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A Measurement Framework for Green Supply Chain Management and its Relationship with the Circular Economy Principle in MSME's

Shruti Vadukiya[1*], Dr. Sheetal Mundra[2]

[1*]Institute of Management, JK Lakshmipat University, Jaipur, Rajasthan, India.

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Abstract

Purpose: The paper highlights the growing importance of green supply chain management (GSCM) in management research over the past two years. GSCM seeks to integrate environmental considerations into various aspects of supply chain management, including purchase planning, material selection, production methods, product delivery, and post-project management throughout the product's lifecycle. The research explores the relationship between GSCM and the Circular Economy (CE) concept by developing a framework to evaluate GSCM practices in correlation with circular economic principles, with a specific focus on small and medium-sized enterprises (MSMEs).

Design/Methodology /Approach:

The study engaged 360 participants from micro, small, and medium enterprises (MSMEs) in the Rajasthan region of India. Confirmatory factor analysis (CFA) was used to identify the key determinants that influence firm performance. The data was analyzed using SPSS and AMOS software, which led to the creation of a conceptual framework through structural equation modeling (SEM). The study's focus on the intersection of GSCM and CE, and its practical implications for MSMEs, make it a relevant and timely contribution to the growing area of research on sustainable business practices.

Findings: The paper presents a comprehensive measurement framework tailored for assessing the performance of green supply chain management (GSCM) practices and their relationship to circular economy (CE) principles within the context of micro, small, and medium-sized enterprises (MSMEs). This holistic framework provides a structured approach for MSMEs to evaluate the integration of GSCM and CE in their operations. Also, the research empirically investigates the synergies between GSCM and CE principles and their implications for MSME performance. The findings reveal significant positive relationships between the implementation of GSCM practices (e.g., green procurement, eco-design, reverse logistics) and the adoption of CE principles (e.g., resource efficiency, closed-loop systems, waste reduction) within the MSME segment.

Originality/value: The research is centered on MSMEs operating in the Rajasthan region, providing insights specific to this business environment. The study aims to develop a comprehensive framework for assessing green practices and its relationship with circular economic approaches within small and medium-sized enterprises.

Keywords – Green supply chain management (GSCM), Structural equation modeling (SEM), Circular economy (CE).

Paper type- Research Article.

1.0 Introduction

Green supply chain management (GSCM) has gained significant traction in management research over the past two years. This approach seeks to incorporate ecological considerations into supply chain management, encompassing aspects such as project planning, material selection, production methods, delivery to consumers, and post-project management throughout the product's lifecycle.

Industrial emissions are increasingly recognized as a significant risk, underscoring the pressing necessity for sustainable practices that address environmental, economic, and social demands (Ghosh et al., 2022). Industries face considerable pressure to ensure their strategies are in accordance with local regulations and policies, shaped by market dynamics, societal expectations, and competitive forces. This is especially relevant for organizations aiming to harmonize social, environmental, managerial, and economic aspects to maintain long-term competitiveness (Kim et al., 2021). However, the path to achieving these objectives is not without its challenges (Ghosh et al., 2021b). Notably, various practices related to Green Supply Chain Management (GSCM) have attracted considerable attention from both researchers and industry professionals within the sustainability framework (Wang and Feng, 2022). Many leading firms in developed countries have effectively adopted GSCM practices to gain a competitive advantage (Natalie et al., 2022). In contrast, the implementation of GSCM practices in developing nations has been slower (Lamba and Thareja, 2021).

Green manufacturing is characterized by the implementation of efficient product design and production methods that prioritize low environmental impact inputs, aiming to produce minimal or no waste and pollution. This approach to product design focuses on reducing the number of components, simplifying assembly and operational processes, and enhancing material recovery, reuse, and recycling. Furthermore, green manufacturing encompasses environmentally sustainable practices that aim to decrease the consumption of raw materials, energy, waste, and emissions.

Greening supply chains has become both a priority and a challenge for businesses in the 21st century, particularly in fostering environmental awareness and implementing Green Practices within their supply chain activities (Duarte et al., 2011. According to Balon et al. (2019), GSCM operations integrate environmental considerations into industrial structures, organizational frameworks, and economic systems. Unlike traditional supply chains, which often overlook ecological factors, GSCM prioritizes sustainability. Laari et al., (2018) presented GSCM as a strategic management approach focusing on environmental concerns that links supply chain practices with natural resource conservation. Gurtu et al. (2015) explained how GSCM reduces the negative environmental impacts of supply chains, reinforcing its essential role in sustainability programs. Toke et al. (2010) defined the Green Supply Chain as an approach that integrates innovations in supply chain management within the industrial purchasing context, with a particular focus on environmental considerations. Duarte, Cabrita, and Machado (2011) emphasized that Green Supply Chain Practices are intricately linked to environmental concerns, incorporating green purchasing into lifecycle management across supply chains, including suppliers, manufacturers, customers, and reverse logistics.

The Green Supply Chain Management (GSCM) framework incorporates environmental factors into the domain of supply chain management (SCM). Its main objective is to reduce or eliminate waste, including harmful materials, emissions, and energy usage linked to product development, manufacturing, and distribution. As a result, GSCM plays a crucial role in shaping a company's overall environmental impact. Unlike conventional supply chain management, which primarily prioritizes profitability, GSCM focuses on sustainability and ecological effects. Additionally, conventional SCM frequently emphasizes final outcomes without sufficiently considering the social and environmental repercussions of its operations. As organizations set standards for natural resources, materials, and

products, it is essential for them to improve their financial management practices to align with these environmental objectives.

The Circular Economy (CE) is recognized as a viable alternative for promoting sustainable manufacturing and consumption. It facilitates enhancements in sustainability, resilience, and economic growth by addressing "resource scarcity" through practices such as reuse and re-consumption, which are vital for economic stability. This approach not only fosters a more sustainable community but also aids in achieving the Sustainable Development Goals (SDGs). To capitalize on these opportunities within the supply chain, specific CE practices must be implemented. A study conducted by Rosane Aparecida G. Battistelle (2024) aimed to diagnose the factors, barriers, and practices influencing the adoption of circular economy principles in supply chains. The research categorized CE practices into eight distinct groups based on existing literature and their similarities: governance initiatives, economic initiatives, clean production, product development, management support, infrastructure, knowledge, and social and cultural aspects. This proposed framework illustrates the relationship between Green Supply Chain Management (GSCM) and CE, contributing to the literature by highlighting their commonalities and establishing GSCM as a crucial step toward CE. Furthermore, this study enhances organizational practices by identifying and correlating GSCM practices that can facilitate the integration of CE within organizations.

2.0 Review of Literature

The start of the GSCM concept emerged at the beginning of this time. The experts including Srivastava (2007) understood how manufacturing businesses must decrease their ecological impact. Studies began examining resource-efficient practices and waste reduction within supply chains. Early findings indicated that manufacturers could reduce waste and improve resource efficiency, though environmental considerations were often secondary to economic goals. Scholars explored the role of purchasing decisions in environmental sustainability. It was noted that companies could incentivize suppliers to adopt green practices through supplier selection and evaluation criteria that focused on environmental performance. During this time, there was an increasing awareness of regulatory pressure on companies to adopt green practices.
The literature also highlights the need for a comprehensive measurement framework to assess the adoption and implementation of GSCM practices by organizations, particularly MSMEs (Diabat & Govindan, 2011; Luthra et al., 2016).Key GSCM practices that have been identified in the literature include green procurement, green manufacturing, green distribution, green packaging, reverse logistics, and environmental collaboration with suppliers and customers (Srivastava, 2007; Diabat & Govindan, 2011).The measurement of GSCM practices should consider both the extent of implementation and the level of integration within the overall supply chain management system (Diabat & Govindan, 2011; Jayaram & Avittathur, 2015).

The literature establishes GSCM as a crucial step toward the integration of circular economy (CE) principles within organizations, including MSMEs.CE practices, such as reuse, recycling, and remanufacturing, can be facilitated through the implementation of GSCM initiatives (Battistelle, 2024). Specific CE practices that can be integrated into the GSCM framework for MSMEs include product design for disassembly, use of recycled and renewable materials, and the establishment of reverse logistics systems. The alignment of GSCM practices with CE principles can enhance the overall sustainability and resource efficiency of supply chain operations in MSMEs.

MSMEs often face barriers such as limited financial resources, lack of awareness, and organizational resistance to change, which can hinder the adoption of integrated GSCM-CE practices (Diabat & Govindan, 2011; Luthra et al., 2016). Enablers for GSCM-CE integration in MSMEs include stakeholder pressure, collaborative initiatives, and government support through incentives and policies.

The literature review also reveals that awareness of green supply chain management is particularly prominent in industries such as automotive, especially among multinational corporations and medium-sized enterprises, where it is viewed as a competitive advantage for micro, small, and medium enterprises (MSMEs). The adoption of GSCM practices is most prevalent in areas linked to efficiency, cost reduction, and sustainability, yet it remains lower among MSMEs. Consequently, there exists a research gap regarding the adoption of green practices by MSMEs, which is essential for meeting the competitive demands of green industries driven by supplier and customer expectations. Thus, the following research questions are to be investigated.
RQ 1: Can green supply chain practices measurement framework be developed for MSME manufacturing industries of Rajasthan region?
RQ 2: How do GSCM practices and CE principles complement each other?

3.0 Research Methodology.

The research carried out in this paper for Green Supply Chain Management (GSCM) performance framework was exploratory. It was focused specifically on the Rajasthan region and employed a survey-based methodology. A structured questionnaire was distributed, and interviews were conducted with respondents from manufacturing sectors that either implemented green supply chain practices or following circular economy practices.

Purposive sampling method followed to approach respondents because it represents a non-probability method that selects individuals based on population characteristics and research aims. The research relied on purposive sampling techniques to acquire information through surveys based on prepared research questionnaires from the FMCG Industries of Rajasthan together with different industrial zones of Rajasthan Industrial Area. The questionnaires were assessed for internal consistency through reliability statistics, and exploratory factor analysis was performed to reduce numerous variables into key dimensions. To fulfill the objective, exploration factor analysis will be executed using SPSS Version 23. SPSS analysis uses SEM to evaluate these elements as well as their interaction effects through the structured features obtained from SEM model outputs. The research provides elements that can serve as a successful blueprint for green practice execution with all its related aspects.

4.0 Analysis of Data.

The identified factors have been analyzed using SPSS, and Structural Equation Modeling (SEM) allows for the evaluation of the relationships between these factors and their effects on each parameter, based on the organized factors and conceptual framework established from the results of the SEM model.
The results of the study are anticipated to enhance organizational performance, support the evolution and sustainability of the Supply Chain system, and tackle both tangible (Business Performance) and intangible (Environmental Performance) elements. It will provide a framework for effectively implementing green practices and their related factors. Furthermore, it encourages the efficient utilization of resources by adhering to waste management principles, including recycling, reusing, and remanufacturing products and their components.

4.1 Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) is a statistical technique used to investigate the connections between observed variables and the latent factors that affect them (Suhr, n.d.). In this study, the concept of CFA applied to verify the results derived from exploratory factor analysis (EFA), which produced favorable outcomes.3.6 Conceptual Framework with SEM (Structure Equation Modeling)

Structural Equation Modeling (SEM) represents an advanced methodology for examining the interconnections among constructs that consist of multiple items within a model. This study utilized a two-stage SEM approach, which involved first validating latent constructs through Confirmatory Factor Analysis (CFA) before proceeding to model the structural relationships and conduct hypothesis testing. SEM, also referred to as Covariance-Structure Modeling, is a robust multivariate statistical analysis technique that employs a parametric approach for data analysis. According to Rao, Purba (2019), the analysis in structural equation modeling aimed to identify the causal relationships among various latent constructs.

Confirmatory Factor Analysis (CFA) is a statistical method employed to evaluate and validate the factors identified in a dataset. In this research, CFA was utilized to assess the validity of the suggested measurement scale. This analysis determines if the data aligns with the proposed model derived from the previous Exploratory Factor Analysis (EFA), thereby ensuring that the constructs are represented and measured correctly.

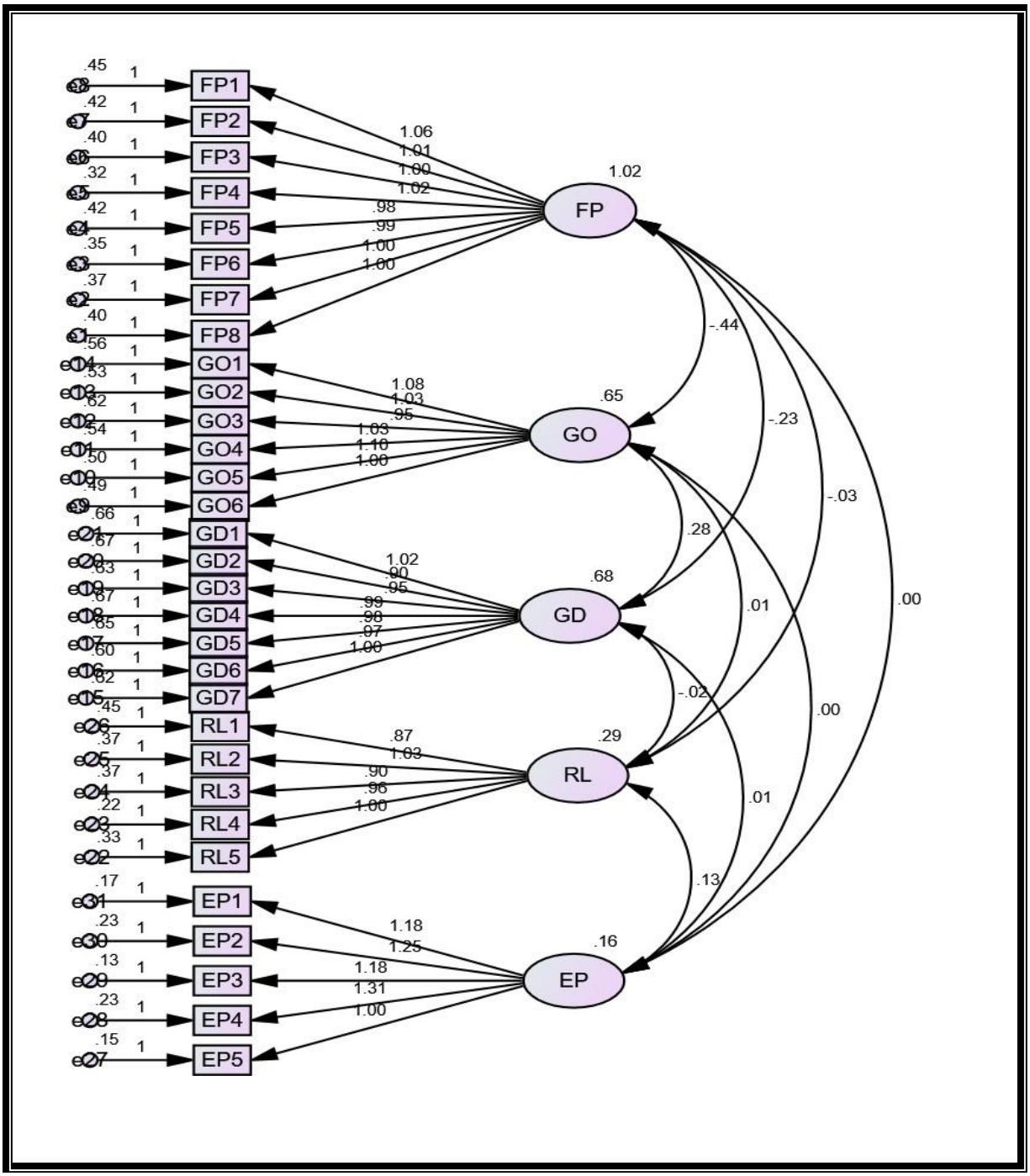

Figure.1: Confirmatory Factor Analysis

Source: CFA confirmatory factor Analysis output Amos Vs. 24

4.2 Common Model Fit Indices:

The Chi-Square (χ^2) Test assesses how well the model fits by comparing the observed covariance matrix with the expected one. A significant χ^2 result (usually $p < 0.05$) suggests a poor fit, indicating that the model may not accurately reflect the data. The Root Mean Square Error of Approximation (RMSEA) measures the average difference between observed and expected data, imposing a penalty on models with a higher number of parameters. RMSEA values below 0.05 indicate a close fit, while those ranging from 0.05 to 0.08 are deemed acceptable. The Comparative Fit Index (CFI) evaluates the fit of the proposed model against a baseline model, with a CFI value of 0.95 or higher typically signifying a good fit. In summary, RMSEA values under 0.05 suggest a close fit, values between 0.05 and 0.08 are acceptable, and values exceeding 008 indicate a poor fit. Similarly, CFI values near or above 0.95 reflect a good fit.

Table 1 : Model fit categories and their level of Acceptance

Name of category	Indices	Level of acceptance	Observed value
Absolute fit	RMSEA	RMSEA < 0.08	0.043
	GFI	GFI > 0.90	0.904
	AGFI	AGFI >0.90	0.906
	RMR	RMR < 0.08	0.044
Incremental/Relative fit	CFI	CFI > 0.90	0.956
Parsimonious fit	Chisq /df	Chi-Square/ df < 3.0	1.598

Source: CFA, Data Analysis

These results, along with the values for the model fit indices, validate the Confirmatory Factor Analysis, indicating that the output model for the green supply chain performance measurement framework is robust. The framework is visually represented in the figure below, derived from AMOS, which outlines the relationships and constructs identified in the analysis.

The findings from the Confirmatory Factor Analysis (CFA) have revealed five significant factors influencing the adoption of green practices among MSMEs in the manufacturing sector of Rajasthan. These factors include Financial Performance and Green Demands, along with additional factors categorized as Green Operational Practices Measurement, which encompass Environmental Performance and Reverse Logistics.

The identified factors play a crucial role in promoting the adoption of environmentally friendly practices and in evaluating performance through the creation of Key Performance Indicators (KPIs) linked to each factor. Further analysis and discussions surrounding the output of the Confirmatory Factor Analysis (CFA) will contribute to the formulation of a conceptual framework model based on these identified elements.

This framework acts as a blueprint for establishing a performance measurement system for Green Practices. By incorporating a range of sustainability indicators and metrics, it seeks to provide a

comprehensive assessment of sustainability efforts within supply chains, ensuring that all pertinent dimensions are effectively measured and evaluated. This methodology not only deepens the understanding of sustainability performance but also supports ongoing improvement and alignment with leading practices in supply chain management.

4.3 Structural Equation Modeling (SEM).

In AMOS (Analysis of Moment Structures), a conceptual framework visually represents the relationships between observed variables (indicators) and latent variables (constructs) within a model. The framework is developed based on a theoretical model that you intend to test, using techniques like Confirmatory Factor Analysis (CFA) or Structural Equation Modeling (SEM).

4.3.1 Path Diagram:

A diagram illustrates the model, with arrows showing causal connections. Solid arrows denote direct effects, while dashed arrows suggest indirect or proposed effects. Variables: Exogenous variables: These are variables that are not affected by others in the model, typically independent variables. In figure No. 4.3, Reverse Logistics, Green Demands, and Green Operational Practices are identified as independent variables. Endogenous variables: These are variables that are affected by other variables, usually dependent variables. In this path diagram, financial performance and environmental performance are considered dependent variables.

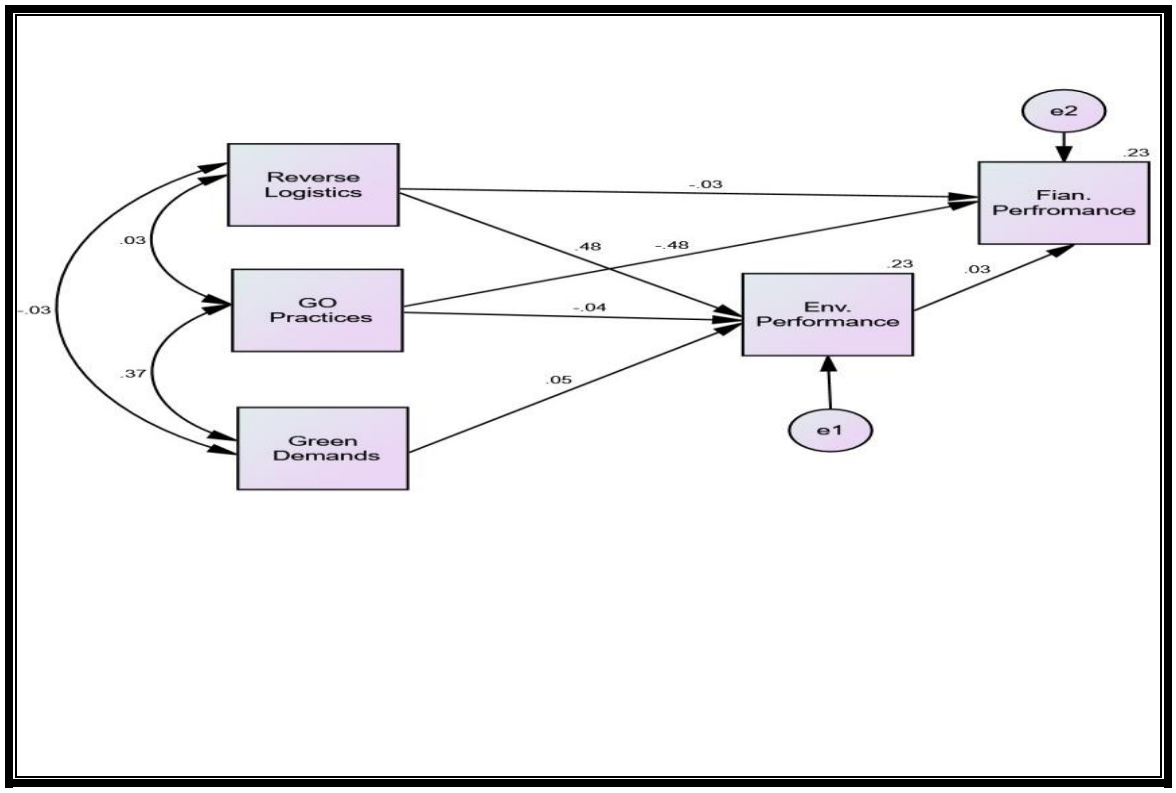

Figure 2: Conceptual Framework for Green Practices Performance Measurement

Source: Amos - Structure Equation Modeling: Path Diagram: Conceptual Framework.

This section outlines the framework structure in relation to assessing various elements associated with green performance and the circular economy. Green Demands, considered a latent construct, can be evaluated through multiple indicators, including customer demand and market trends. Green Operational Practices may be indicated by factors linked to internal processes aimed at minimizing waste and enhancing energy efficiency. Reverse Logistics can encompass metrics such as recycling initiatives and product return processes. Environmental Performance can be gauged through reductions in emissions and adherence to environmental regulations. Financial Performance may be reflected in profitability and cost savings achieved through sustainable practices. Byrne, Barbara & St, Cahyono. (2022). Structural Equation Modeling With AMOS.

Table 2: Model fit Summary of Structure Equation Model.

Name of category	Indices	Level of acceptance	Observed value
Absolute fit	P Value	-	0.011
	RMSEA	RMSEA < 0.08	0.067
	GFI	GFI > 0.90	0.997
	AGFI	AGFI >0.90	0.955
	RMR	RMR < 0.08	0.044
	NFI	NFI>0.90	0.989
Incremental/Relative fit	CFI	CFI > 0.90	0.993
Parsimonious fit	Chisq /df	Chi-Square/ df < 3.0	2.468

Source: CFA, Data Analysis

The findings indicate a P-value of 0.011, which exceeds the 0.05 threshold, demonstrating that the model is statistically significant. Additionally, other fit indices reinforce the model's strong fitness. The Goodness of Fit Index (GFI) stands at 0.997, and the Adjusted Goodness of Fit Index (AGFI) is 0.955, both surpassing the 0.9 benchmark, which suggests a favorable fit. The Normed Fit Index (NFI) is recorded at 0.989, indicating an excellent fit as it is very close to 1.0. Furthermore, the Root Mean Square Error of Approximation (RMSEA) is 0.067, which is below the 0.08 threshold, further validating the model's adequacy.

According to the findings of Hair et al. (1998) and Hu & Bentler (1999), the values presented suggest that the model demonstrates a good fit. In summary of the CFA results, this model reveals the relationship of each factor within the framework. Additionally, five key factors have been identified that facilitate the adoption of green practices among manufacturing MSMEs in Rajasthan: Green Demands, Green Operational Practices, Reverse Logistics, Environmental Performance, and

Financial Performance. These factors play a crucial role, either directly or indirectly, in promoting green practices and evaluating performance through the establishment of relevant KPIs.

4.4 Relationship between Green supply chain Practices and Circular Economy

Green supply chain management (GSCM) practices can directly support the transition towards a more circular economy. As defined by Sarkis et al. (2011), GSCM involves "integrating environmental thinking into supply-chain management." This includes activities like green procurement, eco-design, reverse logistics, and closed-loop supply chains - all of which are closely aligned with circular economy principles.

For example, Govindan and Hasanagic (2018) found that GSCM practices such as eco-design, green manufacturing, and reverse logistics can help companies "close the loop" and move towards a more circular model. By designing products for disassembly, reuse, and recycling, and implementing effective reverse logistics systems, companies can keep materials in use for longer and minimize waste.

Similarly, Jabbour et al. (2017) highlighted how GSCM initiatives like green purchasing, eco-design, and industrial symbiosis can contribute to the development of a circular economy. The authors note that these practices help to "reduce, reuse, and recycle" resources, which is a core tenet of the circular economy framework.

Importantly, the relationship between GSCM and the circular economy is not unidirectional. Adopting a circular economy approach can also drive the implementation of greener supply chain practices. As Lieder and Rashid (2016) argue, the circular economy "provides a framework for the development of closed-loop supply chains," which in turn necessitates the integration of GSCM activities.

Overall, the literature demonstrates a strong and mutually reinforcing relationship between green supply chain management and the circular economy. By aligning their supply chain practices with circular economy principles, companies can unlock significant environmental, economic, and social benefits. This underscores the importance of taking an integrated, system-level approach to sustainable supply chain management.

The circular economy is gaining increasing attention as a more sustainable alternative to the traditional linear "take-make-waste" economy. As defined by the Ellen MacArthur Foundation (2017), the circular economy is "an industrial system that is restorative or regenerative by intention and design." Reverse logistics plays a critical role in supporting the circular economy by facilitating the return and recovery of materials.

According to Govindan et al. (2015), effective reverse logistics management can help companies achieve "economic, environmental, and social sustainability" by reducing waste, conserving resources, and creating new value streams. The authors highlight how reverse logistics activities like collection, sorting, and reprocessing are essential for closing material loops and transitioning to a more circular model.

This research also investigates the mediating effects of three types of green innovation: green product innovation, green process innovation, and green management innovation. Some researchers suggest that institutional theory is essential for creating sustainable business models for small and medium-sized enterprises (MSMEs). This theory aids in developing manufacturing practices that are in line with circular economy principles, as noted by Surajit Bag, Pavitra Dhamija, David J. Bryde, and Rajesh Kumar Singh (2021).

5.0 Conclusion and Discussion

The findings of our research indicate that Green Operational Practices (GO), Green Demand (GD), and Regulatory Pressure (RL) are the primary catalysts for Green Supply Chain Management (GSCM) initiatives within the medium and small-scale industries of the fast-moving consumer goods (FMCG) sector in Rajasthan. Each of these three factors exerts a unique and significant influence.

The notable correlation identified between green demands and GSCM initiatives suggests that regulatory pressure serves as a powerful motivator for the manufacturing sector to enhance and adopt its internal green supply chain practices. These results align with numerous studies conducted in both developing and developed nations, which have identified regulatory pressures as the most crucial drivers for the adoption of GSCM practices (Eltayeb & Zailani, 2009; Hanim et al., 2012; Yu & Ramanathan, 2015; Zhu & Sarkis, 2004).

The results of the Confirmatory Factor Analysis (CFA) concerning the extraction of Environmental Performance (EP) and Financial Performance (FP) indicate a significant influence on (RL) Reverse Logistics and (GO) Green Operational Practices.

This framework outlines the conceptual relationship of both environmental as well as financial performance with production patterns. The purpose of the framework is Concerned with adopting practices that can help reduce the Carbon and material footprint of companies and, therefore Our nations. From the outcome of this study, it shows that reverse logistics and green operational practices are likely to facilitate positive improvements in several aspects of green performance by the industries.

The implementation of Green Supply Chain Management (GSCM) methodologies in India is still in its nascent stages, presenting substantial opportunities for advancement. However, this observation is specifically limited to the FMCG sector.

6.0 Implications

The research presents a conceptual framework that is designed to be a flexible and adaptable tool, which can be tailored to different supply chain contexts and industries. This framework serves as a guide for researchers to conduct studies that examine real-world practices related to Green Supply Chain Management (GSCM) and Circular Economy (CE) principles.

Key highlights of the framework's applications and implications:

1) Expanding Environmental Management:

The framework allows organizations to go beyond just internal processes and expand their environmental management efforts across the entire supply chain.

2) Managerial Applications:

Managers can utilize the framework to develop relevant metrics for evaluating their performance in GSCM and circular economy practices. This can help organizations identify competitive advantages over their competitors.

3) Practical Implications for Indian MSMEs:

The framework will assist Indian micro, small, and medium enterprises (MSMEs) in quickly identifying key challenges in measuring their GSCM and circular economy practices.

It will also help evaluate the preparedness of Indian MSMEs for sustainability initiatives.

This conceptual framework represents a valuable tool that can guide both researchers and practitioners in advancing the integration of green supply chain management and circular economy principles, particularly in the context of Indian MSMEs. The framework's flexibility and practical applications make it a promising framework for driving sustainability efforts across various supply chain settings.

7.0 Limitation of the study

The study is limited to only examining the responses from MSMEs in the Rajasthan region, without considering perspectives from different levels of the supply chain.

Expanding the scope to include responses and performance data from various supply chain stakeholders could provide a more comprehensive understanding. The use of cross-sectional data limits the understanding of how the relationship between GSCM and circular economy (CE) practices evolves over time. Longitudinal studies could offer insights into the dynamic nature of these concepts and their impact on MSME performance.

7.1 Further Research Scope

The ideas of circular economy and Green Supply Chain Management, along with performance measurement, are still relatively new in this field.

These concepts are likely to continue evolving, and future research should account for the dynamic nature of these frameworks.

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