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Digital Transformation and Competitive Advantage: A PLS-SEM Analysis of the Dual Mediation of Customer Participation and Innovation Capability

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ABSTRACT. This study pioneers an exploration of the mediating roles of customer participation (CP), service innovation capability (SIC), and process innovation capability (PIC) in the relationship between digital transformation (DT) and competitive advantage (CAD) among logistics enterprises, an aspect that has not been addressed in prior research. The research adopts a mixed-methods approach that integrates a systematic literature review, expert interviews, and a quantitative survey. Data were collected from 380 logistics enterprises operating in Ho Chi Minh City, Vietnam. Partial least squares structural equation modeling was employed to test the proposed relationships. The findings indicate that digital transformation (DT) has a positive effect on competitive advantage (CAD), customer participation (CP), service innovation capability (SIC), and process innovation capability (PIC). The study elucidates the mechanisms through which digital transformation (DT) influences competitive advantage (CAD). These findings provide important theoretical and practical implications, enabling firms to formulate more effective digital transformation strategies.

1. Introduction

The rapid growth of e-commerce has created significant opportunities for logistics enterprises, as demand for transportation, warehousing, and supply chain management continues to increase sharply.

However, alongside these opportunities come increasingly complex challenges, stemming from customers' rising expectations and the intensifying competition within the industry. Previous studies have regarded digital transformation as a critical strategic imperative [1], not

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merely as the adoption of new technologies, but as a comprehensive restructuring of business models, operational processes, and organizational culture.

Digital transformation (DT) enables customers to engage more deeply in the process of co-creating value, sharing knowledge, and providing service feedback. This interaction allows enterprises to collect valuable data and gain deeper insights into customer behaviors and needs, forming the foundation for service innovation capability (SIC) and process innovation capability (PIC). Therefore, exploring the interrelationships among digital transformation (DT), customer participation (CP), service innovation capability (SIC), process innovation capability (PIC), and competitive advantage (CAD) holds both theoretical and practical significance for logistics enterprises in the digital era. This topic has also emerged as a central focus of scholarly inquiry in recent literature.

However, existing research in this field can generally be classified into third main streams. The first explores the impact of digital transformation (DT) on competitive advantage (CAD) [2]; [3]; [4]; [5]. The second examines the relationship between digital transformation (DT), service innovation capability (SIC) and process innovation capability (PIC) [6]; [7]; [8]; [9]; [10]; [11]. The third examines the relationship between SIC, PIC and CAD [12]; [13]; [14]; [15].

Although previous studies have provided valuable insights, integrated research that simultaneously examines DT, SIC, PIC, and CAD remains limited. In particular, the role of CP in the context of DT, which is a critical factor in enhancing SIC, PIC, and CAD, has not been adequately explored. Moreover, the mediating mechanisms underlying these relationships have not been thoroughly investigated, indicating the need for further empirical research to clarify their nature.

Furthermore, studies on this topic in developing countries, such as Vietnam, remain scarce, highlighting a significant research gap that warrants greater scholarly attention.

As Logistics 4.0 advances, logistics service providers must undergo comprehensive digital transformation to remain competitive in an increasingly technology-driven environment [16]. Within this context, DT has become a strategic necessity. Beyond process optimization and cost reduction, it enables real-time interaction, enhances transparency, and fosters customer co-creation in service design, transforming customers from passive recipients into active value co-creators. Such engagement not only improves customer satisfaction but also stimulates innovation and strengthens sustainable competitive advantage.

However, the interrelationships among digital transformation (DT), customer participation (CP), service innovation capability (SIC), process innovation capability (PIC), and competitive advantage (CAD) remain underexplored, particularly in developing economies like Vietnam. Addressing this gap is essential to provide actionable insights that can help logistics enterprises enhance competitiveness and achieve sustainable growth.

Vietnam's logistics industry has emerged as a strategically significant and rapidly expanding sector, contributing an estimated USD 42 billion annually to national economic growth [17]. Despite domestic firms comprising nearly 89% of all logistics service providers, they control only about 30% of the market share, revealing persistent competitive weaknesses and structural constraints that hinder their development and global integration. As the country's economic hub and primary trade gateway, HCM City (HCMC) has become a key logistics center. In this context, examining the challenges of DT is essential, particularly in understanding how it can be integrated with CP, SIC and PIC to enhance the CAD of logistics enterprises.

Building on the issues identified above, the primary objective of this study is to elucidate the relationships among DT, CP, SIC, PIC, and CAD within logistics enterprises in HCMC.

2. Literature Review

2.1. Theoretical Basis

This study focuses on exploring the mediating roles of CP, SIC, and PIC in the relationship between DT and CAD among logistics enterprises. The pursuit of sustainable competitive advantage is fundamentally rooted in a firm's internal architecture, a concept best articulated by the Resource-Based View (RBV) [18]. This perspective posits that proprietary, valuable, rare, inimitable, and non-substitutable internal resources, such as technological infrastructure, comprehensive customer data repositories, and advanced logistics management systems are pivotal drivers of superior firm performance.

Expanding upon the RBV, the Knowledge-Based View (KBV) elevates knowledge to the status of the most strategically significant resource. The KBV asserts that knowledge forms the bedrock for developing and maintaining long-term competitiveness, with customer knowledge being particularly instrumental in enhancing innovation capacity and securing a competitive edge [19].

The necessity of strategic agility, especially in the context of disruptive DT, is further illuminated by the Dynamic Capabilities [20]. This framework provides a critical lens for understanding how enterprises sustain relevance, arguing that they must continually sense emerging technological opportunities, seize them by integrating digital resources into core operations (such as supply chain and distribution processes), and reconfigure existing business models. This continuous renewal is essential for maintaining adaptiveness in the face of market volatility and rapidly evolving customer demands.

Finally, these resource- and capability-based approaches complement the foundational tenets of Porter's theory of competitive advantage [21]. Porter suggests that superior performance can be achieved through deliberate strategic positioning supported by operational excellence.

Specifically, this involves strategically improving supply chain efficiency, optimizing distribution activities, and enhancing service value to achieve cost leadership or differentiation.

2.2. Research concepts

Digital Transformation: Digital transformation is characterized by planned changes grounded in advanced technological foundations [6]. According to [22] further describe digital transformation as a mechanism for transforming business processes, organizational culture, and other organizational aspects to respond to the evolving market demands driven by digital technologies. It encompasses the combined effects of digital technologies and innovation, introducing new actors, structures, values, and beliefs that alter, disrupt, replace, or complement existing rules within organizations, ecosystems, industries, or sectors [23]. Digital transformation enables firms to reshape business models, influencing interactions among leaders, employees, and organizational culture [24].

Competitive Advantage: A firm attains competitive advantage when it implements a value-creating strategy that is not simultaneously being pursued by any current or potential competitors [18]. Competitive advantage encompasses capabilities that enable an organization to distinguish itself from its competitors [25]. According to [26] identify factors of competitive advantage that reflect an organization's capacity to meet customer needs, including pricing, product quality, product line breadth, order fulfillment rate, order lead time, order information accuracy, and delivery frequency.

2.3. Hypotheses development

Hypotheses development: Digital transformation influences competitive advantage, customer participation, service innovation capability, and process innovation capability:

Digital transformation (DT) is widely conceptualized as a strategic process of organizational change in which firms deploy digital technologies to redesign business models, optimize operational processes, enhance managerial capabilities, and create new value for stakeholders [1]; [27]. Within the logistics industry, DT transcends the mere adoption of technology to improve efficiency in core functions such as transportation, warehousing, and supply chain management. It entails the reorientation of business strategies toward enhancing customer experience, developing digitalized service offerings, and fostering innovative, technology driven business models [28]; [29].

Logistics enterprises that adopt digital technologies early are more likely to enhance service quality, shorten delivery times, optimize inventory management, and improve customer experience, key determinants of CAD in a highly competitive industry [16]. Through digital platforms, such as online order management systems, mobile applications, and intelligent customer service portals, customers are no longer passive recipients of logistics services but become co-creators of value [30]. They actively participate in service design, customization, and

feedback processes, which enhances interaction, trust, and engagement with the enterprise [27].

This active involvement not only improves service quality and customer experience but also generates sustainable competitive advantage, as customer insights are transformed into valuable organizational knowledge that drives innovation and operational excellence within logistics enterprises [31].

DT enables logistics enterprises to achieve service differentiation through the provision of customized, data-driven, and value-added solutions that significantly enhance the customer experience. The strategic integration of digital technologies, therefore, not only optimizes internal logistics operations but also critically strengthens the enterprise's inherent capacity to innovate its service offerings [32]. Digital technology effectively contributes to positive changes in consumer perception, experience satisfaction, and value creation [33].

In addition, the integration of core digital technologies such as the IoT, Big Data Analytics, AI, and Cloud Computing provides the necessary infrastructure for data connectivity, automation, and intelligent decision-making in process innovation [10]. First, process optimization and transparency, real-time operational data enable enterprises to identify bottlenecks and redesign core processes toward greater efficiency, automation, and flexibility [6]. Second, organizational learning and continuous experimentation, the digital environment fosters cross-functional collaboration and rapid prototyping of new process models, facilitating ongoing innovation [6]. Therefore, DT is not merely an operational tool but a strategic enabler that strengthens logistics enterprises' ability to develop and implement innovative, agile, and data-driven processes, thereby improving operational efficiency and market responsiveness [34].

Accordingly, this study proposes the following hypothesis:

H1: Digital transformation positively impacts the competitive advantage of logistics enterprises.

H2: Digital transformation has a positive impact on the service innovation capacity of logistics enterprises.

H3: Digital transformation has a positive impact on the process innovation capability of logistics enterprises.

H4: Digital transformation has a positive impact on customer participation of logistics enterprises.

Customer participation influences service innovation capability, process innovation capability, and competitive advantage:

Customer participation (CP) refers to the extent to which customers actively contribute resources, information, and effort during the design, production, and delivery of services [35]. This conceptualization shifts the customer's role from a passive recipient to an active co-creator of value [36]. CP encompasses behaviors such as providing feedback, sharing knowledge, and

collaborating with service providers to enhance the service process [37]; [38]. In the logistics context, CP is reflected through activities like sharing shipment information, evaluating service quality, and engaging with digital platforms to support supply chain coordination. These participatory behaviors not only improve customer experience but also foster service innovation and strengthen the CAD of logistics enterprises.

In the contemporary logistics industry, where service quality, responsiveness, and customization are essential for sustaining competitiveness, CP serves as a critical catalyst for enhancing the SIC of logistics enterprises [39]. CP enables the seamless integration of customer insights, preferences, and experiential feedback into the service development process, generating valuable and context-specific knowledge that supports continuous innovation in logistics solutions, service processes, and digital platforms. From the perspective of the KBV [19], CP strengthens a logistics enterprise's ability to acquire, share, and apply external knowledge, which is vital for fostering innovation effectiveness and aligning newly developed services with evolving customer needs and dynamic market conditions. Moreover, drawing on the Dynamic Capabilities framework [20], CP enhances the enterprise's sensing, learning, and reconfiguring capacities, enabling it to identify emerging opportunities, incorporate customer-driven ideas, and adapt resources to deliver innovative and value-added logistics services.

CP functions as a strategic organizational enabler that drives SIC, thereby fostering adaptability, creativity, and sustained competitiveness in an increasingly customer-centric logistics environment. In addition, when customers actively engage in service design, problem-solving, and feedback provision, they contribute valuable experiential knowledge that enables enterprises to identify bottlenecks, restructure workflows, and enhance operational performance. Such interactive processes facilitate knowledge co-creation, allowing logistics enterprises to integrate customer insights into their process innovation initiatives. Through customer participation, logistics enterprises can enhance the adaptability of their processes to dynamic market conditions and evolving customer needs, thereby strengthening their process innovation capability. Customers are viewed not merely as recipients of services but as co-creators of value who actively contribute to the design, delivery, and improvement of service processes [20]. CP in activities such as order tracking, service customization, feedback provision, and problem resolution fosters closer customer, enterprise interaction, thereby enhancing service relevance, efficiency, satisfaction and CAD [40]. Accordingly, this study proposes the following hypothesis:

H5: Customer participation has a positive impact on the SIC of logistics enterprises.

H6: Customer participation has a positive effect on the process innovation capability of logistics enterprises.

H7: Customer participation has a positive impact on the competitive advantage of logistics enterprises.

Hypotheses development: Service innovation capability and process innovation capability influences competitive advantage.

According to the RBV, from the perspective of the RBV, SIC is conceptualized as a crucial strategic organizational resource possessing the VRIN attributes [18]. Dynamic Capabilities (DC), the DC framework explains the dynamic nature of SIC [20]. Logistics enterprises with a strong SIC can effectively sense emerging market opportunities, seize them by creating customized and technology-enabled logistics services, and reconfigure their internal resources to adapt swiftly to evolving customer and market demands [15]. According to the Competitive advantage theory, the continuous pursuit of service innovation enables logistics enterprises to achieve a dual competitive advantage: cost leadership through internal process optimization and differentiation through superior customer experience and unique value creation [21].

Moreover, in the context of increasingly volatile supply chains and diversified customer demands, logistics enterprises must continuously innovate their processes to enhance flexibility and achieve service differentiation [21]. According to the RBV, sustainable competitive advantage stems from capabilities that are valuable, rare, inimitable, and non-substitutable [18]. PIC represents such a strategic capability, enabling logistics enterprises to redesign workflows, automate operations, and optimize resource utilization, thereby improving cost efficiency and service differentiation.

From the perspective of the KBV, PIC reflects an enterprise's capacity to capture, share, and reconfigure operational and technological knowledge [19], supporting learning and adaptability in complex supply chain environments. Consistent with the Dynamic Capabilities Framework [20], PIC allows logistics enterprises to sense changes in customer requirements and market dynamics, seize emerging opportunities through agile process redesign, and transform internal systems to sustain competitive performance.

Accordingly, this study proposes the following hypothesis:

H8: Service innovation capability has a positive impact on the competitive advantage of logistics enterprises.

H9: Process innovation capability has a positive impact on the competitive advantage of logistics enterprises.

Building upon previous research findings, the author developed the research model presented in Figure 1.

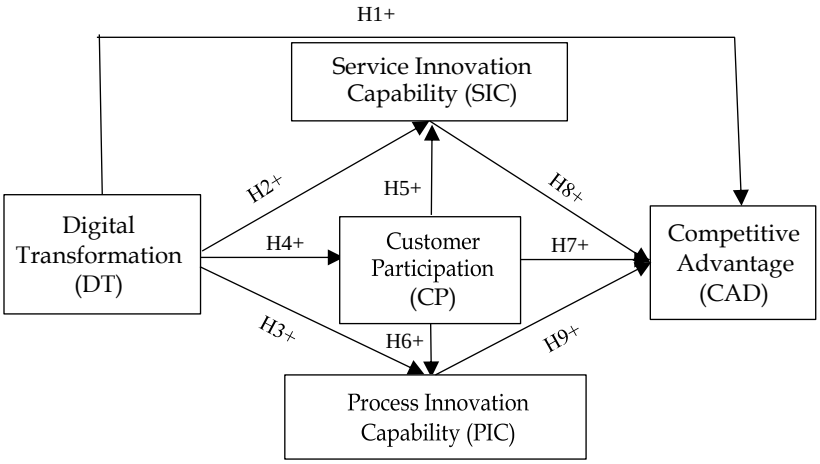

Figure 1. Propose research model

3. Research Methodology

Scales: The measurement scales were adapted from prior research and refined through consultations with 10 experts in logistics, each with over 10 years of experience, to enhance their reliability and contextual suitability for logistics businesses in developing countries, particularly Vietnam. Specifically, the scales for competitive advantage [41], digital transformation [15], customer participation [35], Service innovation capability [42], Process innovation capability (PIC) [43] were modified to fit the research context. Each construct was measured using three to four observed variables. The measurement scales were verified and refined through expert consultation within the logistics industry. All items were evaluated using a five-point Likert scale, supplemented with demographic questions to capture respondents' characteristics.

Data collection: This study focused on managers of logistics enterprises operating in HCMC. The sample size was determined based on the widely accepted guideline recommending a ratio of 5:1 to 10:1, which proposes collecting at least five to ten observations for each estimated parameter [44]. A total of 400 questionnaires were distributed, of which 20 were excluded due to incomplete responses or insufficient variance across key variables, indicating potential response bias. Ultimately, 380 valid questionnaires were retained for the final analysis. A non-probability sampling strategy, combining snowball sampling with direct interviews, was employed to ensure the inclusion of respondents possessing substantial expertise in the logistics industry.

Data analysis: A reflective measurement model was employed in accordance with established reliability and validity assessment guidelines [45]. The measurement model was evaluated using factor loadings, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE), while discriminant validity was assessed using the Heterotrait–Monotrait Ratio (HTMT). Subsequently, the structural model was examined to determine its explanatory power and to estimate the path coefficients.

The structural model was evaluated following the four-step procedure proposed by [45]: (1) assessing collinearity using the Variance Inflation Factor (VIF); (2) evaluating the significance and relevance of structural relationships through path coefficients (β) and corresponding p-values; (3) determining the model's explanatory power based on R^2, adjusted R^2, and the Standardized Root Mean Square Residual (SRMR); and (4) examining predictive capability using the Q^2 statistic. All constructs were measured using a five-point Likert scale ranging from 'strongly disagree' to 'strongly agree.' Data analysis was performed using SPSS version 26 and SmartPLS 3.

4. Results

4.1. Measurement Model Assessment

Evaluation of the measurement model: The results met the reliability and validity criteria recommended by [46]. Cronbach's alpha and composite reliability values exceeded 0.70 but remained below 0.95, while average variance extracted (AVE) values were greater than 0.50 (Table 1). Discriminant validity was confirmed using the Heterotrait–Monotrait (HTMT) ratio (Table 2), as all HTMT values were below the threshold of 0.847 [47], indicating that each construct was empirically distinct within the measurement model.

Table 1: Reliability Assessment of the Measurement Model

Measurement Scale Validation	Items	Outer loadings	Cronbach's alpha	CR	AVE
Digital transformation (DT)	DT1	0.863	0.847	0.907	0.766
	DT2	0.899			
	DT3	0.863			
Service Innovation Capability (SIC)	SIC1	0.827	0.858	0.904	0.701
	SIC2	0.851			
	SIC3	0.862			
	SIC4	0.808			
Process Innovation Capability (PIC)	PIC1	0822	0.836	0.891	0.670
	PIC2	0.823			
	PIC3	0.799			
	PIC4	0.831			
Customer Participation (CP)	CP1	0.876	0.831	0.833	0.624
	CP2	0.841			
	CP3	0.877			
Competitive advantage (CAD)	CAD1	0.792	0.850	0.899	0.690
	CAD2	0.840			
	CAD3	0.859			
	CAD4	0.831			

Source(s): Authors' compilation

Table 2. HTMT Criterion for Discriminant Validity Assessment

Construct	CAD	CP	DT	PIC	SIC
CAD					
CP	0.724				
DT	0.693	0.847			
PIC	0.496	0.588	0.553		
SIC	0.545	0.471	0.516	0.275	

Source(s): Authors' compilation

The reliability and validity results confirm the robustness of the measurement model, with all indicators meeting the recommended thresholds [46]. Accordingly, the constructs in this study satisfy both convergent and discriminant validity criteria.

4.2. Evaluation of the structural model

Evaluation of the structural model: Multicollinearity and overall model fit were assessed using the Variance Inflation Factor (VIF) and the Standardized Root Mean Square Residual (SRMR). As presented in Table 4, all VIF values range from 1.000 to 2.233, which are well below the recommended threshold of 3, indicating that multicollinearity is not a concern in the model [44]. Furthermore, the SRMR value was 0.056, lower than the commonly accepted cutoff of 0.08, confirming that the model demonstrates a good fit [47].

Table 3. Multicollinearity assessment results

Construct	CAD	CP	DT	PIC	SIC
CAD					
CP	2.208			2.027	2.027
DT	2.233	1.000		2.027	2.027
PIC	1.365				
SIC	1.273				

Source(s): Authors' compilation

The explanatory power of the model is assessed using the coefficient of determination (R^2). The results indicate that the R^2 values for CAD, CP, SIC and PIC were 0.469, 0.507, 0.214 and 0.268, respectively, indicating moderate and acceptable explanatory power [48]. Furthermore, the predictive capability of the model was examined using the blindfolding procedure based on the Q^2 statistic. The results show that the Q^2 value for CAD is 0.318, which falls within the range of 0.02 to below 0.35, indicating a medium level of predictive relevance. In contrast, the Q^2 value for CP is 0.375, which exceeds the threshold of 0.35 and therefore reflects a high level of predictive relevance. The Q^2 values for SIC and PIC are 0.145 and 0.176, respectively, both of which lie within the range of 0.00 to below 0.02, suggesting relatively weak predictive relevance.

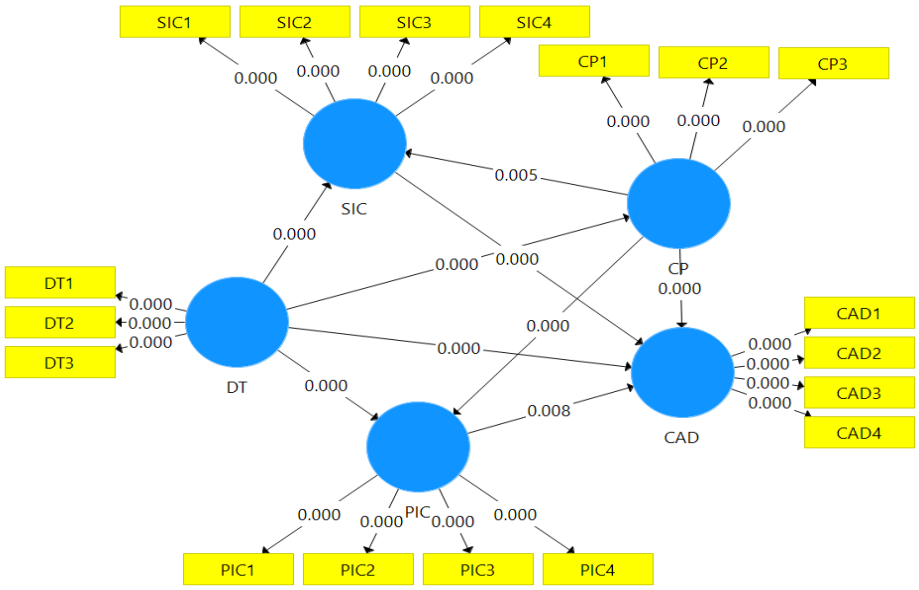

Figure 2. Results of PLS-SEM

These findings indicate that the model exhibits satisfactory predictive capability, particularly in explaining the variance in CAD and CP [49]. The direct effects within the structural model were evaluated using t-tests combined with a bootstrapping procedure (N = 1,000), ensuring the robustness and reliability of the statistical estimates.

The results of the structural model evaluation and hypothesis testing, including all significant direct effects, are presented in Figure 2. Moreover, the estimation results in Table 4 confirm that all hypothesized relationships are statistically significant, with p-values below 0.05.

Table 4. Results of hypothesis testing

Hypo-the-sis	Impact	Coefficient	P-value	Decision
H1	DT→ CAD	0.217	0.000	Accepted
H2	DT→ SIC	0.320	0.000	Accepted
H3	DT→ PIC	0.236	0.000	Accepted
H4	DT→ CP	0.712	0.000	Accepted
H5	CP→ SIC	0.177	0.005	Accepted
H6	CP→ PIC	0.322	0.000	Accepted
H7	CP→CAD	0.314	0.000	Accepted
H8	SIC →CAD	0.217	0.000	Accepted
H9	PIC →CAD	0.113	0.008	Accepted

Source(s): Authors' compilation

5. Discussion

This study provides empirical evidence demonstrating that DT has a significant impact on enterprises' competitive advantage. This finding is consistent with previous studies that consider digital transformation (DT) a critical driver of competitive advantage across various

industries, such as [2]; [3]; [4]; [30]. This relationship occurs not only through direct effects but also indirectly through the mediating roles of customer participation, service innovation capability, and process innovation capability. These findings underscore the critical importance of digital transformation in shaping competitive strategy for enterprises. Moreover, by incorporating customer participation, service innovation capability, and process innovation capability as mediating variables, this study extends previous models that primarily focused on the direct effects of digital transformation [2]; [3]; [4]; [30] and on internal organizational factors [4]; [31], while largely neglecting external factors such as customer participation. Another notable finding indicates that DT exerts a positive and significant influence on CP within logistics enterprises. This finding aligns with prior research highlighting the pivotal role of DT as a catalyst for enhancing CP, facilitating knowledge sharing, and promoting value co-creation [1]; [9]. The results also reveal that CP has a positive and significant effect on the CAD of logistics enterprises. This highlights the strategic importance of proactive CP in facilitating the development of distinctive, customer-centric logistics solutions. Through the continuous integration of customer feedback and active involvement in service co-creation, logistics enterprises enhance service quality and strengthen their competitive positioning. These findings are in line with prior research demonstrating that deep customer involvement promotes innovation and strategic differentiation in knowledge-intensive, service-driven industries [5]; [40]. At the same time, the study also reveals that SIC and PIC have a positive and significant impact on CAD. This result is consistent with the RBV and Dynamic Capabilities Theory, as well as with the findings of previous studies [13]; [14].

From a practical perspective, the findings indicate that digital transformation is a prerequisite for enabling customer participation in information sharing and the co-design of services tailored to individual needs. This establishes a foundation for building competitive advantages, aligning with the orientations proposed in previous studies such as [14]; [16]. For logistics enterprises, customers engage by providing information about their needs, collaborating in the design and selection of logistics solutions, monitoring and supervising service progress, coordinating delivery activities, and offering timely feedback on emerging changes. They also participate through service quality evaluations, feedback provision, and suggestions for improvement. The degree of customer participation directly influences operational efficiency through enhanced service and process innovation capabilities, thereby contributing to the development of sustainable competitive advantages for logistics enterprises.

6. Conclusions

This study provides empirical evidence on the role of digital transformation in enhancing customer participation, service innovation capability, process innovation capability, and

competitive advantage among logistics enterprises. The findings not only confirm the direct impact of digital transformation but also clarify its indirect mechanisms through customer participation, service innovation capability, and process innovation capability.

These results offer several important managerial implications for logistics managers in Vietnam. The study highlights that digital transformation can generate the competitive advantage only when it is accompanied by active customer participation in information sharing and co-designing logistics services, which in turn fosters continuous service and process innovation. Therefore, logistics enterprises should develop comprehensive digital transformation strategies that emphasize customer participation while simultaneously promoting innovation across both service and process dimensions.

However, this study has several limitations. The data were collected exclusively from logistics enterprises operating in HCMC. Although this context offers valuable insights into an emerging logistics market such as Vietnam, it may not fully represent the circumstances of logistics firms in other national settings, particularly those in developed economies or regions with different governance systems and regulatory frameworks. Therefore, caution should be exercised when generalizing the findings beyond the Vietnamese context. Furthermore, the relationships among DT, CP, SIC, PIC, and CAD are inherently complex and may be influenced by additional mediating or moderating factors not explored in this study. Such as customer information quality, and internal coordination mechanisms could also play important roles and should be considered in future research.

Future research should be conducted in different regional contexts, particularly in developed economies, to enable comparison and enhance the generalizability of the findings. Moreover, incorporating additional factors such as customer information quality and internal coordination mechanisms would further strengthen the robustness and applicability of the proposed model.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

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