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The Impact of Extended TOE Factors on E-commerce Adoption and Financial Performance of SMEs in Vietnam

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Abstract

Despite the substantial benefits that e-commerce can bring to small and medium-sized enterprises (SMEs), its adoption rate among Vietnamese SMEs remains relatively low. Identifying the key factors that drive e-commerce adoption is therefore essential. Existing studies have primarily focused on large-scale enterprises, leaving empirical evidence on e-commerce adoption among SMEs—particularly in the Vietnamese context—relatively scarce. While some research has addressed SMEs, these studies often employ simplified analytical frameworks that do not fully capture the TOE factors shaping e-commerce adoption decisions.

This study examines the impact of an extended Technology–Organization–Environment (TOE) framework on e-commerce adoption and the financial performance of Vietnamese SMEs, with digital capability and operational performance acting as mediating variables. The research model incorporates eight determinants: AI integration, firm capability, customer technology savviness, innovative culture, information culture, competitive pressure, business partner pressure, and government support.

This study employs a mixed-methods approach, combining expert interviews with a survey of Vietnamese SMEs engaged in e-commerce. Data were collected from 301 SMEs through an online survey. Measurement reliability and validity were assessed using Cronbach's Alpha and Exploratory Factor Analysis (EFA) in SPSS. Partial Least Squares Structural Equation Modeling (PLS-SEM) was then applied using SmartPLS to evaluate the measurement and structural models.

The results show that AI integration and firm capability exert the strongest influence on e-commerce adoption, while information culture and customer technology savviness have relatively weaker effects. Furthermore, e-commerce adoption improves SMEs' financial performance indirectly through enhanced operational performance. These findings provide useful insights for managers and policymakers aiming to promote effective e-commerce adoption among Vietnamese SMEs.

Keywords: E-commerce, SMEs, Financial Performance, TOE Framework, Vietnam.

1. Introduction

In the era of the global digital economy, electronic commerce (e-commerce) has increasingly emerged as a critical driver of business transformation, innovation, and economic growth, particularly for small and medium-sized enterprises (SMEs) in developing economies. The rapid expansion of digital platforms and

advanced technologies has fundamentally reshaped the ways in which firms access markets, organize operations, and create value. However, not all enterprises are able to fully capitalize on the benefits offered by e-commerce, especially SMEs—despite their dominant presence in the economy—due to inherent limitations in resources and capabilities.

A growing body of international literature suggests that the adoption and implementation of e-commerce by firms is not a random decision but rather the outcome of the combined influence of technological, organizational, and environmental factors, which are systematically conceptualized within the Technology–Organization–Environment (TOE) framework (Awiagah et al., 2016)[1]. According to this perspective, technological readiness, internal organizational capabilities, and external environmental pressures or support mechanisms play pivotal roles in shaping SMEs' decisions to adopt e-commerce.

Empirical evidence from several developing countries, including Ghana, Bangladesh, and Iraq, indicates that all three dimensions of the TOE framework exert positive effects on the level of e-commerce adoption among SMEs, although the relative strength of these effects varies across contexts, as evidenced by Awiagah et al. (2016), Emon and Nahid (2023), and Ibrahim et al. (2024) [1, 2, 3].

More recently, scholars have extended the traditional TOE framework by incorporating factors that reflect contemporary digital transformation trends, such as artificial intelligence integration, customer technological sophistication, innovation culture, and partner pressure. These extensions highlight the growing importance of such factors in accelerating e-commerce adoption among SMEs (Omar & Mohandah, 2024)[4].

Alongside research focusing on the determinants of e-commerce adoption, another stream of studies has examined the consequences of e-commerce implementation for firms' marketing performance and financial outcomes. International studies consistently demonstrate that e-commerce adoption enables SMEs to increase revenues, improve profitability, reduce transaction costs, and enhance the efficiency of resource utilization (Abebe, 2014; Efendi et al., 2013; Hanum & Sinarasri, 2017) [5–7]. Nevertheless, most existing findings primarily capture direct relationships, while the mechanisms through which e-commerce adoption is translated into financial performance remain insufficiently explored.

Despite the growing volume of research on e-commerce, significant gaps persist. First, the majority of prior studies concentrate on identifying factors influencing e-commerce adoption, without constructing a comprehensive causal chain linking TOE-related factors to firms' financial performance. Second, the roles of key mediating variables—such as digital capability and operational performance—which may determine whether firms can effectively transform e-commerce adoption into tangible financial outcomes, have not been systematically examined (Fonseka et al., 2022; Wahyudi, 2019) [8, 9].

In the Vietnamese context, empirical findings remain inconclusive. While some studies report a positive impact of e-commerce adoption on SMEs' financial performance Đặng Thái Bình et al. (2023) [10], others suggest a short-term decline in profitability when firms lack sufficient organizational preparedness and operational capabilities Đoàn Vũ Nguyên et al. (2024) [11]. This inconsistency underscores the need for deeper investigation into the conditions and mechanisms through which e-commerce affects firm performance, particularly for Vietnamese SMEs in the post-COVID-19 period.

Against this backdrop, the present study aims to propose and empirically test an extended TOE framework to examine the factors influencing e-commerce adoption and its impact on the financial performance of SMEs in Vietnam. Building upon prior theoretical approaches, the study further extends the analytical model by integrating additional factors that reflect the contemporary digital transformation context.

From a theoretical perspective, this study contributes to the literature by extending the TOE framework and elucidating indirect impact mechanisms through key mediating variables, namely digital capability and operational performance. From a practical standpoint, the findings provide valuable empirical evidence to help SME managers better understand the conditions under which e-commerce adoption can lead to sustainable financial performance. Moreover, the study offers policy-relevant insights to support the design of digital transformation initiatives tailored to the specific characteristics of the SME sector in Vietnam.

To achieve these objectives, the study seeks to address the following research questions:

1. How do technological, organizational, and environmental factors within the extended TOE framework influence the level of e-commerce adoption among SMEs in Vietnam?
2. How does e-commerce adoption affect the financial performance of SMEs?
3. Do digital capability and operational performance mediate the relationship between e-commerce adoption and SMEs' financial performance?

This study argues that e-commerce adoption can generate sustainable financial performance for Vietnamese SMEs only when it is supported by appropriate technological, organizational, and environmental conditions and effectively transformed through firms' digital capabilities and operational performance in the post-digital transformation context.

2. Literature Review.

2.1 Theoretical Framework.

In this study, electronic commerce (e-commerce) is defined as the use of the Internet and related digital technologies to conduct business activities, including information exchange, transactions, payments, and the delivery of goods and services among economic actors. According to the (OECD, 2001) and the World Trade Organization - (WTO, 2002) [11, 12] e-commerce is not limited to online buying and selling; rather, it represents a mode of organizing and optimizing business processes based on information technology. Accordingly, e-commerce is regarded as a manifestation of enterprise digitalization within the context of the digital economy. For small and medium-sized enterprises (SMEs), e-commerce plays a particularly critical role, as it enables firms to overcome inherent constraints related to scale, capital, and market reach. Through e-commerce, SMEs can directly access customers, reduce transaction costs, and enhance operational efficiency. Numerous studies suggest that e-commerce is not merely a technical tool but also a strategic factor that helps SMEs improve their competitiveness in an increasingly digitalized business environment.

The level of e-commerce adoption reflects the extent and depth to which SMEs implement and integrate e-commerce into their business operations. This adoption process is not binary in nature (i.e., "adopted" or "not adopted") but rather occurs along a continuum, ranging from the use of e-commerce as a supplementary sales channel to the deep integration of digital technologies into managerial functions and strategic decision-making. In the Vietnamese context, the level of e-commerce adoption among SMEs remains uneven, reflecting disparities in resources, managerial capabilities, and technological readiness. According to the Vietnam E-commerce Business Index (EBI) Report (2025) [13], e-commerce adoption among SMEs is currently undergoing a transitional phase, characterized by notable developments in infrastructure, sales channels, and business performance.

Regarding firm performance outcomes, the financial performance of SMEs is understood as the degree of improvement in business results, as reflected in indicators such as revenue growth, profitability, and the

efficiency of resource utilization. E-commerce is considered a dynamic capability of the firm (K. M. Eisenhardt & J. A. Martin, 2000; Zhu and Kraemer (2002) [14, 15]. Investments in or utilization of valuable resources such as e-commerce can generate substantial economic value and competitive advantages. Specifically, e-commerce enables firms to optimize operating costs while simultaneously stimulating transaction volumes and sales revenues through access to broader markets. Although e-commerce is widely expected to deliver financial benefits, prior studies indicate that its impact on financial performance is not automatic; rather, it depends critically on how firms implement and leverage the technology.

This study is developed based on an integrated framework that combines technology acceptance theories and strategic management theories to comprehensively explain both the motivations behind e-commerce adoption and the mechanisms through which financial performance outcomes are generated for SMEs.

The Technology Acceptance Model (TAM) proposed by Davis et al. (1989) [16] is employed to explain e-commerce adoption behavior based on decision-makers' perceptions. TAM posits that perceived usefulness (PU) and perceived ease of use (PEU) directly influence behavioral intention and actual technology use. In the SME context, where technology adoption decisions are often centralized in the hands of business owners or senior managers, TAM is particularly useful for explaining the initial stage of e-commerce adoption, during which decisions are primarily driven by perceived benefits and costs.

From a strategic perspective, the Resource-Based View (RBV), originally introduced by Edith Penrose in The Theory of the Growth of the Firm (1959), emphasizes the role of internal resources in generating sustainable competitive advantage [17]. For SMEs, RBV is especially relevant due to their inherent limitations in scale, financial resources, and market access compared to large enterprises. According to RBV, e-commerce can create value only when it is exploited as a strategic resource and effectively combined with other firm-specific resources, such as managerial capabilities, organizational knowledge, and technological skills. RBV thus provides a robust theoretical foundation for explaining how firms can leverage internal resources to maximize the benefits of e-commerce adoption. In this study, RBV serves as a key theoretical lens to clarify the role of technological and organizational resources in promoting e-commerce adoption and, subsequently, enhancing the financial performance of SMEs in Vietnam.

Extending the analysis of technology adoption behavior, the Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Venkatesh et al. (2003) [18] synthesizes several prior technology acceptance models. UTAUT highlights the roles of performance expectancy, effort expectancy, social influence, and facilitating conditions in explaining technology use behavior. By integrating multiple theories and models related to e-commerce adoption and the financial performance of SMEs in Vietnam, UTAUT is considered capable of providing a relatively accurate explanation of users' technology usage intentions.

The Technology - Organization - Environment (TOE) framework, proposed by Tornatzky et al. (1990) [19], is employed as the central theoretical framework of this study. TOE enables a comprehensive analysis of technological, organizational, and environmental factors influencing firms' decisions to adopt e-commerce. This framework has been widely applied in e-commerce research due to its strong explanatory power at the organizational level and its particular suitability for SMEs in developing economies.

Finally, the Dynamic Capabilities View (DCV) Teece et al. (1997) [20] is used to explain the mechanisms through which SMEs transform e-commerce adoption into sustainable financial benefits. DCV emphasizes firms' abilities to integrate, reconfigure, and renew resources in response to dynamic business

environments. In the context of e-commerce, dynamic capabilities determine whether technology adoption yields only short-term gains or can generate long-term financial performance improvements for SMEs. Based on the systematic integration of these theories in the sequence outlined above, this study proposes an extended TOE framework to analyze the relationship between the level of e-commerce adoption and the financial performance of small and medium-sized enterprises in Vietnam.

2.2 Previous Studies.

In recent years, the adoption of e-commerce, digital transformation, and artificial intelligence (AI) integration in small and medium-sized enterprises (SMEs) has attracted considerable attention from researchers, particularly in the context of developing economies. Empirical studies have been conducted in Vietnam and several emerging countries to analyze the factors influencing e-commerce adoption as well as to evaluate the impact of this process on SMEs' operational performance and financial performance.

In Vietnam, empirical studies indicate that the level of e-commerce adoption among SMEs has been increasing but remains fragmented. The study by Dang Thai Binh et al. (2023) [10] identifies the extent of the impact of various factors on e-commerce adoption among SMEs in Vietnam. Technological factors exert the strongest influence, including technological infrastructure, websites, compatibility and costs, and IT human resources. Organizational and managerial factors have a moderate impact, relating to technological readiness, IT experience, firm size, employee support, market orientation, and the owner's knowledge and innovativeness. These findings suggest that the owner's perception of benefits and innovativeness has a positive correlation and plays a decisive role in determining the likelihood of e-commerce adoption. Environmental factors have the weakest impact; however, pressure from customers, suppliers, and competitors encourages firms to adopt e-commerce.

The study by Le Thi Bich Phuong and Le Thi Hao (2024) [21] presents research findings and evaluates applications of artificial intelligence in the field of e-commerce among Vietnamese enterprises. The results show that artificial intelligence has had and continues to have profound impacts on e-commerce firms in Vietnam, particularly in improving user experience through product and service personalization, optimizing supply chain management processes, and enhancing the effectiveness of marketing strategies. In addition, artificial intelligence plays an important role in providing rapid and efficient customer support. The article not only clarifies the role of artificial intelligence in improving the operational performance of e-commerce enterprises in Vietnam but also provides a scientific basis for managers and firms to apply artificial intelligence effectively, while opening new directions for future research on AI applications across various fields.

Dinh Van Son and Nguyen Tran Hung (2025) [22] integrated the Technology - Organization - Environment (TOE) framework with the Technology Acceptance Model (TAM) to examine factors influencing the use of AI in e-commerce enterprises. The study identifies that organizational factors (O) have the strongest impact on perceived usefulness (PU), while technological factors (T) have a moderate impact on perceived ease of use (PEU); meanwhile, environmental factors (E) have only a minor impact on both PU and PEU. At the same time, perceived ease of use (PEU) has a stronger influence on the behavioral intention to use AI technology among Vietnamese enterprises than perceived usefulness (PU).

Pham Dinh Dzu (2025) [23] focuses on Vietnamese SMEs, employing a combined approach of Covariance-Based Structural Equation Modeling (CB-SEM) and Fuzzy-set Qualitative Comparative

Analysis (fsQCA) to examine digital transformation and AI application. Key factors such as transformational leadership, organizational capability, corporate culture, and the working environment positively influence digital transformation, with AI playing a mediating role. The study demonstrates significant improvements in business performance, including financial performance (revenue growth and cost reduction) and non-financial aspects (innovation), highlighting the role of AI in enhancing competitiveness in alignment with national digital transformation objectives. Data were collected through the distribution of questionnaires to SMEs in Vietnam, resulting in exactly 500 valid responses after screening, ensuring the generalizability of measurements using the applied analytical tools.

In the context of Malaysia, numerous studies have explored factors influencing SMEs' adoption of e-commerce, with a particular focus on how SMEs adopt e-commerce. Shah Alam et al. (2011) [24] conducted a study using data from a sample of 200 SMEs to identify factors affecting e-commerce adoption. The findings reveal that SMEs' e-commerce adoption is strongly influenced by relative advantage, compatibility, organizational readiness, management quality, and security.

In addition, Abebe (2014) [5] examined the relationship between SME performance and e-commerce adoption from the perspective of owners' and managers' entrepreneurial attitudes. The results indicate that the average sales growth rate of SMEs is strongly driven by e-commerce adoption, and firms that adopt e-commerce technologies exhibit higher average sales growth rates compared to those that do not. The study also finds that e-commerce adoption has a more favorable impact on SMEs' annual sales growth rates when compared with SMEs that display lower levels of entrepreneurial orientation.

In a related study, factors influencing e-commerce adoption among SMEs in Semarang, Indonesia, were also examined by Tusyanah et al. (2021) [25]. The findings indicate that SMEs' entrepreneurs' decisions to adopt e-commerce are influenced by several factors, including trading partner readiness, perceived service quality, consumer trust, social influence, perceived ease of use, perceived usefulness, individual differences, and competitive pressure. Alzahrani (2019) [26] also finds that e-commerce positively affects business strategy among SMEs in Saudi Arabia and that various factors, including technological, cultural, financial, and organizational factors, may influence this relationship. Insights into variables affecting e-commerce adoption among SMEs in developing countries are provided by Dahbi and Benmoussa (2019) [27]. These findings emphasize the importance of organizational, cultural, financial, and technological aspects in determining SMEs' readiness to implement e-commerce.

A synthesis of the studies reveals several important commonalities. First, most studies agree that technological factors play a central role in promoting e-commerce and AI adoption among SMEs, particularly in developing economies. Technological infrastructure, compatibility, implementation costs, and information technology capability are identified as the most influential factors. In addition, organizational and managerial factors, including organizational readiness, leadership capability, innovative culture, and the owner's perception of benefits, are positively associated with technology adoption decisions. Recent studies also concur that artificial intelligence plays a crucial role in enhancing the effectiveness of e-commerce through improved marketing, optimized operations, and enhanced customer experience [28, 29].

However, research findings still exhibit certain inconsistencies. The role of environmental factors is evaluated differently across research contexts; while some studies in Vietnam indicate that environmental influences remain limited, studies conducted in Malaysia, Indonesia, and Saudi Arabia emphasize the impact of competitive pressure and institutional factors [24–27]. Moreover, there is no consensus regarding the mechanism through which e-commerce adoption affects financial performance, as some

studies report a direct effect, whereas others argue that this impact is indirect and contingent upon organizational capabilities and the degree of artificial intelligence integration [8, 9].

2.3. Research Hypotheses

2.3.1. AI Integration

The level of AI integration reflects the depth of the digital transformation process within enterprises, particularly in the e-commerce activities of SMEs, as it represents the extent to which firms implement and integrate AI applications into core business processes. Within the TOE framework, the level of AI integration is considered an expression of internal technological capability and the ability to transform technology into economic value. AI integration enables firms to enhance customer interaction efficiency, improve online shopping experiences, and optimize marketing activities, thereby promoting the adoption and exploitation of e-commerce [28]. Empirical studies also indicate that the level of AI integration has a positive and statistically significant impact on e-commerce adoption, while simultaneously playing a mediating role in the relationship between technological capability and business performance outcomes. In addition, the level of AI integration reflects technological readiness and organizational capability, including information technology infrastructure, data quality, human resources, and managerial capacity, enabling firms to automate processes, reduce costs, and improve overall operational efficiency [29]. In the Vietnamese context, the level of AI integration is simultaneously influenced by technological, organizational, and environmental factors, in which leadership awareness and strategic orientation play a decisive role in the implementation and exploitation of AI in e-commerce [22]. The research group proposes the following hypothesis:

H1: The level of AI integration has a positive effect on the level of e-commerce adoption by enterprises.

2.3.2. Customer Savviness

Customer technological literacy is understood as the level of customers' knowledge, skills, and readiness to access and use digital technologies, particularly e-commerce platforms. Within the extended TOE framework, this variable is considered a factor belonging to the environmental context, representing the level of technological readiness of the market served by the enterprise. Studies show that when customers have a high level of technological literacy, they tend to accept and exploit online transaction channels more rapidly, while simultaneously creating pressure that compels enterprises to implement e-commerce at a deeper level [28]. In addition, customer technological literacy also helps enhance the effectiveness of exploiting AI applications in e-commerce through active interaction with recommendation systems, chatbots, and content personalization. This contributes to improving marketing effectiveness, increasing conversion rates, and enhancing the financial performance of enterprises, particularly for SMEs with limited resources [30]. On this basis, the study proposes the following hypothesis:

H2: Customer technological literacy has a positive impact on the level of e-commerce adoption of enterprises.

2.3.3. Firm Capability

Firm capability is the combination of tangible and intangible resources, together with organizational capabilities, that enable enterprises to implement, operate, and effectively exploit digital technologies, particularly e-commerce and supporting technologies such as artificial intelligence. Within the TOE framework, this is a core factor belonging to the organizational context, representing the level of internal readiness to transform technology into operational performance and financial performance. Components such as managerial capability, technological capability, human resource capability, and organizational

coordination capability play a key role in promoting e-commerce adoption, especially for SMEs with limited resources [19]. Enterprises with high organizational capability tend to integrate e-commerce platforms more effectively into business processes, thereby reducing transaction costs, improving service quality, and creating competitive advantages. Empirical studies also indicate that firms' internal capabilities are positively associated with the level of e-commerce adoption and operational efficiency, and constitute a necessary condition for investments in digital technologies to be transformed into sustainable financial performance [28,29]. On this basis, the research group proposes the following hypothesis:

H3: Firm capability has a positive impact on the level of e-commerce adoption.

2.3.4. Innovative Culture

Firm innovation culture reflects the extent to which an organization values and nurtures innovative behaviors, including openness to new ideas, a positive attitude toward change, and the level of risk acceptance in the process of experimenting with technological solutions and new business models. Within the TOE framework, innovation culture is considered a foundational factor belonging to the organizational context, playing a role in guiding behavior and firms' technology adoption decisions. Studies show that firms with a high level of innovation culture tend to proactively adopt e-commerce, improve operational processes, and restructure business activities to exploit benefits from the digital environment, while organizations inclined toward traditional managerial thinking tend to implement technology more cautiously [31]. In addition, innovation culture also acts as a catalyst in transforming technological capability into practical outcomes by promoting internal coordination, encouraging the application of technology in problem solving, and flexibly adjusting strategies based on market data [29]. As a result, firms can improve customer experience, enhance digital marketing effectiveness, and better exploit revenue opportunities in e-commerce, thereby contributing to improved financial performance [28]. From these foundations, the research group proposes the following hypothesis:

H4: Firm innovation culture has a positive impact on the level of e-commerce adoption.

2.3.5. Information culture

Information culture is the extent to which an organization values the creation, sharing, and use of information and data as strategic resources in management and business activities. Within the extended TOE framework, information culture is regarded as a core factor belonging to the organizational context, forming the foundation for the effective implementation of digital technologies and e-commerce. Firms with a strong information culture typically encourage the systematic collection, analysis, and use of data in the decision-making process, thereby supporting more effective deployment of e-commerce platforms and data analytics tools [32]. Information culture also enables firms to exploit customer and market data to optimize products, pricing, digital marketing, and customer experience, while transforming data into knowledge that supports strategic decision-making [33]. For SMEs, information culture plays a particularly important role in optimizing limited resources, enhancing decision-making quality, and reducing risks in e-commerce activities, thereby helping to explain differences in financial performance among firms with similar levels of technological investment. From these foundations, the research group proposes the following hypothesis:

H5: Information culture has a positive impact on the level of e-commerce adoption.

2.3.6. Competitive Pressure

Competitive pressure reflects the extent to which firms are influenced by competitors in the market and is considered an important factor within the environmental context of the TOE framework that drives firms

to adopt new technologies [34]. Numerous studies show that as competition intensifies, particularly in highly digitalized environments, firms tend to adopt e-commerce in order to expand markets, reduce transaction costs, and enhance competitiveness [35]. For SMEs, competitive pressure not only creates challenges but also acts as a driving force that encourages firms to accept technological risks and experiment with more flexible online business models [36,37,38]. In addition, competitive pressure not only influences adoption decisions but also affects the level of e-commerce implementation and the adoption of supporting technologies such as data analytics and AI. Within the extended TOE framework, competitive pressure is regarded as a triggering factor that promotes digital transformation, while indirectly influencing financial performance through firms' ability to transform market pressure into innovation incentives and improved business performance. From these foundations, the research group proposes the following hypothesis:

H6: Competitive pressure has a positive impact on the level of e-commerce adoption.

2.3.7. Business Partner Pressure

In the context of digital economic integration, SMEs do not operate independently but function as links within the global supply chain. When key trading partners—such as major suppliers, distributors, or corporate customers—have adopted e-commerce, they tend to exert pressure on satellite firms to synchronize transaction processes [39]. Dependence on large partners creates coercive pressure, forcing smaller firms to adopt new technologies in order to maintain competitive advantages and avoid the risk of being excluded from business networks [40]. Specifically, these partners may require firms to use digital platforms for data exchange, ordering, or payment in order to optimize overall operational efficiency [41]. Therefore, expectations and requirements from trading partners constitute a strong exogenous driver that promotes SMEs' adoption of e-commerce. Based on these theoretical foundations, the research group proposes the following hypothesis:

H7: Pressure from trading partners has an impact on firms' decisions to adopt e-commerce.

2.3.8. Government support

Government support is a key environmental factor influencing firms' behavior and decisions regarding technology adoption, particularly in developing economies. Government intervention through regulations and incentive policies has a significant impact on encouraging and facilitating firms' digital transformation processes [42, 43]. The government plays an enabling role by providing essential infrastructure, establishing a transparent legal framework, and offering financial support packages or technical training, thereby reducing risks and barriers for firms when accessing new technologies [44]. For SMEs with limited resources, government guidance and support constitute a strong exogenous driver that encourages their participation in the digital market. From these foundations, the research group proposes the following hypothesis:

H8: Government support has a positive impact on firms' intention to adopt e-commerce.

2.3.9. E-commerce Adoption

The concept of the "level of e-commerce adoption" does not merely refer to the initial technology investment decision but is measured by the degree of penetration and frequency of technology use across core activities of the value chain [35]. From a process-based view, the level of e-commerce adoption is comprehensively reflected through three dimensions: (1) sales and customer interaction (front-end), (2) internal management processes (internal processes), and (3) transaction coordination and payment (back-end) [45]. When firms expand the scope of e-commerce application from simple sales activities to deep integration into customer services and internal processes, they develop superior digital capabilities and

significantly improve operational performance [10, 8]. Based on this foundation, the research group proposes the following hypotheses:

H9: The level of e-commerce adoption has an impact on firms' digital capability.

H10: The level of e-commerce adoption has an impact on firms' operational performance.

2.3.10. Digital Capabilities

Digital capability refers to a firm's ability to use and mobilize digital technologies to develop new products, improve processes, and respond rapidly to market changes [46]. Numerous studies argue that digital capability is a core prerequisite for digital transformation, as firms not only need to possess technology but also must be able to orchestrate and integrate it into daily operational activities. For SMEs, digital capability helps overcome scale limitations, optimize costs, and quickly capture niche market opportunities through flexibility in process reconfiguration and experimentation with digital business models [47]. In addition, digital capability directly affects operational performance and innovation capability by enhancing data analytics capacity, supporting decision-making, and strengthening the integration of e-commerce into existing business systems [48]. In the research model, digital capability is considered a critical mediating factor that transforms technological resources into improvements in business performance and sustainable competitive advantage. Conversely, a lack of internal digital capability may lead to inefficient and fragmented technology investments, thereby reducing overall performance. In the research model, digital capability is viewed as an important mediating factor that converts input resources into output outcomes in terms of business performance. Based on this foundation, the research group proposes the following hypothesis:

H11: Digital capability has an impact on firms' financial performance.

2.3.11. Operational Performance

Operational performance is defined as a firm's ability to optimize internal processes, reduce operating costs, and improve order fulfillment speed. The integration of e-commerce and digital tools into the value chain not only enables firms to expand markets but also directly contributes to streamlining operational structures [49]. Specifically, e-commerce allows for the automation of information flows across departments, thereby significantly reducing manual operations and human errors. Real-time data sharing enables firms to better control inventory, shorten ordering cycles, and improve labor productivity. In the context of intense competitive pressure, [49]. emphasize that firms that successfully adopt new technological solutions often experience marked improvements in process efficiency compared to traditional competitors. From these theoretical foundations, the research group proposes the following hypothesis:

H12: Operational performance resulting from e-commerce adoption has an impact on firms' financial performance.

2.3.12. Financial Performance

Financial performance is considered the most important empirical measure reflecting the final outcomes of digital transformation and e-commerce adoption, representing a firm's ability to convert technological advantages into sustainable economic value. In the digital economy context, financial performance is not only measured by short-term profits but also by cost optimization, improved profitability, and enhanced asset utilization efficiency. Studies indicate that the adoption and integration of e-commerce enable firms to expand markets, reduce transaction costs, and automate processes, thereby improving profit margins and cash flows [50]. Empirical evidence also confirms that the level of e-commerce integration has a positive and statistically significant impact on key financial indicators of SMEs, such as ROA and overall

profitability, while enhancing cost management efficiency and operational effectiveness. When firms reach a mature level of technology utilization, financial benefits become more evident, increasing resilience to market volatility and supporting long-term growth [50]. From these theoretical foundations, the research group proposes the following hypothesis:
H13: E-commerce adoption has an impact on firms' financial performance.

3. Research Methodology

This study adopts a mixed-methods approach, integrating both qualitative and quantitative methods to examine the effects of factors derived from the extended Technology–Organization–Environment (TOE) framework on e-commerce adoption and financial performance of small and medium-sized enterprises (SMEs) in Vietnam. This approach is consistent with prior international studies on technology adoption, as it allows for contextual exploration as well as rigorous empirical testing of the proposed research hypotheses.

3.1. Questionnaire development

A structured questionnaire was employed as the primary data collection instrument, as it is appropriate for measuring latent constructs in studies on e-commerce adoption. The questionnaire was developed based on an extensive review of prior studies related to the extended TOE framework and was adapted to reflect the specific context of Vietnamese SMEs.
The measurement scales were adopted from validated studies and subsequently refined through qualitative research and expert consultation. The final questionnaire consisted of 51 measurement items, capturing technological, organizational, and environmental factors, as well as mediating and outcome variables included in the research model. All items were measured using a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree. Prior to the formal survey, the questionnaire was reviewed to ensure clarity and contextual relevance, providing a reliable basis for subsequent SEM analysis.

Table 1. Measurement Scales and Sources

Construct	Code	Number of items	Sources
AI Integration	AII	5	(Fonseka, Jaharadak and Raman, 2022)[8]
Customer Savviness	CUS	3	Kumar et al. (2016); Titiloye et al.
Firm Capability	FC	4	Teo & Tan (1998); Ling (2001); Lê Văn Huy (2008) [44]
Innovative Culture	INC	4	(Škerlavaj, Song and Lee, 2010)
Information Culture	IC	4	Mohammed A. Al-Sharafi (2020), Abrahamson and Goodman-Delahunty (2013), Choo et al. (2008) and Sinitsyna (2014)[33]
Competitive Pressure	COP	5	Salah et al. (2021) [28]
Business Partner Pressure	BPP	3	Sharma et al. (2023) [54]
Government Support	GS	3	Teo & Tan (1998); Ling (2001); Lê Văn Huy (2008) [44]
E-commerce Adoption	ECA	4	Đặng, T.B (2022) [10]
Digital Capabilities	DC	5	Khin & Ho (2019); Annarelli et al. (2021) [55]

Operational Performance	OP	4	Almuwallad & Alhumoudi (2024) [57]
Financial Performance	FP	5	Sodeinde (2025) [56]

Note: All items were measured using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

3.2. Data Collection

Primary data were collected through a structured questionnaire survey targeting Vietnamese SMEs that have implemented or plan to implement e-commerce. The questionnaire was developed based on prior studies on the TOE framework, e-commerce adoption, digital capabilities, operational performance, and financial performance, and was refined through qualitative research involving in-depth interviews with experts and SME managers to ensure contextual suitability.

Data were collected using two approaches: an online survey administered via Google Forms and direct distribution of questionnaires to enterprises. The formal data collection period lasted from October 2025 to January 2026. A total of 338 questionnaires were returned; after removing invalid responses, 301 valid questionnaires were retained for quantitative analysis.

3.3. Sample and Sampling Method

The study focused on SMEs in Vietnam that engage in e-commerce activities. A non-probability convenience sampling method was employed, with the survey extended across the Northern, Central, and Southern regions of Vietnam to enhance sample diversity and representativeness.

The research model included 51 observed variables. Following the commonly accepted minimum ratio of five observations per variable, the required sample size was 255 observations. With 301 valid responses, the sample size satisfied the requirements for conducting exploratory factor analysis (EFA) and PLS-SEM, ensuring the reliability and statistical validity of the results.

3.4. Data Analysis Method

The collected data were processed and analyzed using SPSS and SmartPLS 4, following analytical procedures commonly applied in SEM-based studies.

First, descriptive statistical analysis was conducted to summarize sample characteristics and assess data suitability. Next, the reliability of measurement scales was evaluated using Cronbach's Alpha in SPSS, with a threshold value of 0.7 or higher.

Subsequently, exploratory factor analysis (EFA) was performed to assess the convergent and discriminant validity of the measurement scales, employing the Principal Components extraction method and Varimax rotation. Evaluation criteria included the KMO measure, Bartlett's test of sphericity, factor loadings, and total variance explained.

Finally, partial least squares structural equation modeling (PLS-SEM) was conducted using SmartPLS 4 to test the research model and hypotheses. The model was assessed through both the measurement model (reliability, convergent validity, and discriminant validity) and the structural model (path coefficients, R^2, f^2, Q^2, and VIF). Hypotheses were tested using the bootstrapping procedure with 5,000 resamples.

4. Results and Discussion

4.1. Descriptive Statistics

This section presents the descriptive statistical results of the research sample, aiming to provide an overall overview of the characteristics of the small and medium-sized enterprises (SMEs) participating in the survey. Descriptive statistics are employed to assess the representativeness of the sample and to serve as

a foundation for subsequent quantitative analyses.

The study is based on 301 valid observations, which satisfy the minimum sample size requirements for studies employing Exploratory Factor Analysis (EFA) and Partial Least Squares Structural Equation Modelling (PLS-SEM). The questionnaires were collected from employees working in enterprises located in major cities in Vietnam, including Hanoi, Ho Chi Minh City, Da Nang, and Hai Phong. The sample covers a wide range of departments and job positions, thereby ensuring its relevance to the research objectives.

Table 2 presents the demographic profile of the respondents. The majority of the participants are male (61.9%), belong to the 36–45 age group (57.1%), and hold employee/specialist positions (66.7%). This composition indicates that the sample primarily represents the core workforce directly involved in daily operations and decision-making processes within SMEs.

Table 2. Demographic Profile of Respondents

Variable	Category	N	%
Gender	Male	186	61.9%
	Female	115	38.1%
Age group	18–25 years	29	9.5%
	26–35 years	43	14.3%
	36–45 years	173	57.1%
	46–55 years	43	14.3%
	Above 56 years	14	4.8%
Department	Board of Directors	57	19.0%
	Legal	0	0.0%
	Finance – Accounting	114	38.1%
	Auditing	0	0.0%
	Planning	0	0.0%
	Technical	29	9.5%
	Human Resources	43	14.3%
	Logistics	29	9.5%
	Sales & Marketing	29	9.5%

Job position	Board of Directors / CEO / Chairman	43	14.3%
	Team Leader / Department Manager	57	19.0%
	Employee / Specialist	201	66.7%

Table 2.1 presents the mean values and standard deviations of e-commerce adoption and its influencing factors. The mean values range from 3.226 for BPP to 3.847 for CUS. Meanwhile, the standard deviations range from 0.848 for BPP to 0.920 for ECA and FP, indicating a relatively low dispersion of the data around the mean. This suggests a relatively high level of consensus among respondents regarding the factors examined in this study.

Table 2.1. Descriptive statistics of variables

	Mean	Standard Deviation
AII	3.600	0.883
BPP	3.226	0.848
COP	3.571	0.860
CUS	3.847	0.870
DC	3.617	0.916
ECA	3.609	0.920
FC	3.458	0.888
FP	3.584	0.920
GS	3.657	0.911
IC	3.599	0.912
INC	3.648	0.868
OP	3.613	0.912

4.2. Regression Results

4.2.1. Measurement Model

This study employs the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach using SmartPLS 4 software to evaluate the reliability and validity of the constructs in the proposed research model. The assessment of the measurement model was conducted in accordance with the guidelines proposed by Fornell and Larcker (1981) [52] and the updated recommendations of Hair et al. (2016) [53]. According to Hair et al. (2016) [53], a measurement model is considered reliable only when it simultaneously satisfies convergent validity—the ability to accurately measure latent constructs—and

discriminant validity—the ability to clearly distinguish between different constructs. Accordingly, this study assesses the measurement model based on three key criteria: indicator reliability, convergent validity, and discriminant validity.

The reliability of the measurement scales was evaluated using Cronbach's alpha and Composite Reliability (CR), both of which reflect the internal consistency of the indicators in measuring the same construct. The results presented in Table 1 indicate that all Cronbach's alpha and CR values exceed the recommended threshold of 0.70, thereby confirming a high level of reliability for all research constructs.

Furthermore, convergent validity was assessed through factor loadings and the Average Variance Extracted (AVE). As suggested by Hair et al. (2016) [53], factor loadings should exceed 0.708; however, in empirical studies, a threshold of 0.60 is considered acceptable. The results show that all indicators exhibit loadings above the acceptable level, ensuring indicator reliability. In addition, the AVE values for all constructs are greater than 0.50, indicating that more than 50% of the variance in the observed variables is explained by their corresponding latent constructs. These findings confirm that convergent validity of the measurement model has been adequately established.

Table 3. Descriptive Statistics

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
AII	0.832	0.836	0.881	0.598
BPP	0.796	0.818	0.880	0.709
COP	0.845	0.851	0.889	0.616
CUS	0.791	0.802	0.877	0.704
DC	0.858	0.858	0.898	0.637
ECA	0.819	0.819	0.881	0.648
FC	0.827	0.832	0.885	0.658
FP	0.844	0.844	0.889	0.616
GS	0.795	0.795	0.880	0.709
IC	0.829	0.839	0.886	0.660
INC	0.797	0.812	0.880	0.709
OP	0.814	0.816	0.877	0.641

After establishing convergent validity, the study proceeded to assess discriminant validity using the Fornell–Larcker criterion. According to this criterion, the square root of the Average Variance Extracted (AVE) for each construct must be greater than its correlations with all other constructs in the model [52]. The results presented in Table 4 indicate that all diagonal values exceed the corresponding off-diagonal correlation coefficients, thereby confirming that the research constructs are statistically distinct and demonstrating adequate discriminant validity.

Table 4. Discriminant Validity (Fornell–Larcker Criterion)

	AII	BPP	COP	CUS	DC	ECA	FC	FP	GS	IC	INC	OP
AII	0.773											
BPP	0.126	0.842										
COP	0.369	0.340	0.785									

CUS	0.254	0.278	0.253	0.839								
DC	0.312	0.269	0.278	0.210	0.798							
ECA	0.617	0.473	0.572	0.427	0.529	0.805						
FC	0.246	0.261	0.397	0.305	0.199	0.552	0.811					
FP	0.192	0.163	0.183	0.147	0.255	0.336	0.193	0.785				
GS	0.302	0.233	0.376	0.236	0.232	0.461	0.262	0.096	0.842			
IC	0.196	0.298	0.303	0.208	0.213	0.386	0.239	0.091	0.179	0.813		
INC	0.277	0.232	0.212	0.197	0.296	0.395	0.154	0.090	0.164	0.189	0.842	
OP	0.317	0.228	0.230	0.207	0.278	0.496	0.275	0.637	0.221	0.222	0.148	0.801

In addition, to control for multicollinearity and common method bias, this study employed the full collinearity test as proposed by Kock (2015). The results indicate that the Variance Inflation Factor (VIF) values for all latent constructs are below the threshold of 3.3, suggesting that the model is free from serious multicollinearity issues and is not substantially affected by common method bias.

Table 5. Collinearity Statistics (VIF)

	AII	**BPP**	**COP**	**CUS**	**DC**	**ECA**	**FC**	**FP**	**GS**	**IC**	**INC**	**OP**
AII						1.000						
BPP						1.000						
COP						1.000						
CUS						1.000						
DC								1.000				
ECA					1.000							1.000
FC						1.000						
FP												
GS						1.000						
IC						1.000						
INC						1.000						
OP								1.000				

Overall, the assessment results indicate that the measurement model demonstrates high reliability, adequate convergent validity, and clear discriminant validity, thereby providing a robust foundation for subsequent analysis of the structural model and hypothesis testing.

4.2.2. The Structural Model

In this study, after completing the assessment of the measurement model, the structural model (inner model) was further analyzed to examine the causal relationships among the constructs in the proposed research framework. The evaluation of the structural model was conducted using the bootstrapping procedure with 5,000 resamples, as recommended by Hair et al. (2016) [53],, to determine the statistical significance of the path coefficients.

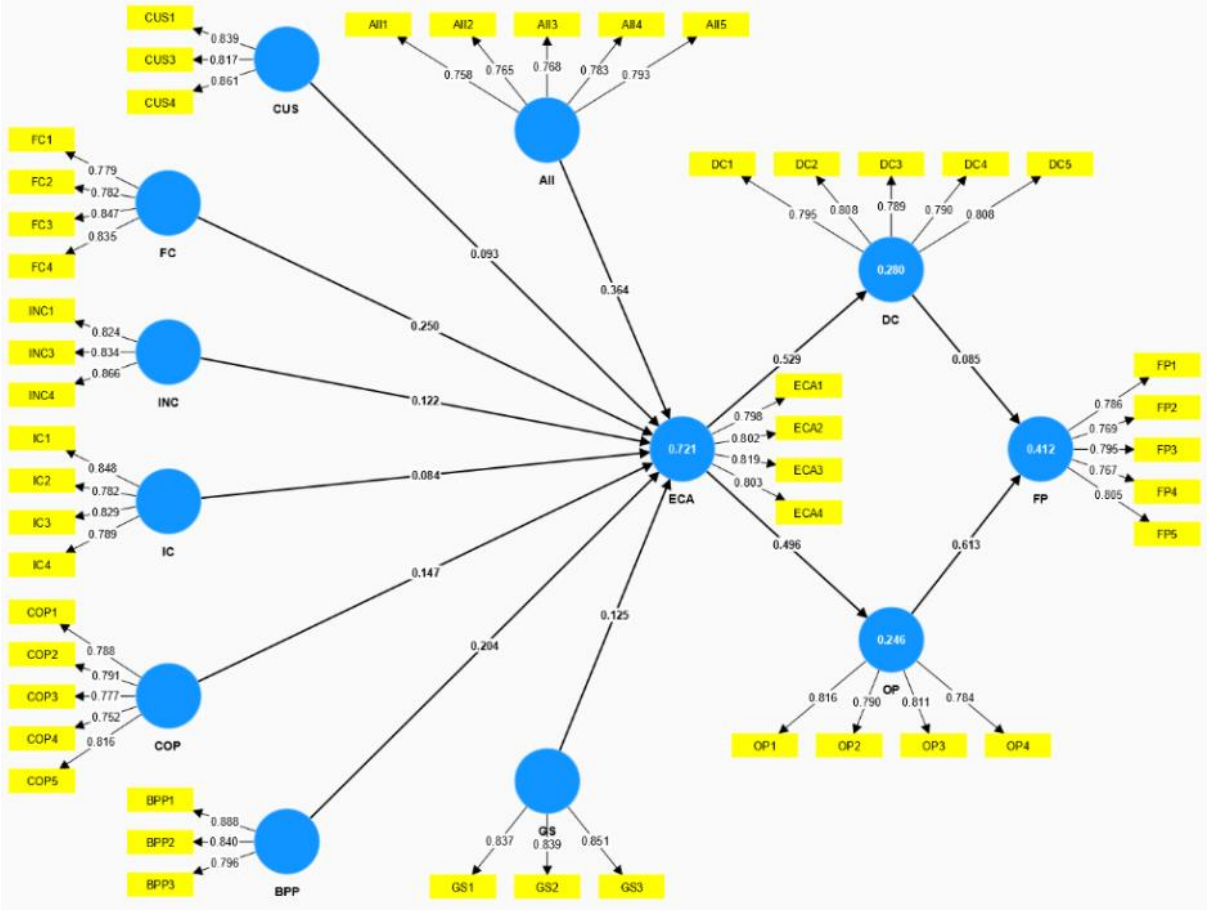
The research model was developed to elucidate the dependency relationships between the factors of the Technology–Organization–Environment (TOE) framework and e-commerce adoption (ECA), as well as the spillover effects of ECA on digital capability (DC), operating performance (OP), and financial performance (FP). In total, 13 hypotheses (H1–H13) were proposed and tested within the structural model.

According to Hair et al. (2016) [53], path coefficients (β) are used to assess the magnitude and direction of the relationships between constructs, with values ranging from –1 to +1. A β value closer to +1 indicates a stronger positive relationship, whereas a value closer to –1 reflects a stronger negative relationship. In addition, t-values and p-values were employed as criteria for hypothesis testing, whereby a relationship is considered statistically significant when the t-value exceeds 1.96 at the 5% significance level ($p < 0.05$). The results of the structural model assessment are presented in Table 6, indicating that 12 out of the 13 proposed hypotheses were supported.

Table 6. Hypothesis Testing Results

Hypothesis	Statement	Result
H1	AI integration has a positive effect on firms' e-commerce adoption.	Supported
H2	Customer technological knowledge has a positive effect on firms' e-commerce adoption.	Supported
H3	Firm capability has a positive effect on e-commerce adoption.	Supported
H4	Innovation culture has a positive effect on e-commerce adoption.	Supported
H5	Information culture has a positive effect on e-commerce adoption.	Supported
H6	Competitive pressure has a positive effect on e-commerce adoption.	Supported
H7	Partner pressure (suppliers, customers, and intermediaries) has a positive effect on e-commerce adoption.	Supported
H8	Government support has a positive effect on e-commerce adoption.	Supported
H9	E-commerce adoption has a positive effect on digital capability.	Supported
H10	E-commerce adoption has a positive effect on operating performance.	Supported
H11	Digital capability has a positive effect on financial performance.	Not supported
H12	Operating performance has a positive effect on financial performance.	Supported
H13	E-commerce adoption has a direct positive effect on financial performance.	Supported

Figure 1. Structural Model Results



Specifically, the bootstrapping results indicate that AI integration exerts (β=0,364; t=10,390; p<0,001). In addition, firm capability and customer knowledge also demonstrate positive and statistically significant effects on ECA, highlighting the critical roles of both internal resources and market-related factors in SMEs' decisions to adopt e-commerce.

In contrast, Hypothesis H11, which posits that digital capability has a direct effect on financial performance, is not supported (β=0,085; t=1,513; p=0,130). This finding suggests that possessing digital capabilities alone is insufficient to generate financial benefits in the absence of effective implementation mechanisms within business operations. Conversely, operating performance exhibits a strong positive impact on financial performance (β=0.613; t=14.489; p<0.001), underscoring the central role of operational efficiency in translating technological investments into economic value.

Beyond testing the statistical significance of the relationships, the study further evaluates the explanatory power and predictive capability of the structural model using the coefficient of determination (R^2) and effect size (f^2), as recommended by Hair et al. (2016)[53]. The R^2 value represents the proportion of variance in endogenous constructs explained by exogenous variables in the model. The results reveal that the R^2 value for e-commerce adoption (ECA) is 0.721, indicating that 72.1% of the variance in ECA is explained by the TOE framework factors. Furthermore, the model accounts for 28.0% of the variance in digital capability (DC) and 41.2% of the variance in financial performance (FP), reflecting a high level of explanatory power.

In addition, all f^2 values fall within the recommended thresholds, confirming that the exogenous constructs exert appropriate effect sizes on their corresponding endogenous variables. Overall, these findings demonstrate that the structural model exhibits satisfactory model fit, explanatory strength, and predictive relevance, thereby providing a solid foundation for the discussion of research findings in the subsequent section.

Table 7. Path Coefficients

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Result
AII -> ECA	0.364	0.365	0.035	10.390	0.000	Supported
BPP -> ECA	0.204	0.204	0.031	6.675	0.000	Supported
COP -> ECA	0.147	0.147	0.036	4.116	0.000	Supported
CUS -> ECA	0.093	0.092	0.033	2.833	0.005	Supported
DC -> FP	0.085	0.085	0.056	1.513	0.130	Not supported
ECA -> DC	0.529	0.531	0.040	13.245	0.000	Supported
ECA -> OP	0.496	0.498	0.048	10.257	0.000	Supported
FC -> ECA	0.250	0.249	0.037	6.706	0.000	Supported
GS -> ECA	0.125	0.127	0.032	3.889	0.000	Supported
IC -> ECA	0.084	0.085	0.034	2.466	0.014	Supported
INC -> ECA	0.122	0.122	0.031	3.865	0.000	Supported
OP -> FP	0.613	0.615	0.042	14.489	0.000	Supported

Table 8. R-square Values

	R-square	**R-square adjusted**
DC	0.280	0.278
ECA	0.721	0.714
FP	0.412	0.408
OP	0.246	0.243

Table 9. f-square Values

	AII	**BPP**	**COP**	**CUS**	**DC**	**ECA**	**FC**	**FP**	**GS**	**IC**	**INC**	**OP**
AII						0.368						
BPP						0.117						
COP						0.052						
CUS						0.025						
DC								0.011				
ECA					0.389							0.326
FC						0.174						
FP												
GS						0.045						
IC						0.021						
INC						0.046						

OP								0.590				

4.3 Discussion

This study provides empirical evidence on the digital transformation of small and medium-sized enterprises (SMEs) in Vietnam by examining the determinants of e-commerce adoption and the subsequent impact of e-commerce on firm performance. The discussion section interprets the key findings in relation to established theoretical frameworks and prior empirical studies.

First, the results indicate that SMEs' decisions to adopt e-commerce are multidimensional in nature and are simultaneously influenced by factors within the Technology–Organization–Environment (TOE) framework. The statistical significance of all TOE dimensions confirms that digital transformation is not merely a process of technological investment. Among the technological factors, AI integration exerts the strongest effect on e-commerce adoption (β=0.364), reflecting a shift from basic forms of e-commerce toward intelligent, data-driven e-commerce models. At the same time, the significant effects of firm capability and competitive pressure suggest that many SMEs' adoption decisions remain constrained by internal resource availability and market conditions, rather than being guided by long-term digital transformation strategies.

Second, the finding that digital capability does not exert a statistically significant direct effect on financial performance ($p>0.05$) represents an important contribution of this study. This result implies that the mere possession of digital skills and technological resources may not generate commensurate financial returns unless such capabilities are effectively integrated into core business activities. Accordingly, digital capability should be viewed as a potential resource, whose economic value depends on the extent to which it is leveraged through appropriate operational mechanisms.

Third, the empirical results strongly support the Resource-Based View (RBV). Consistent with Penrose (1959)[17] conceptualization of the firm as a bundle of productive resources, the findings demonstrate that operating performance plays a central mediating role in the relationship between e-commerce adoption, digital capability, and financial performance. Technological resources and digital capabilities can generate economic benefits only when they are effectively deployed through operational processes, including improvements in operational efficiency, process integration, and cost control.

Overall, the findings highlight operating performance as the critical link connecting digital technologies to firms' financial outcomes. In the context of Vietnamese SMEs, these results suggest that prioritizing internal process optimization and enhancing operational efficiency based on existing digital technologies is a necessary condition for translating technological investments into sustainable financial performance. By elucidating the conditional mechanism through which e-commerce influences SME performance in developing economies, this study contributes to the existing literature on digital transformation and e-commerce adoption.

5. Conclusion

This study successfully developed and empirically validated an extended Technology–Organization–Environment (TOE) framework to explain the level of e-commerce adoption and its impact on the financial performance of small and medium-sized enterprises (SMEs) in Vietnam. Using a convenience sampling approach, 301 valid survey responses were collected and analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) to assess reliability, validity, and the structural model for hypothesis testing. The statistical evidence indicates that factors within the extended TOE framework have positive

and significant relationships with the level of e-commerce adoption among Vietnamese SMEs. In particular, factors such as AI integration and Firm Capability were found to exert a strong and sustained influence on e-commerce adoption decisions. These relationships were empirically confirmed by the model testing results, with 12 out of 13 hypotheses supported.

Furthermore, the findings reveal that e-commerce adoption has a positive and significant impact on both operational performance and financial performance of SMEs. This implicitly confirms the critical mediating role of e-commerce adoption in the relationship between TOE-related factors and firm performance, although the hypothesis regarding the direct effect of digital capability on financial performance was not supported in this study.

The research findings provide important managerial implications for SME managers in Vietnam in optimizing their digital transformation strategies. Firms should proactively enhance their technological readiness by selecting e-commerce solutions that align with their scale and gradually integrating artificial intelligence to optimize business processes. In addition, fostering an innovation-oriented culture and an information-driven organizational culture is essential, requiring investments in workforce training and the establishment of data-driven decision-making mechanisms. Moreover, managers should perceive competitive pressure as a catalyst for innovation, shifting from price-based competition toward creating differentiated value through enhanced customer experience and improved operational efficiency. Finally, effectively leveraging government support policies and strengthening collaboration with partners within the digital ecosystem can help SMEs mitigate risks and overcome resource constraints during the implementation process.

Despite the establishment of clear research objectives and a thorough examination of these objectives, several limitations and challenges remain. First, the survey-based data may lack comprehensive generalizability due to the use of convenience sampling with a sample size of 301 firms, primarily concentrated in major urban areas, which may not fully capture the characteristics of SMEs in rural or remote regions. Second, although the study extensively investigated influencing factors, the measurement of financial performance relied on respondents' subjective assessments rather than quantitative financial statement data. Additionally, the cross-sectional nature of the study limits the ability to capture long-term variations in financial performance following e-commerce adoption.

To address these limitations and further advance this research stream, future studies should expand the sample size and apply probability sampling techniques to enhance representativeness across the Vietnamese business community. Longitudinal, practice-based research is also needed to more accurately assess the impact of digital capability on actual financial performance over time. Furthermore, subsequent research may consider incorporating additional contextual factors or alternative mediating variables in response to rapid technological changes, as well as integrating both primary data and secondary financial reporting data to improve the accuracy of business performance measurements.

References

1. Awiagah R., Kang J., Lim J.I., "Factors affecting e-commerce adoption among SMEs in Ghana", Information Development, 2016, 32 (4), 815–836. https://www.academia.edu/37601911/Factors_affecting_e_commerce_adoption_among_SMEs_in_Ghana
2. Emon M.H., Nahid K.A., "Determinants of e-commerce adoption among small and medium enterprises: Evidence from Bangladesh", Journal of Asian Business and Economic Studies, 2023, 30

2), 125–142. https://csmj.com.my/archive/1csmj2023/1csmj2023-32-36.pdf
3. Ibrahim A.A., Alshurideh M., Kurdi B., Salloum S., "Integrating TOE and DOI frameworks to examine e-commerce adoption among SMEs: The moderating role of trust", Journal of Theoretical and Applied Electronic Commerce Research, 2024, 19 (1), 150–170. https://www.tandfonline.com/doi/full/10.1080/1097198X.2024.2327945
4. Omar A., Mohandah A., "Extending the TOE framework to examine e-commerce adoption among SMEs: The role of artificial intelligence and innovation culture", Journal of Electronic Commerce in Organizations, 2024, 22 (1), 1–18. https://www.researchgate.net/publication/365971761_Factors_Affecting_ECommerce_Adoption_A_Conceptual_Model_and_Research_Propositions
5. Abebe M., "Electronic commerce adoption, entrepreneurial orientation and small- and medium-sized enterprise performance", Journal of Small Business and Enterprise Development, 2014, 21 (1), 100–116. https://www.scirp.org/reference/referencespapers?referenceid=3283033
6. Efendi R., Indrawati, Murtiyani S., "The effect of e-commerce adoption on business performance of SMEs", Journal of Economics, Business, and Accountancy Ventura, 2013, 16 (1), 1–10. https://www.researchgate.net/publication/256027867_Marketing_Supply_Chain_Using_B2B_Buy-Side_E-Commerce_Systems_Does_Adoption_Impact_Financial_Performance
7. Hanum A.N., Sinarasri A., "Analysis of factors affecting SMEs' adoption of e-commerce and its impact on business performance", International Journal of Economics, Commerce and Management, 2017, 5 (10), 456–470. https://www.researchgate.net/publication/347413551_ANALISIS_FAKTOR-FAKTOR_YANG_MEMPENGARUHI_ADOPSI_E_COMMERCE
8. Fonseka K., Jaharadak A.A., Raman M., "Impact of e-commerce adoption on business performance of SMEs in Sri Lanka: Moderating role of artificial intelligence", International Journal of Social Economics, 2022, 49 (10), 1518–1531. https://www.emerald.com/ijse/article-abstract/49/10/1518/152442
9. Wahyudi S., "Competitive advantage as a mediating variable in the relationship between e-commerce adoption and business performance of SMEs", International Journal of Economics and Management Studies, 2019, 6 (5), 45–53. https://www.academia.edu/143687361_E_Commerce_Competitive_Advantage_And_Business_Performance
10. Dang T.B., "E-commerce Adoption: A Case Study of Small and Medium-Sized Enterprises in Vietnam", National Economics University Press, 2023. https://www.researchgate.net/publication/371539543
11. Doan N.T., Do P.D., Bien T.H., "E-commerce usage and the impact of e-commerce usage on firms' financial performance in the context of COVID-19", Journal of International Economics and Management, 2022, 147. https://drive.google.com/file/d/1VAyyTb5n-X4zpJZVTI88zJrNYqDXQnkF/view
12. World Trade Organization, "Electronic Commerce". https://www.wto.org
13. Vietnam E-Commerce Association, "Vietnam E-commerce Business Index Report", 2025. https://drive.google.com/file/d/18hUNrKSJXQmKOQl7mLhqhV1bg2MiKcmN/view
14. Eisenhardt K.M., Martin J.A., "Dynamic capabilities: What are they?", Strategic Management Journal, 2000, 21, 1105–1121. https://www.academia.edu/59037221/Dynamic_capabilities_what_are_they

15. Zhu K., Kraemer K.L., "E-commerce metrics for net-enhanced organizations: Assessing the value of e-commerce to firm performance", Information Systems Research, 2002, 13, 275–295. https://www.scirp.org/reference/referencespapers?referenceid=26161
16. Davis F.D., Bagozzi R.P., Warshaw P.R., "User acceptance of computer technology: A comparison of two theoretical models", Management Science, 1989, 35 (8), 982–1003. https://www.researchgate.net/publication/227446117
17. Penrose E., The Theory of the Growth of the Firm, Oxford University Press, 1959. https://doi.org/10.1093/0198289774.001.0001
18. Venkatesh V., Morris M.G., Davis G.B., Davis F.D., "User acceptance of information technology: Toward a unified view", MIS Quarterly, 2003, 27 (3), 425–478. https://www.researchgate.net/publication/345693792
19. Tornatzky L.G., Fleischer M., Chakrabarti A.K., The Processes of Technological Innovation, Lexington Books, 1990. https://fr.scribd.com/document/852057567
20. Teece D.J., Pisano G., Shuen A., "Dynamic capabilities and strategic management", Strategic Management Journal, 1997, 18 (7), 509–533. https://josephmahoney.web.illinois.edu/BA545_Fall%202022/Teece,%20Pisano%20and%20Shuen%20(1997).pdf
21. Le T.B.P., Le T.H., "Application of artificial intelligence in electronic commerce at enterprises in Vietnam", Thang Long University Journal of Science, 2024, 14. https://drive.google.com/file/d/1uNjXOvrCMGz-Ez15gvGgGBRJg95PSb79/view
22. Dinh V.S., Nguyen T.H., "Factors affecting the use of artificial intelligence technology by Vietnamese e-commerce enterprises", Journal of Commercial Science, 2025, 199. https://tailieu.vn/doc/nghien-cuu-cac-yeu-to-tac-dong-den-viec-su-dung-ai
23. Pham D.D., "Business performance of SMEs in Vietnam in digital transformation and AI application", Economics and Forecasting, 2025. https://kinhtevadubao.vn/hieu-qua-hoat-dong-kinh-doanh
24. Shah Alam S., Ali M.Y., Mohd. Jani M., "Factors affecting electronic commerce adoption among SMEs in Malaysia", Journal of Business Economics and Management, 2011, 12 (2), 375–399. https://journals.vilniustech.lt/index.php/JBEM/article/view/5028
25. Tusyanah T., et al., "What makes SMEs entrepreneurs in Central Java adopt e-commerce?", Handbook of Research on Disruptive Innovation and Digital Transformation in Asia, IGI Global, 2021, 17–36. https://www.igi-global.com/gateway/chapter/275904
26. Alzahrani J., "The impact of e-commerce adoption on business strategy in Saudi Arabian SMEs", Review of Economics and Political Science, 2019, 4 (1), 73–88. https://www.emerald.com/reps/article/4/1/73/369316
27. Dahbi S., Benmoussa C., "What hinders SMEs from adopting e-commerce? A multiple case analysis", Procedia Computer Science, 2019, 158, 811–818. https://www.sciencedirect.com/science/article/pii/S1877050919312888
28. Salah O.H., Ayyash M.M., "E-commerce adoption by SMEs and its effect on marketing performance", Journal of Open Innovation: Technology, Market, and Complexity, 2024, 10 (2). https://www.researchgate.net/publication/375905527
29. Mustafa H.N., Ab Ghani N.I., Adam A., "Enhancing performance in SMEs: A conceptual framework for AI adoption", International Journal of Entrepreneurship and Management Practices, 2025, 8 (31). https://gaexcellence.com/ijemp/article/view/6003

30. Agarwal R., Prasad J., "A conceptual and operational definition of personal innovativeness in the domain of information technology", Information Systems Research, 1998, 9 (2), 204–215. https://pubsonline.informs.org/doi/10.1287/isre.9.2.204
31. Hurley R.F., Hult G.T.M., "Innovation, market orientation, and organizational learning", Journal of Marketing, 1998, 62 (3), 42–54. https://www.researchgate.net/publication/228137751
32. Marchand D.A., Kettinger W.J., Rollins J., Information Orientation: The Link to Business Performance, Oxford University Press, 2002. https://academic.oup.com/book/6371
33. Choo C.W., Bergeron P., Detlor B., Heaton L., "Information culture and information use", Journal of the American Society for Information Science and Technology, 2008, 59 (5), 792–804. https://www.researchgate.net/publication/220434786
34. Al-Jabri I.M., Alabdulhadi M.H., "Factors affecting cloud computing adoption", International Journal of Business Information Systems, 2016, 23 (4), 389–405. https://www.inderscienceonline.com/doi/abs/10.1504/IJBIS.2016.80215
35. Zhu K., Kraemer K.L., "Post-adoption variations in usage and value of e-business", Information Systems Research, 2005, 16 (1), 61–84. https://www.researchgate.net/publication/220079546
36. Addy M.N., et al., "Using the TOE theoretical framework to study the adoption of BIM-AR", Journal of Engineering, Design and Technology, 2023. https://www.researchgate.net/publication/369993556
37. Amini M., Jahanbakhsh Javid N., "A multi-perspective framework established on diffusion of innovation theory and the TOE framework", International Journal of Information Technology and Innovation Adoption, 2023, 11 (8), 1217–1234. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4340207
38. Zhong Y., Moon H.C., "Investigating the impact of Industry 4.0 technology through a TOE-based innovation model", Systems, 2023, 11 (6). https://www.mdpi.com/2079-8954/11/6/277
39. Wu F., Mahajan V., Balasubramanian S., "An analysis of e-business adoption and its impact on business performance", Journal of the Academy of Marketing Science, 2003, 31 (4), 425–447. https://www.researchgate.net/publication/257868829
40. Grandon E.E., Pearson J.M., "Electronic commerce adoption: An empirical study of small and medium US businesses", Information and Management, 2004, 42 (1), 197–216. https://doi.org/10.1016/j.im.2003.12.010
41. Lin H.F., "Understanding the determinants of electronic supply chain management system adoption", Technological Forecasting and Social Change, 2014, 86, 80–92. https://www.sciencedirect.com/science/article/abs/pii/S0040162513002278
42. Zhu K., Kraemer K.L., Xu S., "The process of innovation assimilation by firms in different countries", Management Science, 2006, 52 (10), 1557–1576. https://www.researchgate.net/publication/220534861
43. Lutfi A.A., Idris K.M., Mohamad R., "The influence of technological, organizational and environmental factors on accounting information system usage", International Journal of Economics and Financial Issues, 2016, 6 (7S), 240–248. https://www.researchgate.net/publication/311387907
44. Tan M., Teo T.S.H., "Factors influencing the adoption of Internet banking", Journal of the Association for Information Systems, 2000. https://aisel.aisnet.org/jais/vol1/iss1/5/
45. Gibbs J.L., Kraemer K.L., "A cross-country investigation of the determinants of scope of e-commerce use", Electronic Markets, 2004, 14 (2), 124–137. https://www.researchgate.net/publication/220505243

46. Khin S., Ho T.C.F., "Digital technology, digital capability and organizational performance", International Journal of Innovation Science, 2018, 11 (2), 177–195. https://www.researchgate.net/publication/329406242
47. Li L., Su F., Zhang W., Mao J.Y., "Digital transformation by SME entrepreneurs", Information Systems Journal, 2018, 28 (6), 1129–1157. https://www.researchgate.net/publication/318131142
48. Gupta M., George J.F., "Toward the development of a big data analytics capability", Information and Management, 2016, 53 (8), 1049–1064. https://www.researchgate.net/publication/305717307
49. Almuwallad H., Alhumoudi H., "The impact of e-commerce on organizational and financial performance in SMEs: Evidence from Saudi Arabia", International Journal of Business and Management, 2024, 19 (4), 1–15. https://doi.org/10.5539/ijbm.v19n4p1
50. Sodeinde G.M., "An empirical study of e-commerce adoption and financial performance among SMEs in Ibadan", International Journal of Innovation Research and Advanced Studies, 2025, 9 (2). https://www.researchgate.net/publication/396559472
51. Mohammed A.A., Al-Swidi A., Faaeq M.K., "Information quality and e-commerce adoption in SMEs", International Journal of Information Management, 2020, 52, 102056. https://www.researchgate.net/publication/334446600
52. Fornell C., Larcker D.F., "Structural equation models with unobservable variables and measurement error", Journal of Marketing, 1981. http://dx.doi.org/10.2307/3150980
53. Hair J.F., Hult G.T.M., Ringle C.M., Sarstedt M., A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM), Sage Publications, 2016. https://www.scirp.org/reference/referencespapers?referenceid=2886679
54. Sharma C., Bharadwaj S.S., Gupta N., Jain H., "Robotic process automation adoption: contextual factors from service sectors in an emerging economy", Journal of Enterprise Information Management, 2023. https://www.researchgate.net/publication/362445796
55. Khin S., Ho T.C.F., "Digital technology, digital capability and organizational performance: A mediating role of digital innovation", International Journal of Innovation Science, 2019. https://www.researchgate.net/publication/329406242
56. Sodeinde G.M., "An empirical study of e-commerce adoption and financial performance among SMEs in Ibadan", International Journal of Innovation Research and Advanced Studies, 2025. https://www.researchgate.net/publication/396559472
57. Almuwallad H., Alhumoudi H., "The impact of e-commerce on organizational and financial performance in SMEs: Evidence from Saudi Arabia", International Journal of Business and Management, 2024, 19 (4). https://doi.org/10.5539/ijbm.v19n4p1