Supply chain collaboration for sustainability

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Abstract

Corporations have recently started to acknowledge that they cannot tackle their social and environmental responsibilities alone. Concepts such as extended producer responsibility and life cycle assessment approaches have drawn attention to the product chain beyond immediate buyer-supplier interfaces. In fact, consumers and end users hold a corporation liable even for the actions of its suppliers. At the same time, approaches based on stakeholder theory and industrial ecology extend the boundaries of a sustainability network beyond the supply chain. Companies can employ different environmental strategies also within their supply chain. This paper proposes a framework of environmental strategies, and links this to alternative approaches in supply chain collaboration. From an environmental demand perspective, the focus is on the communication of expectations and demand for corporate environmental responsibility toward the corporation, and from the corporation to its suppliers. The paper concludes with guidelines for environmental supply chain management.

1. Raison d'être

"No business is an island". This could be the slogan of very diverse research areas from industrial ecology (Korhonen et al., 2004; Posch, 2004) to supply chain management (Lambert et al., 1998; Mentzer et al., 2001). Different theories have been designed to focus on the interactive nature of business with its environment, other businesses or organisations. Such are e.g. stakeholder theory (Friedman and Miles, 2004; Mitchell et al., 1997) and industrial network theory (Easton, 1992; Håkansson and Snehota, 1989). Governmental bodies even attempt to capture the responsibility of corporations beyond their ownership boundaries for their products and other actions in newer legislation (see OECD, 2001). And corporations are about to realise

that their customers hold them responsible for actions of their suppliers on various echelons in their supply chain (Lippman, 1999). But as trends towards outsourcing in a global environment prevail, managing suppliers becomes a challenge. After all, how many corporations even know the actors in their supply chain beyond immediate interfaces to first tier customers and suppliers? Thus it is not surprising that environmental management literature calls for attention to be paid to supply chain management, nor that supply chain management literature struggles with its environmental dimension (Gubi et al., 2003; Murphy and Poist, 2002; Skjøtt-Larsen, 2000).

The aim of this paper is thus, to increase the understanding for supply chain collaboration from an environmental strategy perspective, in order to propose a set of guidelines for environmental supply chain management. Thus the focus is on the ecological dimension of corporate social responsibility. The paper begins with an introduction to environmental supply chain management. The discussion then turns to the role of environmental demand in greening the supply chain. A portfolio of environmental strategies is presented next, and then linked to different supply chain collaboration strategies. Subsequently, different steps in environmental purchasing are discussed. The paper concludes with guidelines for environmental supply chain management.

2. Greening the supply chain

Outsourcing activities to corporations all around the world provides opportunities for ecologically sound or also unsound measures. Pollution scandals, such as oil spills of tankers flagged out to countries in which double- (or triple-) hull standards are unheard of, are usually highly publicised, but some positive examples of green supply chains have also found their way into literature, such as Bodyshop's supplier environmental assessment (Wycherley, 1999) or Akzo Nobel's eco-efficiency measures in their product chain (Cramer, 2000). Thus environmental supply chain management (ESCM) encompasses a variety of problems and examples. Handfield et al. (2005) classify this literature according to their topicalities of environmental risk management, environmental purchasing, product and process design for the environment, and environmentally friendly manufacturing practices. Other related topics are collaboration in environmental innovation (Geffen and Rothenberg, 2000) and reverse, or closed-loop supply chains (Guide and van Wassenhove, 2001; Rogers

and Tibben-Lembke, 2001; Stock, 1998). Generally, taking a systems perspective on environmental logistics (Wu and Dunn, 1995) enabled the development of the idea of green supply chains (van Hoek, 1999). Concluding, Sarkis (2001) views ESCM as the operationalisation of industrial ecology. Thus, ESCM encompasses the cradle-to-grave notion of life cycle assessment alongside the holistic view of industrial ecology. It is the more surprising that ESCM literature tends to focus on post-ownership issues such as extended producer responsibility (see Lamming and Hampson, 1996) or on assessing direct (i.e. first-tier) suppliers in the product chain (see Cramer, 2000; Wycherley, 1999) only. On the other hand, supply chains encompass material, information, capital and even energy flows in a variety of business processes across a network of firms on various levels. Thus, Lambert et al. (1998) distinguish between the structure, processes and management components in a supply chain. From a structural perspective, Mentzer et al. (2001) delineate different units of analysis: the direct supply chain, i.e. a focal company with its first tier customers and suppliers, the extended supply chain, i.e. from suppliers' suppliers to customers' customers, and the ultimate supply chain that follows a cradle-to-grave approach related to products and materials but also includes other non-manufacturing-related actors such as transportation or financial providers in the chain. From a procedural perspective, Lambert et al. (1998) (revisited in e.g. Lambert et al., 2005) list seven (later eight) business processes that span across various actors in the supply chain, and emphasise the interconnectedness of business functions within a corporation, and of business processes across corporations. Supply chain management is thus, an integrative function (Chen and Paulraj, 2004).

3. Environmental demand in the supply chain

The collaborative aspect of environmental supply chain management is manifested in the environmental demand of various stakeholders towards a focal company (see Cramer, 2000), as well as in environmental purchasing (Handfield et al., 2005). The tenor is to determine what stakeholders want and then take internal measures as well as supply-related choices in accordance with this demand. Environmental demand comes from many different stakeholder groups, customers, authorities, investors, industry associations, competitors, neighbourhood organisations, the media, employees etc. These groups can be grouped into internal and external stakeholders, or even further distinguished as coming from the input/output, regulatory or

competitive environment of the firm (Achrol et al., 1983; Carter and Ellram, 1998; Friedman and Miles, 2004).

Stakeholders from the *input/output environment* are essentially the supply chain of a corporation, comprising its most salient stakeholders (Williamson and Lynch-Wood, 2001). Due to their contractual binding to the corporation they are also seen as its necessary stakeholders (cf. Friedman and Miles, 2004). Customers are in fact seen as the most salient stakeholders of a corporation (Hall, 2001; Williamson and Lynch-Wood, 2001), and the foremost drivers of environmental demand (Carter and Jennings, 2004; Lewis and Harvey, 2001). According to Drumwight (1994), customers want more environmentally friendly products and pay attention to the environmental reputation of corporations. Lippman (1999) argues that customers don't even distinguish between the environmental performance of a focal company and its suppliers. Nonetheless, while the poor environmental reputation of an even n-tier supplier can have severe consequences for a focal company (see Williamson and Lynch-Wood, 2001), environmental purchasing measures are scarce (Green et al., 1996; Handfield et al., 2005; Preuss, 2005) and rarely extend beyond first tier suppliers. At the same time, consumers and even corporate customers tend to paint a better picture of themselves than their actual behaviour would reflect (see Hall, 2001). The combined impacts of consumer hypocrisy (or the social acceptability bias of corporate buyers) and the scarce measures of environmental purchasing lead to the proposition that **(P1)** the demand for environmental responsibility diminishes upstream in the supply chain.

In the *regulatory environment*, governmental legislation is most cited as a driver for environmental strategies (see Achrol et al., 1983). Following regulatory measures such as the requirements for extended producer responsibility, waste management or packaging directives in the EU is, however, a necessity for corporations operating there, and thus often regarded as a lower level of environmental responsibility (see Carter and Jennings, 2004; Carroll, 1979 and 1991). Nonetheless, following environmental legislation in some geographical areas can spill over to knowledge, and manufacturing practices in others. Thus even a very resistant adaptation to environmental legislation (see Handfield et al., 1997) can lead to global improvements in environmental performance. Furthermore, as regulatory measures often aim at specific industries, the second proposition of the paper is that **(P2)** the environmental strategy of a corporation depends on its industrial background.

The *competitive environment* contributes to environmental demand with voluntary agreements mainly. Such voluntary agreements are the sustainable forest certificates in the forestry and paper making industry (see FSC, 2005) or the Responsible Care programme in the chemical industry (see Prakash, 2000). However, after revising voluntary agreements for environmental policies in different industries, the OECD came to the conclusion that these approaches are generally designed to delimit the impacts of environmental legislation on the production costs of participating firms, and usually capture the status quo of an industry rather than setting more stringent environmental standards and targets (OECD, 2003). Therefore the proposition is that **(P3)** voluntary agreements are detrimental to the environmental performance of an industry.

4. Environmental supply chain strategies

Corporations employ different environmental strategies to respond to these demands. Drumwright (1994) distinguish between environmental converts and policy entrepreneuts; Handfield et al. (1997) discuss a scale of possible environmental strategies ranging from passive minimal adaptations to legislative requirements – in their terms resistant adaptations – to proactive, innovative strategies, or in the terms of Lamming and Hampson (1996), product stewards. Environmental strategies can be reactive (to legislative requirements), receptive (to customers' needs) or integrated in measures of product quality (Handfield et al., 1997). A minimal distinction is usually made between compliance versus innovative strategies (Geffen and Rothenberg, 2000; Hall, 2001) or reactive versus proactive approaches to corporate sustainability (Zsidisin and Siferd, 2001).

These strategies can be linked to environmental risks and profit contribution (Handfield et al., 2005; Seuring and Müller, 2005), not unlike supply chain strategies being linked to productivity and value advantages (Christopher, 2005; Porter and van der Linde, 1995) or efficient and responsive supply chains (Fisher, 1997). Similarly, Towill and Christopher (2002) distinguish between lean and agile towards even leagile supply chain strategies. According to these distinctions, corporations seeking a productivity advantage (Christopher, 2005) would strive for efficiency (Fisher, 1997) and leanness (Towill and Christopher, 2002), thus aim to minimise the costs of their operations. Corporations in the extremes of this category are those manufacturing functional, homogeneous products with predictable market demand (Fisher, 1997). On

the extreme other end, corporations need to differentiate their products and maximise the flexibility of their supply chains (Fisher, 1997). Leagile strategies propose a combination of product differentiation and supply chain flexibility with cost minimising approaches (Towill and Christopher, 2002). Thus competitiveness can be achieved through productivity advantages, differentiation in the marketplace, or both. Following this differentiation, four environmental strategies can be distinguished **(P4)**: the strategies of (I) resistant adaptation, (II) seeking eco-efficiency, (III) competing in environmental reputation, and (IV) eco-entrepreneurship (see Figure 1).

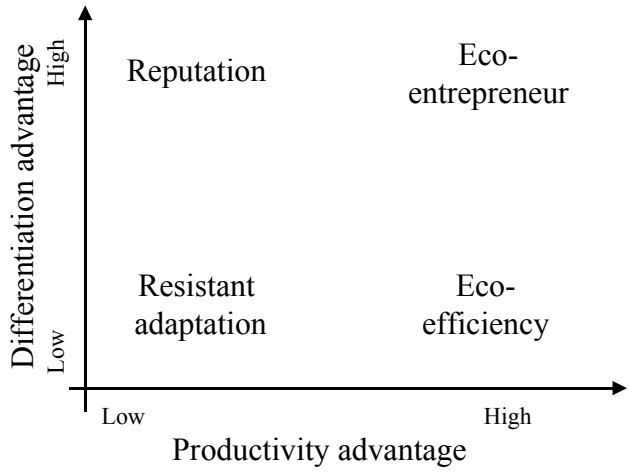

Figure 1: Environmental strategy portfolio

(I) Corporations with the environmental strategy of *resistant adaptation* do not see environmental policies as leading to any competitive advantage. They follow environmental legislation (Handfield et al., 1997) but do not engage in any activity beyond compliance, which Carter and Jennings (2004) describe as the lowest level on the scale of morality in corporate social responsibility. Therefore they are merely reactive in their environmental strategy, adapting in small, incremental steps to regulatory measures. Most of these measures are end-of-pipe solutions dealing with waste management or necessary take-backs of packaging (Lamming and Hampson, 1996). Even though these corporations do not actively minimise their costs nor differentiate their products and processes through environmental adaptations, it should be denoted that the stringency of environmental regulations depend on the industry they operate in. In other words, even corporations with a resistant adaptation-strategy may need to adhere to high environmental performance standards. (II) *Eco-efficiency*

strategies seek the minimisation of (environmental) costs. Reverse logistics literature often emphasises savings derived from material reuse or recycling (see Guide and van Wassenhove, 2001). Productivity advantages are achieved through the adoption of environmental technologies that minimise material and energy resources in the manufacturing process (Handfield et al., 1997; Porter and van der Linde, 1995). Thus the focus is on environmentally sound manufacturing processes, and process innovation. (III) Corporations seeking a positive environmental image, differentiate themselves in terms of their environmental *reputation* (Brown and Dacin, 1997). This differentiation in the marketplace (Lamming and Hampson, 1996) is driven by innovation and environmental product designs (Porter and van der Linde, 1995). The focus is on materials, and the product chain. (IV) *Eco-entrepreneurs* are the most proactive drivers of environmental strategy (cf. Handfield et al., 1997; Zsidisin and Siferd, 2001). More than mere respondents to environmental demand, they are first movers in setting standards and striving for higher environmental performance (see Drumwright, 1994) through both product and process innovations. As this eco-entrepreneurship is proactive and thus, internal-driven, the paper proposes that **(P5)** the environmental strategy of a corporation depends on its ownership structure.

Environmental strategies relate to both the products and the processes of a corporation (de Burgos Jiménez and Céspedes Lorente, 2001). Customers easily establish the link between a focal company and the actors in its product chain. These are the suppliers of raw materials, work in progress and finished items, which constitute parts of the final product of the company. Consequently, the material flows environmental management is concerned with are delimited to these suppliers, i.e. to the product chain (Heiskanen et al., 1998). At the same time, taking this perspective disregards process and technology suppliers that supply the machinery for manufacturing these products, as well as suppliers of other overhead-related items such as office supplies. In fact, process and technology suppliers are linked to cleaner production initiatives and ultimately impact on the (even environmental) quality of a product. Nonetheless, **(P6)** customers focus on the product chain only. This affects the criticality of technology versus product and material suppliers from an environmental responsibility perspective.

5. Supply chain collaboration

Portfolio approaches are abundant in supply chain management. However, while environmental management explains collaborative approaches as a function of stakeholder power (de Bakker and Nijhof, 2002; Friedman and Miles, 2004; Mitchell et al., 1997), supply chain collaboration is based on trust and commitment instead of power, control or dependence (Skjøtt-Larsen et al., 2003; van Donk and van der Vaart, 2005). Skjøtt-Larsen et al. (2003) even propose a portfolio for supply chain collaboration based on power versus trust-based relationships. Different approaches towards supply chain collaboration can be distinguished according to the depth and scope of collaboration. Short-term transactional relations in the supply chain are described as being based on power structures (van Donk and van der Vaart, 2005), encompass only few functionalities and a low amount and frequency of transactions, and focus on operational exchanges only (Skjøtt-Larsen et al., 2003). These transactional relations are often criticised for neglecting quality considerations (Lee-Mortimer, 1993) and pursuing sole cost minimising aims (Kaufman et al., 2000; Kumar and van Dissel, 1996). Moving towards more integrative and resource-dependent relations in a power-based environment will lead to vertical integration, thus an increased level of control over these operations (Kaufman et al., 2000), but to lower flexibility in the supply chain (cf. Skjøtt-Larsen et al., 2003). Supply chain collaboration as opposed to vertical integration is based on trust (Fynes et al., 2005; Kumar and van Dissel, 1996), and long-term relations (Boddy et al., 2000; van Donk and van der Vaart, 2005). Moving towards more integrative relations in a trust-based environment is argued to maintain the flexibility and responsiveness of the supply chain (Fisher et al., 1997).

Supply chain collaboration denotes the sharing of materials, information, capital, risks, technology and other resources. Materials can be shared in terms of reserving manufacturing capacities for particular customers (Xu and Yang, 2004) and redistributing responsibilities for operational functions such as material replenishment (Mishra and Raghunathan, 2004). Information sharing ranges from the availability of point-of-sales data, information about inventory levels, production and delivery schedules throughout the supply chain (Webster, 1995; Xu and Yang, 2004), sharing of information technology platforms (Kumar and van Dissel, 1996), to the arrangement of common product specifications in workshops (Lee-Mortimer, 1993) to the question of knowledge spill-overs (Kotabe et al., 2003) and even knowledge

creation in common R&D centres (Kaufman et al., 2000; Samaddar and Kadiyala, 2004). Kumar and Dissel (1996) discuss the possibility of pooling capital for common investments in e.g. information technology, and minimising the risks for supply chain uncertainties (Boddy et al., 2000) such as variations in replenishment times and quantities. Adaptations of supply chain actors to each other are seen as investments into these relations (Fynes et al., 2005). Other resources can be pooled in common engineering and manufacturing teams (Chatterjee et al., 2002; Kaufman et al., 2000). Supply chain collaboration can even affect the price-setting mechanisms and responsibilities in the chain (Mishra and Raghunathan, 2004). Generally, supply chain management emphasises the heterogeneity of firms and their capabilities, and their need of access to complementary resources (Boddy et al., 2000; Kumar and van Dissel, 1996; Xu and Yang, 2004).

The depth of supply chain collaboration increases with the volume and frequency of material and information exchanges and the employed co-ordination mechanisms (Carter and Jennings, 2004; Skjøtt-Larsen et al., 2003). Deeper collaboration implies the setting of joint objectives, relationships based on trust, relationship-specific investments and ultimately, the implementation of reward structures (cf. Skjøtt-Larsen et al., 2003). Thus deeper collaboration moves away from power- towards trust-based relations (cf. van Donk and van der Vaart, 2005). At the same time, the scope of supply chain collaboration is a measure of the business processes that have been aligned along the supply chain (Skjøtt-Larsen et al., 2003). The larger the scope of the collaboration in the supply chain, the more it also encompasses strategic planning activities.

It is important to note, however, that corporations don't employ the same supply chain strategy to all their customers and suppliers. Rather, just as stakeholder salience is dependent on various factors, e.g. their power, legitimacy and urgency (de Bakker and Nijhof, 2002; Mitchell et al., 1997), or necessity and contingency (Friedman and Miles, 2004), different suppliers are more or less critical to a focal company. According to Skjøtt-Larsen et al. (2003) increased supplier or customer dependence calls for more collaborative supply chain management. Supplier criticality can be seen as a function of supply risks and supply chain vulnerability (Boyd et al., 2005; Handfield et al., 2005; Lamming and Hampson, 1996; Seuring and Müller, 2005), i.e. the potential of a supplier to disrupt the operations of the focal company, or to affect its (environmental) reputation. As corporations with an efficient supply chain compete

in operational efficiencies (Christopher, 2005; Fisher, 1997; Towill and Christopher, 2002), they focus on minimising risks associated with operational disruptions. On the other hand, corporations competing in their environmental reputation will have to consider the reputational risks associated with their suppliers. Seuring and Müller (2005) suggest yet another portfolio of environmental supplier criticality, linking environmental risk avoidance productivity advantage, and the offering of environmentally friendly products to differentiation advantages (comp. Figure 1). This calls for an alignment of environmental strategies with supply chain strategies (see also Handfield et al., 2005).

6. Environmental purchasing

Purchasing spans the boundary between a firm's internal functions and the upstream actors in its supply chain (cf. Carter and Jennings, 2004). According to Handfield et al. (2005), environmental risks can be passed on through suppliers. Therefore different purchasing-related measures are associated with environmental supply chain management (ESCM). Lamming and Hampson (1996) discuss vendor assessment, total quality management, lean supply and collaborative supply strategies as different ESCM tools. Similarly, Green et al. (1996) tie most of their steps in green SCM to purchasing.

Environmental purchasing consists of measures related to supplier selection, supplier monitoring, and responses to non-compliance (Boyd et al., 2005; OECD, 2003; Preuss, 2005; Wycherley, 1999). Tools used for *environmental supplier selection* are corporate codes of conduct (Cerin, 2002), and environmental vendor selection criteria (Handfield et al., 2005; Noci, 1997). Fernholm and Fernström (2002) found that some companies – even if employing environmental strategies – abstain from publishing their corporate codes of conduct due to fears of being held liable for supplier actions. Similarly, employing environmental vendor selection criteria does not necessarily implicate their enforcement, nor their weights in actual supplier selection. Environmental vendor selection relates to both product and process-related measures. Preuss (2005) discusses the setting of environmental standards for raw materials and/or packaging materials as product-related measures of environmental purchasing, and the request for suppliers' environmental management systems as process-related measures. Following the proposition of customers neglecting process-related environmental issues in their environmental demand, the role of environmental

management systems in greening the supply chain is far from clear (Green et al., 1996).

Tools for vendor evaluation, ranging from (periodical) vendor evaluation criteria to supplier audits (Lamming and Hampson, 1996) are used in the *monitoring* phase. These relate to the operational environmental performance evaluation (de Burgos Jiménez and Céspedes Lorente, 2001; Handfield *et al.*, 2005) of suppliers. Periodical monitoring and supplier audits imply the need for supply chain collaboration (Green *et al.*, 1996; Lamming and Hampson, 1996). Collaborative approaches to environmental supply chain management are also needed in light of reverse material flows (Green *et al.*, 1996; Handfield *et al.*, 2005; Zsidisin and Siferd, 2001). Training suppliers to comply with demands for sustainability is discussed in relation with the implementation of environmental strategies (Carter, 2005; Handfield *et al.*, 2005; Seuring, 2004), or in relation with supplier *non-compliance*. Another option to deal with supplier non-compliance is switching suppliers. However, depending on switching cost (Donaldson, 1996) it is often neither easy nor desirable to switch critical suppliers (Seuring, 2004). Engaging in collaborative activities in the supply chain such as even the strategic use of reverse logistics capabilities are often discussed to increase switching costs (Rogers and Tibben-Lembke, 1998). Therefore this paper proposes a **(P8)** positive link between supply chain collaboration and the supplier switching costs.

7. Guidelines for environmental supply chain management

This paper calls for an alignment of environmental strategies with supply chain collaboration. Therefore it is important to determine the environmental demand a corporation faces on its environmental strategy. [1] Environmental demand can be derived from customers (Carter and Jennings, 2004; Lewis and Harvey, 2001), the regulatory environment (Handfield et al., 2005) and the competitive environment of the corporation (Prakash, 2000; OECD, 2003). Depending on the direction of this demand its nature and scope can be derived from stakeholder dialogues, customer surveys and legal documents, including legislation in preparation.

Corresponding to this environmental demand, the next step [2] is to determine the environmental strategy of a corporation. This strategy is directed internally as well as towards other actors in the supply chain. Alternative environmental strategies pursue mere resistant adaptation to environmental legislation (see Handfield et al., 1997),

seek productivity advantages and/or differentiate the products/services of the corporation on the market (Porter and van der Linde, 1995). Productivity advantages relate to the minimisation of resource use (Porter and van der Linde, 1995) through the adoption of environmental technologies (Handfield et al., 1997) and the use of secondary raw materials (Rogers and Tibben-Lembke, 1998). The potential use of secondary raw materials also calls for a selection of suppliers that can design products for disassembly. Resource efficiencies can also be achieved via transportation consolidation, thus minimising the unit costs of transportation. Furthermore the aim is to find suppliers that can design products. Seeking environmental productivity advantages in eco-efficiency strategies is aligned with homogeneous functional products in efficient supply chains (comp. Fisher, 1997). Differentiation advantages, on the other hand, aim to enhance the environmental reputation of the corporation. They can be achieved through product development and diversification, e.g. the creation of environmentally friendly product lines. Given top management support and an inner drive towards environmental friendliness (Drumwright, 1994), these approaches come together in the environmental strategy of eco-entrepreneurs.

As for determining the constraints on alternative environmental strategies, it is important to [3] determine the vulnerability of a corporation's supply chain. This encompasses a risk assessment in terms of operational and reputational risk factors related to different suppliers on various echelons in the supply chain. Operational risks also relate to technology suppliers, i.e. to machinery breakdowns, while reputational risks are bound to suppliers in the product chain. Suppliers can be grouped according to this risk assessment on different levels of supplier criticality.

For a first step within environmental purchasing, Boyd et al. (2005) suggest the [4] establishment of corporate codes of conduct. These are also internally binding and include a training and reward system for the purchasers in the corporation. It also determines the minimal environmental standards the corporation seeks to follow globally for each supplier, following their level of supplier criticality. These corporate codes of conduct need to be [5] communicated with suppliers. Explicit requirements as for the conduct of suppliers towards their suppliers help to roll out these codes of conduct on various echelons of the supply chain. The codes of conduct, however, not only need to establish environmental standards, but also their monitoring procedures, and contingency plans for non-compliance. Questions on monitoring procedures include the responsibility for monitoring (which actor is monitoring which other

actors in the supply chain), the scope of the monitoring and the communication procedures of results. Finally, [6] concurrent engineering suggests a periodical revisiting of the established environmental standards, and a feedback loop in this stepwise assessment of environmental supply chain management.

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