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The Impact of Green Supply Chain Management on Competitive Advantage, Operational Efficiency, and Business Sustainability

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Abstract

Green supply chain management, also referred to as sustainable supply chain management, is gaining more attention in organizations to meet sustainable goals while enhancing competitive advantage. In recent years, many companies have decided to adopt environmentally sustainable practices within their supply chain management processes. This article explores the relationship of GSCM with competitive advantage, operational efficiency, business sustainability and the moderating role of supply chain integration (SCI). This paper, therefore, used a quantitative research methodology. Data was gathered from 313 manufacturing companies in Indonesia operating in the electronics, agriculture, food and textile sectors. SEM was employed to examine the link between GSCM and competitive advantage drivers, including cost efficiency, innovation, product quality, delivery reliability, time to market, and firm performance. The findings also suggest that the GSCM relationship enhances operational efficiency and firm performance by lowering cost, improving resource utilization and impacting sustainability excellence. These factors create competitive advantages, such as cost and delivery reliability, and moderate the GSCM performance. Moreover, with SCI, these effects are further enhanced, especially the implications on the need for better supply chain integration of the various networks. GSCM brings benefits to firms in improving their performance and competitiveness; however, it is notable that this management system would encounter several barriers during its implementation, such as the high cost of implementation and resistance to change. To avoid short-term thinking and maximize all gains from GSCM, firms should implement investment in Digital SC solutions, train employees, and work closely with suppliers.

Keywords: Green Supply Chain Management (GSCM), Competitive Advantage, Operational Efficiency, Business Sustainability, Supply Chain Integration (SCI), Sustainable Procurement, Eco-Friendly Manufacturing, Carbon-Neutral Logistics, Structural Equation Modeling (SEM), Emerging Markets.

1. Introduction

Green supply chain management (GSCM) is considered a critical strategy for organizations pursuing successful implementation of environmental sustainability strategies to gain a competitive advantage. Amid globalization, heightened concern for environmental issues and rising pressures from governments and regulatory bodies, companies are experiencing the need to reduce impacts on the global environment. Consumers, governments and investors are asking for more revelation and corporate responsibility to the environment, thus forcing organizational houses to categorically incorporate sustainability in the chain links of their supply systems (Al-Khawaldah et al., 2022). GSCM takes normal supply chain management a notch higher as it involves environmental aspects in each chain stage, including designing,

procurement, manufacturing, distribution, and disposal. Implementing GSCM reduces waste, enhances resource use efficiency, and achieves an equal balance for economic and environmental targets (Assumpção et al., 2022). This embracive system effectively solves emerging ecological issues. Also, it fosters responsive corporate organizational systems to become operationally excellent and develop a positive image in the market. Implementing GSCM practices is beneficial to businesses and has many advantages. It first improves operational effectiveness by better managing resources in line with lean operations, which reduces costs and improves output. Secondly, GSCM is also associated with a competitive advantage because it differentiates businesses in environmentally sensitive markets. Today's consumers tend to go with environment-sensitive companies; therefore, GSCM can act as a strategic marketing movement (Amjad et al., 2022). Also, GSCM plays a vital role in establishing sustainable business development by managing many potential risks relating to scarce resources, noncompliance with laws, and negative brand image. The literature review demonstrated that it has an enormous influence on organizational performance. For example, (Lerman et al., 2022) noted that companies that engage in green procurement, eco-friendly product designs or recycling usually receive better environmental and financial performance. Similarly, (Ricardianto et al., 2022) have pointed out that there are benefits in supply chain green practices both in terms of environmental impact and innovation/value co-generation. Such findings provide a deeper understanding of the impact of GSCM as a tool that can revolutionize conventional business strategies toward the achievement of sustainable development goals. However, the implementation of GSCM has its drawbacks: Challenges, including high implementation costs, resistance to change, and scarcity of knowledge among organizations on sustainability remain a challenge. Furthermore, the integration of GSCM may be hampered by the problem of formulating, implementing and coordinating initiatives in green supply chains across multiple players within the supply chain process. This means that enabling these challenges to be dealt with entails cooperation, where various stakeholders come together and implement solutions based on innovation and sharing exemplary practices (El Baz and Iddik, 2022). That is the reason why this research aims to evaluate the impact of incorporating the GSCM practices on competitive advantage, operational efficiency, and business sustainability. This research, therefore, seeks to establish the correlation between GSCM and performance measures in which insight into exploring sustainable supply chain management strategies for use by organizations will be made. The research results will dissolve with the existing literature on GSCM and highlight its proactive impact on organizations to achieve sustainable competitive advantage globally.

1.1 **Conceptual Framework**

Organizations have begun adopting Green Supply Chain Management (GSCM) to adopt sustainable environmental management. The components, which make GSCM advance SCM to embrace environmental factors are as follows: GSCM involves supply chain activities such as procurement, manufacturing, product distribution and end-of-life management of products. Based on the Resource-Based View (RBV), it is established that firms that undertake good management of their green supply chains have competitive advantages since they accord the chain distinctive and rare resources (Lubis, 2022). Also, the TBL approach is important to the organization's economic, environmental, and social performance (Elkington, 1994). These theoretical foundations mainly contribute to formulating the following conceptual framework that tests the relationship between GSCM, competitive advantage, and firm performance, moderated by supply chain integration. As suggested by the conceptual model, implementing GSCM practice has other benefits as far as firm performance is concerned in the sense that it has a positive effect on the efficiency of operations, minimizes waste and increases brand equity reputation. Besides, it was concluded that GSCM increases competitive advantage by decreasing costs, raising quality, introducing new ideas, and increasing delivery reliability (Khan et al., 2023). Gardner and Hammond identified competitive advantage into five forms: price/cost, quality, new product/service and delivery dependability, and time to market.

Research shows that companies implementing the GSCM practices benefit from these aspects and get better investment and market share returns (Chanana and Singh, 2024). Speaking of GSCM and its effect, it is not the same for all firms as it depends on supply chain integration (SCI), which is a median for the relationship between GSCM and firm performance. Customers, suppliers, and internal integration of SCI make it easier for firms to experience better returns and overall GSCM performance since proper coordination will lead to proper implementation (Gavronski et al., 2011; Yu, Chavez and Feng, 2017).

1.2 Direct Effect of GSCM on Firm Performance

The first hypothesis in this case is that GSCM positively impacts the firm's performance. Some literature also backs up this assertion as organizations implementing green supply chain management best practices realize better performance, compliance with rules and regulations, and better customer satisfaction, resulting in better organizational performance (Choi and Hwang, 2015; Foo et al., 2018). The hypothesis that can be formulated concerning this study is as follows:

H1: Green Supply Chain Management (GSCM) positively impacts firm performance.

Mediating Role of Competitive Advantage

Competitive advantage is viewed as one of the ways GSCM affects the firm's performance. Some of the key factors of competitive advantage in the context of supply chain management have been established by (Al-Khawaldah et al., 2022) as consisting of five elements, which include:

Cost– Esc – mentioned that for the firms that implement GSCM practices, there are several benefits in terms of cost, such as energy, waste, and resources (Roh et al., 2022).

H2a: Price/cost mediates the relationship between GSCM and firm performance.

Quality: Implementing product quality and green manufacturing can also make products of superior quality, hence improving customer satisfaction (Mustafi et al., 2024). Nevertheless, the mediating effect of conscientiousness in the relationship between staffing and job performance was insignificant in the empirical study by Tran et al.

H2b: Quality has a moderating effect on the link between GSCM and firm performance.

Sustainability initiatives—The green supply chain encourages firms to develop environmentally friendly products and devise environmentally friendly production methods, promoting innovation (Samad et al., 2021).

H2c: Innovation mediates the relationship between GSCM and firm performance.

Reliability—Sound logistics and transport measures ensure prompt and timely product delivery (Novitasari and Agustia, 2021).

H2d: Delivery dependability mediates the relationship between GSCM and firm performance.

Speed/First-Mover Advantage—Green practices, including lean production and efficient resource management within organizations, help early product introductions in the market (Al-Ghwayeen and Abdallah, 2018).

H2e: The time of entering the market interacts with the relationship between GSCM and firm performance.

1.3 Moderating Mechanism concerning Supply Chain Integration (SCI)

It has been ascertained that improved organizational performance results from GSCM practices, but the impact depends on the SCI. SCI can be defined as the level of integration between the firm's internal operations and its operations with external partners such as suppliers and consumers. SCI has a positive effect, increasing the impact of GSCM measures by providing an efficient information dissemination process, minimizing operational costs, and promoting collaboration between members (Jum'a and Bushnaq, 2024). According to Tran et al. (2022), the impact of GSCM on supply chain performance is significantly moderated by SCI, indicating that firms with a high level of SCI achieved a higher positive effect of GSCM practices.

H3: Supply chain integration (SCI) is a third variable that indirectly impacts green supply chain management and firm performance.

This conceptual framework underlines GSCM as a tool for achieving a firm's performance and its role in decreasing the improving quality, innovations, dependability of delivery, and decreasing the market. However, it is important to note that the success of GSCM depends on the supply chain integration that enables better planning and, hence, increases the benefits that result from green practices. According to the research, both internal and external integration of models should be implemented to enhance the effectiveness of GSCM (Kalyar, Shafique and Ahmad, 2020). The management of sustainable supply chain approaches shows that organizational value and performance can be achieved by implementing organizational sustainability initiatives (Shekarian et al., 2022).

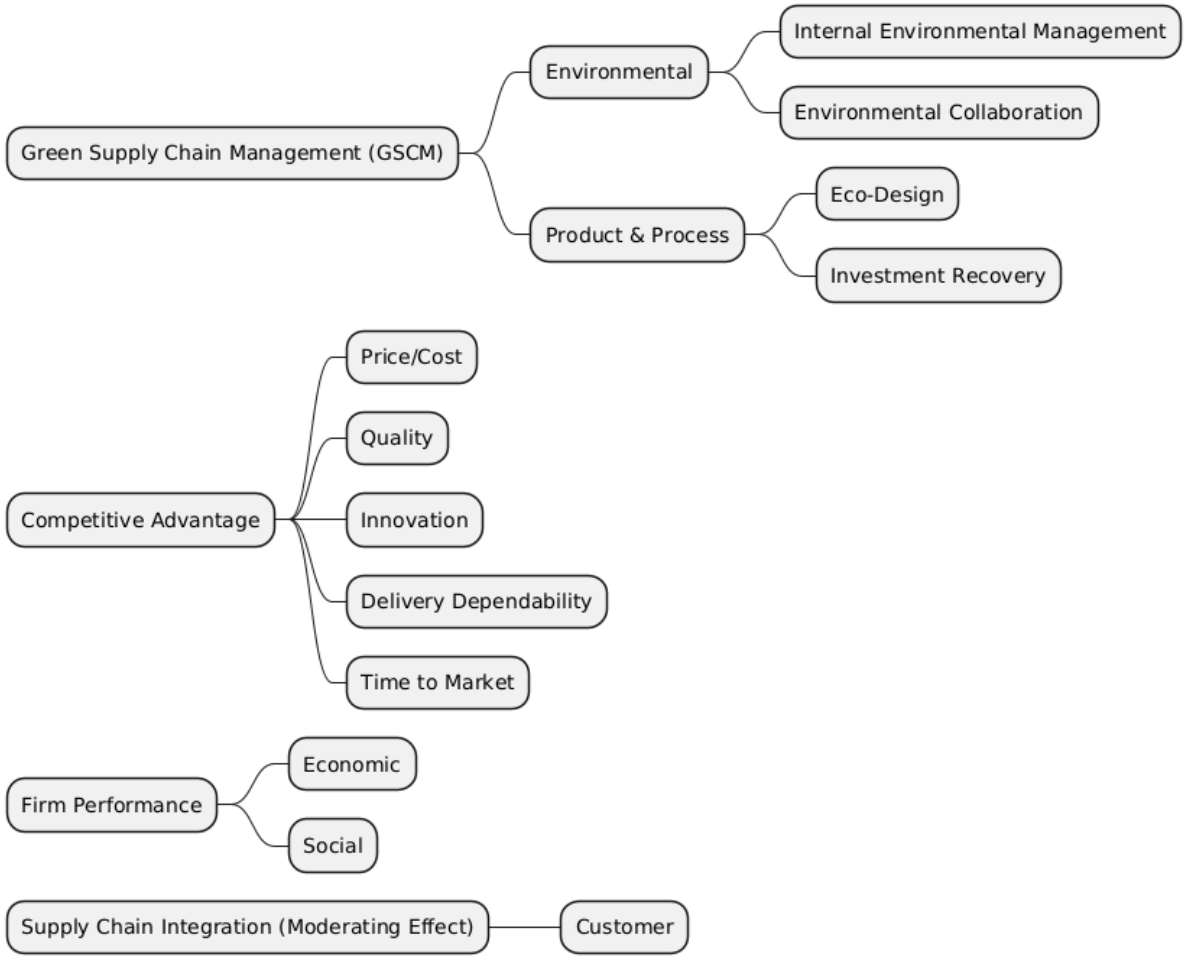

Figure 1: Research Model

2. Literature Review

2.1 Defining Green Supply Chain Management (GSCM)

Green supply chain management has emerged as a management model incorporating environmental factors in supply chain management. This paper shows how this integration will address the green supply chain management approach while considering economic benefits and environmental costs (Gera et al., 2022). GSCM embraces several activities, such as environmental product design, buying eco-materials, green manufacturing, efficient logistics and eco-final recycling or services (El Baz and Iddik, 2022). There has been escalating awareness and consciousness of climate change impacts and limited resource availability in the environment, making organizations embrace GSCM to ensure that they align with the current

sustainable goals and requirements and compete effectively in the market (Department of Management, Azad University Dubai, United Arab Emirates and Nozari, 2024).
Implementation of GSCM involves some key factors that include the following:

2.1.1 Sustainable Sourcing

Sustainability in supply chain management refers to acquiring resources that are friendly to the natural environment, obtained through proper means, and socially acceptable. This practice ensures that suppliers achieve goals in sustainability agendas such as reduction of carbon footprint, use of renewable energy, and disposal of hazardous waste (Schulze, Bals and Warwick, 2022). Those who go the extra mile to achieve sustainable procurement not only meet regulatory requirements but also add value to their brands by embracing the emerging market preference for goods produced in an environment-friendly manner(Jia and Jiang, 2018). Also, the long-term relationships between buyers and suppliers that sustainable sourcing encourages make the supply chain compatible and, thus, more resilient in terms of environmental and social aspects.

2.1.2 Eco-Friendly Packaging

Indeed, packaging is vital in supply chain management, but it is also one of the major sources of environmental degradation (Nguyen et al., 2020). Sustainable packaging can, therefore, be defined as using eco-friendly materials that can be degraded, reused or recycled. By involving sustainable packaging, there are gains in cost in the long run, a better reputation among the customers, and meeting the set state laws concerning the disposal of waste (Moustafa et al., 2019). Further, (Rahma, Debora and Rahmani, 2024) reported that governments of the world are changing their policies in disposing of non-recyclable plastic waste, which forced companies to consider sustainable packaging to meet the regulations as well as remain operational to compete in the market (Mitterer-Daltoé et al., 2024).

2.1.3 Carbon-Neutral Logistics

Material transportation and fuel consumption are some of the major reasons why the logistics sector has been identified as a generator of greenhouse greenhouse gases (Kauhanen, 2024). Carbon neutrality can be reduced through the proper positioning of depots and ways of moving goods and products and by utilizing electric and hybrid vehicles and renewable energy sources in the depots. It is also important for the companies to reduce their operational costs. At the same time, it increases their conformity to the existing green regulations since the sustainability markets offer an opportunity for the firms to improve their competitiveness (Yasir, Shen and Lin, 2024). Carbon-neutral logistics can be defined as one of the pressing issues for businesses that are to become compliant with the established international standards and decrease their emissions.

2.2 Theoretical Perspectives on GSCM

Two theoretical underpinnings—the Resource-Based View (RBV) and the Triple Bottom Line (TBL)—explain why GSCM practices should be developed and adopted.

2.2.1 Resource-Based View (RBV)

According to the RBV, firms that develop resources that are valuable, rare and difficult to imitate are the firms that are likely to achieve competitive advantage, namely green supply chain capabilities (Shibin et al., 2020). Regarding applying GSCM, eco-design, investment recovery and supplier collaboration represent strategic factors that improve sustainability and create competitive advantage within firms operating in highly competitive environments (Sahu, Padhy and Dhir, 2022). In the opinion of Lee et al. (2014), those companies make money by investing in green technology and sustainable supply chain operations while avoiding regulatory risks and liabilities.

2.2.2Triple Bottom Line (TBL)

TBL used by international business is a concept drawn from the evaluation of regular financial-performance indicators developed by Elkington in 1994. It assesses business outcomes in three aspects:

- **Economic Performance:** Achieving cost savings and profitability through sustainable operations.
- **Environmental performance:** Management of natural resources, particularly in reducing carbon footprints and other negative environmental impacts.
- **Social Responsibility:** Promoting and upholding the standards envisioned for ethical labor and providing for the betterment of the community.

Cognitive evidence generated from the empirical analysis also shows that when firms implement the TBL concept in their supply chain management, they experience enhanced stakeholders' engagement, better compliance levels on the sustainability standards, and superior and sustainable financial performances (Thamsatitdej et al., 2015; Khokhar et al., 2022).

2.3 GSCM and Competitive Advantage

Implementing GSCM practices has been observed and appreciated as an effective factor for competitive advantage. Here, the author establishes that Porter (1985) suggests two possibilities directly related to GSCM: cost leadership and innovation for sustainability. The following areas explain how GSCM has a competitiveness advantage:

Reduced Operating Costs: The adoption of GSCM reduces operating costs in the organization since the organization will attain more efficient energy, waste and resources (Sharabati, 2021). The study established that firms that integrate green aspects into their manufacturing and supply chain usually reap lower production costs and higher productivity (Astawa et al., 2021).

Brand Differentiation: Recently, customers have become extremely sensitive to patrons over environmental issues, so they appreciate those brands that attend to sustainable environmentally friendly strategies (Laari, Töyli and Ojala, 2017). The main opportunity for sustainability practices in supply chains is for businesses that are able to incorporate sustainability in their supply chain to gain customer loyalty and improve their organizational image (Montshiwa, 2018).

Legal Requirement: Today, governments and environmental agencies are taking legal action for sustainability measures, such as carbon emission standards, waste disposal policies and rules regarding a product's lifecycle (Çetin and Knouch, 2018). Together, firms that are active in these laws can avoid the legal consequences and benefits of compliance in a regulated environment.

Market expansion and investor confidence: Investors and stakeholders have now directed their attention towards Environmental, Social and Governance scores for firms they wish to invest in (UDDIN, 2021). Managers who implement green supply chain initiatives are likely to persuade socially mature finance capitalists, hence the ideal funding prospects and the broader market.

2.4 Challenges in GSCM Implementation

Albeit the importance and benefits found in the GSCM, the following are some of the major challenges found in the implementation of this framework:

High Initial Costs: SSCP involves using costly technological innovations, training employees, and installing environmentally friendly equipment and services whose expenses may turn off SMEs (Chen, Huang and Do, 2022).

Lack of Employee Support: Due to cost, complexity, or disruption of work, supply chain members and employees may be reluctant to support green initiatives (Kumar et al., 2018). For this to happen, leadership, incentives, and awareness programs have to be implemented in the organization.

Many and Variegated: GSCM involves cooperation with suppliers, manufacturers, logistics companies, and other organizations (Islam et al., 2022). Coordination and communication failures also challenge properly implementing sustainability initiatives.

Some of the common challenges that affect firms include a lack of awareness and expertise. Supply chain sustainability frequently demands new knowledge and technical competency that most firms, especially those in developing nations, lack (Younis, Sundarakani and Vel, 2016). To address this issue, it is necessary to design corresponding activities related to education and cooperation with industries.

3. Methodology

Since this study aims to testify to the effect of GSCM on firm romance and competitive advantage, it studies various industries across Indonesia, an emerging country with fast-growing industries and alarming environmental issues. Industrialization in Indonesia leads to a large extent of environmental pollution through energy consumption, poor waste disposal, and emissions of excessive carbon. While different policies exist in an attempt to encourage the implementation of GSCM, it is up to the various businesses to embrace them. As mentioned earlier, most of the previous studies on GSCM only concern the developed countries and the developed nations, while fewer studies target developing countries. This is a research void that this analysis seeks to fit in, given the emerging problem of industrial pollution in Indonesia, specifically firms in the country. The selected industries are as follows: (i) Electronics Industries, (ii) Agriculture industries, (iii) Food industries and (iv) Textiles industries, as these are the major industries which are involved in polluting the environment and are under pressure to adopt sustainability measures. In the electronics sector, there is a large production of e-waste, which is hazardous to the environment if not disposed of by having proper recycling systems (Ahirwar and Tripathi, 2021). As much as there is an increase in demand for electronics, people are reluctant to take proper measures to dispose of electronics correctly, polluting the environment. On the other hand, the agriculture sector has not been very Mexican regarding waste management issues, use of excessive pesticides and inefficient supply chain systems, which have been noted in the literature by other sources such as Loehr (2012). As much as governments and organizations have sought to make agriculture sustainable, these factors, such as water pollution and soil degradation, are still rife, especially in developing countries like Indonesia. Similarly, the food industry is known to contribute to food wastage, which can be quantified in terms of money and the environment. Approximately one-third of the food produced for human consumption is wasted, costing around $ 2 billion annually globally (Kumar, Holuszko and Espinosa, 2017). Based on these two factors, food wastage will rise in the next few decades following economic growth, especially in South Asian countries. Finally, the textile industry of Indonesia, which is among the most important export industries yet, has bleaching effects of environmental pollution. Textile industries involve the generation of wastewater containing dyes and chemical effluents that adversely impact the environment (Madhav et al., 2018). Although there has been an increase in the implementation of green supply chain management initiatives in the textile firms of Indonesia, particularly due to rising regulatory pressure, knowledge about their relationship with the firms' performance remains limited. Due to these challenges, businesses in Indonesia have shown their willingness to adopt GSCM strategies that aim to minimize the organization's impact on the environment. However, scientific research related to GSCM and firm performance is quite limited. To do this, this study chooses the following four industries to examine the hypothesized relations between GSCM practices, competitive advantage, and firm performance. A research sample was developed through an elaborate list of electronics, agriculture, food, and textile businesses. These manufacturing companies are chosen because they have top-line on the immediate earthly environment and are mostly bound to sustainability-driven programs. To achieve the study's objective, 500 manufacturing enterprises were chosen through a stratified random sampling technique to have controlled samples of firms of different sizes and regions: North, Central, and South regions of Indonesia. The survey participants were selected from top management

personnel, operations, procurement, and supply chain managers since they have a tactical understanding of GSCM and business performance. To reduce response bias, the survey included reversed questions to add credibility to participants' responses. Furthermore, to ensure the participants' cooperation, they were assured of anonymity in the study's report, whereas the firms were provided with an aggregated report of the study results.

A total of 313 questionnaires were used for the study, and the valid response rate was 62.6% 313/500 after the direct data collection efforts were conducted. Regarding the distribution of responses by industries, the findings were as follows:

- Electronics Industry: 51 firms (16%)
- Agriculture Sector: 54 firms (17%)
- Food Industry: 86 firms (27%)
- Textile Industry: 121 firms (39%)

The high response rate points to the extent of the importance of GSCM adoption in these industries since firms acknowledge the rising value of sustainability for future business viability. Therefore, it was expected that the findings of this study would help understand the role of GSCM practices in enhancing firm performance and achieving competitive advantage within the industrial sector of Indonesia.

3.1 Internal and External Environmental Orientations

In this study, GSCM is measured using scales developed in previous research. All the proposed items are based on a five-point Likert scale, highlighted as follows: 1 = strongly disagree—5 = strongly agree, to measure the degree of GSCM implementation within firms. Several dimensions of GSCM are included in the measurement. Internal Environmental Management is established through five items derived from the work of Chatzopoulou, Manolopoulos and Agapitou, (2022) and Ozgul, (2022). These include aspects that measure the business's internal sustainability commitment, such as the extent of the firm's management's firm's management's use of sustainable performance measurements. Environmental Collaboration with Partners is assessed using four items from Laari et al. (2016), a scale regarding the degree of interaction firms have with other stakeholders for sustainability. An example statement for this measure is "cooperating with other organizations to address environmental concerns in product development. Also, the Environmental Monitoring by Customers and Environmental Monitoring of Suppliers are observed using four items each and adopted from Laari et al. (2016). These issues determine how customers and suppliers affect the firm's sustainability initiatives. For example, one of the items is "Customers have adopted and employed environmental impacts as a key factor when selecting suppliers," which captured the pressure from the customers in influencing the green supply chain. Similarly, entries such as 'approach/target environmental issues as one and the same as cost when selecting a supplier' are included in the list of aspects of supplier monitoring. Some other prevalent areas of GSCM are Eco Design, Investment Recovery and Green Manufacturing and Packaging. Thus, activities related to Eco-Design are evaluated using six criteria based on Kirchoff et al., 2016 and Lee et al., 2012 and concern the attempts at design or re-design of products with lower material and energy intensity. Investment Recovery is determined by three items borrowed and adapted from (Chan et al., 2012; Choi and Hwang, 2015). An example of such an item is the "sale of excess inventories/materials for product investments." Last, Green Manufacturing and Packaging are measured by eight items from (Shang, Lu and Li, 2010) that aim to determine the extent of the practices used in reducing environmental impacts by using statements such as substituting, polluting and hazardous materials/parts.

3.2 Supply Chain Integration (SCI)

Supply Chain Integration (SCI) is the proxy for the level of integration in the study and the extent of integration of internal departments and external suppliers and customers. All the measurement items for SCI were developed by (Flynn, Huo and Zhao, 2010; Huo, 2012;

Leuschner, Rogers and Charvet, 2013). They are ordinal scales that measure the degree of integration on a scale of 1 – "not at all" to 5 – "extensive."
Davis and Richardson's seven areas of SCI are customer integration, supplier integration, and internal integration; the remaining four elements are analytical thinking, supplier relationships, customer relationships, and information technology. Customer integration has 11 items, including the example item of "the degree of connection with key customers by using information hierarchy." Supplier integration, which is attuned to 13 particulars, refers to the cooperation with suppliers, such as 'the extent of exchange with major suppliers through information networks.' Finally, nine items will be used to measure internal integration, which is the extent to which available functions integrate data to operate efficiently and sustainably.

3.3 Competitive Advantage

Competitive Advantage is measured using items borrowed from (Li et al., 2006; Kristal, Huang and Roth, 2010; Liao et al., 2017). Unlike the personal data sheet, these items are measured on a five-point Likert scale, starting from one as "strongly disagree" to five as "strongly agree." Competitive Advantage is measured using five criteria: price/Cost, Quality, Product Innovation, Delivery Dependability, and Time to Market. Relative to the Price/Cost item, two items are used: "offer the lowest price" and "offer prices that are as low as or lower than those of competitors." One of the four items used to capture quality is "use the product or service quality to compete with rivals." Product Innovation is measured by three items that relate to the adaptability to produce different products, such as, "Some product can be adapted according to the need of the customer so that they meet his/her needs." Delivery dependability is represented by three questions, one of which is ''commitment to ensure market demand for product or service by guarantee'. Finally, a Time to Market consists of four items, with an example item being "launch new products within a short period of time."

3.4 Firm Performance

Firm Performance is measured using (Zaid, Jaaron and Bon, 2018) in three categories: economic performance, Environmental performance, and Social performance. Every item is answered using a five-point Likert scale, with one end indicating a very low extent and the other end corresponding to a very high extent in terms of the firms' performance improvements. Another scale set is economic performance, which consists of three items, including "have adequate sales and business volume," which describes financial position and business revenues. Environmental Performance is assessed by eight aspects of sustainability, such as "provide sufficient measures to curb air pollution." Last is Social Performance, established by eight items; an example item is "Offers standard wages and overtime."

3.5 Data Analysis

This research uses the SEM technique to conduct a path analysis on GSCM, competitive advantage, and organizational performance. SEM is a technique that investigates the different relationships of various measures simultaneously and between the latent independent and dependent variables in particular (Mazumder et al., 2018). Among all SEM), PLS-SEM is selected because it is an appropriate technique for analyzing non-normal data and a small sample size, according to (Civelek, 2018). As explained above, this study seeks to establish the mediating effects of competitive advantage on the GSCM and firm performance relationship; hence, it falls under the exploratory research type, so PLS-SEM is appropriate for this study. Because theoretical frameworks in this area are poorly developed, PLS-SEM can be seen as appropriate because it can freely develop the model and test the hypotheses. Furthermore, the model effectively examines models that contain one or more mediating and moderating variables, such as the moderating role of supply chain integration (SCI) for the GSCM-performance relationship. The latter is done systematically according to the following plan of the analysis. First, the number of items is checked to ensure it satisfies the criteria of construct reliability, convergent validity, and discriminate validity. This is done after the structural model

has been validated through the examination of path coefficients, coefficients of determination (R^2), coefficient of determination for the prediction of the endogenous variables (f^2), and coefficient of determination for the prediction relevance of the structural model (Q^2). Hence, employing PLS-SEM in this study helps to obtain a strong and comprehensive analysis of GSCM's impact and provides recommendations for firms willing to improve their sustainable supply chain management and competitiveness. The specific outcomes and conclusions are discussed in the following sections of the paper.

4 Analysis and Results

The evaluation of the measurement model in this study is arranged in a systematic approach that includes the measurement model analysis, then the structural model analysis, and finally, hypothesis testing, as Hair et al. (2019) recommend. The measurement model is a formative work to evaluate the reliability and validity of the observed variables used in measuring the latent variables. The evaluation of the measurement model is divided into two research phases. The first step is to examine the validity of each item in terms of the last phase's convergence validity condition. Henseler et al. (2009) state that an outer loading of less than 0.7 should be excluded from the model because it is insignificant in contributing to the construct. According to this criterion, GSCM_GMP8, SCI_CI2, SCI_CI11, SCI_SI7, SCI_SI8, and TM1 were omitted from the analysis as their outer loadings are below 0.7. As a result of this step, all the items in the model have outer loading values of 0.7 and above, satisfying the convergence validity requirements. The second procedure aims to determine internal consistency reliability and convergent validity. Cronbach's alpha determines the internal consistency reliability, and the acceptable level for this measure is 0.7, according to Nunnally and Bernstein (1994). On this basis, convergent validity is also established using the Average Variance Extracted (AVE) > 0.50 criteria, which shows that the majority of the realized variables of the latent construct are captured by the construct (Hair et al., 2019). Thus, since the two conditions are fulfilled, it is possible to move on to the next step, which is the evaluation of the structural model.

Table: Measurement Model (Stage 1)

Factor	Item	Before (Outer Loading)	After Deleting Items (Outer Loading)	Cronbach's Alpha	AVE
Cost & Price (CP)	CP1	0.867	0.867	0.713	0.777
	CP2	0.896	0.896		
Delivery Dependability (DD)	DD1	0.848	0.848	0.804	0.719
	DD2	0.876	0.876		
	DD3	0.819	0.819		
Firm Performance (FP_EC)	FP_EC1	0.863	0.863	0.825	0.657
	FP_EC2	0.786	0.786		
	FP_EC3	0.753	0.753		
	FP_EC4	0.836	0.836		
Firm Performance (FP_ENV)	FP_ENV1	0.805	0.805	0.931	0.676
	FP_ENV2	0.806	0.806		

	FP_ENV3	0.752	0.752		
	FP_ENV4	0.847	0.847		
	FP_ENV5	0.845	0.845		
	FP_ENV6	0.779	0.779		
	FP_ENV7	0.867	0.867		
	FP_ENV8	0.870	0.870		
Firm Performance (FP_SOC)	FP_SOC1	0.853	0.853	0.925	0.655
	FP_SOC2	0.788	0.788		
	FP_SOC3	0.815	0.815		
	FP_SOC4	0.789	0.789		
	FP_SOC5	0.821	0.821		
	FP_SOC6	0.827	0.827		
	FP_SOC7	0.796	0.796		
	FP_SOC8	0.785	0.785		
Green Supply Chain Management (GSCM_ECP)	GSCM_ECP1	0.767	0.765	0.717	0.637
	GSCM_ECP2	0.806	0.806		
	GSCM_ECP3	0.822	0.823		
Green Supply Chain Management (GSCM_ED)	GSCM_ED1	0.778	0.779	0.876	0.617
	GSCM_ED2	0.821	0.821		
	GSCM_ED3	0.789	0.789		
	GSCM_ED4	0.770	0.769		
	GSCM_ED5	0.797	0.798		
	GSCM_ED6	0.756	0.753		
Green Supply Chain Management (GSCM_EMC)	GSCM_EMC1	0.740	0.740	0.757	0.579
	GSCM_EMC2	0.748	0.748		
	GSCM_EMC3	0.801	0.801		
	GSCM_EMC4	0.753	0.754		
Innovation (INNO)	INNO1	0.843	0.843	0.813	0.728
	INNO2	0.818	0.817		

	INNO3	0.897	0.897		
Quality (QUAL)	QUAL1	0.816	0.816	0.797	0.712
	QUAL2	0.866	0.866		
	QUAL3	0.848	0.848		
Supply Chain Integration (SCI_CI)	SCI_CI1	0.767	0.792	0.915	0.596
	SCI_CI2*	0.587	Removed		
	SCI_CI11*	0.631	Removed		
Time to Market (TM)	TM1*	0.692	Removed	0.798	0.709
	TM2	0.755	0.764		
	TM3	0.832	0.861		
	TM4	0.877	0.897		

The Measurement Model (Stage 1) tests the constructs' reliability and validity, using outer loadings, Cronbach's Alpha, and Average Variance Extracted (AVE). Outer loading values refer to the closeness of connection of each indicator to their respective construct, and values above 0.7 are considered adequate. Based on the factor loadings smaller than 0.60, some items of the constructs were excluded, like SCI_CI2, SCI_CI11, SCI_SI7, SCI_SI8 and TM1, to enhance the model fitness and reliability. The reliability using Cronbach's Alpha for all the constructs was above 0.7, which presents a measure of internal consistency reliability for the measurement items used in the study. Further, AVE values were more than 0.5, allowing each construct to adequately pick up variance from its measures, thus satisfying convergent construct validity. As all the constructed factors fulfilled these criteria, both the reliability and validity of the model were established, and the model could move on to phase 2, where the first-order factors were standardized, and the second-order factors emerged as new first-order factors. Since no adjustments and improvements were required, the model was considered appropriate for subsequent evaluation.

Table 2: Measurement Model (Stage 2)

Factor	Item	External Loading	Cronbach's Alpha	AVE
Cost & Price	CP1	0.867	0.713	0.777
	CP2	0.895		
Delivery Dependability	DD1	0.850	0.804	0.719
	DD2	0.875		
	DD3	0.818		
Firm Performance	FP_EC	0.881	*	*
	FP_ENV	0.943		
	FP_SOC	0.861		

Green Supply Chain Management	GSCM_ECP	0.813	0.907	0.679
	GSCM_ED	0.802		
	GSCM_EMC	0.821		
	GSCM_EMS	0.800		
	GSCM_GMP	0.836		
	GSCM_IEM	0.870		
Innovation	INNO1	0.842	0.813	0.728
	INNO2	0.818		
	INNO3	0.897		
Quality	QUAL1	0.815	0.797	0.712
	QUAL2	0.866		
	QUAL3	0.850		
Supply Chain Integration	SCI_CI	0.702	*	*
	SCI_II	0.912		
	SCI_SI	0.953		
Time to Market	TM2	0.763	0.798	0.709
	TM3	0.861		
	TM4	0.897		

In the second step of the analytic process, the first-level factors were standardized into specific values, and second-level factors were redefined as first-level factors. As for the outer loading values, Cronbach's Alpha, and Average Variance Extracted (AVE), all the values met the cutoff value from Phase 1 (Table 2); there was no need for further adjustment or correction. To assess the discriminant validity, this study followed the Heterotrait-Monotrait (HTMT) ratio of correlations that ranges below 0.9, as described by Henseler et al. (2015). By testing the HTMT coefficients, the results showed that all values of the HTMT coefficients were below 0.9, thus meaning that the constructs had discriminant validity. As a result, there is no need to elaborate on more improvements to the model because it has good empirical support for the relationship of the constructs.

Structure Model

The Structural Equation Modeling (SEM) framework quality assessment depends on testing Multicollinearity as well as R-squared (R^2) and Q-squared (Q^2) values for reliability. The main problem in executing SEM occurs when predictor variables demonstrate high interrelation because it results in inaccurate measurement of standard errors and inappropriate parameter estimates. This problem can be resolved by analyzing Variance Inflation Factor (VIF) values according to Hair et al. (2019). When VIF measures lower than three exist in a model, it indicates that multicollinearity problems are absent. The data from Table 3 shows that every VIF coefficient remains below 3, thus demonstrating that the constructs avoid substantial correlations and prevent Multicollinearity in the model. The model's robustness and reliability increase due to this validation process, which enables the proper analysis of variable

interrelations. We will use R-squared values to assess the model's explanatory power and Q-squared values to measure its predictive relevance for increased model credibility.

Table 3: VIF Coefficients

Factor	Cp	Dd	Fp	INNO	QUAL	Tm
Cp	2.034					
Dd		2.146				
GSCM	1.000	1.000	1.263	1.000	1.000	1.000
INNO				1.169		
QUAL					1.850	
SCI						1.215
Tm						1.275

The R-square (R^2) has been defined as a statistic that indicates what percentage of variance within the dependent variable is accounted for by the independent variables in the model. Hair et al. (2019) state that R^2 is interpreted based on the type of study under consideration. Following Chin (1998), the R^2 values are categorized as weak at 0.19, moderate at 0.33, and substantial at 0.67 at the firm level. Firm performance depends on the number of indicators presented in the model, and their explanatory capability is found to be moderate to strong, as the interpretations of the coefficients suggest that the research model accounts for 44% of the total variation in the data ($R^2 = 0.44$). Even though this is a satisfactory explanation, the authors admit that the firm performance could be affected by other factors, including business strategies, which have not been examined in this research. Q-square (Q^2) coefficient was used to determine the relevance of the proposed model for predictions, according to Hair et al. (2019). Regarding the model forecast capability, Q^2 values can be used when $Q^2 > 0$ means low capability power, $Q^2 > 0.25$ means medium capability power, and $Q^2 > 0.50$ means high capability power. It can be concluded that a moderate-to-high level of accuracy is evident from the obtained Q^2 value, 0.345, which shows that the developed model is reasonably good at predicting the firm's performance. These results confirm the significance of the structural model, and it can be understood that some external factors could advance.

Table 4: Direct Effects and Moderating Effect

Effect	Model 1	Model 2
GSCM → FP	0.131*	0.150**
Supply Chain Integration → FP	0.189***	0.153**
GSCM → Cost & Price	0.261***	0.261***
Cost & Price → FP	0.151*	0.165*
GSCM → Quality	0.149*	0.149*
Quality → FP	0.192**	0.169*
GSCM → Innovation	0.195**	0.195**
Innovation → FP	0.133**	0.114*
GSCM → Delivery Dependability	0.273***	0.273***

Delivery Dependability → FP	0.141*	0.133*
GSCM → Time to Market	0.286***	0.286***
Time to Market → FP	0.136**	0.133**
Moderating Effect: SCI * GSCM → FP	0.117**	0.117**

Table 4 summarizes the hypotheses of direct relationships between GSCM, SCI and FP. The results show that GSCM directly impacts FP, with a coefficient estimate of 0.131 in Model 1 and 0.150* in Model 2, which is statistically significant at 5% and 1%, respectively. Likewise, the results also show that Supply Chain Integration (SCI) positively affects FP, as represented by a coefficient value of 0.189 * in Model 1 and 0.153 in Model 2. Other major interactions also produce direct impacts on the following relationships. The result further shows that GSCM positively impacts Cost and price, Quality, Innovation, Delivery Dependability, and Time to Market, which means that GSCM enhances these competitiveness factors. All these factors have also been significant in influencing Firm Performance, thereby confirming their mediator status as shown below:

The table also investigates the influence of the moderating variable, SCI, on the GSCM-FP relation, which is also at a 1% significant level (=0.117 in both models). This could be synonymous with saying that attaining SCI has a moderating influence on GSCM on firm performance and supplies chain integration as an important influence on business performance. In all these cases, GSCM and SCI result in an enhancement in FP, with other competitive factors such as Cost and price, Innovation and TIME to Market serving to enhance the relationship. The fact that SCI is positively affected as a moderator also underlines the value of an integrated supply chain for optimizing the potential of GSCM.

Table 5: Total Effect and Mediating Effects

Effect	Model 1	Model 2
Q1: GSCM → FP	0.302*** (Supported)	0.318*** (Supported)
H2a: GSCM → Quality → FP	0.029 (Not Supported)	0.025 (Not Supported)
H2b: GSCM → Innovation → FP	0.026* (Supported)	0.022 (Not Supported)
H2c: GSCM → Cost & Price → FP	0.039* (Supported)	0.043* (Supported)
H2d: GSCM → Time to Market → FP	0.039* (Supported)	0.038* (Supported)
H2e: GSCM → Delivery Dependability → FP	0.038* (Supported)	0.036* (Supported)

Table 5 further elaborates on the findings by depicting the total effects and mediating roles of GSCM on Firm Performance (FP). In Model 1, the total effect of GSCM is 0.302*; in Model 2, it is 0.318*, and both are significant at $p < 0.001$ level. This supports the notion that GSCM is central to enhancing a firm's FP. The moderator analysis is also done on quality, innovation, cost and price, delivery dependability, and time to market. Therefore, the H2a hypothesis that asserted an indirect relationship between GSCM and FP through the variable Quality is not tenable, as Quality did not act as a mediator in this effect. However, the first part of the hypothesis was Innovation (H2b), was partially significant only in Model 1 (P= 0.026 and supported) but was insignificant in Model 2 (P= 0.022 and not supported), which tentatively

indicates that Innovation may not be very influential in the relationship but is dependent on the model specification. Other mediating relationships also bring about a very significant correlation. Thus, this study established that Cost and price (H2c) partially moderate the GSCM-FP relationship and the coefficients of 0.039 and 0.043 in both the models**. This indicates that GSCM enhances organizational firm performance by reducing cost and proper pricing strategies. Delivery dependability (H2e) and time to market (H2d) also mediate this argument, and when the supply chain operations are fast and dependable, the firm's performance is boosted. Thus, Table 5 validates that GSCM has a total impact on FP performance with partial mediation through Cost and price, TT M, and DD. Although Quality is not a mediating-remediating reality, competitive advantages do significantly impact the relation between GSCM and FP. It is evident from the above-discussed findings that cost effect, innovations, and supply chain agility are critical to enhancing the outcomes of green supply chain management. This study's results reveal a substantial interaction effect of the SCI in mediating the efficiency of GSCM ($\beta = 0.117$). This means that the relationship between GSCM and firm performance is much stronger in businesses with high supply chain integration capabilities. On the other hand, for organizations where the availability of supply chain integration is low, there are also some positive effects of enhancing GSCM. Therefore, in the context of Indonesia, it requests that a firm's GCM practices and supply chain integration be adjusted to obtain optimum performance. There is a rising trend of sustainable supply chain management in most of the manufacturing companies in Indonesia especially in industrial sectors such as textiles, manufacturing and pharmaceuticals due to several factors including but not limited to the rising awareness of environmental concerns and regulatory authorities, pressure from global markets and trade. However, it was found that the level of green practices it is all set to achieve depends on the kind of integration of supply chain processes, technology, and the kind of cooperation with suppliers and logistics partners in the case of the firms.

To strengthen the role of GSCM for firm performance in Indonesia, there should be a better network, digital integration and coordination among suppliers, manufacturers and distributors. This is even more pertinent in affecting the economy's growth in light of Indonesian infrastructure, supply chain systems and conventional trading techniques. These findings indicate that although GSCM enhancements enhance the performance of firms, a connected supply chain enhances the gains derived from such enhancements, making SCI an essential factor for Indonesia's firms.

5 Theoretical Implications

This paper aims to identify the impact of GSCM on improving the enterprise's performance with regard to internal and external GSCM practices. Hence, while looking at external factors' role in GSCM implementation, customers and suppliers have been established to play an important role. The results enrich the theoretical framework and evidence from the study on the relationship between GSCM and firm performance to substantiate the hypothesis that GSCM significantly contributes to competition advantage and increases economic, social, and environmental performance. In light of the findings, the research signpost supports the fruits of a close relationship between GSCM and firm performance. The assessment shows that GSCM enables firms to save on production costs, increase their sales revenue, serve their environmental breakthroughs, and improve the workers' welfare. These results reinforce SM. According to Lee et al. (2012), GSCM has a positive association with business structures and marketing activities like eco-design, investment in recycling, and sustainable packaging programs. In addition, the study offers a new understanding of competitive advantages as the mediators of the GSCM-performance relationship. The outlook supports Chiou et al. (2011), Azizi (2016), and Liao et al. (2015) as it indicates that GSCM improves competitive advantage in Cost and price, Delivery Dependability, and time to Market. Altogether, GSCM has less considerable implications in improving both Innovation and Quality compared to several past studies like that of Chiou et al. (2011). This implies that due to financial challenges and

concentration on the low value-added production sector in Indonesia, its business environment and especially the SMEs, may not fully embrace the concept of technology upgrading.
Supply chain integration as a regulatory factor is another important notion of the investigation. In doing so, SCI also strengthens the impact of GSCM on operational performance, which is supported (by08) and Liao et al. (2017). Effective SCI enables firms to link their internal and external operations, interact with suppliers and customers efficiently, and properly fix resources. Therefore, it would be beneficial for the businesses of Indonesia to enhance SCI, which can fill the possible gaps associated with GSCM practices.

6 Managerial Implications

This paper presents managerial implications for Indonesian or other emergent nation firms interested in improving their performance through GSCM and SCI.

Effectuating Sound Environmental Compliance In Procurement Networks

- GSCM practices suggest that businesses should improve to be a befitting commodity of environmental standards and requirements.
- Non-compliance with environmental standards has adverse effects on a business organization's performance. Therefore, it is advisable for companies to conduct adequate supplier checks and also take measures to monitor the environment.

Expanding Beyond Internal GSCM Practices

- Management should incorporate internal GSCM factors, such as production and green processes, and improve supply chain and customer interactions.
- This element makes GSCM dependent on SCI, and firms with low levels of SCI may not reap the maximum benefits of implementing GSCM.

Investing in Supply Chain Integration and Supply Chain Digitalization

- To this end, SCI posits that companies should increase their investment in advanced technological tools in SCM, including real-time tracking, the application of blockchain technology for increased transparency and intelligent automated logistics optimization systems.
- The essential goals of SCI include enhancing information exchange, enhancing cooperation with suppliers and minimizing risk in supply chain breaks.

Leveraging Competitive Advantages

- As for GSCM's role in creating competitive advantage, businesses should strive to concentrate on Cost and price, Delivery Dependability, and Time to Market.
- Hence, GSCM needs additional investment in R&D, advanced technologies and process innovation to link these strategies with higher value creation.

All of the above strategies can help businesses in Indonesia improve their competitiveness, cut expenses, and fit the framework of sustainable development.

7 Limitations and Future Research Directions

The results of this work are useful, but some limitations give directions for further studies:

- **Industry-Specific and Business Size Considerations**

The research was mainly carried out on SMEs in Vietnam and applied to the Indonesian SME sector. Future researchers should establish whether big organizations, which typically allocate more funds toward GSCM and SCI, perceive varied levels of GSCM adoption.

- **Competitive Strategy as a Driver of GSCM Adoption**

Of course, this study identifies GSCM as an enabler of competitive advantage. However, future studies can analyze how market competition and customer demands force companies to employ GSCM practices. These authors propose that external pressure from competitors and customers is key to firms' sustenance.

- **Additional Explanatory Variables in the GSCM-Performance Relationship**

The new directions to be considered for future research include: environmental orientation, market performance and regulatory pressures in determining the GSCM's impact on the firm performance.

Thus, this study makes methodological and theoretical research contributions to emerging economies' future studies of sustainable supply chain management through empirical insights into GSCM, SCI, and competitive advantages for business efficiency in Indonesia. Future research should continue enhancing the GSCM models with an understanding of the specific challenges and opportunities that the context might present and help businesses achieve performance improvements toward sustainability.

8 - Conclusion

This study establishes the relationship between Green Supply Chain Management (GSCM) and firm performance regarding increased competitive advantage and Supply Chain Integration (SCI) as the moderator. The result supports GSCM as directly impacting performance by cutting costs, delivery reliability and time to market. However, the study also reveals that this relationship is inconclusive as to the extent that GCM influenced innovation and product quality in the economies defined as having low investments and“Wellness Foot” despite technical challenges. The research also aims to establish the relevance of SCI since the results indicate that higher integration capability will gain more benefits than GSCM practices. However, other firms with a weaker SCI also reap benefits from GSCM implementation but suffer less efficiency gain. This is especially important for Indonesia because the fragmented supply chain, low level of tech advancement and other constraints limit the implementation of GSCM practices. From a managerial angle, the research indicates that compliance with environmental legislation, investing in SCI and enhancing supplier relations will help the organization gain more benefits from GSCM. In the same respect, companies must ensure the compatibility of GSCM initiatives with competitive factors such as cost, operations, and sustainability. Nevertheless, it should be noted that limitations exist because of the industry characteristics, firm size and competitive forces outside the vector model. More research should be conducted to explore these parameters and include factors such as the market and other sustainability trends. In conclusion, the present study outlines the propositions for Indonesian and emerging economy firms to implement GSCM and SCI for sustainable and long-term business strategies.

Recommendations

- Employee Development: Companies should train employees and partners in the supply chain on GSCM principles.
- Implement Use of Technology: Advanced technologies like Blockchain for enhanced transparency and IoT for efficiency can enhance the GSCM implementation.
- Facilitate technology innovation: This is about forming partnerships with vendors and carriers, which will likely be more cost-effective and efficient.
- Sustainability Metrics: The GSCM initiatives are controlled by evaluating measures; high-level, continuous objectives support enhancing corporate sustainability.

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