Green Supply Chain Management and Managing the Green Enterprise Affecting Performances in Auto-Parts Manufacturers in Thailand

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Abstract

The purpose of this quantitative study on Green Supply Chain Management and the management of green enterprises affecting performances in auto parts manufacturers in Thailand was to answer the guiding research question: Is there a significant relationship between Green Supply Chain Management practices and the performances of auto parts manufacturing companies in Thailand? The literature review revealed that the relationship between Green Supply Chain Management practices and the performances of auto parts manufacturing companies in Thailand had not been sufficiently explored despite the urgent industry need for these studies. As a methodological approach, SEM modeling was used to collect data from up to 400 respondents in the Thai car manufacturing industry from industrial estates in the provinces of Bangkok, Pathum Thani, Ayutthaya, Chonburi, and Rayong. The findings reveal that managing green enterprises significantly enhances performance and supports Green Supply Chain Management, which, in turn, positively impacts the performance of auto parts manufacturing companies in Thailand.

Keywords: Auto-parts Manufacturers, Green Supply Chain Management, SEM Modelling, Logistics activities, Thailand

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Introduction

The concept of sustainable development has gained immense attention in recent times. With growing concern about environmental degradation, companies are adopting various strategies to reduce their environmental impacts while improving performance. One such strategy is Green Supply Chain Management (GSCM), which integrates environmental considerations into supply chain management practices. GSCM involves developing sustainable sourcing strategies, designing eco-friendly products, optimizing transportation routes, and reducing waste throughout the supply chain.

Several studies have explored the relationship between GSCM and performance, but the findings are not entirely obvious. Many studies suggest that GSCM positively affects performance. Therefore, this study aims to examine the relationship between GSCM and performance in the context of the manufacturing industry. The manufacturing industry has been chosen as the context for this study because it is one of the significant contributors to environmental degradation. Furthermore, manufacturers face increasing pressure to adopt sustainable practices due to increasing regulatory requirements, stakeholder expectations, and competitive pressures.

The study was conducted using quantitative research design. Data was collected through a survey questionnaire administered to a sample of auto parts manufacturing companies in Thailand. It is essential that the automotive and auto-parts industries are under the law of emission. According to the law issued by the Excise Department in 2022, cars with less than 100 grams per kilogram of CO_2 emission have 13% of tax payment. In another class, cars using the same size of cylinder with more than 200 grams per kilogram of CO_2 emission have 34% of tax payment. The laws urge companies in these industries to implement GSCM. Interestingly, GSCM should have positive impacts on their performances in order that they can compete with fierce rivals. In this study, the existence of this impact needs to be proven. The questionnaire comprised questions about GSCM practices and performance measures. SEM was used to analyze the data and test the research hypotheses. The findings of this study contribute to the existing literature on GSCM and performances by providing empirical evidence on the relationship between two concepts of Green Supply Chain Management practices and the performances of auto parts manufacturing. The results of this study were also helpful for manufacturing companies considering implementing GSCM practices to improve their performances while reducing their environmental impacts.

Research Objective

This study aims to explore the relationship between Green Supply Chain Management (GSCM) practices and financial performance in the manufacturing industry. Specifically, this study aims to:

1. Identify the extent of GSCM practices adopted by Thailand auto parts manufacturing companies.

2. Examine the relationship between GSCM practices and the performances of Thailand auto parts manufacturing companies.

3. Investigate the relationship between managing the enterprise and the performances of Thailand auto parts manufacturing companies.

4. Provide insights and recommendations for Thailand manufacturing companies on adopting GSCM practices to improve their performance while reducing environmental impact.

Scope of the study

This study focuses on examining the influence of Green Supply Chain Management (GSCM) practices and the management of green enterprise initiatives on the performance of auto-parts manufacturers in Thailand. The scope of the research is defined by the following dimensions:

1. Auto-parts industry scope: The research is specifically targeted at the auto-parts manufacturing sector in Thailand, which plays a critical role in the country's industrial economy and faces increasing pressure to adopt sustainable and environmentally friendly practices.

2. Content Scope: The study investigates two primary constructions:

- Managing Green Enterprise, which includes policy deployment across all organizational levels, cross-functional team collaboration, the formation of strategic partnerships, and compliance with international environmental standards.
- Green Supply Chain Management (GSCM), covering six key practices: collaborative product design with suppliers, green purchasing, green production, green delivery, green consumption, and reverse logistics.

The research seeks to understand how these constructs individually and collectively impact organizational performance, measured in terms of financial outcomes, environmental performance, and market competitiveness. Lastly, the study is grounded in the Resource-Based View (RBV) theory, which provides a framework for analyzing how internal capabilities and strategic resources—specifically green initiatives—can contribute to achieving sustainable competitive advantage and superior organizational performance.

Relationships among variables in this study

Green culture can support GSCM. The organization aims to enhance key areas, such as training programs, information technologies, incentives (Lunga & Pooe, 2024, pp.1-25). Also, the organization focusing on sustainable practices can improve its financial performances, such as return on asset (ROA) (Pham et al., 2021, pp.1-18).

H1: Managing the green enterprise affects the performance of Thailand's auto parts manufacturing companies. Culture of the organization as the key factor affects the success of GSCM. The organization can go beyond business strategies such as expanding its market (Iddik, 2024, pp.96-122).

H2: Managing the green enterprise affects Thailand auto parts manufacturing companies' green supply chain management. Implementing GSCM in producers can increase environmental, economic & operational performances. Operational performance can have an effect on organizational performance (Green et al., 2012, pp. 290-305). In addition, using technologies supporting green practices are the global trend that urges the businesses to keep relying on green policies and to use green resources for increasing overall performances (Samad et al., 2021, p.1).

H3: Green supply chain management affects the performances of Thailand auto parts manufacturing companies.

Conceptual framework

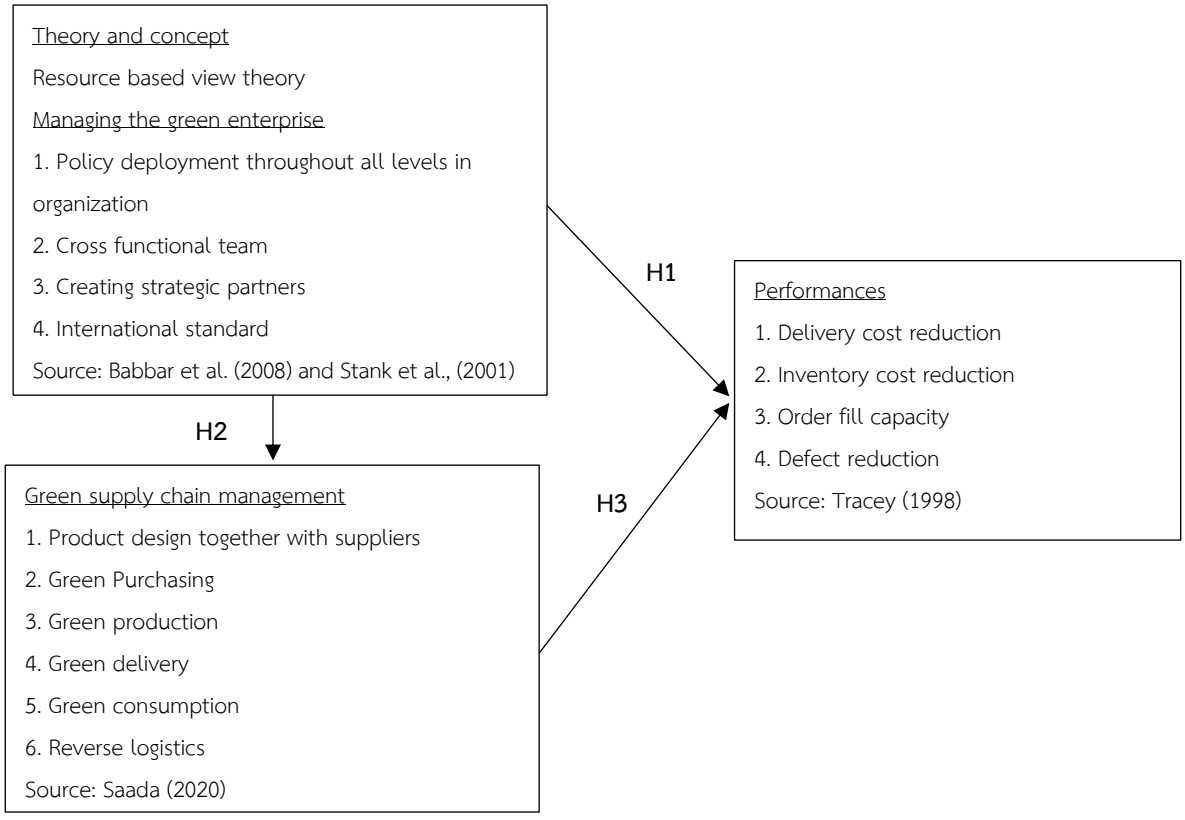


Figure 1 Conceptual framework

Figure 1 presents the conceptual framework of this study, which is grounded in the Resource-Based View (RBV) theory. RBV emphasizes the strategic importance of leveraging an organization's unique resources and capabilities to achieve a sustainable competitive advantage. Within the context of this research, RBV serves as a lens to explain how the effective management of green enterprise initiatives—such as eco-friendly practices and green innovations—and the implementation of green supply chain management (GSCM) practices—including sustainable sourcing, logistics, and production—can enhance organizational performance in terms of cost efficiency and market positioning, particularly within the auto-parts manufacturing sector.

The application of RBV in this study focuses on analyzing how specific green capabilities and practices within the supply chain contribute to sustained competitive advantage, thereby improving both financial outcomes and environmental performance.

The proposed conceptual framework comprises two main constructions: Managing the Green Enterprise and Green Supply Chain Management. The construction of Managing the Green Enterprise includes the following dimensions: (1) policy deployment across all organizational levels, (2) cross-functional teams, (3) the development of strategic partnerships, and (4) adherence to international standards (Babbar et al., 2008; Stank et al., 2001). Furthermore, the Green Supply Chain Management construct encompasses six key dimensions: (1) product design in collaboration with suppliers, (2) green purchasing, (3) green production, (4) green delivery, (5) green consumption, and (6) reverse logistics (Saada, 2020, p.1)

Literature review

The purpose of the literature review is to provide an overview of the latest literature on Green Supply Chain Management (GSCM) due to its relevance in the study context. As presented in Figure 2, a supply chain is concerned with activities that serve customers' needs. From the upstream to downstream of the supply chain, the flow of raw materials & products and information sharing are essential (Ling, 2007, p.1). The companies in the supply chain are involved with designing, producing, and delivering products. A company's success in the supply chain depends on others' operations. Interestingly, a company can be in multiple supply chains and have different roles in different supply chains (Hugos, 2011, p.20).

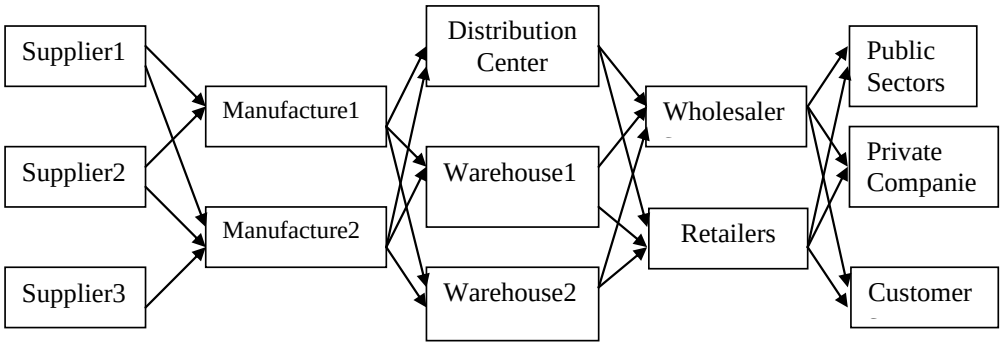


Figure 2 Supply chain diagram

Source: Simchi-Levi (2003, p.92)

Supply chain management.

In effectively managing the supply chain, four parts, as presented below, must be focused on: internal activities, the supply network, customers, and the flows, as presented in Figure 3. Supply chain management needs the partners' corporative actions, such as decision-making logistics activities (Ling, 2007, p.9). The internal supply chain comprises the following activities within the companies' boundary: sourcing, production, and distribution. Sourcing or purchasing departments must evaluate suppliers, select the best deals, and complete purchasing transactions. Production teams need to control costs and product quality. The distribution department needs to focus on how finished goods can be delivered to customers on time. Obviously, most manufacturers are operating internal processes. Large suppliers with the complexity of material fabrication need to be concerned with these activities as well.

Outside the organization's boundary is defined as the external supply chain. First, the supply network (tier1, tier2, tier n) is at the beginning part of any supply chain. Suppliers are responsible for providing manufacturers with raw materials or part components. Suppliers of suppliers are also included in the network. Second, customers are the following organizations in the supply chain or the end users. As the manufacturers' customers, distributors have roles in preparing packages and selecting experienced logistics providers to deliver finished goods to retailers or end users. Distribution managers need to set the plans together with these logistics' providers. End customers should receive products with high service levels and valuable information facilitating their buying process.

The supply chain has the flow of raw materials & products, services, information, and funds as in the last part of this diagram. The integration via Internet-based technologies is beyond the boundaries among supply chain partners. Many companies are operating without supply-chain knowledge. Using a traditional management approach can cause waste in production and

customer dissatisfaction. To survive in the fierce competition, they must start and keep developing internal and external supply chain management. Lockamy III & McCormack (2004, p.276) demonstrated that supply-chain maturity as the indicator for supply-chain development was concerned with the SCOR model ("plan," "source," "make," "deliver," and "return").

Managing Green Enterprise

One of the management models is the strategy formulation process

1. Policy deployment throughout all levels of the organization. Organizational policy aligned with supply chain goals impacts supply chain performances in developing nations (Babbar et al., 2008, p.247). Policies from top executives also affect supply chain performance (Yan & Child, 2004, p.296). It is essential that employees at all levels share ideas to create an action plan to achieve organizational goals. These employees are responsible for the projects in the action plan. In Japanese, policy deployment is the term of Hoshin Kanri, which means shining needle as the tool to give direction. By implementing the right strategy, the company and its supply chain can work together more effectively.

2. Cross-functional management team. Employees from various departments form this team to have a joint goal, share ideas, and work together. The team members can effectively communicate with each other. Companies should improve internal collaboration to improve logistics performances. This results in cooperative activities and information exchanges (Stank et al., 2001, p.39) Areas of internal collaboration are 1) creating the database for the company, 2) exchanging operational information among all teams, 3) sharing internally both standardized and customized information, 4) giving feedback to all teams about integrated logistics performances, 5) introducing assessment and reward systems for activities of integration.

3. Creating strategic partners. Any company needs to work with its suppliers and business partners. Serving customer demands requires a customization strategy. Customers want to design the products themselves, and product models are more complicated. Supply chain members need expertise in their functions to achieve customer satisfaction. They can deliver the right products and services to succeed in the long run. Areas of external collaboration are: 1) sharing operational information with business partners, 2) creating performance measures for all companies, 3) integrating operations in the supply chain to improve performances, 4) sharing rewards and risks among supply chain members, 5) enhancing operational flexibility in the supply chain, 6) adopting good processes and sharing results with business partners.

4. International standard. ISO, which stands for the International Organization for Standardization, is an independent and international organization. Skillful people from various areas create manuals for high working standards. The standards can ensure that customers will be satisfied with the company's product. Its service is of a high quality. The executives can run the company with high ethics and sustainable business strategies. This standard will provide guidelines for environmentally friendly purchasing and procurement. The company can issue high-quality policies.

Green Supply Chain

Green supply chain management (GSCM) is environmentally friendly and can improve financial management (Saada, 2020, p.1). The company can create green products and marketing concepts.

Figure 3 The cycle of green supply chain and its relationship with green transportation.

The green supply chain cycle involves eco-friendly practices from sourcing to disposal. Green transportation, a key part of this cycle, uses low-emission vehicles and efficient logistics to reduce environmental impact. Together, they support sustainability across the supply chain according to the study of Vithayaporn et al. (2022, p.5). The practices are presented as the following.

1. Green transportation and distribution. Transportation costs are a significant portion of the overall logistics cost. This activity can help reduce production costs.

2. Green procurement. This activity needs to follow the purchasing policies on environmental approaches. Green purchasing covers all of these elements: purchasing raw materials and goods that meet the guidelines, evaluating these items before making the decision, and supporting the suppliers to revise their work procedures to comply with green regulations.

3. Green warehouse. Warehousing is one of the highest logistics costs. Having adequate stocks can reduce the costs of production and delivery. However, the warehousing facilities must be renovated to support operations and meet green policies.

4. Green design. This activity involves designing products that are concerned with environmental conservation. The design helps create a safe and clean workplace by focusing on reducing waste and health risks. However, product & service qualities and production productivity are top priorities, along with public relations as a tool to promote the organization. Interestingly, the organization can strongly reduce environmental impact with green management practices.

5. Green production. Any organization wants to operate at a high-efficiency level. Its production process will produce low amounts of waste and pollution. KPIs for the output are the percentage of defects, scraps, and cases of reworks. Machines and equipment will release minimal pollution throughout the machine's life. With green concepts, the production department can reduce the costs of purchasing and delivery.

Nowadays, international marketing needs to use the concept of green marketing. The organization focuses on responding to customer needs with green ideas, which will support the organization's entry into the international market. The green marketing components are product design, promotion, price, selling to the green market, and positioning.

Key performance indicators for logistics activities

The organization's main activities are warehousing, purchasing, delivering, and forecasting. Tracey (1998, p.72) classified logistics processes into three areas: physical supply (PHS), physical distribution (PHD), and logistics spanning processes (LSP). These areas are presented below.

1. Physical supply: inbound transportation, material warehousing, inventory control (inputs), production support

2. Physical distribution: finished goods warehousing, inventory control (outputs), packaging, outbound transportation

3. Spanning processes: purchasing, participation in the strategy.

Lists of leading key performance indicators for logistics activities

1. Transportation. It is the activity of moving materials or products from one location to another. Materials can be moved from storage areas to production lines or products can be taken from storage areas to customers' sites using trucks. Transportation is vital. Significantly, the transportation schedule can be adjusted when inventory levels are

inadequate to serve customers. Delivery time affects inventory levels carried by producers and suppliers. They have high inventory costs in the long delivery lead time. Therefore, the inventory costs of the whole supply chain are affected by the delivery lead time. Reliability is the consistency of delivery times. Receiving on -time receiving and delivery can help producers and suppliers increase service levels and cut delivery costs. If a supplier cannot deliver on time, the producer must have a high inventory level. This approach is called risk management.

Accessibility is the skill of delivering products from the origin to the destination. It is better to use direct delivery to serve the customer on time. Controlling transit time and costs is challenging if the product delivery needs to change trucks along the way. Capability is the ability to respond to customers' special requirements. The delivery team needs flexibility regarding truck spaces, facility types, and ITs to survive in fierce competition. For example, some products must be kept in controlled storage. Therefore, the truck fleet needs to have a refrigerated system for perishable products to maintain product quality. In this case, the IT system helps the company deliver products on time. All manufacturers need to be concerned about security. During product delivery, pallets or packaging are needed to protect products from damage. Also, product loss is unacceptable for customers, who may not buy from that manufacturer again. To ensure good security, the delivery department should have a procedure and use technologies to prevent human errors.

2. Demand fulfillment. It is finding the way and setting a plan to serve customers' needs. The company needs to give customers the promised date, which is affected by delivery lead-time and on-time delivery. Demand fulfillment is related to production and purchasing processes. The supply chain can be separated into two parts: 1) upstream, driven by demand forecasting, and 2) downstream, driven by customer orders (Fleischmann & Meyr, 2004, p.311). In order to generate sales revenues, demand fulfillment can be classified as quantity and price approaches. The quantity approach categorizes customers by their purchasing orders and prioritizes them. The price approach must change prices to compensate for fluctuating demands (Talluri & VanRyzin, 2004, p.26).

Demand fulfillment and capacity usage result in customer satisfaction and sales growth. In addition, demand fulfillment is not an easy task because of significant product volumes, high demand uncertainty, and long launch periods. Good management practice can help match supply to demand. The organization can use its total capacity to generate the highest sales revenues (Chien et al., 2013, p.294).

The review of the existing literature revealed that no works were studying the relationship between Green Supply Chain Management practices and the performances of auto parts manufacturing companies in Thailand. However, understanding this relationship matters as the car manufacturing industry is heavily affected by industrial approaches to producing more environmentally friendly automotives (Bockin & Tillman, 2019, p.980). Hence, there is an urgent need for further research on the subject of study.

Methodology

Research Design: A quantitative research design, specifically a survey method, can be used to collect numerical data on green supply chain management practices, managing the green enterprise, and performance. The population in this study is auto parts manufacturing companies located in the industrial estates in Bangkok, Pathum Thani, Ayutthaya, Chonburi, and Rayong provinces. The respondents who can give essential information about this research topic are company employees who are section managers or above. Moreover, the sample size is calculated by the formula of Cochran (1953, p.30), $n = P(1-P)Z^2/d^2$. In this case, proportion (P) = 0.5, Z-score (Z) =1.96 (as the confidence level of 95%), and the acceptable error range (d) = 0.05. From the calculation, the n value is 384.16. The sample size of this study is up to 400 respondents.

This study employs a convenience sampling method to collect data from managerial-level respondents within auto-parts manufacturing firms in Thailand. Convenience sampling is a non-probability sampling technique that involves selecting participants who are readily accessible and willing to participate in the research.

The primary rationale for using convenience sampling in this study is **the practical** difficulty in accessing managerial-level respondents. Managers and executives in business units often have limited availability due to their demanding roles and responsibilities, making it challenging to gather data through random or probability-based sampling methods. Additionally, obtaining a comprehensive list of all managers within the target industry is not always feasible due to privacy concerns and organizational policies, further limiting the possibility of employing probability sampling techniques.

By utilizing convenience sampling, the study ensures that data can still be collected from relevant respondents who possess the necessary knowledge and experience related to green enterprise management and green supply chain practices. Despite its limitations in terms of generalizability, convenience sampling is considered acceptable for exploration research and studies where the primary objective is to gain insights from specialized, hard-to-reach populations.

Moreover, convenience sampling allows for more efficient use of time and resources, facilitating the timely completion of data collection while still maintaining a focus on respondents who can provide valuable and informed perspectives on the research topic.

The questionnaire packages were distributed by e-mail to the companies located in the industrial estates in all the provinces mentioned above. An online questionnaire format was another option to reduce the data collection time.

Research instrument: Data was collected through a closed-ended and open-ended survey questionnaire. The questionnaire was designed to collect data on company profiles, organizational policies, green supply chain management practices, and performances. To provide information for participants, the first page of the questionnaire has a "Remark." The respondents learned about 1) this research topic. 2) who the researcher is, and 3) that their personal information is protected. 4) that all collected data is only used for academic purposes. Next, this questionnaire has four parts to collect the following data: 1) company profiles as nominal data with six questions 2) managing the green enterprise as interval data with four questions 3) green supply chain management practices as interval data with six questions 4) performances as interval data with four questions and 5) more opinion about related topics that use open-end questions. The questionnaire in this study used a 7-point Likert scale format. The rating scale comprised 1 (exceptionally low), 2 (low), 3 (slightly low), 4 (Moderate), 5 (slightly high), 6 (high), and 7 (exceedingly high).

The pilot test was employed. The draft version of the questionnaire was answered by at least 30 respondents who are executives in Thailand automotive parts manufacturing companies. Gathering their feedback on each question helped create the final version of the questionnaire. To confirm the reliability of questions, the Cronbach's Alpha value needs to be higher than the recommended value (0.700).

Data Analysis: the researcher needed to check the completeness of answers in each returned questionnaire. Each question needed to be coded in order to facilitate entering the data into a computer program. The computer program was used to analyze data. The data collected was analyzed using statistical methods. Confirmatory Factor Analyses (CFA) was to test whether the model is fit; the following statistical tools in Table 1 are implemented: In the first part, descriptive statistics summarized the data collected. In the second part, inferential statistics were used to test all hypotheses. Correlation analysis was used to measure the relationship between green supply chain management practices and performances, as well as the relationship between managing the green enterprise and performance.

Table 1 Statistical tools for checking model fit

No.	Statistical Tools	Name of Tools	Recommended Values	References
1.	χ^2/df	Reduced Chi-Square statistics	< 5	Hu & Bentler (1999)
2.	CFI	Comparative Fit Index	> 0.90	Bentler (1990); Hair et al. (2006)
3.	TLI	Tucker-Lewis Index	> 0.90	Bentler (1990); Hair et al. (2006)
4.	IFI	Incremental Fit Indices	> 0.90	Bentler (1990); Hair et al. (2006)
5.	RMSEA	Root means square error of approximation	< 0.08	Bentler & Bonett (1980)

Overall, the study's methodology is rigorous and systematic to ensure the validity and reliability of the findings. It also aligned with the research questions and objectives and provided empirical evidence on the effects of green supply chain management practices and organizational policies on performance.

Results

In the survey process, the number of distributed questionnaires was 800, and the number of returned questionnaires was 445. So, the response rate was 55.63%. However, 400 sets of completely filled-out questionnaires were used in the data analysis. To ensure internal consistency of the constructs in this study—namely Green Supply Chain Management, Green Enterprise Practices, and Firm Performance—Cronbach's Alpha was calculated for each scale. All constructs yielded values above the recommended threshold of 0.700, indicating that the measurement items were reliable and suitable for further analysis

This section demonstrates both descriptive and inferential research results. Many tables are presented.

Table 2 Respondent and company profiles in this study

Topic	Frequency	Percentage
Management level		
Company President	32	8.0
Plant Manager	52	13.0
Direct/Deputy Director	68	17.0
Section Manager	212	53.0
Other executive level	36	9.0
Total	400	100.0
Years of business operation		
0-3 Years	13	3.3
4-10 Years	35	8.8
11-25 Years	154	38.5
26-50 Years	124	31.0
51-100 Years	60	15.0
More than 100 Years	14	3.5
Total	400	100.0
Number of employees		
less than 50	18	4.5
51-200 people	68	17.0
201-1000 people	118	29.5
more than 1000	196	49.0
Total	400	100.0
Fixed asset		
Less 50 M	36	9.0
51-200 M	67	16.8
201-1000 M	117	29.3
More 1000 M	180	45.0
Total	400	100.0

Table 2 (per)

Topic	Frequency	Percentage
Organization culture		
Thai	143	35.8
Japanese	212	53.0
American	11	2.8
European	13	3.3
Chinese	9	2.3
ASEAN	10	2.5
Other Culture	2	.5
Total	400	100.0
Main part		
Main Body	63	15.8
Electric and Electrical	51	12.8
Interior parts	77	19.3
Engine Parts	94	23.5
Transmission	49	12.3
Machine Maker	5	1.3
Other main parts	61	15.3
Total	400	100.0

From Table 2, most respondents are section managers (53.0%). Most companies have 11 – 25 years of business operation (38.5%). Most have more than 1000 employees (49.0%) and more than 1,000 million baht in fixed assets (45%). This shows that many executives from large companies are respondents to this survey. Most of the companies produce engine parts (23.5%).

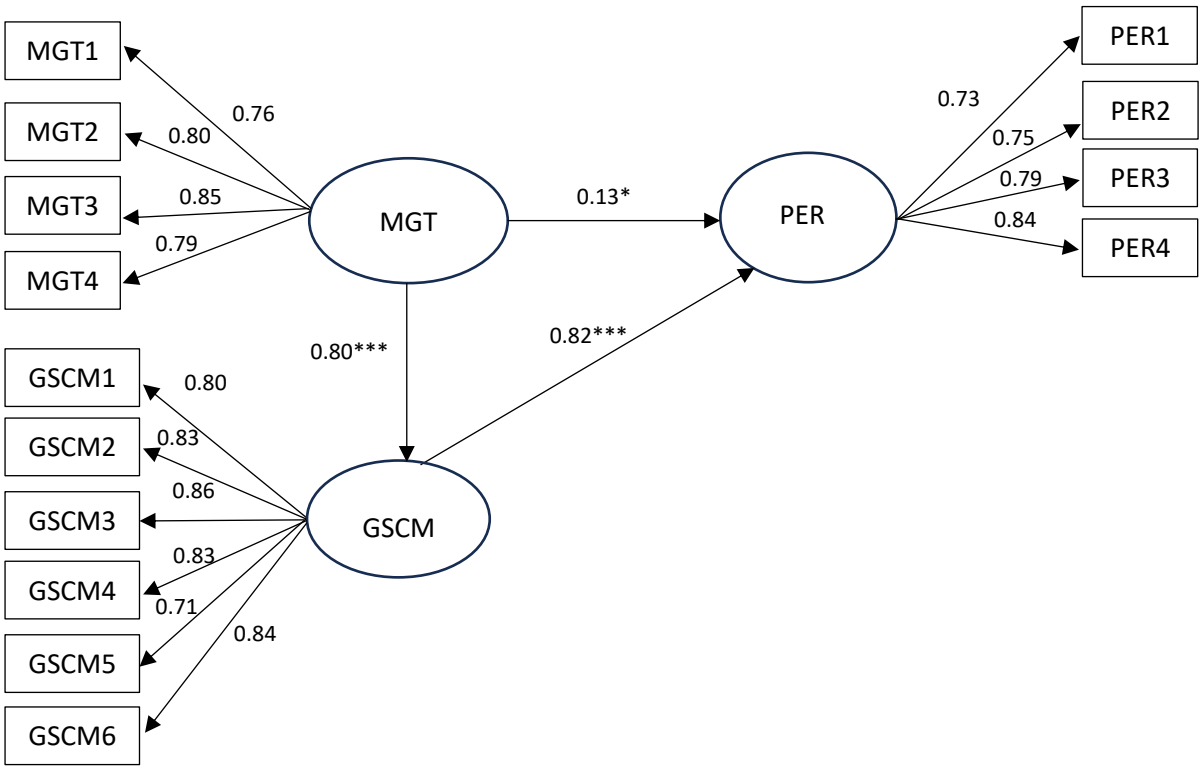
Table 3 Mean and standard deviation of measurement items

Measurement items	Mean	S.D.
MGT1: Policy deployment throughout all levels in companies	5.71	0.979
MGT2: Cross-functional team	5.43	1.048
MGT3: Creating strategic partners	5.47	1.143
MGT4: International standard	5.86	0.935
GSCM1: Product design together with suppliers	5.29	1.194
GSCM2: Green purchasing	5.44	1.019
GSCM3: Green production	5.50	1.043

Table 3 (per)

Measurement items	Mean	S.D.
GSCM4: Green delivery	5.43	1.024
GSCM5: Green consumption	5.77	0.967
GSCM6: Reverse logistics	5.34	1.092
PER1: Delivery cost reduction	5.52	0.955
PER2: Inventory cost reduction	5.60	0.907
PER3: Order fill capacity	5.84	0.959
PER4: Defect reduction	5.76	1.000

Table 3 presents the conceptual framework's mean and standard deviation of all measurement items. In managing the green enterprise (MGT) construction, firstly, giving feedback to international standards (MGT4) is at a high level (5.86). Secondly, policy deployment throughout all organizational levels (MGT1) is high (5.71). In green supply chain management, green consumption (GSCM5) is at a high level (5.77). Secondly, green production (GSCM3) is at a high level (5.50). In the performance measurement construct, order fill capacity (PER3) is at a high level (5.84). Secondly, defect reduction (PER4) is at a high level (5.76).



Note: * is p-value < 0.05, *** is p-value < 0.001

Figure 4 Final version of the structural equation model

From the statistical analysis, the final version of the conceptual framework is presented in Figure 2. Model fit criteria are $\chi 2/df = 3.55$, GFI = 0.926, NFI = 0.923, IFI = 0.943, CFI = 0.943, RMSEA = 0.080. All of these criteria met the minimum requirement: $\chi 2/df < 5.00$ from Hu & Bentler (1999), GFI, NFI, IFI & CFI > 0.900 from Hair et al. (2006, p.778), RMSEA < 0.08 from Bentler & Bonett (1980, p.606).

Figure 2 presents the regression weight values. Regression weight shows how much the impact from an independent variable to a dependent variable is. The regression weight of managing the green enterprise and performances is 0.13 at the significance level of 0.05. The regression weight of managing the green enterprise and supply chain management is 0.80 at the significance level of 0.001. The regression weight of green supply chain management and performances is 0.82 at the significance level of 0.001.

Table 4 Correlation matrix of all variables

Variables	MGT	GSCM	PER
MGT	1.000		
GSCM	0.804	1.000	
PER	0.793	0.928	1.000

Note: The significance level of the relationship between each variable is 0.05.

Table 4 presents the correlation coefficients of the variables in the final model. The correlation coefficient of green supply chain management (GSCM) and performance measurement (PER) is at the first ranking (0.928). The correlation coefficient of managing the green enterprise (MGT) and green supply chain management (GSCM) is at the second rank (0.804). Considering the results of hypothesis tests, all hypotheses are valid, as shown in Table 5.

Table 5 Hypothesis test results

Hypotheses	Results
H1: Managing the green enterprise affects performances.	Support
H2: Managing the green enterprise affects green supply chain management practices.	Support
H3: Green supply chain management practices affect performances.	Support

Table 6 Total, direct, and indirect effects

Dependent Variable	GSCM			PER		
Independent Variable	TE	DE	IE	TE	DE	IE
MGT	0.804	0.804		0.793	0.132	0.661
GSCM				0.822	0.822	

From Table 6, the total effect of managing the green enterprise (MGT) on green supply chain management (GSCM) equals 0.804 at the significance level of 0.001. The total impact of managing the green enterprise (MGT) on performances (PER) equals 0.793 at the significance level of 0.05. The impact of green supply chain management (GSCM) on performances (PER) equals 0.822 at the significant level of 0.001.

Table 7 presents the standardized loading values of all measurement scales. Composite reliability (CR) values of managing the green enterprise, green supply chain management, and performances are 0.705, 0.824, and 0.703, respectively. The CR values exceed 0.7 (Hair et al., 2006, p.12). The average variance extracted (AVE) values of managing the green enterprise, green supply chain management, and performances are 0.644, 0.660, and 0.608. The convergent validity criteria, as their AVE values are more significant than 0.50 (Fornell & Larcker, 1981, p.39).

Table 7 Reliability & Validity

Construct and scale items	Standardized loading	Composite reliability	Average variance extracted
Managing the green enterprise (MGT)			
MGT1: Policy deployment throughout all levels in organization	0.760	0.705	0.644
MGT2: Cross functional team	0.802		
MGT3: Creating strategic partners	0.853		
MGT4: International standard	0.791		
Green supply chain management (GSCM)			
GSCM1: Product design together with suppliers	0.800	0.824	0.660
GSCM2: Green purchasing	0.832		
GSCM3: Green production	0.858		

Table 7 (Per)

Construct and scale items	Standardized loading	Composite reliability	Average variance extracted
GSCM5: Green consumption	0.707		
GSCM6: Reverse logistics	0.836		
Performances (PER)			
PER1: Delivery cost reduction	0.732	0.703	0.604
PER2: Inventory cost reduction	0.754		
PER3: Order fill capacity	0.789		
PER4: Defect reduction	0.843		

Discussion

Most respondents are section managers. They have high experience that suits sharing opinions. Most companies have 11 – 25 years of business operation. Most have more than 1000 employees and more than 1,000 million baht in fixed assets. This shows that this research has collected data from large companies that mostly produce engine parts.

Companies as auto-parts manufacturers can focus on the following actions first. In managing the green enterprise area, getting certificate from international institutes is important. In GSCM area, green consumption is affected by car design, such as energy saving mode. In the performance measurement area, the order fill capacity is the most important. The companies need to operate with high efficiency and can work with logistics providers. Other papers confirm these research findings in many aspects. Managing the green enterprise affects performance. The regression weight of managing the green enterprise and performance is 0.13 at the significance level of 0.05. This finding is similar to the study of Boon-itt & Paul (2006, p.199). They mentioned that integration predicts competitive capability. Internal integration and customer integration also have a relationship with defect reduction. It is obvious that policy deployment and working with business partners can increase the performance of auto-parts manufacturers.

In addition, green supply chain management affects performance. This finding is supported by the research paper of Green et al. (2012). They reveal that production companies using green supply chain management can increase operational, economic, and environmental performances. Starting with product design allows your company to operate

with green processes. Green purchasing can be successful when suppliers also understand green concepts. Green production needs high-efficiency machines that have lower energy consumption. Green delivery needs computer software for truck fleet management. Green consumption depends on consumers understanding the instructions on the packaging and how to properly consume the product or dispose of the packaging at the right places. Therefore, auto-parts manufacturers need to work with car assembly plants to develop green strategies all the time. They have to communicate with car users. As a result, this business becomes a close-loop operation that has incredibly low waste, save costs, and high customer satisfaction.

The regression weight of managing the green enterprise and supply chain management is 0.80 at the significance level of 0.001. This research result is supported by the study of Zhang & Wang (2011, p.233), which is about "empirical research on associations among information technology, supply chain robustness, and supply chain performance." They found that information sharing has a positive impact on supply chain robustness and supply chain performance. Interestingly, information sharing among departments in the organization enhances collaboration with the business partners. This result supports the study of Klein & Rai (2009), who stated that sharing plans with suppliers affects buyer relationship-specific performances. Essentially, auto-parts manufactures themselves need to implement green policies in all departments. This success becomes the first step for working together with supply chain members on GSCM. In this way, their buyers will satisfy both products and services in the long run.

Conclusion

In conclusion, this study confirms that both Green Supply Chain Management and Green Enterprise Management have a positive and significant impact on the performance of auto-parts manufacturers in Thailand. By adopting environmentally responsible practices, firms not only contribute to sustainability goals but also enhance their operational efficiency and market competitiveness. These findings encourage industry leaders to embrace green strategies as a core component of business development. Academically, the research adds to the growing body of knowledge in sustainable operations and supply chain management, particularly in the context of emerging markets. Further studies are encouraged to explore other moderating or mediating variables such as technology adoption, corporate culture, or international regulatory pressures.

Supporting with the findings revealed that managing green enterprises significantly enhances the performance of Thailand's auto parts manufacturing companies. Additionally, effective management of green enterprises has a substantial positive effect on these Thailand companies' Green Supply Chain Management. Finally, Green Supply Chain Management itself has a significant impact on the performance of Thailand's auto parts manufacturing companies.

Academic Implications:

1. Knowledge contributes to the academic literature by providing empirical evidence of how green supply chain management (GSCM) practices impact the performance of auto-parts manufacturers in Thailand.

2. Theoretical advancement to the existing theories by validating or modifying frameworks related to GSCM and organizational performance within the context of auto-parts manufacturing.

3. It provides insights into the effective methodologies for measuring and evaluating GSCM practices and their outcomes, potentially guiding future research in similar contexts.

4. Highlights the relevance of integrating environmental management principles into operations management, bridging disciplines of sustainability, management, and engineering.

Practical Implications:

1. Managerial guidelines Offers practical guidelines for auto-parts manufacturers in Thailand on adopting and implementing effective GSCM strategies to enhance operational efficiencies and environmental performance.

2. Business strategy helps industry practitioners in developing competitive strategies centered around sustainability, potentially leading to enhanced market reputation, cost savings through resource efficiency, and improved stakeholder relationships.

3. Supplier and customer relations emphasizes the importance of fostering green supplier networks and enhancing customer loyalty through transparent and sustainable business practices.

4. Training and development contribute to the training programs to build capabilities within organizations for effective implementation and management of GSCM initiatives, fostering a culture of sustainability within the workforce.

Recommendation

1. Auto-part manufacturers need to manage with green policies. All departments need to work together to achieve the targets of the action plan each year. Also, companies should work seamlessly with business partners, such as suppliers, wholesalers, and third-party logistics providers. Managing the green enterprise can improve its performance.

2. Auto-part manufacturers should implement green supply chain management. Its green steps are in the following sequences: product design, purchasing, production, delivery, consumption, and reverse logistics. Organizations in the green supply chain can cut costs by using resources effectively. Their products are environmentally friendly. They have high opportunities to export their products to European countries using ISO standards.

3. Auto-part manufacturers should set performances: delivery cost reduction, inventory cost reduction, order fill capacity, and defect reduction. Firstly, delivery cost reduction should be a primary activity because the car assembly plant and suppliers can implement milk-run techniques. A truck departs from the car assembly plant to pick up part components from many suppliers in the same location. Secondly, inventory control is essential. Calculating stock levels can help the warehouse to cut costs and satisfy its customers. Thirdly, the organization should increase its order-fill capacity in order to meet customers' needs, especially in urgent cases. Lastly, product quality is critical. Auto-part manufacturers need to produce auto parts that meet the specifications.

4. Managing the green enterprise impacts green supply chain management. Essentially, all departments in the organization can work with business partners at all managerial levels: strategy, tactics, and operations.

Future study

1. Main factors impact green supply chain management in other industries in Thailand. The researcher can collect data from the following industries: electronic, plastic, textile, petrochemical, furniture, etc. These industries generate high sales revenues.

2. Main factors impact performances in other industries in Thailand. Executives need to understand performance concepts, which are called KPIs. Selecting a good set of KPIs helps the company improve its key activities and can be successful in the long run.

3. Mixed research methods (quantitative and qualitative) for similar topics were used to collect and analyze data. The researcher can choose from two research designs. First, the explanatory sequential design starts with quantitative research and ends with qualitative research. Second, the exploratory sequential design starts with qualitative research and ends with quantitative research.

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