

## **The Mediating Role of Green Supply Chain and Supply Chain Collaborative Innovation**

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### **ABSTRACT**

*Manufacturers and consumers have become increasingly aware of the environmental impact of manufacturing and consumption. However, most businesses lack the commitment to adopt sustainable practices and transform themselves into a green business. This study aims to examine the factors that can influence sustainable supply chains within the plastic packaging industry of Thailand and formulate effective sustainable supply chain strategies. This research adopts a quantitative approach and examines 220 business operators in the Thai plastic packaging industry. Data are collected with a questionnaire and analysed using a structural equation model. Findings indicate that latent factors such as stakeholder-driven initiatives, green supply chain practices and supply chain collaborative innovation have a significant positive impact on sustainable supply chain management. In addition, the innovative use of renewable resources within the supply chain can facilitate the transformative shift in business operations and integration of economic and environmental activities to establish a sustainable industry network. The results can serve as valuable guidelines for entrepreneurs for facilitating product development, multichannel distribution, cost reductions, time efficiency and revenue growth. Future research should conduct cross-industry comparisons to analyse demand for and emphasis on green product manufacturing and explore variations in consumers' attitudes towards eco-friendly products and entrepreneurs' attitudes towards the plastic manufacturing industry.*

*Keywords: Stakeholder-driven initiatives; supply chain collaborative innovation; sustainable supply chain management; green packaging*

### **INTRODUCTION**

A change can be seen in consumer behaviour, as consumers lean towards e-commerce as demand for consumer and healthy products grows. This growth has affected the global packaging trade, which reached over USD 100 billion in the first quarter of 2021 or increased by 13%, indicating the industry's potential to grow continuously at 7.5% per year (Olatunji 2022). Thailand is the largest packaging exporter in the ASEAN, exporting 78.2% of the total exported packaging in the world, with a global market share of 1.7%. Thailand boasts technological advantages and high-quality packaging compared with its top rivals, namely, Vietnam, Malaysia and Indonesia, owing to the country's high packaging consumption, as well as consumer needs for food safety, hygiene and sustainable packaging during the COVID-19 pandemic, which are the key forces driving the expansion of the plastic packaging industry (Marinova 2021). In addition, Thailand's plastic packaging industry grows as the ready-to-eat food manufacturing industry and urbanisation expand, which can affect the development of various plastic packaging types, especially single-use packaging. However, Thailand is faced with a packaging waste crisis owing to increasing consumption and the popularity of fast food. More than half of the country's total packaging waste is from food and beverage packaging, which lacks a proper sorting and disposal system (Xu et al. 2023). A change in consumer behaviour is needed to strengthen the market and business growth to respond to the global economic recovery. Specifically, safety packaging innovations can be developed, such as packaging that can be recycled or composted using the postconsumer resin technique and 'sustainable' packaging to add value and attract consumers.

The analysis of plastic packaging use in Thailand can contribute to research on the factors driving the green industry and global environmental preservation in private and public sectors, such as campaigns for reducing or stopping the use of single-use plastic packaging and replacing it with environment-friendly bioplastic packaging (Singh & Pandey 2018). Organisations must recognise the importance of using new process technology to increase their efficiency and reduce their production costs, such as adopting best practices to increase their work efficiency and implementing new information and warehousing systems. Organisations can also employ tools for systematically tracking cargo, such as the global positioning system, and create web channels or applications for customers to express their need for sustainable product designs and services. Manufacturing organisations should adopt environment-friendly operation strategies, from upstream to downstream, for efficient packaging production, as well as supporting conditions, investment promotion measures, raw material substitution options and government measures for packaging waste management.

Researchers are realising the importance of stakeholder relationship management, sustainable supply chain management and organisational performance. Besides its effect on the environment and resource efficiency, sustainable supply chain management can benefit the industry from not only an engineering perspective but also business and marketing perspectives, which is consistent with the research of Bag and Pretorius (2020). Specifically, the authors found that the integration of technology, artificial intelligence and manufacturing management through the use of renewable energy can enhance the sustainability of the industry and the competency of the circular economy. Many organisations have begun to emphasise sustainable development and the environment, because the circular economy has indicated a change in business operations, that is, the integration of economic activities and environmental activities, including supply chain management, to create a sustainable cross-industry network. Industries that impact the environment, especially the plastic packaging industry, must consider sustainable supply chain adjustments. Previous studies identified factors that can drive organisations to develop and implement sustainable development strategies in their supply chain, such as stakeholder-driven initiatives, coupled with collaborative innovation, and green practices. Such factors can increase an organisation's competitive advantage, compliance and social responsibility. This study proposes that the implementation of integrated supply chain management will enable organisations to protect the environment and reduce their resource consumption (Li et al. 2021).

The above discussion and research findings reveal that the implementation of sustainable supply chain management may fail without clear policies. When an organisation's policies are clearly defined by the management and its strategies, it can set goals, action plans, the personnel responsible for the resource allocation and management support, including collaboration with suppliers and customers, which may result in sustainable supply chain management, as well as efficient organisation management. Such management practices must be balanced to increase the sustainability of an organisation through supply chain management. In addition, supply chain management involves the use of strategies, methods, practices and theories to effectively manage the transfer of raw materials, goods or services from one unit to another in the supply chain (Shaharudin et al. 2023). The plastic packaging industry in Thailand must enhance its management approach by emphasising supply chain management, including coordination with suppliers, manufacturers and customers; collaborative innovation within the supply chain; and the implementation of green supply chain practices. Therefore, this research aims to examine the factors that may influence sustainable supply chains in the plastic packaging industry of Thailand and determine an effective sustainable supply chain strategy. This study presents theoretical concepts related to the sustainable development of supply chain management and identifies factors relevant to a product's life cycle and supply chain management, from raw material selection and production to collaboration innovation, such as strategies or empirical factors. No previous research has established a correlation between factors that may affect the sustainable development of supply chains. Research on relevant factors can serve as a practical guide. In addition, this study examines the relationship between stakeholder-driven initiatives and sustainable supply chain management using survey data from plastic packaging business operators.

The remainder of this paper is structured as follows: Section 2 reviews the literature, evaluates the variables and develops the conceptual framework, and Section 3 describes the research methodology. Section 4 reports the results, and Section 5 provides a discussion and presents the conclusion, as well as the practical implications of the study and suggestions for future research.

## LITERATURE REVIEW

### SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Manufacturers and consumers have become aware of the environmental effects of manufacturing and consumption. Nevertheless, most businesses lack sustainability. Sustainable supply chain management is an environmental consideration for the entire supply chain life cycle, from product development, raw material selection, manufacturing, product packing, transportation, inventory management and distribution to use and product waste management, and from upstream to downstream. Besides reducing an organisation's carbon footprint, sustainable supply chain management can enhance its operational efficiency and reduce costs (Ahmed et al. 2021). The efficient integration of sustainable supply chain and organisation management involves 1) reducing business interruption risks from economic, social and environmental factors; 2) protecting the company's reputation and creating brand value; 3) reducing the cost of business operation processes; 4) increasing labour productivity; and 5) developing innovations to respond to the changes in the market.

Song et al. stated that sustainable supply chain management involves the management of economic, social and environmental factors, including effective corporate governance, throughout the life cycle of products and services, that can affect the creation of innovations to respond to the changes in the market (Song et al. 2018). Song et al. (2018) surveyed 198 small and medium-sized enterprises in India that practised sustainable manufacturing and revealed that the ultimate quantitative benefits of green manufacturing are increased motivation and brand value, reduced regulatory concerns, marketing opportunities and product efficiency development. The quantitative benefits of green manufacturing are related to cost reduction in waste management, waste classification, waste treatment, waste disposal, storage or product life cycle, transportation, packaging, manufacturing, operation or usage, maintenance or service and the total organisation expenditure. According to Shafi (2020), to implement sustainable management principles to set clear objectives, businesses must consider three aspects: the economy, the environment and society. In terms of the social aspect, the business units in a supply chain must emphasise the creation of health and safety guidelines, including the welfare of employees, partners and customers, to minimise their negative effects on society. For the economic aspect, businesses should focus on their revenue goals, costs, profits, product and service quality, efficiency and competency in responding to consumers' needs. Meanwhile, with regard to the environmental aspect, businesses must minimise the effect of their supply chain activities by reducing their pollution and waste, using natural resources to maximise their value and promoting recycling. After setting their sustainable supply chain management goals, businesses should adjust their operational guidelines. Traditional procurement methods, which may harm society and the environment, should be adjusted by negotiating for the lowest prices to enable vendors to sell their products at the lowest prices. Thus, customers can play a significant role in driving sustainable supply chain management by minimising the social and environmental effects that can influence the business units in a supply chain, from upstream to downstream, which in turn will prompt organisations to adjust their operations in response to consumers' needs and thus influence the supply chain sustainability.

### STAKEHOLDER-DRIVEN INITIATIVES

Efficient business management is the responsibility of not only the organisation but also the value chain consisting of various stakeholders. An organisation must consider stakeholders' characteristics and relationship with, emphasis on and fit with its operational strategy, because their requirements and expectations can affect its business operations. For example, stakeholders can determine the policies, directional strategies, operational plans and guidelines for organisational development, as well as opportunities for and the benefit of creating new products and services to reduce organisational risks and the negative effects on the organisation (Kitsis & Chen 2021).

Supply chain management for sustainability can result from an organisation's operations adjustment to become environment friendly to benefit society. Therefore, supply chain management refers to an organisation's efforts to manage its supply chain environment through collaboration with stakeholders to attain its goals and improve its performance. The stakeholders in a supply chain can reduce raw material import risks and ensure that the organisation performs properly and meets the quality requirements.

Nevertheless, organisational stakeholders are not only the internal staff of an organisation but also its relevant external staff, the consumers, the government and society, including the indirect stakeholders, the public sector and trade associations. Huber et al. (2008) believed that environmental protection is not an economic activity

but should be a primary regulation for sustainable economic development. Furthermore, relationship management theory emphasises that economic growth and environmental protection should support each other through the implementation of technological innovation that can lead to economic growth and environmental protection. Thus, the factors that can drive economic development and environmental preservation are not only stakeholders but also the government, technological innovation and market mechanisms. For example, the formation of a relationship with stakeholders and raw material suppliers or collaboration with the government will affect an organisation's guidelines for creating an environment-friendly image and the perception of customers and partners (Phochanikorn & Tan 2019). Based on the literature review, this study selects society, suppliers, customers and the government as the empirical variables. Moreover, based on the preceding discussion, this study proposes the following hypotheses:

H<sub>1</sub> Stakeholder-driven initiatives can influence sustainable supply chain management.

H<sub>2</sub> Stakeholder-driven initiatives can influence green supply chain.

H<sub>3</sub> Stakeholder-driven initiatives can influence supply chain collaborative innovation.

### GREEN SUPPLY CHAIN

Logistics management involves the reduction of the environmental effects of logistics activities throughout the supply chain, sources and procurement processes, product and service design, the service process, the transportation process inside and outside the organisation, consumption and life cycle management and the achievement of objectives, such as enhancing logistics activity efficiency throughout the supply chain, reducing logistics costs and improving competency in responding to consumers' needs in a timely manner. Green supply chain management is the key function of supply chain management to support the efficiency and environment-friendly life cycle of products and other manufacturing factors. Green supply chain functions include green procurement or green supply and green reverse logistics, which is reverse logistics, from the consumer to the recycling process. Numerous studies have examined the relationship between technical practices and performance efficiency, such as analyses on integrated ecological design and product life cycle to reduce environmental effects and enhance economic efficiency (Singh & Pandey 2018). Sarkis et al. (2010) stated that the creation of guidelines for environment-friendly manufacturing can reduce pollution and increase market shares by reducing a firm's negative environmental effects. In addition, reverse logistics guidelines will enable firms to reuse raw materials, energy and other resources to enhance their environmental and economic efficiency. Hanna et al. (2000) posited that the combination of the circular economy and sustainable supply chain management, especially an efficient transportation design and waste and spare material recycling, will enhance the sustainability of the circular economy. A green supply chain and sustainable supply chain management can play an important role as intermediaries in promoting environmentally responsible practices within a supply chain (Barney 1991). RBV theory emphasises the strategic importance of a firm's resources and capabilities. Green supply chain practices align with this view by treating environmental sustainability as a valuable resource and capability. As firms adopt sustainable practices, they will expand their resource base, which will contribute to their competitive advantage. Firms' strategic advantage will act as a mediator in their alignment of their supply chain with their sustainability goals. In summary, a green supply chain and sustainable supply chain management can act as mediators by advocating for environmentally responsible practices, promoting compliance, fostering efficiency, building resilience, enhancing reputation, driving innovation and ensuring the long-term sustainability of supply chain operations. The aforementioned aspects collectively strengthen the argument of their pivotal role in promoting responsible and sustainable supply chain management.

The literature review shows that stakeholders, green manufacturing and practical efficiency demonstrate differences and similarities. For example, (1) stakeholder relationships and sustainable supply chains are not examined adequately in the business domain, and (2) stakeholders are responsible for improving society through sustainable supply chain management and promoting the acquisition of economic, social and environmental benefits. Based on the literature review, this study proposes the existence of a relationship between stakeholder-driven initiatives, supply chain collaborative innovation and sustainable supply chain management and develops a conceptual research framework, as shown in Figure 1. Furthermore, this study proposes the following hypothesis:

H<sub>4</sub> A green supply chain can influence sustainable supply chain management.

## SUPPLY CHAIN COLLABORATIVE INNOVATION

Innovation is an organisation's key to maintain its profitability in using renewable resources and competitive advantage in innovation creation, such as new process innovation, new product innovation or a new concept. Innovation is the result of capitalist development, which emphasises entrepreneurs as innovators and earning from innovation, such as new products, new processes, new markets, new resources or raw materials for manufacturing, new industry organisation or being the new industry leader (Li et al. 2021). Innovation is the acceptance or implementation of a new concept in an organisation by inventing a new concept, developing a new product commercially, launching a new market or developing or creating a new process, technique or management system. Moreover, innovation is the key to organisational sustainability, especially in the manufacturing industry, service industry and related industries that must emphasise innovation and enhance their knowledge and skills (Muda 2022). Afuah (1998) defined innovation as the process of changing an opportunity into a new concept, leading to widespread implementation. Innovation can facilitate the improvement of new technical skills and knowledge to develop a new product or service. Supply chain collaborative innovation requires an information technology system and can enhance operation efficiency, processes and service by creating new organisational guidelines, such as a supply chain network, as well as reducing the complexity of structures, processes and collaboration to enhance clarity, simplify processes and share data for decision making, which can affect positive interactions (Chamsuk et al. 2015; Chin et al. 2023). Hence, this study proposes the following hypothesis:

H<sub>5</sub> Supply chain collaborative innovation can influence sustainable supply chain management.

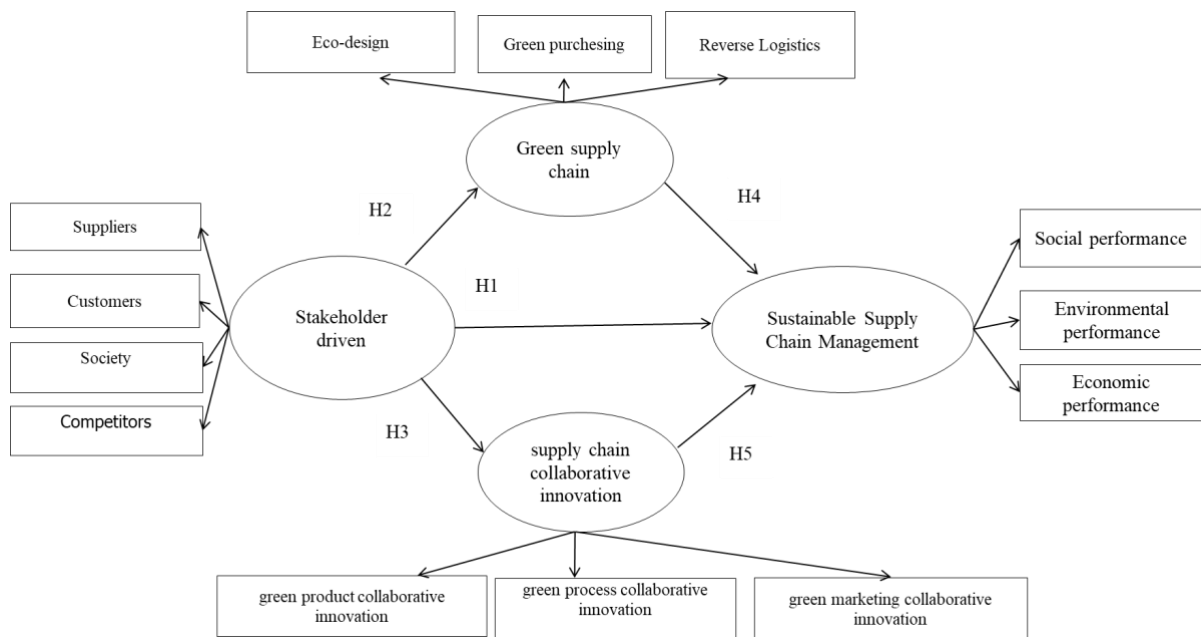


FIGURE 1. Conceptual framework

## METHODOLOGY

### DATA AND SAMPLING

This research uses a quantitative method to analyse the causal relationships between the factors. The research population is 1,067 business operators in the plastic packaging industry of Thailand. Data are collected according to the specified sample size.

1. A total of 220 samples are generated by using the following criterion: the number of variables times 20, that is,  $11 \times 20 = 220$  (Hair et al. 2010).
2. Cluster random sampling is conducted by dividing the population by 6 based on the respondents' location.

3. The proportion method is used relative to the location's population of each juristic person is used to divide the sample size.
4. Simple random sampling, with a sampling frame, is used to sample the population until the appropriate number is reached.

## DATA ANALYSIS PROCEDURES

This study conducts structural equation modelling (SEM) with AMOS version 6 for the comprehensive data analysis. CB-SEM is chosen as the analytical tool to rigorously test and validate the hypotheses (Hair et al. 2017). This methodological choice allows for a systematic examination of the relationships between the variables and offers a robust framework for confirming the theoretical underpinnings of the study. Two tests are conducted to enhance the instrument's validity and reliability. Cronbach's alpha is used to analyse the reliability of and correlation between the items, with a focus on internal consistency. Reliability analysis is conducted before the proposed model is tested, which showed a generally acceptable Cronbach's alpha value of 0.7. Confirmatory factor analysis (CFA) is conducted to test the measurement model. Then, the measurement model is evaluated using a goodness-of-fit (GoF) test. CFA is performed to evaluate and confirm the construct validity and check the consistency of the research constructs within the research model. GoF requires the model to meet the assumptions of multicollinearity, homoscedasticity and normal distribution.

Furthermore, the structural model is tested using the maximum likelihood (ML) estimation method to estimate its parameters. Amos can iteratively adjust parameter values to find the values that can maximise the likelihood or minimise the negative log likelihood. The model fit is assessed using the following fit indices: chi squared ( $\chi^2$ ), CMIN/DF ( $\chi^2/df$ ), the GoF index (GFI), the comparative fit index (CFI), the adjusted GFI (AGFI), the normed fit index (NFI) and the root mean square error of approximation (RMSEA). A good model fit indicates the alignment of the proposed model with the observed data.

## RESEARCH INSTRUMENTS

The research tool is a questionnaire with a five-point Likert rating scale. Existing questions and measurements or indicators are revised, and the issues and contexts of the causal relationships of the factors that can affect the sustainable supply chain of the plastic packaging industry of Thailand are altered. The questionnaire examines the context validity, the index of item-objective congruence and the reliability of 30 sample groups, and the Cronbach's alpha value is 0.935 (higher than 0.7), which indicates that the questionnaire is highly reliable (Hair et al. 2012; Bollen 1989). The data are analysed using descriptive statistics, the structural equation model, the ML estimation method, their conceptual consistency with the literature review findings and empirical data to find the latent factors by using the observable factors, reflective metering and convergent validity, with standard regression weights (estimate) or a critical ratio (CR) value of ( $|t| \geq 1.96$ ; Hair et al. 2012; Fornell & Larcker 1981). The GoF measures meet the accepted standard criteria.

## FINDINGS

The population or analysis data in this research are 1,067 entrepreneurs from the plastic packaging industry of Thailand who are registered with the Department of Business Development and operating in the country. The data are divided based on the location of the participants and the population size of each group into the following regions: Bangkok, north, central, northeast and south. Data are collected from the entrepreneurs until 220 samples are obtained.

As mentioned previously, this research analyses the measurement model using CFA, the consistency of the conceptual framework with the literature review findings and empirical data to measure the reliability of the factors (Hair et al. 2012). Validity is determined by using standard regression weights (estimate) or the CR value of ( $|t| \geq 1.96$ ). The standard regression weight is over 4.0, and the  $R^2$  value is not less than 2.0. The structural equation model is analysed using the ML estimation method to examine the latent factors by using the observable factors, reflective metering and the GOF measures. The analysis techniques used for all the factor variations or empirical factors are consistent with those used for theoretical factors in the literature. The consistency of the conceptual framework and the empirical data is assessed using the accepted standard criteria (Hair et al. 2012). After the modification index is considered and adjusted, the analysis yielded the following model fit values: chi squared (

$\chi^2$ ) = 58.832, df = 46, p = .097, CMIN/DF ( $\chi^2$  /df) = 1.279, GFI = .975, CFI = .996, AGFI = .951, NFI = .981 and RMSEA = .028. The model of factors that can affect the sustainable supply chain of the plastic packaging industry of Thailand demonstrates satisfactory GoF index values (Schumacker & Lomax, 2010), as shown in Tables 1-3 and Figure 2.

TABLE 1. Determination of sample size

Fit index	Symbol	Criterion	Result
Chi squared	$\chi^2$	Ns (p > .05)	58.832 (p = .097)
Relative chi squared	$\chi^2$ /df	< 2.000	1.279
GFI	GFI	>.90	.975
CFI	CFI	>.95	.996
NFI	NFI	>.90	.981
AGFI	AGFI	>.90	.951
Standardised root mean square residual	Standardised RMR	<.05	.019
RMSEA	RMSEA	<.05	.028

Table 2 shows that stakeholder-driven initiatives has a standard regression weight of .484-.858 and an R<sup>2</sup> value of .235-.737. Green supply chain has a standard regression weight of .756-.792 and an R<sup>2</sup> value of .572-.628. Supply chain collaborative innovation has a standard regression weight of .793-.829 and an R<sup>2</sup> value of .629-.688. Sustainable supply chain management has a standard regression weight of .750-.842 and an R<sup>2</sup> value of .562-.708. The weight standard of all the elements is significant at the 0.05 level.

The structural model reveals three latent factors that can explain 99.30% of the variance in the plastic packaging industry of Thailand, namely, stakeholder-driven initiatives, green supply chain and supply chain collaborative innovation.

TABLE 2. Analysis results of structural equation model and relationships between variables

	Relationships between Variables	Standard Regression Weights	SE	R <sup>2</sup>	CR	p
Green SC	<--- Stakeholder-driven initiatives	.844	.075	.713	11.838	***
SC collaborative innovation	<--- Stakeholder-driven initiatives	.671	.060	.451	9.827	***
Sustainable SCM	<--- Stakeholder-driven initiatives	.400	.087	.993	4.669	***
Sustainable SCM	<--- Green SC	.355	.119		2.912	.004
Sustainable SCM	<--- SC collaborative innovation	.322	.091		4.082	***
SD1	<--- Stakeholder-driven initiatives	.710		.505		
SD2	<--- Stakeholder-driven initiatives	.856	.063	.733	17.684	***
SD3	<--- Stakeholder-driven initiatives	.858	.076	.737	14.493	***
SD4	<--- Stakeholder-driven initiatives	.484	.070	.235	8.501	***
GSC1	<--- Green SC	.792		.628		
GSC2	<--- Green SC	.778	.059	.605	14.435	***
GSC3	<--- Green SC	.756	.062	.572	14.896	***
Sustainable1	<--- Sustainable SCM	.814		.663		
Sustainable2	<--- Sustainable SCM	.750	.046	.562	18.837	***
Sustainable3	<--- Sustainable SCM	.842	.059	.708	17.607	***
IN3	<--- SC collaborative innovation	.802	.074	.643	15.585	***
IN2	<--- SC collaborative innovation	.829	.067	.562	16.192	***
IN1	<--- SC collaborative innovation	.793		.708		

Note: \*\*\* p < .001 indicates level of statistical significance; SC = supply chain; SCM = supply chain management

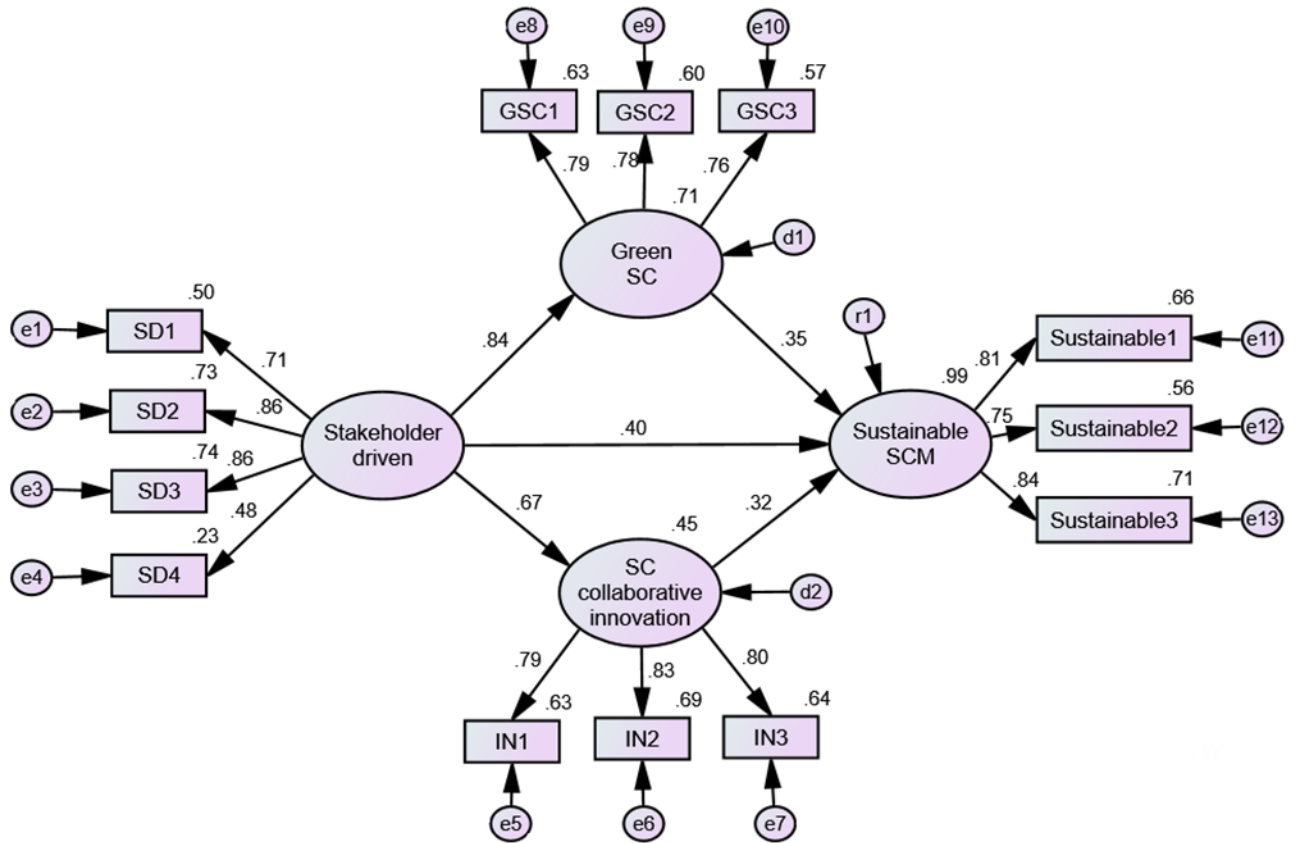


FIGURE 2. Final model

Chi squared ( $\chi^2$ ) = 58.832, df = 46, p = .097, CMIN/DF ( $\chi^2$ /df) = 1.279, GFI = .975, CFI = .996, AGFI = .951, NFI = .981 and RMSEA = .028.

### HYPOTHESIS TESTING

The determination and evaluation of the relationship between pairs of factors and their influence by considering the CR (t-value) and p-value reveal the coefficient value of each relationship proposed in the research hypotheses and that the CR value of all the factors is more than 1.96. Thus, the analysis results support all the hypotheses. The analysis results of the effect size of the factors are shown in Table 3.

TABLE 3. Results of research hypothesis testing

Hypothesis	Coef.	T-test	TE	DE	IE	Test Results
H <sub>1</sub> : Stakeholder-driven initiatives--> Sustainable SCM	.400	4.669	.916	.400	.516	Supported
H <sub>2</sub> : Stakeholder-driven initiatives --> Green SC	.844	11.838	.844	-	-	Supported
H <sub>3</sub> : Stakeholder-driven initiatives --> SC collaborative innovation	.671	9.827				Supported
H <sub>4</sub> : Green SC--> Sustainable SCM	.355	2.912				Supported
H <sub>5</sub> : SC collaborative innovation--> Sustainable SCM	.322	4.082				Supported

Note: Coefficient refers to the beta coefficient ( $\beta$ ); TE- total effects, DE- direct effects, IE- indirect effects, Coef.- coefficient, SC- supply chain, SCM- supply chain management

H<sub>1</sub> proposes that stakeholder-driven initiatives have a positive effect on sustainable supply chain management, which is supported by the path coefficient of 0.400 (t-test = 4.669, p < .001). The direct and positive effects of sustainable supply chain management through green supply chain and supply chain collaborative innovation are significant (total effects = .916).



Meanwhile, H<sub>2</sub> proposes that stakeholder-driven initiatives can affect the green supply chain, which is supported by the path coefficient of 0.844 (t-test = 11.838, p < .001). H<sub>3</sub> proposes that stakeholder-driven initiatives can affect supply chain collaborative innovation, which is supported by the path coefficient of 0.671 (t-test = 9.827, p < .001). H<sub>4</sub> proposes that the green supply chain can affect sustainable supply chain management, which is supported by the path coefficient of 0.400 (t-test = 2.912, p < .01). Finally, H<sub>5</sub> indicates that supply chain collaborative innovation can affect sustainable supply chain management, which is supported by the path coefficient of 0.400 (t-test = 4.082, p < .001).

## DISCUSSION

The analysis of the factors that can affect the sustainable supply chain of the plastic packaging industry of Thailand reveals that the latent factors, namely, stakeholder-driven initiatives, green supply chain and supply chain collaborative innovation, have a positive effect on sustainable supply chain management and are statistically significant. The three latent factors can explain 99.30% of the variance in the sustainable supply chain of the plastic packaging industry of Thailand. In addition, stakeholder-driven initiatives have direct and indirect effects on sustainable supply chain management through the green supply chain and supply chain collaborative innovation, with a total effect of .916. Innovation development through the use of renewable resources in the supply chain indicates a change in business operations towards integrating economic and environmental activities to implement supply chain management to create a sustainable industry network throughout the supply chain, which is consistent with the findings of Giudice et al. (2020), who stated that high profits can be earned by updating the manufacturing process and developing product design innovation with environment-friendly raw materials. Moreover, many organisations have emphasised sustainable and environment-friendly development, which is consistent with the findings of Afuah (1998), who defined innovation as the process of changing an opportunity into a new concept, leading to widespread implementation. Innovation can facilitate the creation of new technical skills and knowledge to develop a new product or service. Supply chain collaborative innovation requires an information technology system and can enhance operation efficiency, processes and service by creating new organisational guidelines and responding to sustainable supply chain development for the economy, society and the environment. The findings are also consistent with the findings of Afum et al. (2020), who observed a link between green manufacturing, competitive competency, reputation and sustainable effectiveness (Afum et al. 2020). The findings reveal that green collaborative innovation has a direct and significant effect on the efficiency of society, the economy and the environment.

Furthermore, the factors of green supply chain performance have a positive effect on the factors of stakeholder relationships. For example, in determining the supply chain strategy, the relationship between suppliers and customer should be linked with the relationship between various departments, manufacturers, suppliers and customers to understand and respond to consumers' needs (Rashid & Shaharudin 2017). This study underscores the importance of diminishing organisations' environmental effects through the reduction of resource consumption and emissions. To achieve such objectives, organisations must alter existing product designs and/or processes to mitigate the negative environmental impact throughout the different stages of a product's life cycle. Thus, the adoption of green innovation has become essential. Although designing a completely new product can be challenging, many companies have demonstrated increased willingness to embrace green innovation by implementing changes in their production and logistics processes, without completely redesigning their products.

Moreover, the findings strongly indicate that a stakeholder-driven approach can have a significant impact on supply chain collaborative innovation (Siems et al. 2023). The influential role of stakeholders is evident in organisations' meticulous incorporation of stakeholders' needs, alignment with their values, proactive facilitation of communication, strategic risk mitigation, fervent promotion of open innovation, steadfast support for sustainability, earnest encouragement of inclusive decision making and deliberate cultivation of trust and relationships in the entire supply chain.

The findings also reveal that supply chain management, combined with environmental elements, is a key factor that can influence an organisation's environment, supply chain activities, sustainable performance development and strategy formulation. The implementation of a supply chain will benefit the environmental cooperation of companies and manufacturers to create green innovations that can improve their environmental performance and competitive advantages. However, the results of this research are based on the opinions of business operators in the plastic packaging industry at a certain period of time; thus, changes in economic conditions, exchange rates and so on may result in discrepancies in the research findings.

This study shows that guidelines for developing the plastic packaging industry can lead to business success in the following aspects: development of products and multiple distribution channels, time and cost reductions and savings and revenue growth by make a profit. Effective management can facilitate continuous product development and planning to control the cost of raw materials for manufacturing, which can be measured using expenses minus sales revenue. In addition, budgeted expenditures can be set and processed with sales by setting expenses in KPIs, including exploring orders to be received monthly and procuring high-quality raw materials at low cost, as specified and planned. Furthermore, a backup plan should be created, such as planning stock replacements and stock suppliers in advance, to increase quality and reduce waste.

## CONCLUSION

This study on a sustainable supply chain for Thailand's plastic packaging industry highlights three pivotal factors as the main contributors: stakeholder-driven initiatives, a green supply chain and supply chain collaborative innovation. Stakeholder-driven efforts can have direct and indirect positive effects on sustainable supply chain management through a green supply chain and collaborative innovation. This study underscores the significance of the creation of a green supply chain through the integration of social, economic and environmental activities and their alignment with prevailing market trends. Supply chain collaborative innovation supported by information technology systems is crucial for enhancing sustainable supply chain development across economic, social and environmental domains.

Furthermore, this study reveals a connection between green performance factors and stakeholder relationships and emphasises the importance of aligning supply chain strategies with interdepartmental relationships to understand and address consumers' needs. This study also finds that stakeholder-driven initiatives play a crucial role in influencing and shaping supply chain collaborative innovation within an industry. The RBV management framework emphasises the role of a company's internal resources and capabilities for achieving sustainable competitive advantages. Moreover, when applied to the plastic packaging industry, it can raise awareness and leverage unique internal resources and capabilities to create competitive advantages in innovation, sustainability, efficiency and customer relationships. Therefore, companies that strategically manage their resources to align them with market demands will likely thrive in the changing landscape of the plastic packaging industry.

This study provides tailored guidelines for entrepreneurs in the plastic packaging industry that emphasise continuous product development, optimised distribution channels, cost reductions, time efficiency and revenue growth. Effective management practices include meticulous cost control, strategic budgeting and discernment of raw materials. Proactive measures, such as estimating monthly orders, securing affordable high-quality raw materials and implementing backup plans, are recommended for organisations to enhance their product quality, reduce their waste and ensure their long-term business success.

Future research should conduct comparisons across diverse industries to analyse the emphasis on and demand for green product manufacturing. In addition, variations in consumers' attitudes towards green products should be explored. Other aspects of entrepreneurs' attitudes towards plastic manufacturing industries should be examined, including positive and negative aspects. Factors that can influence product production, such as responsiveness to demand, concreteness, reliability, customer confidence, environmental understanding and awareness, should also be investigated.

The implementation of logistics management is crucial for reducing the environmental impact of logistics activities throughout a company's supply chain. Encouraging all the stakeholders in a supply chain to reduce their waste during production, adhere to regulations to reduce their environmental impact, optimise their use of packaging materials to cut production costs and decrease their transportation-related heat and greenhouse gas emissions is vital. This study also recommends reusing products to create new value. Such practices will significantly enhance the effectiveness of circular economy principles, especially when influenced by environmental logistics factors. Furthermore, entrepreneurs can enhance the positive impact of such practices by integrating environment-friendly strategies into their organisational management.

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