LEVERAGING SUPPLY CHAIN INTEGRATION FOR OPERATIONAL EXCELLENCE: THE MEDIATING ROLE OF PRODUCT INNOVATION CAPABILITY IN INDONESIAN APPAREL SMES

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Abstract

This study investigates the effect of supply chain integration, comprising internal, supplier, and customer integration, on operational performance, with product innovation capability as a mediating variable, in Indonesian apparel SMEs. Using a quantitative approach, survey data were collected from 151 respondents selected through purposive sampling and analyzed using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results reveal that all three dimensions of supply chain integration positively and significantly enhance product innovation capability, which in turn strongly improves operational performance. Furthermore, product innovation capability mediates the relationship between each integration dimension and operational performance, underscoring its role as a strategic link between supply chain coordination and performance outcomes. The findings contribute to the literature by integrating the dynamic capability perspective into the supply chain innovation performance nexus and highlight the need for SMEs to strengthen both integration and innovation capabilities to achieve operational excellence and competitiveness. Practical implications and recommendations for future research are also discussed.

Keywords: Supply Chain Integration, Product Innovation Capability, Operational Performance, SMEs, Dynamic Capability

INTRODUCTION

The manufacturing industry continues to demonstrate significant growth, particularly in the textile and apparel sectors, which contributed 5.90% and 2.64% year-on-year, respectively (Firman Hidranto, 2024). The sustained increase in apparel demand reinforces this sector's position as a major contributor to business growth in Indonesia. Apparel not only serves as a basic necessity but also as a symbol of identity and lifestyle, making it a strategic sector for attracting investment and influencing national industrial policy (Mardalius & Christy, 2020; Salim & Ernawati, 2015). This condition has also driven the expansion of the garment and retail industries, including Small and Medium Enterprises (SMEs), which play an essential role in national economic development.

SMEs possess advantages in generating employment, adapting to change, and improving productivity through the adoption of technology and investment (Astuti et al., 2018). However, amid an increasingly competitive global economy, SMEs must enhance the efficiency of their operational management and supply chain systems. One strategic approach to managing such complexity is supply chain integration, which encompasses coordination between internal functions and external collaboration with business partners (Jiang et al., 2023). Barriers that hinder SMEs from actively participating in supply chain integration can obstruct the execution of well-coordinated value creation strategies (Ali et al., 2022). Well-implemented integration is believed to strengthen operational sustainability through coordinated flows of information, products, and services (Budiman, 2017).

Supply chain integration plays a crucial role in improving operational performance by combining internal and external integration to maximize information sharing, coordination, and collaboration aimed at achieving superior performance (Masa'deh et al., 2022). Nevertheless, the influence of supply chain integration on operational performance is not always direct. Its effectiveness depends greatly on product innovation capability, a firm's ability to create, develop, and adapt products to remain relevant to market dynamics (Najafi-Tavani et al., 2018). This aligns with the concept of dynamic capability, which emphasizes organizational flexibility in responding to changes in the business environment.

Previous studies remain limited in examining the relationship between supply chain integration and operational performance by incorporating product innovation capability as a mediating variable, particularly in the apparel industry. Most prior research has focused on the direct relationship between supply chain integration and operational performance, without considering the mediating role of product innovation capability. In fact, the success of operational performance in manufacturing organizations is largely determined by the extent of their innovation capability (Iranmanesh et al., 2021).

Given this research gap, this study aims to empirically examine the mediating role of product innovation capability in the relationship between the dimensions of supply chain integration (internal, supplier, and customer) and operational performance in SMEs within Indonesia's apparel industry. The findings of this study are expected to contribute both theoretically and practically to the development of supply chain strategies and product innovation initiatives among SME practitioners.

REVIEW OF LITERATURE

Dynamic Capability

The concept of dynamic capability was first introduced by Teece et al. (1997) and refers to a firm's capacity to systematically integrate, develop, and reconfigure internal and external competencies in response to rapidly changing environments (Teece, Pisano, & Shuen, 1997). In highly volatile environments, this capability serves as a critical foundation for firms to maintain or even create sustainable competitive advantages. Consequently, dynamic capability is considered highly relevant in continuously evolving business contexts, as it provides strategic flexibility in decision-making (Vu, 2020).

In practice, dynamic capability not only enhances a firm's internal strengths but also aligns them with those of business partners to support value creation and profit enhancement (Teece, 2018). By enabling firms to sense opportunities, seize them, and transform resources in line with environmental shifts, dynamic capability becomes a strategic foundation for long-term performance and adaptability.

Supply Chain Integration and Product Innovation Capability

Internal integration plays a pivotal role in developing product innovation capability by enhancing the efficiency of innovation stages. The involvement of internal integration in new product development processes helps accelerate workflows and minimize the risks of delays and resource wastage (Turkulainen & Ketokivi, 2012). Furthermore, information sharing across departments, such as marketing and production, supports the development of product innovation capability (Caridi et al., 2012). This perspective is reinforced by Freije et al. (2022), who found that internal integration positively and significantly contributes to product innovation capability. Cross-functional coordination fosters strategic collaboration and goal alignment in product development activities.

Supplier integration also contributes to the success of product innovation, even though its influence is not solely dependent on internal integration levels (Un et al., 2010). Involving suppliers in the product development process can enhance the innovative capacity of manufacturing firms (Lii & Kuo, 2016). Innovation-oriented companies tend to establish integrated relationships with both suppliers and customers to strengthen collaboration, engage in intensive information sharing, and align business processes for competitive advantage (Kalyar et al., 2020).

Collaboration between companies and customers makes a tangible contribution to enhancing innovation capability (Xu et al., 2019). Customer involvement not only broadens the pool of ideas but also deepens the understanding of consumer preferences. The innovation network approach emphasizes synergy between firms and external partners such as customers, suppliers, and even competitors to strengthen innovation capacity (Najafi-Tavani et al., 2018). Based on these arguments, the following hypotheses are formulated:

H1a: Internal integration positively affects product innovation capability.
H1b: Supplier integration positively affects product innovation capability.
H1c: Customer integration positively affects product innovation capability.

Product Innovation Capability and Operational Performance

Firms with strong innovative capacity can identify, acquire, and apply knowledge more effectively across organizational units (Saulina, 2016). This capability fosters efficient work systems and responsiveness to business environments. Product innovation capability has

been shown to positively and significantly influence operational performance (Pradana & Safitri, 2023; Ranatiwi & Mulyana, 2018).

As one of the key drivers of operational performance, product innovation capability determines the extent to which manufacturing organizations can improve their processes and outputs (Iranmanesh et al., 2021). Ali et al. (2022) further confirmed that both product and organizational innovation capabilities have a significant positive effect on operational and financial performance among SMEs.

H2: Product innovation capability positively affects operational performance.

Supply Chain Integration, Product Innovation Capability, and Operational Performance

In facing the growth challenges of SMEs, implementing supply chain integration is essential to improving operational performance (Yoga et al., 2022). This integration extends beyond internal processes to include collaboration with suppliers and customers. Information sharing and coordination within the supply chain can increase inventory transparency, reduce the bullwhip effect, shorten lead times, lower costs, and improve supply chain profitability, ultimately enhancing operational performance (Flynn et al., 2010).

Beyond operational improvements, supply chain integration is also linked to innovation. (Lii & Kuo (2016) noted that innovation plays a role in influencing supply chain integration and, in turn, affects firm performance. Najafi-Tavani et al. (2018) emphasized that supply chain integration positively affects product innovation capability, which then contributes to operational performance.

The relationship between supply chain integration and operational performance is not always direct. In fast-changing business environments, firms must adapt their products to market needs, making product innovation capability a critical bridge between integration and desired operational outcomes. Arshad Ali & Mahmood (2024) demonstrated that product innovation capability mediates the relationship between supply chain integration and operational performance.

Based on this reasoning, the following hypotheses are proposed:

H3a: Product innovation capability mediates the relationship between internal integration and operational performance.

H3b: Product innovation capability mediates the relationship between supplier integration and operational performance.

H3c: Product innovation capability mediates the relationship between customer integration and operational performance.

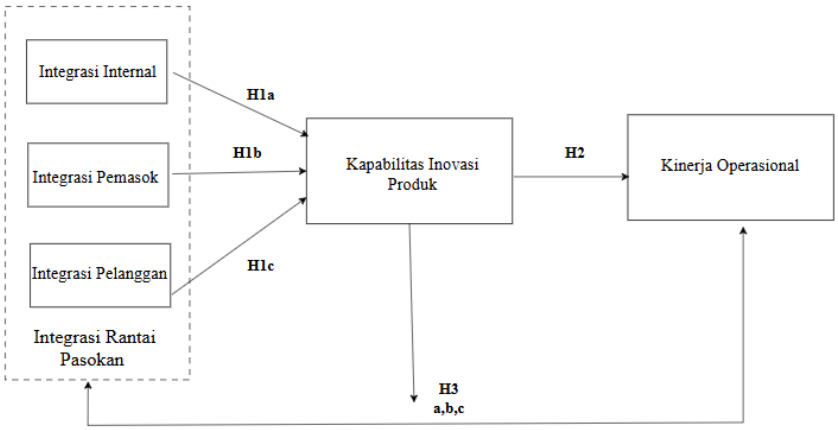


Figure 1
Conceptual model

RESEARCH METHOD

This study employs a quantitative approach using a survey method and Structural Equation Modelling-Partial Least Squares (SEM–PLS) analysis. The quantitative approach is chosen because it is appropriate for systematically and measurably testing causal relationships among variables (Mawa & Cahyadi, 2021). The survey method was used to obtain quantitative data from respondents via a questionnaire, which was then analyzed to identify the effects of the independent variable (supply chain integration) on the dependent variable (operational performance), while considering the mediating variable (product innovation capability). This approach is aligned with the research objective of examining both direct and indirect relationships among variables in the context of SMEs in the apparel industry.

The research location was SMEs operating in Indonesia's apparel industry. This location was chosen due to the high concentration of SMEs actively engaged in production and distribution activities. The study was conducted from April to July, with the timing and location designed to obtain relevant and up-to-date data on supply chain activities and product innovation in this sector. Location selection is an important element in quantitative research, as it helps clarify the research object and facilitates the implementation process (Wibawa Lafaila et al., 2022).

The population of this study comprises all SMEs in the apparel industry operating in Indonesia. SMEs were selected as the population due to their diversity in business scale, business models, and level of involvement in the national supply chain system. The sample was determined using purposive sampling, a non-probability technique that applies specific criteria to select relevant respondents, namely, SME owners or managers actively involved in apparel production and distribution. Because the exact population size is unknown, the sample size was determined following Hair et al. (2019), which suggests a range of five to ten times the number of indicators in the research questionnaire. With 21 indicators, the required sample size ranges from 105 to 210 respondents.

Primary data were collected using a closed-ended questionnaire with a 1- 5 Likert scale, distributed to respondents meeting the criteria for SMEs in Indonesia's apparel industry. The questionnaire items were adapted from validated and reliable prior studies and contextually adjusted to suit the research setting. Supply chain integration, consisting of internal, supplier, and customer integration, was measured with 12 items based on Chamdan et al. (2020). Product innovation capability was measured with four items, also based on Chamdan et al. (2020). Operational performance was measured with five items based on Taghizadeh et al. (2020). The analysis stages included:

1. Instrument testing through convergent validity, discriminant validity, and internal reliability (composite reliability and Cronbach's alpha).
2. Measurement model evaluation (outer model).
3. Structural model evaluation (inner model) using SEM–PLS with SmartPLS version 4 software.

SEM–PLS was selected because it can handle complex models with a large number of indicators, is robust against non-normal data distribution, and is suitable for exploratory research examining mediation relationships among variables.

RESULTS AND DISCUSSION

Measurement model

The evaluation of the outer model revealed that several indicators did not meet the threshold values for convergent and discriminant validity. As a result, six indicators (INT2, INT4, INT6, SUP3, CUS2, and PIC1) were removed from the model to enhance measurement accuracy and ensure the reliability of subsequent analyses. Convergent validity was assessed by examining the outer loading values of each indicator. All remaining items demonstrated loadings above 0.70, thereby meeting the minimum standard for validity (Hair et al., 2019).

As presented in Table 1, all indicator loadings exceeded the threshold value of 0.70, confirming convergent validity. Furthermore, all constructs demonstrated adequate reliability, with Cronbach's Alpha and Composite Reliability values ranging from 0.809 to 0.941, well above the recommended minimum of 0.70. The AVE values for all constructs were also greater than 0.50, with the highest being 0.839 for Operational Performance. These results indicate that each construct possesses sufficient internal consistency and that the indicators appropriately measure their intended latent variables

Table 1.
Reliability and Convergent Validity

Construct	Item	Loading Factor	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
Internal Integration	INT1	0.889	0.861	0.794	0.906	0.829
	INT3	0.891				
	INT5	0.874				
Supplier Integration	SUP1	0.915	0.809	0.865	0.915	0.783
	SUP2	0.918				
Customer Integration	CUS1	0.909	0.794	0.941	0.955	0.810
	CUS2	0.912				

Construct	Item	Loading Factor	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
Product Innovation Capability	PIC2	0.886	0.844	0.844	0.906	0.762
	PIC3	0.870				
	PIC4	0.864				
Operational Performance	KOP1	0.911	0.941	0.809	0.914	0.839
	KOP2	0.889				
	KOP3	0.919				
	KOP4	0.880				
	KOP5	0.899				

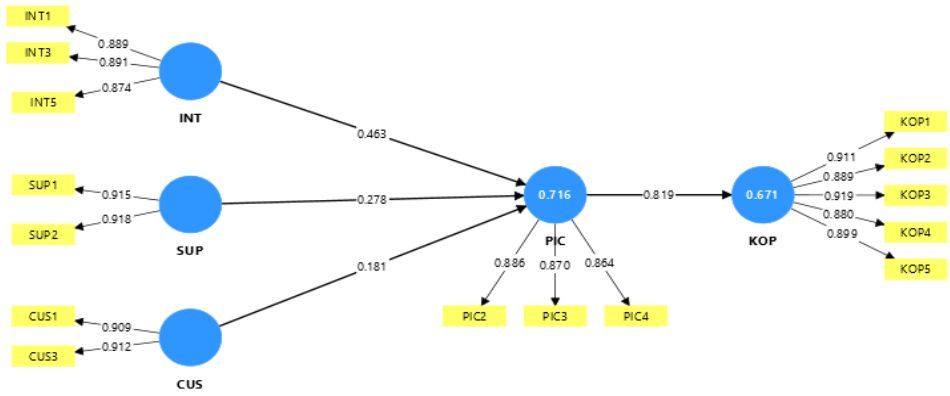
Discriminant validity was assessed using the Fornell–Larcker criterion, as shown in Table 2. The square root of AVE (diagonal values in bold) was greater than the correlations between constructs, thereby confirming discriminant validity. For instance, the square root of AVE for Internal Integration (0.910) was higher than its correlations with Supplier Integration (0.612) and Customer Integration (0.583). Similar patterns were observed across all constructs, indicating that each construct is empirically distinct from the others.

The confirmation of both convergent and discriminant validity ensures the robustness of the measurement model, which provides a strong foundation for further structural model analysis. These findings imply that the constructs of supply chain integration, product innovation capability, and operational performance were measured reliably and distinctly, enabling accurate testing of the hypothesized relationships.

Table 2.
Discriminant Validity (Fornell–Larcker Criterion)

Construct	INT	SUP	CUS	PIC	KOP
Internal Integration (INT)	**0.910**				
Supplier Integration (SUP)	0.612	**0.885**			
Customer Integration (CUS)	0.583	0.645	**0.900**		
Product Innovation Capability (PIC)	0.621	0.603	0.554	**0.873**	
Operational Performance (KOP)	0.634	0.655	0.601	0.679	**0.916**

Figure 2.
Outer Loading Values of the Initial Model



Inner Model Evaluation (R^2 and Q^2)

In the evaluation of the inner model, the coefficient of determination (R^2) values indicated a substantial explanatory power of the model. Product innovation capability recorded an R^2 value of 0.716, while operational performance scored 0.671, both surpassing the 0.50 benchmark suggested by (Halin et al., 2017). These results demonstrate that the independent variables collectively explained a substantial proportion of variance in the mediating and dependent variables. The predictive relevance (Q^2) of the model, assessed through the blindfolding procedure, also confirmed its robustness. The Q^2 values for product innovation capability 0.705 and operational performance 0.689 were greater than zero, which indicates that the structural model possesses adequate predictive relevance (Nurhalizah et al., 2024). Taken together, these results confirm that the model is both explanatory and predictive, thus suitable for hypothesis testing in the SME apparel industry context, as shown in Table 3.

Table 3.
R^2 and Q^2 Values of the Structural Model

	R square	R-square adjusted	Q Square
Product Innovation Capability	0.716	0.710	0.716
Operational Performance	0.671	0.699	0.671

Hypothesis Test Results

The results of hypothesis testing confirmed the significance of both direct and indirect relationships in the proposed model. For the direct effects, internal integration ($\beta = 0.463$; $p = 0.000$), supplier integration ($\beta = 0.278$; $p = 0.002$), and customer integration ($\beta = 0.181$; $p = 0.008$) were all found to significantly enhance product innovation capability. In turn, product innovation capability exerted a strong positive effect on operational performance ($\beta = 0.819$; $p = 0.000$). These findings suggest that greater integration both internally and externally improves the firm's ability to innovate, which subsequently strengthens operational outcomes.

The mediation analysis provided further insights into the mechanisms underlying these relationships. Product innovation capability was found to mediate the link between internal

integration and operational performance (β = 0.380; *p* = 0.000), supplier integration and operational performance (β = 0.228; *p* = 0.002), as well as customer integration and operational performance (β = 0.148; *p* = 0.009). This implies that the benefits of supply chain integration are most effectively realized when firms are able to translate integration efforts into enhanced innovation capacity. To provide a clearer picture, the results of the hypothesis testing are presented in Table 4, which summarizes the path coefficients, t-statistics, and significance levels for both direct and indirect effects.

Table 1.
Hypothesis Testing Summary

Hypothesis Path	Type	Coefficient (β)	T Statistics	P values	Result
INT→PIC	Direct	0.463	5.026	0.000	Significant
SUP→PIC	Direct	0.278	3.058	0.002	Significant
CUS→PIC	Direct	0.181	2.646	0.008	Significant
PIC→KOP	Direct	0.819	29.337	0.000	Significant
INT→PIC→ KOP	Indirect	0,380	4,764	0,000	Significant
SUP→PIC→ KOP	Indirect	0,228	3,109	0,002	Significant
CUS→PIC→ KOP	Indirect	1,148	2,611	0,009	Significant

These results align with and extend previous research. For instance, Freije et al. (2022) emphasized the role of internal collaboration in improving innovation responsiveness, while Lii & Kuo (2016) highlighted the value of involving suppliers in product development to strengthen innovation capacity. Similarly, Kalyar et al. (2020) and Xu et al. (2019) identified customer integration as a critical driver of innovative capability, as customers often provide unique insights into product needs and market preferences. The present study confirms these perspectives within the context of Indonesian apparel SMEs, demonstrating that both internal and external integration foster an environment conducive to innovation.

Furthermore, the strong positive link between product innovation capability and operational performance is consistent with the findings of Ali et al. (2022) and Ranatiwi & Mulyana (2018), which showed that innovative firms are better positioned to streamline processes, reduce lead times, and respond effectively to market changes. In the highly competitive apparel sector, innovation not only affects the end product but also transforms operational systems, enabling SMEs to achieve greater efficiency and quality in production.

The mediating role of product innovation capability also reflects the theoretical foundations of the dynamic capability framework (Teece, 2018). By effectively integrating resources across internal functions, suppliers, and customers, SMEs develop adaptive mechanisms that allow them to sense opportunities, seize them through innovation, and reconfigure processes to achieve superior operational performance. This finding underlines the notion that integration alone may not guarantee operational excellence; rather, its impact is maximized when combined with the firm's ability to innovate.

In sum, the empirical evidence from this study reinforces the critical importance of both supply chain integration and product innovation capability for operational success in SMEs. The interplay between integration and innovation not only enhances competitiveness but also equips firms to navigate the volatility of today's business environment.

CONCLUSION

This study examined the influence of supply chain integration comprising internal, supplier, and customer integration on operational performance, with product innovation capability serving as a mediating variable, in the context of Indonesian apparel SMEs. The empirical findings confirmed that all three dimensions of supply chain integration positively and significantly enhance product innovation capability. Moreover, product innovation capability was found to exert a strong positive impact on operational performance, underscoring its role as a key driver of operational excellence.

The mediation analysis further revealed that product innovation capability significantly bridges the relationship between each integration dimension and operational performance. This indicates that the benefits of supply chain integration are maximized when SMEs are able to translate integration into innovative product development. Without such capability, the potential of integration to improve operational outcomes may remain underutilized.

Theoretically, this research contributes to the supply chain and innovation literature by integrating the dynamic capability perspective into the relationship between supply chain integration and operational performance. By demonstrating the mediating role of product innovation capability, the study addresses a gap in prior research, which has often examined these relationships in isolation. The findings confirm that integration alone is insufficient; it is the firm's adaptive capacity to innovate that transforms integration into tangible performance gains.

From a practical standpoint, the results offer valuable implications for SME managers and policymakers. For managers, strengthening cross-functional coordination, fostering close collaboration with suppliers, and actively engaging customers can create an innovation-enabling environment. Policymakers, on the other hand, may design targeted support programs—such as supplier development initiatives, collaborative design platforms, and customer feedback mechanisms to facilitate both integration and innovation among SMEs

Despite these contributions, the study has several limitations. First, the sample was limited to 151 respondents within the apparel sector, which may restrict the generalizability of the results to other industries. Second, the measurement of external integration relied on only two indicators for each dimension, potentially limiting the depth of analysis. Third, the cross-sectional design of this study does not capture dynamic changes in the relationships over time.

Future research may address these limitations by expanding the sample size, including SMEs from diverse sectors, and enriching the measurement of external integration with more comprehensive indicators. Longitudinal designs are also recommended to track how integration, innovation, and performance evolve in response to market and technological shifts. Such extensions would provide a more nuanced understanding of sustainable supply chain and innovation practices, particularly for SMEs navigating volatile business environments.

In conclusion, this study affirms that in the fast-paced and competitive apparel industry, operational excellence is achieved not merely through supply chain integration but through the synergistic interaction between integration and innovation capability. SMEs that

successfully combine these elements are better positioned to enhance efficiency, responsiveness, and long-term competitiveness.

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