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The Impact of Green Supply Chain Management Components on Organizational Performance

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ARTICLE INFO	ABSTRACT
Article History: Received 7 November 2025 Received in revised form 10 December 2025 Accepted 6 February 2026 Available online 1 March 2026 Keywords: Sustainability, Organizational Performance, Environmental Performance, Green Supply Chain Management, Structural Equation Modeling, Natural-Resource-Based View	This study tests an integrated model in which internal environmental management (IEM) and green information systems (GIS) enable five green supply chain management (GSCM) practices, which in turn shape environmental, economic, operational, social and overall organizational performance. Drawing on the natural-resource-based view and institutional theory, 30 hypotheses were tested with survey data from 206 senior and middle managers, one per firm, in 23 manufacturing industries in Iran. In a two-step approach, confirmatory factor analysis supported the measurement model (CFI = .953, RMSEA = .031, SRMR = .046; CR = .83–.94; AVE = .55–.67; HTMT ≤ .66), and a path model with 5,000 bootstrap resamples estimated the structural relations (CFI = 1.00, SRMR = .023). Twenty-five hypotheses were supported. GIS was strongly associated with IEM ($\beta = .54$), and both enablers predicted most GSCM practices; GIS was related to green production only indirectly, through IEM (indirect effect = .17, 95% CI [.09, .25]). Green purchasing, eco-design, green production and reverse logistics were associated with environmental performance, whereas customer collaboration was not. Environmental performance predicted economic, operational and social performance, and it was linked to overall organizational performance only indirectly (indirect effect = .22, 95% CI [.14, .31]). Because the design is cross-sectional and relies on single-informant self-reports, the associations should not be read as causal effects. The results suggest that firms should build environmental management and information infrastructure before expanding GSCM practices.

1. INTRODUCTION

Today, business sustainability and the greening of operations have become critical issues for organizations [1–5] and are increasingly recognized as important competitive tools [6–8]. Supply chain management requires the integration and coordination of business processes and strategic orientation across the entire chain to ensure customer satisfaction [9]. Numerous business processes including procurement, production, marketing, logistics, and more

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must be integrated. Additionally, companies need to align customer focus, efficiency, quality, responsiveness [10], and environmental sustainability with green operations.

Given the variability of customer demands and the intensity of market competition, companies are compelled to compete at the supply chain level and identify strategies and solutions that create competitive advantage at this level, ultimately improving performance for supply chain partners. As a result, leading organizations have adopted Green Supply Chain Management (GSCM) components to produce sustainable products, thereby meeting customer needs while complying with government environmental regulations.

Various definitions of GSCM have been proposed [11–13]; in summary, it refers to efforts to minimize or even eliminate the negative environmental impacts of supply chains [14]. GSCM also encompasses post-use stages of products in their lifecycle. Studies indicate that some organizations adopt GSCM components primarily to satisfy customer expectations, while others do so mainly to comply with environmental regulations [15]. In recent years, this topic has attracted increasing attention from both researchers and operations and supply chain managers [16], and a significant number of manufacturers are striving to eliminate the environmental damage caused by their activities through GSCM practices [17].

The need to balance economic and environmental performance is growing steadily, as it contributes to overall sustainability. To achieve sustainability, companies must engage all elements of the supply chain. GSCM represents an advanced version of traditional supply chain management, incorporating a set of internal and external components [18] that influence organizational environmental performance and, ultimately, allow organizations to balance it with economic performance.

As discussed, GSCM is a critical area of interest for both researchers and managers. Studying GSCM and its impact on organizational performance is therefore essential to address the demands for organizational sustainability and to clarify the pathway toward achieving it [19]. Accordingly, this study not only develops a comprehensive model and explains how GSCM components affect performance but also contributes to the theoretical foundations of the field and validates previous research. Overall, one of the main objectives of this study is to highlight the importance of integrating environmental sustainability concepts into organizational practices and the strategic necessity of developing information systems to monitor sustainability-related activities.

To achieve this objective, Section 2 sets out the theoretical framework, reviews the literature and develops the hypotheses. Section 3 describes the research methodology, including the sample, measures and analytical strategy. Section 4 presents the measurement and structural results, and Section 5 discusses the findings, their theoretical and managerial implications, and the study's limitations.

2. THEORETICAL FOUNDATIONS AND LITERATURE REVIEW

The concept of Green Supply Chain Management (GSCM) has been observed in academic journals and publications since the 1990s [20]. Leading organizations have adopted GSCM as an effective managerial tool and philosophy [21]. GSCM mitigates the negative impacts of organizational activities, establishes control mechanisms, facilitates recycling, and promotes efficient resource utilization [11]. Consequently, implementing GSCM components can create a competitive advantage for organizations [9]. Numerous manufacturers have enhanced their environmental management practices through GSCM adoption [17].

The theoretical foundations and dedicated studies on GSCM are still in the early stages of development [9]. Additionally, a portion of research has focused on developing and refining measurement scales related to environmental sustainability [21–23]. For example, Olfat, Khatami Firouzabadi, and Khodaverdi [24] examined the drivers, barriers, actions, and outcomes necessary for implementing GSCM in the Iranian automotive industry and prioritized the required actions. In another study, the essential drivers for supply chain management were identified and hierarchically structured using the Interpretive Structural Modeling (ISM) approach [25]. Safaei Ghadikolaei, Tabibi, and Hajiabadi [26] applied multi-criteria decision-making methods to rank evaluation criteria for green supplier performance. Other researchers have proposed an integrative modeling approach to assess supply chain sustainability [27].

Given the growing importance of balancing economic and environmental performance, some studies have explored the relationship between the implementation of GSCM components and these two performance dimensions in Chinese organizations. The results indicated that internal environmental management, improved investments, and eco-design mediated by quality management and Just-in-Time (JIT) practices are associated with both environmental and economic performance [28]. In another study, performance indicators were identified and introduced for evaluating GSCM components [29]. Green et al. [9] examined the effects of GSCM components, including green purchasing, customer collaboration, eco-design, and investment improvement, on environmental, economic, operational, and organizational performance.

Another critical aspect of GSCM research concerns the role and impact of green human resource management on supply chain sustainability; however, no study has yet evaluated the nature and strength of this relationship [13]. Younis et al. [20] aimed to investigate the implementation of GSCM components and their impact on organizational performance. Their findings indicated that GSCM components affect different performance dimensions differently: green purchasing and environmental collaboration influence operational performance, whereas only reverse logistics impacts social performance.

A review of the literature indicates that, despite the growing importance of GSCM, few studies have examined its impact on overall organizational performance. Existing research has often overlooked certain performance dimensions or evaluated only a limited set of GSCM components. Therefore, this study contributes to the development of theoretical foundations in this field by offering a more comprehensive assessment of GSCM's effects on organizational performance.

2.1. Theoretical Framework

Two complementary theories explain why environmental practices inside the firm and across the supply chain should translate into performance. The natural-resource-based view (NRBV) argues that firms can build competitive advantage from capabilities that reduce their environmental burden, namely pollution prevention, product stewardship and sustainable development [40]. Internal environmental management and green information systems are capability-building investments of this kind: they create the managerial commitment, routines and data that GSCM practices require, and the resulting reductions in waste, energy use and environmental risk are expected to appear first as environmental performance and then as economic and operational gains. Institutional theory adds an external explanation: coercive pressures from regulators, normative pressures from professional and industry bodies, and mimetic pressures from competitors push firms to adopt similar environmental practices [41], [49]. Under institutional pressure, practices may be adopted for legitimacy rather than efficiency, which helps explain why some GSCM practices are associated with environmental but not economic outcomes.

2.2. Hypothesis Development

Combining the two perspectives yields a sequential logic. First, green information systems provide the monitoring and reporting infrastructure on which internal environmental management depends [33], so GIS should be positively related to IEM (H1). Second, IEM and GIS act as enablers of external GSCM practices, because managerial commitment and environmental data are preconditions for evaluating suppliers, collaborating with customers, redesigning products and organizing reverse flows (H2a–H3e) [9], [21]. Third, consistent with the NRBV, GSCM practices should reduce environmental harm and, through lower material, energy and disposal costs, improve economic performance (H4a–H8b) [28], [31]. Fourth, environmental performance is expected to support economic performance (H9) and, together with it, operational and social performance (H10a–H11c). Finally, operational and social performance are expected to feed into overall organizational performance (H12–H13) [20], [38]. The full set of hypotheses is listed in Section 3 and shown in Figure 1.

3. RESEARCH METHODOLOGY

In an effort to develop the conceptual model of this study (Figure 1), multiple studies were reviewed, particularly the research conducted by Green et al. [9], Jabbour & Jabbour [13], Uygun & Dede [14], Sari [15], Younis et al. [20], Zhu et al. [21], Rostamzadeh, Govindan, Esmaeili, & Sabbaghi [30], Rao & Holt [31], and Awasthi & Kannan [32]. Table 1 presents the definitions of the constructs used in the model.

In this model, Green Information Systems (GIS) and Internal Environmental Management (IEM) are considered independent variables, while the components of the Green Supply Chain Management (GSCM) serve as mediating variables. Ultimately, organizational performance comprising environmental, economic, operational, social, and overall organizational performance is treated as the dependent variable, with overall organizational performance identified as the final dependent outcome.

Enhancements in IEM and GIS influence an organization's capability to implement GSCM components, which in turn lead to changes in organizational performance. The Green Information System represents a critical element of environmental management efforts and supports internal environmental management systems [33]; therefore, GIS can affect IEM. Given the inevitability of implementing IEM within organizations [9], GSCM is consequently influenced by this mandatory strategy.

Table 1. Construct Definitions

Construct	Definition
Internal Environmental Management (IEM)	The process of developing environmental sustainability as an organizational requirement through the commitment and reinforcement of this requirement by middle and senior managers [21].
Green Information Systems (GIS)	Information systems designed and implemented to monitor and control environmental activities and outcomes [9].
Green Purchasing (GP)	A set of principles and activities, such as evaluating suppliers in areas like distribution, packaging, recycling, etc., aimed at meeting environmental requirements in the purchasing process [21].
Customer Collaboration (CC)	Collaboration in designing cleaner products that result in greener packaging and higher environmental sustainability [13].
Eco-Design (ED)	Integration of environmental considerations into product development processes, such as manufacturing, marketing, and purchasing, while simultaneously ensuring product efficiency and minimizing environmental impact [34].
Green Production (PO)	Green production operations including designing recyclable products, utilizing clean technologies, improving organizational capacity usage, and enhancing remanufacturing [15].
Reverse Logistics (RL)	The process of returning products to the supplier after the end of their life cycle, enabling refurbishment, reconstruction, repackaging, or material replacement [18].
Economic Performance (ECP)	Reflects the manufacturing facility's ability to reduce costs related to material procurement, energy consumption, waste management, waste elimination, and environmental penalty fines [9].
Environmental Performance (ENP)	Indicates the environmental impact of a company's activities on the natural environment [12].
Operational Performance (OPP)	Relates to the manufacturing facility's capabilities in enhancing the efficiency of product distribution to customers [21].
Social Performance (SP)	Reflects the organization's beliefs regarding social responsibility, social accountability practices, policies, programs, and tangible outcomes related to organizational social relationships [20].
Organizational Performance (ORP)	Represents the financial and marketing performance of the organization in comparison to the industry average [38].

Researchers have categorized GSCM components in various ways. Table 2 presents the components identified by different studies.

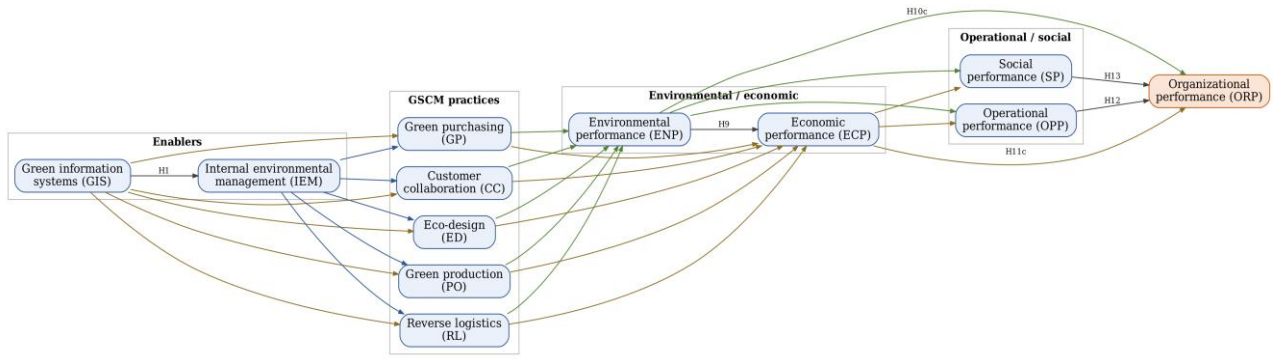


Fig. 1. Conceptual Model of the Study

Note. Blue arrows: H2a–H2e; brown arrows: H3a–H3e, H4b–H8b, H11a–H11c; green arrows: H4a–H8a, H10a–H10c. Each arrow represents one positive hypothesis.

Table 2. Components of Green Supply Chain Management (GSCM)

Component	[21]	[36]	[9]	[30]	[14]	[32]	[13]	[20]	[35]	[15]
Internal Environmental Management (IEM)	✓						✓		✓	
Green Purchasing (GP)	✓	✓	✓	✓	✓		✓	✓	✓	
Customer Collaboration (CC)	✓		✓				✓	✓	✓	
Eco-Design (ED)	✓		✓	✓	✓	✓	✓	✓	✓	
Investment Improvement	✓		✓				✓			
Green Packaging		✓				✓				
Green Transportation		✓		✓	✓					
Green Production (PO)				✓		✓			✓	✓
Warehousing				✓						
Recycling / Waste Management				✓					✓	
Logistics					✓					
Reverse Logistics (RL)					✓	✓	✓	✓	✓	✓
Input Operations						✓				✓
Output Operations						✓				✓
Life Cycle Assessment									✓	

Note. ✓ = component explicitly measured or discussed in the study.

During the development of the theoretical framework, all of the aforementioned studies were considered. As a result, GSCM components were categorized into five main groups:

1. Green Purchasing (GP)
2. Customer Collaboration (CC)
3. Eco-Design (ED)
4. Reverse Logistics (RL)
5. Green Production (PO)

Based on the theoretical review and the conceptual model presented in Figure 1, 30 hypotheses were formulated and tested in this study. All hypotheses are expressed as direct and positive relationships:

H1: Green Information Systems (GIS) have a direct and positive effect on Internal Environmental Management (IEM).

H2a: Internal Environmental Management (IEM) has a direct and positive effect on Green Purchasing (GP).

H2b: Internal Environmental Management (IEM) has a direct and positive effect on Customer Collaboration (CC).

H2c: Internal Environmental Management (IEM) has a direct and positive effect on Eco-Design (ED).

H2d: Internal Environmental Management (IEM) has a direct and positive effect on Green Production (PO).

H2e: Internal Environmental Management (IEM) has a direct and positive effect on Reverse Logistics (RL).

H3a: Green Information Systems (GIS) have a direct and positive effect on Green Purchasing (GP).

H3b: Green Information Systems (GIS) have a direct and positive effect on Customer Collaboration (CC).

H3c: Green Information Systems (GIS) have a direct and positive effect on Eco-Design (ED).

H3d: Green Information Systems (GIS) have a direct and positive effect on Green Production (PO).

H3e: Green Information Systems (GIS) have a direct and positive effect on Reverse Logistics (RL).

H4a: Green Purchasing (GP) has a direct and positive effect on Environmental Performance (ENP).

H4b: Green Purchasing (GP) has a direct and positive effect on Economic Performance (ECP).

H5a: Customer Collaboration (CC) has a direct and positive effect on Environmental Performance (ENP).

H5b: Customer Collaboration (CC) has a direct and positive effect on Economic Performance (ECP).

H6a: Eco-Design (ED) has a direct and positive effect on Environmental Performance (ENP).

H6b: Eco-Design (ED) has a direct and positive effect on Economic Performance (ECP).

H7a: Green Production (PO) has a direct and positive effect on Environmental Performance (ENP).

H7b: Green Production (PO) has a direct and positive effect on Economic Performance (ECP).

H8a: Reverse Logistics (RL) has a direct and positive effect on Environmental Performance (ENP).

H8b: Reverse Logistics (RL) has a direct and positive effect on Economic Performance (ECP).

H9: Environmental Performance (ENP) has a direct and positive effect on Economic Performance (ECP).

H10a: Environmental Performance (ENP) has a direct and positive effect on Operational Performance (OPP).

H10b: Environmental Performance (ENP) has a direct and positive effect on Social Performance (SP).

H10c: Environmental Performance (ENP) has a direct and positive effect on Organizational Performance (ORP).

H11a: Economic Performance (ECP) has a direct and positive effect on Operational Performance (OPP).

H11b: Economic Performance (ECP) has a direct and positive effect on Social Performance (SP).

H11c: Economic Performance (ECP) has a direct and positive effect on Organizational Performance (ORP).

H12: Operational Performance (OPP) has a direct and positive effect on Organizational Performance (ORP).

H13: Social Performance (SP) has a direct and positive effect on Organizational Performance (ORP).

The items used for assessing and validating the GSCM components and organizational performance in the questionnaire were adopted from previous research. Table 3 presents the number of items for each construct and their respective sources.

Table 3. Measurement Items

Variable	Number of Items	Source
Internal Environmental Management (IEM)	7	[21]
Green Information Systems (GIS)	10	[9]
Green Purchasing (GP)	4	[37]
Customer Collaboration (CC)	3	[18]
Eco-Design (ED)	3	[18]
Green Production (PO)	4	[15]
Reverse Logistics (RL)	4	[35]
Economic Performance (ECP)	5	[9], [20]
Environmental Performance (ENP)	6	[20], [21]
Operational Performance (OPP)	6	[9], [21]
Social Performance (SP)	5	[21]
Organizational Performance (ORP)	7	[38]

All items were measured on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The English items were translated into Persian and back-translated by two bilingual researchers [48], and the Persian

version was pretested with 12 supply chain managers, which led to minor wording changes. Field data were collected between April and June 2023 via an electronic questionnaire targeting manufacturing organizations. The population consisted of senior and middle managers of manufacturing firms in Iran. Screening questions ensured that only senior and middle managers completed the survey, and respondents reported their company name so that only one questionnaire per firm was retained; the 206 responses therefore represent 206 different firms, which avoids non-independence of observations within firms.

Using existing databases of professionals and specialized networks (scientific and industrial associations, national expert directories and LinkedIn), 2,750 invitations were sent. After approximately one month, 742 questionnaires had been returned; 536 were discarded because they were incomplete, were completed by non-managers or duplicated a firm already represented. The final sample of 206 usable questionnaires corresponds to a usable response rate of 7.5%. Because a low response rate can bias the results, non-response bias was assessed by comparing early (first quartile) and late (last quartile) respondents, who approximate non-respondents [50]; none of the 12 construct means differed significantly (Welch t-tests, all $p \geq .10$). Participation was voluntary and anonymous, respondents gave informed consent on the first page of the questionnaire, and no personal identifiers other than the company name were stored.

Table 4 presents the demographic characteristics of the sample.

Table 4. Demographic Characteristics of the Sample

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	178	86.4
	Female	28	13.6
Age	30 or younger	29	14.1
	31–40	58	28.2
	41–50	84	40.7
	Over 50	35	17.0
	10 or fewer	50	24.3
Work Experience (Years)	11–20	73	35.4
	21–30	64	31.1
	Over 30	19	9.2
	CEO	17	8.3
Job Title	Deputy CEO	29	14.1
	Plant Manager	39	18.9
	Marketing & Sales Manager	22	10.7
	Purchasing Manager	28	13.6
	Production Manager	8	3.9
	Logistics Manager	16	7.8
	Supply Chain Manager	23	11.2
	IT Manager	24	11.7
	Total	206	100

The sample consisted of 206 senior and middle managers from 206 manufacturing firms. Most respondents were male (86.4%), and the largest age group was 41–50 years (40.7%). The most common work-experience band was 11–20 years (35.4%). Respondents held a range of managerial positions, with plant managers (18.9%), deputy CEOs (14.1%) and purchasing managers (13.6%) the most represented roles.

Table 5a presents the 23 manufacturing industries in which the respondents' firms operate, and Table 5b their ownership type.

Table 5a. Respondents' Industries

Industry	Frequency	Percentage (%)
Food Industry	25	12.1
Dairy Products	13	6.3
Rolling and Pipe Manufacturing	1	0.5
Electronic Products Manufacturing	3	1.5
Building Hygiene Products	19	9.2
Tile and Ceramic	2	1.0
Iron and Steel Industry	3	1.5
Automotive Parts Manufacturing	14	6.8
Automobile Manufacturing	4	1.9
Medical Equipment Manufacturing	4	1.9
Machine-Made Carpet Manufacturing	1	0.5
Textile Industry	1	0.5
Tobacco Products Manufacturing	2	1.0
Wood Products Manufacturing	5	2.4
Office Furniture Manufacturing	8	3.9
Paper and Related Products	3	1.5
Chemical Products and Related Manufacturing	16	7.8
Pharmaceutical Products Manufacturing	10	4.9
Petrochemical Products Manufacturing	15	7.3
Plastic Products Manufacturing	21	10.2
Cement and Concrete Production	9	4.4
Leather and Leather Products Manufacturing	10	4.9
Transportation Products Manufacturing	17	8.3
Total	206	100

Table 5b. Ownership Type of Respondents' Organizations

Ownership Type	Frequency	Percentage (%)
Multinational Company	8	3.9
Private Company	119	57.8
Governmental or Semi-Governmental	79	38.3
Total	206	100

The analysis followed the two-step approach of Anderson and Gerbing [42]. First, a confirmatory factor analysis (CFA) with maximum-likelihood estimation tested the 12-factor measurement model; convergent validity was assessed with standardized loadings, composite reliability (CR) and average variance extracted (AVE), and discriminant validity with the Fornell–Larcker criterion [43] and the heterotrait–monotrait ratio (HTMT) [44]. Second, because the full latent model (64 indicators, 30 structural paths) is large relative to the sample, the structural relations were estimated as a path model on the construct scores, with disturbances of the five GSCM practices and of OPP and SP allowed to covary. Confidence intervals for all paths and indirect effects were obtained from 5,000 bootstrap resamples, which do not assume multivariate normality [39], [47]. Model fit was evaluated with χ^2 , CFI, TLI, RMSEA and SRMR against the cut-offs of Hu and Bentler [45].

Table 6 presents the descriptive statistics, distributional checks and reliability of the constructs. Shapiro–Wilk tests rejected exact univariate normality for all 12 composite scores ($p = .003-.045$), but skewness ($|\text{skew}| \leq 0.40$) and kurtosis ($|\text{kurtosis}| \leq 0.85$) were well within the ± 2 range usually considered acceptable for maximum-likelihood estimation; Mardia's multivariate kurtosis was 162.8 (normalized $z = -2.02$).

Because normality was not perfect, inference for the structural model relies on bootstrap confidence intervals. Cronbach's alpha ranged from .83 to .94.

Table 6. Descriptive Statistics, Normality Checks, Reliability and Convergent Validity

Construct	Items	Mean	SD	Skew.	Kurt.	S–W <i>W</i>	<i>p</i>	α	CR	AVE
Internal Environmental Management (IEM)	7	4.64	1.20	-0.29	-0.51	0.984	.019	.91	.91	.58
Green Information Systems (GIS)	10	4.58	1.24	-0.17	-0.85	0.978	.003	.94	.94	.62
Green Purchasing (GP)	4	4.73	1.23	-0.21	-0.37	0.978	.003	.85	.85	.59
Customer Collaboration (CC)	3	4.62	1.30	-0.20	-0.49	0.981	.007	.85	.86	.67
Eco-Design (ED)	3	4.64	1.25	-0.22	-0.37	0.983	.014	.83	.84	.63
Green Production (PO)	4	4.65	1.23	0.01	-0.55	0.984	.021	.83	.83	.55
Reverse Logistics (RL)	4	4.64	1.24	-0.05	-0.24	0.981	.007	.85	.85	.59
Economic Performance (ECP)	5	4.68	1.22	-0.40	-0.17	0.980	.006	.88	.88	.60
Environmental Performance (ENP)	6	4.63	1.22	-0.18	-0.64	0.983	.014	.91	.91	.62
Operational Performance (OPP)	6	4.63	1.22	-0.38	-0.22	0.979	.004	.90	.90	.60
Social Performance (SP)	5	4.59	1.24	-0.21	-0.33	0.986	.045	.88	.88	.60
Organizational Performance (ORP)	7	4.62	1.20	-0.25	-0.33	0.986	.039	.90	.91	.58

Notes:

1. All constructs were adapted from previously validated scales (Table 3), and content validity was reviewed by three academic experts in supply chain management.
2. CR and AVE were computed from the standardized CFA loadings, which ranged from .65 to .90 (all $p < .001$).
3. S–W = Shapiro–Wilk test of the composite score; Skew. and Kurt. = skewness and excess kurtosis. Because normality was rejected, standard errors of the structural model were checked against 5,000 bootstrap resamples [39].
4. All CR values exceed .70 and all AVE values exceed .50, supporting convergent validity [43].

Table 7. Fit Indices of the Measurement (CFA) and Structural (Path) Models

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA [90% CI]	SRMR
Measurement model (CFA, 12 factors)	2259.32	1886	1.20	.953	.950	.031 [.026, .036]	.046
Structural (path) model	19.41	25	0.78	1.000	1.000	.000	.023
Recommended cut-off [45]	–	–	< 3	$\geq .95$	$\geq .95$	$\leq .06$	$\leq .08$

Notes:

1. The CFA χ^2 was significant ($\chi^2(1886) = 2259.32$, $p < .001$), as is usual with 64 indicators, but χ^2/df , CFI, TLI, RMSEA and SRMR all met the recommended cut-offs. The structural path model reproduced the construct covariances closely ($\chi^2(25) = 19.41$, $p = .777$). TLI values above 1 are reported as 1.000. All analyses were run in Python (NumPy/SciPy) with custom code for the CFA, path model and bootstrap.
2. GFI, AGFI and NFI are not reported because they are sensitive to sample size and model complexity and are no longer recommended [45].

4. FINDINGS**4.1. Measurement Model and Discriminant Validity**

Table 8 reports the correlations between construct scores (below the diagonal), the square root of the AVE (diagonal) and the HTMT ratios (above the diagonal). All 66 correlations were positive ($r = .10\text{--}.59$); 64 were significant at $p < .05$ and 59 at $p < .01$ ($|r| \geq .18$ for $p < .01$ with $n = 206$). The square root of each construct's AVE exceeded its correlations with all other constructs, satisfying the Fornell–Larcker criterion, and every HTMT ratio was below .85 (maximum = .66), indicating that the 12 constructs are empirically distinct [44].

Table 8. Correlations, Square Root of AVE (Diagonal) and HTMT Ratios (Above the Diagonal)

	IEM	GIS	GP	CC	ED	PO	RL	ECP	ENP	OPP	SP	ORP
IEM	.76	.59	.57	.52	.40	.40	.54	.45	.45	.24	.19	.22
GIS	.54	.79	.50	.43	.42	.26	.52	.46	.44	.25	.12	.22
GP	.49	.44	.77	.45	.44	.36	.46	.39	.56	.29	.20	.19
CC	.45	.38	.38	.82	.43	.33	.44	.57	.36	.19	.18	.26
ED	.35	.38	.36	.37	.80	.26	.43	.56	.62	.22	.21	.31
PO	.34	.23	.30	.27	.21	.74	.32	.47	.47	.29	.16	.22
RL	.48	.46	.39	.37	.36	.27	.77	.60	.61	.30	.29	.20
ECP	.41	.42	.34	.49	.49	.40	.52	.78	.66	.54	.33	.50
ENP	.41	.41	.49	.32	.54	.41	.54	.59	.79	.51	.42	.41
OPP	.22	.23	.25	.17	.19	.25	.26	.48	.46	.77	.41	.48
SP	.17	.10	.17	.16	.18	.13	.25	.29	.37	.37	.77	.40
ORP	.20	.20	.17	.23	.27	.19	.18	.45	.37	.43	.36	.76

Note. Lower triangle: Pearson correlations of construct scores ($|r| \geq .14$: $p < .05$; $|r| \geq .18$: $p < .01$); diagonal (bold): $\sqrt{\text{AVE}}$; upper triangle (italic): HTMT.

4.2. Structural Model

Table 9 presents the standardized path coefficients, t-values and 95% bootstrap confidence intervals. Overall, 25 of the 30 hypotheses were supported; the five unsupported hypotheses were H3d, H4b, H5a, H10c, H11b. The model explained 51% of the variance in environmental performance, 51% in economic performance, 28% in operational performance, 15% in social performance and 30% in overall organizational performance.

1. H1: Green information systems were strongly and positively associated with internal environmental management ($\beta = .54$, 95% CI [.44, .63]); H1 was supported.
2. H2a–H3e: IEM was positively related to all five GSCM practices ($\beta = .21$ –.36), and GIS to green purchasing, customer collaboration, eco-design and reverse logistics ($\beta = .19$ –.29). The direct path from GIS to green production was not significant (H3d: $\beta = .06$, 95% CI [-.09, .21]), so GIS relates to green production only through IEM.
3. H4a–H8b: Green purchasing, eco-design, green production and reverse logistics were positively related to environmental performance, whereas customer collaboration was not (H5a: $\beta = -.05$, 95% CI [-.15, .05]). Customer collaboration, eco-design, green production and reverse logistics were positively related to economic performance, whereas green purchasing was not (H4b: $\beta = -.08$, 95% CI [-.19, .03]).
4. H9–H11c: Environmental performance predicted economic performance (H9: $\beta = .29$), operational performance (H10a: $\beta = .27$) and social performance (H10b: $\beta = .31$). Economic performance predicted operational (H11a: $\beta = .32$) and organizational performance (H11c: $\beta = .26$). The direct paths from environmental to organizational performance (H10c: $\beta = .06$) and from economic to social performance (H11b: $\beta = .11$) were not significant.
5. H12–H13: Operational ($\beta = .22$) and social performance ($\beta = .18$) were positively related to overall organizational performance.

4.3. Indirect Effects

Table 10 reports selected indirect effects with bootstrap confidence intervals. GIS was related to green production indirectly through IEM (indirect = .17, 95% CI [.09, .25]), IEM was related to environmental performance through the five GSCM practices (indirect = .29, 95% CI [.19, .38]), and environmental performance was related to organizational performance through economic, operational and social performance (indirect = .22, 95% CI [.14, .31]), even though its direct path was not significant.

4.4. Common Method Variance. Because all constructs were reported by a single informant, common method variance was examined. In Harman's single-factor test, the first unrotated factor of the 64 items explained 28.0% of the variance, well below 50%, and the 12-factor CFA fitted the data much better than would be possible if one general factor dominated [46]. These checks reduce, but do not eliminate, the concern [46].

Table 9. Structural Model Results

Hyp.	Path	β	t	95% bootstrap CI	Result
H1	GIS → IEM	.54***	9.25	[.44, .63]	Supported
H2a	IEM → GP	.36***	5.13	[.21, .49]	Supported
H2b	IEM → CC	.35***	4.78	[.20, .49]	Supported
H2c	IEM → ED	.21**	2.74	[.07, .35]	Supported
H2d	IEM → PO	.31***	3.97	[.17, .45]	Supported
H2e	IEM → RL	.32***	4.57	[.19, .45]	Supported
H3a	GIS → GP	.25***	3.51	[.12, .38]	Supported
H3b	GIS → CC	.19**	2.66	[.06, .32]	Supported
H3c	GIS → ED	.26***	3.46	[.12, .40]	Supported
H3d	GIS → PO	.06	0.82	[-.09, .21]	Not supported
H3e	GIS → RL	.29***	4.10	[.16, .42]	Supported
H4a	GP → ENP	.21***	3.71	[.11, .32]	Supported
H4b	GP → ECP	-.08	-1.40	[-.19, .03]	Not supported
H5a	CC → ENP	-.05	-0.89	[-.15, .05]	Not supported
H5b	CC → ECP	.26***	4.49	[.14, .37]	Supported
H6a	ED → ENP	.33***	5.85	[.23, .43]	Supported
H6b	ED → ECP	.16**	2.63	[.04, .29]	Supported
H7a	PO → ENP	.21***	3.87	[.12, .29]	Supported
H7b	PO → ECP	.15**	2.70	[.05, .26]	Supported
H8a	RL → ENP	.30***	5.22	[.18, .41]	Supported
H8b	RL → ECP	.20**	3.27	[.09, .31]	Supported
H9	ENP → ECP	.29***	4.16	[.15, .43]	Supported
H10a	ENP → OPP	.27***	3.61	[.13, .39]	Supported
H10b	ENP → SP	.31***	3.83	[.14, .46]	Supported
H10c	ENP → ORP	.06	0.73	[-.09, .20]	Not supported
H11a	ECP → OPP	.32***	4.42	[.18, .47]	Supported
H11b	ECP → SP	.11	1.38	[-.05, .27]	Not supported
H11c	ECP → ORP	.26***	3.37	[.11, .41]	Supported
H12	OPP → ORP	.22**	3.02	[.05, .37]	Supported
H13	SP → ORP	.18**	2.81	[.04, .33]	Supported

Notes:

- IEM: Internal Environmental Management
- GIS: Green Information System
- GP: Green Purchasing
- CC: Customer Collaboration
- ED: Eco-Design
- PO: Green Production
- RL: Reverse Logistics
- ENP: Environmental Performance
- ECP: Economic Performance
- OPP: Operational Performance
- SP: Social Performance
- ORP: Organizational Performance
- $p < .05$, $p < .01$, $p < .001$ (two-tailed). β = standardized coefficient; CI = percentile confidence interval from 5,000 bootstrap resamples. R^2 : IEM = .29, GP = .29, CC = .23, ED = .17, PO = .12, RL = .29, ENP = .51, ECP = .51, OPP = .28, SP = .15, ORP = .3

Table 10. Selected Indirect Effects

Indirect path	Estimate	95% bootstrap CI
GIS→IEM→PO	.17	[.09, .25]
IEM→GSCM→ENP	.29	[.19, .38]
ENP→(ECP, OPP, SP)→ORP	.22	[.14, .31]
ECP→(OPP, SP)→ORP	.09	[.03, .16]

5. CONCLUSION AND RECOMMENDATIONS

Environmental considerations have become an unavoidable approach for organizations, particularly large-scale enterprises. Accordingly, the primary objective of this study was to examine the impact of Green Supply Chain Management (GSCM) components on organizational performance. To achieve this objective, a comprehensive literature review was first conducted to identify the most critical GSCM components. Subsequently, the influence of GSCM on organizational performance was assessed using data collected from industry experts. The findings provide valuable insights that managers can leverage as tools to enhance organizational performance.

The results support most of the proposed model. Green information systems were strongly associated with internal environmental management, and the two enablers were related to almost all GSCM practices; the only exception, the direct path from GIS to green production, was replaced by an indirect path through IEM. This pattern is consistent with the NRBV view that information and managerial routines are the capabilities from which environmental practices are built [40]. Four of the five GSCM practices were associated with environmental performance, and four with economic performance. Customer collaboration was linked to economic but not to environmental performance, and green purchasing to environmental but not to economic performance, which suggests that supplier-side greening may raise purchasing costs in the short term even when it reduces environmental harm.

Environmental performance was positively related to economic, operational and social performance, but its relationship with overall organizational performance was entirely indirect. Economic performance predicted operational and organizational performance but not social performance, and both operational and social performance predicted organizational performance. In institutional terms, environmental results appear to matter for overall performance when they are converted into cost, efficiency and legitimacy gains rather than in themselves [41].

Managerial implications: Managers who wish to implement GSCM should first invest in environmental management commitment and in information systems that monitor environmental activities, because these enablers precede the external practices. Green purchasing programs should be designed together with cost controls, since their economic payoff was not observed, and customer collaboration should be given explicit environmental targets if it is to improve environmental outcomes. Finally, environmental gains should be deliberately translated into operational and social results, the channels through which they reach overall performance.

Limitations and future research: The study has several limitations. First, the cross-sectional design does not allow causal conclusions; the paths represent associations consistent with the model, and reverse or reciprocal relations cannot be excluded. Second, all variables were reported by one manager per firm, so common method variance cannot be fully ruled out even though Harman's test and the CFA results were reassuring; future studies should combine survey data with objective environmental and financial indicators. Third, the usable response rate was low (7.5%), and although early and late respondents did not differ, firms with stronger environmental programs may have been more willing to respond. Fourth, the sample size is modest relative to the number of indicators, which is why the structural model was estimated on construct scores; replication with larger samples and a fully latent model, and multi-group comparisons across industries and ownership types, would strengthen the conclusions.

Authors' Contributions

All authors contributed to the development of the research framework, the interpretation of the findings, and the preparation and revision of the manuscript. All authors read and approved the final manuscript.

Declaration of Generative AI Use

During the preparation of this manuscript, the authors used generative AI to improve the language and readability of the text. Following the use of this tool, the authors reviewed and edited the content as necessary and take full responsibility for the content of the publication.

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Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical Considerations

This study involved a survey of senior and middle managers in manufacturing firms in Iran. Participation was voluntary, and the confidentiality of respondents and their organizations was respected. The collected data were used solely for research purposes. Information regarding formal ethical approval and informed consent should be included in accordance with the actual procedures followed and the applicable institutional requirements.

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