14th Annual International Conference on Industrial Engineering and Operations Management Dubai United Arab Emirates (UAE), February 12-14, 2024

Publisher: IEOM Society International, USA DOI: 10.46254/AN14.20240603
Published: February 12, 2024

Modeling Critical Success Factors for Green Supply Chain Management in Saudi Arabia

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Abstract

The successful management of green supply chain management (GSCM) needs dedicated environmental principles and global benchmarking that can lead to a proactive strategy to improve environmental performance. The critical success factors (CSFs) play a significant role in accomplishing the implementation of strategy towards the defined objective/goal. The present research explores the CSFs for GSCM. The objectives are to diminish carbon footprint by implementing GSCM practices, reduce waste generation, and endorse sustainable sourcing through environmentally responsible practices. It also attempts to measure awareness regarding the significance of sustainable green supply chain practices and evaluate the CSFs based on their importance to GSCM. The questionnaire-based empirical analysis of the collected data was done using the Statistical Package for Social Sciences (SPSS) v 23.0. The analyses reveal valuable insights into the CSFs responsible for GSCM. The research reveals the effectiveness and prioritization of CSFs in achieving GSCM. The manufacturing companies will benefit from the present findings to improve the product manufacturing cycle and accomplish GSCM.

Keywords

Carbon footprint, Critical Success Factors (CSFs), Empirical Analysis, Green Supply Chain Management (GSCM).

1. Introduction

Green supply chain management (GSCM) supports green practices in supplier sourcing, materials management, manufacturing systems, material handling, packaging, warehousing, inbound and outbound logistics management and product distribution, throughout the supply chain until it reaches the customer. The GSCM helps in realising cost savings by optimizing the resources for lower energy consumption, material usage, and efficient eco-friendly manufacturing process selection. Thus, the GSCM can cut down the operational costs and provide cutting-edge for manufacturers to build competitive strategies to stay in the global market with enhanced market share. Nowadays, manufacturers adopt a proactive approach in adopting GSCM practices that can lead to better environmental performance to satisfy the stakeholder's demand and customers' needs by adopting green design, green supplier collaboration, green manufacturing, and recycling to accomplish circular economy for profit building.

The proactive approach of manufacturers to imbibe green supply chain practices faces the resistance of several barriers therefore manufacturers must identify and adopt the CSFs to manage and pursue effective GSCM practices inside and outside of the firm across its supply chain (SC). The manufacturing firms must also realise the significance of GSCM practices and their subsequent adoption in their SC for GSCM. The manufacturing firms must know the CSFs responsible for such objectives. The present research adopts an empirical study to investigate the CSFs for GSCM in KSA.

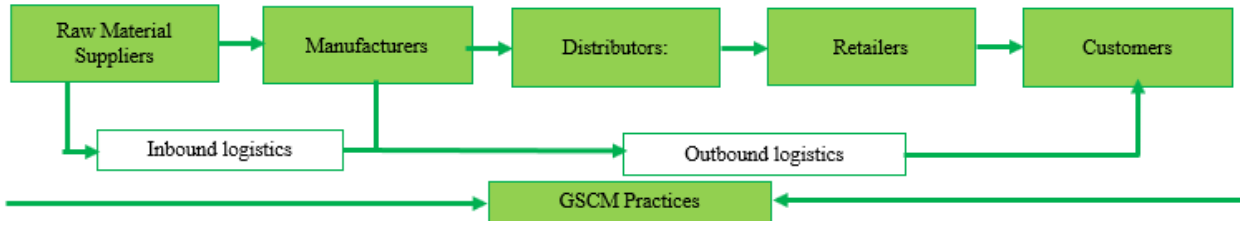

Figure 1. GSCM across SC.

Figure 1 depicts the GSCM practices adopted across the raw material suppliers until the raw material is processed through green manufacturing processes and reachers to customers through the green channel of distributors and retailers using green inbound and outbound logistics management.

1.1 Objectives

The GSCM can boost the manufacturing supply chain performance, which can improve the green working environment, save operational costs, and result in better green practices throughout the GSCM. Hence, it is significant to investigate the CSFS of GSCM boosting green practices among the manufacturers based in KSA. Thus, the present research has multifold objectives:

1. What are the various significant CSFs of GSCM?
2. How they can be prioritised based on their significance in manufacturing firms of KSA?

2. Literature Review

An in-depth review of the literature has been carried out to identify the CSFs boosting GSCM in manufacturing firms. There is a vast amount of literature that has been assessed using the various keywords of green practices, CSFs for GSCM, GSCM practices in manufacturing firms, GSCM across SC, Green practices in KSA etc. Several significant studies leading to GSCM practices have been identified as follows: Chin et al. (2015) contributed to the green supply chain by proposing a model that integrates environmental and economic aspects, emphasizing the importance of collaboration among supply chain partners for sustainability. Tseng et al. (2019) focused on the role of circular economy principles in green supply chain management, highlighting strategies to reduce waste and promote resource efficiency. Wu (2013) contributed to the green supply chain by proposing a framework that integrates environmental and economic factors, fostering sustainability. Omara et al. (2019) focused on the role of information technology in enhancing environmental performance within supply chains. Van Hoek et al. (2001) emphasized the importance of integrating environmental concerns into supply chain management for overall sustainability. Hsu et al. (20) contributed to the green supply chain by developing a model that integrates sustainability practices and performance metrics, facilitating decision-making for environmentally responsible supply chain management. Abdul-Rashid et al. (2017) emphasized the importance of stakeholder collaboration and engagement in implementing green supply chain practices, fostering a holistic and sustainable approach. Kamolkittiwong (2015) introduced the concept of green culture to the values, beliefs, and behaviours within an organization that prioritizes environmental sustainability and responsible practices. Based on the above literature review around 38 CSFs were initially identified which were subjected to a questionnaire study for further empirical analysis as discussed in the methodology section.

3. Method

A questionnaire covering two parts covering the demographic profile of respondents and a list of CSFs for GSCM was built. The 5-point Likert scale was adopted for identifying the importance of each CSF involved in GSCM. 1 indicates the least significant, 5 indicates very high significant, and 3 indicates normal significance. The sample size was calculated based on the formula as indicated in equation (1). Based on the population size and selected confidence level the sample size arrived was 385 as shown in equation (2).

$$S = \frac{z^2 x\ m\ x\ n}{e^2} \quad (1)$$

Where S = Sample Size; Z = 1.96 (95% confidence level); m = prevalence level (0.5 used for sample size needed); $n = (1 - m)$; e = error term (0.05)

$$S = \frac{1.96^2 x\ 0.5\ x\ 0.5}{0.05^2} = 385 \quad (2)$$

495 questionnaires were distributed using social media sites like LinkedIn, WhatsApp, Email etc. 398 responses were collected against the 475 distributed questionnaires. The 7 questionnaires were found to be incomplete hence accepted responses of 391 were found to satisfy the sample size requirement with a response rate of 78.98%. The questionnaire was tested by a group of 10 experts consisting of four academicians and 6 senior managers practising GSCM for its pilot study. The questionnaire was okayed except for some textural changes. The questionnaire survey was conducted in mid-December 2023. The collected responses were analysed using Statistical Package for Social Sciences (SPSS) v 23.0.

4. Results and Discussion

Collecting survey data from respondents to gain insights into their approach and behaviours related to green supply chain practices is an important step. The survey responses were analyzed to understand the level of awareness and importance placed on green practices. In Figure 2 for example, 67% of participants agreed that governments should motivate businesses to adopt green practices. Another example is in Figure 3 64% of participants believed that adopting technology in a sustainable supply chain leads to societal progress, environmental conservation, and economic growth. Figure 4 displays the position/ role of respondents.

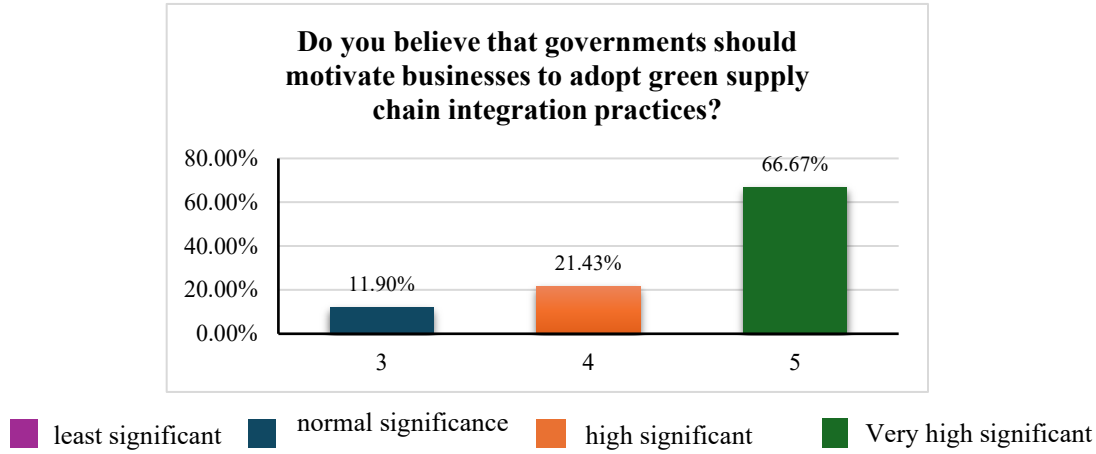

Figure 2. Question response analysis

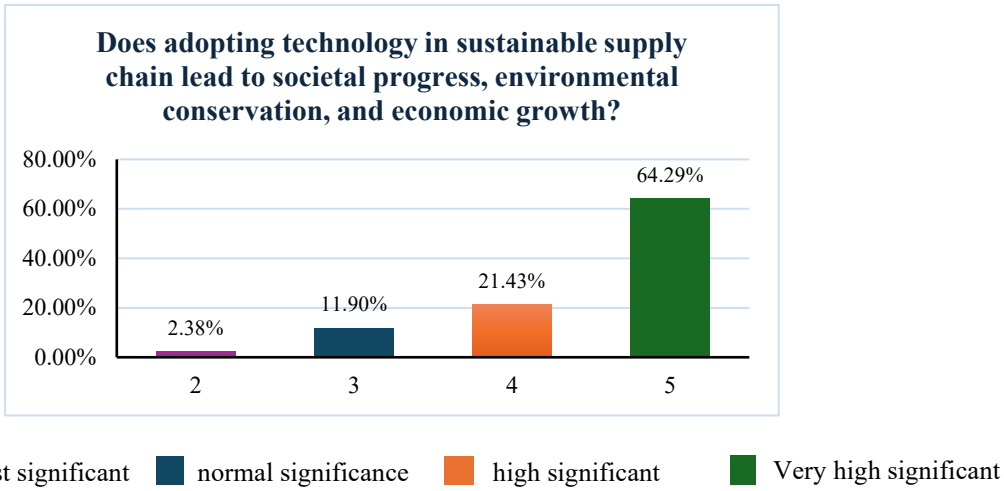

Figure 3. Question response analysis

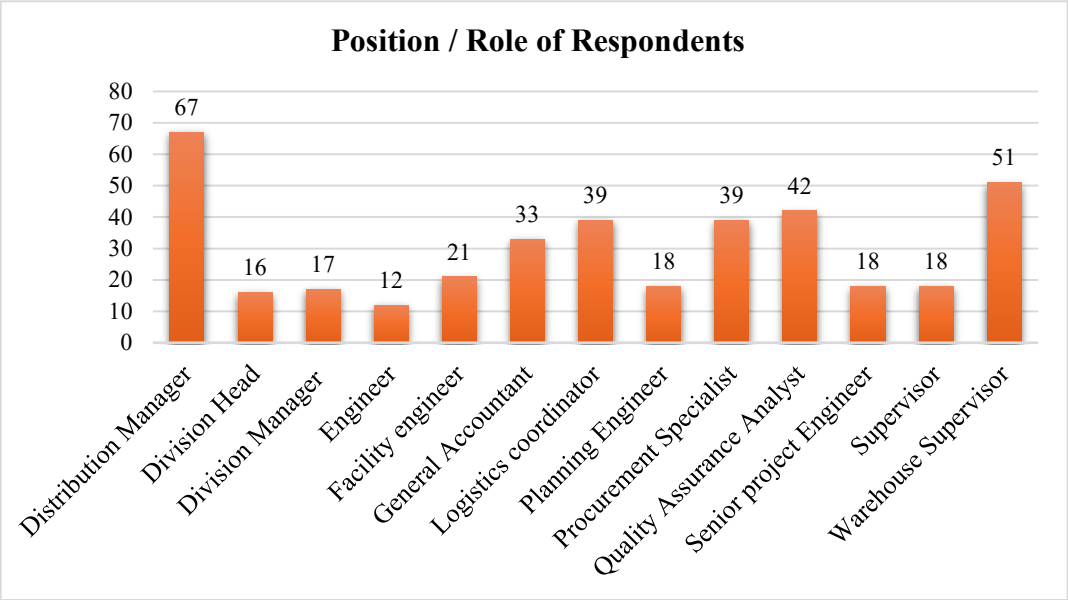

Figure 4. Position/ Role of Respondents

One of the critical success factors in Table 1 identified in the project is "green manufacturing Practices." CSF 3 This factor emphasizes the adoption of environmentally sustainable manufacturing processes. By integrating green manufacturing practices, companies can reduce waste generation, minimize carbon emissions, and enhance overall environmental performance. For instance, companies can use renewable energy sources, implement efficient production techniques, and prioritize the use of eco-friendly materials.

The project's findings provide valuable insights into critical success factors for green supply chain management. By understanding these factors and their respective rankings, organizations can prioritize and implement strategies that contribute to sustainability, reduce environmental impact, and enhance their overall performance. The project's outcomes contribute to the ongoing efforts to promote environmentally responsible practices in supply chain management. Figure 5 displays the type of industry respondents.

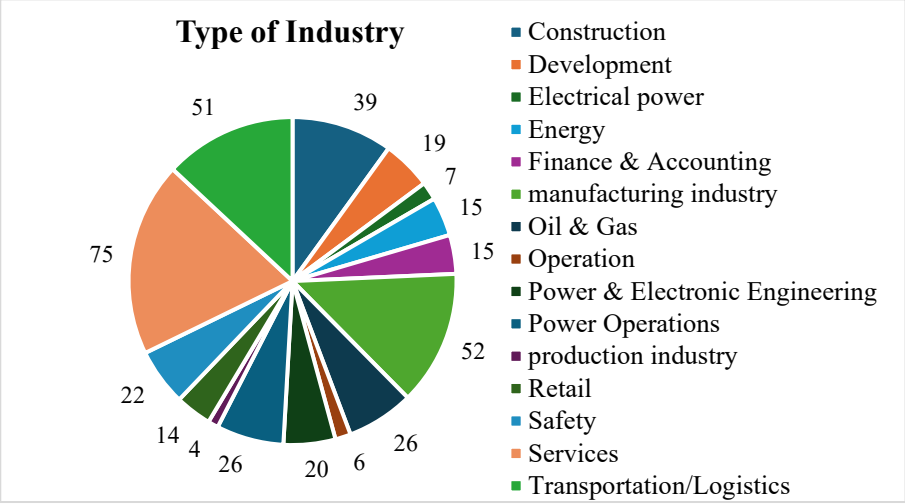

Figure 5. Type of Industry Respondents

Engaging stakeholders was yet another crucial component of gathering data. Customers, staff members, and local communities were among the stakeholders consulted to gather input on green supply chain management techniques. To comprehend the topic matter more thoroughly, their viewpoints and opinions were sought.
Primary data from people and organizations engaged in green supply chain management were gathered via questionnaires and surveys. The goal of this all-encompassing strategy is to gather trustworthy data for the analysis of crucial success variables in this industry. The results of this data analysis have strengthened our knowledge of efficient green supply chain management. Table 1 displays the statistical analysis of CSFs for GSCM displaying mean, SD and rank whereas Table 2 displays the identification and description of CSFs for GSCM. The Cronbach's Alpha value was found to be 0.785, which shows high reliability.

Table 1. Statistical analysis of CSFs for GSCM

Sr No.	Name of the CSF	Mean	SD	Rank
CSF1	Green Supply Chain Management Practices	4.23	3.22	8
CSF2	Green Supply Chain Integration	4.75	2.95	5
CSF3	Green Manufacturing Practices	4.60	2.64	6
CSF4	Green Culture	3.98	2.19	9
CSF5	Regulatory Compliance and Risk Management	4.56	2.51	7
CSF6	Lifecycle Assessment and Eco-design	5.60	2.45	1
CSF7	Technology Adoption and Innovation	5.23	2.57	3
CSF8	Continuous Improvement and Performance Evaluation	5.10	2.71	4
CSF9	Green Transportation and Logistics Practices	5.42	2.90	2

Table 2. Identification and description of CSFs for GSCM

Sr.No.	Critical Success Factor	Description
CSF1	GSCM practices	Environmentally sustainable strategies in the supply chain for reduced ecological impact.
CSF2	GSC integration	Embedding eco-friendly practices throughout the supply chain for sustainability.
CSF3	Green manufacturing practices	Eco-friendly production methods to reduce environmental impact.
CSF4	Green culture	Green culture embodies an organization's commitment to environmentally friendly practices and sustainability.
CSF5	Regulatory compliance and risk management	Ensuring adherence to rules while minimizing potential hazards.
CSF6	Life-cycle Assessment and eco-design concept	Analyzing and improving products' environmental impact from creation to disposal.
CSF7	Technology adoption and innovation	Embracing and implementing new tech for progress and efficiency.
CSF8	Continuous improvement and performance evaluation	Ongoing refinement and assessment for enhanced effectiveness.
CSF9	Green transportation and logistics practices	Environmentally friendly strategies for sustainable and efficient movement of goods.

The data provided presents the mean, standard deviation (SD), and ranking for each CSF related to GSCM in KSA. CSFs such as Lifecycle assessment and eco-design concept, Technology adoption and innovation, and Continuous improvement and performance evaluation appear to be highly valued in the context of GSCM in Saudi Arabia, based on their mean scores and rankings. These findings can inform strategic decisions for organizations aiming to enhance their sustainability practices in the supply chain.

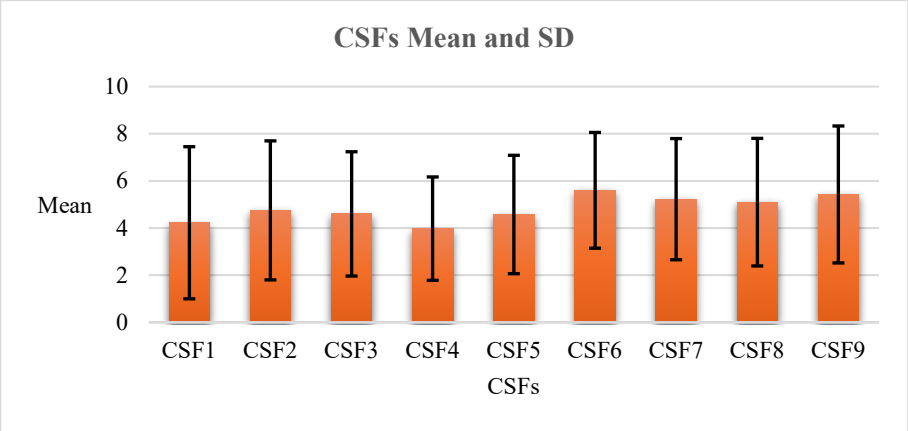

Figure 6. Mean and SD of CSFs

The error bar plot Figure 6 provides insights into the variability of responses for each CSF. Longer error bars signify greater standard deviation, indicating a wider range of opinions among respondents. CSF6 (Lifecycle Assessment and Eco-design) stands out with a high mean score and relatively short error bars, suggesting that respondents generally agree on its importance with less variability. In contrast, CSF1 (Green Supply Chain Management Practices) has longer error bars, indicating a more diverse range of opinions on its significance. Figure 6 displays the mean and SD of CSFs.

4.1 Discussion

In the context of GSCM in Saudi Arabia, the identified CSFs hold significant implications for sustainable practices including sustainable procurement, energy efficiency and renewable energy adoption, green packaging and waste reduction, reverse logistics and product lifecycle management, environmental impact assessments, collaboration and partnerships, and continuous improvement and innovation. These factors drive integrating environmentally friendly practices into the supply chain, promoting sustainability, and reducing environmental impact.

The study's findings, which emphasize collaboration, technology adoption, and continuous improvement in GSCM, align with well-established theoretical frameworks. Surprisingly, the strong emphasis on collaboration challenges the traditional ideas of transaction cost economics, highlighting the significance of relational contracting in the Saudi Arabian business context. The unexpected finding that "Lifecycle Assessment and Eco-design" is the most important factor for environmentally friendly supply chains in Saudi Arabia might be because companies there really care about reducing the impact their products have on the environment. This could be because the government has strict rules, consumers want eco-friendly products, and businesses see it as a way to stand out. To make this work, companies might need to learn more about eco-design, and the government could keep supporting businesses that are going green. Everyone in the industry should also work together and raise awareness of why eco-friendly products are important.

However, it's important to acknowledge certain limitations in the study. Cultural biases in survey responses and the evolving nature of sustainability practices may affect the generalizability of the findings across all industries and business sizes in Saudi Arabia. To address these limitations, future research could explore the cultural influences on collaboration more deeply. This could involve investigating how cultural factors impact the way businesses in Saudi Arabia form relationships. Additionally, researchers could explore the specific challenges and opportunities for GSCM in different industries within the country. Furthermore, longitudinal studies could be conducted to track how effective these GSCM practices are over time. This would provide valuable insights into the sustainability and durability of the implemented strategies. Additionally, comparative studies with other regions could offer a broader.

5. Conclusion

In conclusion, the examination of CSFs for GSCM in Saudi Arabia provides valuable insights into the key determinants of successful sustainability practices. The research underscores the paramount significance of incorporating Lifecycle Assessment and Eco-design practices, as reflected in this study. Moreover, the study

emphasizes the pivotal role of Technology Adoption and Innovation, along with Continuous Improvement and Performance Evaluation, as critical drivers for fostering sustainability within the supply chain. However, the variable perceptions surrounding the overall importance of Green supply chain management practices (CSF1) suggest a need for further exploration to understand the factors contributing to this variability. Additionally, the challenges associated with cultivating a Green culture (CSF4) within organizations emerge as a notable area for consideration, emphasizing the importance of targeted efforts in shaping sustainable mindsets. These findings hold implications for both businesses and policymakers engaged in GSCM in Saudi Arabia, guiding strategic decisions and policy formulations to enhance sustainability practices within the evolving landscape of the supply chain. The dynamic nature of these factors emphasizes the need for ongoing research to deepen our understanding of their complexities and implications on sustainable business practices in the region.

Acknowledgments: We extend our heartfelt gratitude to the College of Engineering at King Khalid University for their unwavering support. We also extend our sincere thanks to the faculty members of the College of Engineering who have generously shared their expertise and insights.

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Biography

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