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Green supply chain management and organizational performance: Moderated mediation of green operational capability under perceived governmental environmental signaling intensity in manufacturing firms

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A B S T R A C T

Green supply chain management has emerged as a critical strategic approach for improving environmental sustainability and organizational performance in manufacturing firms. However, existing literature remains limited and missed the mechanisms and contextual conditions that shape these relationships. This study examines the relationship between green supply chain management and organizational performance through green operational capability as mediating mechanism, while considering perceived governmental environmental signaling intensity as moderated mediator. The study employed a quantitative research approach with explanatory research design. The data were collected from 327 respondents who are working in manufacturing factories. Data were analyzed using Smart PLS to test both the measurement and structural models. The findings show that green supply chain management has significant effect on organizational performance and green operational capability. Green operational capability also significantly enhances organizational performance and mediated the relationship between green supply chain management and organizational performance. Furthermore, perceived governmental environmental signaling intensity significantly strengthen the relationship between green supply chain management and green operational capability then influence the organizational performance which confirm moderated mediation effect. This study suggests that manufacturing firms institutionalize green supply chain management as a strategic capability. Policymakers should strengthen clear and consistent environmental signaling to enhance firm responsiveness. Managers should develop green operational capabilities to effectively translate sustainability practices into improved organizational performance and long-term competitive advantage.

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1. Introduction

Green supply chain management has become a critical strategic priority in modern organization due to intensifying environmental degradation, climate change pressure, regulatory enforcement, and increasing stakeholder expectation for sustainable performance (Asamoah *et al*., 2024; Mustafi *et al*., 2024). As it is a global issue in today's business environment, require firms to integrate environmentally friendly initiatives into every aspect of the supply chain practices such as sourcing, product design and development, manufacturing, transportation, packaging, storage, retrieval, disposal, and post-sales services to maintain competitiveness and corporate image (Gupta *et al*., 2025; Kim & Kim, 2017). Empirical evidence confirms that firms adopting green supply chain management practices achieve superior environmental, operational, and financial performance, reinforcing its role as a key driver o sustainable competitive advantage (Gelmez *et al*., 2024; Kim & Kim, 2017; Sun *et al*., 2022). It also strengthens long term relationship with supplier and customer while supporting natural resource management (Cui *et al*., 2026; Kalaitzi *et al*., 2018). In developing countries, green supply chain management particularly crucial as it shapes environmental, economic, social, and ethical concerns of the organizations (Zeleke & Hailemariam, 2023).

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A critical mechanism through which green supply chain management (GSCM) translate into performance outcome is green operational capability, which represent the operational execution of green strategies within firms. Green operational capability includes energy efficiency initiatives, waste minimization, emission reduction, environmental auditing, and sustainable resource utilization (Hassan *et al*., 2024). Recent studies confirm that firms with strong Green operational capability achieve higher efficiency, improved regulatory compliance, and enhanced organizational performance (Dubey *et al*., 2025; Hosain & Mustafi, 2025; Sharma *et al*, 2025). However, the strength of this relationship is highly contingent on institutional environments, particularly perceived governmental environmental signaling intensity. These initiatives include environmental regulations, carbon taxation policies, green industrial strategies, sustainability incentives, and enforcement mechanisms aimed at promoting environmentally responsible corporate behavior (Middya *et al*., 2026; Wang *et al*., 2026). Recent evidence shows that strong governmental environmental frameworks significantly influence firms' adoption of sustainability practices by increasing regulatory pressure and providing institutional support for green transformation (Islam *et al*., 2026; Wang *et al*., 2025; Sharma *et al*., 2025). From an institutional theory perspective, perceived governmental environmental signaling intensity act as external coercive forces that strengthen the translation of GSCM into effective green operational capability, thereby enhance organizational performance.

In manufacturing industries, green supply chain management is particularly important because this sector is highly resource intensive and environmentally sensitive, contributing significantly to pollution, energy consumption, and waste generation (Nazir *et al*., 2024). They are expected to adopt green practices to fulfill the corporate social responsibility and respond to growing stakeholder pressure (Abbasi, 2017; Köksal *et al*., 2017; Wiredu *et al*., 2023). As globalization and competition intensify, firms must integrate sustainable practices to maintain the performance and long-term viability (Chin *et al*., 2015). Green supply chain management enables manufacturing firms to improve efficiency, align with environmental regulations, and ensure their operations remain compatible with environmental sustainability goals (Munir *et al*., 2022). Green supply chain management practices in Ethiopia are gradually expanding due to increased awareness of environmental protection and government support for sustainability practices across industries (Beyene, 2015). Ethiopian manufacturing industries have long been involved in global sustainable supply chains; however, their level of development and effective implementation of sustainable practices remain limited (Zeleke & Hailemariam, 2023). Green supply chain management in manufacturing firms is constrained by multiple persistent operational and institutional problems. Weak environmental regulation enforcement and inconsistent governmental pressure reduce firms' motivation to adopt green practices effectively (Setyawan *et al*., 2022). Firms also face inadequate infrastructure, limited access to green technologies, and high implementation costs, which hinder scalable adoption of sustainable supply chain systems (Abebaw & Virdi, 2019; Kormych *et al*., 2019). Internal capability gaps such as shortage of skilled personnel, low environmental awareness, and weak managerial commitment further restrict effective implementation of green practices (Andaregie & Astatkie, 2022; Ojo *et al*, 2014). In addition, poor supplier collaboration and limited availability of environmentally compliant suppliers disrupt green integration across the supply chain (Torban *et al*., 2024). Methodological fragmentation and overreliance on descriptive approaches in prior studies also limit robust understanding of causal relationships in GSCM outcomes (Beyene, 2015; Worku & Virdi, 2019).

Despite many researches have been conducted, only few studies addressed in Ethioia. Kumar *et al*. (2022) and Boson *et al.* (2023) used SEM in Ethiopian manufacturing but small number of responses that limits robustness and generalizability. Beyene (2015) studied in Ethiopian tannery industry but lacks advanced analytical strength that limit SEM-based analysis. Worku and Virdi (2019) used descriptive statistics only, lacking inferential multivariate rigor. Berkesa et al. (2025) miss integrated framework linking government signaling pressures, capabilities, and outcomes in GSCM adoption. Shebeshe and Sharma (2024) lack strong theory link for sustainable SCM and performance outcomes. Gelagay & Werke (2024) omit governmental pressures and internal capabilities shaping green performance. To addresses these methodological, contextual and theoretical gaps, this study is investigated on the relationship between green supply chain management and organizational performance with mediating role of green operational capability and moderated mediating role of perceived governmental environmental signaling intensity.

2. Literature Review

2.1 Theoretical Foundations

Natural resource-based view, institutional theory, and the practice-based view considered to establish a strong theoretical foundation for the study. The natural resource-based view found by Hart (1995), serves as the primary strategic framework, asserts that a firm's competitive advantage is increasingly determined by its ability to manage environmental constraints. Unlike traditional models, the NRBV posits green supply chain management that is a proactive capability that transforms the ecological risks into operational strengths though pollution prevention, product stewardship and sustainable development capabilities (Asamoah et al., 2024). By integrating green sourcing and eco-design, firms through optimized resource utilization and enhanced market reputation (Dzikrianshyah *et al*., 2025; Manzoor *et al*., 2026). Institutional theory is developed by Dimaggio and Powell (1983). Provides the rationale for the moderation role of perceived governmental environmental signaling intensity that suggests external environmental pressures shape organizations' response particularly though state regulators or governmental environmental signaling. Therefore this, the government environmental signaling enforcement plays a critical role that intensify the green supply chain management to consider the operational efficiency and green

operational capability (Mustafi *et al*., 2026). When regulatory enforcement and green subsides are strong, the relationship between green supply chain management and green operational capability significantly strengthen (Domenek *et al*., 2022; Polash *et al*., 2026).

The practice-based view is introduced by Bromiley and Rau (2014), elucidates the mediating role of green operational capability, argue that performance variation emerges from successful implementation of specific best practices. While green supply chain management represents the overarching strategic intent, it is specific day-to-day green operational capability such as waste reduction and energy efficiency that generate tangible performance results (Lie *et al*., 2024). Consequently, these practices serve as the vital conduit that translate broad green supply chain management into measurable gains in organizational performance (Inman & Green, 2022; Vijayvargy *et al*., 2017).

2.2 Green supply chain management and Organizational Performance

Green supply chain management is one of the strategic capabilities that directly enhances organizational performance in competitive and regulated environments (Jatav & Nema, 2021). Empirical evidence shows that green procurement practices significantly improve firms' cost efficiency and financial performance (Galdos-Urbizu *et al*., 2024). Similarly, eco-design initiatives have a positive effect on product quality and operational performance (Khan *et al*., 2024). Green logistics practices also significantly contribute to improved delivery efficiency and reduced operational costs (Diab *et al*., 2015). In manufacturing industries, green supply chain management adoption leads to measurable improvements in firm's productivity and profitability (Alkandi *et al*., 2024). Furthermore, green manufacturing practices have influences on enhancing environmental and economic performance (Liu *et al*., 2026). Another study also confirms that green supply chain management improves resource utilization efficiency, thereby strengthening overall firm performance (Shebeshe & Sharma, 2024). Evidence indicates that firms implementing green supply chain management practices enable to achieve higher operational performance through waste reduction and process optimization (Yu *et al*., 2014). Additionally, green supply chain management practices enhance organizational competitiveness and market performance (Holling & Backhaus, 2023; Sugandini *et al*., 2020; Tan *et al*., 2016).

H_1: *There is significant relationship between green supply chain management and organizational performance*

2.3 Green Supply Chain Management and Green Operational Capability

Green supply chain management become a critical driver of green operational capability within organizations that enables firms to integrate sustainability into supply chain activities (Handoyo, 2024). Recent study confirms that green supply chain management practices significantly enhance environmental performance across industries (Mousa *et al*., 2024). Among these, green purchasing and eco-design reduce environmental influences by minimizing waste and emissions (Nazir *et al*., 2024). Similarly, internal environmental management practices strengthen firms' ability to implement effective environmental strategies (Karakaş-Kelten *et al*., 2026). Green supply chain management adoption also promotes efficient resource utilization and pollution prevention (Gelmez *et al*., 2024). Additional evidence indicates that green practices within supply chains significantly improve ecological outcomes in manufacturing firms (Feng *et al*., 2024). Sustainable supply chain initiatives are found to reduce environmental degradation and energy consumption (Abuzawida *et al*., 2023). Moreover, green supply chain management fosters environmental innovation, strengthening green operational capability (Ahmad *et al*., 2022). Moreover, empirical studies also highlight that green supply chain management enhances firms' environmental capabilities and compliance with regulations (Holling & Backhaus, 2023; Nyamah *et al*., 2026).

H_2: *There is significant relationship between green supply chain management and green operational capability*

2.4 Green Operational Capability and Organizational Performance

Green operational capabilities are widely recognized as a catalyst for organizational performance by improving efficiency, compliance, and resource utilization (Mousa *et al*., 2024). A study shows that firms that adopt strong green operational capability able to achieve higher financial and operational performance through reduced waste and energy consumption (Feng *et al*., 2024). Green operational practices significantly enhance productivity and cost efficiency particularly in manufacturing firms (Gelmez *et al*., 2024). Environmental compliance initiatives have positive relationship with firm's reputation and market performance (Jaswita *et al*., 2026). Sustainability-oriented practices also improve stakeholder trust and competitive advantage (Ahmad *et al*., 2022). Internal environmental management enhances operational resilience and process quality (Abuzawida *et al*., 2023). Green innovation practices contribute to long-term financial sustainability (Handoyo, 2024). Firms integrating environmental standards report stronger performance outcomes across industries (Karakaş-Kelten *et al*., 2026). This is supported consistently that confirms a positive relationship between green operational capability and organizational performance (Holling & Backhaus, 2023).

H_3: *There is significant relationship between green operational capability and organizational performance*

2.5 Green Operational Capability: Mediating Role

Green supply chain management is one of the significant actors that strengthens firms' green operational capability through structured sustainability integration across procurement, production, and logistics systems. When firms adopt it by reducing emissions, waste generation, and energy consumption in manufacturing and service industries, their performance became improved (Aldaas *et al*., 2025). Similarly, green supply chain management practices drive green operational capability that enhance resource efficiency and pollution control mechanisms within firms (Shebeshe *et al*., 2025). Additionally, green operational capability serves as a catalyst in which green supply chain management enhance environmental compliance and operational performances (Camila *et al*., 2026). When firms implement green supply chain management practices, they develop stronger environmental capabilities, and then improve the organizational performance (Green Jr *et al*., 2012). Moreover, green supply chain management practices reinforce environmental performance by optimizing transport routes and reducing carbon emissions (Ali *et al*., 2023). Other findings also support a strong and positive relationship between green supply chain management and green operational capability across industries (Huma *et al*., 2024).

H4: *Green operational capability mediates the relationship between green supply chain management and organizational performance.*

2.6 Perceived Governmental Environmental Signaling Intensity: Moderating Role

The role of governmental initiatives for environment becomes increased across industries. Studies consistently show that regulatory pressure, environmental policies, and incentive schemes significantly strengthen firms to adopt green supply chain management by improving compliance motivation and reducing uncertainty (Kaodui *et al*., 2026; Wang *et al*., 2026). Additional empirical research indicates that firms' green operational capability is enhanced by environmental governance initiatives and policies enforcement through stronger institutional alignment and accountability mechanisms (Wabanhu *et al*., 2026). Furthermore, public green initiatives subsidies support supply chain practices that are focused on sustainability, making businesses more sensitive to environmental issues (Cho *et al*., 2023; Shan *et al*., 2026). By incorporating environmental responsibility into operational choices, carbon taxes and more comprehensive environmental governance frameworks strengthen this relationship (Ali *et al*., 2021; Ye, 2026). Institutional support has a significant effect on sustainability results in developing economies (Addai *et al*., 2024). Ethiopia's government has shown a great commitment to sustainability transitions through programs like the national green legacy program and environmental legislation improvements. These practices link and its indirect effect on organizational performance (Torban *et al*., 2023).

H5: *Perceived governmental environmental signaling intensity positively moderate the relationship between green supply chain management and green operational capability.*
H6: *Perceived governmental environmental signaling intensity positively moderate the indirect effect of green supply chain management on organizational performance through green operational capability.*

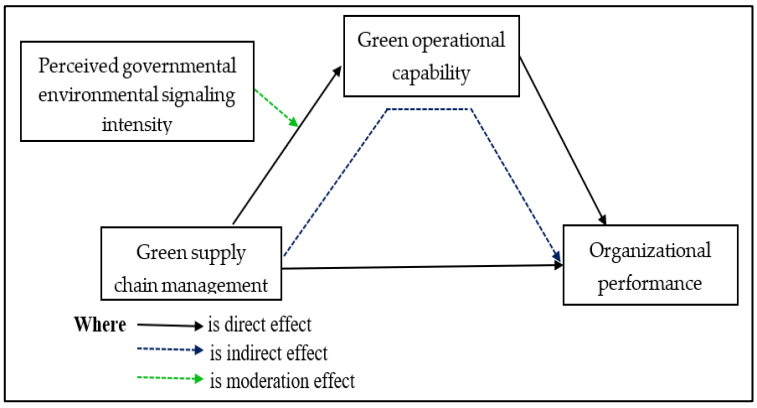

Fig. 1. Conceptual framework

3. Methods

The study employed an explanatory research design with a quantitative approach to investigate the relationships between green supply chain management and organizational performance, taking into account green operational capability as mediating and perceived governmental environmental signaling intensity as moderating factor. The target population comprised employees of in manufacturing organizations, including management-level staff and operational personnel involved in production, logistics, and environmental management activities. The study conducted in Bedele Brewery S.C., Jimma Industrial Park, and Gumero tea plantation that provide a relevant information in manufacturing context. A proportional stratified sampling and then simple random sampling approaches were applied to ensure representativeness of responses from different factories. Data were collected from 327 respondents using a structured Likert-scale questionnaire, with measurement items adapted from prior studies. The analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-

SEM) via SmartPLS 4 software. The measurement model was assessed to check the quality matters. The structural model analysis was evaluated test direct, indirect, and moderated mediation effects. This methodological approach enables rigorous examination of how GSCM influences organizational performance through green operational capability, and how perceived governmental environmental signaling intensity strengthen this relationship, providing strong empirical and policy-relevant insights for sustainability-driven manufacturing contexts.

4. Result and Discussions

4.1 Descriptive Analysis

Table 1 presents the demographic profile of the 327 respondents who participated in the study. The sample consisted of 59.33% male and 40.67% female participants. In terms of age distribution, the workforce appears relatively young and mid-career oriented. The largest group falls within the 31-40 years age bracket (36.70%), closely followed by those aged 21-30 years (33.64%). Respondents aged 41-50 years accounted for 19.88%, while those aged 51 years and above represented the smallest proportion at 9.78%. Regarding marital status, the majority of respondents (72.76%) were married, whereas 27.24% were unmarried. Educational qualifications showed that most participants had attained at least diploma-level education. Bachelor's degree holders formed the largest group (51.38%), followed by diploma holders (32.42%), certificate holders (11.31%), and those with a master's degree or higher (4.89%). Finally, work experience was concentrated in the mid-tenure range, with 52.91% of respondents having 6-10 years of experience. Another 36.39% had 1-5 years of experience, while those with less than one year accounted for 7.03%, and only 3.67% had more than 11 years of service.

Table 1
Demographic profile (N=327)

Variables	Category	Frequency	Percent	Variables	Category	Frequency	Percent
Gender	Male	194	59.33	Marital status	Married	238	72.76
	Female	133	40.67		Unmarried	89	27.24
Age in group	21-30 years	110	33.64	Educational level	Certificate	37	11.31
	31-40 years	120	36.70		Diploma	106	32.42
	41-50 years	65	19.88		Degree	168	51.38
	51 years and above	32	9.78		Master's an	16	4.89
Tenure/experience	Below 1 year	23	7.03				
	1-5 years	119	36.39				
	6-10 years	173	52.91				
	11 years and above	12	3.67				

4.2 Measurement Model Analysis

Reliability Tests

Table 2 presents the results of the measurement model assessment, confirming acceptable reliability across all constructs.

Table 2
Outer Loading, Composite Reliability, Average Variance Extracted

Constructs	Indicators	Loadings	CA	CR	AVE
Green supply chain management	GSCM1	0.792	0.863	0.895	0.550
	GSCM2	0.683			
	GSCM3	0.765			
	GSCM4	0.689			
	GSCM5	0.742			
	GSCM6	0.720			
	GSCM7	0.790			
Perceived governmental environmental signaling intensity	PGESII1	0.791	0.888	0.912	0.598
	PGESI2	0.773			
	PGESI3	0.774			
	PGESI4	0.792			
	PGESI5	0.814			
	PGESI6	0.786			
	PGESI7	0.675			
Green operational capability	GOC1	0.761	0.845	0.886	0.565
	GOC 2	0.854			
	GOC 3	0.682			
	GOC 4	0.760			
	GOC 5	0.643			
	GOC 6	0.791			
Organizational performance	OP1	0.758	0.778	0.849	0.531
	OP2	0.752			
	OP3	0.681			
	OP4	0.748			
	OP5	0.700			

Most indicator outer loadings were above the recommended threshold of 0.70, although a few fell slightly below this value. However, these marginal loadings were considered acceptable given that the Average Variance Extracted (AVE) for each construct remained above the 0.50 threshold. Cronbach's Alpha values ranged from 0.778 to 0.888, all exceeding the minimum requirement of 0.70 and indicating good internal consistency. Similarly, Composite Reliability (CR) values ranged from 0.849 to 0.912, further confirming strong construct reliability. Taken together, these results show that all constructs meet established SEM criteria, making the measurement model suitable for proceeding with structural analysis.

Validity Tests

Validity test is another criterion for the quality of the measurement model. Among the validity test, one is convergent validity that check through AVE. As Table 2 show the AVE values are above 0.50 for all constructs (0.531- 0.598), satisfying convergent validity requirements.

Table 3
Fornell- Larcker Criterion

	GSCM	PGESI	GOC	OP
GSCM				
PGESI	0.835			
GOC	0.655	0.628		
OP	0.742	0.783	0.725	

Table 3 shows that the Fornell-Larcker criterion which is the square root of AVE, for each construct exceeds its correlations with other constructs. This indicates that the discriminant validity is satisfied.

Table 4
Hetrotriate-Monotriate Matrix

	GSCM	PGESI	GOC	OP
GSCM	0.741			
PGESI	0.730	0.773		
GOC	0.567	0.560	0.752	
OP	0.577	0.617	0.595	0.728

Table 4 presents the HTMT ratios, which is another criterion for discriminant validity. Based on the result presented in the table all values are below the threshold, and this also confirms the validity issue is achieved.

Structural Model Analysis

The Path coefficient analysis

Table 5 presents the direct path coefficients among the study variables. The results reveal that all hypothesized relationships are statistically significant at the 0.05 level. Green supply chain management (GSCM) demonstrates a strong positive effect on organizational performance ($\beta = 0.647$, $T = 17.867$, $p < 0.001$). This finding suggests that manufacturing firms that actively implement robust green supply chain practices tend to achieve noticeably higher levels of overall performance.

Table 5
Direct effects

Relationships	β	Mean	Std. Dev.	T-value	P values	Decisions
GSCM → OP	0.647	0.649	0.036	17.867	0.000	***H1***: Supported
GSCM → GOC	0.332	0.333	0.073	4.556	0.000	***H2***: Supported
GOC → OP	0.228	0.228	0.043	5.262	0.000	***H3***: Supported

Note: β = Path Coefficient (Original Sample), Mean = Sample Mean, Std. Dev. = Standard Deviation, T-value = T-statistic, p-value = Significance Level.

In addition, GSCM exerts a significant positive influence on green operational capability ($\beta = 0.332$, $T = 4.556$, $p < 0.001$), indicating that effective green supply chain initiatives help firms build stronger capabilities in managing environmental operations. Likewise, green operational capability itself shows a positive and statistically significant relationship with organizational performance ($\beta = 0.228$, $T = 5.262$, $p < 0.001$). This confirms that when firms develop solid green operational competencies, these capabilities meaningfully contribute to improved performance outcomes.

The Mediation and Moderation Analysis

Table 6 summarizes the mediation and moderation results, including the interaction and conditional indirect effects involving GSCM, PGESI, GOC, and OP. All hypothesized effects emerged as statistically significant at the 0.05 level.
The analysis reveals a positive and significant indirect effect of green supply chain management on organizational performance through perceived governmental environmental signaling intensity ($\beta = 0.076$, $T = 4.289$, $p < 0.001$). This finding

supports partial mediation, suggesting that GSCM influences performance partly by shaping how firms perceive and respond to government environmental signals.

Table 6
Indirect Effects

Relationship	β	Mean	Std. Dev.	T-value	P values	Decisions
GSCM → PGESI → OP	0.076	0.075	0.018	4.289	0.000	***H4***: Supported
PGESI × GSCM → GOC	0.175	0.176	0.046	3.773	0.000	***H5***: Supported
PGESI × GSCM → GOC → OP	0.040	0.040	0.012	3.312	0.001	***H6***: Supported

Additionally, the interaction term between perceived governmental environmental signaling intensity and GSCM showed a significant positive effect on green operational capability ($\beta = 0.175$, $T = 3.773$, $p < 0.001$). This indicates that stronger governmental environmental signaling enhances the positive impact of green supply chain practices on firms' operational capabilities. Furthermore, the moderated mediation effect was also significant ($\beta = 0.040$, $T = 3.312$, $p = 0.001$). In other words, the indirect influence of GSCM on organizational performance via green operational capability is not fixed; it becomes stronger when firms perceive clearer and more intense governmental environmental signals.

5. Conclusion

The findings of this study provide compelling evidence that green supply chain management plays a pivotal role in enhancing organizational performance among manufacturing firms. The results reveal a strong direct positive relationship between GSCM and organizational performance, suggest that firms adopt environmentally responsible supply chain strategies are better positioned to achieve superior outcomes in terms of efficiency, competitiveness, and sustainability. Furthermore, green operational capability was found to partially mediate this relationship, indicates that effective green practices not only deliver immediate benefits but also build internal operational strengths that further drive performance.

Interestingly, perceived governmental environmental signaling intensity emerged as both a mediator and a significant moderator. It not only transmits the influence of GSCM on performance but also strengthens the link between green supply chain practices and green operational capability. This highlights the critical importance of clear, consistent, and supportive government signals in shaping how firms translate sustainability initiatives into tangible operational advantages. In environments where governmental environmental expectations are strongly and credibly communicated, the benefits of GSCM become even more pronounced.

Overall, the study underscores that successful green transformation in manufacturing requires a synergistic approach that combines robust internal green supply chain practices, enhanced operational capabilities, and a supportive external policy environment. These interconnected elements collectively contribute to improved organizational performance while advancing broader environmental goals. The research contributes to the growing body of knowledge on sustainable operations by demonstrating the contingent role of governmental signaling in emerging market contexts.

6. Recommendations

Based on the findings, several recommendations are offered to manufacturing firms and policymakers. First, organizations should prioritize the integration of comprehensive green supply chain management practices across procurement, production, and distribution processes. Investing in supplier collaboration, eco-friendly materials, and waste reduction initiatives can yield substantial returns through improved operational capability and overall performance.

Second, firms need to consciously develop their green operational capabilities by building internal competencies in environmental management, process innovation, and resource efficiency. Training programs, technology adoption, and cross-functional teams focused on sustainability can accelerate this capability-building process.

For policymakers, the study emphasizes the need to strengthen and clarify governmental environmental signaling. Consistent policies, transparent communication, and credible enforcement mechanisms are essential to amplify the positive impact of green practices. Rather than relying solely on coercive regulations, governments should consider incentive-based approaches that encourage voluntary adoption of sustainable supply chain strategies.

Finally, manufacturing firms operating in dynamic regulatory environments should closely monitor government environmental signals and align their strategies accordingly. Those that proactively respond to strong signaling are likely to gain greater competitive advantages through enhanced green operational capabilities and superior performance. Future research could explore these dynamics across different industries and cultural contexts to further validate and extend these insights.

Theoretical Implications

This study contributes to theory by opening the black box between green supply chain management and organizational performance. It demonstrates that green operational capability serves as a critical bridge, shows how GSCM practices translate into performance gains when converted into operational strengths, thereby extending the natural resource-based view. More importantly, the research advances institutional theory by treating perceived governmental environmental signaling intensity as an active contextual force. The findings reveal that strong governmental signals significantly strengthen the link from GSCM to green operational capability and condition the indirect effect on performance. Overall, the study highlights how internal capabilities and external institutional pressures together drive sustainable performance.

Practical Implications

Practical recommendations for managers and policymakers are straightforward. Managers should focus on building strong green operational capabilities, particularly in areas like waste reduction and resource efficiency, to better translate green supply chain practices into improved performance. Staying attuned to government environmental signals help firms align their internal processes with external expectations and gain a real competitive edge. At the same time, policymakers need to strengthen environmental signaling through clear policy roadmaps and meaningful incentives. Such stronger signals can turn sustainability from a mere compliance issue into a genuine strategic capability, ultimately supporting a more sustainable manufacturing sector.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Ethical Consideration

This study was conducted in accordance with established ethical research principles and standards. Participation in the study was entirely voluntary, and informed consent was obtained from all respondents. The confidentiality and anonymity of participants and the information provided were strictly maintained throughout the research process.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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