

# How do Supply Chain Strategies and Supply Chain Integration Affect Operational Performance: The Mediating Roles of Supply Chain Risk Management

Siti Nursyamsiah<sup>1\*</sup>, Anas Hidayat<sup>2</sup>, Zailani Aboe<sup>3</sup>,

<sup>1,2</sup>Universitas Islam Indonesia, Yogyakarta

<sup>3</sup>Akademi Manajemen Putra Jaya, Yogyakarta

\*Corresponding author: [siti.nursyamsiah@uii.ac.id](mailto:siti.nursyamsiah@uii.ac.id)

## ABSTRACT

The importance of supply chain strategies and integrative practices in addressing complex supply chain issues is well acknowledged by both academia and industry professionals. Companies are also focused on risk management, handling unexpected disruptions, and enhancing performance in an uncertain business environment. This study empirically investigates the impact of supply chain strategy on supply chain integration, the effect of supply chain integration on operational performance, and the mediating role of supply chain risk management (SCRM) in these relationships. Covariance-based structural equation modelling was used to test hypotheses with data from 343 SMEs. Findings indicate that supply chain strategy positively influences supply chain integration, which is measured by internal integration, supplier integration and customer integration. Additionally, supply chain integration directly affects operational performance. The study also confirms the mediating role of SCRM in supply chain integration and operational performance. These findings contribute to a more comprehensive understanding of the interplay between supply chain strategy, S.C. integration, S.C. risk management, and operational performance, offering insights for organizations to enhance their supply chain management practices and gain competitive advantage.

**Keywords:** *Supply Chain Strategies, Supply Chain Integration, Supply Chain Risk Management, Operational Performance.*

## Citation:

Nursyamsiah, S., Hidayat, A., & Aboe, Z. (2024). Conference Proceedings Paper: How do Supply Chain Strategies and Supply Chain Integration Affect Operational Performance: The Mediating Roles of Supply Chain Risk Management. *Proceedings of ASBN International Conference 2024* (pp. 652-666), Yogyakarta, Indonesia. ASEAN School of Business Network.

DOI: <https://doi.org/10.64458/asbnic.v1.13>

## INTRODUCTION

The current competitive landscape has prompted businesses to shift their focus from internal efficiency to managing their supply chains effectively Prajogo et al. (2016). The ability to navigate the complexities and uncertainties of global supply chains has become a crucial determinant of a firm's operational performance. This study investigates the relationships between supply chain strategy, supply chain integration, supply chain risk management, and operational performance.

<sup>1</sup> <https://orcid.org/0000-0003-3572-6066>

<sup>2</sup> <https://orcid.org/0000-0002-4180-5767>

<sup>3</sup> <https://orcid.org/0009-0009-7168-6023>

Existing literature suggests that firms that prioritize supply chain integration and risk management are better positioned to achieve superior operational outcomes (Duong & Ha, 2021; Cucchiella & Gastaldi, 2006). Integrating supply chain processes, both internally and externally, has been linked to improved inbound supply performance and lean production processes (Prajogo et al., 2016), which in turn enhance a firm's competitive operational performance. Additionally, effective supply chain risk management has been identified as a critical factor in enabling firms to mitigate the challenges posed by the dynamic business environment and achieve their strategic objectives. By proactively managing supply chain risks, organizations can improve their ability to respond to disruptions, reduce operational costs, and enhance their overall competitiveness.

Supply Chain Risk Management (SCRM) is an information-intensive process (Fan et al., 2017), where the success of its implementation depends on collaboration and coordination between companies and their supplier partners (Kauppi et al., 2016; Li et al., 2015). Therefore, the need for a collaborative risk management approach is increasing (Li et al., 2015), and the key to achieving this is the integration of all supply chain members (SCI).

Integrated Supply Chain (SCI) is achieved by expanding the scope of management both internally and externally by involving suppliers and customers. Integration within a company allows the circulation of information between departments within the company, whereas integration between companies enhances the exchange of information among supply chain partners and helps them to stay alert and respond quickly to disruptions through information exchange and coordinated operations (Liu & Lee, 2018). Therefore, companies need to facilitate intra- and inter-company integration so that SCRM can run effectively.

Some studies show that supply chain strategies such as *lean* and *agile* have an impact on supply chain integration (S. et al., 2021). These findings indicate that companies whose supply chains are *lean* or *agile* will be more successful in connecting their internal improvement processes with external suppliers and customers. Furthermore, lean supply chain management makes it easier to connect the flow of physical, information, and financial flows from upstream to downstream. Flow works collaboratively to reduce costs and waste and satisfy every customer need (S. Kunnapadeelert and K. Pitchayadejanant, 2021). In a manufacturing system, *agility* and *lean* S.C. provide value to customers, are better prepared to face change and have the ability to adapt to meet customer needs while avoiding supply chain risks. The implementation of *lean* and *agile* strategies requires internal and external collaboration in the supply chain that will improve operational performance.

Several studies on the Impact of SCI on operational performance have not shown consistent results. Fabbe-Costes and Jahre (2008), in their literature review study, showed that a large number of studies showed that increasing SCI does not necessarily improve performance. Various factors are considered in the literature to explain these mixed findings, such as logistical capability (Wiengarten et al., 2014), environmental uncertainty (Wong et al., 2011) and risk (Wiengarten et al., 2016). However, the Role of SCRM in explaining the relationship between SCI and performance has been neglected. Therefore, companies need to develop SCRM processes to better identify, mitigate and respond to risks adequately and improve their performance.

Building on these insights, this study proposes a research model that examines the direct and indirect influences of supply chain strategy and supply chain integration on operational performance. Specifically, the model investigates how supply chain risk management mediates the relationships between supply chain integration and operational performance. By exploring these complex linkages, the study aims to provide a more comprehensive understanding of the mechanisms through which supply chain management practices can enhance a firm's operational outcomes.

## LITERATUR REVIEW AND HYPOTHESES DEVELOPMENT

### Supply Chain Strategies and Supply Chain Integration

Supply chain integration refers to the level of strategic cooperation in the process, both within and between organizations (Flynn, Huo, and Zhao 2010; Narasimhan and Jayaram 1998). Several studies measured supply chain-based integration on internal and external integration. External integration can be divided into supplier integration and customer integration (Huo 2012; Wong, Boon-Itt, and Wong 2011). Supplier integration, customer integration and internal integration are considered as key resources and are considered as sources of improvement to the company's performance (Combs, J. G. and D. J. Ketchen, 1999).

Supplier integration is defined as an organization's ability to develop, manage, and maintain long-term relationships with suppliers, and customer integration is defined as a practice to improve customer satisfaction and manage relationships with customers (Ayoub, et al,2017). Such external integration provides benefits such as reduced costs, increased productivity and agility, and ease of obtaining resources (Amoako Gyampah et al., 2020; Jajja et al., 2018). External integration also has a positive impact on operational performance, such as quality costs, product delivery, and flexibility, ultimately improving company performance (Wong et al., 2011).

Internal integration is defined as the practice of an organization to achieve cross-border knowledge exchange between departments to support external integration and achieve organizational goals. Internal integration allows for cooperation and information sharing between departments, reducing conflicts between departments and contributing to stabilization (Jun, Qiuzhen, and Qingguo 2011). In addition, cooperation and information sharing can ensure consistency in goals and improve company performance (Jun, Qiuzhen, and Qingguo, 2011; Schoenherr and Swink, 2012).

An agile *strategy* in the supply chain is the direction of the organization and a commitment to an effective and rapid response to changing customer needs. The researchers described agility as a collaboration between suppliers, customers, and manufacturers (M. J., Braunscheidel, and N. C., Suresh, 2009). The selection of the right supplier has been considered an essential function for the successful collaboration between suppliers and manufacturers to improve the ability of both parties to create value and detect changes in demand quickly.

Meanwhile, *the lean strategy* implements continuous improvement efforts that emphasize the elimination of non-value-added activities through the supply chain. This concept is especially effective when demand is relatively stable and predictable and product diversity is low (D., Birhanu et al., 2014). Supplier integration involves business integration between suppliers and manufacturers through information technology. This concerns purchasing, production, and logistics planning systems. Various researchers propose that supplier integration is one of the important criteria for selecting suppliers (D. J., Bowersox, et al, 1999; C. G. Chatzopoulos and M. Weber, 2021, M., Cho, M. A, et al, 2021). So, companies that implement *lean* or *agile* strategies in their supply chains will be able to integrate suppliers better. Therefore, the first hypothesis developed is as follows:

H1a. Supply Chain Strategies have a positive impact on supplier integration

*Agility* is described as the management of speed, flexibility, innovation, and quality to provide customer-oriented products and services in a rapidly changing environment (P. Y., Huang, B, et al, 2021). Nowadays, customers have become an important source of knowledge for companies. This is because customers have gained a lot of knowledge and experience about the products and services they use. Customer integration can improve supply chain agility with faster observation while sharing information with partners and responding to market and customer demands. Researchers reveal that customer engagement is essential for the Implementation of an agile supply chain (R., Hoda, J., et al, 2011).

Lean principles such as waste elimination and continuous improvement seem to be never-ending activities (J. G., Schmidt, and D. Lyle, 2020). Long-term repairs may take years to complete the entire system. The development of Industry 4.0 requires value and teamwork from the principle of lean production (H., Bauer, F., et al., 2018); value must always be obtained from the customer's point of view. The lean concept focuses on customer orientation, and customer collaboration in value is critical. Therefore, the following hypothesis was developed.

H1b. Supply Chain Strategies have a positive impact on customer integration

Agile strategies emphasize market sensitivity and quick response to customers. To achieve this, all functions in the organization must be integrated to coordinate processes between different functions (J., Roh, P., et al., 2014). Internal integration is another supply chain integration that extends to an organization that connects the practical activities of the functional units internally to synchronize to meet customer needs. Each unit in the organization shares data on demand forecasts, inventory, and production plans through a management information system (MIS). An agile supply chain combines all internal functions within an organization to meet customer needs. It also improves the organization's ability to mitigate problems, errors, and conflicts effectively. Employees need to understand their work standards with a transparent process to produce the perfect work for customers. In the lean concept, this strategy emphasizes collaboration. All functions in the organization must have solid integration to drive the organization to succeed based on a lean supply chain. Therefore, the following hypothesis was developed:

H1c. Supply Chain Strategies have a positive impact on internal integration.

### **Supply Chain Integration and Operational Performance**

In increasing production output, companies usually refer to increasing efficiency and effectiveness by using almost the same amount of production inputs. Supplier and customer involvement in the form of integration will support the company's efficiency. (Tarigan et al., 2019). One of the factors that most affects the smoothness of supply chain integration is flexibility due to direct collaboration and information exchange between divisions, which leads to alignment of decision-making (Chaudhuri et al., 2018).

Supplier integration is a collaboration between a manufacturer and its suppliers (J., Roh, P., Hong, and H. Min, 2014). Good collaboration and relationships will help manage upstream activities between organizations by sharing relevant information and making multiple decisions. The general goal of supplier integration is to collaborate on demand planning and forecasting to reduce supply, inventory, time, and cost risks. Several studies have found that sharing information with suppliers or making decisions with each other provides better results on operational performance in terms of cost, delivery, product quality, and flexibility (J., Roh, P., Hong, and H. Min, 2014; J., Wang, and W. Zhuo, 2020; C. J. Yuik and P. Puvanasvaran, 2020).

Customer integration helps organizations to have more understanding of market needs (Y., Shou, Y., et al, 2018). This is due to the increased accuracy of product information, reduced errors, and rework. Thus, customer integration will result in better adoption and production plans that will result in better operations.

Internal integration can be described as a cross-functional strategy related to collaborative procurement, product design, manufacturing, warehousing, marketing, and distribution to satisfy customer needs (E. A., Morash, et al, 1996; I., de la Calle, et al, 2021). Information sharing and collaboration between functions within an organization enhances the organization for shared decision-making. This can improve the organization's ability to process the available information. An effective collaboration will help reduce inventory, errors, rework, and speed of each activity. This

means that it can reduce production cycle time and costs and increase flexibility (B. B., Flynn, X., et al., 2016). Therefore, the hypothesis developed is as follows:

- H2a. Supplier integration has a positive impact on operational performance
- H2b. Customer integration has a positive impact on operational performance
- H2c. Internal integration has a positive impact on operational performance

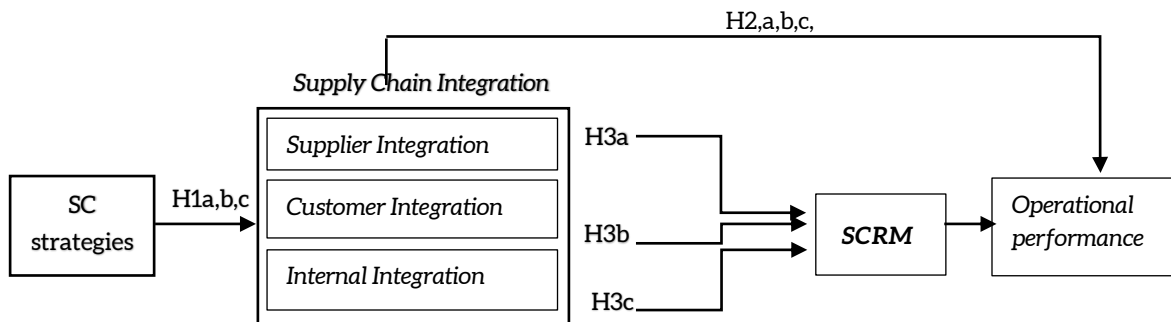
**Supply Chain Risk Management as a mediator**

The relationship between suppliers, customers, and internal integration and company performance has been an active research area, and several studies show SCI significantly affects operational performance (Danese and Romano, 2011; Flynn et al., 2010; Huo, 2012; Schoenherr and Swink, 2012). However, some studies have also reported mixed findings regarding the relationship between firm performance and different SCI dimensions (Devaraj et al, 2007; Gimenez and Ventura, 2005; Koufteros et al., 2005).

Some researchers also argue that higher levels of integration increase dependencies between supply chain relationships (Perrow, 1984) and may result in increased vulnerability to risk (Wieland and Wallenburg, 2013) and inflexibility (Terjesen et al., 2012). Therefore, SCRM can help reduce uncertainty and ambiguity (Fan et al., 2017) and also increase flexibility. Companies need to develop SCRM to more adequately detect, prevent, mitigate and respond to supply chain risks and improve their responsiveness to environmental changes. SCRM equips companies with the ability to identify and control potential risks, thereby contributing to improved performance. Although the Role of SCRM in mediating the relationship between SCI and operational performance has been proven in research conducted by Manal Munir, et al, 2020, the Role of SCRM in explaining the relationship between integration and performance has been ignored at this time. To further reaffirm the Role of SCRM as a mediator between SCI and operational performance, the following hypothesis is developed in this study:

- H3a. SCRM mediates the relationship between supplier integration and operational performance.
- H3b. SCRM mediates the relationship between customer integration and operational performance
- H3c. SCRM mediates the relationship between internal integration and operational performance

**Research Model**



**Figure 1.** Conceptual model

**RESEARCH METHODOLOGY**

**Population and Sampling**

This study collected data from small and medium-sized enterprises in Yogyakarta, Indonesia. Samples were collected through convenience sampling and purposive sampling methods. Convenience sampling is indefinite non-probability sampling, where samples are selected from members of the

population that are easy to find and interview. Purposive sampling is a method of selecting samples based on certain considerations (Ghozali, 2005). In determining the number of samples, Hair, et al, (2009), stated that the minimum number of samples for SEM analysis is 100 to 200. Given the proportion of the number of samples suggested by experts, the researcher determined that the sample in this study amounted to 350 SME respondents to anticipate outlier data. After applying the data examination steps, the final sample consisted of 343 responses. Profiles and demographics are presented in Table 1.

**Table 1.** Profile summary

Demographic information	Frequency	(%)
<i>Business age</i>		
6 month - 1 years	89	25,94%
> 1 - 3 years	161	46,94%
> 3 - 5 years	58	16,91%
> 5 years	35	10,20%
<i>Position</i>		
Employees	34	9,91%
Owner	243	71,84%
Manager	66	19,24%
<i>Industry</i>		
Food	205	59,77%
Beverage	130	37,90%
Services	8	2,33%

Based on the data in Table 1, a demographic descriptive analysis for a total of 343 business units was carried out with details of businesses aged between 6 months to 1 year, totalling 89 units, which covered 25.94% of the total sample. Businesses with an age of more than 1 year to 3 years are the largest group, with 161 units, accounting for 46.94%. Businesses that have been operating for more than 3 to 5 years were recorded as many as 58 units, or 16.91%. Finally, businesses that are more than five years old totalled 35 units, which represented 10.20% of the total sample. In terms of job positions, the majority of respondents are business owners, with a total of 243 individuals or 71.84% of the total respondents. Managers occupy the second position with 66 individuals or 19.24%; the rest, 34 individuals, are employees with a percentage of 9.91%. Descriptions of respondents from the industrial sector are mostly in the food industry, with 205 business units covering 59.77% of the total. The beverage industry is 130 units, representing 37.90%. Meanwhile, the service industry only consists of 8 business units, which contribute 2.33%. This data shows a diverse distribution in terms of business age, job position, and industry sector. The majority of businesses are in the food sector, owned by business owners, and most are between 1 and 3 years old.

#### **Data collection instrument**

The study will employ a quantitative research methodology involving the collection and analysis of survey data from SMEs. The findings will contribute to a deeper understanding of how supply chain management practices, particularly supply chain strategy, S.C. integration, and S.C. risk management, can be leveraged to drive operational excellence.

Variable measurements are developed based on a comprehensive investigation of the existing literature. The survey is divided into two parts: the first part is designed to collect information about the demographic profiles of respondents, while the second part contains theoretical construction measurements for the study. All constructions were measured reflectively, and participants were asked to determine their level of agreement/disagreement with each statement using a five-point Likert scale, where "1" indicates strong disagreement and "5" represents strong agreement. The items that make up the survey include four constructs, each of which is measured by its dimensions. The constructs in this study include *Supply Chain Strategies*, *Supply Chain Integration*, *Supply Chain Risk Management* and *Operational Performance*. Strategic Supply Chain, Supply Chain Integration and Operational performance are measured by adopting an instrument developed by S. Kunnappapdeelert and K. Pitchayadejanant, 2021, while the instrument to measure *Supply Chain Risk Management* is adopted from the research of Manal Munir, et al, 2020.

### **Analytical methods**

We used PLS-SEM to analyze the relationships developed in this study. PLS-SEM is used because of its ability to predict complex models (Akter et al., 2017). In addition, our model estimation is carried out in two ways: first, a measurement model regarding validity and reliability statistics is identified, and second, an analysis of a structural model in which relationships are identified (Dubey et al., 2019). SMART PLS 3.2.7 is used as a tool to analyze data, validate models, and verify hypotheses. The choice of use of PLS-SEM is based on its ability to estimate causal relationships among all latent constructs simultaneously while handling measurement errors in structural models (Hair et al, 2014,2016). In addition, according to Sinkovics et al. (2016), PLS-SEM is suitable for use because its purpose is to identify key drive constructs, its sample size is small, and the data is not normally distributed. The same reference argues that using the PLS-SEM approach is equivalent to assessing two models: the outer model and the inner model.

### **Measurement model**

Validity and reliability analysis is a crucial step in research involving the measurement of latent variables. In this study, the validity and reliability of the construct were measured using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method. The data analyzed includes several constructs, namely S.C. Strategies, Customer Integration, Internal Integration, Supplier Integration, SC Risk Management, and Operational Performance.

In the first step, the reliability and validity (convergence and discrimination) of all measurement models are determined. The extracted mean-variance (AVE) showed a value of <0.5; it can be concluded that most of the constructs have inadequate convergent validity. However, the composite reliability (C.R.) and Cronbach's Alpha values of each construct are above the threshold value, which is 0.4 (Noor, 2017), which indicates the reliability of each latent construct and its measurements. In addition, the loading factor values are in the range of 0.4 and 0.7 and are also significant at the level of 0.01, as presented in Table 2. As a general rule, an outer loading value greater than 0.7 is considered good, while a value between 0.4 and 0.7 is still acceptable depending on the context of the research and model construction (Hair et al., 1998; Trianasari et al., 2022). In this study, all indicators had an outer loading value above 0.4, which shows a fairly strong contribution to the construction. Further, the Fornell and Larcker (1981) criteria were followed to obtain strong evidence of sufficient validity of discrimination. The square root of the AVE is measured against all construction correlations to meet the criteria. The results presented in Table 3 show that the validity of the discrimination has been confirmed to meet the F.L. criteria.

**Table 2.** Construct reliability and validity

Construct	Item	Outer loading	AVE	Cronbach's Alpha	CR
SC Strategies	X1.1	0,590	0,356	0,545	0,731
	X1.2	0,463			
	X1.3	0,656			
	X1.4	0,690			
	X1.5	0,557			
Customer Integration	X2.1	0,588	0,404	0,630	0,769
	X2.2	0,775			
	X2.3	0,598			
	X2.4	0,528			
	X2.5	0,661			
Internal Integration	X3.1	0,673	0,437	0,572	0,756
	X3.2	0,669			
	X3.3	0,610			
	X3.4	0,691			
Supplier Integration	X4.1	0,533	0,352	0,633	0,765
	X4.2	0,566			
	X4.3	0,624			
	X4.4	0,601			
	X4.5	0,622			
	X4.6	0,609			
SC Risk Management	X5.1	0,718	0,477	0,637	0,784
	X5.2	0,648			
	X5.3	0,737			
	X5.4	0,655			
Operational Performance	Y1	0,475	0,341	0,781	0,836
	Y2	0,588			
	Y3	0,591			
	Y4	0,567			
	Y5	0,588			
	Y6	0,488			
	Y7	0,701			
	Y8	0,494			
	Y9	0,706			
	Y10	0,589			

**Table 3.** Fornell-Larcker criteria

	Customer Integration	Internal Integration	Operational Performance	SCRM	Supplier Integration	Supply Chain Strategies
Customer Integration	0,636					
Internal Integration	0,609	0,661				
Operational Performance	0,788	0,715	0,584			
SCRM Capability	0,541	0,564	0,698	0,691		
Supplier Integration	0,606	0,587	0,670	0,535	0,593	
Supply Chain Strategies	0,530	0,582	0,617	0,517	0,527	0,597

## RESULTS AND ANALYSIS

The path estimation from the PLS-SEM analysis is presented in Figure 2. The path coefficients of the bootstrapping results and each p-value for testing the hypothesis are shown in Table 4, where the t-

statistics are greater than 1.96, and the p-value is less than 0.05. These results show that all hypotheses are supported. Hypothesis 1a,1b,1c, which tests the influence of supply chain strategy on Supply Chain Integration, is supported. Likewise, hypotheses 2a, 2b and 2c, which test the influence of Supply Chain Integration on Operational Performance, are also supported.

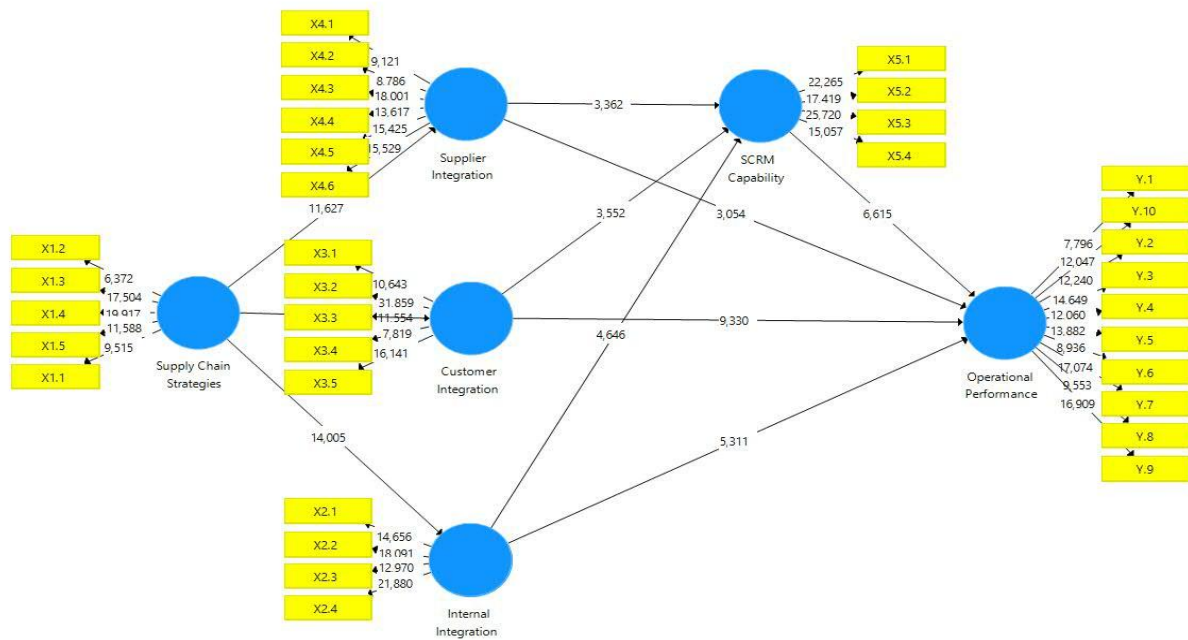


Figure 2. Hypothesized model

Table 4. Path estimates

	Standard Deviation	T Statistics ( O/STDEV )	P-values	Results
SC Strategies → Supplier Integration	0,045	11,627	0,000	H1a Accepted
SC Strategies → Customer Integration	0,049	10,821	0,000	H1b Accepted
SC Strategies → Internal Integration	0,042	14,005	0,000	H1c Accepted
Supplier Integration → Performance	0,045	3,054	0,002	H2a Accepted
Customer Integration → Performance	0,045	9,330	0,000	H2b Accepted
Internal Integration → Performance	0,042	5,311	0,000	H2c Accepted

These results confirm that supply chain strategy plays a critical role in improving supply chain integration, which in turn has a positive impact on operational performance. Each hypothesis tested (H1a, H1b, H1c, H2a, H2b, H2c) is accepted, indicating the importance of strategic planning in supply chain management to achieve superior operational outcomes. Strong statistical significance across all relationships underscores the critical role of integration at various levels in the supply chain. The findings in this study reaffirm the importance of lean and agile strategies in supply chain management. In line with research conducted by S. Kunnapapdeelert and K. Pitchayadejanant, 2021, companies whose supply chains are lean or agile will be more successful in connecting their internal improvement processes with external suppliers and customers.

The results of the data analysis in Table 5, which tests the mediation role of S.C. risk management, show that all hypotheses are supported. Hypothesis 3a is accepted, suggesting that supply chain risk management significantly mediates the relationship between supplier integration and operational performance. The p-value of 0.005 is less than the typical significance level of 0.05, which confirms the statistical significance of this mediating effect. Likewise, hypothesis 3b is accepted, suggesting that supply chain risk management significantly mediates the relationship between

customer integration and operational performance. A very low p-value of 0.001 further strengthens the evidence of a significant mediation effect. Furthermore, the 3c hypothesis is also accepted, which shows the significant mediating role of supply chain risk management in the relationship between internal integration and operational performance. A p-value of 0.000 indicates solid evidence of mediation.

The analysis confirms that supply chain risk management plays a significant mediating role in the relationship between various aspects of supply chain integration (suppliers, customers, and internals) and operational performance. Each hypothesis tested (H3a, H3b, H3c) was accepted, demonstrating the robustness of the mediation effect in different types of integration in the supply chain. These findings underscore the importance of managing supply chain risks to increase the positive Impact of supply chain integration on operational performance. These results also reaffirm previous research conducted by Manal Munir et al, 2020, that SCRM has an important role in mitigating and responding to risks that often arise when companies integrate S.C. so that companies can improve their performance optimally.

**Table 5.** Mediation estimates

	Standard Deviation	T Statistics	P-values	Results
Supplier Integration → SCRM → Performance	0,022	2,807	0,005	H3a Accepted
Customer Integration → SCRM → Performance	0,018	3,336	0,001	H3b Accepted
Internal Integration → SCRM → Performance	0,021	3,740	0,000	H3c Accepted

## CONCLUSION AND IMPLICATIONS

This study comprehensively examines the Impact of S.C.'s strategy on supply chain integration and the influence of supply chain integration on operational performance. This study also examines the mediation role of S.C. Risk management in the relationship between S.C. integration and operational performance. The results indicate that the Implementation of the right supply chain strategy and strengthening supply chain integration can significantly improve the company's operational performance. In addition, the mediating role of supply chain risk management strengthens the relationship between supply chain integration and operational performance. These results show the importance of risk management in maintaining operational stability and efficiency. Companies must focus on these three aspects to achieve competitive advantage and sustainability in their operations.

This study offers several insights for managers. First, managers need to formulate and implement a strong supply chain strategy to drive integration with suppliers, customers, and internally. A comprehensive strategy will help ensure all parts of the supply chain work synergistically to achieve better operational goals. Second, management should focus on improving supply chain integration through closer collaboration with suppliers and customers and improving internal coordination. These efforts can include the use of advanced information technology, the development of long-term relationships with supply chain partners, and the establishment of cross-functional teams. Finally, it is important for companies to adopt effective supply chain risk management practices. This includes identifying, evaluating, and mitigating risks that may disrupt the flow of the supply chain. With good risk management, companies can minimize the negative Impact of disruptions and improve overall operational performance. Managers must be aware of the importance of integrative practices in reducing supply chain risk. Key supply chain partners are sources of external environmental information which are important inputs to the company's decision-making process, especially in risk-prone situations, while cross-functional integration among different departments acts as information processing capabilities to absorb, process, and implement information in a timely manner to respond to changes in the external environment.

The weakness in this study lies in the inadequate convergence validity; for future research, it is necessary to revise items with low outer loading or consider adding or replacing indicators that are in accordance with the SME object to increase the validity and reliability of the construct in this research model.

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