“The moderating role of ICT capability in the relationship between supply chain integration and supply chain performance in manufacturing firms in Vietnam”

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THE MODERATING ROLE OF ICT CAPABILITY IN THE RELATIONSHIP BETWEEN SUPPLY CHAIN INTEGRATION AND SUPPLY CHAIN PERFORMANCE IN MANUFACTURING FIRMS IN VIETNAM

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Abstract

Supply chain integration has become critical for improving firm performance in highly competitive and uncertain manufacturing environments. This study examines the relationships between supplier integration, internal integration, customer integration, and supply chain performance, while also investigating the moderating role of information and communication technology (ICT) capability in Vietnamese manufacturing firms. The study uses survey data collected from 386 middle and senior managers during 2024 and applies partial least squares structural equation modeling (PLS-SEM) to test six hypotheses grounded in the resource-based view (RBV) and the extended resource-based view (ERBV). The results indicate that supplier integration ($\beta = 0.249$, $p < 0.001$), internal integration ($\beta = 0.357$, $p < 0.001$), and customer integration ($\beta = 0.388$, $p < 0.001$) are positively associated with supply chain performance. The model explains 71.1% of the variance in supply chain performance. The findings suggest that the moderating role of ICT capability is more evident in the relationships between supplier integration, internal integration, and supply chain performance than in the relationship between customer integration and supply chain performance. This study contributes to the supply chain integration literature by providing evidence from an emerging economy and highlighting the heterogeneous moderating role of ICT capability across different dimensions of supply chain integration.

Keywords supply chain integration, ICT capability, supply chain performance, manufacturing firms, Vietnam

JEL Classification M11, L23, O32

INTRODUCTION

Manufacturing firms are increasingly operating in complex environments characterized by supply disruptions, rapid technological change, and intensifying global competition (Ivanov & Dolgui, 2020). In such environments, coordination among supply chain partners and internal functional units is considered essential for achieving operational efficiency and maintaining supply chain performance (Wong et al., 2011). Supply chain integration, which reflects the extent to which firms collaborate and share information with suppliers, coordinate activities across internal functions, and work closely with customers, has therefore attracted considerable attention in both academic research and managerial practice (Flynn et al., 2010). Information and communication technology (ICT) is widely recognized as an important organizational capability that facilitates information sharing, communication, and process synchronization across supply chain activi-

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ties (Vanpoucke et al., 2017). However, despite extensive research on supply chain integration, previous studies have reported mixed findings regarding its relationship with organizational performance, and the role of ICT capability in shaping these relationships remains insufficiently understood.

Vietnam provides a particularly relevant context for examining these issues. Manufacturing remains a key pillar of the national economy and a major contributor to industrial production and export growth. According to the Ministry of Industry and Trade of Vietnam (2024), exports of processed and manufactured industrial products reached USD 343.7 billion in 2024, representing a 14.2% increase compared with 2023 and accounting for nearly 85% of the country's total export value. As the leading export sector, manufacturing has played a critical role in strengthening Vietnam's participation in global value chains and attracting substantial foreign direct investment (FDI), particularly in electronics, textiles and garments, leather and footwear, and mechanical engineering industries. At the same time, the Vietnamese government has actively promoted digital transformation through initiatives such as the National Digital Transformation Program, encouraging firms to invest in ICT infrastructure and smart manufacturing technologies.

Despite these developments, significant disparities in technological capability, managerial practices, and ICT adoption continue to exist among supply chain members in Vietnam. Many small and medium-sized enterprises (SMEs) lack sufficient resources to invest in digital technologies, data integration, and international compliance requirements. Consequently, these firms often encounter difficulties in coordinating effectively with supply chain partners, connecting with foreign-invested enterprises (FDI), and upgrading their positions within global value chains. Such challenges suggest that the effectiveness of supply chain integration may depend not only on the extent of integration itself but also on the technological capabilities that support information exchange and collaborative processes across the supply chain.

1. LITERATURE REVIEW

Previous studies have extensively examined the relationship between supply chain integration and supply chain performance from operational, relational, and technological perspectives (Flynn et al., 2010; Cao & Zhang, 2011; Vanpoucke et al., 2017). The increasing complexity of global supply chains has intensified the need for coordination, information sharing, and collaborative decision-making among supply chain members. As competition increasingly occurs between supply chains rather than individual firms, supply chain integration has become an important capability for improving operational efficiency and sustaining competitive advantage (Dyer & Singh, 1998).

Supply chain integration generally refers to the strategic coordination and alignment of processes, information, decisions, and resources both within firms and across external supply chain partners (Stevens, 1989; Mentzer et al., 2001; Flynn et al., 2010). Through collaborative relationships and information sharing, it enables firms to improve responsiveness, reduce operational inefficiencies, and enhance overall operational performance (Chen & Paulraj, 2004; Frohlich & Westbrook, 2001). The literature commonly conceptualizes integration as a multidimensional construct consisting of supplier integration, internal integration, and customer integration (Li et al., 2006; Flynn et al., 2010; Kim, 2006).

Supplier integration focuses on collaborative relationships and information exchange with upstream partners to improve procurement coordination, operational reliability, and supply continuity. Prior studies suggest that effective supplier integration contributes to lower operational costs, shorter lead times, improved delivery flexibility, and enhanced new product development performance (Boon-itt & Wong, 2011; Abdallah et al., 2014; Ganbold et al., 2021). Internal integration emphasizes cross-functional coordination, timely information sharing, and process synchronization within the firm. Strong internal integration improves organizational responsiveness, production planning, operational flexibility, and deci-

sion-making efficiency, thereby enhancing supply chain performance (Flynn et al., 2010; Khalaf & El Mokadem, 2019; Zhao et al., 2013). Customer integration involves strategic collaboration and information sharing with customers to better understand market expectations and improve responsiveness to customer requirements. Prior studies indicate that customer integration improves service quality, customer satisfaction, delivery performance, and collective problem-solving capabilities across supply chain activities (Wong et al., 2011; Yaseen et al., 2018).

Supply chain performance is commonly conceptualized as the capability of the supply chain to efficiently and effectively satisfy customer requirements in terms of cost, quality, flexibility, responsiveness, and delivery performance (Beamon, 1999; Gunasekaran et al., 2001; Hausman, 2004). Existing studies primarily assess supply chain performance from an operational perspective, emphasizing process efficiency and service effectiveness rather than purely financial outcomes (Al-Shboul et al., 2017). Dimensions such as supply chain flexibility, delivery speed, product quality, and cost efficiency are frequently used to evaluate supply chain performance because they reflect firms' operational capability to respond to market and customer demands (Boon-itt & Wong, 2011; Prajogo et al., 2016; Zhao et al., 2013).

Information and communication technology (ICT) is increasingly recognized as a critical capability that supports effective supply chain integration through improved information exchange and inter-organizational coordination. ICT facilitates the collection, processing, and exchange of information across supply chain activities, thereby improving communication, process synchronization, and responsiveness among supply chain partners (Nyambura, 2018). Previous studies indicate that ICT contributes to improved operational efficiency, cost reduction, market responsiveness, and competitive advantage by supporting more effective coordination of internal and external resources (Choshin & Ghaffari, 2017; Wu et al., 2017; Dehning et al., 2007). In practice, technologies such as enterprise systems, enterprise resource planning, customer relationship management, electronic invoice presentation and payment systems, and purchasing cards facilitate information sharing and integration among firms and supply chain partners (Wang, 2017).

The present study is grounded in the resource-based view (RBV) and the extended resource-based view (ERBV). RBV argues that firms achieve superior performance through the effective deployment of valuable, rare, inimitable, and non-substitutable resources and organizational capabilities (Wernerfelt, 1984; Barney, 1991). Within the supply chain management context, capabilities related to coordination, information sharing, and interfunctional integration are increasingly recognized as strategic resources that contribute to operational efficiency and competitive advantage (Dyer & Singh, 1998; Rai et al., 2006). Building upon RBV, the ERBV extends the analysis beyond firm boundaries by emphasizing that interorganizational relationships, collaborative routines, and externally embedded resources can also generate superior performance outcomes (Lavie, 2006; Lai et al., 2012; Xu et al., 2014). From this perspective, supply chain integration and information and communication technology (ICT) capability can be viewed as complementary organizational capabilities that facilitate process synchronization, information exchange, and collaborative decision-making across supply chain partners, thereby enhancing supply chain performance (Flynn et al., 2010; Wong et al., 2011). Moreover, ICT capability may strengthen the effectiveness of supply chain integration by improving coordination efficiency and enabling real-time communication and operational responsiveness across supply chain activities (Rai et al., 2006; Wu et al., 2017; Cai et al., 2016).

Overall, previous studies generally report positive relationships between supply chain integration and various dimensions of organizational and supply chain performance. However, the findings remain mixed regarding the relative importance of supplier integration, internal integration, and customer integration, with some studies reporting inconsistent effects across different contexts and performance measures. Similarly, although ICT capability has been recognized as an important organizational capability that facilitates information exchange and coordination, empirical evidence regarding its moderating role in the relationship between supply chain integration and

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supply chain performance remains limited and inconclusive.

These inconsistencies may be particularly relevant in emerging economies, where firms often face substantial differences in technological capability, resource availability, and supply chain maturity. Despite the strategic importance of the manufacturing sector in Vietnam, empirical studies examining the combined roles of supply chain integration and ICT capability remain scarce. Consequently, there is limited understanding of how different dimensions of supply chain integration relate to supply chain performance and whether ICT capability influences the strength of these relationships in the Vietnamese manufacturing context.

Drawing on the resource-based view (RBV) and the extended resource-based view (ERBV), this study proposes that supplier integration, internal integration, and customer integration are positively associated with supply chain performance. Furthermore, ICT capability is expected to moderate these relationships by facilitating information exchange, coordination, and collaborative decision-making across supply chain activities. Based on these arguments, the following hypotheses are proposed (Figure 1).

H1: Supplier integration is positively associated with supply chain performance.

H2: Internal integration is positively associated with supply chain performance.

H3: Customer integration is positively associated with supply chain performance.

H4: ICT capability positively moderates the relationship between supplier integration and supply chain performance.

H5: ICT capability positively moderates the relationship between internal integration and supply chain performance.

H6: ICT capability positively moderates the relationship between customer integration and supply chain performance.

2. METHOD

This study employed a quantitative cross-sectional survey design to examine the relationships among supply chain integration, information and communication technology (ICT) capability, and supply chain performance in Vietnamese manufacturing firms. Consistent with prior supply chain management studies, data were collected through a structured questionnaire administered between May and December 2024 using both face-to-face and email-based survey methods.

A purposive sampling approach was adopted to target export-oriented manufacturing firms that are actively involved in supply chain coordination activities. Given the absence of a comprehensive national database identifying firms with established supply chain integration practices, the sampling strategy focused on manufacturing in-

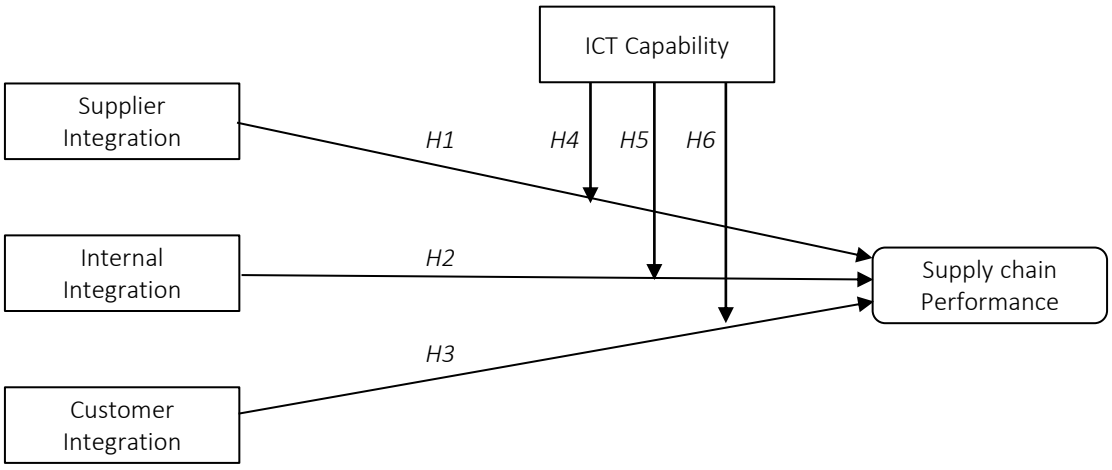

Figure 1. Conceptual model

dustries characterized by intensive interactions among suppliers, customers, and internal functional units. These industries provide an appropriate context for examining the relationships among supply chain integration, ICT capability, and supply chain performance.

The target respondents were middle- and senior-level managers responsible for procurement, logistics, production, supply chain management, planning, marketing, sales, and export activities. These individuals were selected because their positions provide them with direct knowledge of operational processes, supplier relationships, customer coordination, and ICT implementation within their organizations. Since the unit of analysis was the firm, only one respondent from each enterprise was included in the study. Although the data were based on managerial perceptions, respondents occupied positions directly associated with supply chain coordination and operational decision-making, making them suitable informants for evaluating the constructs examined in this study.

Participation in the survey was voluntary and anonymous. Respondents were informed that all

Table 1. Descriptive statistics

Sample size (n = 386)	Quantity	Ratio (%)
Type of ownership		
State-owned enterprises	3	0.8
Non-state enterprises	354	91.7
Foreign-invested enterprises (FDI)	29	7.5
Years of operation		
5–10 years	66	17.1
10–15 years	83	21.5
15–20 years	71	18.4
20–25 years	78	20.2
Over 25 years	88	22.8
Number of employees		
Below 100	39	10.1
100–200	78	20.2
200–500	253	65.6
500–1,000	11	2.8
Over 1,000	5	1.3
Industry		
Leather and related products manufacturing	32	8.3
Textile manufacturing	31	8.0
Rubber and plastic products manufacturing	29	7.5
Wood processing and products from wood, bamboo, rattan	18	4.7
Chemical and chemical products manufacturing	7	1.8
Electronics, computer and optical products manufacturing	14	3.6
Apparel manufacturing	58	15.0
Food manufacturing and processing	45	11.7
Motor vehicle manufacturing	34	8.8
Metal manufacturing	49	12.7
Machinery and equipment manufacturing	16	4.2
Other manufacturing industries	53	13.7
Headquarters location		
Northern	203	52.6
Central	84	21.8
Southern	99	25.6
Export ratio		
Below 20%	136	35.2
20%–40%	161	41.7
40%–60%	37	9.6
60%–80%	18	4.7
Over 80%	34	8.8

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information would be treated confidentially and used exclusively for academic research purposes. More than 900 questionnaires were distributed during the data collection period. A total of 412 responses were returned, yielding an initial response rate of 45.8%. After eliminating incomplete questionnaires and responses showing signs of inconsistency, 386 valid questionnaires remained for subsequent analyses. The final sample size exceeds the minimum requirements recommended for PLS-SEM and is considered adequate for the estimation of the proposed research model (Hair et al., 2019). The characteristics of the sampled firms are presented in Table 1.

All constructs were measured using multi-item scales adapted from previously validated studies in the supply chain management literature. A five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree") was employed to capture respondents' perceptions. To enhance content validity and ensure the suitability of the measurement items for the Vietnamese manufacturing context, the questionnaire was reviewed through preliminary discussions and in-depth interviews with six managers from manufacturing firms prior to the main survey. Minor wording adjustments were made based on their feedback while preserving the original meaning of the scales.

Supplier integration was measured using five items adapted from Abdallah et al. (2021) and Li et al. (2006). Internal integration was measured using five items adapted from Abdallah et al. (2021), Abdallah and Nabass (2018), and Li et al. (2006). Customer integration was measured using five items adapted from Abdallah et al. (2021) and Zhao et al. (2013). Supply chain performance was measured using ten items adapted from Prajogo et al. (2016), Wong et al. (2011), and Chen and Paulraj (2004). ICT capability was measured using five items adapted from Amoako et al. (2022). The complete list of measurement items is provided in Appendix A.

The proposed hypotheses were tested using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4 software. PLS-SEM was considered appropriate because the study examines multiple relationships among latent constructs and evaluates moderating effects within a prediction-oriented framework (Hair et al., 2019).

The analysis was conducted in four stages. First, the measurement model was assessed by examining indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Second, common method bias (CMB) was evaluated using Harman's single-factor test because all constructs were measured using a single questionnaire completed by a single respondent at one point in time. Third, the structural model was assessed by examining collinearity through variance inflation factor (VIF) values and the coefficient of determination (R^2). Finally, the proposed hypotheses were tested using the bootstrapping procedure to evaluate the significance of the path coefficients and moderating effects.

3. RESULTS

3.1. Measurement model assessment

Following Hair et al. (2017), the measurement model was assessed in terms of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. Indicator reliability was evaluated using outer loadings; internal consistency reliability was assessed through Cronbach's alpha and Composite Reliability (CR); convergent validity was examined using the Average Variance Extracted (AVE); and discriminant validity was verified through the HTMT criterion.

To assess the measurement model, indicator reliability was first examined through the outer loadings of all measurement items. Following the recommendation of Hair et al. (2017), indicators with outer loadings below the threshold of 0.70 were removed from further analysis. Accordingly, SCP6 was excluded from the model. As presented in Table 2, the Cronbach's alpha values ranged from 0.862 to 0.931, while the Composite Reliability (CR) values ranged from 0.882 to 0.942. All values exceeded the recommended minimum threshold of 0.70 and remained below the upper threshold of 0.95, indicating satisfactory internal consistency reliability and suggesting the absence of redundancy among the measurement items (Hair et al., 2021). In addition, the Average Variance Extracted

(AVE) values ranged from 0.602 to 0.678, exceeding the recommended threshold of 0.50 and thereby confirming adequate convergent validity. Overall, these results demonstrate that the measurement model possesses satisfactory reliability and convergent validity.

Table 2. Reliability and validity assessment

	Cronbach's alpha	Composite reliability (rho_c)	Average Variance Extracted (AVE)
SI	0.870	0.906	0.657
II	0.881	0.913	0.678
CI	0.864	0.902	0.647
ICT	0.862	0.882	0.602
SCP	0.931	0.942	0.643

Note: SI = supplier integration; II = internal integration; CI = customer integration; SCP = supply chain performance.

Table 3 presents the heterotrait–monotrait (HTMT) ratio values used to assess discriminant validity. The results indicate that none of the HTMT values exceed 0.85, thereby confirming that the constructs are distinct from one another and that discriminant validity is established (Henseler et al., 2015).

Table 3. Heterotrait-monotrait factors (HTMT)

	CI	ICT	II	SCP	SI
CI	–	–	–	–	–
ICT	0.061	–	–	–	–
II	0.373	0.097	–	–	–
SCP	0.664	0.076	0.660	–	–
SI	0.329	0.158	0.425	0.577	–

Note: SI = supplier integration; II = internal integration; CI = customer integration; SCP = supply chain performance.

3.2. Common method bias assessment

Because all constructs were measured using a single questionnaire completed by a single respondent at one point in time, common method bias (CMB) was assessed prior to evaluating the measurement and structural models. Harman's single-factor test was conducted by entering all measurement items into an unrotated exploratory factor analysis. As shown in Table 4, the first factor accounted for 34.364% of the total variance, which is below the commonly recommended threshold of 50% (Tehseen et al., 2017). The result suggests that common method bias is unlikely to pose a serious threat to the validity of the findings.

Table 4. Harman's single-factor test for common method bias

Measure	Value
Variance explained by the first factor (%)	34.364
Recommended threshold (%)	50
Common method bias concern	No

3.3. Structural model assessment

Before assessing the explanatory power of the structural model, collinearity among the predictor constructs was examined using the variance inflation factor (VIF). As presented in Table 5, the VIF values ranged from 1.037 to 1.294, which are well below the recommended threshold of 3.0 (Hair et al., 2017). These results indicate that multicollinearity is not a concern in the structural model and that the predictor constructs can be reliably used for subsequent analyses.

Table 5. Multicollinearity test (VIF)

Path	VIF
SI → SCP	1.230
II → SCP	1.270
CI → SCP	1.207
ICT → SCP	1.037
ICT x CI → SCP	1.221
ICT x II → SCP	1.246
ICT x SI → SCP	1.294

Note: SI = supplier integration; II = internal integration; CI = customer integration; SCP = supply chain performance.

The coefficient of determination (R^2) was used to assess the explanatory power of the structural model. The results indicate that the R^2 value for supply chain performance is 0.711, meaning that 71.1% of its variance is explained by the exogenous constructs and their interaction effects included in the model. This finding suggests that the model possesses substantial explanatory power.

3.4. Hypothesis testing

The significance and direction of the hypothesized relationships were assessed using a bootstrapping procedure with 5,000 resamples. The results of the hypothesis testing are presented in Figure 2 and Table 6.

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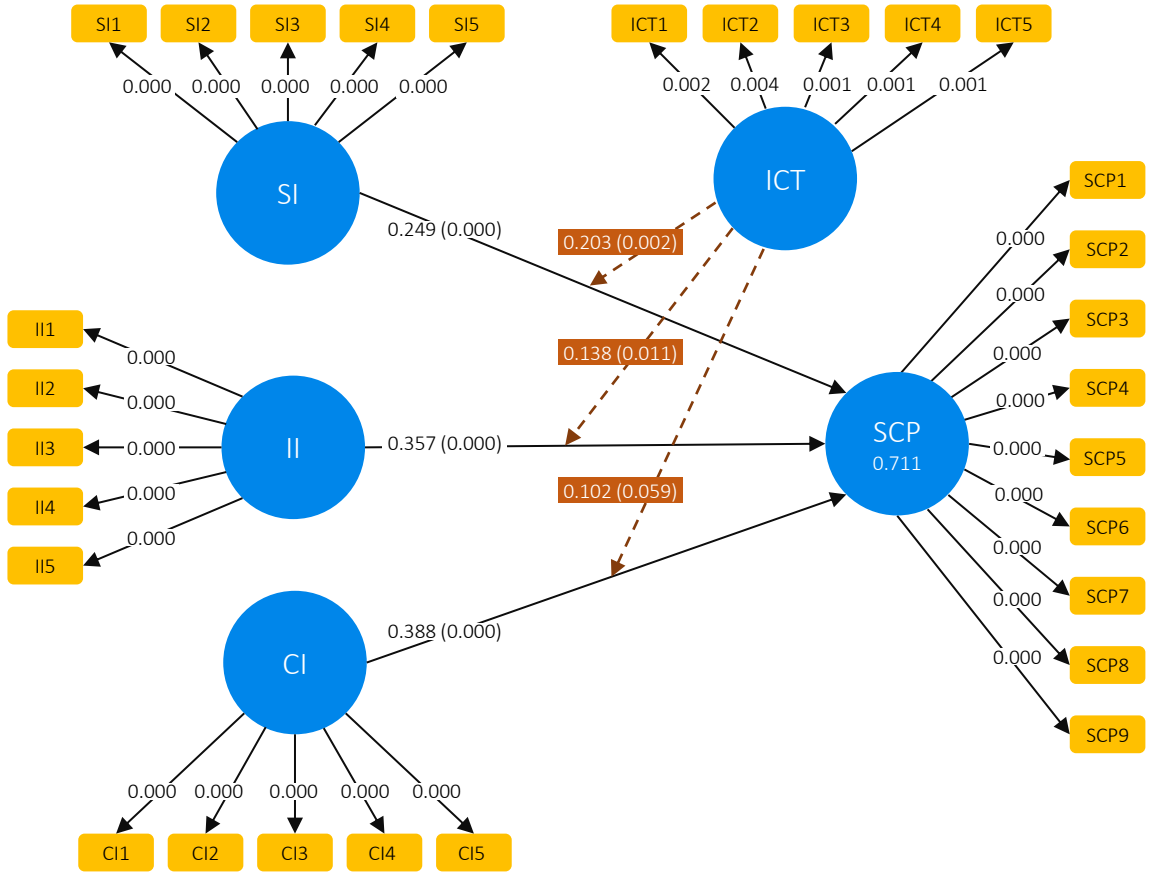

Note: SI = supplier integration; II = internal integration; CI = customer integration; SCP = supply chain performance.

Figure 2. Research results

The PLS-SEM results indicate significant positive relationships between the three dimensions of supply chain integration and supply chain performance. Specifically, customer integration was positively associated with supply chain performance (β = 0.388, $p < 0.001$). Internal integration was positively associated with supply chain performance (β = 0.357, $p < 0.001$). Supplier integration was positively associated with supply chain performance (β = 0.249, $p < 0.001$) (see Table 6). Therefore, H1, H2, and H3 were supported at the 1% significance level.

Regarding the moderating relationships, ICT capability positively moderated the relationship between supplier integration and supply chain performance (β = 0.203, $p = 0.002$). Since the p-value is below the 0.01 significance threshold, H4 was supported at the 1% significance level. ICT capability also positively moderated the relationship between internal integration and supply chain performance (β = 0.138, $p = 0.011$). Although the p-value exceeded the 0.01 threshold, it remained below the 0.05 significance level, providing support for H5 at the 5% significance level. The posi-

Table 6. Hypothesis testing results

Hypothesis	Relationship	β	t values	p values	Results
H1	SI → SCP	0.249	6.477	0.000	Supported
H2	II → SCP	0.357	10.623	0.000	Supported
H3	CI → SCP	0.388	10.973	0.000	Supported
H4	ICT x SI → SCP	0.203	3.063	0.002	Supported
H5	ICT x II → SCP	0.138	2.560	0.011	Supported
H6	ICT x CI → SCP	0.102	1.888	0.059	Not Supported

Note: SI = supplier integration; II = internal integration; CI = customer integration; SCP = supply chain performance.

tive interaction coefficients suggest that the positive relationships between supplier integration and supply chain performance and between internal integration and supply chain performance become stronger at higher levels of ICT capability (see Table 6).

The moderating effect of ICT capability on the relationship between customer integration and supply chain performance was not statistically significant ($\beta = 0.120$, $p = 0.059$). Because the p-value exceeded the conventional 0.05 significance threshold, the evidence was insufficient to support the proposed moderating relationship. Therefore, H6 was not supported.

4. DISCUSSION

The findings indicate that all three dimensions of supply chain integration, namely supplier integration, internal integration, and customer integration, were positively associated with supply chain performance among Vietnamese manufacturing firms. These results suggest that firms characterized by higher levels of coordination and information sharing both within the organization and with external supply chain partners tend to report higher levels of supply chain performance. In increasingly competitive and uncertain business environments, closer collaboration with suppliers and customers, together with stronger internal coordination, may be associated with greater operational responsiveness and supply chain effectiveness. These findings are consistent with previous studies reporting positive relationships between supply chain integration and operational or supply chain performance (Flynn et al., 2010; Wong et al., 2011; Gimenez et al., 2012; Zhao et al., 2013; Kumar et al., 2017; Khanuja & Jain, 2020).

The positive relationships observed across all three supply chain integration dimensions differ somewhat from the findings of Flynn et al. (2010), who suggested that the performance implications of supply chain integration may vary across integration dimensions. In the present study, supplier integration, internal integration, and customer integration were all significantly associated with supply chain performance. One possible explanation is that manufacturing firms operating in emerging economies may rely more heavily on coordinated relationships with both internal and external supply chain partners to maintain operational stability and competitiveness within global supply chains. The findings are also consistent with evidence from other emerging market contexts reporting positive associations between integrated supply chain practices and operational performance outcomes (Abdallah et al., 2014; Ganbold et al., 2021).

The results further indicate that ICT capability positively moderated the relationships between supplier integration, internal integration, and supply chain performance. This finding suggests that higher levels of ICT capability are associated with stronger positive relationships between these integration dimensions and supply chain performance. A possible explanation is that ICT facilitates information exchange, process synchronization, and coordination among internal departments and upstream supply chain partners. Technologies such as enterprise resource planning (ERP) systems, digital communication platforms, and integrated information systems may support collaborative processes and information visibility across supply chain activities. These findings are broadly consistent with previous studies highlighting the role of ICT in supporting supply chain integration and coordination (Choshin & Ghaffari, 2017; Wu et al., 2017).

However, the moderating relationship between ICT capability and customer integration was not statistically significant. This finding differs from previous studies suggesting that ICT may support downstream coordination and customer responsiveness through improved communication and demand visibility (Prajogo & Olhager, 2012; Huo et al., 2014). One possible explanation is that ICT applications associated with customer-related activities in Vietnamese manufacturing firms may remain concentrated on specific operational functions, such as demand forecasting, customer communication, and after-sales services, rather than supporting fully integrated downstream coordination processes. In addition, export-oriented manufacturing firms often operate across diverse markets characterized by heterogeneous customer requirements and varying demand patterns, which may limit the extent to which ICT capabil-

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ity is associated with stronger customer integration–performance relationships. Similar challenges related to downstream integration have been discussed in studies conducted in developing and emerging economies (Vanpoucke et al., 2017).

Overall, the findings suggest that ICT capability is more strongly associated with supplier integration and internal integration than with customer integration in the context of Vietnamese manufacturing firms. The results highlight the importance of considering both technological capability and supply chain integration when examining supply chain performance. At the same time, the findings suggest that contextual factors may influence the extent to which ICT capability is associated with different dimensions of supply chain integration, particularly in emerging economy settings such as Vietnam.

CONCLUSION

This study examined the relationships between supply chain integration dimensions and supply chain performance and investigated the moderating role of ICT capability in Vietnamese manufacturing firms. The findings indicate that supplier integration, internal integration, and customer integration were all positively associated with supply chain performance. These results suggest that firms characterized by higher levels of coordination and information sharing across supply chain activities tend to report higher levels of supply chain performance. The findings further indicate that ICT capability positively moderated the relationships between supplier integration, internal integration, and supply chain performance. In contrast, the moderating relationship between ICT capability and customer integration was not statistically significant. Taken together, the results suggest that ICT capability may be more closely associated with internally focused and upstream integration activities than with downstream customer integration in the context of Vietnamese manufacturing firms. These findings highlight the importance of considering both technological capability and supply chain integration when examining supply chain performance. From a theoretical perspective, this study contributes to the supply chain management literature by extending the application of the resource-based view (RBV) and the extended resource-based view (ERBV) to the context of an emerging economy. The findings provide additional evidence regarding the relationships among supply chain integration, ICT capability, and supply chain performance in Vietnamese manufacturing firms.

Several limitations should be acknowledged. First, the study relied on cross-sectional survey data, which limits the ability to draw definitive causal conclusions from the observed relationships. Second, all variables were measured using self-reported data collected from a single respondent per firm, which may increase the risk of common method bias despite the procedural and statistical assessments conducted in this study. Third, the sample was limited to Vietnamese manufacturing firms, which may restrict the generalizability of the findings to other industries and national contexts. Future research may employ longitudinal research designs to examine how the relationships among supply chain integration, ICT capability, and supply chain performance evolve over time. In addition, comparative studies across industries or countries and the inclusion of contextual variables such as environmental uncertainty, digital transformation capability, and supply chain resilience may provide further insights into the conditions under which supply chain integration and ICT capability are associated with supply chain performance.

AUTHOR CONTRIBUTIONS

Conceptualization: Mai Trang Le.
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Formal analysis: Thi Quynh Chau Le.
Funding acquisition: Mai Trang Le.
Investigation: Thi Hoang An Nguyen.
Methodology: Mai Trang Le.

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Visualization: Thi Hoang An Nguyen.
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Writing – review & editing: Mai Trang Le.

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AI DISCLOSURE STATEMENT

The authors did not use AI tools in the preparation of this manuscript.

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APPENDIX A

Table A1. Measurement scales

Variables	Items	Measurement Scales	Source
Supplier Integration (SI)	SI1	Our firm consistently collaborates with suppliers to address operational issues.	Abdallah et al. (2021); Li et al. (2006)
	SI2	Key suppliers are actively engaged in our new product development activities.	
	SI3	The firm seeks to build and maintain long-term partnerships with its suppliers.	
	SI4	Close coordination with suppliers is emphasized to enhance mutual processes.	
	SI5	There is a high level of information sharing with major suppliers.	
Internal Integration (II)	II1	Our organization utilizes a well-integrated information system that connects internal departments.	Abdallah et al. (2021); Abdallah and Nabass (2018); Li et al. (2006)
	II2	Different departments and units collaborate effectively to resolve conflicts when they occur.	
	II3	All functional areas within the organization interact closely with one another.	
	II4	The organization demonstrates strong responsiveness to the needs of other departments.	
	II5	Integrated systems are implemented across functional areas under plant-level coordination.	
Customer Integration (CI)	CI1	Our organization maintains frequent and close interactions with its customers.	Abdallah et al. (2021); Zhao et al. (2013)
	CI2	Customers regularly provide feedback on our product quality and delivery performance.	
	CI3	Key customers often suggest improvements for our products.	
	CI4	There is a high level of information sharing with major customers.	
	CI5	Key customers are involved in the product design and development process.	
Supply Chain Performance (SCP)	SCP1	Our supply chain is capable of quickly adjusting products to meet customer requirements.	Prajogo et al. (2016); Wong et al. (2011); Chen and Paulraj (2004)
	SCP2	The firm can rapidly adapt production volume when needed.	
	SCP3	Suppliers demonstrate flexibility in adjusting their capacity and output levels.	
	SCP4	We consistently ensure on-time delivery to customers.	
	SCP5	Suppliers reliably deliver orders on schedule.	
	SCP6	The organization is able to manufacture products at low cost.	
	SCP7	Inventory-related costs are effectively minimized in our operations.	
	SCP8	Overhead costs are maintained at a low level.	
	SCP9	The firm is capable of offering customized product features.	
	SCP10	We deliver high-performance products that satisfy customer expectations.	
Information Communication Technology (ICT)	ICT1	Our firm has a well-defined strategy for information and communication technology (ICT).	Amoako et al. (2022)
	ICT2	The organization possesses a skilled workforce capable of operating various ICT systems (e.g., Internet, email, accounting software, inventory systems, ERP).	
	ICT3	The firm's culture is supportive of adopting and utilizing new technologies.	
	ICT4	Decisions regarding ICT investments are made in consultation with experts and professional networks.	
	ICT5	The firm allocates a dedicated budget for ICT-related investments.	