Spring 6-10-2017

PROFIT, PLANET AND PEOPLE IN SUPPLY CHAIN: GRAND CHALLENGES AND FUTURE OPPORTUNITIES

Taghikhah Firouzeh
University of Technology Sydney, Australia, firouzeh.taghikhah@student.uts.edu.au

Daniel Jay
University of Technology Sydney, Australia, jay.daniel@uts.edu.au

Mooney Grant
University of Technology Sydney, Australia, grant.mooney@uts.edu.au

PROFIT, PLANET AND PEOPLE IN SUPPLY CHAIN: GRAND CHALLENGES AND FUTURE OPPORTUNITIES

Research paper

Firouzeh, Taghikhah, University of Technology Sydney, Australia, firouzeh.taghikhah@student.uts.edu.au
Jay, Daniel, University of Technology Sydney, Australia, jay.daniel@uts.edu.au
Grant, Mooney, University of Technology Sydney, Australia, grant.mooney@uts.edu.au

Abstract

Recent pressure from governments and customers on supply chain organizations to consider environmental and social issues has increased dramatically. The challenge ahead for supply chain managers is how to grow business profit while protecting the planet and respecting people's rights. The significance of this issue motivates researchers in the fields of "sustainability" and "supply chain" to further integrate these concepts. To identify affected areas, and how sustainability influences them, this research has employed a literature survey of related papers published between 2012 and 2016 within 16 A indexed journals that are relevant to Information and Computing Science, Transportation/Freight Services and Manufacturing Engineering. Findings show that sustainable supply chain network structure, impact factors, relationship integration and performance evaluation are the main research topics in these streams. The role of decision-making tools within each discipline, the key methodologies and techniques are discussed. Generally speaking, primary challenges in the sustainable supply chain domain devolve from use of inadequate decision-making tools and inappropriate information systems. The holistic picture presented in this paper is important for helping scholars, system developers, and supply chain analysts to become more aware of current grand challenges and future research opportunities within this field.*

Keywords: Sustainable Supply Chain, Sustainability, Environmental and Social, Literature Survey

1 Introduction

Supply chains (SC) are an integrated system of organizations working collaboratively to increase value. While these systems are profitable for their stakeholders, there are concerns about their performance with regards to ecological impacts and social effects. It has been confirmed by many researchers (Carter & Rogers, 2008; Reefke & Sundaram, 2016) that SC processes directly contribute to climate change, growth of greenhouse gas emissions, degradation of energy resources and social inequality. Because of this, SCs are under high pressure from both government and non-government organizations (NGO) to minimize the detrimental impacts on planet and people. To deal with these matters, both academia and industry have started working on how to better integrate different aspects of sustainability into various areas of SC (Daniel & Talaei-Khoei, 2016). The idea of substituting the traditional chains with sustainable ones has prompted the concept of "sustainable supply chain (SSC)".

Instead of focusing on traditional economic objectives, SSC organizations adjust their processes with legislative regulation to demonstrate their commitment to sustainability (Burgess et al., 2006). As stated by Seuring and Müller (2008), the synergy of sustainability in the literature of supply chain and operations management is relatively new but growing continuously. Considering the triple bottom line

concept of profit, planet, and people (3P), the main challenge ahead would be balancing monetary income, environmental care and social concerns simultaneously (Fortes, 2009) to achieve ideal SSC. Being mindful of this statement, two critical questions should therefore be addressed:

- RQ1: In which areas of the supply chain domain has the integration of sustainability (in terms of profit, planet, and people) already been explored?
- RQ2: What challenges and potential future directions apply within SSC research?

In order to answer these questions, this paper provides a broad view of the SSC discipline by identifying the themes prevalent within recent SSC research:

1. Network Structure - explores the extent to which sustainability affects supply chain design, planning, and operation;
2. Impact Factor - identifies drivers for, and barriers to, implementing sustainability in SC;
3. Relationship Integration - investigates relationship strategies, organizational capabilities, and managerial perceptions of SSC;
4. Performance Evaluation - assesses the sustainable performance of supply chain from the partner assessment and industry sector perspectives.

Although several literature reviews have been published about SSC, few directly address a 3P concept of sustainability. This research contributes to the body of knowledge from both practical and theoretical perspectives by providing important implications for investigators seeking to identify challenges and opportunities in SSC research.

The current study is structured as following. In section 2, the definitions of SSC are elaborated. In section 3, the research methodology is outlined. Section 4 examines and classifies SSC literature over the last five years. Section 5 discusses the findings of the pervious section and highlights challenges and implications for academics and practitioners interested in SSC. Finally, section 7 summarises conclusions and limitations of this study.

2 Sustainable Supply Chain

Sustainability: United Nations' Brundtland Commission (WCED, 1987) defines sustainable development as responding to the needs of current populations without endangering the resources for future generations. Sustainability in terms of triple bottom lines is defined as profit, planet and people:

- Profit: Economic dimension of sustainability - emphasises increasing outputs value, while reducing inputs value, thus maximising profit, revenue and economic growth (Closs et al., 2011). Such growth should also be aligned to environmental and social benefits.
- Planet: Environmental dimension of sustainability - encourages organizations to reduce (or at least minimize) their negative ecological impacts and to actively contribute to green practices, such as natural resources protection, waste collection, pollution prevention, etc.
- People: Social dimension of sustainability - supports the development of programs related to society welfare and stakeholders' satisfaction. Often overlooked in the literature, this dimension lacks broad consensus on analyzing impacts, as reflected by Seuring and Müller (2008).

One example of a conceptual framework for such a triple bottom line is presented in Figure 1.

Figure 1. Triple bottom line framework (Shnayder et al., 2015)

Sustainable supply chain: Evolving from lean thinking (with a cost minimization focus) towards agile paradigms (responding quickly to changes) enterprises move from just-in-time towards quickly-respond strategies. Thereafter, SC emphasizes a philosophy of resilience, absorbing uncertainty and straightforward recovery to a basic state. Additionally, the green/sustainable paradigm has emerged to encourage ecological and social performance of the business. This paradigm also underpins definitions around SSC as "the strategic, transparent integration and achievement of sustainability social, environmental, and economic goals in the systemic coordination of critical inter-organizational business processes within a chain for the long-term existence" (Carter & Rogers, 2008).

3 Literature survey approach

Addressing the research questions, this study undertakes a literature survey to evaluate and explore the wide-ranging body of knowledge related to SSC. In order to prevent bias, the study was conducted through structural stages inspired from Kitchenham (2004) and White and Marsh (2006). To assist readers in comprehending the logical order of the research process, a conceptual scheme of the methodology is depicted in Figure 2.

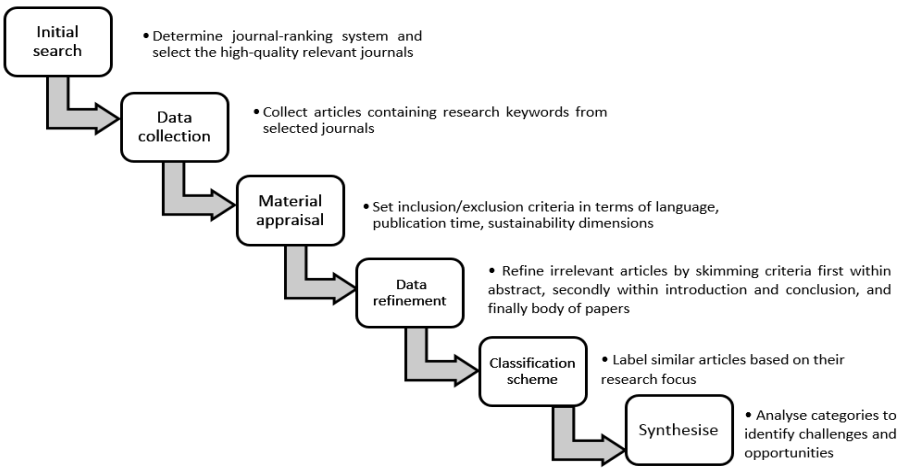

Figure 2. Research process diagram

3.1 Initial journal list development

In commencing the process, the research questions and objectives were reviewed in depth to determine research parameters and decide initial development of the dataset. Instead of search for keywords within electronic databases and library services, it was decided to extract SSC papers from a journal list called Excellence in Research for Australia (ERA). The reason behind this choice is that the prime focus of this research is finding the highly relevant journals in the relevant discipline. ERA evaluates research produced in Australian universities against national and international benchmarks. The quality of journals within the categories of Information and Computing Science, Business and Management, Transportation and Freight Services, Applied Mathematics and Manufacturing Engineering were examined using ABDC ranking system. To conduct the study on highest impact journals, only ones ranked A* (i.e. top quality) were selected for further analysis. Finally, 16 highest-quality journals remained in the initial dataset (see Table 1).

3.2 Data collection, appraisal, and refinement

In the next step, inclusion/exclusion criteria were determined enabling the refinement of the research dataset. For inclusion, an article should be English; be published within the last five-years between January 2012 and September 2016. This time span represents the current state of the research domain.

"Sustainable supply chain" was the key phrase used for locating relevant articles in the selected journals. By the end of this stage, a total of 311 articles were collected from 16 journals.

Afterward, those not addressing the economic, environmental and social dimensions of sustainability simultaneously were eliminated through a three stage refinement process. In the first stage, abstracts of 311 papers were reviewed. From this number, 190 articles were excluded, 35 articles included and 86 entries required a more detailed examination. In the second stage, the introduction and conclusion sections of the 86 debatable articles were reviewed and, subsequently, 43 papers removed while a further 15 articles accepted. In the final stage, the whole text of the 28 remaining objects went through a careful scrutiny and 3 more papers were added to the refined dataset. Table 1 presents the final list of 16 journals hosting 53 papers which meet the research criteria.

No.	Title	Academic Database	Initial number of papers	Final number of papers
1	International Journal of Production Economics	Science Direct	173	29
2	European Journal of Operational Research	Science Direct	48	9
3	Transportation Research Part E: Logistics and Transportation Review	Science Direct	29	5
4	OMEGA	Science Direct	22	5
5	Transportation Research Part B: Methodological	Science Direct	5	0
6	Journal of Operations Management	Science Direct	5	2
7	Decision Support Systems	Science Direct	3	1
8	Decision Science	Wiley online library	5	1
9	Regional Studies	Taylor & Francis	3	1
10	Management Science	INFORMS Journals	7	0
11	Journal of the Association for Information Science and Technology	Wiley online library	3	0
12	European Journal of Information Systems	Springer	2	0
13	IEEE Transactions on Fuzzy Systems	IEEE Xplore Digital Library	2	0
14	Operations Research	INFORMS Journals	2	0
15	Information Systems Journal	Wiley online library	1	0
16	Journal of Information Technology	Springer	1	0
	Total number of papers		**311**	**53**

Table 1. List of selected journals and the number of relevant articles

3.3 Classification scheme and dataset analysis

To satisfy outcomes of the investigation, content analysis and classification criteria have to address the research questions. Therefore, in this stage, all the articles were carefully scrutinized and labeled based upon their research objectives and dominant motifs. This appraisal permitted the articles to be grouped into categories:

1. *Network structure* of sustainable supply chain;
2. *Impact factors* that drive or hinder sustainability adoption in supply chain;
3. *Relationship integration* of focal firm with other partners to extend sustainability in chain;
4. *Performance evaluation* of supply chain in terms of sustainability;

A detailed analysis for each category and its related sub-categories is presented in the results section.

4 Results

Regarding bibliographical data, an overview of the article and time distribution is provided in Figure 3. For journal articles, a great portion of studies (nearing 75%) appeared in "International Journal of Production Economics" and" European Journal of Operational Research" implying the importance of SSC researches for the two aforementioned journals. Moreover, dates indicate a publication peak (16 out of 53) occurring in 2016 after maintaining a constant state 2012-2015 with a lag in 2013.

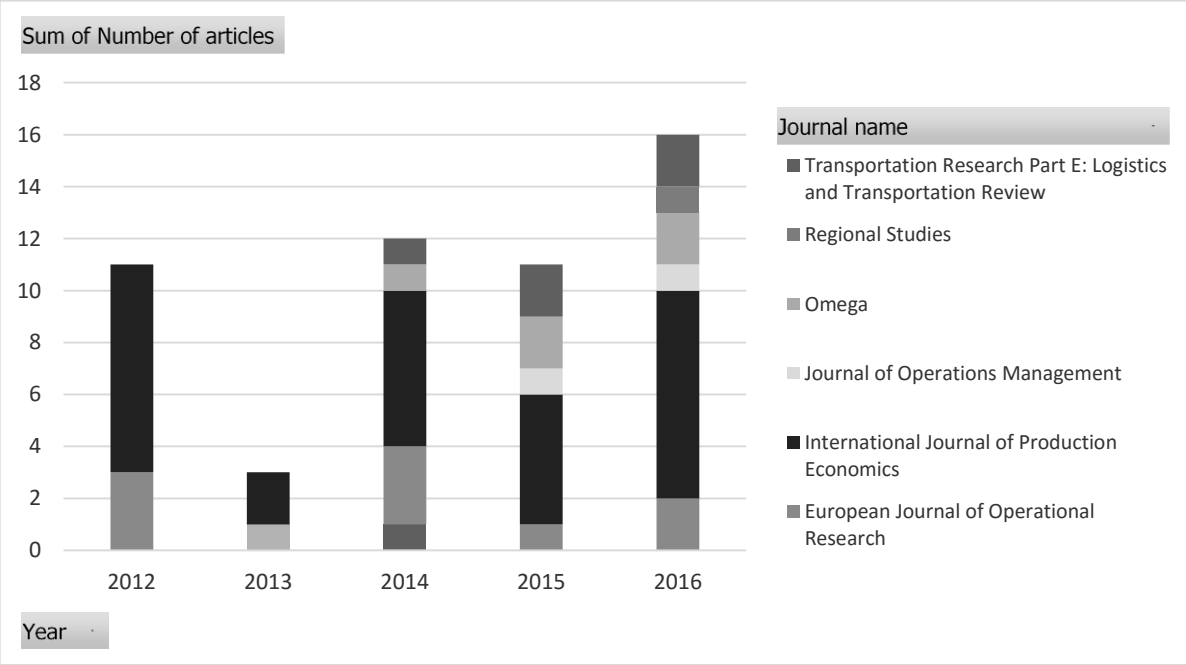

Figure 3. Distribution of articles across time

Research focus of filtered articles emphasized four core topics, namely: (4.1) SSC network structure; (4.2) SSC impact factors; (4.3) SSC relationship integration; and (4.4) SSC performance evaluation. Figure 4 depicts a general picture of identified themes with the associated items explicated in sub-sections after.

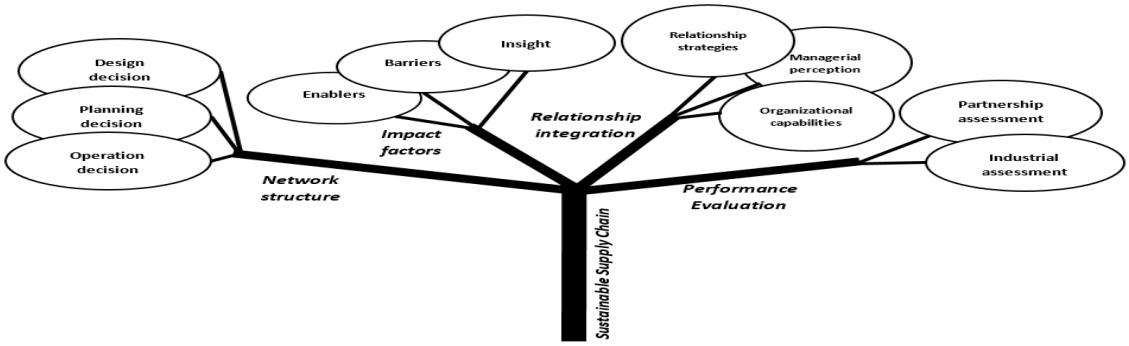

Figure 4. Research themes of SSC

4.1 SSC: Network structure

Requirements for sustainability (e.g. environmental regulation imposed by government, workers' rights, etc.) have significantly impacted SC networks necessitating that they reform their structure. To become compatible with sustainability principals, SC organizations remodel processes and activities aligned to economic, environmental and social principals. Depending upon the duration of impact and frequency of occurrence, network configuration decisions fall into three phases – namely, design, planning and operation. Network designs embody strategic decisions related to chains' structure, resources and processes long-term. Network planning then considers tactical decisions related to production capacity and flow of material after the structure of a chain is set. Finally, network operation references day-to-day (or week-to-week) decisions concerned with inventory management. Methodical reviews of sustainable supply chain network configuration literature have been produced by both Tang and Zhou (2012) and Jaehn (2016).

Design decisions: This phase is associated with designing/optimizing a supply chain network for the long-term, while ensuring its performance is sustainable (in terms of economic, environmental, and social objectives) and also using appropriate decision-making tools. For example, Varsei and Polyakovskiy (2016) adapted multi-objective mixed-integer programming to design a sustainable wine supply chain network. The reliability of designed networks would grow as uncertainty around decision parameters for demand, supply, price, etc. are increasingly taken into account. The study of Gonela et al. (2015) (where the uncertainty of demand, price and supply in bioethanol supply chain was considered using stochastic approaches) is an instance of such research. Alternatively, and unlike traditional SC processes, a reverse/circular supply chain has responsibility to collect used products for recycling, refurbishment, remanufacturing, repair or disposal, so that they can be more environmentally friendly, economic profitable and socially acceptable. As an example, Pishvaee et al. (2014) designed a closed-loop medical supply chain for adapting fuzzy-possibilistic programming techniques to address supply, process and demand uncertainties. Further to such instances, two comprehensive reviews of sustainable supply chain network design literature have been conducted by Chen et al. (2014) and Eskandarpour et al. (2015).

Planning decisions: This implies making decisions about technology selection, route selection and resource allocation within a supply chain to ensure that sustainability requirements are met. As one example among many, Gebrezgabher et al. (2014) investigated the type of processing technologies that waste management systems should adopt to help make supply chains sustainable.

Operation decisions: This refers to handling inventory systems for short-term sustainability consideration, when supply chain strategies are fixed and planning policies already defined. For instance, Bouchery et al. (2012) considered three key sustainability objectives when optimizing inventory.

4.2 SSC: Impact Factors

Implementing a designed network structure for sustainability within supply chains requires taking a close look at the driving and hindering factors affecting the transaction process – these can also differ by industry when considering SSC program adoption. Drivers are motivating factors facilitating supply chain engagement with sustainable practices; conversely, barriers deter and hinder this integration (Ansari & Kant, 2016).

Enablers: Assisting implementation of sustainability initiatives was often a principal focus for many studies. For example, Gmelin and Seuring (2014) considered cross-functional work, top management involvement, formalized processes and market planning as key success factors towards sustainable development of new product. Alternatively, Gopalakrishnan et al. (2012) considered the essential elements of sustainability adoption as government legislation, stakeholder pressures, resource depletion, low carbon economy, environmental standards and social responsibility. With a holistic view, regulation and policies, information technology, management commitment, customer requirements, competition pressure and extended relationship with partners were the most cited enabling factors addressed in the literature.

Barriers: Impediments to sustainability implantation were the research interest of many investigators such as Luthra et al. (2016), Silvestre (2015) to name just two. These hindrances may exist in the external or internal environment of a business. For instance, Chowdhury and Quaddus (2016) identified internal barriers to adopting sustainable service design as lack of information, skilled human resource, training and development, responsiveness of service delivery and resources/funds.

Insight: These are the action plans organizations take to ensure sustainability strategies can be implemented in SC networks. In this regard, Klooster and Mercado-Celis (2015) demonstrated the important role of institutional arrangements which support network governance and upgrading strategies in developing the sustainability of local furniture production networks in the state of Mexico.

4.3 SSC: Relationship Integration

Besides enabling/deterring factors, there are also influencing strategies assisting focal firms to manage relationships with partners towards implementing sustainability across the chain. In addition, to adapt sustainability relationship strategies, the enterprise must improve associated organizational capabilities.

Relationship strategies are the principals that focal firms employ to engage partners in such a way that they comply with SC sustainability expectations. The number of publications regarding sustainable supplier-manufacturer relationships indicates that it is becoming an interesting area for researchers. As the general public can censure focal firms for the unsustainable activities of their suppliers, they therefore need to enact sustainability beyond purely organizational boundaries to the supply chain level (Wilhelm et al., 2016b). For instance, the commitment to sustainability also affects sustainability outcomes where intra-and inter-firm collaborative strategies are embedded in buyer-supplier relations (Beske et al., 2014). Another example would be the study of Wilhelm et al. (2016b) which considered vertical complexity, horizontal complexity, institutional distance, transparency, supplier capabilities and power as critical strategies and contingencies for managing sustainability in multi-tier supply chains. Wilhelm et al. (2016a) further explored the influence of agency factors (incentives for primary and secondary agency role, information transparency between lead firm and first and second tier supplier) and institutional factors (regulatory pressure for sustainability, lead firm pressure for sustainability) on the first-tier suppliers' strategies for sustainability standards adoption.

Organizational capabilities are factors enabling the process of relationship strategies adoption in sustainable supply chains. For example, Grimm et al. (2014) identified focal firm-related, relationships-related (trust and commitment), supply chain partners-related, contextual-related (cultural distance) factors as critical success elements for sustainability in sub-supplier management. Moreover, the influence of ethical culture elements (including ethical behaviour of top management, incentives, imple-

mentation of codes of conduct, obedience to authority) on sustainable purchasing decisions have also been investigated (Zailani et al., 2012).

Managerial perception encompasses a wide variety of issues involved in the sustainable supply chain area. Analysing current trends, and providing insight for future sustainability integration within the context of forward supply chain and closed-loop supply chain, Reefke and Sundaram (2016) and Govindan et al. (2015) covered a broad-spectrum of the relevant literature.

4.4 SSC: Performance Evaluation

Sustainable performance measurement is concerned with quantifying information about the effectiveness (extent environmental and social objectives are being met) and efficiency (extent financial objectives are being met) of a dynamic system (Tajbakhsh & Hassini, 2015). However, developing SSC performance measurement systems to assess the progress of implementing sustainability practices is a complicated task due to the expanded (and expanding) scope of SCs. As different partners adopt different sustainability initiatives, various and often contradictory measures are required to assess the sustainability performance of SC. Carter and Rogers (2008) categorized a performance framework based on the supply chain partner, type of industry, and size of firm.

Partner assessment: Refers to aspects of an evaluation framework designed to measure sustainable performance of only one supply chain entity such as supplier, manufacturer, retailer or distributor. The process of selecting suppliers and extending the relationship with them is a long term and considered decision. Each party follows certain objectives in making relations with the other - vendors are interested in buyer companies with higher business opportunities while buyers seek suppliers with higher sustainability performance. For example, Baskaran et al. (2012) used sustainability measures including discrimination, human rights violations, child labour, long working hours, societal/unfair competition and pollution/concern for the environment to assess the sustainable performance of suppliers.

Industry sector assessment: Points to sustainable assessment frameworks developed based upon supply chain industry focus and geographical location. The complex and oft-changing situation around executing sustainability practices has altered the focus of organizations away from using all-purpose assessment frameworks. One criticism regarding application of such is that outcomes are not sufficiently reliable when specifically linked to a chosen case study. Searching within the SSC papers, they largely intended to develop new metrics and framework for evaluating the performance of SSC. The reviewed evaluation frameworks of this category concentrate on automotive, textile, mining, electronic, oil, and bioenergy industries operating in different countries (United States of America, Ghana, United Kingdom, and China). As a sample of other references pertaining to this issue, Kusi-Sarpong et al. (2016) evaluated the performance of mining industry in Ghana in regards to 34 sustainability criteria using fuzzy analytical network process approach. Tseng et al. (2016) s' study was the sole article which proposed a sustainable performance model for service supply chain regardless of geographical location.

5 Discussion and Analysis

Key research themes in SSC were elaborated and analyzed in section 4 and Figure 5 demonstrates the annual percentage of articles in each theme from 2012 to 2016. In highlight, researchers put a considerable amount of effort on developing research into SSC network structure and relationship integration. Less attention has been given to SSC performance evaluation and impact factor analysis. Particularly in the former area, the number of papers dropped significantly from 4% in 2012 to less than 2% in 2014, before becoming of more interest once more in 2016 and rising to nearly 6%. Regarding the latter theme, the number of publications also rose to around 6% during the period of study after sharp falls in 2013 and 2015. In fact, all the research themes witnessed a fall in 2013 due to the low number of SSC publication that year before peaking in 2016, as the concept of sustainability once more become heavily topical.

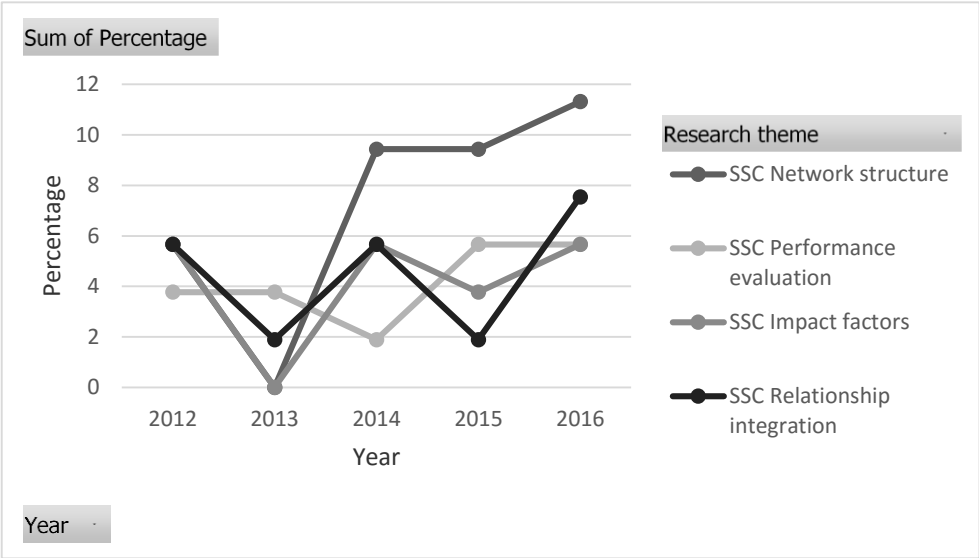

Figure 5. Distribution of articles across research themes and time

SSC themes were analyzed against research methodologies and analysis techniques per Table 2. Scholars of this field have utilized a variety of research methodologies including both quantitative (mathematical models, survey) and qualitative approaches (interview, literature review) or some hybrid mixture of them. To analyze the collected data and uncover latent patterns a number of statistical and mathematical analysis techniques such as mathematical programming, regression, cluster analysis, etc. were employed. Interestingly, the studies referencing qualitative methodologies were approximately twice the number of those employing quantitative ones. However, the frequency of use of mathematical techniques was considerably higher than those founded upon statistical analysis alone.

Regarding mathematical analysis, studies used Multi-Objective Linear Programming (MILP)/ Multi-Objective Non-linear Programming (MINLP) much more often (13 instances) than other available techniques (e.g. Analytical Hierarchy Process (AHP)/Analytical Network Process (ANP) (9 instances), Simulation (3 instances) and Game Theory (1 instance)). Comparatively, data analysis techniques gained less attention as they were only utilized in 12 studies. The most popular techniques were Regression (4 instances), Consensus Analysis (2 instances) and Analysis of Variance (ANOVA) (2 instances). Structural Equation Modelling (SEM), Cluster Analysis, Failure Mode and Effects Analysis (FMEA) and Input-Output Analysis techniques were cited one time each.

From the aforementioned discussion, it can be argued that the application of data analysis techniques was narrow as only 35 out of 53 papers derived their results using them. Another point is that the methodological focus of SSC network structure and performance evaluation largely relied upon quantitative approaches. Having said that, survey and interview were the more appealing methods for SSC relationship integration and impact factor areas.

More explicitly regarding the challenges and opportunities posed within SSC some common implications for academics and practitioners have been identified:

- *Literature gaps and future directions associated with SSC network structure*: There is clearly room for improving research into sustainable configuration impediments from both contextual and methodological aspects. Research targeting sequentially optimized designs, planning and operations decision-making around sustainability impacts have not been well developed, instead tending to start from simplistic assumptions such as no facility disruption, no machine breakage and that product price is determined by market demand independent of production cost. It is likely that the limited capability of decision-making techniques (like MILP/MINLP) in confronting sophisticated problems has encouraged this one-dimensional perspective. Upgrading advanced heuristic and meta-heuristic algorithms (e.g. non-dominated sorting genetic

algorithm), or developing new ones towards better solving multi-dimensional problems using multi-level decision variables, is recommended as a direction for future investigation.

		Research methodology					*Analysis technique*											*Total papers in each category*
		Quantitative	*Qualitative*				*Mathematical analysis*				*Statistical analysis*							
		Mathematical model	Interview	Survey	Literature review	Mixed-approach	Optimization	Game theory	AHP/ANP	Simulation	Input-Output	ANOVA	SEM	Cluster analysis	Consensus analy-sis	FMEA	Regression	
SSC network structure	(Chen et al., 2014)				■													19
	(Pishvaee et al., 2014)	■		■			■											
	(Devika et al., 2014)	■		■			■											
	(Lam, 2015)	■		■					■									
	(Fahimnia & Jabbarzadeh, 2016)	■		■			■											
	(Gonela et al., 2015)	■		■			■											
	(Zhalechian et al., 2016)	■		■			■											
	(Eskandarpour et al., 2015)				■													
	(Bouchery et al., 2012)	■		■			■											
	(Khan et al., 2016)	■		■			■											
	(Boukherroub et al., 2015)	■		■			■		■									
	(Gebrezgabher et al., 2014)	■		■			■		■									
	(M. Wang et al., 2015)	■		■				■										
	(Besiou et al., 2012)	■		■						■								
	(Varsei & Polyakovskiy, 2016)	■		■			■											
	(Ramos et al., 2014)	■		■			■											
	(Tang & Zhou, 2012)				■													
	(Jaehn, 2016)				■													
	(Sgarbossa & Russo, 2016)		■								■							
SSC impact factors	(Giannakis & Papadopoulos, 2016)															■		11
	(Chowdhury & Quaddus, 2016)	■		■			■		■									
	(Silvestre, 2015)		■															
	(Luthra et al., 2016)	■		■					■									
	(Ageron et al., 2012)					■									■			
	(Touboulic et al., 2014)		■															
	(Gmelin & Seuring, 2014)		■															
	(Grimm et al., 2014)					■												
	(Luzzini et al., 2015)												■					
	(Gopalakrishnan et al., 2012)					■												
	(Goebel et al., 2012)																■	
SSC relationship integration	(Seuring, 2013)				■													12
	(Reefke & Sundaram, 2016)				■									■	■			
	(Brandenburg et al., 2014)				■													
	(Govindan et al., 2015)				■													
	(Bergenwall et al., 2012)		■															
	(Gimenez et al., 2012)																■	
	(Klooster & Mercado-Celis, 2015)		■															
	(Zailani et al., 2012)																■	
	(Beske et al., 2014)				■													
	(Longoni et al., 2014)					■											■	
	(Wilhelm et al., 2016a)		■															
	(Wilhelm et al., 2016b)		■															
SSC performance evaluation	(Tseng et al., 2016)	■		■					■									11
	(Kusi-Sarpong et al., 2016)	■		■					■									
	(Z. Wang et al., 2015)	■		■			■											
	(Sarkis & Dhavale, 2015)	■		■						■								
	(Hassini et al., 2012)		■															
	(Bourlakis et al., 2014)		■									■						
	(Baskaran et al., 2012)	■		■					■									
	(Scott et al., 2013)	■		■					■									
	(Gualandris et al., 2015)					■												
	(Duran-Encalada et al., 2016)	■		■						■								
	(Yusuf et al., 2013)		■									■						
Total		23	11	12	13	5	13	1	9	3	1	2	1	1	2	1	4	

Table 2. Employed research methodologies against SSC themes

- *Literature gaps and future directions associated with SSC impact factors:* Although enablers and barriers for sustainability implementation within supply chain can vary across different countries and industries the degree of influence of each factor in facilitating/delaying sustainability adop-

tion is unknown. Future researchers may wish to better estimate the impact factor of enablers/disruptors using predictive analytics techniques such as data mining. In addition, methods like VlseKriterijuska Optimizacija I Komoromisno Resenje (VIKOR), Elimination and Choice Expressing Reality (ELECTRE) could be applied for prioritizing different influential factors.

- *Literature gaps and future direction related to SSC relationship integration:* The small number of publications and lack of solid studies regarding relationship integration for sustainability implementation mark this area as a worthwhile opportunity for researchers. A potential direction for research might be comparing the strategies for relationship management across SSC under conflicting scenarios (central, active, reactive and pro-active scenarios per (Chen et al., 2014). Since conducting research on multi-scenario states is not feasible, employment of modelling techniques (rare in this theme) is highly recommended. Generally, future researchers with interest in this area are advised to move towards developing more real-time decision-making tools to better monitor the process of sustainability integration into supply chain activities.
- *Literature gaps and future directions related to SSC performance evaluation:* while the performance of SSC is clearly subject to change over time, the moderating effect of time is not often incorporated within current evaluation models. Therefore, one possible future research direction could encompass exploring the performance of sustainability practices over longer periods and/or predicting the evolutionary maturation of such practices (Gimenez et al., 2012; Kusi-Sarpong et al., 2016). Additionally, inconsistency associated with sustainability characteristics of manufacturing-oriented and service-oriented industries leaves a void in performance evaluation literature that is open for addressing in future (Reefke & Sundaram, 2016; M. Wang et al., 2015).

6 Conclusion and Limitation

This paper is an attempt to present a snapshot of research areas involved in SSC. A landscape analysis on 53 selected articles (from a pool of 311 papers) was conducted to find out the research areas of SSC, the challenges involved and the opportunities for future enhancement. Based on the similarity found in researches objectives, the SSC domain was grouped into four areas - SSC network structure, impact factors, relationships integration and performance evaluation. Identified research themes were synthesized against the research methodologies and techniques and were discussed further for identifying the literature gaps from both theoretical and methodological aspects. The grand challenges revealed by this study are found in making multi-level configuration decisions, predicting the influence degree of sustainability enabling/hindering factors, identifying the complexity of relationship strategies for extending sustainability and considering the dynamic nature of sustainability in performance evaluation frameworks. To overcome these challenges, it is suggested that researchers place additional focus upon developing decision-making tools utilizing a combination of quantitative techniques.

This study also has a couple of limitations. First, the terms of reference for sourcing articles restricted search and examination to high-impact A* journals included in the ERA list. Therefore, it is possible that relevant articles appearing in other respected publications were overlooked as falling outside research boundaries. Second, filtering articles for currency to those published between 2012 and 2016 further narrowed the search domain, admitting a potential for older seminal, but oft-cited, papers to fall outside our parameters and be excluded from influencing discussion. A deeper and wider research scope would be required to more comprehensively cover the interdisciplinary context of SSC.

We hope that the information contained in this paper will be helpful for future researchers intending to further understanding of supply chain evolution and the complexities inherent in sustaining them long-term.

References

Ageron, B., Gunasekaran, A., & Spalanzani, A. (2012). Sustainable supply management: An empirical study. *International Journal of Production Economics, 140*(1), 168-182.

Ansari, Z. N., & Kant, R. (2016). A state-of-art literature review reflecting 15 years of focus on sustainable supply chain management. *Journal of cleaner production*.

Baskaran, V., Nachiappan, S., & Rahman, S. (2012). Indian textile suppliers' sustainability evaluation using the grey approach. *International Journal of Production Economics, 135*(2), 647-658.

Bergenwall, A. L., Chen, C., & White, R. E. (2012). TPS's process design in American automotive plants and its effects on the triple bottom line and sustainability. *International Journal of Production Economics, 140*(1), 374-384.

Besiou, M., Georgiadis, P., & Van Wassenhove, L. N. (2012). Official recycling and scavengers: Symbiotic or conflicting? *European Journal of Operational Research, 218*(2), 563-576.

Beske, P., Land, A., & Seuring, S. (2014). Sustainable supply chain management practices and dynamic capabilities in the food industry: A critical analysis of the literature. *International Journal of Production Economics, 152*, 131-143.

Bouchery, Y., Ghaffari, A., Jemai, Z., & Dallery, Y. (2012). Including sustainability criteria into inventory models. *European Journal of Operational Research, 222*(2), 229-240.

Boukherroub, T., LeBel, L., & Ruiz, A. (2015). A framework for sustainable forest resource allocation: A Canadian case study. *Omega*.

Bourlakis, M., Maglaras, G., Aktas, E., Gallear, D., & Fotopoulos, C. (2014). Firm size and sustainable performance in food supply chains: Insights from Greek SMEs. *International Journal of Production Economics, 152*, 112-130.

Brandenburg, M., Govindan, K., Sarkis, J., & Seuring, S. (2014). Quantitative models for sustainable supply chain management: Developments and directions. *European Journal of Operational Research, 233*(2), 299-312.

Burgess, K., Singh, P. J., & Koroglu, R. (2006). Supply chain management: a structured literature review and implications for future research. *International Journal of Operations & Production Management, 26*(7), 703-729.

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. *International journal of physical distribution & logistics management, 38*(5), 360-387.

Chen, L., Olhager, J., & Tang, O. (2014). Manufacturing facility location and sustainability: a literature review and research agenda. *International Journal of Production Economics, 149*, 154-163.

Chowdhury, M. M. H., & Quaddus, M. A. (2016). A multi-phased QFD based optimization approach to sustainable service design. *International Journal of Production Economics, 171*, 165-178.

Closs, D. J., Speier, C., & Meacham, N. (2011). Sustainability to support end-to-end value chains: the role of supply chain management. *Journal of the Academy of Marketing Science, 39*(1), 101-116.

Daniel, J., & Talaei-Khoei, A. (2016). *Developing a conceptual model to evaluate green suppliers: Decision making method using DEMATEL.* Paper presented at the AMCIS 2016: Surfing the IT Innovation Wave - 22nd Americas Conference on Information Systems.

Devika, K., Jafarian, A., & Nourbakhsh, V. (2014). Designing a sustainable closed-loop supply chain network based on triple bottom line approach: A comparison of metaheuristics hybridization techniques. *European Journal of Operational Research, 235*(3), 594-615.

Duran-Encalada, J., Paucar-Caceres, A., Bandala, E., & Wright, G. (2016). The impact of global climate change on water quantity and quality: A system dynamics approach to the US–Mexican transborder region. *European Journal of Operational Research*.

Eskandarpour, M., Dejax, P., Miemczyk, J., & Péton, O. (2015). Sustainable supply chain network design: an optimization-oriented review. *Omega, 54*, 11-32.

Fahimnia, B., & Jabbarzadeh, A. (2016). Marrying supply chain sustainability and resilience: A match made in heaven. *Transportation Research Part E: Logistics and Transportation Review, 91*, 306-324.

Fortes, J. (2009). Green supply chain management: A literature. *Otago Management Graduate Review, 7*(1), 51-62.

Gebrezgabher, S. A., Meuwissen, M. P., & Lansink, A. G. O. (2014). A multiple criteria decision making approach to manure management systems in the Netherlands. *European Journal of Operational Research, 232*(3), 643-653.

Giannakis, M., & Papadopoulos, T. (2016). Supply chain sustainability: a risk management approach. *International Journal of Production Economics, 171*, 455-470.

Gimenez, C., Sierra, V., & Rodon, J. (2012). Sustainable operations: Their impact on the triple bottom line. *International Journal of Production Economics, 140*(1), 149-159.

Gmelin, H., & Seuring, S. (2014). Achieving sustainable new product development by integrating product life-cycle management capabilities. *International Journal of Production Economics, 154*, 166-177.

Goebel, P., Reuter, C., Pibernik, R., & Sichtmann, C. (2012). The influence of ethical culture on supplier selection in the context of sustainable sourcing. *International Journal of Production Economics, 140*(1), 7-17.

Gonela, V., Zhang, J., Osmani, A., & Onyeaghala, R. (2015). Stochastic optimization of sustainable hybrid generation bioethanol supply chains. *Transportation Research Part E: Logistics and Transportation Review, 77*, 1-28.

Gopalakrishnan, K., Yusuf, Y. Y., Musa, A., Abubakar, T., & Ambursa, H. M. (2012). Sustainable supply chain management: A case study of British Aerospace (BAe) Systems. *International Journal of Production Economics, 140*(1), 193-203.

Govindan, K., Soleimani, H., & Kannan, D. (2015). Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future. *European Journal of Operational Research, 240*(3), 603-626.

Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2014). Critical factors for sub-supplier management: A sustainable food supply chains perspective. *International Journal of Production Economics, 152*, 159-173.

Gualandris, J., Klassen, R. D., Vachon, S., & Kalchschmidt, M. (2015). Sustainable evaluation and verification in supply chains: Aligning and leveraging accountability to stakeholders. *Journal of Operations Management, 38*, 1-13.

Hassini, E., Surti, C., & Searcy, C. (2012). A literature review and a case study of sustainable supply chains with a focus on metrics. *International Journal of Production Economics, 140*(1), 69-82.

Jaehn, F. (2016). Sustainable Operations. *European Journal of Operational Research, 253*(2), 243-264.

Khan, M., Hussain, M., & Saber, H. M. (2016). Information sharing in a sustainable supply chain. *International Journal of Production Economics*.

Kitchenham, B. (2004). Procedures for performing systematic reviews. *Keele, UK, Keele University, 33*(2004), 1-26.

Klooster, D., & Mercado-Celis, A. (2015). Sustainable Production Networks: Capturing Value for Labour and Nature in a Furniture Production Network in Oaxaca, Mexico. *Regional Studies*, 1-14.

Kusi-Sarpong, S., Sarkis, J., & Wang, X. (2016). Assessing green supply chain practices in the Ghanaian mining industry: A framework and evaluation. *International Journal of Production Economics*.

Lam, J. S. L. (2015). Designing a sustainable maritime supply chain: A hybrid QFD–ANP approach. *Transportation Research Part E: Logistics and Transportation Review, 78*, 70-81.

Longoni, A., Golini, R., & Cagliano, R. (2014). The role of New Forms of Work Organization in developing sustainability strategies in operations. *International Journal of Production Economics, 147*, 147-160.

Luthra, S., Mangla, S. K., Xu, L., & Diabat, A. (2016). Using AHP to evaluate barriers in adopting sustainable consumption and production initiatives in a supply chain. *International Journal of Production Economics*.

Luzzini, D., Brandon-Jones, E., Brandon-Jones, A., & Spina, G. (2015). From sustainability commitment to performance: The role of intra-and inter-firm collaborative capabilities in the upstream supply chain. *International Journal of Production Economics, 165*, 51-63.

Pishvaee, M., Razmi, J., & Torabi, S. (2014). An accelerated Benders decomposition algorithm for sustainable supply chain network design under uncertainty: A case study of medical needle and syringe supply chain. *Transportation Research Part E: Logistics and Transportation Review, 67*, 14-38.

Ramos, T. R. P., Gomes, M. I., & Barbosa-Póvoa, A. P. (2014). Planning a sustainable reverse logistics system: Balancing costs with environmental and social concerns. *Omega, 48*, 60-74.

Reefke, H., & Sundaram, D. (2016). Key themes and research opportunities in sustainable supply chain management–identification and evaluation. *Omega*.

Sarkis, J., & Dhavale, D. G. (2015). Supplier selection for sustainable operations: A triple-bottom-line approach using a Bayesian framework. *International Journal of Production Economics, 166*, 177-191.

Scott, J. A., Ho, W., & Dey, P. K. (2013). Strategic sourcing in the UK bioenergy industry. *International Journal of Production Economics, 146*(2), 478-490.

Seuring, S. (2013). A review of modeling approaches for sustainable supply chain management. *Decision support systems, 54*(4), 1513-1520.

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of cleaner production, 16*(15), 1699-1710.

Sgarbossa, F., & Russo, I. (2016). A proactive model in sustainable food supply chain: Insight from a case study. *International Journal of Production Economics*.

Shnayder, L., Van Rijnsoever, F. J., & Hekkert, M. P. (2015). Putting your money where your mouth is: Why sustainability reporting based on the triple bottom line can be misleading. *PloS one, 10*(3), e0119036.

Silvestre, B. S. (2015). Sustainable supply chain management in emerging economies: Environmental turbulence, institutional voids and sustainability trajectories. *International Journal of Production Economics, 167*, 156-169.

Tajbakhsh, A., & Hassini, E. (2015). Performance measurement of sustainable supply chains: a review and research questions. *International Journal of Productivity and Performance Management, 64*(6), 744-783.

Tang, C. S., & Zhou, S. (2012). Research advances in environmentally and socially sustainable operations. *European Journal of Operational Research, 223*(3), 585-594.

Touboulic, A., Chicksand, D., & Walker, H. (2014). Managing imbalanced supply chain relationships for sustainability: A power perspective. *Decision Sciences, 45*(4), 577-619.

Tseng, M.-L., Lim, M. K., Wong, W.-P., Chen, Y.-C., & Zhan, Y. (2016). A framework for evaluating the performance of sustainable service supply chain management under uncertainty. *International Journal of Production Economics*.

Varsei, M., & Polyakovskiy, S. (2016). Sustainable supply chain network design: A case of the wine industry in Australia. *Omega*.

Wang, M., Liu, J., Chan, H.-L., Choi, T.-M., & Yue, X. (2015). Effects of carbon tariffs trading policy on duopoly market entry decisions and price competition: Insights from textile firms of developing countries. *International Journal of Production Economics*.

Wang, Z., Subramanian, N., Gunasekaran, A., Abdulrahman, M. D., & Liu, C. (2015). Composite sustainable manufacturing practice and performance framework: Chinese auto-parts suppliers′ perspective. *International Journal of Production Economics, 170*, 219-233.

WCED, U. (1987). Our common future. *World Commission on Environment and DevelopmentOxford University Press*.

White, M. D., & Marsh, E. E. (2006). Content analysis: A flexible methodology. *Library trends, 55*(1), 22-45.

Wilhelm, M. M., Blome, C., Bhakoo, V., & Paulraj, A. (2016a). Implementing sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier. *Journal of Operations Management, 41*, 42-60.

Wilhelm, M. M., Blome, C., Bhakoo, V., & Paulraj, A. (2016b). Sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier. *Journal of Operations Management, 41*, 42-60.

Yusuf, Y. Y., Gunasekaran, A., Musa, A., El-Berishy, N. M., Abubakar, T., & Ambursa, H. M. (2013). The UK oil and gas supply chains: An empirical analysis of adoption of sustainable measures and performance outcomes. *International Journal of Production Economics, 146*(2), 501-514.

Zailani, S., Jeyaraman, K., Vengadasan, G., & Premkumar, R. (2012). Sustainable supply chain management (SSCM) in Malaysia: A survey. *International Journal of Production Economics, 140*(1), 330-340.

Zhalechian, M., Tavakkoli-Moghaddam, R., Zahiri, B., & Mohammadi, M. (2016). Sustainable design of a closed-loop location-routing-inventory supply chain network under mixed uncertainty. *Transportation Research Part E: Logistics and Transportation Review, 89*, 182-214.