

Issues In A Sustainable Supply Chain Logistics

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Abstract

Sustainable development has made remarkable progress drawing the attention of researchers and practitioners in establishing sustainable supply chain logistics. The purpose of this study is to briefly review the literature of the sustainable supply chain logistics over the last decade. The themes classified in terms of economic, environmental and social sustainability. This paper will discuss the gap in the literature towards sustainable supply chain logistics. Opportunities are identified for integration and cross-fertilisation between research papers in disciplines such as logistics and occupational safety and health management. This paper identifies future research directions.

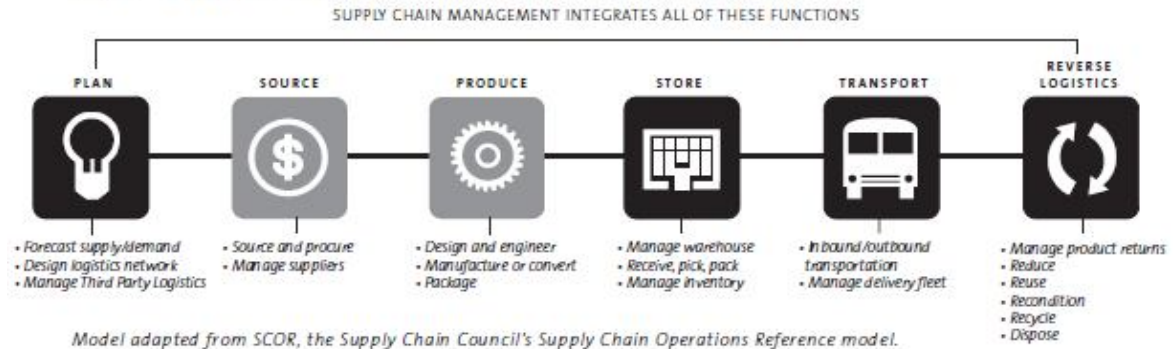
Keywords: Literature Review; Logistics; Sustainability, Supply Chain Logistics (SCL).

1. Introduction

Market globalisation and competition have forced many companies to revisit their supply chain logistics strategies. In recent years, there has been increasing awareness of the sustainability of supply chain logistics. Enterprises compete based on multiple competitive performance objectives such as quality, price, responsiveness, flexibility, and dependability. However, issues of sustainable supply chain logistics have important implications for business opportunities to clients with a low risk tolerance.

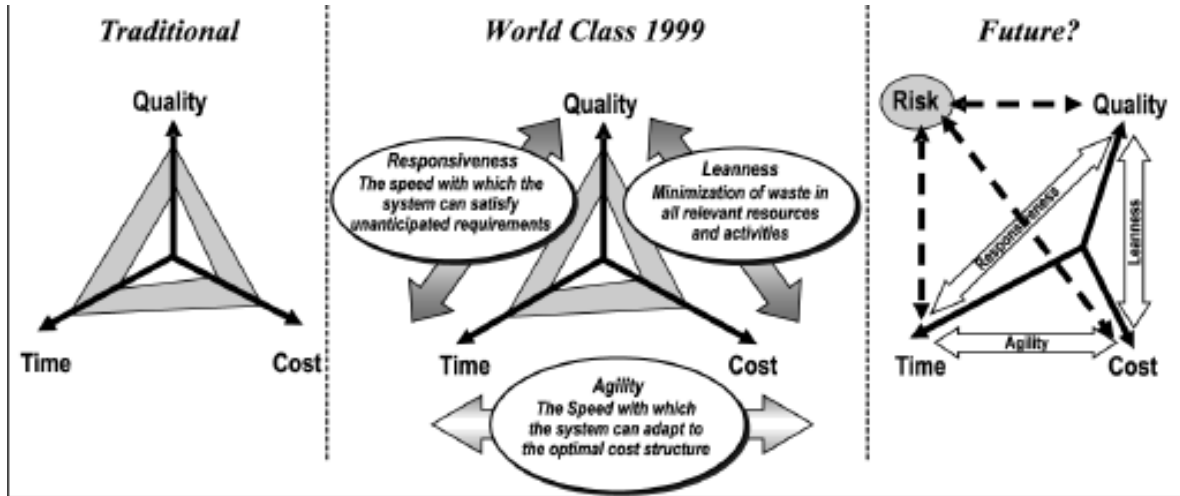
Supply chain logistics (SCL) is better understood within the context of end-to-end supply chain management, depicted in Figure 1 [57]. End-to-end supply chain management emphasizes communication, collaboration and coordination between a company's supply chain functions and those of its suppliers, customers and service providers. SCL functions — the darker-shaded areas labelled plan, store, transport and reverse logistics — are integral to a high-performing supply chain.

Figure 1 – Supply Chain Logistics Functions within an End-to-End Supply Chain



Source: Sustainable Supply Chain Logistics Guide [54]

The principles of logistics and supply chain have been influenced in the last few decades, first to reduce costs, then time and quality, and lately focused on concepts of responsiveness, agility and leanness [64] (See Figure 2).



Source: Adapted from A.T. Kearney [6] by Norman and Jansson [64]
Figure 2 Key focus areas within logistics and SCM

In the concept of supply chain risk management, March and Shapira [52] define 'risk' as "the variation in the distribution of possible supply chain outcomes, their likelihood, and their subjective values" (p. 1404). The focus of supply chain risk management is to try avoiding the devastating ripple effects that business disruptions can have in a supply chain. Examples of such "supply chain rippling effects" from are:

- Natural Disasters. Japan Tohoku Earthquake 2011 and Thai Flood 2011 caused disturbance of semiconductor and hard disc drives supply chains.

- Fires. Supplier's chips contamination affected the Ericsson production of mobile phones, caused a quarterly operating loss of US\$200 million in its division, loss of market share, sale of plants and eventual creation of Sony Ericsson.

Norrman and Jansson [64] described how Ericsson, after a fire at a sub-supplier, with a huge impact on Ericsson, has implemented a new organization, and new processes and tools for SCRM. The article concludes with a discussion of risk related to traditional logistics concepts (time, cost, quality, agility and leanness) by arguing that supply chain risks should also be put into the trade-off analysis when evaluating new logistics solutions – not with the purpose to minimize risks, however, but to find the efficient level of risk and prevention. Employees' work performance is of great importance to any organization. It determines the quality and promptness of services provided by the organisations. Corporations are under the attention of consumers, NGOs, and media on top of government enforcer in order to be good world citizens and to be responsible for the society that their operations affect and to take into consideration the sustainability of the globe.

In the ISO 9004: 2009, sustainability is defined as: "The sustained success of an organisation is demonstrated by its ability to satisfy needs and expectations of its customers and other interested parties over the long term and in a balanced way" [45]. Among the interested parties or business stakeholders are customers/clients, shareholders, people in the organisation (management, employees), suppliers / partners (insurers, financial institutions/lenders, and society (public / surrounding community/ government /regulatory bodies). ISO 9004:2009 provides guidance for the continual improvement of an organisation's overall performance, efficiency and effectiveness based on a process-based approach. It focuses on meeting the needs and expectations of customers and other relevant parties, over the long term, and in a balanced way.

Companies have improvements in working conditions and labour rights at these workplaces. However, these improvements might often be limited in their scope and therefore not always sustained. Consequently, changing the 'mind-sets' of the suppliers by Corporate Social Responsibility (CSR) managers is important towards establishing long term strategic relation with their stakeholders and suppliers in particular. Halldorsson et al. [40] pointed out that the best way to describe a company's social responsibility is people. As a result, the UN Global Compact Office [89] has also developed a guide offering practical guidance on how to develop a sustainable supply chain program by featuring numerous examples of good corporate practice, based on the values and principles of the Global Compact. The risk mitigation activities may include providing suppliers with training on sustainability issues, developing worker empowerment programs, or partnering with suppliers to develop sustainability management systems such as health and safety conditions, to reduce the risk of poor quality or production disruptions [88].

Carter and Rogers [20] defined sustainable supply chain management as '...the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains'. Usually, the authority may employ factory audits and the threat of sanctions to drive behavioural change, on the other hand, the commitment approach used information gathering and the tracking of workplace conditions over time to engage factory managers over how best to tackle workplace problems may be a cost-effective and sustainable. On the other hand, by embracing the role of consultant, advisor, and even teacher and layering this on top of their traditional role as compliance officer, the auditors were able to enrich their own jobs and gain legitimacy in the eyes of the firms they audited (by giving them valuable advice) since their work was clearly leading to sustained improvements in working conditions and labour standards at these particular factories.

Seuring and Muller [74] presented the findings from a Delphi study. To identify and measuring impacts on sustainable supply chain, the trade-off or win-win situations among the three dimensions of sustainability

(1: totally disagree to 5: totally; environmental mean = 3.52, economic mean = 3.36 and social mean = 2.76), it was found that all mean values are close to 3, which implies that there is no obvious relation among the single dimensions of sustainability. If at all, environmental (mean = 3.52) and social issues (2.76) seem to go hand in hand with the strongest tendency towards win-win situations as well as only minor differences among the three groups of participants. They conclude that competitiveness of supply chains has also to be reached including environmental and social performance of all companies involved.

As reported at the Damco website [25], in conjunction with the SCM Logistics World Conference, Damco was honoured at the 8th annual SCM Logistics Excellence Awards 2012 at the category "Supply Chain Sustainability Award" for excellence in showcasing customer sustainability results. Damco was recognized for their efforts in working with their clients and stakeholders in reducing their carbon footprint. Damco was helping their partners drive change to green their operations.

2. Literature Review

This paper will provide an overview of the Sustainable Supply Chain Logistics literature. Knowing the wider perspective of the Sustainable SCL is an important step in knowing the branch of sustainability. Research in sustainable supply chain logistics and broader corporate social responsibility has been developed rapidly since the turn of new millennium. Linton, Klassen and Jayaraman [51] found that papers mention the concept of sustainability in the management literature increased explosively between 1996 and 2005. Sloan [78] introduces a new framework that will be used to guide the development a measure of supply chain sustainability, involves factors in three broad dimensions: environment, society, and economy.

In a survey conducted by Abukhader and Jonson [1], they reported the ties between environment and SCM & OM research that was still not as strong as desired, let alone sustainability. The main exceptions were on either greening the supply chain or reverse logistics and closed-loop supply chain management. Svensson [85] argues that to be sustainable, the definition of a supply chain must be expanded and be classified according to the degree of renewable and recycled resources used. Carter and Rogers [20] put forward a sustainable supply chain management framework in the form of propositions based on resource dependence theory, transaction cost economics, population ecology, and the resource-based view of the firm. Hutchins and Sutherland [44] reviewed metrics, indicators, and frameworks of social impacts and initiatives relative to their ability to evaluate the social sustainability of supply chains, and added social sustainability into business decision-making. De Brito, and van der Laan [28] concluded that the reasons for procrastinating integration of sustainability in supply chain research is the focus on operations rather than environmental or social issues. In short, review of previous researchers reveals that many of the sustainable studies focus on environmental issues probably driven by economic costs priority. Nevertheless, emphasis on social issues has started to gain attention in recent years.

3. Methodology

Besides providing a review of literature on sustainable supply chain logistics, this paper covers the following objectives:

- Organising the publications in an orderly manner to enable easy and quick search;

- Classification of the literature;
 - Highlighting gaps and providing suggestions for further research.
- This paper identifies scholars and contributions in sustainable supply chain logistics.

The attributes of the classification scheme considered essential to developing sustainable supply chain logistics for comparisons are:

- (a) Sustainable SCL: economical approaches. Under this categorisation, all literatures dealing with economic applications specific to SCL. This category forms a major aspect of the present paper.
- (b) Sustainable SCL: environmental approaches. Under this categorisation, all literatures dealing with environment applications specific to SCL. This category forms a recent aspect of the literature.
- (c) Sustainable SCL: social approaches. Under this categorisation, all literatures dealing with social applications specific to SCL. This category is considered to recognise paradigm shifts in its applications.

Over one hundred articles reviewed inclusive those cited by ISI Journal Citation Reports (JCR) were mainly published in the following journals:

- California Management Review
- Corporate Social Responsibility and Environmental Management
- European Journal of Operational Research
- International Journal of Production Economics
- Journal of Cleaner Production
- Omega
- Resources, Conservation, and Recycling
- Supply Chain Management: An International Journal
- Transportation Research Part E: Logistics and Transportation Review

4. Review Of Previous Research On Sustainable Supply Chain Logistics

Montreuil [58] considered economic as internal to the supply chain logistics network while environmental and social (includes occupational safety and health) as external to the network. Previous studies (mostly from journal articles) available on sustainable SCL were reviewed for their application and development based on three dimensions of sustainability classification scheme, namely sustainable economically, environmentally and socially.

Global Reporting Initiative [35] provided aspects of sustainability that include economic, environmental, social (labour practices and human rights), society and product responsibility. United Nations Global Compact and BSR [88] provided guide on supply chain sustainability which explains the steps of determining the scope, engaging with suppliers, determining roles and responsibilities, industry collaboration and multi-stakeholder partnerships, and establishing goals and tracking and communicating performance. The supplier code of conduct may include its principles on human rights, labour, environment and anti-corruption.

Table 1 Classification of Sustainable SCL Literature

Classification	Literature
Internal: Economic factors	Norrman & Jansson [64], Kleindorfer & Saad [50], Narasimhan & Talluri [62]
External:	Wu & Dunn [97], Enarsson [32], Guide & Srivastava [37], Beamon [7],

Environmental factors	Walton et al. [94], Handfield et al. [42], Arena et al. [4], Sarkis [70], Vachon & Klassen [93], Matos & Hall [53], Srivastava [81], Vachon [91], de Brito & van der Laan [28], Gold et al. [36], Sarkis et al. [71],
External: Social factors	Cantor [15], Hutchins & Sutherland [44], Halldorsson et al. [40]

Fundamentally, it is probably advantageous to work with a variety of decision-makers and experts to obtain an agreed upon rating system or importance of intensity factors [95]. In general the study from Wilson [96] reported the greatest impact occurs when transportation was disrupted between the tier 1 supplier and warehouse due to the traditional structure of which the retailer, warehouse, and tier 1 supplier experience the greatest inventory fluctuations and the highest goods in transit to their facilities. Later, the study of Pia [66] found that while material damages make up 58% of unwanted events in the supply chain, occupational accidents account for as much as 26%.

4.1. Research of SCL Sustainable Economically

Literatures on SCL sustainable economically are mainly focus on supply chain risks. As noted by Braithwaite and Hall [11] supply chains that run to hundreds if not thousands of companies over several tiers present significant risk. For supply chain contexts, they emphasise that the relationship between corporate strategy, risk and the implications for supply chain management are poorly understood and in need of further exploration. Souter [80] stressed that companies should not only focus on their own risks: they must also focus on risks in other links in their supply chain. Johnson [46] divided supply chains risks between supply risks (e.g. capacity limitations, currency fluctuations and supply disruptions) and demand risks (e.g. seasonal imbalances, volatility of fads, new products). Zsidisin et al. [100] focused on supply risks related to design, quality, cost, availability, manufacturability, supplier, legal, and environmental, health and safety. Christopher et al. [24] suggested that in order to assess supply chain risk exposures, the company must identify not only direct risks to its operations, but also the potential causes or sources of those risks at every significant link along the supply chain. Chopra and Sodhi's [22] approach to supply chain risk involved stress testing to identify specific risks and tailoring strategies to adapt a risk mitigation approach for each specific risk. Christopher and Peck [23] argued that as supply chains become more complex as a result of global sourcing, supply chain risk increases. Hence, the challenge to business was to mitigate that risk through creating more resilient supply chains. In this perspective, resilience implied flexibility and agility, and its implications on supply chain extend beyond process redesign to fundamental decisions on sourcing and the establishment of more collaborative supply chain relationships based on far greater transparency of information. Kleindorfer and Saad [50] used operations principles, such as supply chain optimization, supply chain agility, contingency planning, collaborative sharing of information in the supply chain, flexibility and modularity, and total quality management (TQM) as the building blocks to effectively manage disruptive risk in a supply chain. According to Chopra and Meindl [21], all supply chains were subject to some amount of risk, including supply disruptions and delays, demand fluctuations, and price fluctuations; while Narasimhan and Talluri [62] characterized supply chain risk as a disruption or negative outcome triggered by unpredictable and/or uncertain events.

4.2. Research of SCL Sustainable Environmentally

A carbon footprint is “The total set of greenhouse gas emissions caused directly and indirectly by an [individual, event, organisation, product] expressed as CO₂ [17]. Srivastara [81] defined green supply chain management (GSCM) as integrating environment thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the product after its useful life. Aronsson [5] highlighted how environmental problems have received increased attention during the last decade. Khoo et al. [48], Sarkis [70] discussed related to the development of green supply chains. Key academics have argued different angles to green supply chain management. The key themes over the last twenty years were the concepts of green design, green operations, reverse logistics, waste management and green manufacturing [37, 81].

Among these themes, eco-design was the most adopted green supply chain initiative followed by green purchasing, while reverse logistics showed the lowest level of adoption [31]. Works such as Byrne and Deeb [14]; Geyer and Jackson [34]; Srivastava and Srivastava [83]; Shih [76]; Nagorney and Toyasaki [61]; Min et al. [56]; Sarkis et al. [71] discussed reverse logistics, whereas Arena et al. [4] and Beamon [7], Beamon [8], De Carvalho [29], Handfield et al. [41], Hart [43], Khiewnavawongsa and Schmidt [47], Matos and Hall [53] discussed life-cycle analysis. Enarsson [32] discussed on green purchasing and Shang et al. [75] discussed green marketing respectively. Gold et al. [36], McKinnon [55], Rodrigue, Slack and Comtois [67], Rosen et al. [68], Ryan [69], Seuring [73], Vachon [90], Wu and Dunn [97] discussed resource or transaction costs while BearingPoint [9], Ngo and Mohanta [63], McKinnon [55], Murphy et al. [60], Srivastava [82] discussed environmental / ecological impacts, ecological footprint or waste. Trunick [87] discussed environmental regulations while Handfield et al. [42], Walton et al. [94], Beamon [7], Pesonen [65], Simpson et al. [77], Vachon and Klassen [93] discussed environmental performance measures. Carbon Disclosure Project (CDP) [16], De Brito et al. [27]; Delmas and Montiel [30], Fortes [33], Gunther and Scheibe [38], Hall [39], Sarkis, Zhu and Lai [72], Theyel [86], Zhu et al. [98], Zhu et al. [99] discussed in relation to stakeholder theory, while Anbumozhi and Kanda [3] and Murphy and Poist [59] discussed green supply chain logistics across geographical regions.

4.3. Research of SCL Sustainable Socially

As early in the beginning of the millennium, Broman, Holmberg and Robert [12] forwarded the ‘The Natural Step’ framework to create a vision of how companies can pursue sustainability while satisfying customer needs. For instance, in the transportation sector, Deakin ([26], p.6) defined sustainable transportation as “transportation that meets mobility needs while also preserving and enhancing human and ecosystem health, economic progress, and social justice now and for the future.”

McIntyre [54] suggested that those parts of the supply chain that could respond to ‘sustainability’ issues would generally be more proactive and able to meet changing customer requirements and market forces, ultimately possible to differentiate and innovate to create value. The supply chain as an entity also has a variety of stakeholders, even more so than individual enterprises with an expansion of these stakeholder groups particularly when environmental issues are introduced [27]. Hutchins and Sutherland [44] further proposed four social performances that businesses should establish. Firstly, labour equity expresses the distribution of worker compensation within a company. Secondly, health care was needed to characterize a

corporation's role in providing or helping the health care of companies' staff as well as their families. Safety refers to the safety of the workplace within a company. Lastly, philanthropy described financial support that companies offer to community and to greater community.

Literatures shown Carter [19] studied issues on the environment, safety, and human rights in logistics and supply chain and the interrelationships among these aspects of social responsibility. Specifically, Carter and Jennings [18] argued that logistics providers should take their drivers' quality of life into account, such as operating schedules that permit drivers' adequate time at home, and paying adequate salary; where safety issue is also concerned such as adequately maintained vehicles as well as properly cleaned trailers and tankers. Cantor [15] urged that it was important that firms across all echelons of the supply chain improve their safety practices.

The findings from Kiathulthorn and Sathapornwanit [49] demonstrated that CSR was one of the considerations when selecting Third Party Logistics (TPL) providers as the buyer company applied CSR requirements to the suppliers. Montreuil [58] suggested exploiting the digital internet metaphor to develop a physical internet vision towards meeting the global logistics sustainability grand challenge by defining its thirteen characteristics. Blanco and Cottrill [10] cited the case of ASICS, a Kobe, Japan-based manufacturer which sees structural opportunities of sustainability management over the long run, such as more transparency along the value chain to environmental performance, efficiency gains that decrease the barriers to enter into active sustainability management and collaboration, and through sustainability management disclosure, easier to compare different companies.

5. Concluding Remarks and Implications for Future Studies

Research that attempts to create a sustainable SCL is rather limited. It is necessary to understand the types of sustainable SCL, and then the appropriate initiatives. Researchers have studied different angles to sustainable SCL. The industry has developed beyond internal aspects of risk controls that ensure economical interest, to intense attention on environmental sustainability, and currently focuses on social aspects such as occupational safety, freedom of association or anti-corruption. This will facilitate a migration of knowledge and practice so that industry can benefit from sustainable SCL implementation. As the sustainable SCL research is growing rapidly, we see continual progress in building knowledge and insight. Hopefully, the research approaches suggested here could facilitate leveraging the lessons learned.

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