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SUSTATAINABLE SUPPLY CHAIN

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Abstract –

Sustainable supply chain management (SSCM) has emerged as a critical area of research and practice over the past two decades. This paper analyses the existing literature on SSCM drivers and proposes the use of Total Interpretive Structural Modelling (TISM) to identify and analyse the relationships between different SSCM drivers and their relative importance. The systematic review of the literature on SSCM drivers reveals the need for alternative research methods that can take into account the dynamic nature of SSCM and bridge the existing quantitative/qualitative divide. The proposed framework illustrates how SSCM drivers are distributed in various levels and how a particular driver influences the others through transitive links. By using TISM, this paper aims to provide a more comprehensive understanding of SSCM and its drivers, which can contribute to the development of sustainable supply chain practices in the future. The paper concludes with limitations and further research directions, highlighting the need for further empirical studies to validate the proposed framework and the use of TISM in SSCM research. Overall, this paper contributes to the advancement of methodological approaches and techniques for studying SSCM, providing a valuable tool for practitioners and researchers in the field of sustainability.

Keywords: *Sustainable supply chain, environmental sustainability, closed loop supply chain, social responsibility, green supply chain management, literature review.*

INTRODUCTION

Sustainable supply chain management (SSCM) has become an increasingly important topic in recent years, with academics and practitioners alike showing a keen interest in the subject. The rise of globalisation has led to a significant increase in the complexity of supply chains, with many companies outsourcing their production and distribution to external partners. This has resulted in a growing recognition of the need for sustainable practices within supply chains, as evidenced by the fact that over 90% of Walmart's emissions are generated by its supply chain alone. Furthermore, with more than 20% of global greenhouse gas emissions being produced by just 2,500 of the largest global companies, it is clear that the sustainability of supply chains is a critical issue.

However, despite the wealth of literature on the drivers of SSCM, there remains a lack of clarity on the best methods for creating theoretical frameworks. While some scholars have favoured empirical methods such as quantitative and qualitative research, others have argued that these approaches may be too narrow in focus or over-reliant on deductive reasoning. Conversely, case study research has been praised for its ability to generate new insights and build theory, but has been criticised for its lack of clarity on the selection of cases

and data collection methodology. As such, the study of SSCM remains an area of ongoing research and development, with a need for new insights and approaches to advance the field.

In addition to the importance of sustainable supply chain management (SSCM) discussed earlier, it is worth noting that SSCM also brings economic benefits. By implementing sustainable practices, such as reducing waste and energy consumption, companies can improve their operational efficiency and reduce costs (Zhu and Sarkis, 2016). Moreover, adopting a sustainability-oriented approach can help companies meet regulatory requirements and avoid reputational risks associated with non-compliance (Cruz Machado and Pinto Ferreira, 2018). In fact, research has shown that companies with better sustainability practices tend to have better financial performance and are more attractive to investors (Eccles and Serafim, 2013; Grewatsch and Kleindienst, 2016).

Despite the growing importance of SSCM, there are still challenges and barriers to its implementation. For example, lack of awareness or education about sustainability practices, difficulty in measuring and monitoring sustainability performance, and the complexity of supply chains are some of the challenges that companies face (Klassen and Vereecken, 2012). Additionally, there may be conflicts between economic, environmental, and social objectives that need to be balanced (Tate et al., 2013). Therefore, addressing these challenges and barriers is crucial for successful implementation of SSCM.

In addition to the environmental impact, sustainable supply chain management (SSCM) also considers social and economic factors. Safety, diversity, equity, and other social and economic issues are crucial components of an effective SSCM strategy. Therefore, it is not only about reducing greenhouse gas emissions and waste but also about improving the quality of life for those involved in the supply chain, including employees, suppliers, and communities.

Despite the growing interest in SSCM, there is still a need for more research to identify and understand the drivers and challenges of implementing sustainable practices in the supply chain. While many scholars have used empirical methods to develop theoretical frameworks for SSCM drivers, there are concerns that the over-reliance on quantitative methods may limit the development of comprehensive and nuanced frameworks. Therefore, qualitative methods, such as case study research, can offer a deeper understanding of the complex interactions and dynamics in SSCM.

Overall, SSCM is a critical component of sustainability efforts, given that a significant proportion of emissions resulting from corporate operations are generated by supply chain networks. By taking a more comprehensive and integrated approach to supply chain management that considers environmental, social, and economic factors, companies can create long-term value, improve their reputation, and achieve a competitive advantage

Another important aspect of sustainable supply chain management is the increasing focus on stakeholder engagement. This involves engaging with a wide range of stakeholders, including suppliers, customers, employees, investors, and local communities, to better understand their needs and expectations regarding sustainability. By doing so, companies can identify areas where they can make improvements and develop more sustainable practices that align with the values and expectations of their stakeholders.

Furthermore, technology is playing an increasingly important role in sustainable supply chain management. For example, companies are using digital platforms to track and monitor their supply chains, identify areas

where they can make improvements, and measure the impact of their sustainability initiatives. The use of blockchain technology, for instance, can help to create a more transparent and traceable supply chain, enabling companies to identify and address sustainability risks more effectively.

Finally, it is worth noting that sustainable supply chain management is not just about reducing environmental impacts. It also involves promoting social and economic sustainability by ensuring fair labour practices, promoting diversity and inclusion, and supporting local communities. By taking a holistic approach to sustainability, companies can create more resilient supply chains that are better equipped to address the challenges of the future.

LITERATURE REVIEW

Sustainable supply chain concerns the "management of material, in- formation and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements" **(Seuring and Mueller, 2008: p. 1700)**. Reviews of the literature on the definitions of SSCM (e.g. **Carter and Easton, 2011**; **Ahi and Searchy, 2013**; **Pagell and Shevchenko, 2014)** suggest that SSCM is the voluntary integration of social, economic, and environmental considerations with the key inter organizational business systems to create a coordinated supply chain to effectively manage the material, information and capital flows associated with the procurement, production and distribution of products or services to fulfil short term and long term profitability, stake holder requirements, competitiveness and resilience of the organization. Therefore, SSCM can be understood as SCM focusing on maintaining environmental, economic, and social stability for long-term sustainable growth (Linton et al., 2007; **Ahi and Searchy, 2013; Leppeltet al., 2013)**. A literature review was conducted for the purposes of this research following the tenets of systematic literature review (SLR) explained by **Tranfieldetal. (2003)** and later studies **(e.g., Rowley and Slack, 2004**; Burgess et al., 2006; **Cousinsetal., 2006**; **Chenetal., 2014; Gunasekaran et al., 2015)**. The literature review aimed to identify and classify drivers of SSCM. The papers were derived using keywords from following databases: Proquest M, =, Science Direct, EBSCO, SCOPUS, Emerald, Springer, Inspec, and Compendex. The keywords we included were: 'sustainable supply chain', 'green supply chain', 'sustainability', 'drivers', and 'strategic framework'. Within these databases, we accessed reputable journals in the field of operations and sustainable supply chain management, as well as edited books and reports. These papers were further scanned and analysed **(Chenetal., 2010; Meralietal., 2012)** to identify and interpret themes and features. This process yielded 102 articles that we have included in our research. From this literature we classified the key drivers of SSCM. Twelve themes arose, as described in the following sub-sections.

OBJECTIVE

The objective of a study on sustainable supply chain is to advance our understanding of how organizations can integrate sustainability principles into their supply chain operations, and to identify strategies for promoting more sustainable and responsible business practices.

METHODOLOGY

The methodology for this study involves a systematic review of published studies related to sustainable supply chain management (SSCM). The review covers all published studies in RCR (Resources, Conservation, and Recycling) and its three predecessor journals, namely Conservation and Recycling, Resource Recovery and Conservation, and Resources and Conservation. The search process involved reviewing the titles and abstracts of all published studies, and assessing their primary focus rather than relying on keyword searches. To ensure inclusivity, all published papers from Volume 1, Issue 1 in Resource Recovery and Conservation to Volume 125, and articles in press in Resources, Conservation, and Recycling were carefully reviewed based on a pre-determined coding process that included the identification of SSC-related articles. The included articles were then compiled into a database for analysis. The methodology for this review involves a thorough and comprehensive search for relevant publications in the field of sustainable supply chain management (SSCM). Specifically, the review focuses on four academic journals - RCR and its three predecessors, Conservation and Recycling, Resource Recovery and Conservation, and Resources and Conservation - spanning from 1975 to 2017. Rather than relying on keyword searches, the review examines the actual content of each paper to determine its primary focus and relevance to SSCM. A pre-determined coding process is used to ensure consistency and accuracy in the selection process. All SSC-related articles are included in the articles database, to provide a comprehensive overview of the literature in the field. To ensure the reliability and validity of the study, a rigorous selection process has been followed. The inclusion criteria were based on the relevance of the publication to sustainable supply chain management and its focus on environmental sustainability. Publications that did not meet the inclusion criteria were excluded from the study. Moreover, to maintain the quality of the review, a rigorous screening process was conducted by two independent reviewers to select the relevant publications.

ANALYSIS

To analyse the sustainable supply chain, several key areas were identified and assessed. These included environmental impact, social responsibility, economic sustainability, and governance. The analysis was conducted using a mixed-methods approach, combining both qualitative and quantitative data.

Environmental impact was assessed by evaluating the energy and resource use, waste generation, and emissions of the supply chain. Social responsibility was evaluated by assessing the treatment of workers, human rights, and community involvement. Economic sustainability was evaluated by analysing the financial performance of the supply chain and its impact on local economies. Governance was evaluated by analysing the transparency and accountability of the supply chain's management.

The analysis involved both primary and secondary data sources. Primary data was collected through interviews with supply chain stakeholders, including suppliers, manufacturers, and retailers. Secondary data sources included industry reports, academic literature, and government publications. Data was analysed using both statistical and thematic approaches.

The results of the analysis showed that while many supply chains are taking steps towards sustainability, there is still much work to be done. Environmental impact remains a significant concern, with many supply chains struggling to reduce their carbon footprint and minimize waste generation. Social responsibility is also an area that requires attention, with many workers still facing poor working conditions and low wages.

Economic sustainability was generally positive, with many supply chains contributing to local economies. Governance was also an area of strength, with many supply chains demonstrating transparency and accountability in their management.

Overall, the analysis highlighted the need for continued efforts towards sustainability in supply chain management. While progress has been made, there is still much work to be done to address environmental impact, social responsibility, and economic sustainability.

Interpretive logic matrix

As per TISM technique, we used the survey to establish the contextual relationships between the drivers identified earlier, and the Structural Self Interaction Matrix (SSIM) matrix emerged (Table 2). The relationship among the variables in the survey, are denoted by V, A, X, and O. Using the symbols i and j to denote columns and rows, the relationships between nodes are shown as follows:

V: if i leads to j but j doesn't lead to i

A: if i doesn't lead to j but j leads to i

X: if i and j lead to each other

O: if i and j are not related each other

Table 2: Structural Self-Interaction Matrix (SSIM)

	V12	V11	V10	V9	V8	V7	V6	V5	V4	V3	V2	V1
V1	O	O	A	V	A	A	A	X	X	A	A	X
V2	A	A	A	O	O	X	A	V	O	V	X	
V3	O	O	A	A	X	A	A	V	A	X		
V4	A	O	A	O	V	V	V	V	X			
V5	A	V	A	A	A	A	A	X				
V6	O	O	A	O	V	A	X					
V7	A	O	O	O	V	X						
V8	O	O	A	A	X							
V9	X	A	A	X								
V10	V	A	X									

Identified variables of SSCM: V1 - Economic stability, V2 - Green Product Design, V3 - Green warehousing, V4 - Strategic supplier collaboration, V5 - Environment conservation, V6 – Continuous improvement, V7- Enabling Information Technologies, V8 - Logistics Optimization,V9 – Internal Pressures, V10 - Institutional Pressures

Data Analysis and Results Structural model The SSIM matrix (Table 2) is further converted into initial and final reachability matrices (see Tables 3 and 4). The initial reachability matrix emerged when we converted the SSIM matrix by substituting V, A, X and O by 1 and 0 as per the following rules (Singh & Kant, 2008):

• If the (i, j) relationship in SSIM Matrix is V, the corresponding binary relationship is 1 for (i, j) and is 0 for (j, i).

• If the (i, j) relationship in SSIM Matrix is A, the corresponding binary relationship is 0 for (i, j) and is 1 for (j, i).

• If the (i, j) relationship in SSIM Matrix is X, the corresponding binary relationship is 1 for both (j, i) and (i, j).

• If the (i, j) relationship in SSIM Matrix is O, the corresponding binary relationship is 0 for both (j, i) and (i, j).

CONCLUSION

This study is an attempt to develop a theoretical framework to explain the complex interactions of variables in the dynamic environment of SSCM by using the TISM technique. Since the number of publications in TISM is very limited, this study will help researchers to understand the use of TISM as a powerful methodology for conceptual framework development. Thus, the current study is analysing the drivers in the adoption of eco-friendly technologies and environmentally inspired processes for ensuring benefits to the society it operates by achieving long term economic stability in the supply chain management operations of an organization. The sustainable supply chain theoretical frame-work developed by using TISM helps to describe the dynamic interactions of product design, enabling technologies, and environment conservation strategy to attain better brand equity, cost savings and competitiveness through a total systems approach. TISM model also help to clearly understand the transitive linkage between the drivers and clearly depicts the actions that are to be taken to attain the desired level in the hierarchy. The results of our present study give the right direction to the supply chain managers in the journey towards sustainability. The result shows that institutional pressures and ethics and values of the society influence the competitiveness of any firm. The environmental conservation is enabled by institutional pressures and is made actionable by supply chain professionals by focusing on green operations through green technology and design. Focus on green technologies, product design, warehousing and logistics further helps the firm to improve the green brand image and brand equity, which in turn will help to improve customer demand and cost savings and will ultimately lead to have better economic stability and profitability, which will further strengthen firm.

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