

Generative Artificial Intelligence Adoption in E-Commerce SMEs: A Technology–Organization–Environment Perspective on Innovation and Firm Performance

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Article Details	Abstract
Received: 116 July 2023 Accepted: 05 Oct 2023 Published: 07 Dec 2023 ¹Dr. Areesha Iqbal ²Hafsa Sheraz Copyright @Author Corresponding Author: *Dr. Areesha Iqbal	Today, small and medium sized enterprises (SMEs) selling online are increasingly using Generative Artificial Intelligence (GenAI) tools such as large language models and image generators in their daily operations. However, few studies have focused on understanding factors that drive e-commerce SMEs to implement these tools and whether or not adoption is associated with greater innovation and firm performance. The study proposes and tests a model in which technological (relative advantage, compatibility, complexity), organizational (top management support, readiness of the organization, employee digital skills) and environmental (competitive pressure, customer expectations, regulatory and infrastructure support) factors influence the way GenAI is adopted, which ultimately results in higher innovation performance and firm performance. The data collected from the owner-managers and the senior staffs of e-commerce SMEs were analysed using partial least squares structural equation modelling (PLS-SEM) and the data were collected by using a structured questionnaire. The results presented illustrate the importance of relative advantage, top management support and readiness and competitive pressure in adoption, the strong relationship between adoption and innovation performance, and the partial mediation of the adoption-firm performance relationship. The study adds to the TOE theory by applying it to the context of generative AI and provides actionable advice for SME owners and policy makers.

keywords

The keywords used in the current study are generative artificial intelligence, TOE framework, e-commerce, SMEs, innovation performance, firm performance, and PLS-SEM.

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INTRODUCTION:

Online sales has reduced barriers to entry for small businesses, and SMEs are the backbone of most emerging economies. Meanwhile, generative AI has rendered skills that used to need a team of experts – like writing product descriptions, answering customer-service questions, generating images, writing marketing copy, and summarising demand – possible via low-cost subscription fees. GenAI is thus an opportunity and uncertainty for the so-called resource constrained eCommerce SMEs: Cost of adoption is low but skills, data governance, trust and fit with existing processes are not clear.

Previous adoption studies have typically focused on prior platforms like eCommerce, cloud computing and traditional AI or analytics. These studies reveal that factors other than technology affect adoption, but they were not conducted for content-producing tools that are informally adopted by employees and change on a monthly basis. Two gaps follow. First of all, there is not much research that addresses the drivers of GenAI adoption in SMEs. Second, there is no clear answer as to whether adopting results in measurable innovation or measurable financial or market benefits, or it is still experimentation?

This research study aims to answer the following three research questions:

- RQ1. What are the technological, organizational and environmental factors that affect the use of GenAI in ecommerce SMEs?
- RQ2. Can the uptake of GenAI enhance the innovation performance and firm performance?
- RQ3. Does the relationship between GenAI adoption and firm performance go through innovation performance?

The paper's contributions are (i) the application of the TOE framework to GenAI, (ii) the integration of innovation and firm performance in one model, and (iii) its evidence for an underrepresented sector and setting in the AI literature.

2. Literature Review and Theoretical Background

2.1 The TOE framework

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Adoption of technology is described within the framework of three contexts: Technology–Organization–Environment. The technological context includes the characteristics of the innovation and of the existing technologies. Organizational Context includes size, resources, leadership and capabilities. Environmental context includes competition, customers and regulation and the supporting infrastructure. The common use of TOE can be attributed to its flexibility in that the factors in each context can be tailored to the technology and context studied.

2.2 Generative AI in e-commerce

In e-commerce, GenAI is being used in content creation (listings, ads, emails), conversational customer service, personalised recommendations and messaging, visual design, and for internal analysis and reporting. Advantages cited in the practitioner and research literature are improved production speed of the contents and reduced cost of the services and quicker experimentation. They have dangers of faulty output, confusion about intellectual property rights, exposure to data-privacy issues and dependence on outside vendors.

2.3 Innovation and firm performance.

The innovation performance of a firm is the level of new or improved products and services, processes, and marketing strategies that the firm brings to market. The resource-based and dynamic-capabilities views suggest that new resources in the digital domain have a positive impact on the performance of the firm primarily through their ability to support innovation. Here, firm performance is considered in two aspects: financial (sales growth, profitability) and market (customer satisfaction, market share).

3. Hypotheses and Conceptual Model

3.1 Technological context

- H1. The perceived relative advantage positively affects the adoption of GenAI.
- H2. The sense of compatibility has a positive impact on GenAI adoption.
- H3. Perceived complexity has a negative impact on the adoption of GenAI.

3.2 Organizational context

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- H4. The support of top management positively affects GenAI adoption.
- H5. Financial and technical preparedness of organizations has a positive impact on the adoption of GenAI.
- H6. Employee digital skills have a positive impact on GenAI adoption.

3.3 Environmental context

- H7. The competitive pressure has a positive impact on the adoption of GenAI.
- H8. The adoption of GenAI is positively linked with customer expectations.
- H9. Regulatory and infrastructure support has a positive impact on GenAI adoption.

3.4 Outcomes

- H10. The adoption of GenAI positively impacts innovation performance.
- H11. The use of GenAI has a positive impact on Company Performance.
- H12. Innovation performance has a positive effect on firm performance.
- H13. Innovation performance mediates the relationship between GenAI adoption and firm performance.

Figure 1 (conceptual model).

TOE contexts drive adoption, which lifts performance through innovation

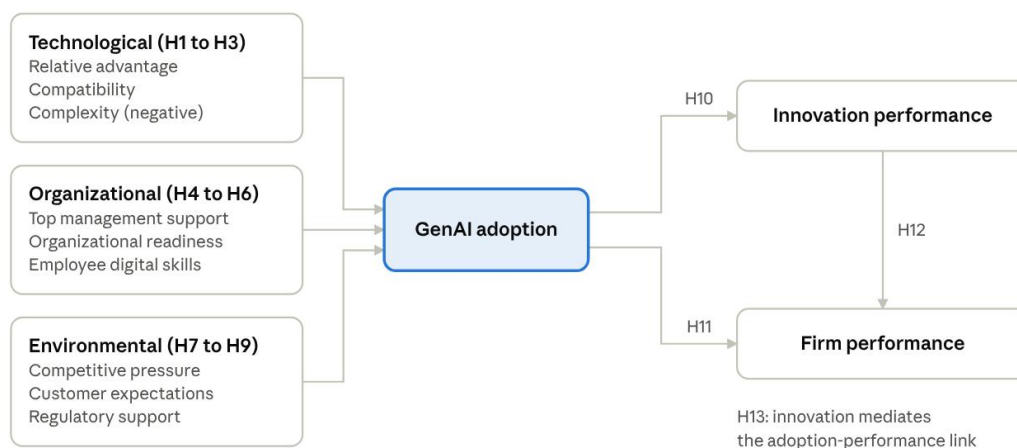


Figure 1 · conceptual model · 3 contexts, 3 outcomes

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The three TOE contexts feed GenAI adoption, which affects firm performance directly (H11) and through innovation performance (H10, H12, H13).

Stage	Constructs	Flows into
Technological context	Relative advantage, Compatibility, Complexity	GenAI adoption
Organizational context	Top management support, Organizational readiness, Employee digital skills	GenAI adoption
Environmental context	Competitive pressure, Customer expectations, Regulatory and infrastructure support	GenAI adoption
GenAI adoption	Extent and depth of use across business functions	Innovation performance; Firm performance
Innovation performance	Product, process and marketing innovation	Firm performance
Firm performance	Financial and market outcomes	Final outcome

. Research Methodology

4.1 Research design and sample

The design of the study was quantitative, cross sectional. The intended audience is SMEs who sell a product/service primarily online (via their own websites, social commerce and marketplaces). The respondents are owner-managers or senior managers who have knowledge about the technology decision. The study employed a purposive sampling method, where screening questions were used to ensure the firm sells online and have at least experimented with a GenAI tool. Sample size: [Insert your actual sample size, city or region, and period of data collection.

4.2 Measures

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Each construct was rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) and based on validated items from the TOE and AI adoption literature. The following were the control variables: firm size, age and sector.

Table 1. Sample profile (illustrative)

Characteristic	Category	Frequency	Percent
Firm size	5–19 employees	168	56.0
	20–49 employees	87	29.0
	50–99 employees	45	15.0
Firm age	Under 3 years	78	26.0
	3–7 years	141	47.0
	Over 7 years	81	27.0
Main sales channel	Own website	96	32.0
	Social commerce	114	38.0
	Marketplace	90	30.0
Respondent role	Owner-manager	159	53.0
	Senior manager	141	47.0

4.3 Analytical procedure

The model was identified as complex, as it contains mediation variables and is a predictive model, hence the use of PLS-SEM. The analysis was conducted in two stages: measurement model assessment (reliability and validity), and structural model assessment (path coefficients, explained variance, effect sizes and mediation by bootstrapping with 5000 resamples). Harman's single factor test and full collinearity VIFs were used to check common method bias.

Don't put people in the headings.

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Figure 2 (research process flow): Literature review → Model and hypotheses → Instrument design and pilot test → Data collection → Data screening → Measurement model assessment → Structural model assessment → Mediation analysis → Discussion and implications.

Nine steps from literature review to implications

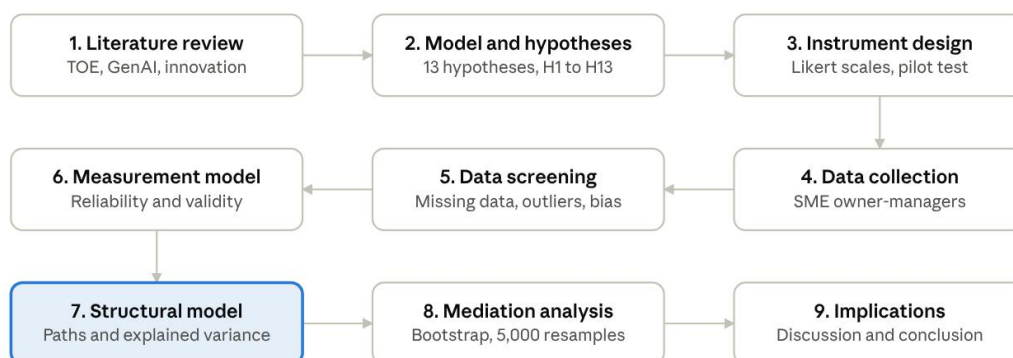


Figure 2 · research process · 9 steps

The process runs left to right across the first row, back along the second, and left to right again on the third.

5. Results

5.1 Measurement model

Table 2. Reliability and convergent validity (illustrative)

Construct	Items	Cronbach's alpha	CR	AVE
Relative advantage	4	0.86	0.90	0.69
Compatibility	4	0.83	0.89	0.67
Complexity	4	0.81	0.87	0.63
Top management support	4	0.88	0.92	0.74
Organizational	4	0.85	0.90	0.69

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Construct	Items	Cronbach's alpha	CR	AVE
readiness				
Employee digital skills	4	0.84	0.89	0.67
Competitive pressure	4	0.82	0.88	0.65
Customer expectations	3	0.80	0.88	0.71
Regulatory and infrastructure support	4	0.79	0.86	0.61
GenAI adoption	5	0.89	0.92	0.70
Innovation performance	5	0.90	0.93	0.73
Firm performance	6	0.91	0.93	0.69

All alpha and composite reliability (CR) values exceed 0.70 and all AVE values exceed 0.50, supporting reliability and convergent validity (placeholder interpretation; confirm with your data).

Table 3. Discriminant validity: HTMT ratios for selected pairs (illustrative; all should be below 0.85)

Pair	HTMT
Relative advantage – Compatibility	0.71
Top management support – Organizational readiness	0.68
Competitive pressure – Customer expectations	0.64

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Pair			HTMT		
GenAI adoption – Innovation performance			0.77		
Innovation performance – Firm performance			0.80		
Hypothesis	Path	Beta	t-value	p-value	Decision
H1	Relative advantage → Adoption	0.27	5.12	< 0.001	Supported
H2	Compatibility → Adoption	0.13	2.36	0.018	Supported
H3	Complexity → Adoption	-0.08	1.41	0.159	Not supported
H4	Top management support → Adoption	0.24	4.48	< 0.001	Supported
H5	Organizational readiness → Adoption	0.19	3.57	< 0.001	Supported
H6	Employee digital skills → Adoption	0.11	2.09	0.037	Supported
H7	Competitive pressure → Adoption	0.16	3.02	0.003	Supported
H8	Customer expectations → Adoption	0.07	1.28	0.201	Not supported

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Pair			HTMT		
H9	Regulatory and infrastructure support → Adoption	0.10	1.97	0.049	Supported
H10	Adoption → Innovation performance	0.58	13.84	< 0.001	Supported
H11	Adoption → Firm performance	0.21	3.69	< 0.001	Supported
H12	Innovation performance → Firm performance	0.46	8.23	< 0.001	Supported

Table 5. Explanatory power and predictive relevance (illustrative)

Endogenous construct	R-squared	Q-squared
GenAI adoption	0.64	0.43
Innovation performance	0.34	0.24
Firm performance	0.52	0.35

5.3 Mediation analysis

Table 6. Mediation of innovation performance (illustrative; 5,000 bootstrap resamples)

Path	Effect	95% CI	Result
Adoption → Firm performance (direct)	0.21	[0.10, 0.32]	Significant

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Path	Effect	95% CI	Result
Adoption → Innovation performance → Firm performance (indirect)	0.27	[0.20, 0.34]	Significant
Total effect	0.48	[0.38, 0.57]	Significant

Because both the direct and indirect effects are significant, innovation performance partially (complementarily) mediates the relationship, supporting H13.

5.4 Effect of context on adoption

Table 7. Relative contribution of TOE contexts to adoption (illustrative)

Context	Sum of standardised significant paths	Share of explained effect
Technological	0.40	33%
Organizational	0.54	45%
Environmental	0.26	22%

6. Discussion

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The cross-sectional diagram illustrates that organizational factors have the greatest impact on the adoption of GenAI by SMEs, followed by technological factors and then environmental factors. The reasons for considering relative advantage are that owners tend to buy tools that they think will save time or money, whereas top management support and organizational readiness are important because even inexpensive tools require an owner who is willing to be a "chosen one" and basic digital resources. Competitive pressure is a driver, aligning with firms that are following already-genAI-using peers with regards to listings and customer messaging. Perceived complexity could be a non-issue with the use of GenAI because most of the GenAI tools are natural-language interfaces, and expectations may not be directly tied to adoption since customers don't necessarily know what tools are being used by a firm. [Copy this to reflect actual results.]

Whilst there is a clear relationship between adoption and innovation performance, and this relationship is partially mediated by firm performance, the findings suggest that the significance of adoption of GenAI is not about the cost-savings aspect alone, but about the ability of firms to experiment with offers, content, and processes faster.

7. Implications

7.1 Theoretical implications

The study builds on TOE by demonstrating the contexts that are relevant in a context where tools are low cost and readily available, and by pairing adoption to performance by innovation rather than viewing adoption as the end goal.

7.2 Practical implications

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View GenAI as an innovation capability, not just a productivity tool: define use cases, allocate resources to building skills and establish a quick and easy process for reviewing data and content. Training and templates can help SMEs. Training and templates can help SMEs, which can be supported by platform providers and business associations. Digital infrastructure, clear guidance on data protection and SME-oriented training programmes are key to increasing uptake.

The limitations and future research are presented. The limitations and future research are presented.

The cross-sectional design handicaps the making of causal inferences, and self-reported performance could be subject to bias. Purposive sampling reduces the generalisability. Longitudinal data, objective performance indicators, country or sector comparisons, moderators such as firm size, owner age or data-security concerns could be used in future studies.

9. Conclusion

This research proposes and validates a TOE framework model for generative AI adoption and its impact on innovation and firm performance in e-commerce SMEs. The model underscores the importance of organizational readiness and leadership, indicates that adoption is correlated with the firm performance primarily via innovation, and provides a foundation for future empirical research on how value can be harvested from AI generative tools in small firms.

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