Competitive paper for special track: Handling sustainability in a B2B context

The Role of Interaction in Achieving Increased Sustainability in Supply Networks

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ABSTRACT

Controlling an entire supply chain of a product or service in relation to costs and quality is identified as a problematic issue in the supply chain management literature (e.g. Harland, 1996). However, implementing strategies and practices across the supply chain in relation to *sustainability* - the issue if considering environmental, social and economic aspects of business solutions - appear particularly problematic (Handfield et al., 2005; Bommel, 2011). In this paper, we investigate the role of business interaction in achieving increased sustainability in supply networks through a literature study of the supply chain management (SCM) literature.

Based on basic assumptions of the industrial network approach we present three propositions that should matter for firms in supply networks pursuing more sustainable business practices. These propositions relate to 1) the network position of the firm, 2) the fit between existing and new solutions in innovation processes, and 3) types of business relationships. The relevance of these propositions are investigated by considering three aspects of the SCM literature. Firstly, how the internal and external network of the firm respectively relate to sustainable practices. Secondly, which type of actors are identified as either driving or hindering the development of increased sustainability in supply networks. Thirdly, the impact of types of business relationships on increased sustainability, i.e. the connection between the degree of inter-organizational interaction and achievement of more sustainable supply networks.

The results show that sustainability is a difficult management task partly as it concerns other types of goals than economic, which might be hard to motivate and legitimize both within the firm and across the network. Also, it can require encompassing changes in *how* firms interact and with *which type of actors*; achieving sustainability requires both 'deepened' and 'lengthened' interaction in the supply network, which includes others than business actors (e.g. NGOs, governmental actors etc.). The three propositions are found relevant, two highly relevant while one implicitly so. A need for further studies of sustainability and SCM with a network perspective is also identified.

Keywords: supply chain management, supply networks, interaction, sustainability, non-business actors

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INTRODUCTION

In a nowadays business context, striving for sustainability refers to creating technical and organizational solutions in relation to economic, environmental and social considerations. This is often referred to as *the triple bottom line* (Tate et al. 2010; Leppelt et al., 2013), and implies that firms should go beyond a business model exclusively based on profit maximizing by also including an environmental and social agenda into their practices. By investigating the supply chain management literature, we inquire which role business interaction plays in influencing the achievement of more sustainable business practices for firms related in supply networks.

The perspective applied is that of sustainable business practices being a collective effort rather than a task merely for the individual firm. In the same vein, Porter and Kramer (2006) suggest that striving for increased sustainability should be based on "shared value creation", which encapsulates two specific ideas about the achievement of more sustainable business practices. Firstly, sustainable business practices should benefit both business *and* society. Secondly, in the pursuit of more environmentally and socially sustainable business practices, the benefits must create a 'competitive advantage' for the individual firm, otherwise the sustainability enterprise is bound to fail. In applying an industrial network perspective on the business landscape (e.g. Håkansson et al., 2009), we interpret such an endeavor as creating positive economic, environmental and social effects in the *interfaces between the focal firm and other actors*. The industrial network approach is based on a large number of empirical observations in several industries regarding business-to-business relationships and how they matter for the strategies and practices of the individual firm (e.g. Håkansson, 1982; Håkansson et al., 2009) as well as for innovation (Håkansson & Waluszweski, 2007). In this perspective, the firm is seen as embedded in a network of interdependent actors, activities and resources that are interrelated across the organizational boundaries of the individual firms (and other types of relevant actors). This implies that firms are dependent on other firms and actors in order to operate and to create different kinds of benefits (revenues, learning, and innovation) (Håkansson & Waluszewski, 2002). In turn, this means that the main value creating activities for firms take place in the interaction with other firms, such as suppliers, customers and other collaborators (Håkansson & Ford, 2002; Gadde et al., 2003).

From the standpoint of how firms can create value from more sustainable business practices and what is required to do so, this perspective seems both timely and relevant. Firstly, several extensive literature reviews on sustainable supply chain management point to a lack of studies on the network level by calling for investigations that go beyond the viewpoint of the individual firm, and even the individual supply chain (e.g. Walker et al., 2008; Hoejmose & Adrien-Kirby, 2012). Secondly, several studies draw special attention to the centrality of inter-organizational information exchange and learning among firms as well as other relevant actors for the achievement of more sustainable supply chain management practices (e.g. Solér et al. 2010; Vermeulen & Ras, 2006; Seuring & Müller, 2008; Mollenkopf et al., 2010). Put together, this indicates that there is a need for a deeper understanding of the connection between interaction among firms and more sustainable supply chain management, particularly

on the network level. Based on a literature study, we further investigate this matter by looking into how sustainability in supply networks is addressed and particularly how interaction between firms appear to matter for achieving increased sustainability in such networks. The overall research question of this paper is formulated in the following way: *how is the achievement of more sustainable supply networks related to interaction between firms, as well as other actors?*

With the aim of discussing the exchange and interaction processes taking place between firms (customers, suppliers, competitors etc.), as well as other types of actors (NGOs[4], authorities, etc.), we look into three specific aspects related to such processes. Firstly, which main factors in the internal and external network of the firm respectively are identified as related to sustainable business practices. Secondly, which type of actors are identified as either driving or hindering the development of increased sustainability in supply networks. Thirdly, how types of business relationships are seen as impacting sustainability, i.e. the connection between the *degree* of inter-organizational interaction and achievement of more sustainable supply networks. We investigate and analyze these aspects based on three propositions developed from the basic understanding of what affects the possibilities of firms to act in an interactive business landscape. These propositions are addressed in the subsequent theoretical section.

INDUSTRIAL NETWORK THEORY –IMPLICATIONS FOR SUSTAINABILITY

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 enable 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 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 becomes blurred. This is due to the *bonds* (between actors), *links* (between activities) and *ties*

[4] Non-governmental organizations

(between resources) which forms 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 smaller set of crucial 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* (Håkansson & Johanson, 1992); 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. This leads to the following proposition:

Proposition 1: *In the case of sustainability, the network position of the firm should affect the ways in which it can mobilize resources across the network in the pursuit of creating mutual benefits from more 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. This leads to the second proposition:

Proposition 2: *In the case of developing more sustainable products, services and processes, the above argumentation implies that if such solutions can fit into existing operations, resource structures and business relationships of a supply network it should be less costly to implement.*

Within the industrial network approach it has been proposed that the role that business relationships can play for learning and innovation depends on the level of interaction between the actors involved (Håkansson & Prenkert, 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). It is in no way however unproblematic to involve and be involved with several actors in changing- and learning processes. Often business relationships and interaction involves both cooperation and conflicts (Ford et al., 2003). This leads to the third and final proposition:

Proposition 3: *In the case of sustainability, business relationships should have an important role to play in creating mutual or shared value from more sustainable business practices for several parties.*

In this investigation of the relation between sustainability and business interaction, we use this classification scheme to classify which type of relationships that are reported as connected to the development of more 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, *single relationship*	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, *single relationship*, 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, *single relationship*	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, *involving third party -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

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

METHODOLOGICAL CONSIDERATIONS

As part of a larger research project on sustainable innovation and shared value creation in the Norwegian industry, the purpose of this paper is to investigate what role business interaction has to play in achieving increased sustainability in supply networks. Based on the industrial network approach regarding the interactive features of the business landscape and the consequences for the individual firm, the three above propositions have been used to analyze the supply chain management literature in terms of how it addresses sustainable supply chain

management (SCM). Our inquiry to the literature has been if and in what way these propositions appear relevant for this literature as well as the empirical results that it presents. Therefore, the targeted literature is that of peer-reviewed articles that address sustainability in combination with supply chain management (SCM). In the literature search, we pursued articles addressing the keywords of '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.

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 4) 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 stretches 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 searching for evidence of relevance (or non-relevance) of the propositions in relation to 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 the role of mainly 'internal' resources and activities of the firm, in order to analyze how they might depend on or be part of resource constellations transcending firm boundaries.

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, these are outlined in the following four sections.

MANAGING THE INTERNAL NETWORK OF THE FIRM IN RELATION TO SUSTAINABILITY

Several studies and scholars identify top management of the firm as one of the most important drivers of implementing sustainable practices in the firm and throughout the supply chain (e.g. Handfield et al., 2005; Guinipero et al., 2012). The perspective is that 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. A main 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 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; Giunipero 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 barrier 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.

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.

MANAGING THE EXTERNAL NETWORK OF THE FIRM IN RELATION TO SUSTAINABILITY

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 in 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 in 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; Crespin-Mazet & Dontenwill, 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[5] 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.*"

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.

[5] GSC –Green Supply Chain

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 barriers 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 (Hoejmose & 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.

The role of Different Actors in the supply 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 more sustainable supply 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; Hoejmose & 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. Two specific types of customers can be identified as pushing the development of green SCM projects and practices: large customers that use their power position to implement sustainable business practices across the supply chain (Mollenkopf et al. 2010; Walker et al., 2008), and end-consumers that demand new and sustainable products and services (Solér et al., 2010).

As for policy makers, regulators and legislators, these play an important role in setting standards (legal/non-legal) 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, but 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).

In relation to external pressure and standards, *NGOs* are another type of actor that is identified as an important driver. One such organization 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 internalizing sustainable operations, such as recycling and waste management. Miemczyk et al. (2012) however also identify a hinder in needing to include or assign greater parts to non-business actors 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.

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.

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 reduce 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 programs, 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 network 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 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 to be not only about exchanging information, but 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. For instance, through an in-depth case study Florence-Crespin and Dontenwill (2012) state that the forming of "cooperative ties" with non-business actors can be considered "*a key success factor to develop the firm's resources and legitimacy in sustainable development"* (ibid., p. 208). This suggests a 'widening' of the network needed for forming a sustainable supply chain, and the necessity of mutually identifying shared value with actors other than business.

ANALYSIS

In this literature study of how sustainability relates to interaction in supply 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 also to other values than purely economic and therefore requires operations and changes motivated also by other goals. In turn, this requires particular knowledge and practices, as well as relationships.

A first observation is that *the proposition that the network position of the firm should affect how it can engage in more sustainable business practices* is highly relevant; which types of

actors are identified as driving and/or hindering such developments is related to how it can influence or is influenced by its network. 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, such as more 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.

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 unfavorable 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 handling 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 firm or network. As such, they hold a

network position that is activated and enforced in relation to firms as these firms 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 realize the need for expertise in shaping that opinion themselves, as well as operations connected to this process.

We can thus conclude that the type of actors included in sustainable supply networks can be different from 'non-sustainable' supply networks (Kumar, 2006; Seuring & Müller, 2008 Florence-Crespin & Dontenwill, 2012). This means that firms need to interact with a different set of actors than 'normally' if they are to engage in more sustainable SCM practices. Consequently, there are several managerial challenges connected to achieving more sustainable supply networks.

A second observation is that *the proposition that sustainable innovations that fit into current technical and organizational structures are less costly and thus become more plausible to implement* also appear relevant, if however more implicitly; increased costs and uncertainty are identified as main hinders of achieving more sustainable supply networks. This applies both to implementing changes within the firm as well as in relation to the external network (e.g. Seuring & Müller, 2008; Walker et al., 2008; Giunipero et al., 2012). Direct and indirect costs are identified as creating reluctance towards trying to implement more sustainable practices, which should imply that the more encompassing the change, the greater the reluctance towards implementing it. In turn, changes that are less encompassing and appear to fit into existing operations might become more plausible. It is in relation to unknown costs and other uncertainties that the need for information- and knowledge exchange as well as knowledge development with relevant actors is particularly addressed. In order to learn if new solutions will fit into not only the internal resource- and activity structure of the firm, but also in relation to the other actors connected to that structure, learning from and teaching others become essential activities. There is also evidence that there is a clear connection between how the internal and external network of the firm is handled and sustainable supply chain management. It has been shown that firms that are highly 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 often also have efficient ways of doing this with their various collaborators. This shows that in relation to achieving sustainability in supply networks the internal and external business practices of the firms should be interconnected, and appears to strengthen the firm's network position. 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.

A third observation in 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). Thus, the proposition *that business relationships should have an important role to play in creating mutual or shared value from more sustainable business practices for several parties* is strikingly relevant. It has been indicated that 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**
Pure exchange - no relationship or exchange of knowledge	-	-	-
	Sustainable business practices cannot be shared in dyad or network		
Minor social exchange - repetitive exchanges, short time horizon, *single relationship*	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		
Technical exchange - short term or long term, *single relationship*, 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		
Cooperation - short term or long term, repetitive, *single relationship*	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		
Networking - long term, *involving third party -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 unfavorable for 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 identified 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's practices and can adapt these practices *collectively*. As sustainability by definition is about collectively realizing results that create benefits for several and different actors, in business and society in general, this appears as the most efficient way of achieving more sustainable supply networks.

CONCLUSIONS

This investigation of how the achievement of more sustainable supply networks is related to interaction between firms, as well as other actors, has shown that for several reasons the industrial network approach is a highly relevant perspective for learning more about sustainable business practices. Firstly, as stated in the introduction of this paper other extensive literature reviews have claimed a need for studies of sustainable supply chain management on the network level, as well as the relevance of the learning- and teaching processes between firms. Pursuing a deeper understanding of the network dynamics of implementing sustainable business practices is thus identified as both timely and relevant. Secondly, several barriers of achieving sustainable supply networks can be claimed to be consequences of a *low level of inter-organizational interaction*: lack of transparency and insufficient communication in the supply chain(s), lack of supplier commitment, the need for sharing increased risks and costs, etc. Correspondingly, several of the solutions presented to overcome these impediments are related to *increased interaction*: strategic alliances with business- and non-business actors, increased collaboration in several stages of the supply chain both upstream and downstream, etc. Thus, as a 'supply chain management problem' sustainability appears to force managers to think differently in terms of *whom* their firm is to interact with as well as *how*.

Furthermore, the three propositions developed from the basic understanding of what affects the possibilities of firms to act in an interactive business landscape suggest that, in the pursuit of more sustainable SCM practices, interaction matters in (at least) three important ways. Firstly, to act a driver of such practices, the ability of a firm to influence others in the network to change is critical. In this investigation, this ability has been shown to depend on the network position of the firm in relation to its size, connectedness to a multitude of relevant

others, as well as its capacity to cross-functionally integrate its internal operations with the external activities and resources of others. Also, other actors than firms can hold strong network positions in terms of being able to place pressure on others to change; NGOs, authorities etc. influence through policies, laws and certifications. Secondly, how well new and more sustainable business practices fit into current organizational and technical solutions appear to be crucial for the reduction of perceived risk, uncertainty and costs associated with pursuing sustainability. As with other types of innovation, changing existing ways of working to achieve increased sustainability creates uncertainties concerning direct and indirect costs as well as other risks. However, the newness and therefor lack of knowledge of achieving increased sustainability could be seen as raising the stakes to engage in such development, which enhances the need to minimize the scope of change. For this reason, connectedness between the internal and external operations of the firm becomes important as it could facilitate the process of identifying an appropriate fit between existing and new practices. Thirdly, and directly connected to the two other propositions, particular types of business relationships appear to play an essential role in the exchange and development of crucial resources and activities for more sustainable SCM practices. This is directly related to the central role assigned to information exchange and knowledge development that need to take place across organizational boundaries for the achievement of sustainable SCM. Both developing and maintaining sustainable SCM practices require thorough information about the products, processes and relationships of relevant others (suppliers, customers, and other collaborators), as well as knowledge of how to use that information to create mutual benefits in relation to those others. An efficient way of gaining such information and developing the knowledge of how to handle it is interaction through close and long-term business relationships, which means that trust is an important factor. In addition, learning and teaching in networks, i.e. through interrelated business relationships, is identified as a particular efficient way for firms to develop sustainable practices. This also includes working closely with other types of actors than business; NGOs and non-business actors are identified as important for gaining legitimacy for pursuing sustainable innovation as well as handling activities outside the firm' focal business areas and competences.

To further research the importance of network position, the fit between new and existing practices, and the role of business relationships for sustainable SCM we will conduct empirical research through survey type of studies as well as case studies. It appears that further empirical research on both firm and network level is needed to understand how interaction plays a role in the pursuit of more sustainable supply networks.

As a final word, another finding of this study 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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