Sustainability and internal supply chain management –

A conceptual approach to intra-organisational knowledge transfer

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Abstract

This conceptual paper provides an analysis and discussion about intra-organisational knowledge transfer within sustainable supply chain management (SSCM). By adopting the perspective of the knowledge-based theory introduced by Grant (1996) the focus is on the transfer of SSCM associated information and knowledge between functional units. Apart from a characterisation of internal SSCM and cross-functional cooperation, appropriate mechanisms, related opportunities and risks as well as tools are discussed.

1 Introduction

Sustainable supply chain management (SSCM), understood as the linkage between supply chain management (SCM) and environmental, social, and economic issues, gains increasing interest in research and business (Carter & Rogers, 2008; Seuring & Müller, 2008; Sarkis et al., 2011). As an effect, today, sustainable supply chain management is considered as an established field of research (Seuring, 2011). Theoretical approaches refer, for instance, to different SSCM strategies (e.g. Halldórsson et al., 2009), a model of SSCM practices (e.g. Pagell & Wu, 2009), or internal and external relationships in SSCM (e.g. Harland, 1996; Lambert et al., 1998). Nevertheless, present research still addresses a need for further study, in particular, with regard to an advanced building of theory and a development of new concepts (Seuring 2011; Carter & Easton, 2011). Furthermore, research assumes (Pagell et al., 2010) that there is a potential shift from conventional SCM and purchasing to more sustainability-oriented efforts.

This shift can be a guiding concern for a companies' current and future procurement and supply management activities since the companies do not only have to deal with suppliers which are broadly spread across the globe and with significant complexity because of, for instance, cultural differences, (e.g. Carter et al., 1998; Cousins & Spekman, 2003; Moses & Åhlström, 2008). The companies also face risks and opportunities because of environmental and social requirements by stakeholders (Seuring & Müller, 2008; Halldórsson et al., 2009). On the one hand, boycotts and reputation damages are possible risks due to, for instance, poor working conditions at the suppliers and pressure from stakeholders such as customers, NGOs, or media (e.g. Teuscher et al., 2006; Beske et al., 2008, Walker et al., 2008). On the other hand, product and process innovations can be considered as opportunities in SSCM since they can be of use to respond to an increasing market demand for environmental friendly and

socially responsible products and services (Carter & Jennings, 2004; Seuring & Müller, 2008; Hansen et al., 2009; Seuring, 2011).

In this context, the supply chain perspective can be divided into two sections, first there are inter-organisational, *external supply chains* which comprise the upstream and downstream relationships from the source to the customer (Vachon & Klassen, 2006; Gold et al., 2010; Mentzer et al., 2001) as well as the materials, capital, and information flows (Seuring & Müller, 2008) between the different members of the supply chain (suppliers, focal company, retail, consumers, disposal/recycling). Second, the intra-organisational, *internal supply chains* encompass the flows of material and information (Håkansson & Persson, 2004) and the interaction between the different functional units within a company (Harland, 1996; Lambert et al., 1998; Seuring & Müller, 2008). Combining both supply chain perspectives implies that the functional units have to exchange sustainability relevant information to meet the external requirements of stakeholders (e.g. information about human rights compliance) or to comply with internal quests (e.g. reduction of negative environmental and social impacts of products and processes or an improvement of energy efficiency).

In order to enable this information and knowledge transfer and to address the above mentioned risks and opportunities, the purchasing department is not only involved in an ongoing dialogue with its suppliers but also with other functional units such as the environmental department, R&D, or marketing (Lambert et al., 1998; Seuring & Müller, 2008). Since the gathering, sharing, and transferring of sustainability related information and the application of the related knowledge is sometimes difficult because of competing aims of the different functional units (e.g. Grant, 1996; Alavi & Leidner, 2001; Moses & & Åhlström, 2008) the following question arises: *How do different mechanisms of knowledge transfer play a role in intra-organisational sharing of SSCM relevant information and knowledge?*

To answer this question the knowledge-based theory (Grant, 1996) is used in order to discuss the knowledge transfer between functional units in SSCM. Building on this, the present conceptual paper will concentrate on mechanisms as well as opportunities, risks, and tools which are related to intra-organisational knowledge transfer.

Although, as mentioned above, there is a considerable interest for SSCM and for new theoretical approaches from both the academic's and practitioner's side (Matos & Hall, 2007; Simpson et al., 2007; Reuter et al., 2010), the SSCM literature is limited with regard to a discussion about intra-organisational alignment from a theory-based perspectives (e.g. Gattiker & Carter, 2010). In order to help filling this gap and to investigate SSCM with the focus on cross-functional collaboration and knowledge transfer the knowledge-based theory (Grant, 1996) seems to be suitable. This theory emphasises the role and relevance of knowledge for a company – the "creating, storing, and applying knowledge" (Dyer & Nobeoka, 2000, p. 345) – to gain competitive advantage (Grant, 1996; Spender, 1996).

The paper is structured as follows. After this introduction, part two gives an overview on the background literature regarding sustainable supply chain management and cross-functional collaboration. Part three outlines the knowledge-based view with focus on intra-organisational aspects. In the subsequent section, a conceptual approach to cross-functional collaboration and knowledge transfer in intra-organisational SSCM is developed and discussed with regard to corresponding measurements. Finally, part five draws a conclusion and points out directions for future research.

2 Sustainable supply chain management and cross-function collaboration

As SSCM is already seen as an established field of research (Seuring, 2011) and cross-functional collaboration has been discussed since the 1980's (Takeuchi & Nonaka, 1986). In the following an overview of related literature and findings so far is given.

2.1 Sustainable supply chain management

SSCM can be understood as a further development of the conventional SCM – extended by the integration of the three (environmental, social, and economic) dimensions (Carter & Rogers, 2008; Seuring & Müller, 2008). SCM aims at "delivering enhanced customer service and economic value" (Mentzer et al., 2001, p. 15, with reference to La Londe, 1997). It is associated with the management of upstream and downstream flows of materials, capital, and information between the different members of the supply chain (Handfield & Nichols, 1999, p. 2; Mentzer et al., 2001). Therefore, external supply chain members such as the different suppliers (1st tier, 2nd tier, etc.), customers (e.g. wholesaler), consumers, and waste disposal respectively recycling companies as well as *internal* supply chain members have to exchange information. In this sense, internal supply chain members are the functional units which participate in the internal chain (e.g. purchasing, production, R&D, sales, and distribution; Harland, 1996; Lambert et al., 1998). First and foremost, the purchasing department and logistics which constitute an interface with suppliers play the central role in the management of supply chains (Cooper & Ellram, 1993).

With respect to different functional units, Moses and Åhlström (2008) demonstrate which information flows have to be considered in sourcing decision processes. Furthermore, they illustrate a multitude of dependency between the supply chain members. Since internal and external supply chain structures are characterised by a great number of combination possibilities of resources and supply chain members, these structures can be regarded as rather complex. Following this thought, the management of information and knowledge between the different supply chain partners is rather challenging in SSCM (Carter et al., 1998; Cousins & Spekman, 2003; Moses & Åhlström, 2008).

When the conventional SCM is extended to the environmental and social perspective, the notion *sustainable supply chain management* is used. SSCM can be defined as

> *"the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements. In sustainable supply chains, environmental and social criteria need to be fulfilled by the members to remain within the supply chain, while it is expected that competitiveness would be maintained through meeting customer needs and related economic criteria"* (Seuring & Müller, 2008, p. 1700).

According to this definition of SSCM companies have to manage *material, information, and capital flows* within their internal and external sustainable supply chains. This means that the various stakeholder requirements have to be taken into account and that the functional units are supposed to work jointly together in order to take the different disciplinary perspectives (Wagner, 2007). Such cross-functional cooperation (Hsu & Hu, 2008) demands a transfer of information and knowledge. According to Schaltegger and Burritt (2000, p. 404) such management of information can be understood as "the creation of purpose-oriented knowledge". For a better understanding of how and which information can be transferred between the functional silos key characteristics of cross-functional collaboration are displayed in the subsequent section.

2.2 Cross-functional collaboration in the context of SSCM

As previously described, SSCM is not just an issue which affects procurement but also other functional units such as marketing, PR, or production (Carter & Dresner, 2001; Sarkis et al., 2011). This phenomenon that several sustainability issues (such as waste reduction, health protection, or energy saving) can be relevant for more than just one functional unit is, in fact, in the nature of sustainability things since these often cover at least two of the three (environmental, social, and economic) aspects (Schaltegger et al., 2002, p. 6¸ Darnall et al., 2008). Energy saving, for instance, can be both, a matter addressed in purchasing and in production since products might have to purchased and processed to satisfy environmental requirements for energy efficiency.

Nevertheless, within a company every functional unit covers its own area of specialisation in order to contribute to the company's success by fulfilling particular tasks. The different specialisations and tasks are associated with different functional strategies and related qualifications (Moses & Åhlström, 2008). From the perspective of the knowledge-based view introduced by Grant (1996) specialisation is needed since

> "*bounded rationality is recognition that human brain has limited capacity to acquire, store and process knowledge. The result is that efficiency in knowledge production […] requires that individuals specialize in particular areas of knowledge*" (Grant, 1996, p. 112).

However, it has to be taken into account that specialisation creates a need for coordination between the functional silos and increases interdependencies between the units (Olson, 1995). Looking at the SSCM literature, some scholars underline that SSCM can be facilitated by cross-functional collaboration and they emphasise the want for unison work of the supply chain partners (Bowen et al., 2001; Gold et al., 2010). But, there is an indication that cross-functional collaboration sometimes is just a wishful thinking (Pagell, 2004) and barriers are identified (Carter & Dresner, 2001; Moses & Åhlström, 2008). These barriers internally or externally lower the potential of transferring (sustainability-oriented) information from one member of the supply chain to another.

Based on a case study approach, Moses and Åhlström (2008) identified several problems in cross-functional processes of sourcing decisions which can be associated with three main areas of problems, namely, *interdependency* between the functional units, *strategy complications*, and *functional goals which are not aligned*. *Table 1* gives an overview of the results obtained by Moses and Åhlström (2008).

Area of problems	Interdependency between the functional units	Strategy complications	Misaligned functional goals
Identified problems	- Lack of holistic view - Lack of system-support - Information dependency - Problems in design of decision processes - Ad hoc decisions	- Unclear strategies - Inconsistent data	- Functional imbalance - Forced path dependency - Timing of functional needs

Table 1: Problems in cross-functional processes of sourcing decisions (Moses & Åhlström, 2008).

In order to hurdle these barriers Moses and Åhlström (2008) recommend, for instance, that all functional goals should be strategically coordinated so that the purchasing strategy is in line with the sourcing decision processes and the overall strategy of the company. Regarding these sourcing decision processes, on the one hand, they also stress the necessity of updated information (Leenders et al., 2003; Pagell, 2004), on the other, the risk of information overload (Olson et al., 1995).

Therefore, it has to be assumed that the ’right’ management of information and knowledge seems to be crucial for a successful SSCM. A lack of knowledge might be an explanation for no or partial cross-functional integration (Pagell, 2004). For this reason the knowledge-based view is used to expose the potential of cross-functional collaboration. Moreover, the application of this theory-based approach presented in this paper is an attempt to help overcoming the mentioned challenges within sustainable supply chains (risk of a reputation loss, demand for environmental friendly and socially responsible products, etc.).

3 Knowledge-based view from a internal SSCM perspective

The importance of knowledge transfer is discussed in several intra-organisational (e.g. Gupta & Govindarajan, 2000; Moses & Åhlström, 2008; Gattiker & Carter, 2010), inter-organisational (e.g. Dyer & Nobeoka, 2000; Martinkenaite, 2011), or both (e.g. Cousins & Spekman, 2003; Van Wijk et al., 2008; Frazier, 2009) contexts of companies. Whereas information can be defined as purpose-oriented knowledge (Schaltegger & Burritt, 2000, p.

404), knowledge can be considered as “which is known” (Grant, 1996, p. 119). Although there are various definitions of knowledge and of associated concepts (e.g. for a typology of knowledge management, see Lavergne & Earl, 2006; Geisler, 2007) this paper principally refers to the understanding of knowledge provided in the Grant’s (1996) knowledge-based view. Hence, based on the resourced-based theory (Wernerfelt, 1984; Barney, 1991) *knowledge* is considered as very important strategically resource which can promise competitive advantage to the firm (Kogut & Zander, 1992; Grant, 1996; Gold et al., 2010).

With reference to the foundations of the theory Grant (1996, pp. 111–112) describes five characteristics of knowledge which are relevant for the application within a company:

- *Transferability*: The knowledge has to be transferrable with regard to time, space, and between individuals. For a more precise determination regarding *transferability* knowledge can be distinguished into the tacit and explicit one. *Tacit* knowledge – as the *knowing how* – is what implicitly exists through its application. Its transfer is uncertain and can be costly and slow (Kogut & Zander, 1992). *Explicit* knowledge, in contrast, can be regarded as the *knowing about*. Hence, regarding SSCM issues within a company, corresponding explicit knowledge can be transferred by communication between the different functional units.

- *Capacity for aggregation*: Knowledge can be transmitted, receipted, aggregated, and applied (e.g. Grant, 1996). However, the knowledge transfer is dependent on the recipient’s capacity to gain knowledge. If there is a common language this capacity is expanded. A company’s internal job rotation system, for instance, can be a possible way to increase a person’s capacity to acquire new knowledge. Job rotation can mean that a purchasing manager works in the sustainability department or in marketing and sales for some while. When he does so he will have the chance to better understand the tasks and

processes within the other functional units. Furthermore, he can become familiar with specific the language and culture in the other functional units (Turkulainen, 2008, p. 136).

- *Appropriability*: Regarding the appropriability of knowledge a distinction should be made between the already mentioned tacit and explicit knowledge. Whereas tacit knowledge cannot be appropriated, as it is stored within individuals, explicit knowledge might be acquired. As a consequence for cross-functional integration, Matos & Hall (2007) recommend that collaborative teams should use both, tacit and explicit knowledge, so that they cover "a diverse spectrum of skills and expertise" (Matos & Hall, 2007, p. 1097).

- *Specialisation in knowledge acquisition*: Individuals have limited capacities for acquisition, storage and processing knowledge. Hence, specialisation helps persons and organisations to manage profound knowledge. However, this specialisation requires the coordination between the different employees and functional units (Turkulainen, 2008, p. 58)

- *Knowledge requirements of production*: Finally, the knowledge transfer starts from "*the assumption that the critical input in production and primary source of value is knowledge*" (Grant, 1996, p. 112). This means that knowledge is a prerequisite for people to be productive and, for instance, is necessary to construct and operate a machine (Grant, 1996).

These five described characteristics of knowledge should to be taken into account when SSCM relevant information and knowledge are exchanged between the different members of the internal supply chain.

Knowledge within sustainable supply chains

Regarding sustainable supply chains, detailed information about environmental, social, and economic impacts and performance across the entire (external and internal) chain has to be

collected and processed (Foster & Green, 2000). This is due to the fact that external stakeholders such as customers or media are interested in product properties (e.g. product carbon footprint) or production conditions at the company's and supplier's sites (e.g. human rights compliance). As a consequence, the different functional units have to exchange corresponding information and knowledge (Foster & Green, 2000; Carter & Dresner, 2001). The purchasing department, for instance, requires environmental information from its suppliers (about e.g. left out hazardous substances), this information has to be submitted to the production department, and finally, sales and marketing can provide this information to the company's customers as a sales argument. Such typical information flow within a supply chain can be associated with the *product life cycle* perspective (Hayes & Wheelwright, 1979; Birou et al., 1998; Carter & Dresner, 2001). According to this perspective, several members of the internal and external supply chain are aligned so that there is a "greater cooperation across functional boundaries" (Birou et al., 1998, p. 37). This involves the requirement for transmitting, receiving, and applying knowledge within cross-functional cooperation. Although the two supply chain perspectives, namely, the external and internal one, are relevant for the investigation of knowledge transfer in SSCM, in this paper the focus is on the latter.

Transfer of knowledge in SSCM

In order to coordinate the transfer of knowledge, Grant (1996) points out that the differences between tacit and explicit knowledge (Nonaka, 1994) has to be considered. As a consequence, the more informal 'knowing how' and the rather formal 'knowing about' have to be merged so that the specialised knowledge of the different functional units can be integrated. Here, Grant (1996, p. 114–115) suggests four mechanisms, whereas the first three aim at reducing cost of communication and learning, the last one rather aims to rely on communication (*Table 2*).

Coordination mechanisms	Description
Rules and directives	These mechanisms present a standardised format of communication (Van de Ven et al., 1976). In the context of SSCM there exist, for instance, the European directives on hazardous substances in the electronics industry (Preuss, 2007) or in companies there are internal rules concerning purchasing restrictions to suppliers who exploit child labour (Koplin et al., 2007). Furthermore, rules can convert tacit knowledge in explicit one (Grant, 1996).
Sequencing	According to Thompson (1967, 2003) sequencing can be coordination by plans, meaning that knowledge and other issues such as capabilities and activities can develop gradually and dynamically (Helfat & Raubitschek, 2000). Regarding a logistical integration, for instance, production planning or inventory management could be measurements which affect energy consumption across the entire supply chain (Vachon & Klassen, 2007).
Routines	In comparison to the mechanism sequencing, routines can be understood as "simple sequences" (Grant, 1996, p. 115). They can differ greatly (Pentland & Rueter, 1994) and, within a company, they refer to coordination patterns and can be used for simultaneous activities (Hutchins, 1991, Alavi & Leidner, 2001). Examples are assessment or monitoring routines which help to evaluate the environmental performance within a company (Klassen & Vachon, 2003; Simpson et al., 2007).
Problem solving by groups and decision making	Since problem solving processes by groups are communication intensive they can be rather resource consuming (regarding time and capital). Thus, the building of cross-functional task force teams should focus on "unusual, complex, and important tasks" (Grant, 1996, p. 115) meaning, for instance, product development (Pagell, 2004) or crisis management (Hutchins, 1991).

Table 2: Mechanisms of knowledge transfer (Grant, 1996).

With reference to product development activities Pagell (2004) quotes that there are a considerable number of related studies which emphasise the importance of cross-functional team work (e.g. Wheelwright & Clark, 1992). Although Pagell (2004) expresses a need for internal cross-functional collaboration in such occasional tasks, he also stresses that repetitive tasks require other approaches. Such approaches, in turn, can be connected to Grant's first mentioned mechanisms, the rules and directives, sequencing, and routines.

Furthermore, apart from the mechanisms mentioned, Grant (1996) emphasis that the application of knowledge is rather important than the knowledge creation, meaning in the context of internal supply chains that the different functional units should transfer and apply their individual existing knowledge when they collaborate.

In the subsequent section, intra-organisational SSCM and potential measurements of knowledge transfer will be discussed.

4 Information and knowledge transfer in internal SSCM

Knowledge transfer and application within *internal structures* implies that SSCM relevant tacit and explicit knowledge can be shared and spread within the internal boundaries of the company. Activities such as using a common database (Sveiby, 2001), tools to improve interactive IT communication (e.g. intranet, wiki, etc.), or holding meetings on a regular basis can support such knowledge transfer and application. Furthermore, cross-functional collaboration can facilitate the transmission and receipt of information and knowledge. Since an internal structure is related to a manifoldness of economic, environmental, and social challenges and solutions the collaboration of different functional units is proposed (Sweet et al., 2003). The idea is to

> *"capture this system complexity by integrating information from different sources, and relating this information to the unique environmental and business contexts within which it arises"* (Sweet et al., 2003, p. 266; with reference to Roome, 1994, 1998).

Sveiby (2001) also emphasises the information and knowledge transfer with external stakeholders as well as the relevance of individual's competences for transferring the information in the company. Although, in a broader SSCM context, these aspects are reasonable to consider, in this paper the focus is on the internal supply chains so that the external and the individual perspective in SSCM are not discussed in detail. In the following the discussion will rather centre the transfer of information and knowledge in internal SSCM as well as measurements on how the transfer can take place.

4.1 Measurements to facilitate knowledge transfer in internal SSCM

The measures which facilitate knowledge transfer within internal SSCM can be structured in coordination mechanisms, measurements, opportunities, risks, and tools (*Table 3*). Whereas the categorisation of the coordination mechanisms is based on the work of Grant (1996) the reference to opportunities, risks, and tools mainly derives from the literature cited earlier (e.g. Alavi & Leidner, 2001; Moses & Åhlström, 2008, Gattiker & Carter, 2010).

Coordination mechanisms	Examples: Measurements	Opportunities	Risks	Tools
Rules and directives	Rule that information on energy consumption has to be recorded for every product manufactured	Ability to use the gathered information for various purposes in the functional units	Inconsistent data; information dependency	Checklist
Sequencing	Adding expert's information in a internal data base (open for every department)	Time and location independent access to SSCM data (such as environmental impact data)	Lack of system support (of IT)	Intranet, wiki
Routines	Holding daily meetings of several functions (specific to management level)	Developing a common understanding of goals and strategies	Functional imbalance	To Do list
Problem solving by groups and decision making	Setting up a task force group for internal supply chain improvements (e.g. waste reduction, health protection energy cost savings)	Necessary resources and knowledge can be shared by different functional units	Contrasting timing of functional needs	Internal workshop

Table 3: Measurements to facilitate internal knowledge transfer in sustainable supply chains.

Given the classification shown in *Table 3*, the four mechanisms can be discussed with regard to how SSCM relevant information and knowledge can be transferred between functional units. In order to relate these categories to practical application of knowledge they will be discussed by using appropriate examples.

Rules and directives

In cross-functional collaboration rules and directives can serve as coordination mechanisms which minimize communication (Grant, 1996). This can be useful if there is no or little need

for coordination. Internal rules, for instance, can refer to the requirement that the energy consumption and impact on the environment have to be recorded and assessed for every product which is manufactured and sold by the company. Once gathered, this information can be used by several functional units such as marketing and sales as a sales argument or the production department to assess energy efficiency and environmental compatibility of products and processes. Furthermore, purchasing and R&D can use the collected information as a basis for decision making when they plan to develop new products whose manufacture uses little energy and which are environment-friendly. However, it has to be taken into account that such a rule may lead to gathering inconsistent data since it might be difficult to assess the overall environmental impact of products and processes (Moses & Åhlström, 2008). Furthermore, there occurs the risk of information dependency since the data might be gathered by different functional units at different times (Moses & Åhlström, 2008). As a consequence, this shortcoming can lead to poor decisions on how products should be developed and manufactured. Therefore, in order to avoid such problems of inconsistent data and information dependency rules and directives for knowledge transfer should be clear. Checklists, for instance, can be of help to keep track of compliance with the rules and directives. In addition, Bowen et al. (2001, p. 177) suggest “detailed purchasing policies and procedures” to formulate guidelines how sustainability issues can be implemented in purchasing decisions. After rules and directives have once been set out they can be used with little communication effort.

Sequencing

Sequencing means that it is organised how different functional units can share their expertise on SSCM relevant issues. For instance, if a new product has to be assessed with regard to its environmental impact the different functional units such as purchasing, R&D, and production can transfer their specific knowledge into a data base. As some of this information is

dependent on background data from other departments this data collection can be organised sequentially, meaning that a work flow is generated. Tools such as intranet, wiki, or Enterprise Resource Planning (ERP) software can be beneficial to bring together all relevant information in a central database. Such a technical solution is advantageous with regard to a time and location independent access to SSCM data. Nevertheless, technical solutions have to fulfil different requirements such as offering data security, updated information, and accessibility (Alavi & Leidner, 2001). If the system would not be tailored to the company-specific requirements, miscalculation and inaccuracy of information could imply problems in knowledge sharing between the functional units (Moses & Åhlström, 2008).

Routines

Within internal SSCM structures routines can help to share knowledge between the various functional units. Routines such as brief daily meetings of employees from different departments can facilitate the transfer of up-to-date information. Here, routines can serve as coordination patterns where the emphasis is on basic information and on exchanging news between functional units such as purchasing, R&D, production, and the sustainability department. Although, some routines can be followed even without any need for internal communication (such as following an established procedure to assess the sustainable performance of a supplier; Alavi & Leidner, 2001), other routines such as regular meetings can help to develop a common understanding of goals and strategies of the other functional units. Since SSCM related activities such as the development of new products, the initiative for environmental projects, or the establishment of social and environmental standards (Pagell, 2004; Gattiker & Carter, 2007) require a common understanding of what is intended such frequent meetings are useful. However, routines can also bear the risk of functional imbalance, meaning that different departments pursue their own goals although they are aware of potential conflicts with other functional units. Furthermore, there can be an imbalance in

meetings when some departments have less headcount than others so that they may have less influence on the internal decisions (Moses & Åhlström, 2008).

Problem solving by groups and decision making

Product development, internal supply chain improvements, and crisis management are potential application areas of problem solving by groups and decision making processes (Hutchins, 1991; Grant, 1996; Pagell, 2004). Grant (1996, p. 115) cites "unusual, complex, and important tasks" as examples for problem solving by groups and decision making. The related processes refer to measurements which require the most coordination and interaction compared to the three activities explained above (Grant, 1996). However, it is worth mentioning that task force groups can generate and exchange SSCM relevant tacit and explicit knowledge. When cross-functional teams are constituted the team members can learn from each other's expertise and specialisation. Therefore, necessary knowledge and resources can be shared by the several functional units.

Company's internal workshops on processing information between functional units can be organised in order to better facilitate the team members to transfer and apply their knowledge. The team members can participate in the workshops together so that explicit and tacit knowledge is transferred. Although such internal workshops and intensive teamwork may offer a solid basis for a successful cross-functional collaboration in order to reach, for instance, internal supply chain improvements contrasting timing of functional needs might be a significant shortcoming (Moses & Åhlström, 2008). For instance, if different functional units aim at the same improvement, but with a different time horizon this may lead to an incomplete application of knowledge and a choice of the second best solution. Nevertheless, already at the very start of a cross-functional teamwork, the team members begin to transfer and apply knowledge. This knowledge acquisition can be seen as an individual lasting

achievement (Grant, 1996). This achievement, in turn, can be the basis for further knowledge transfer and application.

Based on the discussion of mechanisms to facilitate internal knowledge transfer, this conceptual paper offers potential implications. From a practitioner's perspective, the outcome of the discussion can provide suggestions concerning the role of cross-functional collaboration with regard to the transfer of SSCM relevant information and knowledge.

Knowledge-sharing

Whereas knowledge sharing routines with suppliers are seen as one potential source to gain competitive advantage (Dyer & Nobeoka, 2000) this sharing of knowledge can also be beneficial in the intra-organisational context. If the different functional units across the internal supply chain spread their know-how and experiences among each other they can improve their understanding for internal and external SSCM relevant information. Furthermore, they can learn to speak a 'common language' so that sustainability relevant information (about, for instance, the environmental impacts of products and processes, necessary information for cause-related marketing activities, or details about environmental and social standards) can be transferred more easily between the different functional units. Since "efficiency of knowledge aggregation is greatly enhanced when knowledge can be expressed in terms of common language" (Grant, 1996, p. 111) it is useful to take appropriate measurements. Such measurements are, for instance, holding brief daily meetings where individuals from different functional units come together or setting up a task force group for internal supply chain improvements. In addition, incentives systems can be an appropriate measurement with regard to collaboration since they can encourage the individual employees of the different departments to pursue one common goal (Pagell & Wu, 2006). Such reward systems might include remunerations (e.g. when waste reduction is achieved within the

company respectively the internal supply chain) or incentives when SSCM goals (e.g. establishing an environmental impact assessment system across the entire supply chain) are commonly reached by the different functional units.

Informal and formal communication

Cross-functional collaboration and knowledge transfer can occur in different ways of communication. Grant (1996) points out the difference between explicit and tacit knowledge: whereas *explicit* knowledge can be transferred by communication, tacit knowledge cannot. *Tacit* knowledge, in fact, is transferred via its application. As a consequence, practitioners should take this difference into account when they establish communication channels between the various functional units. Furthermore, informal and formal communication can be distinguished: informal communication, for instance, can be considered as an effective way to address problems in real time which occur in the different functional units; in contrast, formal communication such as reporting systems embedded in rules and directives can help to exchange information in a more structured way (Daft, 1995, p. 582; Pagell, 2004; Pagell & Wu, 2006). As a consequence, information and knowledge transfer might be communicated formally by means of coordination mechanisms, but informal communication is also necessary to cover all communication levels.

5 Conclusion and future research

This conceptual paper argues that cross-functional collaboration plays a substantial role in the intra-organisational transfer of SSCM relevant information and knowledge. The knowledge-based view is used to discuss different mechanisms, associated opportunities and risks as well as potential tools for the company's internal knowledge transfer and application. In the context of SSCM, there are various internal and external stakeholders whose requirements have to be considered. In addition, to better understand the implications regarding cross-

functional collaboration in SSCM, the differences between tacit and explicit knowledge as well as the distinction of formal and informal communication have to be taken into account.

However, this conceptual approach, like other research papers, also suffers from limitations. First, there are limits regarding the theoretical underpinning of the knowledge-based view. Knowledge cannot be common between all functional units (Grant, 1996). This involves the assumption that every employee has his or her individual background and it might be difficult to develop a similar understanding of what is relevant information in SSCM. Besides this, sustainability issues have a value-laden character which means that every individual will have his or her own perception of what sustainability and related knowledge include (Seelos, 2004; Linnenluecke et al., 2009).

Furthermore, since internal supply chains as well as external ones are rather complex, this paper's approach to discuss mechanisms as well as risks and opportunities of SSCM cannot cover all the specific aspects such all the different interdependencies between the functional units (e.g. Thompson, 1967, 2003; Moses & Åhlström, 2008), the relevance of external stakeholders and individual competencies (e.g. Sveiby, 2001), or the individual's ability to learn and acquire new knowledge (e.g. Teece et al., 1997; Dyer & Nobeoka, 2000). Besides this, it should be noted that sustainability is a rather complex construct itself (Seelos, 2004) which involves a great variety regarding environmental, social, and economic concerns and knowledge.

Therefore, in order to investigate more thoroughly the knowledge transfer and cross-functional collaboration in internal SSCM, future research could, in the first instance, focus on the unique characteristics of knowledge that is to be exchanged between the different functional units. Hence, the question can be put, what are similarities and differences of environmental, social, and economic related information in the internal and extern supply

chain? Furthermore, the transfer and application of knowledge might be influenced by the individual peculiarities of the transmitters and recipients. So it is worth asking, who, in particular, are these persons and organisations which exchange information and apply the knowledge? Another question is what are the goals and strategies of the various functional units in SSCM? In which structure and culture do they act? Based on the conceptual approach discussed in this paper a case study or an action research approach might be suitable to better understand the complex structures of knowledge application and its transfer between different functional units in SSCM.

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