IMPACT OF GREEN SUPPLY CHAIN PRACTICES ON OPERATIONAL PERFORMANCE: SEM ANALYSIS IN SAUDI ARABIA

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ABSTRACT

This study investigates the impact of Green Supply Chain Management (GSCM) practices on operational performance within Saudi Arabian firms. Employing a quantitative survey-based approach, data was collected from managers in diverse sectors actively engaged in sustainable practices. Structural Equation Modelling (SEM) was utilised to analyse the data, validating a theoretical framework that links specific GSCM practices, including eco-design, green procurement, internal environmental management, and cooperation with customers to enhance operational outcomes. Preliminary results indicate a significant positive relationship between adopting green practices and improvements in efficiency, cost reduction, and quality. This research highlights the importance of integrating sustainability into operational strategies and provides practical implications for managers seeking to enhance their firm's operational effectiveness through environmentally responsible practices.

Keywords: Green Supply Chain Management, operational performance, sustainability, Structural Equation Modelling, Saudi Arabia

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1 INTRODUCTION

To address environmental laws, stakeholder expectations, and climate change, modern organisations are under increasing pressure to integrate their supply chains and operations with sustainability. Green Supply Chain Management (GSCM) is a strategy that enhances the sustainability of operations and products while meeting environmental standards [1]. Businesses must reassess their supply chains to meet global environmental challenges, such as greenhouse gas GHG emissions, climate change, and the growing demand for sustainable products [2]. To promote sustainability, many companies have adopted more sustainable supply chain practices. These include carrying out environmental audits, putting certification systems in place, assisting suppliers with their ecological projects, and encouraging collaboration in environmental endeavours [3]. Governments and organisations worldwide are actively working to lessen their environmental impact by the use of sustainable materials, environmentally friendly production techniques, and effective post-consumer waste management strategies [4]. According to [5], [6], several companies have adopted green supply chain practices (GSCP) to enhance quality, reduce expenses, and benefit the environment. GSCM is considered an essential component of business growth and development [7]. It has been observed that companies have adopted GSCM strategies to meet environmental regulations and offer environmentally friendly products and services. Given the growing environmental concerns, businesses will likely need to deal with consumers as well as suppliers in a more environmentally conscious manner [8]. The literature on environmental management indicates that green operations are closely tied to the ecological practices that accompany them. This reduces product deterioration and benefits supply chain operations that rely on natural resources [9]. By adopting green business techniques like GSCM, companies can enhance operational performance and contribute to the creation of a more sustainable future [10].

The relationship between GSCM and performance has not yet been proved in every situation, despite the clear benefits. Since there is insufficient evidence that implementing GSCM enhances the performance of a firm in terms of economics, operations, or the environment, organisations have typically had trouble encouraging its adoption [11]. Given the conflicting findings from various studies, it is imperative to explore the potential advancements that GSCM can offer in understanding its impact on business success. Regarding the relationship between GSCM practices and business performance, conflicting information exists. The study by [12] also highlights the lack of studies on the relationship between GSCM and performance in developing countries. Moreover, developing nations still do not employ GSCM extensively [13]. Additionally, in a study conducted on manufacturing companies in Jordan [14], no connection was found between GSCM and commercial performance. These factors serve as the driving force behind the current investigation, which aims to better understand the connection between operational performance and GSCM. Moreover, COVID-19 has significantly increased awareness of GSCM. This ambiguity, combined with the comparatively small amount of GSCM research that focuses on the Middle East, provides compelling justification for the current investigation. Saudi Arabia offers a crucial context: the country is pursuing economic diversification and sustainable development as part of the Vision 2030 initiative, which is motivating its businesses to modernise their supply chains and embrace more environmentally friendly methods [15].

Saudi Arabia represents a relevant setting for examining the operational implications of GSCM. Recent empirical work in the Saudi industrial context explicitly frames GSCM adoption within the broader sustainability and diversification commitments associated with Vision 2030, suggesting that firms face increasing strategic incentives to embed environmental criteria into supply chain decisions [15]. At the same time, context-specific evidence on how distinct GSCM capabilities translate into operational outcomes remains limited, motivating the present study's focus on eco-design (ECO), green procurement (GP), Internal Environmental Management (IEM), and customer cooperation (CC) as pathways to enhanced operational performance (OP). However, there remains a lack of comprehensive research on how GSCM adoption affects OP in Saudi businesses. To close this gap, this study examines the impact of several GSCM practices: ECO, GP, IEM, and customer collaboration on OP outcomes. Using a survey-based methodology and Structural Equation Modelling (SEM), we aim to address the question of whether GSCM truly helps firms achieve the desired and better OP. Our paper addresses requests for additional empirical data on the connections between GSCM and performance in emerging nations by examining this subject.

2 LITERATURE REVIEW

2.1 Green Supply Chain Management (GSCM) and key practices

GSCM refers to the integration of environmentally friendly practices into supply chain operations, involving product design, material sourcing, manufacturing processes, distribution, and end-of-life management [16]. It is aimed at reducing environmental burden while achieving business objectives [17]. This concept gained popularity in the early 2000s with growing global emphasis on sustainability, as firms recognised that supply chains play an essential role in managing environmental impact [18]. Implementing GSCM has multiple benefits: it can reduce waste and emissions, improve resource efficiency, and strengthen compliance with environmental regulations, all of which contribute to better operational and financial performance [19]. It has been found that companies engaging in practices like green purchasing, eco-friendly product design, and recycling tend to achieve superior environmental and operational outcomes, including cost savings and innovation gains [20].

2.2 Eco-design (green product design) (ECO)

ECO techniques are incorporated into the production, packaging, and distribution of products. Among all the advantages, the organisation's sustainable performance is the most notable [6]. Because it offers a greater environmental commitment, ECO is an essential technique in GSCM for the company's sustainability performance [6]. ECO involves designing products and packaging with minimal environmental impact, focusing on resource efficiency and recyclability from the outset. Since ECO was first proposed by the World Business Council for Sustainable Development (WBCSD), it has affected a product's whole life cycle [21]. Eco-friendly designs enhance environmental performance by minimising environmental impacts [22]. Typical factors include designing products to reduce material and energy usage, designing for reuse/recycling of components, and substituting or eliminating hazardous materials in product and process design.

2.3 Green procurement (green purchasing) (GP)

Considering environmental concerns in purchasing is referred to as "green purchasing," also called "environmentally friendly purchasing" [23]. GP ensures that the material is free from hazardous substances and beneficial to the environment. The idea behind "green purchasing" is that suppliers have to comply with the organisation's established green standards [24]. By utilising and protecting resources, green purchasing enhances economic performance and provides a competitive advantage over the competition. GP promotes social performance by strengthening relationships with stakeholders and improving the organisation's reputation among consumers, society, and the government [25]. There is a favourable correlation between green purchasing and operational performance [26]. GP is essential for both economic and environmental performance, and it is a reliable strategy for reducing pollution [27]. This latent variable represents green purchasing practices in the supply chain. Its key factors include preferring eco-labelled products and environmentally friendly inputs, cooperating with suppliers on environmental objectives, performing environmental audits of suppliers, and requiring suppliers' environmental certification (e.g., ISO 14000). These items have been widely applied in GSCM studies to assess the extent to which ecological criteria are integrated into procurement.

2.4 Internal Environmental Management (IEM)

IEM encompasses the internal policies, systems, and initiatives within a firm that facilitate environmental stewardship in operations [28]. The tactical incorporation of environmental sustainability within a company, recognised and endorsed by managers at all seniority levels, is known as Integrated Environmental Management (IEM) [29]. It is regarded as a crucial part of GSCM [30]. Several environmental regulations, internal policies, assessments of environmental impacts, quantifiable environmental goals, action plans, roles and responsibilities, and regular audits are all part of this structured approach [12]. Therefore, the adoption of IEM requires a systematic monitoring and auditing mechanism [31]. This latent variable shows a firm's internal support for environmental initiatives. Factors include senior management's commitment to GSCM, cross-functional cooperation for environmental improvement, implementation of environmental auditing programmes, and attainment of ISO 14001 certification or an equivalent environmental management system.

2.5 Cooperation with customers (CC)

The company's primary stakeholders are its customers, who have the power to affect the company's policies and manufacturing processes [32]. This practice involves working closely with customers to achieve environmental objectives, such as developing greener products, implementing reuse or recycling programmes, or creating take-back systems for end-of-life products. Consumers can put pressure on businesses to adopt environmentally friendly practices to avoid environmental damage [33]. Strong customer collaboration improves an organisation's GSCM, which in turn boosts productivity and sustainability performance. To encourage GSCM practices in a business, management must accommodate all stakeholders, especially customers [34]. The relationship between supplier evaluation and selection has no significant impact on sustainability performance. When consumer cooperation was taken into account, it was discovered to have a substantial negative correlation with sustainability performance [35]. This latent variable illustrates the extent of collaborative environmental practices with downstream partners. Factors identified in the literature include joint ECO with customers, cooperation for cleaner production processes, and collaboration on green packaging or product recovery programs.

2.6 Operational performance (OP)

The effect of GSCM techniques on OP is frequently illustrated using the Resource-Based View (RBV) hypothesis [6], [30]. According to the RBV, to attain long-term profit, industries must improve their resources and capabilities and make efficient use of them [36]. An intentional asset is described by RBV theory as a resource with the characteristics of rarity, importance, and difficulty to duplicate or replace [37]. Businesses can increase their competitive edge and achieve above-average profits by creatively and strategically integrating these assets [38]. According to the hypothesis, a company's total OP can be significantly impacted by the use of GSCM procedures [30]. Empirical studies support this linkage: for example, implementing GSCM can improve resource utilisation (through energy and materials savings) and process efficiency (through waste reduction and streamlined workflows), leading to lower operational costs and higher productivity [19]. In this study, OP is the primary outcome latent construct, reflecting the firm's internal performance efficiency and effectiveness. Factors used to evaluate OP include on-time delivery improvement, reduction in inventory levels, decrease in scrap/rejection rates, improvement in product quality, and better capacity utilisation. Table 1 summarises the latent constructs, indicators, and measurement items used in the survey, adapted from validated GSCM measurement scales and OP indicators in prior research [28].

Table 1: Summary of constructs, indicators, and observable items [28]

Construct	Indicators	Factors
Internal Environmental Management (IEM)	IEM1	Senior management commitment
	IEM2	Cross-functional cooperation
	IEM3	Implementation of environmental auditing programmes
	IEM4	Attainment of ISO 14001
Green Procurement (GP)	GP1	Eco-labelling of products to prefer environmentally friendly inputs
	GP2	Cooperation with suppliers on environmental objectives
	GP3	Performing environmental audits of suppliers
	GP4	Requiring suppliers' environmental certification
Cooperation with Customers (CC)	CC1	Cooperation for cleaner production processes
	CC2	Collaboration on green packaging or product recovery programs
Eco-Design (ECO)	ECO1	Designing products to reduce material and energy usage
	ECO2	Designing for the reuse/recycling of components
	ECO3	Substituting or eliminating hazardous materials in product and process design
Operational Performance (OP)	OP1	On-time delivery improvement
	OP2	Inventory level reduction
	OP3	Decrease in scrap/rejection rates
	OP4	Improvement in product quality
	OP5	Better capacity utilisation
Green Supply Chain Practice (GSCP)	GSCP1	Integration of environmental requirements across supply chain stages
	GSCP2	Environmental collaboration with supply chain partners
	GSCP3	Monitoring and continuous improvement of green supply chain performance

3 METHODOLOGY

3.1 Research design and sampling

The research structure used in this study was a cross-sectional survey study. The survey was designed to test the proposed relationships between GSCM practices and OP in Saudi Arabia. The sampling frame included manufacturing and logistics firms actively operating within Saudi Arabia, identified through a database of industrial firms that participate in sustainable practices. Respondents were sampled using a purposive stratified random sampling approach to obtain informed key-informant data. The criteria for inclusion in the study were: (i) employment in Saudi Arabia at the time of data collection; (ii) a managerial or supervisory role in supply chain, procurement, operations, sustainability/HSE, or related decision-making roles; and (iii) a minimum of two to three years of experience. Data was excluded if the questionnaire was incomplete (for example, >20% missing data), if the respondent reported no involvement in supply-chain-related decision making, or if the response pattern was indicative of careless responding (for example, straight-lining). Figure 1 outlines all the steps involved in the procedure.

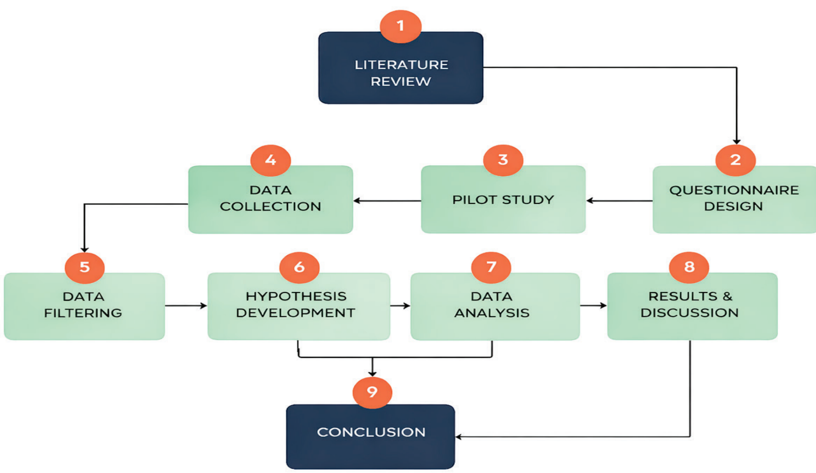

Figure 1 Methodological framework

3.2 Questionnaire structure

The questionnaire contained two sections. Section A asked for the respondent and organisational characteristics, such as role, sector, firm size, and years of experience, to describe the sample. Section B measured the latent constructs using multi-item scales: ECO, GP, IEM, CC, integrated GSCP, and OP. All construct indicators were measured on a 5-point Likert scale (1 = strongly disagree, to 5 = strongly agree). While Likert-type response options are ordinal, such scales are widely used in management and operations research, and SEM-type analyses are commonly applied when items have at least five categories and the analysis method is robust to distributional deviations [39].

3.3 Scale sources, expert evaluation, and pilot testing

Measurement items were adapted from previously validated GSCM measurement scales and OP measures in the green supply chain literature [28]. In particular, the GSCM practice dimensions (ECO, GP, IEM, and CC) and the implementation logic were adapted from established GSCM measurement work and were contextualised to Saudi Arabia through wording adjustments without altering the conceptual meaning of indicators. Consistent with recommended practices for survey measure development and adaptation, an expert evaluation was conducted prior to full deployment. Experts were eligible if they met all of the following criteria: (i) minimum of seven to ten years of professional or research experience in GSCM/sustainability/supply chain management; (ii) direct familiarity with Saudi organisational or industrial settings; and (iii) experience with implementing, auditing, or managing environmental initiatives. (Experts assessed each item for clarity and relevance; revisions were made based on consensus feedback. A pilot test (n = 20) was then conducted with practitioners meeting the respondent inclusion criteria to verify item comprehensibility, completion time, and response variability, after which minor refinements were implemented.

3.4 Data collection outcomes

A total of 300 survey invitations were distributed. We received 137 submissions, of which 121 were usable after applying the inclusion/exclusion criteria, resulting in an effective response rate of 40.33%. To assess potential non-response bias, we compared early and late respondents on key construct scores; no statistically meaningful differences were observed, suggesting that non-response bias is unlikely to materially affect the results. The distribution of respondents among the three primary stakeholder categories, namely owners, contractors, and project managers, is shown in the Respondent Profile chart (Figure 2). This distribution improves the likelihood that the data reflect diverse roles involved in supply chain supervision and execution.

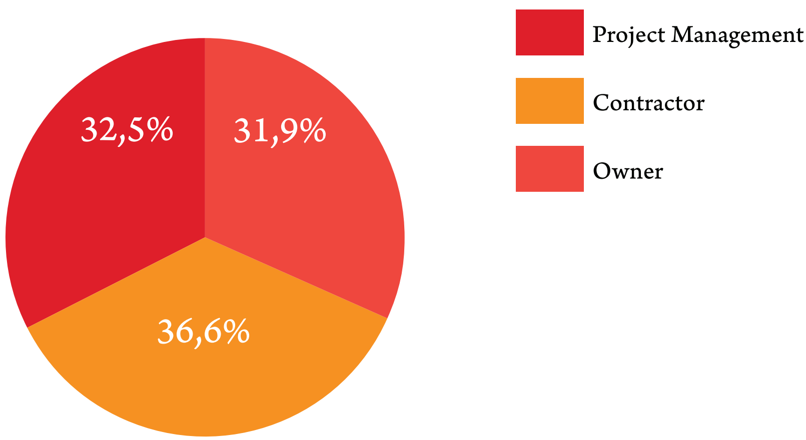

Figure 2 Distribution of respondents by organisation type

3.5 Data analysis: PLS-SEM

The hypothesised model was tested using Partial Least Squares Structural Equation Modelling (PLS-SEM). PLS-SEM is well suited for estimating complex latent-variable models with multiple constructs and indicators, with a primary emphasis on maximising explained variance and prediction-oriented model assessment. Following contemporary PLS-SEM reporting guidance, we evaluated the measurement model prior to interpreting structural relationships. Indicator reliability was assessed via standardised loadings; internal consistency was assessed using Cronbach's alpha and composite reliability; and convergent validity was evaluated using average variance extracted (AVE). Structural paths were estimated and their significance was assessed using bootstrapping (5,000 resamples), and explanatory power was examined using R^2values [40].

We propose that GSCPs improve OP and are driven by four variables: CC, IEM, ECO, and GP. This is based on the resource-based and natural resource-based views, as well as stakeholder logic. The hypothesised relationships shown in Figure 3 were evaluated using the estimated standardised path coefficients (β) and their significance, obtained via bootstrapping.

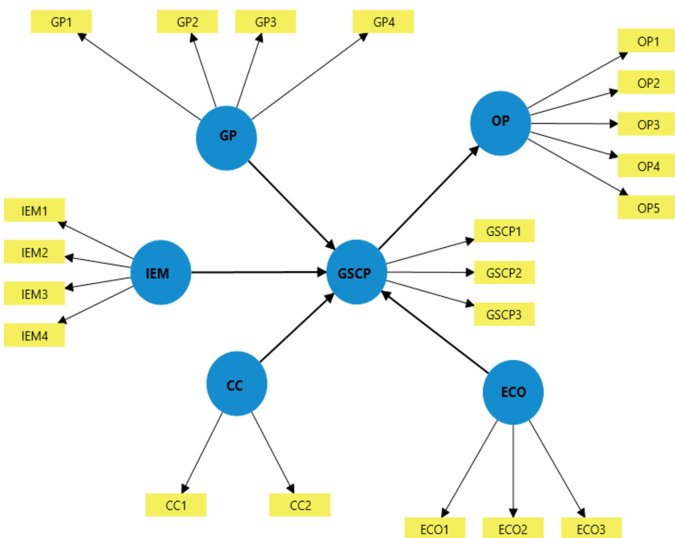

Figure 3 Hypothesis development using SEM

4 RESULTS

In this section, we present the results of the SEM analysis examining how GSCPs influence OP in Saudi Arabia. The findings are organised by measurement model assessment (indicator reliability, internal consistency, and convergent validity) and structural model outcomes (direct effects of latent variables and overall model fit).

4.1 Indicator reliability

All observed indicators demonstrated strong reliability in measuring their respective latent constructs. In the SEM measurement model, each item's standardised factor loading exceeded the recommended threshold of 0.70, indicating that the survey indicators were strong representations of the underlying constructs. High indicator reliability suggests that the measurement items consistently showed the intended aspect of CC, IEM, ECO, GP, GSCPs, and OP. Results can be seen in Figure 4.

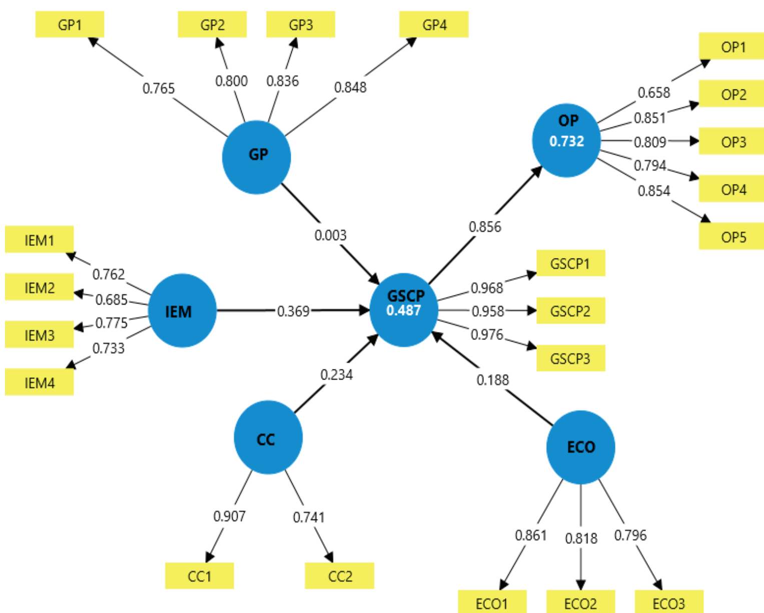

Figure 4 Validated framework using SEM

4.2 Internal Consistency and Convergent Validity

The measurement model fulfils all reliability and convergent validity criteria. Every construct achieved a Cronbach's alpha (α) well above the 0.70 benchmark (the lowest $\alpha \approx$ was 0.724), demonstrating strong internal consistency. Similarly, composite reliability (CR) values ranged from 0.812 upward, exceeding the 0.70 threshold. Convergent validity was confirmed by average variance extracted (AVE) values for each construct, all above the recommended 0.50 level (minimum AVE $\approx$ 0.547). These statistics indicate that the multi-item scales were reliable and that each set of items shared substantial variance with its intended construct, confirming adequate convergent validity of the measures.

Table 2 Internal consistency and Convergent validity of data

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CC	0.761	0.742	0.812	0.686
ECO	0.769	0.787	0.865	0.681
GP	0.829	0.838	0.886	0.661
GSCP	0.966	0.966	0.978	0.936
IEM	0.724	0.729	0.828	0.547
OP	0.861	0.929	0.896	0.635

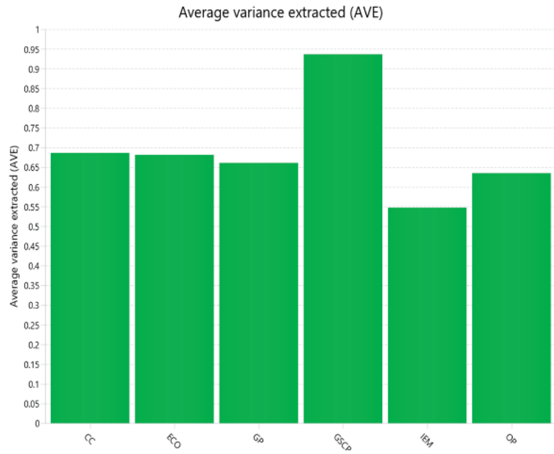

Figure 6 Composite reliability values

4.3 Direct effects of latent variables

Table 3 summarises the significant direct path coefficients in the structural model. The structural model confirms that all four antecedent capabilities have positive and significant direct effects on GSCP. CC ($\beta = 0.234$), ECO ($\beta = 0.188$), GP ($\beta = 0.003$), and IEM ($\beta = 0.369$) all contribute positively to GSCP, with IEM showing the most significant standardised effect. GSCP, in turn, has a powerful, positive and significant impact on OP ($\beta = 0.856$), indicating that higher adoption of integrated green practices can result in better operational outcomes in the Saudi Arabia context.

Table 3 Statistically significant direct relationships

Paths	T Statistics	P Values	Path Coefficient
CC → GSCP	3.847	0.001	0.234
ECO → GSCP	2.614	0.009	0.188
GP → GSCP	2.044	0.042	0.003
IEM → GSCP	5.312	< 0.001	0.369
GSCP → OP	7.183	< 0.001	0.856

Note: T statistics between 1.96 and 8 confirm statistical significance ($p < 0.05$). Path coefficients (β) retained from original model.

4.4 Indirect effects of latent variables

The mediation analysis shows that GSCP effectively transmits the influence of the four antecedent constructs to OP. All indirect effects from CC, ECO, GP, and IEM to OP via GSCP are positive and statistically significant. These results indicate that the primary route through which customer cooperation, ECO, GP, and IEM enhance OP is by strengthening GSCP, rather than through direct effects alone.

Table 4 Statistically significant indirect relationships

Paths	T Statistics	P Values
CC → OP	3.621	0.001
ECO → OP	2.531	0.012
GP → OP	2.108	0.036
IEM → OP	4.897	< 0.001

Note: All indirect effects via GSCP are statistically significant at $p < 0.05$. T statistics reflect bootstrapping with 5,000 resamples (n = 121).

4.5 Model fit evaluation

The SEM model achieved an acceptable fit to the data. The Standardised Root Mean Square Residual (SRMR) was 0.085, which is around the commonly recommended cutoff of 0.08, suggesting an adequate approximate fit of the model's predicted correlations to the observed data. The Normed Fit Index (NFI) reached 0.738; although this NFI value is below the conventional 0.90 criterion for an excellent fit, it falls within tolerable ranges for exploratory SEM models. Furthermore, the high explained variance ($R^2 \approx 0.735$) demonstrates substantial explanatory power for the proposed relationships. The combination of fit indices and R^2 results provide confidence that the specified structural model is sound and captures the key relationships between GSCPs and OP.

Table 5 Model fit indices

Model fit	Saturated model	Estimated model
SRMR	0.085	0.085
d_ULS	1.653	1.653
d_G	2.46	2.46
NFI	0.738	0.738
R^2	0.732	0.735

5 DISCUSSION

The SEM findings provide sufficient evidence that adopting GSCM practices leads to significant improvements in OP for Saudi firms. Our findings are consistent with broader empirical studies showing that GSCM practices are positively associated with firm performance, including operational outcomes, across diverse contexts [41], [42]. The structural model showed a valid fit, indicating that the hypothesised relationships align well with observed data. Strong model fit provides credibility to our framework, suggesting that integrating environmental sustainability into supply chain processes is not only statistically sound but also practically meaningful. The SEM approach also allowed us to capture both direct and indirect pathways among the constructs, revealing that each green practice influences performance in its own way, while also providing benefits through combination. This means that the benefits of one can amplify or enable the others.

Upon examining each construct, the results reveal the distinct roles that each plays. IEM emerged as a particularly influential driver of OP. This suggests that achieving strong internal capabilities, such as top management support for environmental goals, employee training in sustainability, and ISO 14001-aligned processes, directly enhances the efficiency and quality of the firm. Firms with better IEM are likely to achieve better production outcomes (through waste reduction, energy savings, etc.), which immediately increase productivity and reduce costs. Furthermore, IEM appears to enable other green practices as well, suggesting indirect benefits. For example, companies that are committed internally can more effectively implement external collaborations and ECO, ultimately achieving overall performance gains.

The external-facing practices also showed significant, yet varied, contributions to operational outcomes. GP was positively associated with OP; however, its effect in this study was not significant compared to other practices. This finding may reflect the challenges that Saudi firms face in integrating green practices into their supply chains. One interpretation is that the benefits of GP (for example, reduced hazardous materials) are real but not entirely accepted in short-term OP, possibly due to the limited availability of eco-friendly suppliers or higher initial costs in the local context. GP's weaker direct effect suggests that while selecting sustainable suppliers is essential, it may need to be complemented by internal process improvements and market alignment to achieve a significant increase in OP. By contrast, ECO demonstrated an apparent positive effect on OP. This indicates that integrating sustainability at the product design stage can benefit downstream operations. Designing for recyclability, lower material usage, or energy efficiency often leads to cost savings in production and distribution. Our results suggest that firms practising ECO likely reduce waste and improve resource utilisation, resulting in better quality control. Additionally, ECO's impact also carries a strategic dimension: by reconsidering product life cycles, companies not only improve their internal systems but also position themselves for future regulations and customer preferences, creating an operational advantage.

CC in environmental initiatives had a positive, significant linkage to OP in the model. This finding highlights that downstream collaboration can lead to internal improvements. By involving customers, firms become familiar with market demands for sustainability. They can innovate processes accordingly (for example, adjusting production to provide recycled materials or designing products for easier returns/end-of-life processing). The data suggest that customer cooperation not only enhances reputation but can lead to process and product innovations that improve efficiency and quality, thereby increasing OP. All four GSCM practices demonstrated positive roles in enhancing OP, either directly or indirectly.

The relationship among them is significant: for instance, a strong internal environmental foundation can amplify the benefits of collaborating with customers, while customer feedback can inform better ECO. Such a relation matches observations in the literature that GSCM practices are mutually reinforcing and should be addressed in an integrated manner for maximum impact.

From a practical perspective, these results offer important insights for firms operating in Saudi Arabia during the country's sustainability transition. The positive link between GSCM practices and operational efficiency conveys a clear message: embracing environmental sustainability can provide operational excellence, rather than a hindrance. Our findings indicate that companies aligning with Vision 2030's sustainability goals by implementing GSCPs are likely to reap dual benefits: improving their own efficiency and performance while also contributing to national objectives.

6 CONCLUSION

This study demonstrates that GSCPs have a significant positive impact on OP in Saudi Arabian firms. By quantitatively linking specific practices: ECO, GP, IEM, and CC, to key operational outcomes, we provide evidence that integrating sustainability into supply chain operations is an effective strategy for improving efficiency, quality, and cost performance. The main takeaway is that environmental sustainability and operational excellence are not competing goals but mutually reinforcing ones. Companies that invest in greener processes and collaborations get operational benefits, confirming that GSCM can serve as a pathway to both economic and environmental value creation. Our findings contribute to the growing consensus in the literature that sustainability practices can lead to improved internal outcomes, particularly when aligned with a firm's operational strategy and resources. For Saudi Arabia, a notable implication is that the business sector's engagement with Vision 2030's sustainability agenda can directly enhance firms' OP. By adopting green practices, Saudi firms not only support national policy goals but also position themselves for improved productivity and resilience in a changing global market. This study thus provides data-driven confirmation that pursuing sustainability through GSCM is compatible with OP improvements in the context of emerging economies.

These insights carry several practical and policy implications. For managers, the results highlight the importance of a comprehensive approach to GSCM: investing in IEM systems and ECO capabilities will amplify the gains from external collaborations with suppliers and customers. Firms should integrate sustainability criteria throughout their supply chain decisions, from procurement contracts to product development and customer engagement, as this integration provides an operational connection that single initiatives might not achieve. Policymakers and industry bodies in Saudi Arabia can benefit from these findings by creating incentives and guidelines that encourage broader adoption of GSCM practices. Finally, this research opens avenues for future inquiry. While we focused on four key GSCM dimensions and their impact on OP, future studies could explore additional green practices and broader performance outcomes. Examining how sustained GSCM adoption influences OP over time and whether the benefits grow as green capabilities mature can also be a good choice. Comparative studies across industries or countries would help generalise the findings and address context-specific factors. In conclusion, our study contributes to a deeper understanding of the GSCM performance relationship in the Middle East context. It affirms that sustainable supply chain practices are a viable route to operational excellence.

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