



THE ROLE OF LAST MILE DELIVERY IN THE BUSINESS PERFORMANCE OF E-COMMERCE FIRMS

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ARTICLE INFO	ABSTRACT
DOI: 10.52932/jfmr.v4i3en.1454 <i>Received:</i> May 18, 2026 <i>Accepted:</i> July 11, 2026 <i>Published:</i> July 25, 2026 Keywords: AI integration, Business performance, E-commerce use, Last mile delivery Article classification: Research paper JEL codes: L81, M19, L84	Purpose – E-commerce has become an important factor to help businesses improve business performance in today's volatile business conditions. Along with the development of AI and the optimization of logistics operations, it has contributed to changing the way businesses create value. Therefore, it is very necessary to study the factors affecting business efficiency in the context of digital transformation. Accordingly, the article analyzes the impact of using e-commerce and last mile delivery on business performance under the regulatory impact of AI integration. Design/methodology/approach – Using survey data collected from 366 enterprises in the Southern Key Economic Region that engage in e-commerce and integrate AI into their business activities, this study employs partial least squares structural equation modeling (PLS SEM) to evaluate the proposed model and test the research hypotheses. Findings – The findings indicate that e-commerce use and last mile delivery both exert positive effects on business performance. In addition, AI integration positively moderates the relationship between e-commerce use and business performance. However, its moderating effect on the relationship between last mile delivery and business performance is not statistically significant. Originality/value – The study extends current understanding of digital business performance by revealing that the performance benefits of e-commerce use and last mile delivery are not identical under conditions of AI integration. The findings offer important managerial implications for firms aiming to achieve superior business outcomes.

1. Introduction

E-commerce has emerged as one of the most successful business models, bringing many benefits to businesses in a dynamic business environment (Andonov et al., 2021). By buying and selling goods over the internet, businesses not only have the opportunity to market their products and services online, but they can also trade with customers (Salah & Ayyash, 2024). Thus, the e-commerce use by businesses has brought many significant benefits, especially in creating a competitive advantage over competitors (Chen & Zhang, 2015). In Vietnam, the growth rate in 2024 is up to 27% and the size of the online retail market will reach 32 billion USD, which has contributed to affirming the solid position of e-commerce in the digital economy (Vecom, 2025). Studies in Vietnam also confirm the importance of using e-commerce in helping businesses achieve significant benefits (Dang et al., 2022; Van Huy et al., 2012). Along with e-commerce, last mile delivery bringing products to consumers is an indispensable activity in online business and affects operational efficiency due to its direct impact on customer experience (Vakulenko et al., 2019a).

Thus, the e-commerce use has a positive impact on business performance and last mile delivery also contributes to helping businesses optimize online business activities. However, Dang et al. (2022) affirm that there is quite a bit of research on this relationship on these three factors, especially in Vietnam. Specifically, although there are many studies on the effectiveness of online business, most of them only focus on the role of e-commerce in operational efficiency or only consider the importance of logistics activities in general to business efficiency (Han et al., 2025). Therefore, this study focuses on two main objectives: (1) to evaluate the effects of e-commerce use and last mile delivery on business performance; and (2) to examine the moderating role of AI integration in these relationships.

This study brings both theoretical and practical contributions. Theoretically, in addition to demonstrating the positive impact of last mile delivery on business performance, the study provides a comprehensive model by incorporating AI to explain the impact of e-commerce and last mile delivery on business performance. In practical terms, the study is validated at the enterprise level with data collected from managers. In addition, this study in the Southern Key Economic Region also contributes to enriching the empirical evidence that is valuable for reference in other key economic regions in Vietnam or emerging countries such as Vietnam.

2. Theoretical background

2.1. *Dynamic capabilities theory*

Dynamic competencies explain how existing resources are transformed into a sustainable competitive advantage in a dynamic business environment and was developed by Teece et al. (1997). Researchers define dynamic competencies in a variety of ways, and there is currently no consensus on this definition (Zehir & Vural, 2024). Pavlou and El Sawy (2011) have grouped dynamic competencies into the abilities of recognition, learning, integration, and coordination. Ferreira et al. (2020) argue that these are the possibilities of exploitation and exploration. However, the context of this study supports the concept proposed by Teece et al. (1997) and agreed by previous studies. It is the ability of businesses to integrate, build and restructure internal and external competencies to meet the rapidly changing environment, namely the ability to identify opportunities and challenges, the ability to seize and exploit opportunities and the ability to restructure resources (Teece et al., 1997). From this point of view, the integration of AI is considered an important factor contributing to improving the ability to identify opportunities as well as challenges to help businesses seize and exploit opportunities through the ability to process and

analyze data as well as support the decision-making process. In addition, the e-commerce use reflects the capacity of businesses to proactively exploit opportunities in the digital environment. At the same time, last mile delivery demonstrates the ability to restructure logistics and optimize operational processes to minimize costs and meet customer needs.

2.2. Research constructs

E-commerce use. From a technological perspective, the e-commerce use includes communication, delivery and purchase and sale of products, services and information over computer networks (Kunesova & Micik, 2015). In terms of buying and selling transactions, the e-commerce use is defined as the purchase, sale and exchange of goods, services and information online using electronic and communication technologies (Gunasekaran et al., 2002).

Last mile delivery. In the e-commerce market, last mile delivery is defined as a sequence of activities and processes required for the delivery process from the final transshipment point to the final delivery point (Kum et al., 2018). It can be considered from three aspects represented by different stakeholders from the demand side, the supply side, and its physical environment regulated by local governments (Kiba-Janiak et al., 2021).

AI integration. AI mimics several aspects of human intelligence and replicates intelligent human behaviors (Davenport et al., 2019) by relying on deep learning, natural language processing, machine learning, neural networks, and decision-making automation (Huang & Rust, 2018). By automating data-driven tasks, enhancing customer experience, and driving revenue, the integration of AI improves financial efficiency, customer satisfaction, internal business process efficiency (Basri, 2020), and has a positive impact on e-commerce adoption (Fonseka et al., 2022).

Business performance. Business performance is the ultimate measure of a business's efforts to achieve a set goal. It is the standardization

and modification of operational processes in an organization to meet predetermined goals (Sy & Can, 2025). Corporate efficiency can be quantified through indicators such as profitability, sales growth, and market share (Byukusenge et al., 2017).

2.3. Hypothesis development

The relationship between e-commerce use and business performance

E-commerce has emerged as one of the most successful business models, contributing to many benefits for businesses by removing geographical barriers, increasing customer interaction or reducing fixed costs in business (Andonov et al., 2021). The e-commerce use reflects the ability of businesses to actively exploit opportunities in the digital environment such as easy to receive orders, fast delivery, opportunities to enter the market, etc. (Andonov et al., 2021). Dang et al. (2022) also commented that e-commerce contributes significantly to the business performance of Vietnamese businesses and creates a new era in transactions, eliminating physical barriers in transactions and bringing economic returns to both sellers and buyers. Based on these arguments, the following hypothesis is proposed:

Hypothesis H1: E-commerce use has a positive effect on business performance.

The relationship between last mile delivery and business performance

Christopher (2016) argues that good logistics management is a strategic factor for achieving profitability. Similarly, Miller and Liberatore (2015) demonstrated how logistics affects profits. In addition, De Giovanni (2019) emphasizes the importance of cost minimization through the optimization and effective management of inventory. Collectively, these studies highlight the critical role of logistics in enhancing firm profitability and overall business performance.

As part of the logistics system, last mile delivery mentioned by Lim et al. (2018) is one of the most costly and inefficient processes

in the entire supply chain, directly affecting business profits. Vakulenko et al. (2019b) emphasized the difficulty of last mile delivery to optimize costs while still meeting the various needs of omnichannel customers, providing customized delivery services in terms of delivery times, locations, and payment methods, as well as ensuring optimal return conditions. Executing well on final delivery is key in building customer loyalty and encouraging repurchase (Capgemini, 2018). Taken together, these arguments suggest that last mile delivery, as an essential component of logistics operations, exerts a direct influence on business performance. Based on this reasoning, the following hypothesis is proposed:

Hypothesis H2: Last mile delivery has a positive effect on business performance.

The moderating role of AI integration

E-commerce represents a cost-leading strategy and a differentiation strategy to deliver efficiency for businesses (Fonseka et al., 2022). With the outstanding benefits that AI brings such as improving performance that humans cannot control, speeding up processes (Agrawal et al., 2019) to optimize internal business, making better decisions, improving existing products, freeing up employees for more creative work, creating new products, pursuing new markets, ultimately affecting the performance of the enterprise (Zhang et al., 2021). Zhang also made an important conclusion that AI creates business value in three models: process automation, creating breakthrough insights, and interacting with stakeholders in business processes (Zhang et al., 2021).

Within the e-commerce context, AI technologies have also been widely applied, it has become an important driver for the development of e-commerce (Agrawal et al., 2019). The most common and important tool used by e-commerce to attract customers is through their AI bots (Saravanan & Pooja Shri, 2020). Ameen et al. (2021) describe

that AI-powered e-commerce platforms have significantly and positively improved consumers' shopping experience by automating multiple financial and customer service functions. In addition, integrating AI into operational management helps businesses reconcile payments with invoices, chatbots help answer customer questions, analyze data and many other utilities help improve business performance (Dwivedi et al., 2021). Therefore, the following hypothesis is proposed:

Hypothesis H3: AI integration positively moderates the relationship between e-commerce use and business performance, such that the effect becomes stronger at higher levels of AI integration.

Alongside e-commerce use, last mile delivery constitutes an indispensable component of online business operations. Companies are starting to integrate AI into their services to better understand customers and provide more personalized services by analyzing customer history and past data (Aravind et al., 2021). Nichifor et al. (2021) emphasize the importance of technology as a smart tactic in a highly competitive environment. Therefore, the use of chatbots strongly affects the performance of businesses and their commitments to customers. It can be argued that integrating AI into the last mile delivery process will help businesses better connect with customers through an autoresponder system, delivery scheduling as well as receiving feedback on the quality of delivery services to best meet the personalization of customer needs. Based on these arguments, the following hypothesis is proposed:

Hypothesis H4: AI integration positively moderates the relationship between last mile delivery and business performance, such that the effect becomes stronger at higher levels of AI integration

The research model is presented in Figure 1 below.

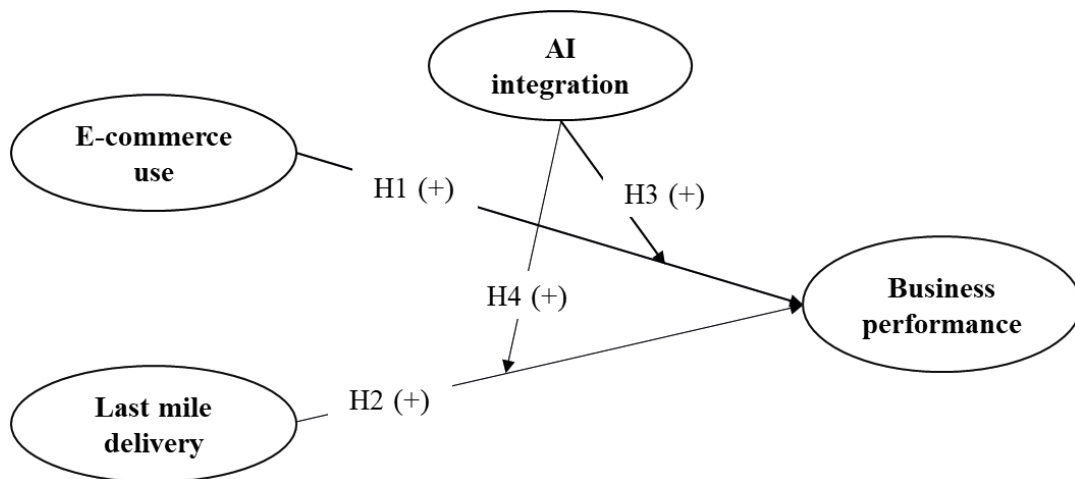


Figure 1. Research Model

3. Research methodology

3.1. Measurement scales of the constructs

The measurement scales employed in this study were adapted from prior research and used to develop the survey questionnaire. The data obtained serves as the basis for the analysis of the research results. Accordingly, the e-commerce usage scale consists of 06 observed variables inherited from Anabila et al. (2024). The last mile delivery scale consists of 11 observed variables inherited from Naclerio and De Giovanni (2022). The AI-integrated scale consists of 05 observed variables and is inherited from Salah and Ayyash (2024). Finally, there is a scale of business performance consisting of 05 observations and inherited from Sy and Can (2025). These are scales in English, so they have been translated into Vietnamese and adjusted to suit the context of the study (*see Appendix 1 online*).

3.2. Sampling and data collection method

This study employs a non-probability sampling approach using purposive sampling techniques to collect data. The target respondents are firms located in the Southern Key Economic Region, specifically in three administrative areas following recent mergers: Ho Chi Minh City, Dong Nai, and Tay Ninh. Since there is no reliable sample framework for statistics on the number of enterprises satisfying the above conditions, the study relies

on the total number of enterprises by province/city published by the National Statistics Office as the basis for sample stratification. Because of the characteristics after the merger, Ho Chi Minh City. Ho Chi Minh City accounted for the highest rate of 86% with 327,828 enterprises, followed by Dong Nai accounting for 9.1% with 34,807 enterprises and the lowest was Tay Ninh with only 4.9% with 18,821 enterprises (TCTK, 2024).

The study focuses on the top 10 industries with the largest e-commerce revenue in Vietnam in 2024 as a basis for data collection. Screening questions (businesses using e-commerce, integrating AI and holding the position for 1 year or more) are included in the questionnaire as a basis for selecting valid answers. Survey respondents are middle and senior managers of enterprises; specifically, the Board of Directors, heads/deputy heads of relevant departments in the Southern Key Economic Region. Respondents can answer via the questionnaire that is live-streamed or via the survey link when it has been thoroughly discussed and explained to ensure the quality of the survey results.

After excluding inconsistent responses, the final sample size for analysis comprised 366 observations. Ho Chi Minh City accounted for the highest proportion of valid responses at 86.1%, followed by Dong Nai with 8.1% and Tay Ninh with 5.4%. The survey results are also

diverse in different industries such as fashion, cosmetics, electronics, household appliances, food, etc. Respondents were mainly the Board of Directors (45.4%) and heads/deputy heads of departments or equivalent (38.5%) with the number of years of service mainly from 1 year to less than 5 years, accounting for 62%.

3.3. Data analysis method

The study used the partial smallest squared structure modeling method (PLS-SEM) and SmartPLS 4.1 software. The technique commonly used to determine the minimum sample size in PLS-SEM is the 10-times rule (Hair et al., 2014). According to this rule, the minimum sample size for a PLS-SEM model should be ten times the maximum number of arrows pointing to any potential variable in the path model (Hair et al., 2014). According to the current model, the maximum number of arrows pointing to any latent variable is 11 arrows, so the minimum sample size is 110 observations. With 366 observations, the study satisfies the sample size requirement for PLS-SEM analysis.

4. Results and discussion

4.1. Results

Measurement model assessment

The results in Appendix 3 (*see Appendix 3 online*) indicate that all outer loadings, Cronbach's alpha values, and composite reliability (CR) exceed the threshold of 0.7. This suggests that the measurement scales demonstrate adequate internal consistency and reliability, and that the constructs in the model satisfy convergent validity requirements (Hair et al., 2022). Furthermore, the average variance extracted (AVE) values are all above 0.5, providing additional support for the adequacy of convergent validity of the measurement scales (Hair et al., 2022).

The results in Appendix 3 (*see Appendix 3 online*) indicate that the measurement scales

satisfy discriminant validity, as all HTMT values are below the threshold of 0.85, meeting the criterion proposed by Hair et al. (2022). Accordingly, all constructs in the model demonstrate adequate discriminant validity.

Thus, the results of the evaluation of the measurement model show that the scales all meet the requirements of reliability, convergence and distinctiveness. The study continues to perform structural model analysis.

Structural model analysis

The results in Table 1 indicate that the variance inflation factor (VIF) values for all direct and moderating relationships are below 3, suggesting that multicollinearity is unlikely to be a concern in the model, in line with the recommendation of Hair et al. (2022).

The study further evaluates the structural model based on statistical significance by examining the p-values associated with each path coefficient and comparing them with the 5% significance level. Using a bootstrapping procedure with 5,000 resamples, the results in Table 1 indicate that the p-value for hypothesis H4 is 0.053, which exceeds the 0.05 threshold; therefore, H4 is not supported. In contrast, hypotheses H1, H2, and H3 are supported, as their p-values are 0.000, which are below the 0.05 significance level. Additionally, Table 1 reports the magnitude of the effects among constructs through the standardized path coefficients (β). Accordingly, e-commerce use exerts the strongest impact on business performance ($\beta = 0.402$), followed by last mile delivery ($\beta = 0.258$). Regarding the moderating effects, AI integration strengthens the relationship between e-commerce use and business performance. Although H4 is not supported at the 5% significance level, the result suggests a marginal effect ($p = 0.053$), which warrants further discussion in the subsequent section.

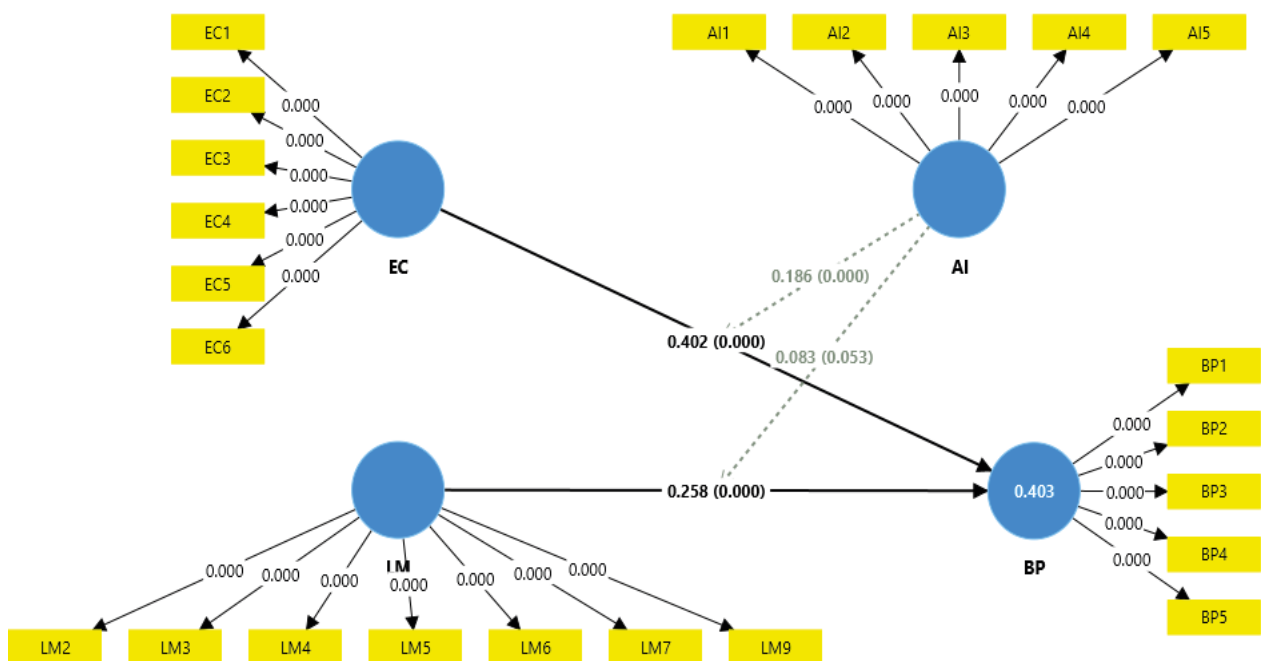
Table 1. Hypothesis testing results

Hypothesis	Relationship	VIF	β	t-value	p-value	f ²	Result
<i>Direct effects</i>							
H1	EC $\rightarrow$ BP	1.029	0.402	9.545	0.000	0.263	Supported
H2	LM $\rightarrow$ BP	1.029	0.258	6.635	0.000	0.108	Supported
<i>Moderating effects</i>							
H3	AI x EC $\rightarrow$ BP	1.017	0.186	3.980	0.000	0.066	Supported
H4	AI x LM $\rightarrow$ BP	1.023	0.083	1.934	0.053	0.010	Not supported

The interaction plot in Appendix 4 (see Appendix 4 online) illustrates that when firms exhibit a higher level of AI integration, the positive relationship between e-commerce use and business performance becomes steeper, indicating a stronger effect compared to firms with lower levels of AI integration. This finding suggests that AI integration enhances firms'

ability to effectively implement e-commerce use. Furthermore, the interaction effect demonstrates the moderating role of AI integration, confirming that firms that intensify AI integration within their e-commerce processes achieve higher levels of business performance.

4.2. Discussion of research findings

**Figure 2.** Results of the structural model analysis

With the acceptance of the H1 hypotheses, the e-commerce use has a positive impact on the performance of businesses. This result is quite similar to the recent study conducted by Fonseka et al. (2022). Hypothesis H2 confirms that last mile delivery positively affects business

performance in the context of e-commerce. This result sheds more light on the rare study of last mile delivery from a business perspective by Naclerio and De Giovanni (2022) because most last mile delivery research is done from a customer perspective. This is a finding that

e-commerce businesses must be more careful about this activity if they want to satisfy daily demand higher for consumers through online channels. The accepted H3 hypothesis shows that AI integration has strengthened the impact of e-commerce use on business performance. This result supports the research of Fonseka et al. (2022). This implies that businesses in the Southern Key Economic Region need to invest more in artificial intelligence applications for online business if they want to improve business performance. Especially in the era of digital transformation that is taking place extensively as it is today. The findings from this study are also consistent with dynamic competency theory as the integration of AI is seen as an important factor contributing to improving the ability to identify opportunities, challenges or support the decision-making process. In addition, the e-commerce use reflects the ability of businesses to proactively exploit opportunities in the context of digitalization, while last mile delivery demonstrates the ability to optimize operational processes.

Although hypothesis H4 is not supported, the p-value of 0.053 approaching the 5% significance threshold suggests the presence of initial indications of a relationship. This result can be explained by the practical context of e-commerce development in Vietnam. First, the level of AI integration within firms remains relatively limited and is primarily concentrated on customer-facing activities, such as product recommendations and customer service, while its application in last mile delivery has not been widely implemented. Second, last mile delivery operations in Vietnam still heavily depend on transportation infrastructure and address characteristics, which constrain the effectiveness of digital technologies, particularly in light of recent administrative boundary changes following regional mergers. Third, the lack of integration between technological systems and logistics operations limits the extent to which AI integration is embedded in operational decision-making processes, such as route optimization and distribution management.

Finally, the impact of AI typically involves a time lag due to requirements for large-scale data and learning processes; therefore, the moderating effect of AI integration may not yet be fully realized in the current stage. These factors collectively help explain why the moderating role of AI integration is not clearly observed in the relationship between last mile delivery and business performance within the research context. Nevertheless, with the anticipated deployment of emerging technologies such as smart lockers, delivery robots, and unmanned aerial vehicles, AI integration is expected to play a more significant moderating role in enhancing business performance in delivery activities and improving customer experience in the near future.

5. Conclusion and managerial implications

5.1. Conclusion

This study elucidates the interrelationships among e-commerce use, last mile delivery, AI integration, and business performance. These factors collectively reflect firms' capabilities to proactively leverage dynamic resources, particularly in the context of increasingly pervasive digital transformation. The findings indicate that both e-commerce use and last mile delivery exert positive effects on business performance. Notably, AI integration plays a significant moderating role by strengthening the impact of e-commerce use on business performance. This suggests that the application of AI not only generates direct value but also amplifies the effectiveness of digital platforms, thereby enhancing overall organizational performance. Although the moderating effect of AI integration on the relationship between last mile delivery and business performance is not statistically supported, the results reveal initial evidence of its potential influence. This represents a novel finding that warrants further investigation in future research, particularly as delivery applications and supporting technologies for logistics operations continue to evolve toward greater digitalization on a global scale.

5.2. Managerial implications

The findings of this study provide several managerial implications for e-commerce firms to enhance business performance, as follows:

First, increase the e-commerce use in enterprises. The benefits brought by doing business via the internet have contributed to the expansion of business activities, overcoming the limitations of space and time. With a growth rate of up to 27% in 2024 and the size of the online retail market reaching 32 billion USD, contributing to Vietnam's e-commerce in a solid position. Along with guidelines and policies to encourage businesses to expand online business activities, especially the construction of a clear legal corridor with the introduction of the E-commerce Law. Therefore, this is an inevitable trend if businesses want to create a competitive advantage to increase business performance in the context of today's digital technology.

Second, optimizing last mile delivery within the business as a direct lever to improve business performance. This includes improving delivery speed, reliability, real-time order tracking, and delivery experience. In the context of increasing competition, last mile delivery is not only an operation but has become a factor that creates a competitive advantage and increases customer value.

Third, firms should place greater emphasis on AI integration within their business processes in the context of e-commerce use. This represents a critical factor in enhancing business performance through practical applications such as route optimization in last mile delivery, demand forecasting, inventory management, and personalized customer experiences. Given the existing constraints faced by Vietnamese firms in terms of big data

infrastructure and technological resources, managers should prioritize the standardization of operational processes and the development of digital capabilities. Such efforts will enable firms to better prepare for and fully leverage the substantial benefits offered by AI integration.

5.3. Research limitations

Despite its contributions, this study has several limitations. First, research using a cross-sectional design should limit the ability to determine causal relationships between variables. In addition, the data collection by a convenient and intentional sample selection method, which only focuses on the top 10 industries with the largest e-commerce revenue in Vietnam, so the possibility of bias and the level of generalization is not high. Further studies need to be implemented vertically so that these findings can be evaluated over time. In addition, the deployment in other key economic regions and combined with control variables such as size, type of enterprise, etc. or expand the survey subjects in a variety of industry and profession groups to be able to compare and further reinforce the findings in this study.

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Data availability statement

Data available upon reasonable request (contact corresponding author)

AI usage statement

This research employed ChatGPT solely for language polishing and grammar refinement during manuscript preparation. No theoretical content, hypotheses, study designs, analyses, or interpretations were generated by the tool.

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