Green Supply Chain Management (GSCM) Practices on Sustainability Performance in the Manufacturing Industry of Batam City

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Abstract

This study aims to investigate the influence of Green Supply Chain Management (GSCM) practices on sustainability performance in the manufacturing industry of Batam City. Using the Resource-Based View (RBV) and Institutional Theory as theoretical foundations, six GSCM dimensions green purchasing, green manufacturing, green distribution, green packaging, environmental education, and green marketing were examined in relation to environmental, economic, and social performance. Data were collected from 140 manufacturing companies and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM).

Findings indicate that GSCM practices positively and significantly influence sustainability performance. Specifically, green purchasing, green manufacturing, green distribution, green packaging, and green marketing showed strong positive effects on at least one dimension of sustainability performance. In contrast, environmental education demonstrated no significant impact. These results suggest that firms should prioritize actionable and operationally embedded GSCM practices to enhance their environmental, economic, and social outcomes. The study contributes to the theoretical development of GSCM by contextualizing its implementation within an export-oriented, emerging industrial zone.

Keywords: Green Supply Chain Management, Sustainability Performance, Manufacturing Industry, Batam City, Resource-Based View, Institutional Theory, PLS-SEM

1. Introduction

In recent years, organizations have shown increasing concern for environmental sustainability and corporate social responsibility. Escalating environmental issues such as pollution, global warming, resource scarcity, and biodiversity loss demand immediate attention from companies, communities, and governments [1]. Industrial activities are a major contributor to these problems.

According to the Urban Environmental Quality Report by Direktorat Statistik Lingkungan Hidup (2019), global warming is partly driven by industrial process residues, including Ozone Depleting Substances (ODS) and uncontrolled Greenhouse Gas (GHG) emissions [2]. In 2017, the energy sector particularly power generation, manufacturing, and transportation was responsible for 48.6% of Indonesia's total GHG emissions, equivalent to 562.2 million tons of CO_2. The growing intensity of industrial activities also increases challenges in managing business waste and pollution.

Every element of the conventional supply chain from raw materials to production, distribution, consumption, and waste can contribute to environmental degradation [3]. Achieving sustainability across all supply chain components is therefore imperative. The Indonesian government has emphasized the importance of sustainable industry

through the promotion of green industry policies, aiming to align economic development with environmental protection and social welfare [4].

In the literature, sustainability performance is typically categorized into three dimensions: environmental, economic, and social. A balance among these aspects is essential for long term competitiveness. GSCM practices have been shown to support sustainability by reducing packaging waste, engaging eco-conscious stakeholders, and minimizing emissions during production [1].

GSCM involves business initiatives to mitigate negative environmental impacts arising from supply chain activities especially those associated with climate change, pollution, and resource depletion [5]. These practices are increasingly seen as strategic resources that enhance firm performance [6]. Moreover, their experiential and knowledge based nature makes them difficult for competitors to replicate, reinforcing their status as a source of competitive advantage [1]. According to [1], seven key dimensions define GSCM practices: green purchasing, green manufacturing, green marketing, green distribution and packaging, internal environmental management, environmental education, and investment recovery.

Batam City, located in Indonesia's Riau Islands Province, is strategically positioned near international trade routes and borders Singapore and Malaysia. As one of Indonesia's key industrial centers, Batam hosts 24 industrial estates and contributes approximately 58% to the city's economic output primarily through the manufacturing sector [7]. Many multinational companies operate in Batam, reinforcing its status as a manufacturing and export hub.

In Batam City, the rapid expansion of the manufacturing sector including extensive supply chain activities poses significant environmental and social risks. Hence, collaborative and sustainable control, including robust GSCM practices, is crucial.

While previous studies have examined the impact of GSCM on environmental and economic performance [6][8], social performance has often received less attention. Furthermore, although GSCM research in emerging countries is expanding, inconsistencies across studies suggest a need for more context-specific investigations [9].

Batam presents a distinctive context that enriches the theoretical development of Green Supply Chain Management (GSCM). As a designated Free Trade Zone (FTZ) and Special Economic Zone (SEZ), Batam functions as a strategic industrial hub with a strong presence of export oriented multinational corporations. Its geographic proximity to Singapore and integration into international supply chains expose firms to both domestic and cross border institutional pressures, particularly in meeting stringent environmental standards.

This context provides a valuable extension to the existing GSCM literature in several ways:

- Institutional Pressure across Borders: The regulatory influence from export destinations such as Singapore and Japan exemplifies how Institutional Theory operates in transnational settings, where firms must adhere not only to national policies but also to foreign environmental standards.
- RBV in Foreign Investment Intensive Zones: Batam's industrial structure dominated by electronics, fabricated metals, and automotive sub sectors offers an ideal setting to examine the development of GSCM capabilities as strategic resources, consistent with the Resource Based View (RBV).
- Underrepresented Emerging Contexts: Although GSCM has been widely studied in developed economies, research in emerging industrial zones such as Batam remains limited. This study expands the empirical application of RBV and Institutional Theory within a globally integrated, regulation-sensitive, developing country context.

Based on the above rationale and research gap, this

study aims to investigate the influence of seven GSCM practice dimensions on environmental, economic, and social performance in the manufacturing industry of Batam City. The findings are anticipated to provide valuable insights and serve as a foundation for companies' strategic deliberations regarding the implementation of GSCM. Additionally, the study contributes to the ongoing academic discourse on sustainability performance in emerging industrial economies.

2. Green Supply Chain Management (GSCM) Practices

GSCM is a management approach that integrates environmental considerations into inter-organizational supply chain activities throughout the product life cycle [10]. Alternatively, [1] describes GSCM as encompassing various stages, from product design, material sourcing and selection, and manufacturing methods, to product shipment and end of life oversight.

The first dimension discussed in this study is green purchasing, which serves as the initial and foundational step in the value chain. Green purchasing refers to environmentally friendly procurement practices [8]. Selecting suitable vendors significantly impacts the achievement of a business's environmentally conscious goals. Once the appropriate supplier is chosen, firms must collaborate with them to enhance environmental performance [1]. Green manufacturing involves minimizing hazardous waste during production in order to protect the environment. It emphasizes reducing energy and resource consumption as part of environmentally responsible operations [8].

Green marketing represents the alignment between fulfilling consumer needs and environmental responsibility. It includes efforts such as product design, pricing, promotion, and distribution, all conducted within the framework of environmental management. In this study, green marketing is primarily viewed through the lens of promotional strategies [1].

Green distribution encompasses all supply chain activities aimed at mitigating or eliminating environmental damage during the delivery process [1]. This includes not only transportation but also packaging, given its impact on product transport [11]. Green packaging involves reducing material use and utilizing recyclable packaging to minimize environmental impact during distribution [1].

Internal environmental management refers to the formulation of business policies and objectives focused on environmental preservation. This includes interdepartmental collaboration for environmental improvements, the implementation of internal policies on recycling, emission reduction, and energy conservation, as well as fostering stakeholder support for environmental initiatives [1].

Environmental education is a vital tool for developing human resources capable of supporting a sustainable society. In the manufacturing context, it is operationalized through structured training programs designed to cultivate environmental awareness among both managers and employees [1].

Investment recovery relates to asset management strategies such as the resale, recycling, or reassessment of excess inventory, waste, or end-of-life products [6]. The aim is to reintegrate such items into reverse logistics, ensuring they are either properly retrieved or responsibly disposed of [1].

Sustainability Performance

Sustainability performance reflects a company's ability to grow profitably while contributing to the pillars of sustainability: environmental, economic, and social. In this study, sustainability performance is evaluated across three dimensions.

Environmental performance measures a business's ability to utilize resources while minimizing waste, pollution, and the use of harmful chemicals [1]. Economic performance relates to overall profitability, which serves as a key motivation for businesses to

implement GSCM practices. Therefore, economic performance is assessed in terms of profit, sales, and incurred costs [1].

Social performance serves as a framework for evaluating the impact of GSCM on enhancing an organization's reputation, strengthening community relations, improving customer satisfaction, and ensuring employee health and safety [1].

3. Conceptual Framework

The conceptual framework of this study is grounded in two prominent theories: the Resource-Based View (RBV) and Institutional Theory. These frameworks help explain how and why Green Supply Chain Management (GSCM) practices can influence a firm's sustainability performance, which encompasses environmental, economic, and social dimensions.

According to the Resource-Based View, organizations can gain sustainable competitive advantages by developing and utilizing valuable, rare, inimitable, and non substitutable (VRIN) resources and capabilities. GSCM practices such as green purchasing, green manufacturing, and green marketing are not easily replicated, as they require unique internal systems, supplier collaboration, and accumulated environmental knowledge. Therefore, they are viewed as strategic resources that can improve firm performance across multiple dimensions. Meanwhile, Institutional Theory emphasizes the role of external pressures such as regulations, societal expectations, and norms in shaping organizational behavior. In the context of emerging economies like Batam City, firms often face strong coercive and normative pressures to comply with environmental standards, particularly due to their participation in global supply chains. These pressures encourage firms to adopt sustainable practices to maintain legitimacy and market access.

Based on these theoretical foundations, the relationships between GSCM practices and sustainability performance are hypothesized as follows:

- Green purchasing enables firms to select suppliers based on environmental criteria, which can reduce environmental risks and improve operational efficiency. This supports both environmental and economic performance.
- Green manufacturing focuses on reducing waste, emissions, and energy use during production, directly contributing to environmental sustainability and potentially lowering costs.
- Green distribution and packaging aim to minimize the environmental impact of logistics through efficient transportation and eco-friendly packaging, thus supporting environmental and economic goals.
- Green marketing enhances a company's image and stakeholder trust, aligning with social and environmental expectations and boosting market competitiveness.
- Internal environmental management involves setting internal policies and structures that embed sustainability into operations, which can enhance performance across all sustainability dimensions.
- Environmental education develops employee awareness and competencies related to environmental issues, facilitating long-term performance improvements, although its effectiveness may depend on organizational commitment and cultural context.
- Investment recovery—the process of reusing, recycling, or reselling obsolete or excess materials—can reduce environmental waste and generate economic returns.

By integrating these dimensions, the framework assumes that GSCM practices collectively influence sustainability performance. Each relationship is informed by prior empirical studies and underpinned by theoretical logic, positioning the model as both relevant and testable.

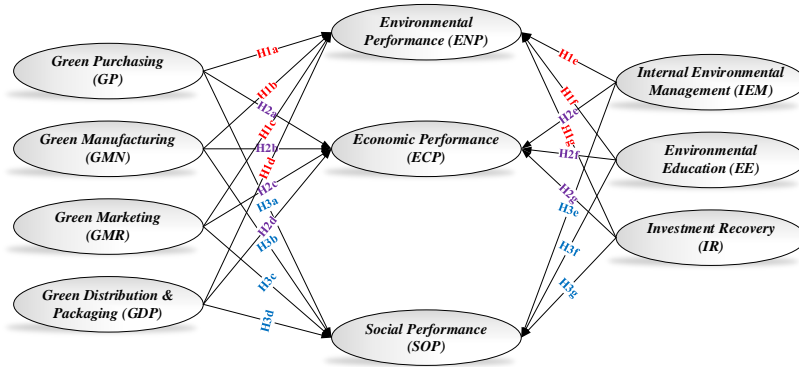The research conceptual framework is illustrated in the figure below:

Figure 1 Conceptual Framework

4. Research Method

This study employed a quantitative research approach with an associative design to examine the relationships between GSCM practices and sustainability performance. Data were primarily collected from primary sources, supplemented by secondary data.

Primary data were gathered through structured questionnaires, while secondary data, supporting the primary collection, were drawn from previous research, academic books, journal articles, reputable websites, and official government publications.

The study population comprised large and medium-sized manufacturing companies in Batam City. The sampling frame was based on the Directory of Large and Medium Industrial Companies of Batam City 2021 published by Badan Pusat Statistik Kota Batam [12].

A nonprobability sampling technique, specifically quota sampling, was used. According to [13], quota sampling involves selecting participants with specific characteristics until the required quota is fulfilled, ensuring representation of the target population.

Following the "10 times rule" suggested by Barclay, Higgins, and Thompson (1995) in [14], which stipulates that the minimum sample size for reflective models should be at least ten times the largest number of structural paths directed at any single construct, this study determined a minimum sample size of 70 respondents, as the most complex construct in the model had seven incoming paths. Consequently, the

final sample size was 70 respondents.

Respondents held positions such as staff specialist, division head, supervisor, or manager in departments related to operations, supply chain/logistics, or procurement/purchasing, and met the criteria of having sufficient knowledge of the company's supply chain and logistics processes.

Data collection was conducted online. The researcher distributed the questionnaire via Gmail and WhatsApp, including a formal request and a link to a Google Form. Follow-up reminders were sent over a two-month period to enhance response rates. In total, 161 emails and 56 WhatsApp messages were sent, yielding 70 complete responses, representing a response rate of approximately 32%.

The collected data were then screened and prepared for statistical analysis. Descriptive statistics (to profile respondent characteristics) were processed using Microsoft Excel, while inferential statistical analysis, including hypothesis testing, was conducted using SmartPLS 4 with Partial Least Squares Structural Equation Modeling (PLS-SEM).

5. Results And Discussion

Primary data totaling 70 data were then analyzed descriptively to determine the characteristics of respondents.

Table 1 Respondents' Characteristics

Characteris-tics	Information	f	%
Industry Category	Electronic Product Manufacturing	29	41.43

Characteris-tics	Information	f	%
	Fabricated Metal Product Manufacturing	15	21.43
	Plastic & Rubber Manufacturing	8	11.43
	Automotive Manufacturing	6	8.57
	Chemical Manufacturing	5	7.14
	Others	7	10.0
Department / Section	Supply Chain/ Logistics	29	41.43
	Procurement/ Purchasing	21	30.0
	Operations	20	28.57
Company Age	< 10 years	7	10.0
	10-25 years	39	55.71

Characteris-tics	Information	f	%
	> 25 years	24	34.29

Source: Data Processed

The majority of respondents work in the electronic product manufacturing industry sector with a company age of 10-25 years and come from the supply chain/logistics department/section.

Measurement Model Evaluation (Outer Model)

The outer model describes how indicators relate to their latent variables. Evaluation of outer model assesses reliability and validity of measurement model by investigating the convergent validity, discriminant validity, and composite reliability.
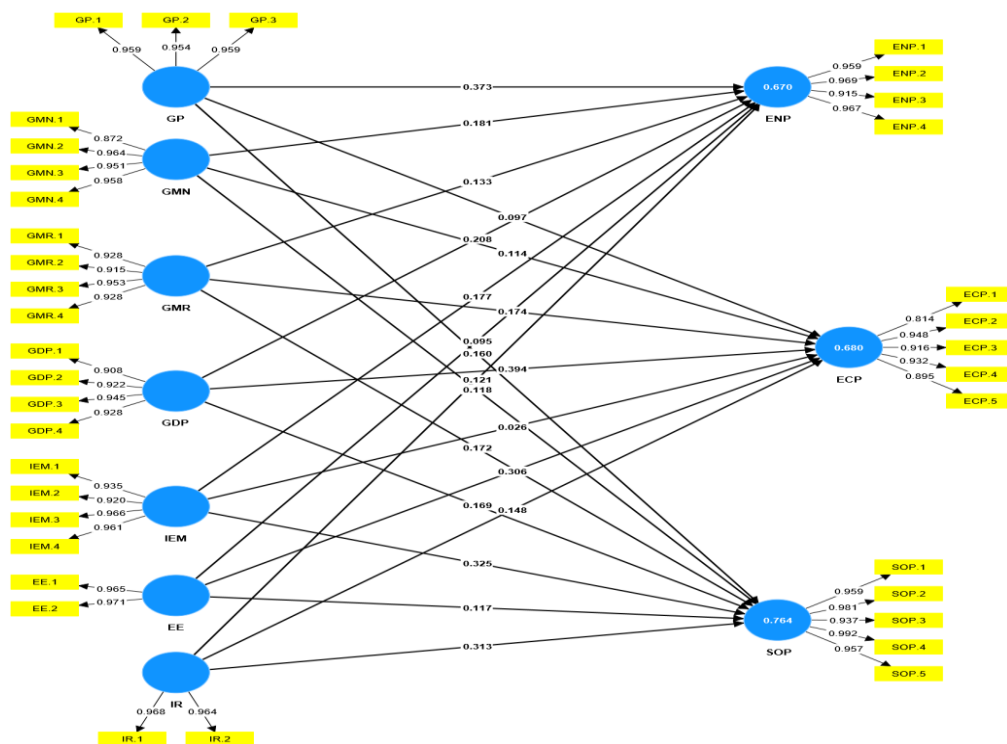

Figure 2 Outer Model Test Result

Convergent Validity

Convergent validity examines how strongly a measure is related to other measures within same construct. Convergent validity evaluated based on outer loading and Average Variance Extracted (AVE) values. The general rule for standard outer loading value is 0.708 or greater [14]. Meanwhile, Fornell and Larcker (1981) in [15] recommended that AVE value be greater than 0.50.

Table 2 Outer Loading and AVE

Variable	Indicator	Outer Loading	AVE	Info
GP	GP.1	0.959	0.917	Valid

Variable	Indicator	Outer Loading	AVE	Info
	GP.2	0.954		Valid
	GP.3	0.959		Valid
GMN	GMN.1	0.872		Valid
	GMN.2	0.964	0.878	Valid
	GMN.3	0.951		Valid
	GMN.4	0.958		Valid
GMR	GMR.1	0.928		Valid
	GMR.2	0.915	0.867	Valid
	GMR.3	0.953		Valid
	GMR.4	0.928		Valid
GDP	GDP.1	0.908		Valid
	GDP.2	0.922	0.858	Valid
	GDP.3	0.945		Valid
	GDP.4	0.928		Valid
IEM	IEM.1	0.935		Valid
	IEM.2	0.920	0.894	Valid
	IEM.3	0.966		Valid
	IEM.4	0.961		Valid
EE	EE.1	0.965	0.937	Valid
	EE.2	0.971		Valid
IR	IR.1	0.968	0.934	Valid
	IR.2	0.964		Valid
ENP	ENP.1	0.959		Valid
	ENP.2	0.969	0.907	Valid
	ENP.3	0.915		Valid
	ENP.4	0.967		Valid
ECP	ECP.1	0.814	0.814	Valid
	ECP.2	0.948		Valid

Variable	Indicator	Outer Loading	AVE	Info
	ECP.3	0.916		Valid
	ECP.4	0.932		Valid
	ECP.5	0.895		Valid
SOP	SOP.1	0.959		Valid
	SOP.2	0.981		Valid
	SOP.3	0.937	0.932	Valid
	SOP.4	0.992		Valid
	SOP.5	0.957		Valid

Source: Data Processed

According to Table 2, one can infer that the construct exhibits robust convergent validity. This is evidenced by the outer loading value > 0.708 and AVE > 0.50, meaning that all indicators are valid to measure each construct.

Discriminant Validity

Discriminant validity quantifies degree that a construct is actually distinct compared to alternative constructs based on evidence. This study assesses discriminant validity by applying the Fornell-Larcker Criterion approach. Specifically, through comparing the square root from AVE (√AVE). The value of (√AVE) within constructs should be higher than correlation value between other constructs.

Based on Table 3, the findings suggest that all constructs in projected model comply with the discriminant validity benchmarks.

Table 3 Fornell-Larcker Criterion

	GP	GMN	GMR	GDP	IEM	EE	IR	ENP	ECP	SOP
GP	*0.957									
GMN	0.289	*0.937								
GMR	0.234	0.280	*0.931							
GDP	0.189	0.282	0.240	*0.926						
IEM	0.316	0.345	0.244	0.324	*0.946					
EE	0.350	0.366	0.271	0.300	0.383	*0.968				
IR	0.212	0.269	0.268	0.302	0.289	0.283	*0.966			
ENP	0.610	0.513	0.423	0.484	0.529	0.492	0.426	*0.952		
ECP	0.391	0.463	0.452	0.631	0.426	0.599	0.459	0.694	*0.902	
SOP	0.476	0.499	0.478	0.508	0.648	0.527	0.603	0.691	0.676	*0.965

Source: Data Processed

Notes: * is the square root from AVE

Reliability Test

This construct is considered reliable when the overall

composite reliability score and Cronbach's Alpha > 0.70. The composite reliability value ranges from zero to one, with higher values suggesting enhanced reliability. This also applies to Cronbach's Alpha.

Table 4 Cronbach's Alpha and Composite Reliability

Variable	Cronbach's Alpha	Composite Reliability
GP	0.955	0.971
GMN	0.954	0.966
GMR	0.949	0.963
GDP	0.945	0.960
IEM	0.960	0.971
EE	0.933	0.968
IR	0.929	0.966
ENP	0.966	0.975
ECP	0.943	0.956
SOP	0.982	0.986

Source: Data Processed

According to Table 4, composite reliability score and the Alpha of Cronbach is above 0.70. Hence, we can deduce the concept demonstrates high reliability.

Structural Model Evaluation (Inner Model)

The inner model displays the relationships/paths between constructs. Structural model is assessed by considering R-Square value for dependent (endogenous) construct, Q-Square for predictive relevance, and statistical significance.

R-Square (R^2)

Variations in R-Square value can help evaluate if independent latent variables have a major effect on dependent latent variable [15]. R-Square values of 0.75, 0.50, and 0.25 for dependent variables in the causal model show that model is "strong", "moderate", and "weak" [14].

Table 5 R-Square (R^2)

Variable	R^2
ENP	0.670
ECP	0.680
SOP	0.764

Source: Data Processed

According to Table 5, it is evident that the R-Square result for ENP variable equals 0.670, ECP equals 0.680, and SOP equals 0.764. Thus, the power of the three construct has a strong effect.

Effect of GSCM Practices on Environmental Performance

Q-Square (Q^2)

The Q-Square measurement is determined using a blindfolding procedure. The method employed to measure the accuracy of structural model is able to forecast baseline data values. Model that has predictive relevance is a model with Q-Square value above 0 (zero).

Table 6 Q-Square (Q^2)

Variable	Q^2 Predict
ENP	0.563
ECP	0.514
SOP	0.677

Source: Data Processed

Considering the Q-Square value above ($Q^2 > 0$), it can be concluded that the exogenous constructs can predict the endogenous constructs.

Bootstrapping Result

After going through the evaluation stage on outer model and inner model, the next stage is hypothesis testing. This hypothesis that that was developed will be examined for statistical significance to measure the influence among variables. By examining the parameter coefficient's value (in the original sample column) and the t-statistic value. The SmartPLS 4 program also presents p-value (probability value). Hypothesis testing is obtained using bootstrapping procedure. Hypotheses are accepted or rejected by analyzing t-statistics value with t-table and observing p-values. The value from t-table can be determined by determining the degree of freedom (df) initially by using this formula:

$$df = n - k - 1$$
$$df = 70 - 7 - 1$$
$$df = 62$$

With information, df = degree of freedom, n = number of samples, and k = number of independent variables. One can infer that the t-table value with degree of freedom (df) = 62 for one-tailed t-test at significance level of 5% or 0.05 is 1.670. The hypothesis is accepted if the t-statistics value > 1,670 and p-values < 0.05, which means that exogenous latent variables have a positive and significant effect on endogenous latent variables.

Table 7 Bootstrapping Results (GSCM Practices on ENP)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Info
GP → ENP	**0.373**	0.358	0.155	**2.408**	**0.008**	*H1a* Accepted
GMN → ENP	**0.181**	0.170	0.092	**1.972**	**0.024**	*H1b* Accepted
GMR → ENP	**0.133**	0.129	0.066	**2.008**	**0.022**	*H1c* Accepted
GDP → ENP	**0.208**	0.210	0.079	**2.647**	**0.004**	*H1d* Accepted
IEM → ENP	**0.177**	0.186	0.088	**2.023**	**0.022**	*H1e* Accepted
EE → ENP	**0.095**	0.091	0.075	**1.265**	**0.103**	*H1f* Rejected
IR → ENP	**0.121**	0.116	0.070	**1.734**	**0.041**	*H1g* Accepted

Source: Data Processed

The bootstrapping results in Table 7 indicate that six dimensions related to GSCM practices positively and significantly effect on environmental performance in the manufacturing industry of Batam City. Six dimensions include green purchasing, green manufacturing, green marketing, green distribution and packaging, internal environmental management, and investment recovery. So that one of the seven hypotheses proposed is rejected or unacceptable. Green purchasing has the greatest impact of environmental performance. It is shown by the original sample value of 0.373. The research yields contrasting findings from earlier studies carried out by [16]. Previous studies indicate that environmental education plays the most significant role concerning environmental performance.

The research concluded that the dimension of environmental education positively effect as proven by the original sample measurement with a value of 0.095. Nevertheless, it is not significant for environmental performance. Supported by research [17], it is explained that education related to the environment to managers and employees is still considered low in Indonesia. It is not easy for these elements to implement green concepts in their daily activities even though they have received training from company management. In practice, this education has a big impact on the company if every element of the company implements the concept in question. It takes a long process to realize the benefits of this educational investment.

Further testing results found that the dimensions of green manufacturing, green distribution and packaging, and investment recovery positively and significantly effect on environmental performance. Most of the impacts that companies have on their environment come from production and distribution activities. Practice of reducing/using less packaging can minimize the resources used, while also reducing the waste generated. Using recycling methods practices, the quantity of discarded materials can be decreased as well. In the meantime, green distribution enhances sustainability by decreasing fuel usage. Additionally, it helps in the optimization to deliver vehicles as well as loading. The findings from this research match with [1] study.

Effect of GSCM Practices on Economic Performance

Table 8 Bootstrapping Results (GSCM Practices on ECP)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Info
GP → ECP	**0.097**	0.089	0.077	**1.253**	**0.105**	*H2a* Rejected

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Info
GMN → ECP	**0.114**	0.100	0.091	**1.263**	**0.103**	*H2b* Rejected
GMR → ECP	**0.174**	0.170	0.087	**1.992**	**0.023**	*H2c* Accepted
GDP → ECP	**0.394**	0.390	0.147	**2.686**	**0.004**	*H2d* Accepted
IEM → ECP	**0.026**	0.019	0.082	**0.317**	**0.376**	*H2e* Rejected
EE → ECP	**0.306**	0.303	0.147	**2.077**	**0.019**	*H2f* Accepted
IR → ECP	**0.148**	0.147	0.093	**1.597**	**0.055**	*H2g* Rejected

Source: Data Processed

The bootstrapping results in Table 8 indicate that three dimensions related to GSCM practices positively and significantly effect on economic performance in the manufacturing industry of Batam City. Three dimensions include green marketing, green distribution and packaging, and environmental education. Therefore, four out of seven hypotheses proposed are rejected or unacceptable. Green distribution and packaging have the greatest impact of economic performance. It is shown by the original sample value of 0.394. The same greatest influence is also shown by [1].

The majority of an organization's effect on the ecosystem is linked to production and distribution processes. A business can use resources more efficiently with green production practices and environmentally friendly packaging and distribution [1]. Since they have a strong connection to the financial results, such strategies are swiftly implemented by businesses. A lot of companies are selecting sustainable wrapping as it is more affordable. Moreover, minimizing the packaging employed can also lessen not just packaging expenses but also the expenses for distribution. This can reduce production costs and increase efficiency.

Further testing results found that the dimensions of green purchasing positively but insignificant effect on economic performance. These findings are consistent with [17] and [1]. As explained by [17], Indonesia as an emerging country still purchases materials traditionally and tends to ignore the impact on environment. Companies have not implemented green suppliers as the primary factor. The organization continues to believe these standards do not significantly impact the economic success of the company. A sustainable distribution system facilitates the company's bottom line. Hence, it is crucial to be mindful of the bond and dedication with suppliers. Restricted understanding regarding environmental conservation by the management to suppliers can lead to procurement actions that do not align with environmental conservation principles.

Regarding the green manufacturing dimension, the findings indicate that this dimension positively but insignificant effect on economic performance. The results are different from [1], but in line with [18] and [17]. This illustrates that environmentally friendly production has not been fully implemented so the production activities that take place in a company are currently based more on market needs. The idea of green manufacturing hasn't yet transformed into a particular focus. Many people believe not always have the potential to deliver gains for the organization. Environmentally friendly production processes still continue to be seen as cause a substantial financial impact on the organization. Although there are companies that have implemented it, the implementation cannot be said to be optimal.

Other findings indicate that internal environmental management dimension has a positive but

insignificant effect on economic performance. In line with [18] and [17], this condition can occur because internal environmental management has not been a major concern of the company so its implementation has not become a top priority. Although some companies may have implemented these activities, the quality cannot be said to be good, even though top management support can provide great economic benefits.

The next test results related to economic performance show that investment recovery has a positive but insignificant effect on economic performance. The results are related to study of [16] and [1]. In [1], explained that investment recovery is a fairly difficult practice for a developing country. Companies need

high investment or costs for recycling activities. Inadequate infrastructure is also one of the factors.

Effect of GSCM Practices on Social Performance

The bootstrapping results in Table 9 indicate that the seven dimensions related to GSCM practices positively and significantly effect on social performance in the manufacturing industry of Batam City. It can be concluded that seven hypotheses proposed are acceptable. Internal environmental management has the greatest impact of social performance. It is shown by the original sample value of 0.325. The research yields contrasting findings from earlier studies carried out by [1] which states that green distribution and packaging has the greatest impact of social performance

Table 9 Bootstrapping Results (GSCM Practices on SOP)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Info
GP → SOP	**0.160**	0.161	0.062	**2.557**	**0.005**	H3a Accepted
GMN → SOP	**0.118**	0.116	0.058	**2.033**	**0.021**	H3b Accepted
GMR → SOP	**0.172**	0.174	0.066	**2.603**	**0.005**	H3c Accepted
GDP → SOP	**0.169**	0.169	0.060	**2.791**	**0.003**	H3d Accepted
IEM → SOP	**0.325**	0.316	0.140	**2.321**	**0.010**	H3e Accepted
EE → SOP	**0.117**	0.116	0.063	**1.852**	**0.032**	H3f Accepted
IR → SOP	**0.313**	0.314	0.110	**2.834**	**0.002**	H3g Accepted

Source: Data Processed

In this research, it was discovered that green manufacturing dimension has a positive and significant effect on social performance. Backed by the findings of study conducted by [1], it is stated that GSCM practices not solely have a positive impact on environmental and economic performance, but also social performance. Companies that embrace a green production approach will discover it more convenient to establish improved rapport with the community via the implementation of these approaches. Implementing green manufacturing such as removing toxic substances in the manufacturing procedure helps safeguard employees against dangerous chemicals. The method is directed at employee well-being.

Further studies findings indicate that green distribution and packaging dimension has a positive and significant effect on social performance. The findings coincide with analysis from [1] and [17]. The execution of delivery and packaging processes can be easily detected by individuals. That is since it is visible without intermediaries. This advantage can strengthen the business relationship with the community and private sector. The next finding shows that internal environmental management dimension has a positive and significant effect on social performance. The results of the test align with the [19] research. The results showed that implementing sustainable internal management in the company can

improve environmental and social performance. The two performances have a cross-impact. Through environmental management, companies can improve employee working conditions. Meanwhile, to improve product image and reputation, companies can promote their social performance. Regarding the environmental education dimension, findings indicate a positive and significant influence on social performance. Environmental education plays a role in promoting environmental mindfulness. Additionally, it contributes to sustainable strategies implemented by corporations to connect with the broader society [1]. Employees, managers, and all elements engaged in the process of distributing should be conscious of environmental concerns. The outcomes of this research are contrary to the literature [17] and [1].

Sub-sectoral Analysis of GSCM Implementation
To enrich the discussion and provide deeper insights, this section presents an analysis of specific sub-sectors within the manufacturing industry in Batam, highlighting how GSCM practices manifest differently based on industrial characteristics.

1. Electronics
This sub-sector dominates the sample (41.43%) and demonstrates the most progressive implementation of GSCM, particularly in green purchasing and green manufacturing. This is driven by the necessity to comply with export standards set by countries like Singapore and Japan, which enforce strict environmental regulations. Moreover, modern production technologies enable more effective adoption of sustainable practices. As a result, significant improvements in environmental performance and cost efficiency via reduced electronic raw material waste are observed.

2. Fabricated Metals
Companies in this sub-sector (21.43%) are more engaged in investment recovery and green packaging, owing to their heavy reliance on large-scale logistics. Efficient packaging and recycling of logistics materials significantly impact their economic

performance. However, internal environmental management remains a challenge, especially regarding emissions and wastewater reporting.

3. Plastics and Rubber
This subsector faces higher challenges in green manufacturing due to the use of less recyclable raw materials. Nevertheless, firms have begun to adopt green marketing strategies to boost their reputation among environmentally conscious consumers. Social performance is notably impacted, as many of these companies involve local communities in waste management initiatives.

4. Automotive
Although smaller in proportion (8.57%), the automotive sub-sector shows strong performance in green distribution and packaging. This stems from a high demand for logistics efficiency and collaboration with third-party logistics firms to reduce CO_2 emissions. However, environmental education remains less effective, as training has not yet reached frontline operational levels.

This sub-sectoral analysis emphasizes the importance of contextualizing GSCM strategies to specific industrial environments for maximum sustainability impact.

Discussion
The findings of this study reveal that several GSCM dimensions—particularly green purchasing, green manufacturing, green marketing, green distribution and packaging, internal environmental management, and investment recovery—have significant and positive effects on various aspects of sustainability performance. These results offer both theoretical reinforcement and practical guidance for the implementation of sustainable practices in the manufacturing industry.

From a Resource-Based View (RBV) perspective, the significant impact of these GSCM practices supports the idea that sustainability-related capabilities can

serve as strategic resources. For instance, green purchasing enhances supply chain efficiency by integrating environmental criteria into supplier selection and collaboration. This not only reduces ecological risk but also fosters long-term economic gains through cost minimization and innovation. Similarly, green manufacturing and investment recovery improve internal operational efficiency, supporting both environmental and economic performance by reducing waste, energy use, and resource input.

Green marketing emerges as a particularly influential variable across all dimensions of sustainability performance. This finding aligns with Signaling Theory, in that environmentally responsible branding enhances legitimacy in the eyes of both consumers and stakeholders. In Batam's context—where many firms are export-oriented and face global scrutiny—green marketing also acts as a mechanism to fulfill institutional expectations across borders, particularly from high-standard markets like Singapore and Japan. Internal environmental management also shows strong significance, which is theoretically consistent with Institutional Theory. Organizations that embed environmental concerns into their internal policies are better positioned to respond to external institutional pressures. This indicates that regulatory and normative influences can effectively be internalized through strategic governance.

Interestingly, environmental education did not show a statistically significant impact on sustainability performance. This may be due to the implementation gap—while training may be conducted, it may not translate into behavioral change without the proper infrastructure, follow-up, or alignment with organizational culture. This calls for further investigation into knowledge-to-action conversion in manufacturing contexts within developing economies.

Theoretical Implications

This study contributes to the theoretical development of GSCM by empirically validating the role of RBV and Institutional Theory in the context of an emerging industrial hub. The unique setting of Batam—an SEZ and FTZ with strong international linkages—demonstrates that institutional pressures do not only arise from domestic policies but also from global markets. The findings support the view that firms operating in export-oriented zones must integrate environmental practices not only as a competitive advantage (RBV) but also as a form of legitimacy in response to multi-level institutional demands.

Managerial Implications

For practitioners, the results suggest that prioritizing GSCM practices—especially green marketing, green purchasing, and internal environmental management—can yield broad sustainability benefits. Managers should consider integrating sustainability goals into vendor criteria, incentivizing environmental performance in operations, and actively communicating green efforts to stakeholders. Moreover, investment in reverse logistics and waste recovery should be viewed not as cost centers but as potential value-generating activities.

Companies are also advised to critically evaluate the effectiveness of their environmental education programs. It is essential to ensure that such programs are not merely symbolic but are tied to measurable outcomes in employee behavior, process efficiency, and environmental compliance.

Recommendations for Future Research

This study opens several avenues for future research. First, researchers may explore the mediating or moderating roles of variables such as organizational culture, leadership commitment, or regulatory intensity. Second, qualitative approaches could be employed to unpack why certain dimensions (like environmental education) may fail to produce expected outcomes. Lastly, comparative studies between Batam and other industrial regions—both domestic and international—could enrich understanding of contextual factors influencing GSCM effectiveness.

Conclusion

Considering the findings and discussion above, the following conclusions can be made: First, six dimensions of GSCM practices positively and significantly effect on environmental performance in the manufacturing industry of Batam City. These dimensions are green purchasing, green manufacturing, green marketing, green distribution and packaging, internal environmental management, and investment recovery. Second, three dimensions of GSCM practices positively and significantly effect on economic performance in the manufacturing industry of Batam City. These dimensions are green marketing, green distribution and packaging, and environmental education. Third, all dimensions of GSCM practices positively and significantly effect on social performance in the manufacturing industry of Batam City. Fourth, of the seven dimensions of GSCM practices, tested, only two dimensions have a positive and significant effect on three dimensions of sustainability performance. These dimensions are green marketing and green distribution & packaging.

The study indicates that every dimension of GSCM practices contribute positively and significantly to at least one dimension of sustainability performance. So, of the 21 hypotheses formulated, there are 16 accepted hypotheses and 5 rejected hypotheses. In order to accomplish the goals in this research, the investigator always works hard to collect dependable and credible outcomes. Nevertheless, there exist limitations still exist for the progress of future research. Upcoming studies is anticipated to broaden the scope of study samples utilizing the same kinds of manufacturer sectors (homogeneous) to achieve more precise results. This will enhance investigation on the influence of GSCM practices on economic performance. As mentioned previously, certain GSCM practices do not exhibit a considerable effect on economic performance. Future studies may therefore investigate how GSCM practices affect economic performance.

To deepen the connection between empirical findings and the theoretical framework used (i.e., Resource-Based View and Institutional Theory), the following elaborations are added to interpret both significant and non-significant results.

1. Green Purchasing → Environmental Performance (Significant)

   The significant influence of green purchasing on environmental performance aligns with Institutional Theory, particularly normative and regulatory pressures. In Batam's export-oriented context, firms are compelled to work with environmentally responsible suppliers to meet foreign market standards. This supports prior findings (e.g., Cankaya & Sezen, 2019) showing that external institutional forces drive green procurement decisions.

   Theoretical contribution: This indicates that in developing countries closely integrated into global markets, cross-border institutional pressure plays a pivotal role in translating green purchasing into environmental gains.

2. Environmental Education → Economic Performance (Not Significant)

   The lack of a significant effect of environmental education on economic performance underscores a limitation in the RBV framework, where resources (e.g., training programs) may not yet have been fully internalized into strategic capabilities. In many firms, environmental training remains superficial or formalistic, lacking operational impact. This observation is in line with organizational inertia theory, which posits that behavior change requires more than knowledge transfer—it demands systemic incentives and reinforcement mechanisms.

   Theoretical contribution: Not all internal resources become strategic capabilities by default; execution context and integration into operations are crucial to realize potential economic benefits.

3. Green Marketing → All Performance Dimensions (Significant)

   The wide-ranging influence of green marketing supports signaling theory. In Batam's competitive, export-driven market, green

marketing serves as a strategic communication tool that builds legitimacy and brand loyalty. This strengthens the RBV argument that marketing capabilities can serve as differentiators in environmentally sensitive markets.

Theoretical contribution: Demonstrates that strategic communication rooted in environmental commitment can be a sustainable competitive advantage, especially in markets where eco-consciousness is valued.

4. Internal Environmental Management → Social Performance (Significant)

The positive link between internal environmental management and social performance echoes Stakeholder Theory, which posits that firms that adopt internal sustainability practices tend to foster better relationships with employees, communities, and regulators. Cleaner operations often enhance workplace safety and improve a company's public image.

Theoretical contribution: Integrates RBV and Stakeholder Theory to show that internal practices not only drive operational outcomes but also enhance external legitimacy and social impact.

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