

# Uncertain Supply Chain Management

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## The effect of supply chain integration capability and green supply chain management (GCSM) on manufacturing industry operational performance

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### ABSTRACT

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The purpose of this study was to determine the effect of supply chain integration capabilities on operational performance by mediating green supply chain management in manufacturing companies. This research method is quantitative and the sampling method in this study uses probability sampling. The primary data is obtained by distributing 490 online questionnaires to manufacturing companies. Validity and reliability testing were carried out using Structural Equation Modeling Partial Least Square (SEM-PLS) and data processing was accomplished using SmartPLS. The findings in this study found that supply chain integration capabilities had a direct positive and significant effect on operational performance while supply chain integration capabilities had a positive and significant effect on green supply chain management. In addition, green supply chain management had a direct positive and significant effect on operational performance. The ability of supply chain integration also maintained a positive and significant effect on operational performance mediated by green supply chain management.

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### 1. Introduction

In this era of the industrial and digital revolution, more and more new companies or industries are developing rapidly. Indirectly these companies contribute to environmental pollution from the production activities they carry out, which can impact the planet, people's lives, and other ecosystems (Yusuf & Soediantono, 2022). Over time, the accumulation of waste that occurs is increasingly worrisome and should be watched out for. According to Rahman et al. (2020), many of these companies use raw materials that are less environmentally friendly and cannot even be recycled or renewed (Seman et al., 2019). Practices like this need to be anticipated, especially for companies that run supply chain systems. A company engaged in manufacturing always wants success in future activities (Sahoo et al., 2021). This shows that every company always strives to continue developing in its line of business in the future. The development of information technology is needed to carry out marketing where in the modern era like today marketing with online methods is needed, so that online-based marketing is one of the factors in achieving operational performance. With increasing business growth and market interest, it has implications for increasing customer demand for the desired product so that goods distribution activities are required to be able to meet market demand more quickly and precisely (Shahzad et al., 2020).

Changes in the new industrial era that demand the role of industry in protecting the environment by reducing waste and pollution have led to the emergence of green supply chain management in implementing supply chain strategies (Wang et al., 2020). According to Cousins et al. (2019), green supply chain management requires industrial activities to improve the balance between marketing performance and environmental issues which give birth to new issues such as saving energy use and reducing pollution to improve competitive strategy (Yu et al., 2019). Companies feel the need to improve their network or increase their supply chain for waste reduction and operational efficiency, including the delivery of products and services.

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Based on this, the purpose of the green supply chain is to consider the environmental effects of all products and processes, including environmental influences originating from goods/products and processes ranging from raw materials to finished products, and the final disposal of these products (Tseng et al., 2019). According to Haiyun et al. (2021), green supply chain management (GSCM) is based on an environmental perspective, namely, how to reduce waste and environmental impacts caused by supply chain activities of industrial companies. This is an important long-term non-financial aspect related to the environment that companies must pay attention to in maintaining good relations for the sustainability of their supply chain activities in the future (Sheng et al., 2023).

According to Kalyar et al. (2020) and Rahman et al. (2020), environmental pollution occurs due to human activities in the process of fulfilling their needs. Irresponsible disposal of waste or production residue in the long term will result in serious environmental damage. Therefore, every company is expected to study production activities in a more mature and planned manner which can later have a positive impact on the economy, environment, and society. To overcome environmental problems, many companies/organizations have started to adopt what is called eco-friendly design or green design. This strategy relates to investing in green design programs. Green design is defined as a systematic design performance consideration with respect to environmental, health, safety, and sustainability goals over the full product life cycle in process. Packaging companies are no exception, which in carrying out their production systems are expected to use environmentally friendly and recyclable materials (Yildiz Çankaya & Sezen, 2019). According to Haiyun et al. (2021), however, the application of environmentally and socially friendly practices often faces challenges, due to their confusing and inconsistent effect on sustainability performance. With increasing environmental problems occurring, it is expected that companies need to implement sustainable supply chain practices with their customers and suppliers to improve Environmental Performance by reducing the environmental impact of products, services and production activities. In addition, environmental concern is exacerbated by a lack of resources and many organizations face pressure from government, non-governmental organizations, internal and external stakeholders related to changes in the production and delivery of goods and services (Shin et al., 2022).

## **2. Literature review and Hypothesis Development**

### *2.1 Green Supply Chain Integration Capability*

Cousins et al. (2019) defined supply chain integration capabilities as, a set of supply chain management (SCM) skills, knowledge and competencies that are developed from time to time through complex interactions, both within the company and with its network partners where the company can accommodate activities SCM and deploying resources towards goals to be achieved together. Chain integration will not be separated from supply terms since supply chain integration is based on the reference of the extent to which an organization is very strategic to be able to work together in supply chain management partners and also manage an organization's processes, whether domestic or international, in order to achieve a product average, information services, payments, as well as taking a decisions efficiently and with the goal of providing a very maximum added value for service users. According to Rahman et al. (2020) there are three main elements that can be explained for an integration of the existing supply chain in the model, with clear and transparent information systems (regarding information management and financial flows), inventory management (product flows and material flows), also supply chain correlation (relationship management between trading partners. Supply chain integration refers to the extent to which strategic organizations cooperate with supply chain partners and manage intra- and inter-organizational processes to achieve an effective and efficient flow of products, services, information, money, and decisions with the aim of providing maximum value to customers. According to Haiyun et al. (2021) and Kalyar et al. (2020), integrating supply chain management is an important business process for transferring products, services and information from suppliers to final consumers and for increasing the added value of products, services and information.

### *2.2 Green Supply chain Management*

According to Cousins et al. (2019) and Deng and Jiang (2019), green supply chain management can be defined as purchasing products that are environmentally friendly and avoiding purchasing products or raw materials that are harmful to the environment. In addition, GSCM can meet the needs of consumers or customers while still contributing to environmental sustainability. GSCM is also a company's environmentally friendly purchasing practices that are oriented towards preserving natural resources, ecosystem sustainability, pollution prevention, minimizing consumption of energy and water resources, and minimizing the disposal of wasted materials from production. According to Haiyun et al. (2021), GSCM can be defined as integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, final product delivery and final management-product life after its useful life. The goal of a green supply chain is to consider the environmental impact of all products and processes, including the environmental impact of goods/products and processes from raw materials to finished products, and the final disposal of these products. GSCM is a concept that integrates environmental aspects into supply chain management, including product design, procurement, selection of raw materials, manufacturing processes, delivery of final products to consumers to managing product flow after it is used by consumers. GSCM plays an important role for sustainability in the industry. Companies need to apply the GSCM

concept because it relates to operational efficiency in their supply chain. This concept is also implemented as a company strategy to advance their brand image, thereby gaining the trust of customers and gaining more market share.

### 2.3 Operational Performance

Operational performance is a standard for measuring the success of a company in managing its operations. The company's success is measured by achieving competitive advantage through the acquisition of value advantage and productivity advantage (Soemadi et al., 2022). According to Benzidia et al. (2021) the sources of competitive advantage are: The ability of a company to serve consumers that can differentiate itself from its competitors which is called value benefit. A very important factor in obtaining value benefits is providing the best possible service. According to Abdallah and Al-Ghwayeen (2020) service to customers, Customer Satisfaction according to the quality of product diversity and timely delivery. Alexandrou et al. (2022) consider performance to be the main measure of a company's performance, because the main goal of an organization is to make profits for shareholders. Company performance relates to external supply chain partners, internal company functions, processes, and all external and internal connections. Environmental Performance

Al-Sheyadi et al. (2019) explained that environmental performance refers to the ability of a business organization to reduce or minimize air, liquid and solid waste emissions and the ability to reduce consumption of hazardous and toxic materials which can ultimately reduce the frequency of environmental pollution. Therefore, every company must consider the impact that will have on the surrounding environment for its production activities. In addition, waste disposal must be considered in more detail so that in the end it does not result in pollution that can harm other ecosystems. Alexandrou et al. (2022) explain economic performance is related to a company's ability to reduce costs from the production process, including purchasing materials and components, energy consumption, water, and waste disposal. This means that every company that carries out production activities, in the end, must pay attention to all related elements from start to finish, which in turn can have a mutually beneficial impact on the company, consumers and the environment. Al-Sheyadi et al. (2019) define economic performance as financial and marketing activities "that is, increasing performance resulting from implementation of GSCM practices thus leading to an increase in the company's position compared to other industry averages".

## 3. Hypothesis development

### 3.1 The relationship between green supply chain integration capabilities and operational performance of the manufacturing industry

According to Bag et al. (2021) and Benzidia et al. (2021), integrating green supply chain management is an important business process for transferring products, services and information from suppliers to final consumers and for increasing the added value of products, services and information. According to Abdallah and Al-Ghwayeen (2020) and Alexandrou et al. (2022) there is a positive and significant effect of the ability to integrate green supply chains on operational performance. Acquah et al. (2020) and Bag et al. (2021) also state that there is a positive and significant effect of green supply chain integration capabilities on operational performance.

**H<sub>1</sub>:** *There is a positive and significant influence of green supply chain integration capabilities on the operational performance of the manufacturing industry.*

### 3.2 The relationship between green supply chain management and the operational performance of the manufacturing industry

Green supply chain management can meet the needs of consumers or customers while still contributing to environmental sustainability. Green Supply Chain Management is also a company's environmentally friendly purchasing practices that are oriented towards preserving natural resources, ecosystem sustainability, pollution prevention, minimizing consumption of energy and water resources, and minimizing the disposal of wasted materials from production. According to Rahman et al. (2020), there is a positive and significant influence of GSCM on operational performance and this is also supported by Cousins et al. (2019) and Deng et al. (2019).

**H<sub>2</sub>:** *There is a positive and significant influence of green supply chain management on the operational performance of the manufacturing industry.*

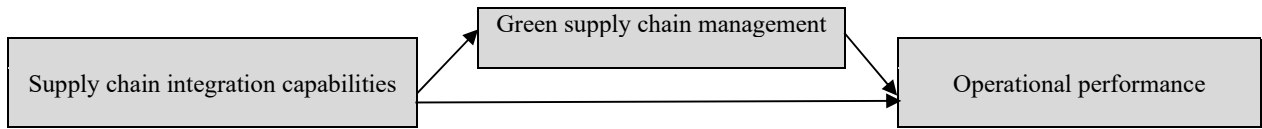
### 3.3 The relationship between green supply chain integration capabilities and green supply chain management

According to Cousins et al. (2019) and Rahman et al. (2020) there is a positive and significant influence of green supply chain integration capabilities on green supply chain management, these results are supported by Kalyar et al. (2020), Permana and Soediantono (2022) there is a positive and significant effect of green supply chain integration capabilities on green supply chain management. Therefore,

**H<sub>3</sub>:** *There is a positive and significant influence of green supply chain integration capabilities on green supply chain management.*

**4. Method**

This research is categorized as hypothesis testing research. Hypothesis testing itself is used to see whether the variables studied have a positive or negative effect according to the formulation of the hypothesis. In addition, this research design uses a causal hypothesis or commonly called a causal relationship. The time used in this research is cross section. Cross Section itself is a type of data consisting of variables that are collected on several selected individuals or respondents at a certain time. Observations in this study were carried out by conducting research or real observations. This means that the objects in this study are employees from 10 manufacturing industries, the unit of analysis used in this study are individuals consisting of supervisors, assistant managers, and managers. This study uses primary data obtained by distributing questionnaires online through social media or directly by giving written questions to respondents, then respondents provide responses. There is a measurement scale that will be filled in by respondents in answering the questionnaire questions. Data collection was carried out at 10 packaging companies in. These companies have been operating for more than 20 years and have a large market share and many employees. Probability sampling is used for the sampling method in this study. The data used is primary data obtained by distributing online questionnaires to manufacturing company respondents totaling 490 respondents who use it for data processing. Validity and reliability testing was carried out using Structural Equation Modeling Partial Least Square (SEM-PLS) and data processing using SmartPLS. Fig. 1 presents the structure of the proposed study.



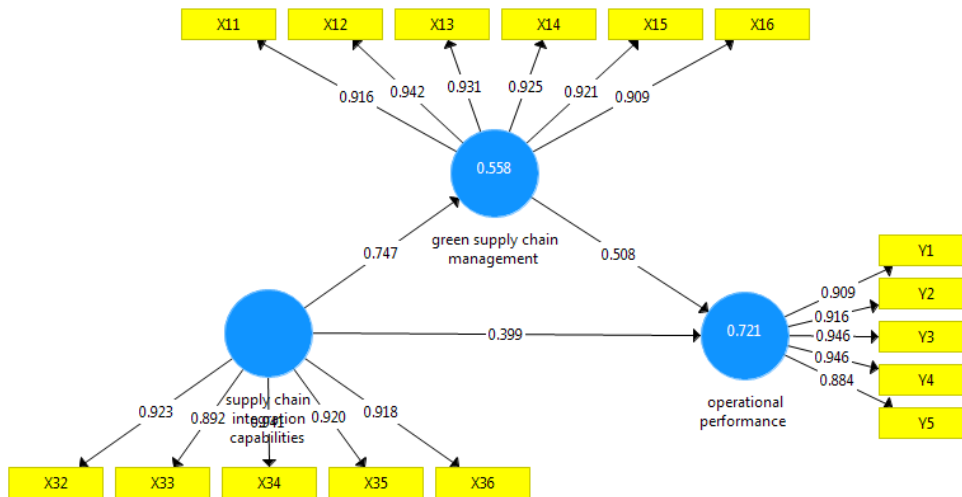
**Fig. 1.** Research Model

**5. Results and Discussion**

The data analysis technique used in this study is the Partial Least Square (PLS) approach using SmartPLS 3.0 software. PLS is a statistical SEM method based on variance designed to solve multiple regression when specific problems occur in the data, such as the study sample size is very small. Testing the outer model aims to see the validity and reliability of a model. The analysis of this test will be seen from the influence of the Loading factor, Average Variance Extracted (AVE), and Discriminant Validity, as well as composite reliability.

*5.1 Loading Factor*

Factor loading is the initial stage in testing the validity of a model, the condition for factor loading is that it must be > 0.6, so that the indicator is said to be valid. If it is not valid then it must be removed from the model. To find out the analysis of the outer model of this study can be seen in Fig. 2. All indicators of the loading factor value are > 0.6 so that they pass the validity test.



**Fig. 2.** Validity Testing

5.2 Average variance extracted (AVE)

Average Variance Extracted (AVE) is the value used in testing convergent validity because the value is obtained from the output of convergent validity. In this study, the expected AVE value is > 0.5, and when viewed from the latent variable constructs, all constructs have a value above 0.5. Because there are no problems with convergent validity, then what is tested next is problems related to discriminant validity.

5.3 Discriminant Validity

Discriminant Validity can be tested by looking at the cross-loading table, this output is used to test discriminant validity at the indicator level with conditions, the correlation between indicators with the latent variable > compared to the correlation between the indicators and other latent variables (outside the block). For more details can be seen in Table 1.

5.4 Composite reliability

To ensure that there are no problems related to measurement, the final step in evaluating the outer model is to test the unidimensionality of the model. This unidimensionality test was carried out using composite reliability and Cronbach's alpha. For both indicators the cutoff point value is 0.7. Table 1 shows that all constructs have a composite reliability value above 0.7, therefore, there is no unidimensionality problem found.

**Table 1**  
Reliability Testing

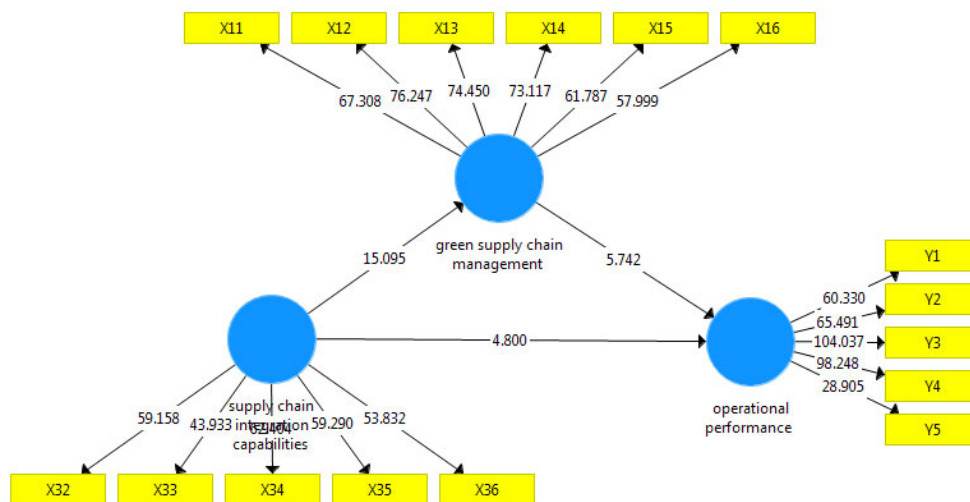
	Cronbach's Alpha	rho A	Composite Reliability	Average Variance Extracted (AVE)
Supply chain integration capabilities	0.843	0.831	0.712	0.612
Green supply chain management	0.813	0.808	0.823	0.623
Operational performance	0.875	0.845	0.808	0.636

5.5 Hypothesis test

Table 2 presents the results of testing the direct structural model. Hypothesis testing is done by looking at the path coefficient which shows the parameters and t-statistics values. The path coefficient score or inner model indicated by the T-statistic value must be above 1.96 for the two-tailed hypothesis. The results of direct model testing are as follows.

**Table 2**  
Hypotheses Testing for Direct Effect

Hypotheses	T - Value	P Value	Result
Supply chain integration capabilities → Operational performance	4.800	0.000	Significant
Green supply chain management → Operational performance	5.742	0.001	Significant
Supply chain integration capabilities → Green supply chain management	15.095	0.002	Significant



**Fig. 3.** Hypothesis Testing

### *The relationship between green supply chain integration capability and operational performance*

Based on the results of the structural equation modeling hypothesis test, a  $p\text{-value}=0.000 < 0.050$  was obtained, so it was concluded that there was a positive and significant influence on the ability to integrate green supply chains on the operational performance of the manufacturing industry. This result is consistent with the findings of Kalyar et al. (2020), Haiyun et al. (2021) and Rahman et al. (2020) where they found a positive and significant effect of green supply chain integration capability on operational performance. Cousins et al. (2019) and Deng et al. (2019) also state that the ability to integrate green supply chains will drive increased operational performance.

### *Green supply chain management relationship and operational performance*

Based on the results of the structural equation modeling hypothesis test, a  $p\text{-value } 0.001 < 0.050$  was obtained, so it was concluded that there was a positive and significant influence of green supply chain management on the operational performance of the manufacturing industry. The results are in line with findings of other researchers such as Bag et al. (2021) Benzidia et al. (2021) and Abdallah and Al-Ghwayeen (2020).

### *The relationship between green supply chain integration capabilities and green supply chain management*

Based on the results of the structural equation modeling hypothesis test, a  $p\text{-value } 0.002 < 0.050$  was obtained, so it was concluded that there was a positive and significant influence on green supply chain integration capabilities on green supply chain management. These results are supported by Al-Sheyadi et al. (2019) and Acquah et al. (2020) and Alexandrou et al. (2022) which state that green supply chain integration capabilities will encourage increased chain management green supply.

In research conducted by Acquah et al. (2020), Bag et al. (2021) and Benzidia et al. (2021), green supply chain management practices properly affect company performance. In managing supply chain management practices that are carried out professionally, it will positively influence the company's targets to be achieved so that the company can increase the company's value in global competition. Thus, this supply chain management practice can affect the company's performance in general. By implementing good supply chain management practices, it will have a significant positive effect on company performance, where every business related to suppliers, customers, and information will flow properly. If this can run smoothly, the flow of goods to consumers will run without any obstacles, so it is hoped that the company's financial flow will run smoothly as well.

According to Arijanto et al. (2022) effective green supply chain management has a positive and significant effect on competitive advantage. Effective supply chain management is influenced by product development, supplier relationship strategy, planning and control, production and distribution, information quality, and purchasing. Research by MAbdallah and Al-Ghwayeen (2020) and Acquah et al. (2020) stated that effective supply chain management has the potential to increase competitive advantage. It is proven that integrated supply chain management starting from the relationship between suppliers and customers, delays and quality can maintain and strengthen its competitiveness in winning the competition in the market.

Research by Al-Sheyadi et al. (2019) states that the application of good green supply chain management in companies will be able to increase competitive advantage. Supply chain management by establishing relationships with suppliers and consumers will be able to increase competitive advantage. The application of good supply chain management will be able to improve company performance. Research on companies shows that many companies pay less attention to aspects of supply chain management in terms of strategic partnerships for continuous improvement involving suppliers. Companies should make continuous improvements on a regular basis with suppliers so that the quality and quality produced by suppliers. The quality and quality produced by suppliers influences the company's performance both in production and sales.

According to Rudyanto et al. (2020); Rizki et al. (2022) effective and optimal supply chain management can increase productivity, market share and customer growth. various dimensions in supply chain management such as supplier strategic partnerships, information quality, and consumer relations have an influence on several aspects of company performance. According to Acquah et al. (2020), Purwanto et al. (2022) and Benzidia et al. (2021), companies should make continuous improvements periodically with suppliers so that the quality and quality produced by suppliers. The quality and quality produced by suppliers affects the company's performance. According to Yusuf et al. (2022) and Soemardi et al. (2022) supply chain management can optimize performance to add as much value as possible at the minimum possible cost. In other words, it aims to link all supply chain agents to work together within the company to maximize productivity in the supply chain and improve performance for all parties involved.

## **6. Conclusion**

The findings in this study have indicated that supply chain integration capabilities have a direct positive and significant effect on operational performance while supply chain integration capabilities have a positive and significant effect on GSCM. In addition, GSCM has a direct positive and significant effect on operational performance. Moreover, the ability of supply chain

integration has a positive and significant effect on operational performance mediated by green supply chain management. GSCM plays an important role for sustainability in the industry. Companies need to apply the GSCM concept because it relates to operational efficiency in their supply chain. This concept is also implemented as a company strategy to advance their brand image, thereby gaining the trust of customers and gaining more market share. Given the importance of implementing GSCM in a company, this concept is no longer an option but an obligation for all members of supply chain management. That is, in making it happen the company cannot be alone. Therefore, it requires the involvement of all stakeholders in the entire supply chain for the successful implementation of the GSCM concept. In addition, GSCM practice and performance evaluation are also very important since it determines the success of GSCM implementation in the company. The implications of this study have indicated that supply chain management has a bigger role in improving company performance. This is because the company provides neutral or the same price as competitors, the same quality and most companies introduce new products at the same time, so the effect through mediation is smaller than the direct effect.

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