

A Systematic Review of Sustainable Supply Chain Management Research

What is there and what is missing?

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1 Introduction

In recent years the topic of Sustainable Supply Chain Management (sSCM) has received growing attention and has become an increasingly popular research area. Today, companies must tackle multiple new challenges: they have to address the problem of rapid climate changes, face the negative impact of the financial crisis and the prices, deal with the growing public interest in ecology (e.g. Green Logistics, Green Computing), and ensure environmental sustainability and energy efficiency. Immense pressure is also exerted by environmental legislation (e.g. EU law) as well as by the mass media and society as a whole, considering consumers' growing demand for transparency and their increasing awareness of the conditions under which products are manufactured and distributed (e.g. with regard to environment, safety, and human rights).

The objective of this paper is to determine the state of the art in sSCM research by using the research method of a systematic literature review. We will also give an outlook on future research that is based on the results of the review.

2 Sustainable Supply Chain Management: A Classification and Conceptualization of the Topic

Sustainable Supply Chain Management has its roots in supply chain management, i.e. it is based on the adoption and extension of its concepts. Harland defines supply chain management as “*the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers*” (Harland 1996, p. 64). In a second step, the concept of supply chain management can be extended by adding the aspect of sustainability. Sustainability refers to an integration of social, environmental, and economic issues (Carter and Rogers 2008, p. 361). Shrivastava defines sustainability as “*the potential for reducing long-term risks*

associated with resource depletion, fluctuations in energy costs, product liabilities, and pollution and waste management” (Shrivastava 1995, p. 955). Here, sustainability is looked at from a more ecological angle without explicit consideration of social aspects. In contrast, Sikdar takes a “macro-viewpoint” that includes social, environmental, and economic aspects. According to him, sustainability is “a wise balance among economic development, environmental stewardship, and social equity” (Sikdar 2003, p. 1928).

With regard to a macro-viewpoint on supply chains and in order to achieve the balance between the environmental, social and economic dimensions (idea of the “triple bottom line” developed by Elkington (2004)) we will follow Carter and Rogers who define Sustainable Supply Chain Management (sSCM) as the strategic achievement and integration of an organization’s social, environmental, and economic goals through the systemic coordination of key inter-organizational business processes to improve the long-term economic performance of the individual company and its value network. (Carter and Rogers 2008, p. 368).

Figure 1 illustrates the problem area and the scope of sSCM (“House of Sustainable Supply Chain Management”). The house is built on the triple-bottom line (Carter and Rogers 2008, p. 369, Elkington 2004). The three dimensions of sustainability are visualized here as pillars which are necessary to keep the building in balance. Risk and compliance management forms the building’s foundation. In order to achieve long-term profits, risks have to be identified and mitigated. Laws, guidelines and standards serve as a starting point for the implementation of sustainability principles and practices along the supply chain.

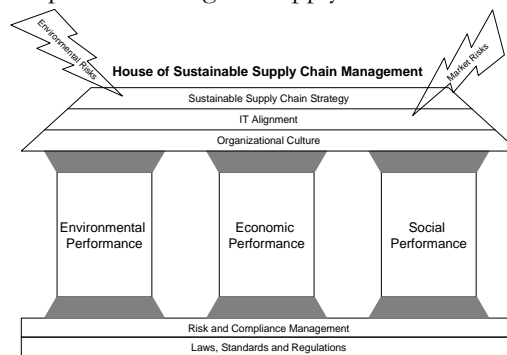


Figure 1: House of sSCM

In addition, sSCM requires the establishment of values and ethics throughout the organization, an efficient, flexible and “green” IT environment as well as the alignment of corporate strategy to sustainable development. If these measures are taken, they effectively protect the network against environmental and social threats and risks.

3 Research Methodology and Framework of Analysis

3.1 Systematic Literature Review and Analyzed Articles

Considering the increasing number of books, journals, conferences and workshops, the systematic literature review has become an indispensable method (Fettke 2006, p. 257). In a systematic literature review relevant work and current findings are analyzed with regard to a particular research question.

In line with Dibbern et al. (2004, p. 13), we use an analytical framework to analyze articles that deal with sSCM. Generally, frameworks are designed to describe the structure of a set of objects within a given domain and the relationships among those objects. This can be especially useful in order to clearly delineate the domain, organize knowledge and highlight opportunities for more specific theory development. Table 1 shows the framework of analysis applied in this paper.

Table 1: Framework of Analysis (cf. Dibbern et al. 2004)

| Phase | Stages | Research Question/Content | Section |
|---------------------------|-----------------|--|---------|
| Motivation | 1. Why? | Why sSCM? | 4.1 |
| Scope and Applied Methods | 2. What? | What are the existing research perspectives on sSCM? | 4.2 |
| | 3. How? | Which research methods are applied in sSCM literature? | 4.3 |
| Evaluation | 4. Outcome | Unsolved research problems | 4.4 |
| | 5. Implications | Trends in sSCM and implications for future research | 5 |

The limitations of a systematic literature review lie in the paper selection process. However, we tried to minimize this risk by following a proven course of action for the creation of a literature review (Swanson and Ramiller 1993, Fettke 2006, Webster and Watson 2002). The restriction of the source material to high-quality articles leads to reliable results about the state of the art in sSCM research.

Figure 2 illustrates the individual steps of our research process.

We conducted our five-step review as follows (Fettke 2006, p. 260):

1. Definition of Review Scope: The subject matter of our review has already been outlined in section 2 of this paper.

2. Conceptualization of Research Topic: The concept of Sustainable Supply Chain Management has also been explained in section 2.

3. Literature Search and Selection: A systematic analysis of nine high-quality journals was conducted. The oldest articles that were included date back to the year 1995. Since a single review cannot identify or analyze the entirety of existing literature on a research area, the research scope must necessarily be limited in order to identify the high-quality research papers.

The “House of sSCM” model implies that sSCM is not restricted to the control of networks, but also applies to IT management, risk management, environmental and compliance management. Therefore, in addition to four top supply chain management journals, the following journals from related fields were examined: “Management Information Systems Quarterly”, “Journal of Business Engineering”, “Ecological Economics”, “Zeitschrift für Umweltpolitik und -recht”, “Journal of Risk” and “Journal of Risk and Uncertainty”. Table 2 shows the se-

lected journals and how they have been evaluated in renowned international rankings. It becomes obvious from the table that only high-quality journals have been taken into account.

The search for relevant articles was conducted as follows: in a first step, a matching list of pre-defined key words was applied to the search engine of each journal or to publisher-independent journal data bases like EBSCO (Business Source Complete, EconLit (full text) or Science Direct. The following key words were used in order to achieve comprehensive search results: Sustainable Supply Chain Management, Supply Chain Management, Sustainable Management, Risk Management, Compliance, Governance, Material Flow Management, Recycling, and Recycling Networks. The inclusion of many synonyms and/or semantically very similar expressions led to more exhaustive search results. The overall results were first saved in a list. In a second step, each article was then checked for its relevance to the topic of sSCM by reading the respective abstract and introduction. A PDF document that includes a comprehensive list of all 142 analyzed articles is available at the following address: www.uwi.uos.de/sscm_references.pdf

4. Literature Analysis and Synthesis: During this phase the main research areas, research methods, trends, main focuses and problem fields in sSCM were analyzed by means of a systematic literature review of the identified papers of relevance. To improve the quality of the analyses, both authors of this paper were involved in reviewing and coding the analyzed articles. The inter-rater reliability was good (inter-rater percentage agreement: > 92 % in all analyses).

Table 2: Journal Selection (cf. Harzing 2009)

| | Cranfield University School of Management 2009 | British Association of Business Schools (ABS) Ranking 2009 | Wirtschaftsuniversität Wien 2008 | VHB Ranking 2008 | Centre National de la Recherche Scientifique 2008 | Australian Business Deans Council 2008 | Aston University 2008 | University of Queensland 2007 | Erasmus Research Institute of Management Journals Listing 2006 | WKWI 2008 |
|--|--|--|----------------------------------|------------------|---|--|--------------------------------|-------------------------------|--|-----------|
| MISQ | 4 (world leading) | 4 (top journal) | A+ (top journal) | A | 1 (intermediate) | A+ (best) | 4 (world leading) | 1 (highest quality) | STAR (top) | A (top) |
| Wirtschaftsinformatik | | | | | | | | | | A |
| Zeitschrift für Umweltpolitik und -recht | | | A (distributed worldwide) | A | | | | | | |
| Ecological Economics | 3 (top international) | 3 (highly regarded journal) | A | B | 1 | A (highly regarded) | | 3 (intermediate quality) | | |
| Int. J. of Phys. Distribution & Logistics Management | 3 | 1 (recognized journal) | A | B | 4 (lowest quality) | C (recognized journal) | 1 (recognized nationally) | 3 | S (recognized academic reputation) | |
| Int. J. of Logistics Management | 3 | 2 (lower international) | A | D | 3 | B (well regarded) | 1 | 3 | S | |
| N. Research Logistics | | 3 | A | B | 3 (intermediate) | B | | | S | |
| Journal of SCM | 1 (national) | 1 | | B | 3 | B | | 3 | S | |
| Journal of Business Logistics | 3 | 2 (well regarded journal) | | B | | B | 2 (recognized internationally) | 3 | S | |
| Journal of Risk | | | A | B | | | | | | |
| Journal of Risk and Uncertainty | 2 (lower international) | 4 | A | B | 2 (intermediate quality) | A+ | 3 (excellent) | 2 (intermediate quality) | S | |

5. Research Agenda: The results were interpreted and research trends were derived from them. Also, consequences for future research as well as elements of a research agenda were outlined (cf. section 5).

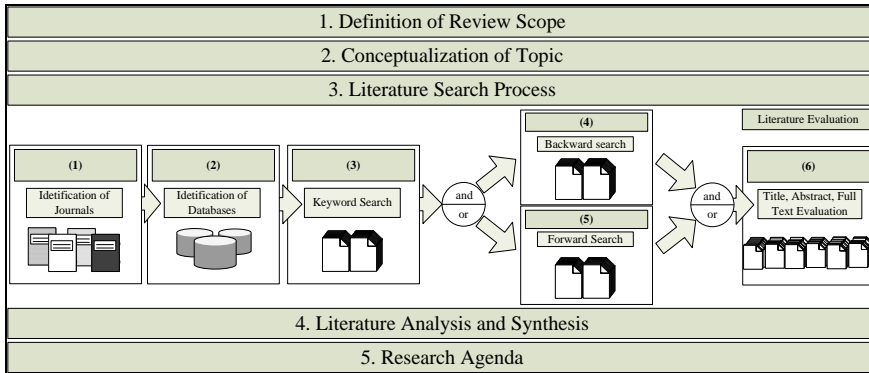


Figure 2: Research Process (vom Brocke et al. 2009, Webster and Watson 2002.)

3.2 Related Work

In order to determine the research status it is necessary to evaluate former research about sSCM. Therefore, existing publications dealing with similar problems were taken into consideration (cf. Table 3).

In total, the authors found 6 different review articles dealing with Supply Chain (Risk) Management and Sustainable Supply Chain Management. Table 3 categorizes all reviews in chronological order and summarizes their research objectives, review methods and results. Our systematic literature review differs from the other 5 identified review articles (cf. Table 3) in some important respects: first of all, only papers from high-quality journals were analyzed. We also conducted a specific analysis of the current research status. In particular, we categorized and analyzed risk management articles on sSCM. Also, our review covers articles about laws, guidelines, methods and standards in sSCM. Additionally, we provide a survey of open research issues.

Table 3: Related Work

| | |
|---|--|
| Authors, Year, Title, Journal, Volume, Number, Pages | Borade A, Bonsad SV (2008) The discipline of supply chain management: a systematic literature review. The Icfai Journal of Supply Chain Management 5(1):7-26. |
| Research objective(s) | The paper provides an overview of supply chain activities by explaining the rationale behind SCM |
| Approach | Arranging main activities in supply chains; exploring the domain of SCM |
| Number and type of covered publications | 82 journal articles |
| Results | SCM is studied either from managerial or from operational point of view. Partnership issues, environmental issues, global issues, IT integration, and performance management are gaining more research attention in the current business environment. An industry-centric research approach is recommended to explore the potential of SCM. |
| Authors, Year, Title, Journal, Volume, Number, Pages | Carter C, Rogers DS (2008) A framework of sustainable supply chain management: moving toward new theory. International Journal of Physical Distribution & Logistics Management 38(5):360-387. |
| Research objective(s) | Building of sustainable supply chain management; demonstration of the relationships among environmental, social, and economic performance within a supply chain management context |
| Approach | Conceptual theory building is used to develop a framework and propositions representing a theory of sustainable supply chain management. Relevant literature was found by a key-word search using ABI/inform and EBSCO. |
| Number and type of covered publications | 166 publications and 35 supply chain managers in 28 fortune 1000 companies in the USA and Germany |
| Results | A validated framework of sSCM is developed and propositions for an sSCM are outlined. In addition, relevant literature on sSCM is presented. |
| Authors, Year, Title, Journal, Volume, Number, Pages | Jüttner U, Peck H, Christopher M (2003) Supply chain risk management: outlining an agenda for future research. International Journal of Logistics: Research & Applications 6(4):197-210. |
| Research objective(s) | The objective of this paper is to delineate the domain of risk management in supply chains. Furthermore, an operational definition shall be provided and an agenda directing future research shall be outlined. |
| Approach | The paper draws on literature on risk management and supply chain management and compares, contrasts and supplements it with the preliminary analysis of empirical findings from exploratory semi-structured field interviews. |
| Number and type of covered publications | 41 books and journal articles and preliminary analysis of empirical findings from exploratory semi-structured field interviews |
| Results | Further research is needed: (1) Assessing the risk sources for the supply chain; (2) Defining the supply chain risk concept and adverse consequences; (3) Identifying the risk drivers in the supply chain strategy; (4) Mitigating risks for the supply chain |
| Authors, Year, Title, Journal, Volume, Number, Pages | Srivastava SK (2007) Green supply-chain management: a state-of-the-art literature review. International Journal of Management Reviews 9(1):53-80. |
| Research objective(s) | The paper presents a comprehensive view of the published literature on aspects and facts of Green SCM. It also takes a 'reverse logistics angle' so as to facilitate further study, practice and research. |
| Approach | Qualitative analysis was applied to classify the existing literature on the basis of addressed problem contexts, applied methodology and adopted approaches. |
| Number and type of covered publications | 227 books, articles from journals and edited volumes from 1999 to 2007 have been covered |
| Results | Outcomes: There is a noticeable paradigm shift, going from end-of-pipe control to meet environmental regulations to the situation of not only minimizing ecological damage, but also achieving overall economic profit. Future Research: (1) Further integrative contributions, green technology transfer and environmental performance measurement is needed; (2) Approaches for artificial intelligence techniques, fuzzy systems and neural networks are needed; (3) Empirical studies are needed: how do recovery strategies influence consumer behaviour? How does the regulatory environment influence the volume of returns? |
| Authors, Year, Title, Journal, Volume, Number, Pages | Seuring M, Müller S (2008) Core issues in sustainable supply chain management – a delphi study. Business Strategy and the Environment 17(8):455-466. |
| Research objective(s) | The first objective of the paper is to present a literature review on sustainable supply chain management. The second objective is to provide a conceptual framework as a summary of the research. |
| Approach | A content-oriented approach was chosen to analyze literature on sSCM. |
| Number and type of covered publications | 191 journal articles published from 1994 to 2007 |
| Results | The authors note that research is still dominated by green/environmental issues. Discussions of social aspects and also the integration of the three dimensions of sustainability are still rarely found. |

4 Analysis of Results

4.1 Laws, Guidelines and Standards – “Why?”

Why do supply chain networks decide to implement sSCM? In essence, the following reasons are mentioned in the analyzed papers: customers put pressure on companies to establish sSCM through their increasing demand for environmentally friendly products.

Companies that have introduced a sSCM system can hope for a long-term increase in customer satisfaction and customer loyalty – in short, they can achieve long-term competitive advantages (Autry et al. 2001, Clendenin 1997). Another argument for the implementation of sSCM is the reduction of production costs (for example, by using recycled materials). It is also argued that a growing sense of responsibility towards the environment motivates the introduction of sSCM (Teunter 2001, Kroon and Vrijens 1995).

A vast number of articles draw out the fact that laws, standards and regulations force companies to implement sSCM. Table 4 contains a selection of laws, standards and guidelines for sSCM.

The analyzed papers mainly discuss guidelines and standards for environmental reporting, as well as frameworks for supply chain risk management. Another main focus is set on possible reforms of recycling legislation.

Table 4: sSCM – Selected Laws, Guidelines, and Standards

| | | | | Covered in Reference | | | |
|--|---|---|---|---|--|------------------------------|---|
| | | | | | | | |
| Sustainable Supply Chain Management | Intrinsic Motivation | Environmental | Supply Chain Uncertainty Model | | 4, 53, 93, 100, 132 | | |
| | | | Framework for Supply Chain Risk Management | | 7, 15, 17, 18, 23, 30, 60, 87, 111, 139, 140, 141, 142 | | |
| | | | The Accountability AA1000 Framework | | 82 | | |
| | | Economic | Financial | (Conditional) Value-at-Risk (CVaR) | | 42, 43, 56, 67, 70, 104, 139 | |
| | | | | Triple Bottom Line Accounting | | 14, 40, 129 | |
| | | | | Risk Adjusted Return on Capital (RAROC) | | | |
| | | | | Supplier Risk Assessment Methodology | | 7 | |
| | | | | Ethical Trading Initiative and Supplier Ethical Data Exchange (ETI) | | 10 | |
| | | IT/ Processes | Database of Business Social Compliance Initiative (BSCI) | | | | |
| | | | Sustainable Supply Chain Management Framework | | 14 | | |
| | | | Statement on Auditing Standards SAS 70 | | | | |
| | | | Social | | | | |
| | | Extrinsic Motivation | Indirect (Guidelines) | Environmental | Social Accountability SA8000 and Fair-Trade Labelling Organisation | | 82, 117 |
| | | | | | Public Reporting Obligations and Standards (ISO 14001 ISO 140649, EMAS, ISO 26000) | | 14, 19, 28, 29, 47, 48, 73, 74, 82, 83, 88, 90, 106, 113, 117, 123, 131 |
| | | | | | European Union (EU) Order on the Disposal of Waste from Electrical Equipment | | |
| | Greenhouse Gas Protocol (GHG Protocol) | | | | | | |
| | European Union (EU) Order for Disposal of Oil | | | | | | |
| | European Union (EU) Order for Batteries | | | | | | |
| | Economic | | | Financial | European Union (EU) Order on the Disposal of Waste from Packaging EU Energy Star | | |
| | | | | | Basel II | | |
| | | | | | Minimum Requirements of Risk Management (German: Mindestanforderungen an das Risikomanagement (MaRisk)) | | 73 |
| | | | | | Committee of Sponsoring Organizations of Treadway Commission | | |
| | | | | | International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) Common Criteria ISO/IEC 13335 | | |
| | IT/ Processes | | | Control Objectives for Information and Related Technology (COBIT) | | | |
| | | | | Supply Chain Operations Reference Model (SCOR Model) | | 52, 100, 113 | |
| | | | | Green Supply Chain Operations Reference Model (GreensCOR) | | | |
| | | | | TCO (Tjänstemännens Central Organisation) | | | |
| | Direct (Laws) | | Social | EMAS – Eco-Management and Audit Scheme | | 29, 47, 84, 90 | |
| | | | | Social and Ethical Auditing, Accounting and Reporting (SEEAR) | | | |
| | | | | Business Social Compliance Initiative | | | |
| Waste Electrical and Electronic Equipment (WEEE) | | | | 5, 6, 27, 33, 62, 106, 107, 130 | | | |
| Reverse Logistics and Waste Avoidance Management Act (German: Kreislaufwirtschafts- und Abfallgesetz (KrW/AbfG)) | | | | 27, 31, 34, 46, 61, 64, 95, 99, 102, 108, 109, 113, 114, 116, 124, 133, 138 | | | |
| Regulation on Disposal of Cars (German: Altfahrzeugverordnung) | | | | 92, 27, 102 | | | |
| Environmental | | | Waste of Oil Amendment (German: Novelle Altölverordnung (AltÖV)) | | | | |
| | | | Disposal of Batteries (German: Batteriegesetz) | | | | |
| | | | Packaging Ordinance (German: Verpackungsverordnung) | | 114 | | |
| | | | Waste Shipment Act (German: Abfallverbringungsgesetz) | | | | |
| | | | Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal | | 1, 57 | | |
| | | | Renewable Energy Sources Act | | | | |
| | | | Atom Act (German: Atomgesetz (AtG)) | | | | |
| | | | Federal Immission Protection Law | | | | |
| | | | Eco-Design Directive | | 138 | | |
| | EU Emission Trading | | 48 | | | | |
| Economic | Financial | Stock Companies Act | | | | | |
| | | Corporate Sector Supervision and Transparency Act (German: Gesetz zur Kontrolle und Transparenz im Unternehmensbereich KonTraG) | | 39 | | | |
| | | Accounting Directives Act | | | | | |
| | | Sarbanes Oxley Act (SOX) | | | | | |
| | | Digital Signature Act | | | | | |
| | IT/ Processes | Telecommunications and Media Act (German: Telemediengesetz) | | | | | |
| | | Data Protection Act | | | | | |
| | | E-Commerce Act (German: Elektronischer- Geschäftsverkehr-Gesetz) | | | | | |
| | | Part-Time Act (German: Teilzeit- und Befristungsgesetz) | | | | | |
| | | Collective Labour Agreement (German: Tarifvertragsgesetz) | | | | | |
| Social | Minimum Wage Order (German: Mindestlohnverordnung) | | | | | | |
| | Worker Posting Law (German: Mitarbeiterentsendungsgesetz) | | | | | | |

4.2 Research Perspectives Taken – “What”?

This section outlines the particular angles from which the authors of our 142 analyzed papers discuss the issue of sSCM. In line with the PEST analysis (Fahey and Narayanan 1986) we identified several different perspectives from which the topic of sSCM has been approached (political, economical, social, technological) and added an organizational and a psychological category. The political category derived from “PEST” was dropped in favour of the term “legal/compliant”. To this “legal/compliant perspective” we assigned all papers dealing with environmental laws, guidelines and standards. A few articles were assigned to two categories, which explains the sum total of 153 articles included in Table 5.

Table 5: Research Perspectives on sSCM

| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Technological | 0 | 2 | 1 | 1 | 2 | 0 | 0 | 1 | 2 | 2 | 3 | 4 | 2 | 1 |
| Organizational | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 2 | 3 | 4 | 4 | 2 |
| Legal/Compliant | 1 | 3 | 0 | 1 | 1 | 0 | 4 | 1 | 0 | 2 | 4 | 1 | 2 | 5 |
| Economic | 2 | 2 | 1 | 3 | 4 | 0 | 2 | 6 | 5 | 9 | 6 | 5 | 5 | 4 |
| Psychological | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 4 | 2 |
| Social | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| <i>Total</i> | 4 | 11 | 3 | 7 | 10 | 4 | 10 | 12 | 9 | 16 | 17 | 17 | 19 | 14 |

4.3 Applied Research Methods – “How?”

This section gives an overview of the research methods applied in sSCM. The methods that are used in the analyzed papers are listed in Figure 3. Since some articles were assigned to more than one methodic category, the total number of analyzed papers is higher than 142. For orientation, we referred to the list of existing IS research methods compiled by Wilde and Hess (2007).

It is important to note that 68 articles did not *explicitly* mention their research method. These articles were assigned to a research method by the authors of this review. This categorization is at least partly problematic. For example, it is not always possible to definitely assign a paper to the method of reference modeling. One important feature of a reference model is its universal validity (vom Brocke 2003, p. 131). The authors could not test every model for this feature. Instead, an article was assigned to the method of reference modeling if the models presented in it were declared universally valid by their constructors.

The analysis shows that case studies, argumentative deductive research and formal deductive research dominate the research area of sSCM. We assume that there are “weaker” research methods (e.g. argumentative-deductive research, case studies) and “stronger” methods (e.g. laboratory experiments) to increase knowledge. Hence, the choice of research methods functions as a research progress

indicator (Heinrich 2006, p. 10). The frequent choice of argumentative-deductive research suggests that the research process on sSCM is still not very advanced. Furthermore, compared to case studies, other methods are clearly underrepresented in this research area. However, previously unused research methods like action research or reference modeling should also be applied in order to gain new insights in sSCM: action research aims to solve current (practical) problems while at the same time expanding scientific knowledge through an iterative and reflective research process that both researchers and research subjects benefit from (Baskerville and Myers 2004). Researchers seek to learn continuously from their own actions. Generic reference models support the development or improvement of processes, information systems and organizational demands (Fettke and Loos 2004).

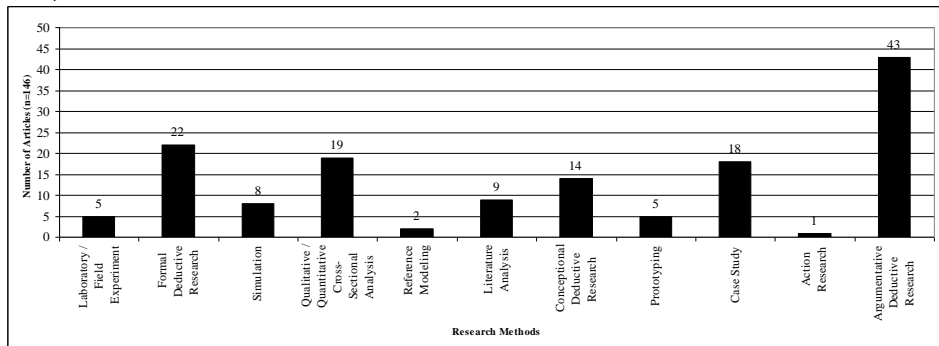


Figure 3: Research Methods

4.4 Outcome: Problems to be solved

In the same way as the existing research perspectives, the unsolved problems in sSCM mentioned in the 142 articles were categorized. Apparently, there is still considerable need for research on these unsolved problems, in spite of the numerous works that have been published on them to date. One possible reason for this is that sustainability is an immaterial value which eludes a precise mathematical definition or economic monitoring. Hence, central research questions are: how can sustainability be measured? Does sustainability delimit economic growth, and under which conditions does sustainable development lead to financial success?

Table 6: Unsolved Problems in sSCM

| Problems to be solved | Reference |
|--|-----------------------------|
| Technological Category | |
| What are the impacts of supply chain uncertainty on IT? | 81, 122, 93 |
| Real-time vehicle management: how could decision support methods be constructed? | 41 |
| How can software agents be incorporated into procurement processes? | 86 |
| How could architectures of hybrid value creation be designed? | 137 |
| What is the cost-benefit relationship of RFID use in supply chains? | 120 |
| How can knowledge be used and presented in environmental management information systems? | 50, 37 |
| Organizational Category | |
| How can product design be integrated into sSCM? | 60 |
| How can models of disintermediation be validated? | 77 |
| What could be the characteristics of reverse logistics models? | 2, 114, 99, 126 |
| What impacts does “green design and manufacturing” have on reverse logistics? | 62 |
| How does proactive SCM work? | 111 |
| Legal/Compliance Category | |
| What are the impacts of the WEEE directive on reverse logistics? | 27, 33, 130 |
| How can guidelines for sustainability be established during a legislative period? | 38, 105, 106 |
| What impact do sustainability regulations have on the performance of value networks? | 28, 47, 82, 128 |
| How do we define the term “Sustainability” in legislation? | 110, 13 |
| How can the environmental statement of the EMAS (=Eco Management and Audit Scheme) be further developed? | 83 |
| How can an ecological tax reform be designed that does not discriminate against one generation? | 9 |
| Is self-commitment a good instrument of environmental politics? | 138 |
| Economic Category | |
| What are the impacts of transport uncertainty on supply chain environmental performance? | 100 |
| How can models for the evaluation of risks in supply chains be designed? | 67, 87, 123, 127, 42, 7, 56 |
| What are the effects of sSCM on organizational performance and vice versa? | 140, 141 |
| How can existing sSCM models be validated? | 72, 14 |
| How do we measure sustainability and sustainable value added? | 73, 54, 39 |
| Does sustainable management delimit growth? | 94, 97, 129 |
| Can a company be both “green” and profitable? – How could this be achieved? | 74, 88 |
| Psychological Category | |
| How reliable is “willingness to pay”? | 55 |
| How could we identify a set of behavioral axioms underlying disappointment without prior expectation? | 25 |
| How could risk preference functions be validated? | 35 |
| Do professionals in different areas take a similar view on supplier risk assessment? | 139 |
| Can agency theory be used as a theoretical underpinning of both research and practical applications in sSCM? | 142 |
| Social Category | |
| Is sSCM with focus on social aspects practicable? | 113 |
| Do social systems regulate themselves? | 11 |

5 Implications

5.1 Current Trends in sSCM

Current developments show that since 2002 sSCM has been analyzed particularly from an economic perspective. Since 2006 the focus has shifted towards the legal/compliance perspective (compliance management in supply chains). As far as economic aspects are concerned, researchers have to deal with one prime question: can a sustainable supply chain be profitable? (cf. e.g. 74). This crucial problem entails further questions: How and with which key performance indicators can sSCM be measured? Which cause and effect relationships exist between Sustain-

able Management and long-term financial success? The answers to these questions can provide important information about the monitoring and controlling of sSCM. For example, if there is information at hand about a sustainability level that increases the company value, key performance indicators can give important steering impulses to the management (cf. 97). These complex questions require long-term analysis, since the impact of sSCM (as e.g. investments into environmental protection and employment conditions) on financial key performance indicators may take years to become perceptible. Papers that look at sSCM from a legislative perspective focus on the laws and guidelines that may have an impact on environmental protection (cf. 47). Moreover, they examine the impact of these laws and guidelines on the operating efficiency and the competitiveness of companies and supply chains. For example, in how far do special national guidelines threaten the competitive capacity of German industrial enterprises (cf. 47)?

5.2 Elements of a Research Agenda

It has become apparent that only two of the analyzed articles applied the method of reference modeling. To the authors' knowledge, no reference model for sSCM has been published to date. However, the GreenSCOR model which "The Supply Chain Council" included in the latest version (9.0) of the SCOR model can be regarded as a closely related concept that new specific reference models could be based on in the future.

Reference models are useful for the support of software implementation and development as well as organizational structuring (Keller and Teufel 1998; Scheer 1995; SCC 2008). The implementation of reference models is helpful because they accelerate the realization of organizational concepts and software implementation and contribute to the minimization of risks (Schütte 1998, p. 76). For this reason, future research should build on the current level of knowledge and develop reference models for sustainable management in specific supply chains, as e.g. in networks for the recycling of electronic devices under special consideration of a proactive risk management.

Therefore, the proposed research agenda illustrated in Figure 4 includes the development of a reference model for sSCM: in a first step, all current theoretical and practical knowledge is collected and categorized, open questions are defined and a research problem is formulated. During this phase, literature analysis and case studies are applicable methods. On this basis, concepts and reference models are developed in a second step.

During the third step, these models have to be validated by means of quantitative cross-sectional analysis in order to find out whether they are suitable for several companies. Finally, after their implementation in the companies, the models get reviewed on a regular basis and are continuously improved. Simulation experiments can help to make the impacts of newly introduced laws on business processes visible in advance and allow for an evaluation of these laws' effects on future

financial performance. Step by step, the applied research methods change from mainly qualitative case studies to quantitative studies and simulations. According to Heinrich (2006), the increased application of quantitative research methods can be an indicator of research advance.

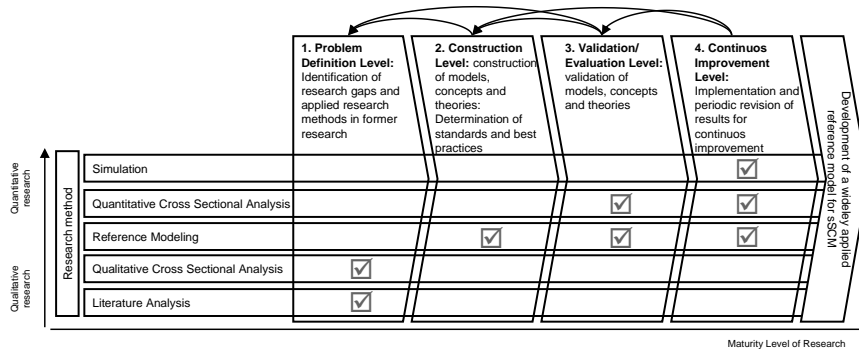


Figure 4: Elements of a Research Agenda in sSCM

Acknowledgement: The authors are indebted to Ms Anja Grube and several anonymous reviewers for fruitful discussions and substantive comments relating to this article.

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Appendix

Note: A PDF document that includes a comprehensive list of all 142 analyzed articles is available at the following address: www.uwi.uos.de/sscm_references.pdf