

Core Issues in Sustainable Supply Chain Management – a Delphi Study

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ABSTRACT

Sustainable supply chain management has emerged as a growing topic, receiving increasing interest in the sustainability and supply chain management area. So far, the field is dominated by either case or survey based research. Few attempts have been made to take a broader look at the overarching issues, which form core topics of sustainable supply chain management. This paper presents the findings from a Delphi study where experts were asked to contribute their opinion. The Delphi study allows an aggregation of these opinions and extracts underlying topics in a structured manner. Four major topics were identified, which are (1) pressures and incentives for sustainable supply chain management, (2) identifying and measuring impacts on sustainable supply chain management, (3) supplier management (particularly addressing issues at the supplier–buyer interface) and (4) supply chain management (dealing with issues across all companies involved in the supply chain). The research presented contributes to substantiating and consolidating the field of sustainable supply chain management. Copyright © 2007 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

THE SCOPE OF OPERATIONS AND SUPPLY CHAIN MANAGEMENT HAS WIDENED IN RECENT YEARS. ONE PARTICULAR impact derives from overall demands for increasing transparency of corporate activities, captured in related terms such as sustainability management, corporate social responsibility or corporate governance. This has led to an increasing amount of research and in particular publications in the field. The related expansion of the field can also be seen in how first attempts are being put forward to summarize such research (still, such attempts are limited: Kleindorfer *et al.* (2005) just take one journal, *Production and Operations Management*, into account, while Seuring and Müller (2007) just look at related developments in German literature). Such papers aiming to reflect on the development of the field are thereby taking a wider perspective. Single papers are usually ‘confined’ to taking a specific research approach such as surveys or case studies. These two research methodologies dominate the field (Seuring, 2008). While this is, of course, useful to develop knowledge and theory, frequently

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one specific approach is followed or one specific problem addressed. This might include unethical working conditions or environmental problems as much as the introduction of green products. A particular approach that allows an aggregated look is offered by conducting an expert survey. Such an attempt is presented in this paper, which builds on a Delphi study conducted in 2006.

The paper aims to address the question of which major issues and problems experts report regarding sustainable supply chain management. Thereby, it also aims at identifying which specific issues have to be addressed in sustainable supply chain management.

After this introduction, relevant literature will be reviewed. Next, the research methodology as applied in the Delphi study will be outlined. The findings from the three polls of the Delphi study will be presented and discussed against the development of the overall field. In particular, comparing them with the literature reviews mentioned will help to conceptualize sustainable supply chain management. The findings will then be discussed, putting them into context and outlining future research.

A Brief View on the Current Status of Research

While earlier publications that address related topics can be found, the major stream of research on sustainable supply chain management started in about the mid-1990s. The papers of Drumwright (1994) on 'socially responsible organizational buying' and Murphy *et al.* (1994) on 'management of environmental problems in logistics' marked the wide range of aspects taken into account later on. Issues addressed could be grouped according to different criteria, based on whether they deal with supply chain management or with sustainability management.

On the supply chain side, this includes research driven by different subthemes. (1) Purchasing (Green *et al.*, 1996; Min and Galle, 2001; Zsidisin and Siferd, 2001) and supply management (Bowen *et al.*, 2001) form the basis towards what kind of additional criteria have to be taken into account. Bowen *et al.* (2001) distinguish between 'greening the supply process', where e.g. criteria for supplier selection are identified, and 'product based green supply' (see also Handfield *et al.*, 1997). The latter one aims to green the product itself, where frequently life-cycle assessment based criteria are taken into account (Lamming and Hampson, 1996; Pesonen, 2001; Seuring, 2004). Dyadic relationships (Carter, 2000) are therefore taken as the unit of analysis to assess the changes if a sustainability approach is taken. (2) The field of logistics has also contributed to this. A detailed literature review on environmental issues in logistics is presented by Abkhader and Jönson (2004). This list can be extended to include (3) operations (Kleindorfer *et al.*, 2005) and (4) supply chain management (Rao and Holt, 2005; Zhu *et al.*, 2005). The economic impact is addressed through e.g. decision making (Sarkis, 2003), cost management (Seuring, 2001) or performance management (Hervani *et al.*, 2005; Rao and Holt, 2005; Zhu *et al.*, 2005).

On the sustainability side, the evaluation involves addressing environmental (Lamming and Hampson, 1996; Preuss, 2005) and ethical (Carter, 2000; Davies and Crane, 2003; Roberts, 2003) or social (Drumwright, 1994; Carter, 2005) problems, but also related green product design (Wolters *et al.*, 1997; Baumann *et al.*, 2002). Particular contributions related to the use of environmental management systems (Darnall *et al.*, 2006) and how sustainability issues might be integrated into supply (chain) management (Koplin *et al.*, 2007). Recently, even the impact of cooperative supply chain environmental management (Vachon and Klassen, 2006; Sharfman *et al.*, 2007) has been studied.

While this list is rather eclectic, it illustrates the wide range of topics that influence sustainable supply chain management and have to be taken into account in related research. As the subsequently presented research is rather of an exploratory nature, it is hard to relate it to any particular existing line of previous research. Hence, such a pursuit is not undertaken here further.

Research Methodology

As mentioned, a Delphi study was chosen for the empirical part of the research. The Delphi method has been developed further since its 'invention' in the 1950s (Dalkey and Helmer, 1963) and has been applied to a wide range of issues. Limestone and Turoff (2002) define the term as follows: 'Delphi may be characterized as a method

for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this “structured communication” the following is provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgement or view; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses’. This definition comprises many of these characteristics, which are seen as a strength of the Delphi method when compared to other methods. Surveys, usually with anonymous feedback, imply that information can be collected only once. Feedback among participants is usually neither possible nor intended. Such feedback can also be accomplished in group discussions, which are conducted in the form of focus (i.e. people meeting in person) or panel groups, which is typical for a Delphi study (Flynn *et al.*, 1990). The major drawback of this personal meeting is that opinion leaders might dominate the discussion, thereby biasing results. Due to global distances an international study bringing different participants together would be rather unsuitable.

A further characteristic is the evaluation of the group opinion. For this purpose questionnaires can be used within the single polls of the Delphi study. One structured approach for a Delphi study has been outlined by Schmidt (1997), allowing a comprehensive description of the research.

Applicability of the Method for the Research Question

As mentioned, much of the research so far has addressed single questions. Hence, a wider research focus was chosen here, so a panel study of experts in the field seemed a valid choice. This allows expert opinion to be identified and even provides the opportunity for a structured feedback among the participants. A Delphi study was therefore seen as a good choice to assess the current comprehension of the field.

Selection of Experts

Okoli and Pawlowski (2004) provide a detailed discussion of the process of how experts can or should be selected, thereby aiming for a rigorous approach. The key point is to identify the kind of knowledge required for an expert entering the study. In this research project, three different sets of experts were selected: academic researchers, experts from non-governmental organizations and corporate sustainability managers. This is justified, as it was intended to achieve a wide range of interest groups and their respective opinions included in the research project.

Researchers were selected based on publications in the field. Here, a total of 37 persons were approached to take part in the study. Experts from non-governmental organizations were searched for through websites as well as personal contacts in the field. This method identified a total of 29 persons. Both groups comprised people from around the world, with more coming from Europe and North America.

Practitioners were approached in a different way. Here, the German branch (BAUM, historically the older, founding organization, which has been internationalized) of the International Network for Environmental Management (INEM) was contacted and asked to provide suitable persons for such a study. Larger companies were selected to make sure that international sourcing (and sales) activities form part of their business. A total of 73 environmental managers of German companies were selected. A higher number was deliberately chosen, as a lower response rate was to be expected, in particular from the practitioners. The focus on German practitioners only has to be taken into account in the study, as this might impact which issues are raised and how they are evaluated. Only people asking to be excluded from the study were removed from the mailing list for subsequent polls. The survey population was 124 and 118 persons for Rounds 2 and 3 respectively.

Number of Polls and Content of the Three Polls

Ideally, a Delphi study is supposed to continue until no further insights are gained, e.g. by receiving stable feedback as in the previous poll (Limestone and Turoff, 2002). In practical terms, it seems rather unlikely to have more than three polls in such a study. The content and outcome of the single rounds will be outlined in more detail below. Overall, the aim was to follow an ideal process of brainstorming, consolidation and evaluation (Häder, 2002; Okoli and Pawlowski, 2004).

The first round was started with an open question on what the most important topics, issues and problems in sustainable supply chain management are. The open answers given were evaluated using content analysis (Neuendorf, 2002) and condensed into four major themes with a total of 27 items that had to be evaluated. While the four themes were kept for the last poll, only a total of 11 items were selected for assessment. On each questionnaire, participants were given the opportunity to add additional comments.

Data Collection and Response Rate

The data collection was conducted in February, April and June 2006. The participants were not contacted before the first round, but were immediately sent the first question. After the questionnaire for each poll was sent out, a follow-up email was sent out in each case after about two weeks.

There were 46, 43 and 42 responses to the three polls, resulting in an average response rate of about 35%. The response rate might be explained by the fact that (1) for a Delphi study a larger population had been chosen and (2) no pre-contact had been made. Nearly half of the answers were derived from researchers, where 22 took part in all three rounds of the research (see Table 1). 37 respondents answered to all three rounds. This stability among respondents contributes to the validity of the research, as the same experts raised the particular issues in the first poll and evaluated then in the two subsequent rounds. As the response rate and the distribution of responses among the three groups indicate, there is some survey bias towards researchers. This will be taken into consideration when interpreting the results.

Data Analysis

The 46 feedbacks obtained in the first round were collected and then assessed for similarities. Building on content analysis, a first list of 19 single items was prepared. Discussing this list among the Delphi study team (see our acknowledgement at the end of the paper), four major topics were identified, as mentioned already. For Rounds 2 and 3, five point Likert scales were used to evaluate individual items. In Poll 2, the emphasis was more on assessing individual items raised by the participants, while the third round focussed on clarifying issues that seemed to be in contradiction to each other. Not all respondents completed all the questions in the second and third poll, reducing the number of useful answers. This will be taken into account when presenting mean values in subsequent sections.

Delphi studies inherently secure the construct validity, as the results of the preceding rounds are sent back to the experts for further assessment (Okoli and Pawlowski, 2004). Internal validity is ensured by applying content analysis and survey techniques for the data analysis. A further element is the discussion among the members of the research team, which also contributes to the internal validity. Reliability is achieved by documenting every process step and describing how the single rounds of the Delphi study build on each other.

Findings from the Three Polls of the Delphi Study

Round 1: List of Issues in Sustainable Supply Chain Management

As mentioned, Round 1 was based on the open question 'What do you consider to be the most important issues, problems or challenges for sustainable supply chain management?'. Respondents were asked to provide up to 10

Group (initial population)	Researchers	NGOs	Practitioners	Responses	Response rate
1st round (139)	23	9	14	46	33%
2nd round (124)	22	5	16	43	35%
3rd round (118)	22	6	14	42	36%

Table 1. Response rate across the participant groups and rounds

items. All answers were then collected and summarized looking at frequently mentioned issues. This resulted in an initial list of 19 items, which are listed in **Table 2**, where the frequencies are also given regarding how often a single item was mentioned. It is evident that the topics raised and their frequencies might be biased by the selection of experts involved in the study. One example is labour conditions, which is mentioned by six participants, only, while it is frequently discussed in related publications (Goldbach *et al.*, 2003; Roberts, 2003; Preuss, 2005).

No.	Description	Researchers (23)	NGOs (9)	Practitioners (14)	Total (46)
1	Identifying and measuring economical, social and environmental impacts and performances	14	1	4	19
2	Risk management	3	1	2	6
3	Aspects of vendor selection and global sourcing (balancing global and local sourcing; lack of standards in developing countries; logistics requirements)	9	2	9	20
4	Supplier integration in sustainability specializing towards SMEs (management control, motivating and developing suppliers)	7	3	9	19
5	Supply chain-wide cooperation and communication (cross-border information management; long-term contracts; providing confidence; generating common values)	12	5	6	23
6	Awareness of social and environmental responsibility; corporate social responsibility	4	1	2	7
7	Closed loop SCM; reverse logistics (product ownership; product take-back)	8	0	1	9
8	Development and implementation of international standards (e.g. ISO 14001)	7	4	3	14
9	Definition and common understanding of sustainability, SCM and SSCM	9	3	2	14
10	Monitoring the supply chain	7	5	4	16
11	View on extended SC; extending sustainability efforts beyond immediate interfaces; SC network; chain-wide process integration; product life-cycle	13	3	0	16
12	Policy for SSCM; legal, government support; cooperation between private and public sector; role of international institutions (e.g. EU, WTO)	7	2	3	12
13	Sustainable innovation	6	0	1	7
14	Lack of demand for sustainability e.g. because of higher prices for sustainable resources/products; need for marketing for sustainability	9	6	8	23
15	(Public) pressure of stakeholders; need for transparency (especially related to focal companies)	7	2	5	14
16	Labour conditions	2	2	2	6
17	Financial perspective in the SC: fair allocation of costs and benefits; realization of win-win-situations	6	4	2	12
18	Unawareness of the economical advantages of SSCM; lack of proactive initiatives	4	1	1	6
19	Need for continuous learning 'sustainability' of organizations with their management and different actors	7	1	3	11

Table 2. Aggregated items identified in the first round

Discussing the interrelation and possible further grouping of these items, four major headings were identified, which were then used for the second and third polls, which will be discussed in more detail in subsequent sections.

1. Pressures and incentives for sustainable supply chain management.
2. Identifying and measuring impacts on sustainable supply chain management.
3. Supplier management (particularly addressing issues at the supplier–buyer interface).
4. Supply chain management (issues across all companies involved in the supply chain).

Round 2: Evaluating Different Items

The four topics just mentioned formed the backbone for both the second and the third round. In the second round, among each of the four headings, between four and 12 individual items were listed, which were mainly formed out of the 19 initial items. One special aspect for this topic has to be mentioned. From the literature reviewed in the context of this research project, it was evident that there are more topics discussed in the field. Hence a few additional items were included in the list of topics to be evaluated.

The experts were asked to (1) rate their importance on a five-point Likert scale from not at all important (=1) to extremely important (=5). As the major indicator for comparing items, the mean will be subsequently used.

As a second measure, participants were asked to rank the single items. This allows a comparison of the individual judgements of the single items with a relative evaluation. Findings will be discussed on the four topics.

Pressures and Incentives for Sustainable Supply Chain Management

On this topic a major addition was seen as necessary for the item list. Customers as a central reference point for companies and their supply chains, which is frequently highlighted in related publications on supply chain management (Korpela *et al.*, 2001; Childerhouse *et al.*, 2002), were hardly mentioned in the experts statements of the first round. Hence, this was included in addition to government regulation and NGO pressure.

Interestingly, two dominating reasons were identified: the top score was reached by ‘lack of final customer demand for sustainable products and services’ (mean 4.12) closely followed by ‘government regulations’ (4.00) and ‘companies pro-actively developing sustainable products and markets’ (3.86). ‘Pressure from NGOs’ (3.72) and ‘political agenda setting’ (3.57) are seen as considerably less relevant, while both have been identified in previous literature as relevant (NGOs, Argenti, 2004; political agenda, Seuring and Müller, 2007). It seems a bit strange that government regulation and thereby legal pressure are still seen as top priorities, which in particular holds true for the responses from the companies. Many supply chains operate on a global basis, where local regulation might have only limited impacts. Researchers point towards the lack of customer demand and thereby a second driving force. It was surprising that the NGOs in particular do not see their pressure on companies as overly relevant, but place it last compared to all other items.

Identifying and Measuring Impacts on Sustainable Supply Chain Management

Under this heading, mainly the three dimensions of sustainability (economic, environmental and social) were assessed on how they impact supply chain management. A fourth item was formed by asking for the relevance of integration of the three sustainability dimensions. The economic dimension is seen as the most important one (4.45). It can be argued that, without economic success, no supply chain will exist in the long run. The other scores are much closer together, with the environmental (4.12) and social (3.95) dimensions reaching scores similar to the integration of the three dimensions (4.05). This was seen as a somehow unsatisfactory result, as no real differentiation among these items was found.

Supplier Management (Particularly Addressing Issues at the Supplier–Buyer Interface)

Supply and supplier management provided the top scorer under this heading, based on the score for ‘supplier selection including environmental and social criteria’ (4.44). This is also in line with ‘auditing and monitoring of suppliers’ (4.28), which closely followed. This can be identified as a priority, so that the integration of

environmental and social criteria into supply policies and processes forms a top priority for future corporate supply management (Koplin *et al.*, 2007). Here, the ‘certification of suppliers according to environmental and social standards’ (3.77) was also seen as helpful.

Supply Chain Management (Issues Across All Companies Involved in the Supply Chain)

This topic takes a look at more the overall supply chain than the individual supplier–customer interface. Most relevant is the ‘cooperation and communication between supply chain members’ (4.40), which contributes to a rather proactive approach. This is followed by ‘risk management across the supply chain’ (4.17), so that environmental and social problems are identified before they are exposed publicly, which might damage the brand reputation of the company. In this respect, the third most important item goes hand in hand with such an approach, as ‘the total life-cycle of the product has to be taken into account’ (4.02), thereby enabling sound environmental and social performance. A joint perspective on what has to be achieved in sustainability and sustainable supply chain management as well as learning and innovation are seen as secondary issues. Still, even the least important issue across all items in this round achieves a mean of 3.59. This can be seen as an indication that all items selected in the first round and condensed by the content analysis are relevant for sustainable supply chain management.

Round 3: Contrasting Explanations

The feedback of the second round was then used as input for the third round. As some of the aforementioned results had not been very clear, emphasis was placed on contrasting different explanations. This aimed at yielding additional insights into how different issues are weighted against each other by the participants. To give one example, the experts were asked to answer the question whether governmental regulation is more or less important than NGO pressure. Again, the four major topics are used to structure the discussion.

Pressures and Incentives for Sustainable Supply Chain Management

Regarding pressures and incentives, two major contradictions were found in Round 2. It remained open whether customer demand (=1) is more important than companies actively developing products and markets (=5). For this item, lack of customer demand was rephrased to better correspond with the contrasting explanations. Regarding market development and new product introduction, two opposing viewpoints are often that either customers demand drives the markets or that companies develop and introduce new products and services then taken up by customers. Hence, respondents were asked to compare these two approaches. Interestingly, the mean of 2.88 implies that both factors are seen as equally important. Here, comparing the three different groups yields significant differences. Practitioners (2.36, 14 answers) and also NGOs (2.67, six answers) rather tend to see an active role for companies, while researchers (3.27, 22 answers) see customer demand as more important. It is hard to put forward a specific reason for these differences. While it can be shown that companies see an active role for themselves, the reactive assessment of their behaviour by researchers is hard to explain.

Such differences among the three groups of participants continue into the comparison of government regulation (=1) versus pressure from NGOs (=5). The overall mean of 2.57, based on the same number of statements, leans somewhat towards government regulation being more important. In particular researchers (2.18) account for this result, while practitioners (2.86) see both issues as almost equal. It is no surprise that respondents from NGOs (3.33) see the biggest impact from their own role. The overall interpretation of this topic consolidates the existing writing. Efforts inside of companies have to match government regulation and customer demands, while also reacting to NGO pressure. Therefore, these forces can be identified as the most important pressures and incentives for sustainable supply chain management.

Identifying and Measuring Impacts on Sustainable Supply Chain Management

One remaining question within this topic was whether ‘reducing impacts or improving performance in the single dimensions of sustainability (social, ecological, economic) dominates over an integrated approach’ (1 = totally disagree to 5 = totally agree). A mean of 2.81 implies that there is a tendency towards this, but also acknowledges

Sustainability dimension		1	2	3	4	5		Sustainability dimension	Mean
Environmental	Trade-off	1	11	5	22	3	Win-win	Economic	3.36
Social	Trade-off	0	4	14	19	4	Win-win	Environmental	3.52
Economic	Trade-off	4	17	8	11	2	Win-win	Social	2.76

Table 3. Trade-off or win-win situations among the three dimensions of sustainability

the importance of integration. Further insights are provided by the second part of the question, where the three dimensions were evaluated on whether win-win or trade-off situations prevail between them (Table 3).

Table 3 provides the evaluation between pairs of the three dimensions with the numbers showing how many experts have chosen a certain value. As the table displays, all mean values are close to 3, which implies that there is no obvious relation among the single dimensions of sustainability. If at all, environmental and social issues seem to go hand in hand with the strongest tendency towards win-win situations as well as only minor differences among the three groups of participants. Economic and environmental issues are also seen as being in line with each other, while researchers are the most sceptical (3.18) about this (practitioners 3.50; NGOs 3.67).

Trade-offs seem to prevail between the economic and social dimension. Here NGOs clearly deviate (3.67) from the two other groups (researchers 2.56; practitioners 2.64), who dominate the overall result due to the higher number of responses from these groups. Recent research on corporate social responsibility issues in supply chains has highlighted related problems (Drumwright, 1994; Roberts, 2003; Carter, 2005). It remains open so far whether the positive relation between corporate social and financial (or economic) performance for companies that Orlitzky *et al.* (2003) found on the basis of a meta-analysis would also hold if a supply chain wide analysis were conducted.

The overall assessment of this topic implies that the integration of the three dimensions towards sustainable supply chain management needs to be assessed on a case by case basis. While this might be seen as 'nothing new', it also emphasizes that supply chain management has to integrate a wider set of objectives than just reaching economic performance. Competitiveness of supply chains has also to be reached including environmental and social performance of all companies involved. At first win-win(-win) measures might be easy to identify, but become more elusive as overall performance is improved (Wagner *et al.*, 2001).

Supplier Management (particularly addressing issues at the supplier-buyer interface)

In line with this analysis in the previous poll under this topic only one item was put for evaluation: 'Supplier selection, auditing and monitoring are far more important for improving sustainability performance than supplier integration and development.' Here, a mean of 2.76 was obtained, somewhat disagreeing with this assumption. The differences among the groups are revealing. Companies confirm this (2.29), researchers see the issues are neutral (2.95), while NGOs (3.17) tend slightly towards supplier auditing and monitoring. Consequently, sustainable supply chain performance would benefit from clear measures for suppliers on what they have to obey rather than their further development. This can be seen in line with critical assessments of supply chain integration, which questions how far this really might be found in corporate practice (Fawcett and Magnan, 2002; van der Vaart and van Donk, 2007).

Supply Chain Management (Issues Across All Companies Involved in the Supply Chain)

This topic was also assessed towards unresolved issues. The mean of 2.24 implies that a joint comprehension of the issues concerned is helpful for improving sustainability performance. This emphasizes cooperation and partnerships among the different actors of the supply chain.

The second question addressed was whether the forward stages of the supply chain are more important than closing the loop, which includes reverse logistics and remanufacturing. The results did not really confirm either side. The lifecycle of the product overall seems to be taken into account. More than any other group, the answers obtained from the researchers are spread out across the whole spectrum.

The second item put forward compares operational information flows in the supply chain with efforts toward improved cooperation and communication among supply chain members. Here, all groups (mean = 3.59) emphasize the importance of an overarching communication. This is particularly in line with examples of new product development and introduction that aim for sustainable products (de Bakker and Nijhof, 2002). As examples, Kogg (2003) and Goldbach *et al.* (2003) offer insight on how in specific supply chains cooperation among all members of the supply chain was required before such products could successfully be offered. In this respect, the Delphi study confirms such arguments as already brought forward in case studies. Seuring and Müller (2006) have even argued that this is one of the key issues differentiating sustainable supply chain management.

As the final item of assessment, corporate responsibility and risk management across the supply chain were contrasted. The mean of 3.07 overall (3.14 for researchers) does not lean to either side. NGOs (2.50) argue more for corporate responsibility, while practitioners (3.23) have a slight tendency towards risk management to avoid problems from environmental and social issues.

Discussion

The Delphi study presented in this paper extends previous research on sustainable supply chain management. Asking experts through the three polls provides a more aggregate picture of the research field. This leads to a number of interesting findings.

NGO pressure on focal companies is frequently mentioned as one major driver to trigger related corporate action (Argenti, 2004; Sharfman *et al.*, 2007). This is in clear contrast to the overall findings of this study, where companies acting according to market forces are presumed to be far more relevant. This holds for companies both proactively developing the market and reacting to customer demand. On the basis of this study no final conclusion can be drawn. Rather, future research would have to identify factors that really drive such engagement. Related case study research, as analysed by Seuring (2008), might place too much emphasis on companies that act as forerunners. This even holds for survey research, where despite the usual non-response bias test companies might report a more proactive role. Hence, this paper questions one frequently mentioned argument regarding the triggers of sustainable supply chain management.

A picture much more in line with publications in the field of sustainability management and sustainable supply chain management is derived regarding the question of whether trade-offs or win–win situations dominate. This debate seems to be carried across from assessing a single company to the overall supply chain. Different explanations have been given (Wagner *et al.*, 2001; Lankoski, 2007) in particular regarding the debate among the environmental and economic dimension. Yet, a meta-study compiled by Orlitzky *et al.* (2003) on the relation between corporate social and financial performance points towards a positive correlation. This also points to a limitation of the study, where a more detailed analysis is required to address how taking a supply chain perspective changes win–win and trade-off situations. Previous research in this respect often takes a very optimistic perspective, as win–win situations are predominantly reported (Seuring and Müller, 2006). The implication for business is to carefully assess the social impacts along the whole supply chain. Codes of conduct are widely discussed as a policy measure (Bondy, 2007) to reduce the risk associated with such sourcing and supply chain activities (Cousins *et al.*, 2004). This would imply that related measures need to be implemented without immediate direct benefits, but rather as a measure to ensure baseline performance (Koplin *et al.*, 2007).

For supply chain managers this study provides interesting insights on how their activities and supply chain processes will have to be developed further. A far more cooperative approach seems to be required (Sharfman *et al.*, 2007; Seuring and Müller, 2006) than is the case in traditional supply chains. This is clearly supported by the findings of this expert survey. Regarding supply and supply chain management, the statements and their evaluation among the experts is far more in line with previous research. The need for communication and integration with suppliers has already been argued for. It might be one of the typical ‘chicken-and-egg’ problems, where the more emphasis is placed on supplier development, the more win–win situations along the supply chain as well as regarding the environmental and social performance might be identified. Yet, understanding the conditions on when and how this is achieved is still an area in the infancy of its development.

A last note has to address policy implications for business and government. The role of codes of conduct for businesses has already been mentioned. There is a need to integrate such measures into the sustainability strategy of companies as well as their particular sourcing and supply chain related policies and processes (Koplin *et al.*, 2007). On the governmental side, e.g. multilateral trade agreements might be extended to include social norms. This might be a trigger and pressure for countries where such legal requirements either do not exist or are not enforced. Still, the role of local governments and their own sourcing policies for green and sustainable public procurement should not be understated (Preuss, 2007). Developing such initiatives further would improve the overall sustainability performance of supply chains.

Conclusion

The Delphi study presented deepens the understanding of a number of issues that are separately discussed in previous literature on sustainable supply chain management. Compared with surveys or case studies, which usually depart from a certain perspective, a much wider perspective was taken. Hence, an open question was chosen as a starting point, which was then developed into a set of issues. The methodological flexibility chosen in conducting the Delphi study might be seen as one of the shortcomings of the research. Yet, even the limited documentation of the research process given in this paper should provide insights on how validity and reliability of the process were ensured.

Against this background the paper makes the following contributions: First, it identifies four dimensions that can be used to structure the overall debate on sustainable supply chains: (1) pressures and incentives, (2) measuring impacts, (3) supplier management and (4) supply chain management. Second, these four dimensions were assessed toward single items, which help to comprehend them. In this respect the role of NGOs as a trigger for related activities is questioned, as it is seen to be of rather lower relevance. Contrasting different explanations, as has been done in the third poll of the Delphi study, revealed interesting insights on the evaluation of the different items. It is no surprise that many of these evaluations are in line with previous publications.

As one interesting outcome, respondents see win-win situations as more likely among the three dimensions of sustainability than trade-offs. This is in line with the finding that it is pro-active companies who are the ones developing sustainable products and supply chains; this development does not arise from customer demand. Yet, such a proactive approach should go hand in hand with supplier development and integration, while this is seen as less relevant than supplier monitoring meant to prevent environmental or social problems, which might damage the reputation of focal companies. The findings of the study form a starting point for further consolidation of research on sustainable supply chain management, which can also inform future empirical research.

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References

- Abukhader SM, Jönson G. 2004. Logistics and the Environment: Is it an Established Subject? *International Journal of Logistics: Research and Applications* 7(2): 17–149.
- Argenti PA. 2004. Collaborating with activists: how Starbucks works with NGOs. *California Management Review* 47(1): 91–116.
- Baumann H, Boons F, Bragd A. 2002. Mapping the green product development field: engineering, policy and business perspectives. *Journal of Cleaner Production* 10(5): 409–425.

- Bondy K. 2007. Evaluating the Potential Effectiveness of Codes: The Statement Strength Evaluation Method (SSEM). *Corporate Social Responsibility & Environmental Management* 14: 1–15.
- Bowen FE, Cousins PD, Lamming RC, Faruk AC. 2001. The role of supply management capabilities in green supply. *Production and Operations Management* 10(2): 174–189.
- Carter CR. 2000. Ethical issues in international buyer–supplier relationships: a dyadic examination. *Journal of Operations Management* 18(2): 191–208.
- Carter CR. 2005. Purchasing social responsibility and firm performance: the key mediating roles of organizational learning and supplier performance. *International Journal of Physical Distribution and Logistics Management* 35(3): 177–194.
- Childerhouse P, Aitken J, Towill D. 2002. Analysis and design of focused demand chains. *Journal of Operations Management* 20(6): 675–689.
- Cousins PD, Lamming RC, Bowen F. 2004. The role of risk in environment-related supplier initiatives. *International Journal of Operations and Production Management* 24(6): 554–565.
- Dalkey N, Helmer O. 1963. An experimental application of the Delphi method to the use of experts. *Management Science* 9(3): 458–467.
- Darnall N, Jolley J, Handfield R. 2006. Environmental management systems and green supply chain management: complements for sustainability? *Business Strategy and the Environment* in press. DOI: 10.1002/bse.557.
- Davies IA, Crane A. 2003. Ethical decision making in fair trade companies. *Journal of Business Ethics* 45: 79–92.
- de Burgos Jiménez J, Céspedes Lorente JJ. 2001. Environmental performance as an operations' objective. *International Journal of Operations and Production Management* 21(12): 1553–1572.
- de Bakker F, Nijhof A. 2002. Responsible chain management: a capability assessment framework. *Business Strategy and the Environment* 11(1): 63–75.
- Drumwright ME. 1994. Socially responsible organizational buying: environmental concern as a non-economic buying criterion. *Journal of Marketing* 58: 1–19.
- Fawcett SE, Magnan GM. 2002. The rhetoric and reality of supply chain integration. *International Journal of Physical Distribution and Logistics Management* 32(5): 339–361.
- Flynn BB, Sakakibara S, Schroeder R, Bates KA, Flynn EJ. 1990. Empirical research methods in operations management. *Journal of Operations Management* 9(2): 250–284.
- Goldbach M, Seuring S, Back S. 2003. Coordinating sustainable cotton chains for the mass market – the case of the German mail order business OTTO. *Greener Management International* 43: 65–78.
- Green K, Morten B, New S. 1996. Purchasing and environmental management: interactions, policies and opportunities. *Business Strategy and the Environment* 5(3): 188–197.
- Häder M. 2002. *Delphi-Befragungen*. Westdeutscher: Wiesbaden.
- Handfield R, Sroufe R, Walton S. 2005. Integrating environmental management and supply chain strategies. *Business Strategy and the Environment* 14(1): 1–19.
- Handfield RB, Walton SV, Seegers LK, Melnyk SA. 1997. 'Green' value chain practices in the furniture industry. *Journal of Operations Management* 15(4): 293–315.
- Hervani AA, Helms MM, Sarkis J. 2005. Performance measurement for green supply chain management. *Benchmarking: an International Journal* 12(4): 330–353.
- Kleindorfer PR, Singhal K, Van Wassenhove LN. 2005. Sustainable operations management. *Production and Operations Management* 14(4): 482–492.
- Kogg B. 2003. Greening a cotton-textile supply chain: a case study of the transition towards organic production without a powerful focal company. *Greener Management International* 43: 53–64.
- Koplin J, Seuring S, Mesterharm M. 2007. Incorporating sustainability into supply policies and supply processes in the automotive industry – the case of Volkswagen. *Journal of Cleaner Production* 15(11): 1053–1062.
- Korpela J, Lehmusvaara A, Tuominen M. 2001. Customer service based design of the supply chain. *International Journal of Production Economics* 69(2): 193–204.
- Lamming RC, Hampson JP. 1996. The Environment as a Supply Chain Management Issue. *British Journal of Management* 7(Special Issue): 45–62.
- Lankoski L. 2007. Corporate responsibility activities and economic performance: a theory of why and how they are connected. *Business Strategy and the Environment* in press. DOI: 10.1002/bse.582.
- Linstone HA, Turoff M (eds). 2002. *The Delphi Method: Techniques and Applications*, online edition of the original published by Addison-Wesley, Reading, MA, 1975.
- Min H, Galle WP. 2001. Green purchasing practices of US firms. *International Journal of Operations and Production Management* 21(9): 1222–1238.
- Murphy PR, Poist RF, Braunschweig CD. 1994. Management of environmental issues in logistics: current status and future potential. *Transportation Journal* 34(1): 48–56.
- Neuendorf KA. 2002. *The Content Analysis Guidebook*. Sage: Thousand Oaks, CA.
- Okoli C, Pawlowski SD. 2004. The Delphi method as a research tool: an example, design considerations and applications. *Information and Management* 42(1): 15–29.
- Orlitzky M, Schmidt FL, Rynes SL. 2003. Corporate social and financial performance: a meta-analysis. *Organisation Studies* 24(3): 403–441.
- Pesonen H-L. 2001. Environmental management of value chains. *Greener Management International* 33: 45–58.

- Preuss L. 2005. Rhetoric and reality of corporate greening: a view from the supply chain management function. *Business Strategy and the Environment* 14(2): 123–139.
- Preuss L. 2007. Buying into our future: sustainability initiatives in local government procurement. *Business Strategy and the Environment* 16(5): 354–365.
- Rao P, Holt D. 2005. Do green supply chains lead to competitiveness and economic performance? *International Journal of Operations and Production Management* 25(9): 898–916.
- Roberts S. 2003. Supply chain specific? Understanding the patchy success of ethical sourcing initiatives. *Journal of Business Ethics* 44(2): 159–170.
- Sarkis J. 2003. A strategic decision framework for green supply chain management. *Journal of Cleaner Production* 11(4): 397–409.
- Schmidt RC. 1997. Managing Delphi surveys using nonparametric statistical techniques. *Decision Sciences* 28(3): 763–774.
- Seuring S. 2001. Green supply chain costing – joint cost management in the polyester linings supply chain. *Greener Management International* 33: 71–80.
- Seuring S. 2004. Industrial ecology, life-cycles, supply chains – differences and interrelations. *Business Strategy and the Environment* 13(5): 306–319.
- Seuring S. 2008. Assessing the rigor of case study research in supply chain management. *Supply Chain Management – an International Journal* in press.
- Seuring S, Müller M. 2006. Zum Entwicklungsstand des nachhaltigen Managements von Wertschöpfungsketten [The current status of sustainable supply chain management]. *Umweltwirtschaftsforum*. 14(3): 5–9.
- Seuring S, Müller M. 2007. Integrated chain management in Germany – identifying schools of thought based on a literature review. *Journal of Cleaner Production* 15(7): 699–710.
- Sharfman MP, Shaft TM, Anex Jr RP. 2007. The road to cooperative supply-chain environmental management: trust and uncertainty among pro-active firms. *Business Strategy and the Environment* in press. DOI: 10.1002/bse.580.
- Vachon S, Klassen RD. 2006. Extending green practices across the supply chain – the impact of upstream and downstream integration. *International Journal of Operations and Production Management* 26(7): 795–821.
- Van der Vaart T, van Donk DP. 2007. A critical review of survey-based research in supply chain integration. *International Journal of Production Economics* preprint. DOI: 10.1016/j.ijpe.2006.10.011.
- Wagner M, Schaltegger S, Wehrmeyer W. 2001. The relationship between the environmental and economic performance of firms: what does theory propose and what does empirical evidence tell us? *Greener Management International* 34: 95–108.
- Zhu Q, Sarkis J, Geng Y. 2005. Green supply chain management in China: pressures, practices and performance. *International Journal of Operations and Production Management* 25(5): 449–468.
- Zsidosin GA, Siferd SP. 2001. Environmental purchasing: a framework for theory development. *European Journal of Purchasing and Supply Management* 7(1): 61–73.