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Research Article

Confirmatory factor analysis of technology organization and environment on artificial intelligence adoption for small and medium enterprises in the metropolitan area

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Abstract: This research aims to analyze the confirmatory factor analysis of technological, organizational, and environmental factors affecting the adoption of Artificial Intelligence (AI) in small and medium-sized enterprises (SMEs) within the Bangkok metropolitan area, utilizing the Technology-Organization-Environment (TOE) framework. The sample consisted of 320 SME entrepreneurs in the metropolitan area selected through purposive sampling. Data were collected using a questionnaire with an overall reliability coefficient (Cronbach's alpha) of 0.86 and analyzed through Confirmatory Factor Analysis using Jamovi software. The findings revealed that the majority of respondents were female (51.2%) working in the manufacturing sector (25.6%) holding bachelor's degrees (48.6%) and aged 31-35 years (66.3%). In the technological factor dimension the observed variable "complexity" exhibited the highest factor loading. For organizational factors “organizational support” demonstrated the highest factor loading. Regarding environmental factors “government support” showed the highest factor loading. For AI adoption the variables “implementing AI to improve company performance” and “utilizing AI to enhance organizational efficiency” had the highest factor loadings. The study demonstrates that AI adoption in SMEs requires integration of all three-dimensional factors, particularly reducing technological complexity, building internal organizational support, and securing government backing to achieve performance improvements and sustainable competitive advantages. These findings provide valuable insights for policymakers and SME managers seeking to facilitate successful AI implementation in metropolitan business environments

Keywords: Confirmatory factor analysis; Technology organization and environment; Artificial intelligence

1. Introduction

Artificial Intelligence (AI) refers to technologies aimed at enabling machines to emulate human cognitive processes by learning from past experiences, adapting to new data, and making reasoned decisions. AI has been widely applied across various domains, ranging from computer programs that play chess, autonomous vehicles, deep learning systems for advanced data analytics, to natural language processing (NLP) systems that enable machines to understand and interact effectively with humans. A prominent example is ChatGPT, a Generative Pre-trained Transformer developed by OpenAI and supported by Microsoft, which possesses diverse capabilities including poetry composition, music creation, programming, and content summarization and analysis. This rapid advancement has catalyzed a global surge in AI investment. According to the Digital Economy Promotion Agency [1], AI offers distinctive advantages such as speed, precision, and tirelessness compared to human capabilities. AI applications also extend to traffic data analysis, weather forecasting, and medical imaging for cancer cell detection.

McKinsey [2] projected that AI could generate up to $13 trillion in economic activity by 2030, with approximately 70% of organizations worldwide expected to adopt AI technologies. Similarly, the Massachusetts Institute of Technology [3] and International Data Corporation [4] estimate that AI could contribute to a 7% increase in global GDP while impacting approximately 40% of global employment. Although certain job roles may be displaced estimated at 75 million positions new opportunities totaling

133 million jobs are anticipated to emerge [5]. ASEAN countries, including Singapore, Malaysia, and Thailand, are actively advancing AI development to boost productivity and economic growth, with AI expected to contribute 18%, 14%, and 13% to the GDP of Singapore, Malaysia, and Thailand respectively [6, 7]. Additionally, Lexalytics [8] reports a positive correlation between AI adoption and economic growth rates across various countries, underscoring AI's critical role as a driver of modern economic development.

Focusing on small and medium enterprises (SMEs) in the Bangkok metropolitan area, there is a growing trend toward integrating AI technologies into business operations. This trend is particularly evident in commerce, sales, and marketing activities facilitated through e-commerce platforms, where large-scale data management and deep data analytics exceed human capabilities. Consequently, SMEs in this region increasingly recognize the necessity of developing AI technologies to enhance decision-making efficiency, customer acquisition, and sales performance [5]. Nonetheless, some SMEs remain unable to fully adopt AI due to a lack of skills, knowledge, and technological understanding, as well as concerns over data security risks and investment costs [9]. Hence, government agencies and supporting organizations should play a pivotal role in establishing digital ecosystems, promoting AI literacy, and facilitating SMEs' effective and sustainable AI adoption amidst the rapidly evolving digital economy [10].

Moreover, SMEs in the metropolitan area, which collectively employ approximately 2,103,050 workers and generate average annual revenues of 17 million THB [11], represent a substantial potential sector for leveraging AI to enhance economic capabilities and operational efficiency. Their strategic proximity to Bangkok offers advantages including convenient transportation, access to exhibition centers, manufacturing hubs, and favorable real estate costs—factors conducive to knowledge development and the integration of technological, organizational, and environmental dimensions for effective AI utilization. As Wasan Kerdsawat et al. [12] emphasize, organizations that successfully integrate these three dimensions tend to achieve reduced operational lead times, increased accuracy, and enhanced business value creation. This aligns with the Office of Small and Medium Enterprises Promotion's strategic focus on fostering AI applications to bolster competitiveness both domestically and internationally.

2. Objective

To analyze the confirmatory factor analysis of technological, organizational, and environmental components on the adoption of Artificial Intelligence (AI) in small and medium enterprises (SMEs) within the Bangkok metropolitan area.

3. Literature review

The technology acceptance and use theory has been applied to study human behavior in accepting and using new technologies. It can accurately predict future acceptance behavior. This theory was developed by integrating concepts from behavioral sciences and focuses on analyzing usage behavior driven by the intention to perform the behavior. The main factors influencing such intention include performance expectancy, which is the belief that using the technology can help improve work efficiency; effort expectancy, which refers to the ease of learning and use; social influence, which is the perception that important individuals or groups have opinions regarding the use of that technology; and facilitating conditions, which means the availability of infrastructure or various resources that support the use of the technology.

In addition, there are other variables that act as moderators or mediators, such as decision-making processes and acceptance behaviors, which are related to technological, organizational, and environmental factors. These form an integrated conceptual framework that can be used to explain innovation adoption behavior at the organizational level comprehensively and help predict the trend of technology usage in the future [3].

The adoption of Artificial Intelligence (AI) in small and medium-sized enterprises (SMEs) in Thailand has become increasingly significant, given the sector's inherent flexibility and adaptability to technological changes. AI applications are being utilized across multiple business functions, including customer data analysis, inventory management, process optimization, and customer service through chatbots, leading to reduced operational costs, enhanced accuracy, and overall improvement in business efficiency [13]. According to Hussain and Rizwan [14], the successful implementation of AI in SMEs

requires a structured approach beginning with the cultivation of awareness and executive support, followed by the adoption of cost-effective AI tools to build technical expertise and foster positive attitudes toward AI integration. In metropolitan areas, where SMEs often face resource constraints, government support plays a crucial role. The Electronic Transactions Development Agency [15] has initiated training programs specifically designed to enhance digital and AI competencies among SMEs in these regions. These initiatives not only facilitate the adoption of emerging technologies but also enhance decision-making capabilities by improving SMEs' understanding of data and AI systems, ultimately contributing to their competitiveness and long-term sustainability.

Emphasize the critical role of organizational culture in preparing SMEs in Bangkok for the adoption of AI [16], highlighting that a culture which supports risk-taking, innovation, and adaptability directly influences successful AI implementation. Their study indicates that SMEs fostering such a culture enable employees to experiment with new technologies and embrace change more readily. Similarly, underscore the importance of cultivating an organizational culture that promotes continuous innovation and learning to ensure the sustainable integration of AI, particularly within SMEs [17]. They argue that learning from both successes and failures in AI application is essential for SMEs to refine their processes and effectively expand AI usage. Overall, fostering a culture that encourages employees to take risks with emerging technologies and develop resilience to setbacks enhances SMEs' ability to adapt rapidly and become leaders in technological adoption within competitive markets.

Assert that external environmental factors significantly influence technological change and the adoption of AI in SMEs, particularly through consumer demand, consumer behavior, and consumer expectations [18]. These factors drive digital transformation and AI implementation by exerting competitive pressure and encouraging improvements in production efficiency. Consequently, the external environment positively impacts internal organizational change, as consumer behavior and expectations act as catalysts for digital adaptation to meet market demands, thereby enhancing operational efficiency and reducing production costs to secure competitive advantage. Furthermore, government policies serve as incentives for companies to effectively implement digital transformations. Supporting this, highlights the environmental factors' critical role in AI adoption for sustainable business practices in Thailand [19]. The study emphasizes that AI technologies, such as machine learning and robotic process automation, enhance operational efficiency, reduce costs, and stimulate innovation across sectors like agriculture, manufacturing, and healthcare. These technological advancements contribute to sustainability goals by optimizing resource allocation and minimizing environmental impacts.

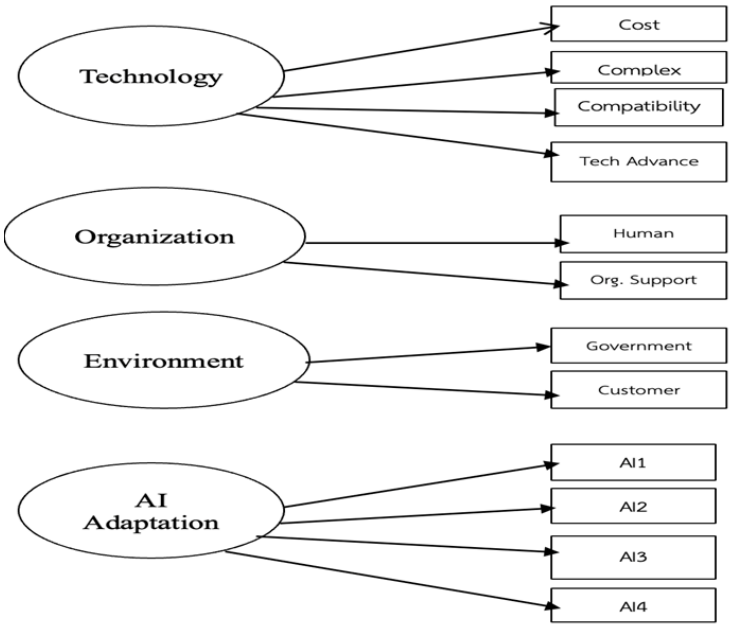


Figure 1. Conceptual framework

4. Research methodology

4.1 Target population

The target population of this study consists of small and medium-sized enterprises (SMEs) located in the metropolitan area, which includes the provinces of Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan, and Samut Sakhon. The total number of SMEs in this region is 330,309 [11]. The sample size was determined following the principle proposed by Hair et al. [9], which recommends using a sample size of 20 times the number of observed variables. In this study, there are 16 observed variables; therefore, the required sample size is 320. Data were collected from managers or authorized decision-makers or company representatives using purposive sampling.

4.2 Research instrument

The questionnaire used in this study is divided into six sections. Section 1 collects respondents' personal information and company-related data, such as age, education level, international experience, and organizational size, using open-ended questions. Section 2 addresses technological factors, including complexity, compatibility, and the cost of technology adoption. Section 3 focuses on organizational factors such as human resources and managerial support. And Section 4 concerns the adoption of AI to improve efficiency and reduce costs across company activities. Using closed-ended questions with responses measured on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

4.3 Validity and reliability testing

The overall reliability coefficient (Cronbach's alpha) of the questionnaire was 0.86. Reliability coefficients for each dimension were as follows: technology factors (0.92), organizational factors (0.86), environmental factors (0.88) and AI adoption (0.85). The overall internal consistency of the instrument was very high, with a Cronbach's alpha of 0.99.

4.4 Data analysis

Descriptive statistics, including percentages, were used to summarize demographic data. Inferential statistics were conducted using the Jamovi software package. The Confirmatory Factor Analysis (CFA) is an analytical technique used to confirm the factor structure. Exploratory factor analysis typically precedes confirmatory factor analysis [4]. Mueller and Hancock [20] stated that CFA has become a crucial analytical tool across various fields of social and behavioral sciences. It enables the examination of causal relationships between latent variables and observed variables within a theoretically specified model.

The main advantage of CFA lies in its ability to assist researchers in bridging the gap between theory and observation, which is often empirically observed. For example, an instrument may be developed by creating multiple items for each specific theoretical construct.

5. Research Findings

5.1 Analysis of entrepreneurial characteristics

Most of the sample were female (51.2%), reflecting the prominent role of women in various businesses, particularly within the context of this study. The manufacturing sector represented the largest proportion of enterprises (25.6%), underscoring the significance of the industrial sector in driving economic growth and employment. Most respondents held a bachelor's degree (48.6%), indicating the basic educational qualification required in the business sector. The most common age range was 31 - 35 years old (66.3%), representing the working-age group with relevant experience and a crucial role in operational or managerial activities. English language proficiency remains limited, with only 38.4% able to <communicate in English, while Japanese was the most frequently used foreign language after English, spoken by 30.3% of respondents, reflecting strong connections with business collaborations involving Japan.

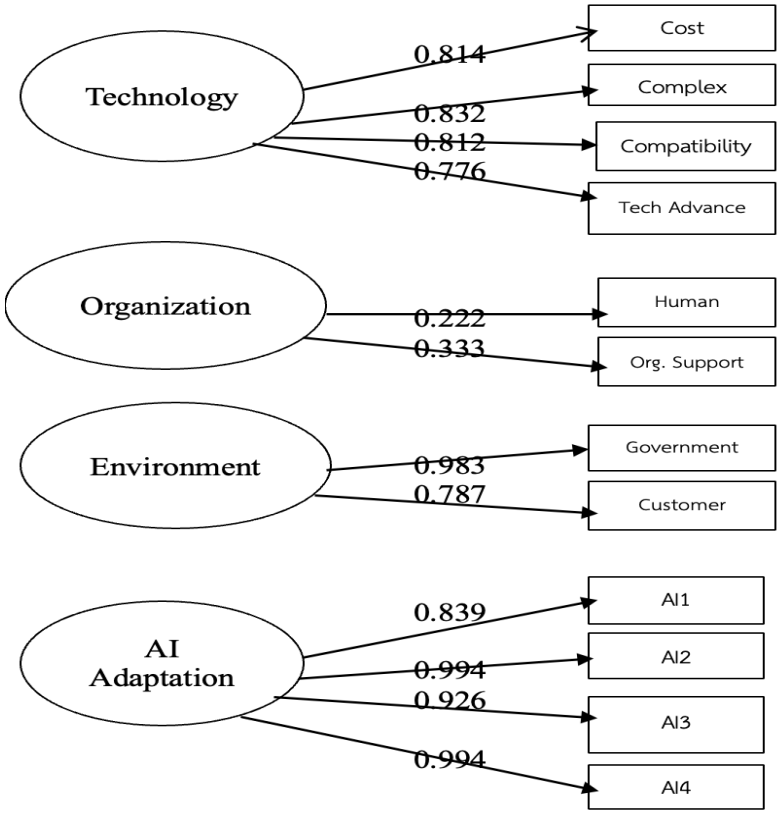
Regarding work experience, 70.9% of respondents had five years or less of experience, suggesting a workforce structure still in the early stages of their careers. The majority were employed in small enterprises, particularly those with 0–10 employees (23.8%), highlighting the important role of SMEs in the metropolitan area's economic system.

5.2 Results of the confirmatory factor analysis

Table 1. Results of the confirmatory factor analysis

Latent	Observed	Estimate	*P*
Technology	Cost	0.814	<.001
	Complex	0.832	<.001
	Compatibility	0.812	<.001
	Tech. advance	0.776	<.001
Organization	Human	0.222	<.001
	Org. support	0.330	<.001
Environment	Government	0.983	<.001
	Customer	0.787	<.001
AI adaptation	AI1	0.839	<.001
Organization	AI2	0.994	<.001
	AI3	0.926	<.001
	AI4	0.994	<.001

From table 1, the results of the Confirmatory Factor Analysis (CFA) indicate that all observed variables are statistically significant indicators of their respective latent constructs, with most factor loadings demonstrating high significance levels ($P < .001$). Within the technology construct, the observed variable complexity shows the highest loading (0.832), followed by cost (0.814), compatibility (0.812), and technological advancement (0.776), suggesting that all four variables strongly represent the latent construct. In contrast, the organization construct presents relatively lower factor loadings, with organizational support (0.330) being higher than human resources (0.222), although both are statistically significant. The environment construct exhibits strong loadings, particularly for government support (0.983), which is the highest in the entire model, followed by customer demand (0.787), both indicating substantial influence from external environmental factors. Regarding the AI adaptation construct, AI2 and AI4 (organizations adopt AI to improve company performance and organizations implement artificial intelligence (AI) to enhance organizational efficiency and overall company performance) show the highest factor loadings (0.994), with AI4 achieving statistical significance at the 0.05 level ($P = 0.036$), while AI3 (Organizations believe that the application of artificial intelligence (AI) can support various activities within the supply chains of SMEs) (0.926) and AI1 (Organizations adopt AI to improve the efficiency of their companies) (0.839) also contribute strongly. These findings support the construct validity of the model and indicate that the latent variables are well-represented by their observed indicators, especially in the cases of environment and AI adaptation, whereas the organization construct may require further refinement due to its comparatively weaker indicators. Based on these findings, the results of confirmatory factory analysis of this research can be developed as shown in Figure 2.



X^2 =55.8, df=30, x^2/df=1.84, RMSEA =0.050

Figure 2. Results of Confirmatory factor analysis

The fit indices are presented in Table 2 as follows:

Table 2. Fit index indicator

Index	Result
CFI	.995
TLI	.990
NFI	.990
NNFI	.990
RFI	.978
IFI	.995
GFI	1.000
AGFI	0.999
RMSEA	0.050
P	<.001

The model fit indices presented in Table 2 indicate an excellent fit between the hypothesized model and the observed data. The Comparative Fit Index (CFI) and Incremental Fit Index (IFI) both achieved values of 0.995, while the Tucker-Lewis Index (TLI), Normed Fit Index (NFI), and Non-Normed Fit Index (NNFI) each reached 0.990, exceeding the commonly accepted threshold of 0.90, indicating a very good model fit. The Relative Fit Index (RFI) also reported a strong value of 0.978. Furthermore, the Goodness-of-Fit Index (GFI) and Adjusted Goodness-of-Fit Index (AGFI) were 1.000 and 0.999 respectively, suggesting an almost perfect fit. The Root Mean Square Error of Approximation (RMSEA) was 0.050, which is within the acceptable range (≤ 0.08) and indicates a close fit of the model in relation to the degrees of freedom. Additionally, the model's overall significance is supported by a *P*-value of less than .001, confirming that the model is statistically significant.

6. Discussions

1. The research findings revealed that within the latent variable of technology, the observed variable complexity exhibited the highest factor loading. This aligns with the study by [21], which underscores the significant role of technological complexity in the adoption of artificial intelligence (AI). Therefore, the application of AI in small and medium-sized enterprises (SMEs) in Thailand holds strong potential to enhance both economic competitiveness and operational performance.

However, the adoption process is inherently complex and involves overcoming various challenges related to technology, organizational capacity, regulatory frameworks, and workforce readiness. A comprehensive review of the literature highlights that although AI offers considerable benefits such as cost reduction, improved decision-making, and process optimization the successful adoption of AI requires adequate infrastructure, workforce training, and a supportive regulatory environment.

For SMEs located in the metropolitan region, these factors are particularly critical. Metropolitan SMEs often operate in highly competitive markets with rapidly changing customer demands and technological advancements. While they may have relatively better access to infrastructure and skilled labor compared to rural counterparts, the complexity of AI adoption still poses significant barriers. Organizational readiness, including management commitment and digital literacy, is often varied among SMEs, affecting their ability to integrate AI effectively.

2. The analysis revealed that, within the latent construct of organization, the observed variable organizational support had the highest factor loading. This finding aligns with the study [22], which employed the Technology–Organization–Environment (TOE) framework to investigate AI adoption in SMEs in Saudi Arabia. Their research indicated that organizational support, including executive backing and sustainable human capital development, has a significant impact on AI implementation, leading to improved business performance. The study emphasizes the importance of internal organizational capacity and external support in ensuring successful AI adoption.

This current finding supports the idea that for SMEs, especially those with limited resources, strong internal leadership, strategic vision, and continuous employee development are essential enablers of AI integration. Organizational support reflects not only resource availability but also the commitment of management, interdepartmental cooperation, and a culture open to technological change.

In metropolitan areas where the pace of technological innovation and customer expectations is high, organizational readiness becomes even more crucial. The presence of executives who understand the strategic benefits of AI, combined with investments in staff training and organizational learning, can significantly improve the likelihood of successful AI implementation.

3. In the analysis of the environmental latent variable, it was found that the observed variable "government support" had the highest factor loading. This result is consistent with the findings of [1], which emphasize that artificial intelligence (AI) has emerged as an effective tool across various industries and holds significant promise for governments, societies, and economies. As such, governmental support is a critical factor influencing the adoption of technology. This includes financial assistance, infrastructure development, ease of access to financial services, regulations that ensure secure digital transactions, and the creation of a supportive legal framework. Government intervention can facilitate and accelerate the implementation of AI technologies.

This finding highlights the essential role that public policy and institutional frameworks play in fostering AI adoption among small and medium-sized enterprises (SMEs), particularly in developing countries. Government support acts as both a catalyst and a safety net for SMEs that often face financial constraints and technological uncertainty. In metropolitan areas—where innovation ecosystems are

more active—such support can have a compounding effect, enabling businesses to integrate AI solutions more efficiently and at lower risk.

Moreover, effective governmental involvement can bridge the gap between innovation and accessibility. By investing in digital infrastructure, offering grants or tax incentives, and providing regulatory clarity, governments can reduce barriers to entry and create a more inclusive technological environment. This, in turn, promotes competitiveness and sustainable growth within the SME sector.

4. Regarding the latent variable of artificial intelligence (AI) adoption, the observed variables AI2 (Organizations adopt AI to improve company performance) and AI4 (Organizations implement artificial intelligence (AI) to enhance organizational efficiency and overall company performance) demonstrated the highest factor loadings. These findings align closely with the study by [23], which emphasized that small and medium-sized enterprises (SMEs) are at the forefront of digital transformation and technology adoption. The integration of digital technologies within SMEs serves to revolutionize operational processes, improve customer satisfaction, foster innovation, and enhance overall competitiveness.

Despite these promising developments, many SMEs continue to face considerable challenges that hinder effective AI implementation. These include limited technological expertise, inadequate financial resources, insufficient digital infrastructure, and a shortage of skilled personnel. Such barriers can significantly delay or disrupt the process of digital adoption.

However, the empirical evidence clearly illustrates that SMEs derive substantial benefits from digital transformation, particularly through the strategic implementation of AI. AI tools can streamline workflows, support data-driven decision-making, automate repetitive tasks, and ultimately improve productivity and operational outcomes. As such, the high factor loadings for AI2 and AI4 underscore the central role that AI adoption plays in driving performance improvements across SME operations.

In the context of SMEs located in the metropolitan regions where market competition is high and digital ecosystems are more robust embracing AI becomes even more crucial. These enterprises must actively seek to leverage AI not merely for automation but as a strategic asset for long-term value creation and innovation. Furthermore, support from public and private institutions in the form of training programs, digital upskilling, and financial incentives can help SMEs overcome adoption barriers and maximize the returns on their technological investments.

7. Recommendations

7.1 Strengthening Organizational Commitment and Internal Support Systems

The findings revealed that within the organizational latent construct, the observed variable concerning organizational support carried the highest factor loading. This underscores the crucial role that leadership and managerial support play in the AI adoption process. SMEs in metropolitan area must foster a culture that prioritizes digital innovation by enhancing managerial vision, allocating strategic resources, and engaging stakeholders at all levels. Senior executives should not only endorse AI initiatives but actively participate in their planning and execution to ensure alignment with organizational goals. Furthermore, the development of human capital through regular training in AI technologies, digital tools, and data literacy is vital. Employees must be empowered with the necessary skills to operate, maintain, and leverage AI systems, thus reducing resistance to technological change and enhancing operational effectiveness.

7.2 Addressing the Complexity of Technological Integration

Technological complexity emerged as the most influential observed factor within the technological construct, indicating that the perceived difficulty of understanding and implementing AI tools acts as a significant barrier to adoption. To mitigate this, SMEs should seek support from technology consultants, research institutions, and AI solution providers who can offer simplified, modular, and scalable AI systems suited to SMEs' specific needs. Collaborative programs between SMEs around metropolitan area and academic institutions can facilitate knowledge transfer and reduce technical ambiguity. Government-led digital incubation centers and public-private innovation clusters can also provide hands-on demonstrations, pilot projects, and tailored technical support to guide SMEs through their initial stages of AI implementation.

7.3 Enhancing Governmental and Institutional Support Mechanisms

In the environmental dimension, government support stood out as the most dominant observed variable, aligning with previous research that emphasized the importance of policy and infrastructure in fostering AI innovation. Governments must play a proactive role in facilitating AI adoption by introducing financial incentives such as tax credits, low-interest loans, and innovation grants targeted at SMEs in metropolitan area engaging in digital transformation. Equally important is the development and maintenance of digital infrastructure, such as high-speed internet, secure cloud services, and data centers, which are foundational for the operation of AI technologies. Furthermore, the creation of a legal and regulatory environment that ensures data security, protects intellectual property, and governs digital transactions is essential to building trust and reducing perceived risks among SMEs.

7.4 Focusing AI Adoption on Tangible Performance Improvements

The analysis also demonstrated that the AI adoption construct was most strongly represented by observed variables relating to improving company performance and operational efficiency (AI2 and AI4). This finding highlights that SMEs are more likely to adopt AI when the outcomes are directly linked to performance enhancements, such as cost reduction, increased productivity, improved customer satisfaction, and streamlined processes. SMEs should be encouraged to begin their AI journey by applying AI solutions in areas that offer measurable returns, such as predictive maintenance, sales forecasting, chatbots for customer service, and inventory management systems. Demonstrating quick wins can build organizational confidence and justify further investment in more complex AI applications.

7.5 Bridging the Gap in Financial and Human Resources

Despite the significant benefits of AI, many SMEs face persistent constraints in terms of financing and skilled labor. Policymakers and financial institutions must develop mechanisms that improve SMEs' access to capital, including dedicated AI adoption funds, public–private partnerships, and AI innovation vouchers. Meanwhile, workforce development should be prioritized by introducing AI competency frameworks, vocational education programs, and collaborative training models that address both technical and managerial aspects of AI implementation. Encouraging talent exchange between large enterprises and SMEs can also facilitate knowledge diffusion.

8. Patents

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References

[1] Digital Economy Promotion Agency, *Artificial intelligence landscape in Thailand*: Opportunities and challenges. DEPA Publications, 2024.
[2] McKinsey & Company, The age of AI: *Artificial intelligence and the future of work*. McKinsey Global Institute, 2018.
[3] Massachusetts Institute of Technology, *Artificial intelligence and global GDP impact: Economic projections for 2030*. MIT Press, 2025.
[4] International Data Corporation, *Global AI market forecast and economic impact analysis*. IDC Research, 2024.
[5] Innoharma Education, *Future of work: AI impact on global employment trends*. Innoharma Publications, 2025.
[6] Thai Rath, Singapore leads ASEAN in AI economic contribution. *Thai Rath Business Daily*, 2024. February 8: p. 18.
[7] Electronic Transactions Development Agency, *Digital competency enhancement programs for SMEs in metropolitan areas.* ETDA Publications, 2023.
[8] Post Today, *AI contribution to ASEAN economic growth*. Post Today Business Section, 2024. March 15: p. B12.

[9] Thai Bankers Association, *Digital banking and AI adoption challenges among Thai SMEs*. TBA Research Department, 2024.
[10] SCB Economic Intelligence Center, *Digital ecosystem development for SME sustainability*. Siam Commercial Bank Publications, 2024.
[11] Office of Small and Medium Enterprises Promotion, *SME white paper 2024: Statistical profile of Thai SMEs.* SME Development Bank Publications, 2024.
[12] Kerdsawat, W., Thanakit, S. and P. Lertwongsatien, *Three-dimensional integration framework for AI utilization in metropolitan SMEs.* Journal of Business and Technology, 2024. **15**(2): p. 112–128.
[13] SME Thailand Club, *AI applications in Thai small and medium enterprises: Current trends and future prospects.* SME Club Publications, 2024.
[14] Hussain, A. and M. Rizwan, Structured approach to AI implementation in SMEs: *Building awareness and technical expertise.* Journal of Small Business Management, 2024. **62**(3): p. 245–268.
[15] Lexalytics, *AI adoption and economic growth correlation study*: *Global analysis*. Lexalytics Research Division, 2024.
[16] Organizational culture as a determinant of AI readiness in Bangkok SMEs: *Risk-taking and innovation perspectives.* International Journal of Innovation Management, 2024. **28**(3): p. 245–267.
[17] Jawapatarakul, D., Thanakit, S. and C. Lertwongsatien, *Organizational culture and AI adoption in Thai SMEs: The role of innovation and learning orientation.* Asian Journal of Technology Innovation, 2024. **32**(2): p. 189–205.
[18] Luo, X., Tong, S., Fang, Z. and Z. Qu, Frontiers in service science: *Environmental factors driving digital transformation and AI adoption in SMEs.* Journal of Service Research, 2022. **25**(4): p. 512–529.
[19] Thanyawatpornkul, R., *Environmental factors and AI adoption for sustainable business practices in Thailand*. Sustainability, 2024. **16**(8): p. 3245.
[20] Mueller, R.O. and G.R. Hancock, *Factor analysis and latent structure: Confirmatory factor analysis. In: Smelser, N.J. and P.B. Baltes (Eds.)*, International Encyclopedia of the Social and Behavioral Sciences. Pergamon, 2001. p. 5239–5244.
[21] Jongwanich, J. and A. Kohpaiboon, *Technological complexity and artificial intelligence adoption in Thai manufacturing SMEs.* Technology Analysis & Strategic Management, 2025. **37**(1): p. 78–95.
[22] Badghish, S. and Y.A. Soomro, *Technology-Organization-Environment framework and artificial intelligence adoption in Saudi Arabian SMEs: Performance implications*. Technology in Society, 2024. 78: p. 102–115.
[23] Faruque, M.O., Sarker, M.R. and M.S. Rahman, *Digital transformation in small and medium enterprises: Challenges and opportunities in emerging economies*. International Journal of Information Management, 2024. 75: p. 102–118.