



# Sustainable supply chain management: evolution and future directions

Craig R. Carter

*Arizona State University, Tempe, Arizona, USA, and*

P. Liane Easton

*Center for Logistics Management, University of Nevada, Reno, Nevada, USA*

## Abstract

**Purpose** – The purpose of this paper is to conduct a systematic review of the sustainable supply chain management (SSCM) literature in the principal logistics and supply chain management journals, across a 20-year time frame.

**Design/methodology/approach** – The authors use a systematic literature review methodology. This methodology allows for the minimization of researcher bias and the maximization of reliability and replicability. The study's empirical validity is further enhanced by demonstrating high levels of inter-coder reliability across families of codes.

**Findings** – The field of SSCM has evolved from a perspective and investigation of standalone research in social and environmental areas; through a corporate social responsibility perspective; to the beginnings of the convergence of perspectives of sustainability as the triple bottom line and the emergence of SSCM as a theoretical framework. While the SSCM research has become more theoretically rich and methodologically rigorous, there are numerous opportunities for further advancing theory, methodology, and the managerial relevance of future inquiries.

**Research limitations/implications** – The trends and gaps identified through our analysis allow us to develop a cogent agenda to guide future SSCM research.

**Practical implications** – The current perspectives of SSCM hold important implications for managers, by directing limited resources toward projects which intersect environmental and/or social performance, and economic performance.

**Originality/value** – The paper provides a systematic, rigorous, and methodologically valid review of the evolution of empirical SSCM research across a 20-year time period.

**Keywords** Supply chain management, Economic sustainability, Social responsibility, Environmental management, Economic performance

**Paper type** Literature review

## Introduction

Sustainability has become a huge buzzword, both in today's business world and within the broader facets of society. It is difficult, for example, to walk by a newsstand without seeing at least one magazine cover featuring alternative sources of energy, climate change issues, or the iconic polar bear floating on a thin sheet of ice. There are a number of drivers for this rising prominence of sustainability, including supply and demand characteristics surrounding energy consumption, an increased understanding of the science relating to climate change, and greater transparency concerning both the environmental and the social actions of organizations.

These issues are relevant to managers, because their stakeholders – customers, regulatory bodies, non-governmental organizations, and even their own employees – are



increasingly demanding that organizations address and manage the environmental and social issues which are impacted by their operations. Supply chain managers are in a particularly advantageous position to impact – positively or negatively – environmental and social performance, through for example supplier selection and supplier development, modal and carrier selection, vehicle routing, location decisions, and packaging choices.

The purpose of this paper is to provide a systematic review of the evolution of sustainable supply chain management (SSCM) over the past 20 years, with the goal of identifying trends, potential consensus in findings and approaches across studies, and gaps, all of which can help to guide future research and improve the management of sustainable supply chain initiatives. In addition, we will take this opportunity to share our own perspectives regarding the current state of the field and where we believe research should be heading.

The remainder of the paper is organized as follows. In the next section, we describe the evolution of the research in, and management of, SSCM. We then describe the systematic literature review methodology and our specific application of this methodology. We present our findings in the final section of the paper, and we discuss the research opportunities and managerial implications associated with each set of findings.

### Summary of the literature

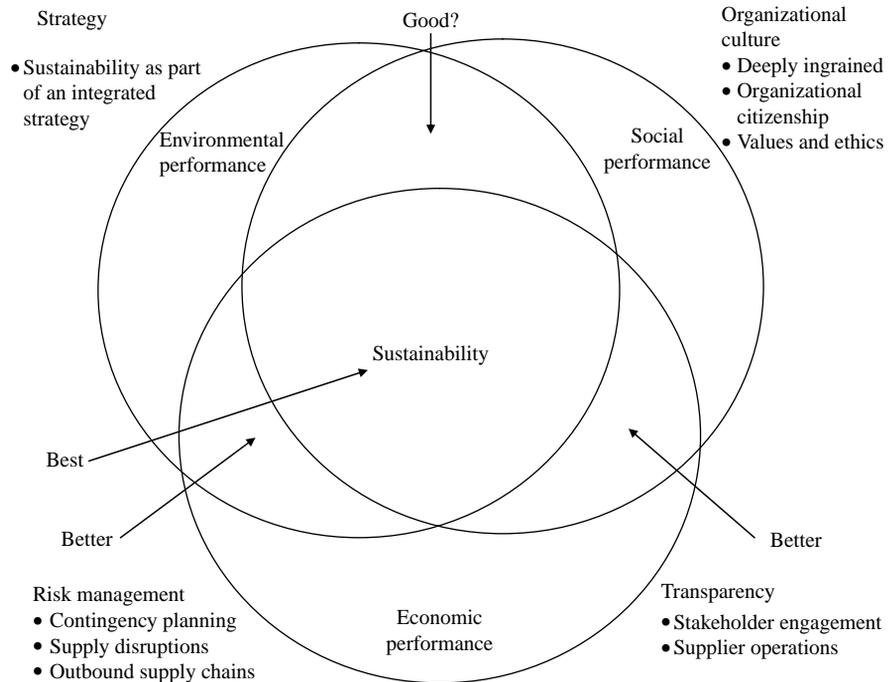
The conceptualization and management of social and environmental issues has evolved from what we term “standalone,” through the notion of social responsibility, and finally to the concept of sustainability. We describe this evolution next.

Much of the supply chain research that many would consider to be a part of corporate social responsibility (CSR) and sustainability has occurred in a standalone fashion, in which there has been little or no recognition of the interrelationships among topics such as the environment, diversity, human rights, philanthropy, and safety, and the fact that these are really components of the larger, more holistic concepts of CSR, and sustainability as they apply to supply chain management (Carter and Jennings, 2002). Similarly, supply chain managers often initiated and managed past projects in a standalone fashion, without a clear, holistic, and more strategic understanding of how these pieces of the puzzle fit together to create their organization’s overall sustainability position. Managers also often overlooked opportunities to learn from the successes and failures of one type of initiative – say in the environmental arena – and apply this knowledge to future projects in other parts of their organization and in other areas of sustainability, such as diversity and safety issues (Carter, 2005).

The works of Carter and Jennings (2002) and Murphy and Poist (2002) were among the earlier papers to view these standalone activities within a broader conceptualization of CSR. Carter and Jennings (2002) incorporate the social responsibility literature from the management field and utilize Carroll’s (1979, 1991) hierarchy of economic, legal, ethical, and discretionary responsibility to place the standalone supply chain management activities within the context of discretionary activities and thus social responsibility. Murphy and Poist (2002, p. 23) also position the standalone activities within the rubric of social responsibility and note the need to “seek socially beneficial results along with economically beneficial ones.” Both of these papers placed environmental as well as social (e.g. diversity, philanthropy, human rights, and safety) activities within the rubric of social responsibility.

Despite the incorporation of economic responsibility by these and other researchers who adopt a social responsibility paradigm, much of the extant literature in the area of “logistics social responsibility” has operationalized the environmental and/or social dimensions of CSR, without explicitly accounting for economic performance. Within industry, managers have often viewed social responsibility as just that – a responsibility – which did not necessarily yield financial rewards (Walley and Whitehead, 1994). While it is somewhat speculative on our part, possible reasons for these misperceptions include the lack of a more explicit incorporation of economic performance into social responsibility frameworks, lack of transparency (e.g. managing corporations during the pre-internet or early-internet time periods), and/or simply the use of the term “responsibility” and how this was presented to and perceived by managers and academics alike.

Carter and Rogers (2008) use a conceptual theory building approach to synthesize the literature at the time and incorporate complementary theoretical bases to introduce a theoretical framework of sustainability as it is applied to the supply chain – a concept which they refer to as SSCM (Figure 1). At the core of this conceptualization is Elkington’s (1998) triple bottom line: the intersection of environmental, social, and economic performance. This is a parsimonious and potentially powerful means of conveying what sustainability means for an organization. Rather than suggesting that firms identify and engage in social and environmental activities which will hopefully help, or at least not harm, economic performance, the triple bottom line explicitly directs managers to identify those activities which improve economic performance and dictate the avoidance of social and environmental activities which fall



**Figure 1.**  
Sustainable supply chain  
management

outside of this intersection. Carter and Rogers (2008) suggest that engaging in sustainability, and SSCM in particular, is not discretionary, but rather a requirement. SSCM involves the long-run improvement of an organization's economic bottom line and helps managers to answer the question of, "What is it that we need to do, not just to survive, but to thrive, and not just one year, three years, or five years from now, but in ten years, 20 years, and beyond?" Again, this is a salient conceptualization that can begin to allow managers to take tangible actions.

Examples of the activities that fall within the triple bottom line include cost savings associated with reduced packaging and more effective design for reuse and recycling; lower health and safety costs, as well as reduced turnover and recruitment costs due to safer warehousing and transport and improved working conditions; reduced labor costs in the form of higher levels of motivation and productivity and less absenteeism resulting from improved working conditions; lower costs, shorter lead-times, improved product quality, and lower disposal costs resulting from the implementation of ISO 14000 standards and the use of design for disassembly and reuse; and an enhanced organizational reputation, which can make a firm more attractive to both customers and suppliers (Carter and Rogers, 2008, pp. 370-1).

Carter and Rogers identify four supporting facets, or facilitators of SSCM, which are also shown in Figure 1:

- (1) strategy – holistically and purposefully identifying individual SSCM initiatives which align with and support the organization's overall sustainability strategy;
- (2) risk management, including contingency planning for both the upstream and the downstream supply chain;
- (3) an organizational culture which is deeply ingrained and encompasses organizational citizenship, and which includes high ethical standards and expectations (a building block for SSCM) along with a respect for society (both within and outside of the organization) and the natural environment; and
- (4) transparency in terms of proactively engaging and communicating with key stakeholders and having traceability and visibility into upstream and downstream supply chain operations.

We use this conceptualization of sustainability, which Carter and Rogers (2008, p. 368) define as, "the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains," in the systematic literature review which we describe next.

## Methodology

We used a systematic review methodology to create a dataset of articles and to analyze those articles. This approach was initially employed largely by medical researchers and has more recently been adopted in the field of management (Tranfield *et al.*, 2003). In contrast to a traditional narrative literature review, a systematic review of the literature reduces researcher bias concerning the inclusion or exclusion of studies, and clearly communicates how the review was performed (Denyer and Neely, 2004).

In particular, a systematic review allows for a high level of transparency, with the goal of maximizing replicability (Crowther and Cook, 2007).

To narrow the scope to a manageable number of articles, the following seven logistics and supply chain management journals were selected:

- (1) *International Journal of Logistics Management*.
- (2) *International Journal of Physical Distribution & Logistics Management*.
- (3) *Journal of Business Logistics*.
- (4) *Journal of Operations Management*.
- (5) *Journal of Supply Chain Management*.
- (6) *Transportation Journal*.
- (7) *Transportation Research Part E*.

These journals are commonly recognized as the top-tier and primary outlets within the broad field of empirical supply chain management research (Carter *et al.*, 2009; Giunipero *et al.*, 2008) and they are often incorporated in similar systematic reviews (Cantor, 2008).

In further narrowing the scope of the literature, the following subjects were excluded from the review: supply chain security; technical issues surrounding life cycle analysis, end-of-life, cost modeling, hazardous materials, etc. including the regulatory issues surrounding these subjects; macro/policy issues (as compared to micro, company, and supply chain-specific issues); reverse logistics and waste disposal; consumer issues (e.g. automobile safety); and papers where sustainability was a very ancillary part of the article's focus.

In addition, only papers that were empirical in nature were included in the review. Here, empirical approaches included the collection and analysis of primary or secondary data and included the use of surveys, case studies, interviews, and laboratory experiments, as well as conceptual theory building and systematic literature reviews. Thus, papers that used non-empirical approaches such as mathematical modeling, and manuscripts which expressed opinions but which relied on anecdotal evidence, were excluded from the review.

Next, we conducted a manual review of all articles published in these seven journals, from the period of 1991 through the most current issue that was available as of June 2010. This period of approximately 20 years was chosen, because:

- the majority of research which has examined standalone issues relating to SSCM has been published after 1990 (Carter and Rogers, 2008; Seuring and Müller, 2008); and
- the empirical research which has examined these supply chain issues from the more holistic perspectives of CSR and sustainability has been published almost exclusively during this period (Linton *et al.*, 2007).

This manual review of the literature resulted in the identification of 121 articles for initial inclusion in the literature database and helped in further refining the keywords used for the second phase of the search process. In this second phase of the search process, the authors conducted an electronic review of the literature, using

the keywords listed in Table I. These keywords were also based on the input of four industry professionals who participated in a conference call in early June 2010.

We used the EBSCO Business Source Complete database, with the keywords from Table I in the All Text and Abstract fields and the seven journal titles in the Publication Name field. The electronic search process resulted in the inclusion of an additional 11 papers in the initial database, for a total of 130 papers.

Based on the above criteria, we eliminated 50 of these papers, leaving 80 papers for our analysis. The most common reasons for the elimination of these papers were:

- a focus on macro-economic/public policy issues (Saltzman and Belzer, 2002) rather than the actual management of the supply chain;
- a modeling (Sheu, 2008) as opposed to an empirical methodology; or
- an article which was an editorial (Jayaraman *et al.*, 2007) or was largely descriptive in nature (Enarsson, 1998).

The basic bibliographic data (authors' names, title of article, journal name, year of publication, volume number, issue number, and pages) were then entered into a database in Microsoft Excel. Next, the lead author coded each article, based on the coding scheme displayed in Table II.

The second author independently check-coded a subsample of the study's articles. We calculated reliability based on the proportion of total pairwise agreements between the coders. The advantages of this method are that it is easy to calculate and to understand. In addition, capitalization on spurious agreement between coders should be minimized given the relatively large number of classification categories (Rust and Cooil, 1994), and accuracy tends to be high due to the relatively large sample size (Kraemer, 1979)[1].

Given the large number of classification categories, the initial inter-coder agreement rate is comparable to Cronbach's (1951) coefficient alpha (Perreault and Leigh, 1989). The overall inter-coder agreement rate across categories ranged from 93.64 to 100.00 percent, with an average of 97.27 percent. These rates far exceed the 0.70 recommended minimum and suggest a very high level of reliability and thus replicability of our data coding.

The results of our data coding are summarized in Table III. Rather than conducting means test after means test (and suffering from high alpha inflation), we instead focus on the most impactful and pragmatic differences within each of the categories displayed in Table III. We discuss these results in the next section of the paper, and in

Carbon	Human rights	Social enterprise
Corporate social responsibility	ISO 14000/1	Social responsibility
Diversity	Labor	Sustainable
	Minority business enterprise/minority women business enterprise	Sustainability
Energy	Minority	Sweatshop
Environment(al)	Philanthropy	Triple bottom line
Fair trade	Resource conservation	Women/women owned
Green	Safety	Working conditions
Health	Social	

**Table I.**  
Search terms

Coding family	Description of codes
Subject	<p>Standalone area(s): the article investigates a specific dimension(s) of sustainability (e.g. the environment)</p> <p>CSR: the article investigates CSR (both environmental and social issues), using framework(s) from the CSR literature</p> <p>Sustainability: the article investigates the triple bottom line and uses the triple bottom line as a framework for the article's conceptualization</p> <p>Note: an article could be coded as both CSR and sustainability, if both literature bases are used in developing the article's conceptualization</p>
Inferential	<p>Coded as inferential if the authors use inferential statistics to test hypotheses or propositions that are stated a priori, or if the authors use an inductive approach (e.g. grounded theory and rigorous analysis of qualitative data) to develop explicitly stated propositions or similar, explicitly stated relationships among variables</p> <p>Coded as descriptive if the authors take a descriptive approach to their analyses (e.g. present summary statistics; compare means; or even use inferential statistics such as analysis of variance (ANOVA), but without testing hypotheses or propositions which were developed and presented prior to the statistical analysis of the data)</p> <p>Coded as both if the authors take an exploratory approach, by, for example, presenting a research objective(s)/research question(s), but they do not explicitly present hypotheses or propositions which they then test. For example, the authors may identify potential antecedents and use regression analysis to see which independent variables "stick"</p>
Moderation Methodology and analysis	<p>Coded as moderation if the authors test for moderation/interaction effects</p> <p>Methodology: this is the primary methodology used to collect the study's data. Examples include case study, survey, archival data, literature review, depth interviews, and focus group interviews</p> <p>Analysis: the approach(es) used to analyze the study's data. Examples include confirmatory factor analysis (CFA), exploratory factor analysis, regression, ANOVA, structural equation modeling, and qualitative data analysis</p> <p>Validity: coded as yes if the authors address both reliability and other facets of validity, somewhat if the authors assess reliability but not other facets of validity, and no if the authors address neither reliability nor validity</p> <p>Social desirability bias: coded as yes if the authors address this bias, and no if they do not</p> <p>Sample size 1: the number of organizations/firms from which data were collected</p> <p>Sample size 2: the total number of respondents/informants (this number is equal to sample size 1 in the case of a single, key informant, or greater than sample size 1 in the case of multiple informants)</p> <p>Unit of analysis: generally, one of the following: the individual, the function or group, the firm (includes a plant or strategic business unit (SBU)), or the supply chain. Examples of other include projects and published articles as the unit of analysis</p>
Context	<p>Key informant: the functional affiliation of the key informant (e.g. procurement, production, distribution, and marketing)</p> <p>Industry: the investigated industry; coded as multiple in the case of multiple industries</p>
Theoretical lens(es)	<p>Assessed whether the authors use any of the following theories as lenses, or even rationale in developing their models: transaction cost economics, the resource-based view, the knowledge-based view, stakeholder theory, and/or other</p>

**Table II.**  
Coding scheme

	Percent <sup>a</sup> (full time period) (%)	Percent <sup>a</sup> (2001-2010) (%)	Percent <sup>a</sup> (1991-2000) (%)
<i>Section A: subject</i>			
Environment	42.50	35.42	53.13
Diversity	15.00	4.17	31.25
Human rights/quality of life	6.25	4.17	9.38
Safety	21.25	27.08	12.50
Philanthropy	0.00	0.00	0.00
CSR	11.25	18.75	0.00
Sustainability	15.00	25.00	0.00
<i>Section B: industry</i>			
Automotive	2.78	4.76	0.00
Consumer products	13.89	11.90	16.67
Food and beverage	2.78	2.38	3.33
Transportation	20.83	23.81	16.67
Multi-industry	48.61	47.62	50.00
Other	11.11	9.52	13.33
<i>Section C: theoretical lens(es)</i>			
Transaction cost economics	6.25	8.33	3.13
Resource-based view	11.25	16.67	3.13
Knowledge-based view/organizational learning	2.50	4.17	0.00
Stakeholder theory	21.25	35.42	0.00
Other	31.25	45.83	9.38
Multiple lenses	21.25	33.33	3.13
None	55.00	33.33	87.50
<i>Section D: validity</i>			
Addressed (reliability and multiple, additional facets of validity)	45.45	64.44	18.75
Partially addressed (reliability, but no additional facets of validity)	11.69	8.89	15.63
Not addressed	42.86	26.67	65.63
<i>Section E: social desirability bias</i>			
Addressed	15.38	25.00	3.45
Not addressed	84.62	75.00	96.55
<i>Section F: unit of analysis</i>			
Individual	20.78	17.78	25.00
Function or group	9.09	8.89	9.38
Firm (including plant or SBU)	62.34	60.00	65.63
Supply chain (at least at dyad)	3.90	6.67	0.00
Other	3.90	6.67	0.00
<i>Section G: methodology</i>			
Survey	60.00	47.92	78.13
(Multiple) Case study	17.50	22.92	9.38
Archival data	8.75	10.42	6.25
Empirical/systematic literature review	5.00	8.33	0.00
Conceptual theory building	3.75	4.17	3.13
Focus group interviews	2.50	2.08	3.13
Individual interviews	2.50	4.17	0.00

(continued)

Table III.  
Results

	Percent <sup>a</sup> (full time period) (%)	Percent <sup>a</sup> (2001-2010) (%)	Percent <sup>a</sup> (1991-2000) (%)
<i>Section H: analysis</i>			
Descriptive statistics (summary statistics, means testing, and rank analysis)	26.53	11.11	54.29
Regression analysis	16.33	19.05	11.43
Qualitative data analysis (data coding, matrix analysis, content analysis)	15.31	17.46	11.43
CFA	12.24	15.87	5.71
Structural equation modeling, path analysis	9.18	12.70	2.86
EFA	8.16	11.11	2.86
Other	5.10	6.35	2.86
ANOVA	4.08	3.17	5.71
Conceptual theory building	3.06	3.17	2.86
<i>Section I: moderation</i>			
Moderation/interaction effects	10.26	13.04	6.25

Table III.

**Note:** <sup>a</sup>Percentages in some sections may not add to 100 percent, due to double coding

doing so, we outline what we believe to be the most pertinent areas of SSCM which require new and/or additional research.

### Discussion: evolution and future directions

#### *Subject*

Environmental aspects of supply chain management have been the leading focus of research over the past 20 years (Section A of Table III). The environment is of course a key component of the triple bottom line and has been in the media spotlight concerning climate change and rising energy prices. To some degree as well, the terms “sustainability” and “environment” have been used interchangeably, both by researchers and by managers. This misunderstanding was particularly prevalent during the early conceptualizations of sustainability. This is not an uncommon phenomenon when a new paradigm emerges. However, as perspectives have begun to converge, we are now seeing an increasingly uniform understanding and application of the term sustainability as the triple bottom line.

Replacing this focus on standalone environmental issues have been articles which take a more holistic approach, either by explicitly incorporating social responsibility (the intersection of environmental and social performance) or sustainability – the triple bottom line. While none of the articles in the 1991-2000 time period investigated their topic of interest using these lenses, 18.75 percent of the articles in the 2001-2010 time period used CSR and 25 percent of the articles in the 2001-2010 time period used sustainability as the frameworks for their research.

#### *Industry*

Unlike our subject analysis, we do not find the dramatic trends and differences in the industries which were selected for investigation in the first versus the second decades of the 20-year time period. There has, however, been a large focus on consumer product

industries and the transportation industry (Section B of Table III). Consumer products firms were often chosen because they have been closest to the consumer and have often been earlier adopters of certain environmental and social initiatives (Carter and Carter, 1998). Transportation carriers have been chosen by researchers who have focused on safety issues and because they have a large carbon footprint that is more obvious to many of their stakeholders. The majority of the industries studied, however, fall under the category of “multi-industry,” which could include consumer products and transportation carriers, but more often included multiple industries in manufacturing or manufacturing together with service. This focus by researchers is understandable, given the need to generate adequate sample sizes and perhaps the desire to increase the external validity and generalizability of their findings.

However, this decision by researchers to use multi-industry samples also presents an opportunity for future research to take deeper dives into individual industries as sampling frames. More importantly, researchers should carefully select individual industries with the goals of identifying specific types of sustainability activities that are germane to those industries, and industries in which the boundaries of specific theories might be extended or shown not to apply. As one broad example, researchers are just beginning to examine service supply chains (Sampson and Spring, 2011), defined here as the procurement and distribution of services (whether by manufacturing or service industries). The sustainability characteristics of service supply chains likely differ from those of their manufacturing counterparts and will be ripe grounds for future investigations.

### *Theoretical lenses*

The most striking result that is displayed in Section C of Table III is the relative dearth in the use of a theoretical lens(es) to examine problems of interest in the sustainability arena. About 55 percent of articles over the full-time period failed to employ any sort of theory. It is encouraging to note, however, that there is a very strong trend toward integrating theory in SSCM research. While more than 87 percent of articles did not employ a theoretical lens in the 1991-2000 time period, this omission dropped to just over 33 percent in the 2001-2010 time frame.

Of the theories which have been used, stakeholder theory (Freeman, 1984) has been the most prevalent, followed by the resource-based view, and the closely aligned natural resource-based view (Hart, 1995). The other category includes a diverse set of theories from multiple fields, such as examining the role of dynamic capabilities in achieving competitive advantage in sustainable global supplier management (Reuter *et al.*, 2010), using brand equity theory to explain how competitive advantages are derived from sustainability (Flint and Golicic, 2009) and employing self efficacy theory to better predict safe employee behavior (Brown *et al.*, 2000).

Another trend which is displayed in Section C of Table III is the increased use over time of multiple theoretical lenses within the same study. When done well, such blending of diverse, complementary, and even overlapping theories can help to better develop hypotheses, add rich insights to the interpretation of findings, and help better understand the boundaries of where these theories apply. As one example, Pagell *et al.* (2010) show that the traditional purchasing portfolio matrix developed by Kraljic is not effective within the realm of SSCM. The authors integrate transaction cost economics, the resource-based view, and stakeholder theory to modify the traditional purchasing

portfolio matrix and create a theoretically derived purchasing portfolio matrix which managers can use as a highly effective strategic tool.

Interestingly, transaction cost economics is one of the lesser used theories in the SSCM literature that we reviewed. This suggests an opportunity for future research. One particularly relevant facet of transaction cost economics is that of the bounded rationality of actors, which occurs due to limits associated with communication and information processing capabilities, and relatedly, the potential for opportunistic behavior (Williamson, 1975, 1985). Bounded rationality also exists due to a lack of transparency, and this can lead to both opportunistic behavior and perceptions of opportunism (whether real or imagined). Such perceptions of opportunistic behavior can be exacerbated as firms source from distant suppliers and as suppliers and other members of the supply chain make claims regarding how their products are manufactured (e.g. “organically certified,” “safe working conditions,” “low emissions,” etc.). Future research might examine how bounded rationality and perceptions of opportunism within the context of SSCM impact the decision to source domestically or even locally, as opposed to internationally, and how supply chain governance structures are affected – e.g. a muscular versus benign approach to hybrid contracting (Williamson, 2008).

#### *Methodology and analysis*

*Validity.* Validity is considered to be the “sine qua none” of empirical research. Indeed, without a rigorous examination of validity, the results of empirical studies are at best suspect. Disturbingly, over 42 percent of the papers did not address validity and another 11.7 percent only partially addressed empirical validity for the 1991-2010 time period (Section D of Table III). However, similar to our other findings, we can see a positive trend concerning methodical assessments of validity in the articles included in our review. Over 64 percent of articles rigorously assessed validity in the 2001-2010 time period, versus fewer than 19 percent in the 1991-2000 time period. In the future, authors must assess not only reliability but also the multiple facets of validity which are relevant to their empirical methodology(ies), including content validity, convergent validity, and discriminant validity.

*Social desirability bias.* Where applicable, articles were coded as either addressing or not addressing social desirability bias[2]. This bias refers to the tendency of study participants to provide answers and share perspectives that they believe will be viewed favorably by the researcher (Crowne and Marlowe, 1960). Over the full-time period, only 15.4 percent of the applicable articles addressed social desirability bias (Section E of Table III). It is encouraging to note that this percentage increased from a scant 3.45 percent in the 1991-2000 time period to 25 percent in the 2001-2010 time period. Still, a large majority of the papers did not assess social desirability bias, or even discuss the potential limitations associated with this bias. While there may be pragmatic limitations to assessing this sort of bias in some studies (ethnographies and even certain case study designs come to mind), there are abbreviated versions of the Crowne-Marlow social desirability bias scale which might be employed (Carter and Jennings, 2004) for survey and laboratory study methodologies in future research.

*Unit of analysis.* The most common unit of analysis displayed in Section F of Table III is the firm, followed by the individual, and the function or group (e.g. the buying center). Unlike many of the other aspects of article methodology and analysis,

we did not find large trends or shifts in the unit of analysis across time periods. There has, however, been an increased emphasis on the supply chain as the unit of analysis (from no articles in the first time period to 6.67 percent in the second time period) and other units of analysis such as a project or a published article (again an increase from 0 to 6.67 percent across the two time frames).

Given the relatively large emphasis on the firm as the unit of analysis, our findings suggest at least three viable opportunities for future SSCM research. First, there is an opportunity to use the individual as the unit of analysis. While we are beginning to develop an understanding of what drives firm behavior, we have much less of an understanding of the drivers of individual managers' behavior and of their decision-making processes (Gattiker and Carter, 2010; Kaufmann *et al.*, 2011). The concept of behavioral supply management, defined as, "the study of how judgment in supply management decision-making deviates from the assumptions of homo economicus" (Carter *et al.*, 2007, p. 634), would be a very logical and fruitful intersection with SSCM. Some sample research questions could include examining supply chain management employees as internal stakeholders, and how employee attitudes and commitment to organizations might differ based on differing levels of SSCM (see Mowday (1998) for an excellent synthesis of the organizational commitment literature); examination of the biases that can enter the individual decision-making process, and how these biases can impact the efficacy of SSCM initiatives; and investigation of how individual managers can influence and gain the commitment of key internal stakeholders to bring SSCM projects to fruition.

Second, the supply chain, even at the dyadic level, is consistently underrepresented as a unit of analysis. While the collection of even dyadic data (as opposed to data involving three or more firms) is quite difficult using methodologies that we have traditionally relied upon (e.g. surveys and case studies), there are certainly opportunities to use archival and secondary data to investigate SSCM. Calantone and Vickery (2010) provide a number of suggestions concerning archival data sources that might be applied to supply chain problems in general. Some of these data sources, such as Compustat, might be combined with other secondary data sources, such as the Wharton Research Data Service, the Dow Jones Sustainability Indexes, and the Global Reporting Initiative™ to investigate, for example, the relationship between company environmental and social performance versus economic performance, and the relationship between regulatory compliance and economic performance across members of a supply chain. Further, most of these databases allow researchers to employ "time series, longitudinal panels, or time series cross-sectional designs," (Calantone and Vickery, 2010, p. 5) to complement and extend existing findings (Carter *et al.*, 2000; Klassen and McLaughlin, 1996).

*Methodology.* About 60 percent of the articles included in our systematic review of the literature used a survey as the primary methodology to collect data (Section G of Table III). There are, however, encouraging trends relating to the dominance of this methodology: while almost 80 percent of the articles from the 1991 to 2000 time period used a survey methodology, this percentage dropped to <50 percent in the later, 2001-2010 time frame. Table III shows a sharp increase in the use of case studies, archival data, and individual interviews during the second half of our 20-year period of study. This is an encouraging sign, since the use of multiple methodologies allows for triangulation and the maximization of internal validity, external validity, and realism across studies (McGrath, 1982). In addition, we will probably see a further decline in

the use of survey methodologies in the future, due to the difficulty of collecting large sample sizes from cross-sectional surveys and limitations associated with common method variance. We will, however, likely see surveys used at least somewhat more often within individual organizations or dyads.

One troubling gap in the data displayed in Table III is the lack of laboratory and field (quasi) experiments. In addition, there are opportunities to use richer qualitative approaches such as ethnographies (see the work of Belk *et al.* (1988, 1989) for an example of an innovative approach to using ethnographies within the field of marketing). Both of these approaches can help to better triangulate findings across extant studies.

*Analysis.* The body of empirical SSCM research relied heavily on descriptive statistics during the first half of the past 20 years (54.29 percent, as given in Section H of Table III); this percentage dropped to below 12 during the 2001-2010 time period. This progression appears to follow a similar movement across the broader body of empirical research in supply chain management (Carter and Ellram, 2003). This is a very encouraging trend for two reasons. First, these summary statistics often lack richness in terms of both advancing theory and providing value-adding managerial implications. Second, and somewhat ironically, while “unsophisticated” from a statistical standpoint, many of the summary statistics which employed means testing were incorrectly performed. In particular, many of these analyses involved a large number of univariate means tests, which failed to adjust individual *p*-values and thus suffered from alpha inflation. In other words, many of the early analyses which involved means testing likely reported significant differences when in fact, some of these significant differences did not exist.

Often replacing the use of summary statistics, papers published in the 2001-2010 time period utilized regression analysis, structural equation modeling, path analysis, and rigorous qualitative data analysis to investigate inferential relationships, and factor analysis to assess measurement validity. In addition, while only about 10 percent of the articles during the full 20-year time period included moderating variables in their models and/or tested for interaction effects (Section I of Table III), this percentage increased from 6.25 percent during the first half of the time period to over 13 percent during the 2001-2010 time frame.

We have also begun to see more innovative approaches to traditional analyses. For example, one particularly innovative alternative to analyzing qualitative data using content analysis was recently employed by Tate *et al.* (2010). Here, the authors used center resonance analysis to examine the CSR reports of 100 leading sustainability organizations. Their analysis allowed them to develop rich understandings of how these companies integrate the triple bottom line into both their internal operations and their broader supply chains. We have also begun to see the use of social network analysis to analyze the relationships among actors as the unit of analysis, as opposed to the actor as the more traditional unit of analysis (Carter *et al.*, 2007). In addition, it is likely that we will see the use of more advanced econometric analyses as researchers begin to employ archival data to test theoretically derived models (Calantone and Vickery, 2010).

Finally, < 4 percent of the articles in our study used conceptual theory building as a methodology to develop or expand theoretical insights. The field of supply chain management has generally relied upon theories developed in adjacent

fields (e.g. management – the resource-based view, institutional theory – and economics – transaction cost economics). This is also true within the realm of SSCM. Given the nascency of sustainability as a whole, along with the pivotal role that supply chain management can play in an organization's sustainability efforts, the area of SSCM is ripe for such theory development. While Carter and Rogers (2008) provide an initial theory development effort, much additional work is needed.

One likely reason for the lack of conceptual theory development in SSCM is a lack of methodological training in the conceptual theory development methodology among the broader community of supply chain management scholars. This lack of training likely limits both motivations to use conceptual theory building and the effectiveness of actual efforts. Further, when journal reviewers lack this training, this can act as an additional barrier to publishing such research. We refer the reader to a forthcoming discussion forum in the *Journal of Supply Chain Management* (2011, Vol. 47 No. 2), which will address these issues and offer guidance concerning both how to craft and review conceptual theory development papers.

### Conclusion

We must admit that many of the trends that appear in the individual analyses of our data are probably signs of a broader trend toward performing more rigorous research in the field of supply chain management as a whole. Still, we believe that these individual analyses, and the trends which they reveal, help to further highlight the many exciting research opportunities in the area of SSCM. As noted in the paper's introduction, there are several reasons why SSCM is enduring and not simply the "flavor of the month." The broad concept of sustainability, and the key interfaces that sustainability has with supply chain management, strongly suggests that sustainability is instead license to do business in the twenty-first century. And supply chain management is an integral component of this license. Our hope is that our systematic review of the literature, coupled with our own perspectives and experiences, will help to meaningfully guide future research in this strategic and imperative area of supply chain management.

### Notes

1.  $n = 80$  is a relatively large number of units of analysis compared to most qualitative data, which are analyzed in our field.
2. For certain methodologies and data sources, such as conceptual theory building and archival data analysis, this field was coded as "not applicable".

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