consequences of a *low level of inter-organizational interaction*: lack of transparency and insufficient communication in the supply chain, lack of supplier commitment, the need for sharing increased risks and costs. In addition, several of the solutions presented to overcome these hinders are suitably related to *increased interaction*: strategic alliances (with business and non-business actors), collaboration in several stages of the supply chain both upstream and downstream, tools for information sharing and learning etc. We can thus conclude that as a ‘supply chain management problem’ sustainability forces managers to think differently in terms of *whom* their firm is to interact with as well as *how*.

As for the identified drivers for sustainability, these are highly related to *type of actor* and *network position*. Customers and governmental authorities are identified as the two main driving actors. The potentially most influential customers are large corporations and MNCs, as well as end-consumers. Large and resourceful customers often have the advantage of being able to exert power over their supply network and as such, implement changes that they deem urgent. Their network position of being highly relevant to a large number of other actors make them influential and therefore drivers of innovation, for instance of sustainable solutions. In addition, MNCs can put pressure across global supply networks; due to its connectivity, this actor can implement change in interaction with a global network of actors and resources causing ‘wide’ effects. It is suggested that while customers (i.e. users) are always important for innovation, they hold an especially vital role in relation to sustainable innovation as there in addition to the ‘normal’ inertia of industrial and technological structures are legitimacy issues that need to be

overcome. Thus, customers play an imperative role in spreading sustainable practices in supply networks. End consumers also influence what type of products and services that are relevant to produce. However, it is stated that in relation to sustainability they can only place pressure on the suppliers closest to them, as opposed to large business actors.

Governmental authorities also hold a special network position as they exercise legal pressure on business communities; companies do not have a choice but to comply with the conditions set by this type of actor. Therefore, authorities have the ability to drive certain issues that they considered beneficial for business and society. However, due to this position they can also act a hindering force if there are conditions or consequences that have not been taken into account. The interface between business and public actors can be problematic as there is a potential clash of different incentive structures and economic logics. Also, while public actors hold a powerful network position and can exert pressure on others, they are themselves governed by strict regulations and legal restraints that limits their flexibility. Public procurement regulations as a hindering force of innovation is one example. Nonetheless, along with NGOs, governmental regulation has an imperative role to play in setting standards and rules for sustainable supply networks. It is however also suggested that as customers hold a network position of being part of the 'full' value chain of the firm or network, not only in relation to shaping sustainability, this actor has a more influential role in embedding sustainable practices in supply networks than authorities.

Suppliers, and especially SMEs, on the other hand are seen as struggling with or even hindering sustainable business practices. As relatively small businesses, they hold an unfavourable position in relation to other larger and more connected actors. They have fewer resources to sustain both internal and external functions (i.e. relationships) and thus hold peripheral and less powerful network positions. Already engaged in matching high customer demands with scarce resources, sustainability can become an overwhelming requirement. There are however also positive examples of small suppliers driving these issues as particularly important, but this requires openness from customers to learn from their suppliers.

NGOs and non-business actors are also important drivers of sustainability issues in supply networks, and this is one of the aspects that make sustainable SCM different from 'normal' SCM. NGOs and non-business actors play vital roles in driving the legitimacy for sustainable business practices, forming environmental and social standards and certifications, as well as handling operations outside of the core business of the chain or network. As such, they hold a network position that is activated and enforced in relation to firms as they start to implement sustainable practices. Either they place pressure on firms through public opinion and thereby become useful in shaping that opinion, or firms reach out as they realise the need for expertise in shaping that opinion themselves, as well as operations connected to this process.

There is also evidence that there is clear connection between the integration of internal and external interaction of the firm and successful sustainable supply chain management. It has been shown that firms that are fully integrated internally also employ the most sophisticated and effective approaches to handling sustainable practices with their supply network. Thus,

firms that have well-organized ways of communicating sustainability cross-functionally *within* the firm also have efficient ways of doing this with their various suppliers. This shows that in relation to achieving sustainability in supply networks the internal and external business practices of the firms should be interconnected. Several authors also argue that the process of getting there should begin with implementing integration, communication and organizational values within the firm and then this approach is to be exercised gradually with suppliers. Here top management is assigned an important part in placing internal pressure and taking initiative.

Thus, regardless if it is due to external pressure from customers or starts from internal initiatives, business relationships play a key role in implementing and spreading sustainable practices across supply networks. The main identified reasons are the need for sharing risks, reducing costs but most importantly for learning from or teaching others and for developing *new* knowledge. By using our classification scheme (Figure 1) and adding the sustainability dimension of economic exchanges (Figure 2) we can discuss which *types of relationships* are most likely to drive sustainability in supply networks.

	Actor bonds	Resources ties	Activity links
Sustainable pure exchange - no relationship or exchange of knowledge	-	-	-
	Sustainable business practices cannot be shared in dyad or network		
Sustainable minor social exchange - repetitive exchanges, short time horizon, <i>single relationship</i>	Some social sentiments	Some degree of orientation in relation to the counterpart's resources. Can be both one/two-sided.	Some degree of orientation in relation the counterpart's activities. Can be both one/two-sided.
	Sustainable business practices are unlikely to be shared in dyad or network		
Sustainable technical exchange - short term or long term, <i>single relationship</i> , maintaining flexibility	Know how to work together in relation to a specific technology or activity	Minor changes in facilities and business units concerning specific technology and projects. Often one-sided.	Minor changes in related activities, often one-sided.
	Sustainable business practices can be shared in relation to particular technology or activity in dyad, but most likely one-sided		
Sustainable cooperation - short term or long term, repetitive, <i>single relationship</i>	Know how to adapt to each other in relation to different types of technologies/activities	Mutual changes in several types of resources	Mutual changes in joint and related activities
	Sustainable business practices are likely shared in relation to several technologies and activities in dyad		
Sustainable networking - long term, <i>involving third party</i> -several relationships	Know how to systematically relate to several parties in co-managing resources and activities (dyad<-> triad<-> network)	Mutual changes in relation to several parties in several types of resources	Mutual changes in relation to several parties in joint and related activities
	Sustainable business practices are likely shared in relation to several resources and activities in networks		

Figure 2. Interaction, adaptations/changes in bonds, ties and links, and the consequences for sustainable business practices in business networks.

It can be concluded that the types of business relationships that are seen as hindering or not driving the implementation of sustainable business practices are those that range from *pure exchange* to *technical exchange*. Based on this literature review, in which long-term, trust-based and interrelated business relationships are seen as vital for achieving sustainable supply networks, the two categories that have the ability to drive sustainability are *cooperation* and *networking*. While cooperation relates to collaboration between two parties - the dyad, networking relates to several actors interrelating their resources and activities to each other. Concerning sustainability, cooperation thus offers the opportunity of (for instance) a single supplier and buyer learning in relation to each other and developing sustainable practices within the dyad. Networking on the other hand, implies that several (tiers of) suppliers and/or buyers learn from each other practices and can adapt these practices *collectively*. As sustainability by definition is about collective achieving results that creates benefits for several and different actors, business and society, this appears as the most efficient way of spreading and implementing sustainable supply chain chains and networks.

However, there is also need for management tools to implement and collectively develop such practices. Here LCA was (briefly) investigated as one such possible tool. The results indicate that how an LCA can be generated as well as used largely reflects the types of network position and relationships exercised by the parties involved. Data retrieval is a problem partly due to that there is such a large amount of data that needs to be collected and partly due to suppliers/customers giving access to such data. However, if the actor collecting the information holds a favourable network position such data can be more easily retrieved, or if there is a close cooperative relationship. In accordance with the discussion above, the level of information-sharing thus depends on the type of relationship and level of interaction. In implementing the LCA it must also be clear what it should be used for and in relation to whom. This must be clear already on the data retrieval stage as it decides which data is relevant. However, as this is a problem in many cases, standardised data on aggregated industrial level is used instead. This is identified as an additional problem as the characteristics of firms, relationships and networks often are highly specific and context-dependent. While LCA remains the most efficient tool to conduct environmental assessments, there are thus a number of issues that need to be studied further: 1) the nature of the data, 2) how the data is perceived by the client, 3) how it can be practiced to make informed management decisions, and finally, 4) how it can function as an information sharing and communication tool in networks.

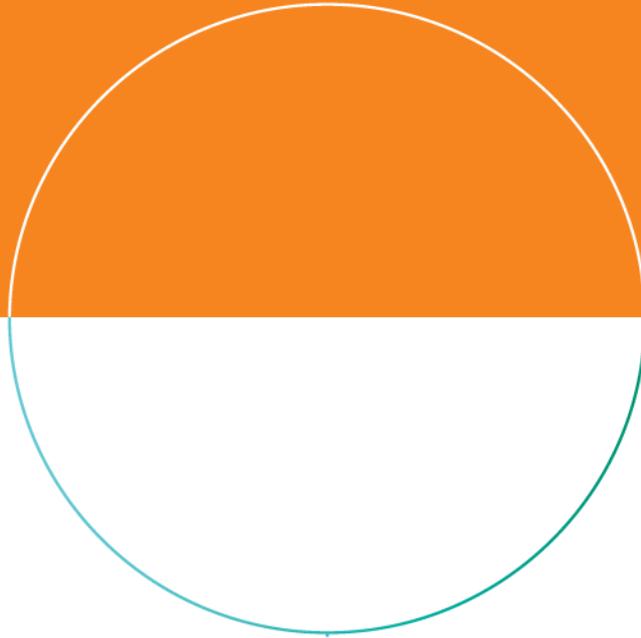
As a final word, another finding of this literature review is that while the literature on sustainable SCM is steadily growing it is mainly environmental or “green” issues that are addressed, and rarely social. Even if we in addition to sustainability also specifically targeted green issues, social aspects could have turned up more frequently in relation to sustainable practices. This appears as a major research need for the future of increasingly sustainable supply networks.

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