



Exploring the integration of sustainability and supply chain management

Current state and opportunities for future inquiry

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Abstract

Purpose – The aim of this paper is to provide a snapshot of the existing research and suggest potential opportunities for academic inquiry related to the concept of sustainable supply chain management.

Design/methodology/approach – The researchers review the extant literature at the intersection of “sustainability” and “supply chain management”. This literature is subsequently categorized with the aid of a classification matrix derived from the literature in order to review the current state of thought development across three distinct disciplines (logistics/supply chain management, operations/production management and social/environmental management). The analysis suggests future research opportunities in this area.

Findings – The findings indicate that the existing literature is primarily focused on individual sustainability and supply chain dimensions rather than taking a more integrated approach. In addition, the findings suggest both the emergence of a group of themes within an individual dimension, such as green logistics within the environmental dimension as well as a set of themes that are consistent across dimensions. The analysis establishes several areas of opportunity for future inquiry.

Originality/value – The paper contributes to our knowledge on sustainability as it relates to supply chain management by using the triple bottom line approach and supply chain management elements that had been previously established in literature as a means to classify extant literature in this space and identify specific research opportunities in a systematic manner.

Keywords Sustainability, Supply chain management, Literature review, Triple bottom line, Sustainable development

Paper type Literature review

Introduction

There is an increasing realization by managers that their company’s social and environmental accountabilities do not fall solely under the control of any individual organization; multiple entities across supply chains must be involved to efficiently and effectively fulfill these societal responsibilities. As a result, managers are looking to identify ways to successfully meet these responsibilities, develop relevant tools that they can use to assist their efforts, and establish mechanisms for pursuing their sustainability



goals in coordination with other members of their supply chain in an economically viable manner. While academic research related to sustainable supply chain management (SCM) has emerged over the past two decades, academic inquiry must continue to evolve in ways that help supply chain managers meet these critical challenges.

The field of SCM has an inherent connection to sustainability, and it has been recognized that the concept of sustainability extends to both the operational drivers of profitability and their relationship to people and the environment we all live in. This natural relationship gives supply chain researchers exciting opportunities to make a profound societal difference through their work. As management principles and theories associated with sustainable supply chains continue to develop, there is a need to examine where we have been and consider where we should be going as we move forward.

The extant literature on sustainable SCM contains studies on a diverse set of topics such as green purchasing, purchasing ethics, remanufacturing, safety management, supplier certification, carbon footprint and reverse logistics. However, to date, much of this research has been focused on individual aspects of sustainability; studies that examine multiple dimensions are the exception. For example, it has been established that the research community has placed much more emphasis on the environmental as compared to other aspects of sustainability (Lehtonen, 2004). In addition, the extant literature has been characterized by a large percentage of papers that are theoretical/conceptual in nature as well as having a large percentage of studies-based on case analysis (Seuring, 2004). This is not to be unexpected given the stage of development of this research stream. Thus, a primary goal of this manuscript is to systematically review the development of research focused on the integration of sustainability and SCM in order to propose future research opportunities.

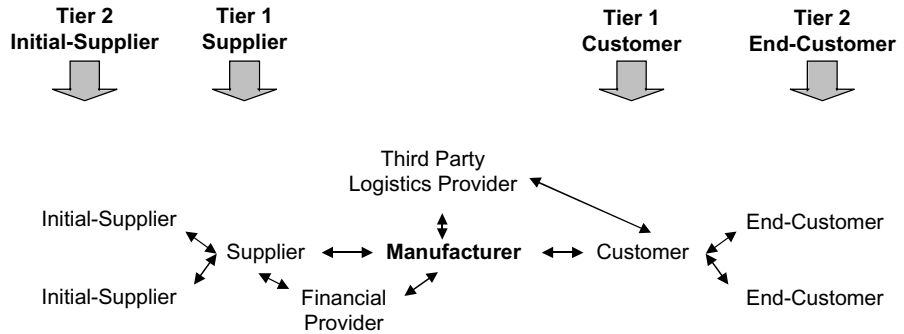
The manuscript is organized as follows. First, a conceptualization of SCM-based on the work of the global supply chain forum (GSCF) is presented and elements of the framework are established. Second, the area of sustainability is examined with a particular focus on using the triple bottom line (3BL) approach to evaluate sustainability efforts in a supply chain context. Third, the methods and results of a systematic classification of the existing literature within leading journals across three disciplines (logistics/SCM, operations/production management, and social/environmental management) during four distinct time periods (1995-1998, 1999-2002, 2003-2006, and 2007-2010) are described. Next, research opportunities are proposed based on an analysis of the classification matrix. Finally, conclusions are drawn based on the results of the study.

Elements of SCM

The term “supply chain” has been a focus of organizations ever since its inception in the early 1980’s (Harland, 1997). The objective of a supply chain is to produce value in the form of products and services that are delivered to a customer. Supply chains are not linear chains, but rather complex relationship networks. According to this network-oriented view, a supply chain is:

[...] a network of organizations that are linked through upstream and downstream relationships in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer (Christopher, 1998).

Figure 1 shows the supply chain network structure of a manufacturer with two tiers of suppliers and two tiers of customers.



Source: Mentzer *et al.* (2001)

Figure 1.
Extended supply chain

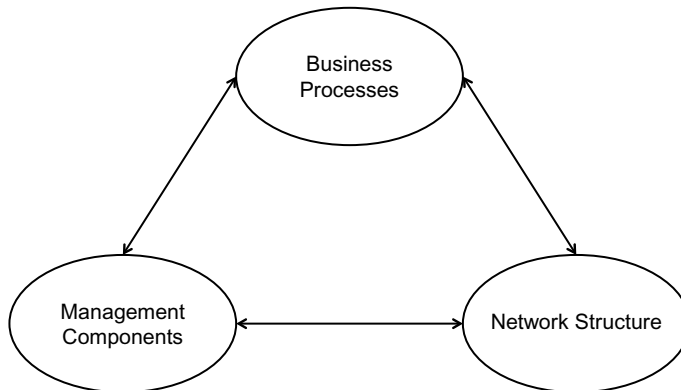
The related term SCM was introduced in the early 1980's (Oliver and Webber, 1992). However, since its introduction researchers have proposed a variety of competing definitions for "SCM" (Mentzer *et al.*, 2001). For the purposes of this article, SCM is defined as:

[...] the integration of key business processes from end-user through original suppliers that provides products, services, and information that add value for customers and other stakeholders (Lambert, 2008).

This definition is very useful for the current study because it emphasizes SCM activities in a cross-functional and cross-firm manner. This is essential because an examination of the integration of sustainability concepts into SCM concerns not only diverse business processes and activities across functional silos within a single company, but also cooperation between parties across the network of relationships that form a supply chain.

Similar to the diversity of definitions for SCM, competing managerial frameworks have been developed to create a structure for organizing and standardizing processes used to manage the supply chain (Moberg *et al.*, 2008). While multiple perspectives exist in the literature, the GSCF framework for SCM serves as the basis of analysis for the current study. This framework has been implemented within major corporations, thus providing face validity for its applicability across both academics and practitioner groups (Lambert *et al.*, 2005).

The GSCF framework consists of three closely inter-related elements: network structure, business processes and management components (Lambert, 2008). The network structure is comprised of the member firms and the links between these firms. Business processes are the activities that produce a specific output of value to the customer. The management components are the managerial methods by which the business processes are integrated and managed across the supply chain. In this framework, the business processes cut across the different functions within the firm and also across other firms within the supply chain (Ellram *et al.*, 2004; Mortensen and Lemoine, 2008; Lambert, 2008). The establishment of these elements serves as a basis for a proposed classification matrix that can be used to provide direction as to future research opportunities focused on the integration of sustainability and SCM (Figure 2).



Source: Cooper *et al.* (1997)

Figure 2.
Elements of SCM

Business processes

Davenport and Short (1990) define business processes as a set of logical tasks performed to achieve a definite business outcome. These authors establish two important characteristics of processes: first they have customers and second they cut across organizational boundaries. With respect to our established definition of SCM, business processes are used to structure specific activities across internal functional areas and between key members of a supply chain. The GSCF framework identifies eight key business processes: customer relationship management, supplier relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, product development and commercialization, and returns management. Customer relationship management and supplier relationship management form the linkages in the supply chain, and the other six processes are coordinated through these linkages (Lambert, 2008). It is important to note, that each key business process has both strategic and operational sub-processes as well as its own objective in order to provide defined outcomes (Lambert, 2008).

Network structure

Another important aspect of the CSCMP SCM-definition presented previously is coordination and collaboration between key supply chain members. The different members act together in a network structure. Baker (1992) asserts that a network form is designed to handle tasks that demand flexibility and adaptability. The supply chain network structure represents the configuration of organizations and their linkage in order to produce a specific value (Lambert, 2008). The formation of appropriate linkages between the members of a supply chain is necessary to implement the individual business processes. Nassimbeni (2004) differentiates between traditional supply management and the need for stable and cooperative relations (traditional vs partnership). Partnerships can be a successful aspect of SCM with substantial benefits for the network (Lambert *et al.*, 2004). However, within a network structure there exist different types and magnitudes of inter-firm relationships. The relationship magnitude can differ, depending on the time and effort the parties put into the relationship (Golicic *et al.*, 2003). Borgatti and Xun (2009) provide a good overview how to apply network concepts to both “hard” types

of relational ties (e.g. materials and money flows) and “soft” types of relational ties (e.g. friendships and sharing-of-information) in a supply chain context.

Management components

The previous two SCM elements must be supported by a system of management components. Some of these components are relevant for a single member within the supply chain; others are applied between two members or they are common across business processes and multiple members of the supply chain (Cooper *et al.*, 1997). To identify useful management components it is helpful to review the literature in the field of change management and business process reengineering (Paton and McCalman, 2000; Evans *et al.*, 1995; Kettinger *et al.*, 1997). It is possible to structure the management components into two groups: structural and behavioral components (Lambert, 2008). The structural components are generally more recognizable and ultimately influence behavior. These components include: planning, control methods, workflow structure, organizational structure, knowledge management, and communication structure. The behavioral components are less tangible and thus are more challenging to coordinate across firms in a supply chain. These components include: management methods, power and leadership, risk and reward, culture and attitude, and trust and commitment.

Dimensions of sustainability

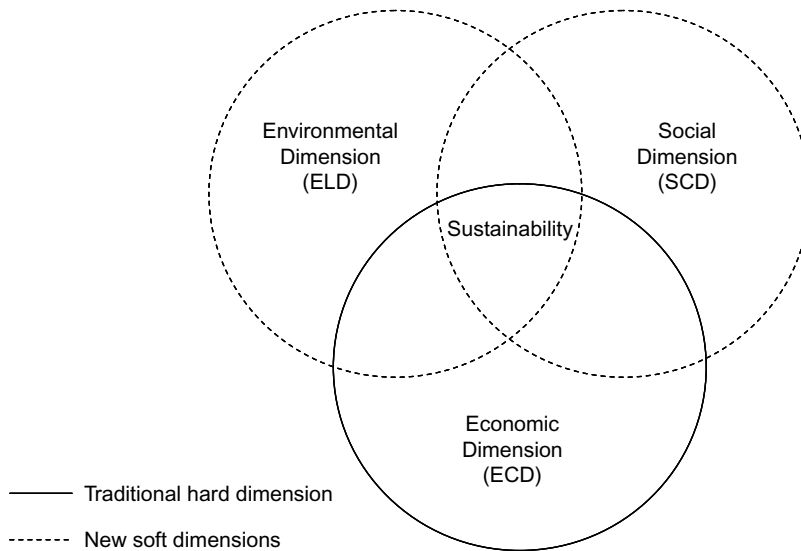
The term “sustainability” has been defined in various disciplines, such as engineering science, operations management and social science (Linton *et al.*, 2007). However, there exists a divergence of definitions of sustainability in the literature (Carter and Rogers, 2008). Similar to the evolution of SCM, this divergence is not surprising due to the fact that the topic is in the early stages of its evolution. Since the term sustainability first appeared in the literature over 20-years ago, numerous academics and practitioners have proposed multiple definitions of the term. The World Commission on Environment and Development (WCED, 1987 – Brundtland Commission) entitled 1987 “our common future”, defined sustainability as “using resources to meet the needs of the present without compromising the ability of future generations to meet their own needs.” From a corporate perspective, this definition suggests not only a focus on economic aspects of one’s business, but also a need to focus on the sustainment of nature’s resources and the societies the companies serve. This fundamental requirement was the starting point to develop concepts for the implementation of sustainability initiatives.

The concept of the 3BL was introduced in the mid-1990s, when a management think tank focused on accountability coined and began using the term in its work (Willard, 2002):

In the simplest terms, the 3BL focuses corporations not just on the economic value that they add, but also on the environmental and social value that they add – or destroy (Elkington, 2004).

Figure 3 shows the three dimensions of the 3BL-concept. It should be noted that some groups use a different nomenclature, such as 3P’s (profits, planet and people) and 3E’s (economics, environment and equity) to reflect similar viewpoints to that of the 3BL. While the nuances of meaning of these other approaches are slightly different, the basic ingredients are consistent.

While the “traditional” economic dimension of the 3BL is widely used in business and measurements are well understood and developed, the “new” environmental and social dimensions are less prevalent and much more difficult to measure.



Source: Carter and Rogers (2008)

Figure 3.
Sustainability dimensions

However, most companies are experiencing an increased variety of internal (e.g. caused by investors, employees, etc.) and external pressures (e.g. caused by legislators, customers, etc.) to improve their social and environmental activities (Seuring and Müller, 2008). This does not mean that the economic performance has to be adversely affected by the increased pressures to address these other dimensions. Organizations can engage in environmental and social activities that not only positively affect the natural environment and society, but also provide long-term economic benefits and a competitive advantage for the company (Carter and Rogers, 2008; Markley and Davis, 2007).

Environmental

The environmental dimension includes the set of objectives, plans and mechanisms that promote greater environmental responsibility and encourage the development and diffusion of environmentally friendly technologies (Klassen, 2001). To date, a large proportion of sustainability research has focused on this dimension (Lehtonen, 2004).

Social

The social dimension is bipolar; it refers both to individuals and organizational levels. While concrete material circumstances lie at the basis of the social dimension, the social phenomena themselves are immaterial and therefore difficult to analyze (Lehtonen, 2004). Hall and Matos (2010) emphasize that the social dimension of sustainable development is emerging as the key challenge in sustainable supply chains, due to the fact that companies have to involve a wide range of stakeholders with different goals, demands, and opinions that may interpret the same situation differently.

Economic

The long-term success and competitiveness of a company is the basis of the economic dimension. In contrast to the social and environmental dimensions, the economic

dimension is principally quantitative in nature and is focused toward the efficient use of resources and achieving a return on investment (Rumelt, 1974).

It is very difficult to measure these three dimensions through the same analytical framework. Conflicts may arise within one dimension (e.g. individual vs collective interests within the social dimension) and between the dimensions (e.g. between the environmental and economic dimension relating to cost aspects). In this context, Pagell and Wu (2009) analyzed case studies (ten supply chains from ten different organizations) to explore what more sustainable companies do that is unique. Their findings indicate that the organizational practices that lead to a more sustainable supply chains are a mixture of best practices in traditional SCM and also new proactive behaviors towards sustainable practices. But being proactive and committed can only be effective if the business model and the environmental and social elements of sustainability are adequately aligned (Pagell and Wu, 2009).

Thus, it is absolutely essential to take the dynamic interactions between the dimensions into account. Changing one parameter could affect several others and may affect the complete system. The key challenges – synergies and trade-offs – of sustainability in the context of SCM emerge at the interfaces between the three dimensions. However, until recently research on the environmental dimension has been more pronounced than the social and even less attention has been paid to the linkages between dimensions (Lehtonen, 2004).

The combination of ideas from these two established frameworks (The GSCF framework and the 3BL framework) serves as the basis for a 3×3 classification matrix that can be used to examine the existing research on sustainable SCM. This classification matrix provides a structured way to examine the extant literature on this topic in an effort to identify potential research gaps that might exist or areas that could use additional focus.

Previous literature reviews

The current study looks to build upon previous literature reviews focused on the intersection of sustainability and SCM in order to provide suggestions for future research. Srivastava (2007) conducted a literature review focused on green SCM. The author examined 227 papers beginning in 1990. His analysis focused on the integration of environmental thinking into SCM. Unlike the current study, his analysis focused only on environmental aspects of sustainability and not the broader TBL viewpoint. Additionally, his review excluded empirical papers focused on firm-level or specific operational issues that are included in the current study.

Seuring and Müller (2008) conducted a literature review to examine sustainable SCM. The authors analyzed 191 papers published from 1994 to 2008 in a variety of peer-reviewed journals. Their analysis provides an effective overview of the research that has been conducted in this area, but it should also be noted that the review is characterized by two restrictions. First, papers focusing on reverse logistics and remanufacturing are not included in their analysis. Second, they assume that the economic dimension of sustainability is covered by all of the papers reviewed because only management-related publications were part of the assessment. In contrast, the current study suggests that it is necessary to consider reverse aspects explicitly, primarily because returns management is a key business process within the GSCF framework and is an important aspect of recycling. Furthermore, it is valuable to specifically examine the economic aspects of articles in this research stream, not just assume this connection.

Carter and Rogers (2008) conducted a large-scale literature review and conceptual theory development focused on introducing a holistic concept of sustainability into the field of SCM. The authors use their literature review to develop a theoretical framework and to discuss future research propositions in the field of sustainable SCM. Building upon their work, the current study provides a more detailed classification of the literature, built upon key aspects of the GSCF framework as well as including additional literature published since 2008.

Finally, Carter and Easton (2011) extends the Carter and Rogers (2008) literature review by providing a systematic review of the sustainable SCM literature across a 20-year time frame (1991-2010). The authors focus on 80 articles appearing in top-tier SCM journals focused primarily on the methodological and analytical aspects of the research as opposed to managerial implications. The authors also exclude non-environmental aspects of reverse logistics and waste disposal from their analysis. As such, the current study provides a broader examination of the literature at the intersection of sustainability and SCM.

Research methodology

To establish the current state and identify opportunities for future research on sustainable SCM, an extensive literature review was conducted. From a methodological point of view, a literature review is a systematic, explicit, and reproducible approach for identifying, evaluating, and interpreting the existing body of documents (Fink, 1998). Figure 4 shows an overview of the underlying literature review methodology utilized in the current study. This six-step classification process is based on the work of Soni and Kodali (2011).

Step 1 – time horizon for selection of papers

The assessment period for the study is between the years of 1995 and 2010. This represents a 16-year time horizon for the analysis. The year of 1995 was selected as the starting point because this was approximately the time when pieces began emerging at the intersection of sustainability and SCM (Seuring, 2004). The decision was made to start the analysis in 1995, instead of 1994, in order to provide an evenly divisible number of years. This approach allowed four distinct and comparable four-year periods to be examined in the analysis: 1995-1998; 1999-2002; 2003-2006; and 2007-2010. The end point 2010 was established based on it being the most complete previous year at the time of the analysis.

Step 2 – selection of database(s)

A determination was made to use a variety of databases (EBSCO, Emerald, Taylor and Francis, Science Direct and Wiley Inter-Science) in order to identify relevant articles across a selected set of journals. These databases are widely accessible at academic institutions and have been used in similar studies.

Step 3 – journal selection

In order to focus the study, a decision was made to focus on three distinct disciplines for the analysis. The three selected disciplines were: logistics/SCM, operations/production management, and social/environmental management. Seuring (2004) was referenced to establish an appropriate list of ten journals to represent each discipline. In an effort

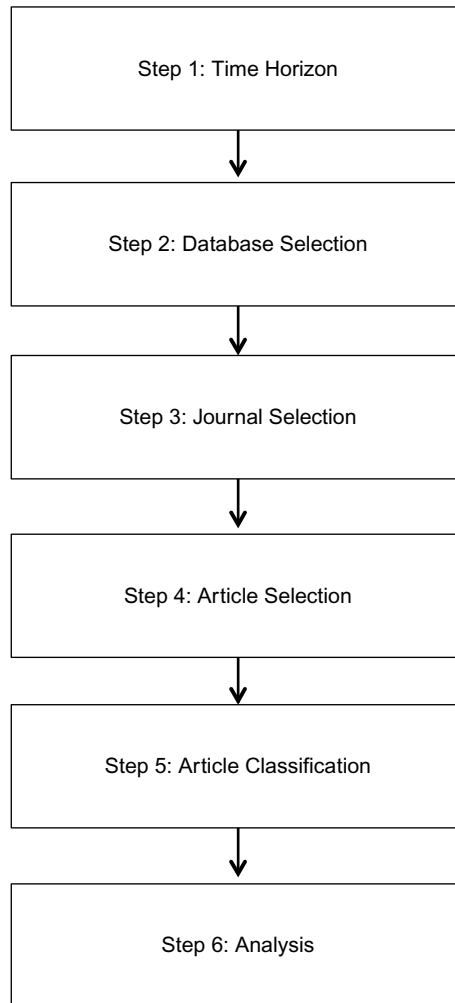


Figure 4.
Literature review
methodology

Source: Adapted from Soni and Kodali (2011)

to focus on highly relevant journals with respect to the intersection of sustainability and SCM, journals that published a significant percentage of the total number of articles (80 percent +) in each of the three disciplines were selected. The list of selected journals included in the analysis is provided in Table I. It should be noted that a potential limitation of the current study is the fact that additional work on sustainable SCM has appeared in other journals within the disciplines selected as well as in disciplines outside of the ones examined (e.g. marketing, strategic management).

Step 4 – article selection

Every article published during the established timeframe in each of the journals selected was examined for potential inclusion in the study. The primary criteria for

Operations/production	Social/environment	Logistics/SCM
<i>Production and Operations Management</i>	<i>Journal of Cleaner Production</i>	<i>International Journal of Physical Distribution & Logistics Management</i>
<i>European Journal of Operational Research Omega</i>	<i>Business Strategy and the Environment Greener Management International</i>	<i>Supply Chain Management: An International Journal Journal of Supply Chain Management</i>
<i>Journal of Operations Management</i>	<i>Corporate Social Responsibility and Environmental Management Journal of Business Ethics</i>	<i>Transportation Research: Part E Journal of Business Logistics</i>
<i>International Journal of Operations & Production Management</i>		
<i>International Journal of Production Research</i>	<i>Journal of Industrial Ecology</i>	<i>International Journal of Logistics Research and Applications</i>
<i>International Journal of Production Economics</i>	<i>Journal of Environmental Management</i>	<i>International Journal of Logistics Management</i>
<i>Journal of Manufacturing Technology Management</i>	<i>Clean Technologies and Environmental Policy</i>	<i>Transportation Journal</i>
<i>Industrial Management & Data Systems</i>	<i>Progress in Industrial Ecology</i>	<i>Journal of Purchasing and Supply Management</i>
<i>International Journal of Product Lifecycle Management</i>	<i>Business Ethics: A European Review</i>	<i>Transportation Research Part D: Transport and Environment</i>

Table I.
Journals selected for analysis

choosing an article to include in the analysis was the ability to establish a clear connection of the article content to the inherent characteristics of one or more of the sustainability dimensions and one or more of the elements of the GSCF framework described previously. The focus was on finding similarities between the characteristics of the two frameworks and the topics described in the published articles, not exact matches. Each of the authors independently identified potential articles and an outside party settled any disagreements regarding the inclusion of a particular article. The authors only disagreed on eight articles with respect to meeting the criteria for inclusion, and of these, five were ultimately included in the analysis database. The final database that was analyzed included a total of 456 peer-reviewed papers published over the 16-year time period.

Step 5 – article classifications

The final set of 456 articles were then individually classified by the authors in terms of the following characteristics.

Sustainability focus(es). The 3BL was used as the basis for classification of the sustainability focus. Each article in the set was analyzed for connections to the environmental, social and/or economic dimensions associated with the 3BL. Some examples of indicators included the terms carbon footprint, green logistics, recycling and emission reduction for the environmental dimension. Indicators for the social dimension included terms such as fair trade, human rights, social responsibility and labor practices. And finally, indicators of the economic dimension included financial performance, cost reduction, competitive advantage and economic benefits.

SCM focus(es). The GSCF framework served as the basis for classifying the SCM focus(es) of each article. Each article was examined for connections to the business processes, management components and/or network structure aspects as delineated by the GSCF framework. Some examples of the indicators of a process focus included articles examining reverse logistics, remanufacturing, demand forecasting and product development. Indicators of the network structure focus included such terms as network configuration, systems design, and network optimization. Finally, the management components focus was determined by the existence of indicators such as, organizational structure, power, culture, and control methods.

Methodology used. Consistent with Seuring (2004) five research methodologies were classified. The five classifications included:

- (1) theoretical and conceptual papers;
- (2) case studies;
- (3) surveys;
- (4) modeling papers; and
- (5) literature reviews.

While the use of multiple methodologies within an article was possible, each article was classified as to the primary methodology used in the piece.

For the sustainability and SCM classifications, the primary criteria for placing an article into a specific category was the ability to establish a connection of the article to aspects of the sustainability dimensions and aspects of the SCM elements of the GSCF framework established previously. Disagreements in article classifications were solved during additional clarification sessions between the authors. Specifically, when disagreements occurred between author classifications, the researchers rechecked the focal article and jointly discussed in detail the elements in the article in an effort to achieve classification agreement. Over the course of the analysis, there were 37 instances where an initial disagreement occurred ($37/456 = 8.11$ percent). Furthermore, ReCal2 (<http://dfreelon.org/utills/recalfront/>) was used to calculate intercoder reliabilities for the article classifications. Krippendorff's α was found to be 0.913, based on the 912 categorical decisions made in the study (Krippendorff, 2004). This is considered to be an acceptable level for drawing conclusions.

Step 6 – analysis of classifications

The final step was to critically analyze the classified articles so as to examine how the research has evolved over time in each of the three disciplines. The analysis also provided an ability to identify research opportunities in the existing literature as it relates to the integration of sustainability and SCM. Specifically, an initial analysis was done regarding the focuses of the articles across the disciplines and the time periods. An additional analysis was conducted that examined the emerging themes across those classifications and time horizons that were more prevalent (defined as ten or more articles published in the category over the entire time horizon) during the initial analysis. This provided additional input and specificity regarding potential research opportunities.

Findings

There exists a general trend of growth in the number of publications in the domain of sustainable SCM. While individual years may display a spike in numbers based on the existence of “special issues” focused on the topic, the general growth trend suggests that more and more researchers across a broad set of disciplines and areas of expertise are undertaking research in this area (Figure 5). While this would seem to represent an indicator of the growing importance of the topic, it also represents a challenge for logistics/SCM researchers in the area to be cognizant of the developments in other fields. In particular, there has been significant growth of sustainable SCM related articles in the environmental/social discipline between 2007-2010 as compared to the other two disciplines (Table II).

Most of the articles that were examined were published in the social/environmental management journals ($n = 180$). The operations/production management journals ($n = 137$) and the logistics/SCM journals ($n = 139$) were roughly equivalent in the number of articles focused on the topic. Given the nature of sustainable SCM,

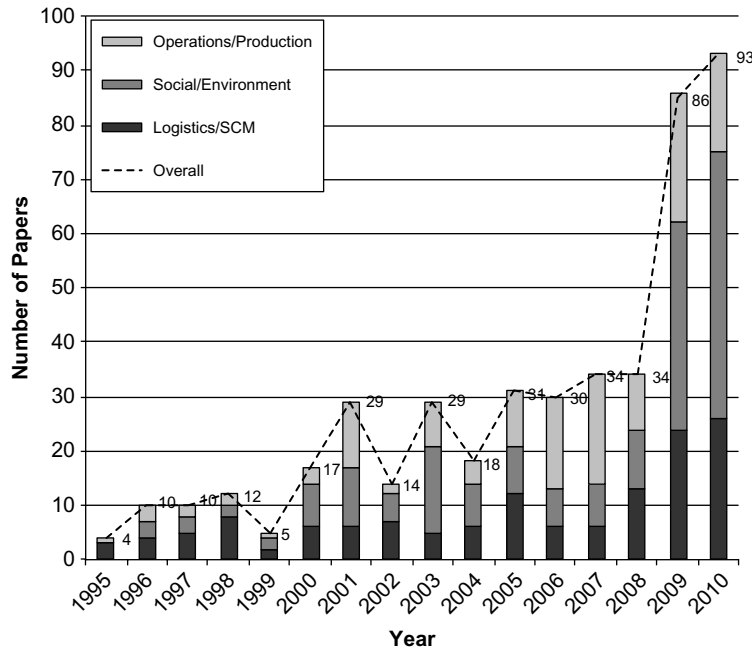


Figure 5. Growth of the sustainable SCM literature

Time period	Logistics/SCM	Operations/production	Social/environmental
1996-1998	20	8	8
1999-2002	21	18	26
2003-2006	29	38	40
2007-2010	69	73	106
Total articles	139	137	180

Table II. Number of articles by discipline by time period

it is particularly important for researchers to consider the literature across disciplines to support inquiry in this area. While most of the previously published literature has been “narrowly focused within disciplines”, there would seem to be opportunities for both researchers and journal editors to promote a more cross-functional and cross-firm approach towards research in this area.

It should be noted that an examination of the articles across the three disciplines indicated several consistent themes with respect to the topics, with slight modifications in focus based on the characteristics of the discipline. For example, returns management was addressed with respect to environmental implications associated to waste management, operational opportunities for remanufacturing and logistical implications for the development of collection networks. Table III provides a list of the selected journals and the number of articles from each journal included in the analysis.

Operations/production	No. of papers	Social/environment	No. of papers	Logistics/SCM	No. of papers
<i>Production and Operations Management</i>	33	<i>Journal of Cleaner Production</i>	52	<i>International Journal of Physical Distribution & Logistics Management</i>	36
<i>European Journal of Operational Research</i>	20	<i>Business Strategy and the Environment</i>	41	<i>Supply Chain Management: An International Journal</i>	21
<i>Omega</i>	19	<i>Greener Management International</i>	21	<i>Journal of Supply Chain Management</i>	16
<i>Journal of Operations Management</i>	19	<i>Corporate Social Responsibility and Environmental Management</i>	12	<i>Transportation Research: Part E</i>	16
<i>International Journal of Operations & Production Management</i>	14	<i>Journal of Business Ethics</i>	12	<i>Journal of Business Logistics</i>	13
<i>International Journal of Production Research</i>	13	<i>Journal of Industrial Ecology</i>	12	<i>International Journal of Logistics Research and Applications</i>	12
<i>International Journal of Production Economics</i>	8	<i>Journal of Environmental Management</i>	10	<i>International Journal of Logistics Management</i>	11
<i>Journal of Manufacturing Technology Management</i>	6	<i>Clean Technologies and Environmental Policy</i>	9	<i>Transportation Journal</i>	6
<i>Industrial Management & Data Systems</i>	4	<i>Progress in Industrial Ecology</i>	7	<i>Journal of Purchasing and Supply Management</i>	7
<i>International Journal of Product Lifecycle Management</i>	1	<i>Business Ethics: A European Review</i>	4	<i>Transportation Research Part D: Transport and Environment</i>	1
	137		180		139

Table III.
Number of articles
by journal

In terms of the methods used to examine topics in this research domain, a qualitative research design was found to be most prevalent. In particular, the extant research has often been conceptual/theoretical in focus (140/456 = 30.7 percent) or has used a case-based approach to examine sustainability issues in SCM (127/456 = 27.9 percent). In comparison, the majority of quantitative papers that have been published were survey-based (79/456 = 17.3 percent). More recently, growth in the number of articles focused on the development of models has occurred (89/456 = 19.5 percent), particularly in the operations/production management discipline (Figure 6). In the most recent time period, 2007-2010, there has also been a marked increase in the number of articles focused on theory development across the disciplines.

In addition to examining the methods used in this research stream, the selected literature was also categorized into the previously described classification matrix (Figure 7). With respect to the focus on the various sustainability dimensions over time, most of the articles examined were found to focus on the environmental dimension rather than sustainability as a holistic integrated concept. However, an increasing number of recent publications were found to take this more holistic perspective (Figure 8). This might suggest the beginnings of a subtle movement towards a more holistic examination of sustainability in the literature. The environmental-related publications in the literature review primarily addressed green initiatives, such as reverse logistics, pollution reduction, waste reduction, etc.

A similar situation emerges when examining the focus on SCM elements in the sustainability literature. With respect to the connections to the various SCM elements

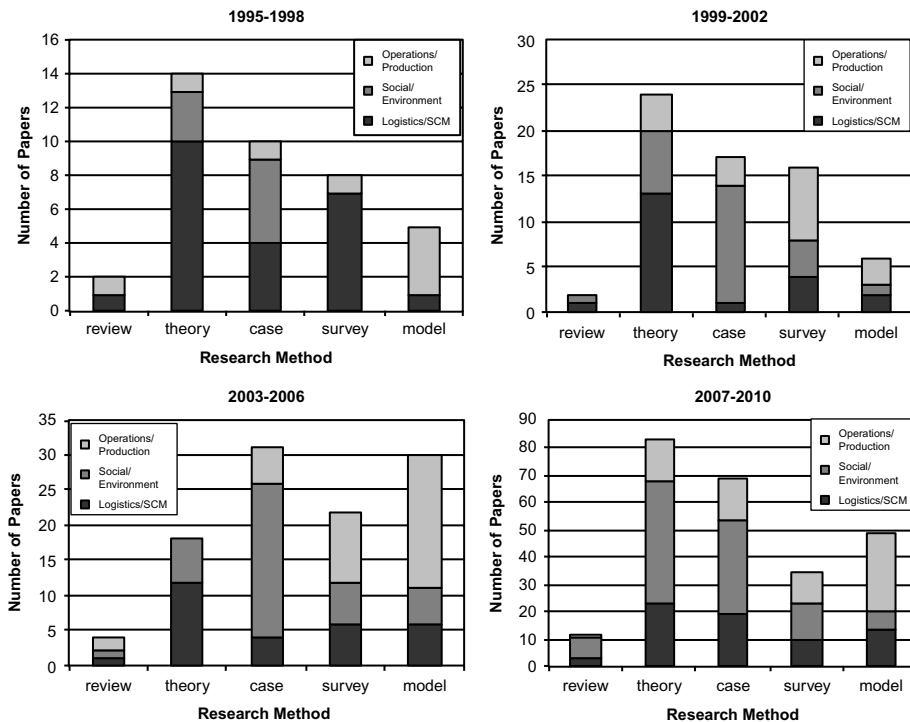


Figure 6. Research methods utilized

Figure 7.
Literature classification
matrix

	Environmental	Environmental/ Economic	Economic	Social	Environmental/ Economic/ Social	Environmental/ Social	Social/ Economic	
SCM Processes	89	41	31	12	16	7	0	196
SCM Processes/ SC Network Structure	34	22	3	8	6	3	0	76
SC Network Structure	27	12	5	6	0	6	0	56
SCM Processes/ SC Network Structure/ SCM Components	20	7	0	2	14	2	0	45
SCM Processes/ SCM Components	14	5	0	2	2	6	1	30
SCM Components	8	6	0	3	3	1	1	22
SC Network Structure/ SCM Components	8	7	0	4	1	9	2	31
	200	100	39	37	42	34	4	

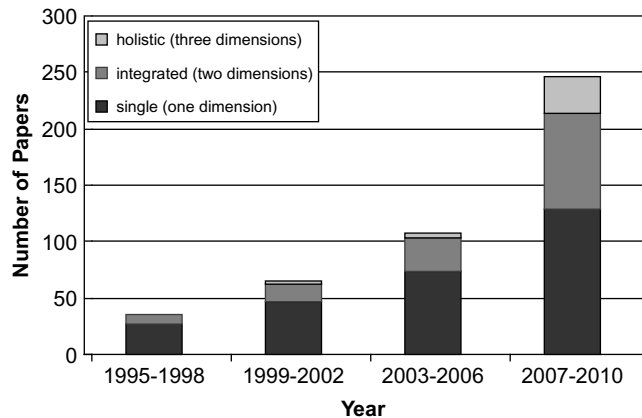


Figure 8.
Development of
sustainability focus

over time, similar results to that found with the sustainability dimensions were discovered. Most of the articles examined focused on aspects related to the individual elements of SCM rather than taking a more integrated or holistic approach (Figure 9). In particular, the predominance of articles examined aspects related to the SCM processes, primarily on aspects of the supplier relationship management, manufacturing flow management and returns management processes. To date, focus on aspects related to network structure and management component elements was significantly less. At the interface of all three dimensions/elements it was only possible to classify 13 publications (less than 3 percent of the entire database) as being holistic in nature. This underlines the apparent contradictoriness of sustainable SCM given that only subsets of each concept are currently receiving significant research focus.

Opportunities for future research

The examination and classification of the extant literature in the domain of sustainable SCM yielded several potential opportunities for future inquiry. The intent of this section is not to propose a comprehensive set of opportunities or to prioritize specific topics, but instead to provide “food for thought” for academics that are interested in conducting research in this area as to some potential topics.

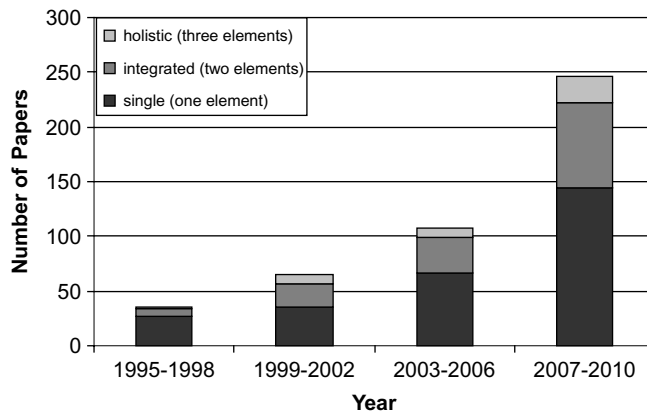


Figure 9.
Development
of SCM focus

An initial consideration should be made as to which methodologies and analysis techniques can or should be used to address the pressing research questions in this stream. While the nature of the research question should always drive these decisions, there may be opportunities to examine the appropriateness of using some of the currently under utilized methods for developing knowledge in this area. As shown by Figure 6, conceptual/theory and case studies have been the most common methodological approaches to date. Researchers may want to consider the potential use of other methods to support their efforts in this stream. However, even with the amount of conceptual work in this area, only a few theoretical constructs have been developed and tested to date. Thus, another potential opportunity for additional research would be to focus on the development of appropriate constructs and associated measurement scales to examine concepts specifically related to sustainable SCM. Given that the main focus has been on qualitative studies, the collection of data to examine issues in this space may also be an opportunity. The use of more quantitative methods will necessarily require an exploration of potential data sources that could support this approach. For example, experimental methods have been used to examine sustainability at a consumer level within the marketing discipline. The potential value of using experiments to address issues in this stream has been identified as an increasingly relevant approach moving forward (Fawcett *et al.*, 2011; Knemeyer and Naylor, 2011).

Researchers should also consider the applicability of a more multidisciplinary approach towards research activities in this stream. An analysis of the literature across the three disciplines of logistics/SCM, operations/production management and social/environmental management resulted in more similarities of themes than differences. While differences were found in the operationalization of the research, common themes in the areas of reverse logistics, product development, supplier relationships, remanufacturing and regulatory issues emerged when looking at topics across the disciplines and time horizons. It will be critical for researchers to take a broader examination of the existing literature as they formulate new research questions and undertake new projects. Additionally, it may be beneficial to bring additional disciplines together (e.g. strategic management, marketing, finance) to support a more holistic examination of sustainable SCM. This could include efforts to

combine or transfer existing theories and approaches to inquiry in this area. For example, potential synergies across the risk management and sustainability literature as it relates to SCM could be fertile areas for research efforts. Likewise, an examination of linkages between sustainable SCM activities and outsourcing or lean initiatives would seem to be viable for future research efforts.

Based on the analysis of the classification matrix, it was determined that additional research opportunities exist with respect to how SCM processes connect to the social dimension or combination of social and other dimensions of sustainability. While there has been a great deal of work focused on the supply chain processes, only 12 out of the 196 process-focused articles looked specifically at the social dimension of sustainability. Additionally, researchers should look to examine how decisions regarding the supplier relationship management process affect one member (e.g. manufacturer) versus multiple members in the supply chain network (e.g. supplier – manufacturer) since the business processes should be cross-functional and cross-firm in nature (Lambert, 2008). Thus, an integration of social network theory (Galaskiewicz, 2011) into the study of sustainability offers potential. As it relates to the GSCF framework, researchers may want to consider how sustainability efforts could influence supplier segmentation activities and/or the development of product and service agreements (PSAs) between companies. Recent issues involving Apple and their suppliers in terms of the social aspects of worker health highlight the applicability of such work.

It is also essential to evaluate the activities related to the supply chain processes and network structure as it relates to the potential economic impact for a firm. The analysis identified only three articles out of the 76 that looked at processes and network structure that addressed the economic dimension of sustainability. Specifically, there appears to be an opportunity for researchers to look beyond a focal firm and instead look at the role of interacting with external parties in this area. If for example, a company decides to work together with local suppliers as part of their supplier relationship management process to avoid the use of child labor, acquisition costs may increase. Due to these potential economic consequences related to a firm's sustainability decisions, it is necessary to consider these types of decisions from a more integrated perspective.

Likewise, there appears to be opportunities to look at the connection between managerial components and sustainability efforts, in an effort to better understand how managerial practices can influence the success or failure of sustainability initiatives. Only 22 out of the 456 articles examined in the study focused specifically on managerial components. Sustainability in SCM requires the application of behavioral management components. For example, trust is crucial across all members in the supply chain network and must be guaranteed from the initial supplier until the end-customer. Social network analysis provides at this point helpful information on mechanisms how to model and optimize dynamic networks. Implementation of each of the behavioral components in pursuit of sustainability initiatives may also require appropriate structural management components. For instance, it is inevitable to claim initiatives and sub-goals concerning sustainable development, but beyond these statements of intention, companies need a concrete toolbox that supports their efforts to reach their sustainability objectives. Concerning the social dimension, a company could start a 'health initiative' for their employees. Referring to this initiative the

company needs to ensure transparency of their efforts and it may need to develop specific “job safety” principles and guidelines to support attainment of their goals. But contemporaneously it is essential to implement the initiative with structural management components and to use adequate control mechanisms.

While there continues to be great value in focusing on particular dimensions of sustainability to develop depth of knowledge on a topic, there is also value for increasing understanding as to how the dimensions and elements support each other in the pursuit of an economically viable and sustainable supply chain. Similar to the social dimension, a detailed economic focus on issues related to sustainability has received only limited attention to date even within the business-oriented journals. This suggests opportunities for taking a more holistic approach towards sustainable SCM research that highlights more specific economic consequences of these efforts. Norman and MacDonald (2004) show in their article how difficult it is to make quantitative assessments of how good or bad some action in terms of sustainability is. Nevertheless, the impact of these activities on the economic performance is unquestioned. Thus, the challenge for researchers is to develop technical management variables to display and measure the impact of the improvement activities on the economic performance without getting lost in detailed accounting. Additionally, the development and validation of appropriate metrics and scorecards in support of sustainable SCM offers an opportunity for highly applicable research. One may consider looking to the economic value added (EVA) analysis as described in the GSCF framework as a starting point.

The financial justification of sustainable activities is without a doubt very difficult to examine. Researchers should assist companies looking to develop estimation tools and techniques. Referring to this, a solution could be to adopt existing tools and techniques to address the new questions of sustainability in SCM. Approaches like “green target costing” are therefore fertile opportunities to connect customer demands to successful sustainable initiatives. Providing the missing link to the economic dimension would seem to be critical in assuring a long-term view towards the implementation of sustainability in SCM.

Finally, another characteristic of the analyzed literature was the primarily upstream focus of the research across the examined disciplines. While this might be expected given the traditional focus of the journals examined, the lack of a downstream perspective was obvious. When classifying the literature, the number of articles relating to the customer relationship management or customer service processes was non-existent. Thus, there may be potential for researchers to conduct research related to how suppliers can engage their customers on sustainability initiatives or to better understand how sustainable supply chain initiatives can be used to enhance a company’s brand and/or marketing efforts. The marketing literature can be a source for ideas and theories that may assist in these efforts.

Conclusions

The current analysis supports the view that research activity focused on sustainable SCM continues to expand. As such, it is valuable for researchers to periodically access where research has been and where additional opportunities exist. Just as companies are faced with pressures to proactively address the topic of sustainability in their supply chains, it is important that researchers continue to look for ways to support these efforts through our work.

Several general as well as more specific opportunities are proposed for future research-based on an analysis using a literature-based classification matrix built on the two axes of “sustainability dimensions” and “SCM elements.” The analysis provides both academics and practitioners with an overview of the existing literature in this area as well as highlighting opportunities for future research effort. A wide variety of articles were analyzed across three distinct disciplines (logistics/SCM, operations/production management and social/environmental management) with a primary finding being that most of the existing approaches focus on narrowly defined aspects of the concept rather than taking a holistic view. In addition, while operationalization differences existed, the research themes were largely consistent across the disciplines and time horizons. Thus, there is a need to be aware of the developments in other disciplines and potentially look for opportunities for collaboration across disciplines. It is hoped that through this understanding of the characteristics of the existing literature as well as some of the proposed research opportunities that were presented, that researchers are better able to proactively conduct sustainable SCM research that helps companies and society address this important issue.

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Further reading

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