

Artificial Intelligence in Small and Medium Enterprises: Its Influence on Business Performance in the Bangsamoro Autonomous Region in Muslim Mindanao

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ABSTRACT

Artificial intelligence (AI) is a key driver of digital transformation, yet its adoption among small and medium enterprises (SMEs) remains uneven, particularly in developing regions. This study examined the readiness of SMEs in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines, to adopt AI and its relationship with business performance using the Technology–Organization–Environment (TOE) framework. A quantitative descriptive–correlational design was employed, with data collected from 150 SME owners and managers, and analyzed using descriptive statistics and Pearson correlation. The results indicate that SMEs demonstrate moderate technological and organizational readiness but low environmental readiness, reflecting limited external support and market demand. Business performance was also found to be moderate, suggesting that AI adoption yields incremental improvements in operational and economic outcomes. Correlation analysis revealed that AI readiness is significantly associated with business performance, with organizational readiness showing the strongest influence. The study concludes that SMEs are in a transitional stage of digital transformation, where internal capabilities play a more critical role than external factors, and emphasizes the need to strengthen human capital, technological capacity, and institutional support to enhance AI adoption and competitiveness.

Keywords: artificial intelligence, SMEs, TOE framework, business performance, digital transformation

INTRODUCTION

The diffusion of artificial intelligence (AI) has accelerated across industries, fundamentally reshaping how organizations create value, manage operations, and sustain competitive advantage. As a cornerstone of the Fourth Industrial Revolution, AI encompasses advanced technologies such as machine learning, deep learning, natural language processing, and data analytics that enable firms to automate processes, extract insights from large datasets, and enhance decision-making capabilities (Brynjolfsson & McAfee, 2014; Dwivedi et al., 2021). Prior studies have consistently demonstrated that AI adoption can improve operational efficiency, forecasting accuracy, productivity, and innovation performance, thereby contributing to superior firm outcomes (Chong et al., 2019; Chen et al., 2022; Ho et al., 2022).

While the strategic value of AI is increasingly recognized, its adoption remains uneven across firm sizes and regional contexts. Small and medium enterprises (SMEs), despite their critical role in employment generation and economic development, often lag behind large firms in adopting advanced digital technologies (Baabdullah et al., 2021). SMEs typically operate under resource constraints related to capital, technical expertise, and organizational capabilities, which may limit their readiness to implement AI-driven solutions. At the same time, their flexible structures and proximity to markets provide opportunities for rapid innovation and responsiveness, making AI adoption both a challenge and a strategic necessity (Sestino & De Mauro, 2022).

In developing and emerging economies, these challenges are further intensified by institutional, infrastructural, and policy-related factors. In the Philippine context, SMEs account for the majority of registered enterprises and are central to inclusive economic growth. However, empirical research examining AI adoption among SMEs remains scarce, particularly at the subnational level. This gap is especially evident in the Bangsamoro

Autonomous Region in Muslim Mindanao (BARMM), a region characterized by a transitioning economy, growing entrepreneurial activity, and increasing policy attention toward digital transformation. Despite these developments, systematic evidence on how SMEs in BARMM perceive, adopt, and benefit from AI technologies is largely absent.

Existing studies on AI adoption have predominantly focused on firms in technologically advanced economies or on large organizations with established digital infrastructures (Zhang et al., 2021; Chen et al., 2022). Although some research has applied frameworks such as the Technology Acceptance Model (TAM) and the Technology–Organization–Environment (TOE) framework to examine AI adoption in SMEs (Baabdullah et al., 2021; Awan et al., 2021), findings remain context-specific and cannot be readily generalized to emerging and post-conflict regions like BARMM. Moreover, much of the existing literature emphasizes adoption intention rather than empirically linking AI adoption to concrete performance outcomes, particularly across both operational and economic dimensions.

This study addresses these gaps by empirically investigating AI adoption among SMEs in the BARMM region using the Technology–Organization–Environment (TOE) framework. Specifically, it examines how technological readiness (cost, relative advantage, complexity, and compatibility), organizational readiness (organizational support and sustainable human capital), and environmental readiness (market and customer demand, and government support) influence AI adoption and, in turn, affect SME business performance. Consistent with prior calls for multidimensional performance assessment (Zhang et al., 2020), this study conceptualizes business performance in terms of both operational and economic outcomes, thereby offering a more comprehensive evaluation of AI's value for SMEs.

By situating AI adoption within an underexplored regional context, this research makes several contributions. First, it extends the AI adoption literature by providing empirical evidence from BARMM, addressing the geographical and contextual bias toward developed economies. Second, it advances theory by integrating readiness factors and performance outcomes within a single empirical model grounded in the TOE framework. Third, it offers practical insights for policymakers, development agencies, and SME owners by identifying key enablers and constraints to effective AI adoption, thereby informing policy design and strategic interventions aimed at strengthening SME competitiveness and sustainable economic development in the region.

METHODS

Research Design

This study employed a descriptive–correlational research design to examine the adoption of artificial intelligence (AI) among small and medium enterprises (SMEs) and its influence on business performance in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines.

The descriptive component was used to determine the level of technological, organizational, and environmental readiness of SMEs toward AI adoption, while the correlational component assessed the relationship between AI adoption factors and business performance outcomes. This design is appropriate for studies that aim to explain relationships among variables without manipulating them and is commonly used in technology adoption and SME performance research.

Research Respondents

The respondents of the study consisted of owners, managers, and key decision-makers of micro, small, and medium enterprises operating in the BARMM region. These individuals were selected because they are directly involved in strategic planning, technology adoption decisions, and business operations within their respective firms.

To ensure the relevance and accuracy of responses, only SMEs that had already adopted AI technologies or were in the process of considering AI implementation were included in the study. A total of 150 SME respondents participated in the survey, representing various sectors such as retail, services, manufacturing, and agriculture.

Locale of the Study

The study was conducted in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), specifically covering SMEs located in Cotabato City, Maguindanao del Norte, and Maguindanao del Sur. BARMM was selected as the study locale due to its emerging entrepreneurial ecosystem, increasing interest in digital transformation, and unique socio-economic conditions. Examining AI adoption in this region provides valuable insights into how SMEs in developing and transitioning economies respond to advanced digital technologies under resource and institutional constraints.

Research Instruments

Data were collected using a structured survey questionnaire adapted from established studies on technology adoption, artificial intelligence, and business performance and anchored on the Technology–Organization–Environment (TOE) framework proposed by Tornatzky and Fleischer (1990). The measurement items for technological readiness specifically cost, relative advantage, complexity, and compatibility were adapted from prior technology adoption and innovation diffusion studies (Rogers, 2003; Davis, 1989; Baabdullah et al., 2021). Organizational readiness measures, including organizational support and sustainable human capital, were adapted from studies examining managerial support, human capital, and innovation capability in technology adoption contexts (Akinçi et al., 2010; Yu et al., 2018; Hosseini et al., 2020). Environmental readiness indicators, covering market and customer demand and government support, were adapted from prior research on external pressures and institutional support influencing innovation adoption (Rogers, 2003; Tornatzky & Fleischer, 1990; Yu et al., 2018).

Business performance measures were adapted from studies that conceptualize firm performance in both operational and economic dimensions in the context of technological and digital innovation (Kaufmann & Tödting, 2002; Brynjolfsson & McAfee, 2014; Zhang et al., 2020). The final instrument consisted of five sections: respondent and firm profile, technological readiness, organizational readiness, environmental readiness, and business performance. All items were measured using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Minor modifications in wording were made to ensure contextual relevance to SMEs operating in the BARMM region without altering the underlying constructs of the original scales.

Issues on Validity of Instruments

To address issues related to instrument validity, the study employed content validity procedures. The questionnaire was reviewed by experts in business management, artificial intelligence, and research methodology to ensure that the items adequately represented the constructs of technological, organizational, and environmental readiness, as well as business performance. Their feedback was used to refine item wording, improve clarity, and eliminate ambiguity.

In addition, a pilot test was conducted among a small group of SME respondents who were not included in the final sample. The pilot testing helped identify unclear instructions, confusing statements, and potential response biases. Revisions were made based on the pilot test results to enhance the reliability and clarity of the instrument prior to full-scale data collection. These steps ensured that the research instrument was both valid and appropriate for measuring AI adoption and its impact on SME performance in the BARMM context.

Ethical Considerations

Ethical principles were strictly observed throughout the conduct of this study to ensure the protection of respondents' rights, dignity, and well-being. Prior to data collection, permission to conduct the study was obtained from the appropriate authorities and relevant stakeholders. All respondents were provided with clear information regarding the purpose of the study, the nature of their participation, and the voluntary character of their involvement. Informed consent was obtained from each participant before the administration of the survey.

Participation in the study was entirely voluntary, and respondents were informed of their right to decline participation or withdraw from the study at any stage without any penalty or negative consequences. To ensure

confidentiality and anonymity, no personally identifiable information was collected, and business names were treated as optional. All responses were used solely for academic and research purposes and were reported only in aggregated form to prevent the identification of individual respondents or enterprises.

Data collected from the survey were securely stored and accessed only by the researcher. Electronic data files were protected through password-secured storage, while any printed materials were kept in a secure location. The study complied with accepted ethical standards for social science research, ensuring honesty, transparency, and integrity in data collection, analysis, and reporting. No form of deception, coercion, or undue influence was employed during the research process.

RESULTS AND DISCUSSION

Status on technological readiness of small and medium enterprises on Artificial Intelligent in BARMM Region, Philippines in terms of:

The findings indicate that small and medium enterprises (SMEs) in the BARMM region exhibit a moderate level of technological readiness for artificial intelligence (AI) adoption (overall mean = 3.11). This suggests that while firms recognize the potential value of AI technologies, their capability to fully integrate such systems into business operations remains at a developmental stage. This pattern is consistent with existing studies, which argue that SMEs often adopt advanced technologies incrementally due to constraints in financial resources, technical expertise, and digital infrastructure (Dwivedi et al., 2023; Troise et al., 2022).

From a theoretical standpoint, the results support the Technology–Organization–Environment (TOE) framework, which posits that technological characteristics such as perceived usefulness, compatibility, and complexity which significantly influence adoption decisions. The moderate ratings for cost and relative advantage suggest that SMEs are still evaluating the economic feasibility and strategic value of AI investments. Prior research confirms that perceived cost and return on investment remain key determinants of AI adoption, particularly among resource-constrained firms (Mhlanga, 2023).

Notably, the dimension of complexity recorded high mean scores, indicating that SMEs perceive AI technologies as difficult to understand and implement. This finding aligns with recent literature emphasizing that technological complexity is a major barrier to AI adoption, as it requires specialized skills, system integration capabilities, and organizational learning (Zhang & Chen, 2023). Conversely, compatibility received relatively higher ratings, suggesting that SMEs perceive AI as potentially alignable with existing processes and organizational goals. This implies that although technical challenges persist, firms recognize the strategic fit of AI within their operations.

Overall, the findings reflect a transitional stage of digital maturity, where SMEs are aware of AI’s benefits but remain constrained by technological and capability-related limitations. This supports broader observations that SMEs in developing regions are gradually moving toward digital transformation but require stronger technological support systems to achieve full integration (OECD, 2021).

Table 1 Level of Technological Readiness of SMEs on Artificial Intelligence

Indicator	Survey Statements	Mean	Interpretation
Cost	1. The cost of adopting AI technologies is affordable for our business.	2.65	Moderate
	2. We consider AI as a worthwhile investment despite its costs.	2.80	Moderate
	3. The long-term savings of AI justify the initial implementation expenses.	3.10	Moderate
	Sub-Mean	2.83	Moderate
Relative Advantage	4. AI improves our decision-making processes.	2.75	Moderate
	5. AI enhances the quality of our business operations.	2.60	Moderate
	6. Using AI gives us a competitive advantage in our industry.	2.80	Moderate

	Sub-Mean	2.72	Moderate
Complexity	7. AI technologies are difficult for our staff to understand and use.	3.74	High
	8. Implementing AI in our operations is a complex process.	3.78	High
	9. We face technical challenges in integrating AI with existing systems.	3.76	High
	Sub-Mean	3.76	High
Compatibility	10. AI systems are compatible with our current business processes.	3.30	Very High
	11. AI solutions align with the goals and needs of our organization.	3.00	High
	12. AI adoption fits well with our organizational culture.	3.20	Very High
	Sub-Mean	3.16	Moderate
	Overall Mean	3.11	Moderate

Legends

Range of Mean	Description	Interpretation
4.20-5.00	Very High	Technological Readiness is always manifested.
3.40-4.19	High	Technological Readiness is often times manifested.
2.60-3.39	Moderate	Technological Readiness is fairly manifested
1.80-2.59	Low	Technological Readiness is rarely manifested.
1.00-1.79	Very Low	Technological Readiness is not manifested at all.

Status on Organizational readiness of small and medium enterprises on Artificial Intelligent in BARMM Region, Philippines in terms of:

The results further reveal that SMEs demonstrate a moderate level of organizational readiness (overall mean = 2.76), indicating that internal capabilities necessary for AI adoption are present but not yet fully developed. In particular, organizational support shows moderate strength, reflecting a certain level of managerial commitment, resource allocation, and strategic direction toward AI initiatives.

This finding is consistent with prior studies highlighting that leadership support and strategic vision are critical enablers of digital transformation (Verhoef et al., 2021). In SMEs, where decision-making is often centralized, the role of owners and managers becomes even more crucial in driving technological innovation (Dwivedi et al., 2023). The moderate rating suggests that while leaders are supportive, AI adoption may not yet be institutionalized as a core strategic priority.

However, a key concern emerges in the area of sustainable human capital, which was rated low. This indicates a lack of employee skills, training, and technical expertise required to effectively implement AI technologies. This finding strongly aligns with existing literature, which identifies human capital as one of the most critical barriers to AI adoption in SMEs (Mhlanga, 2023; Troise et al., 2022). Without adequate digital skills and training, organizations may struggle to operationalize AI systems and derive meaningful value from technological investments.

From the perspective of the Resource-Based View (RBV), human capital represents a strategic asset that enables firms to achieve competitive advantage. Similarly, Dynamic Capabilities Theory emphasizes the importance of continuous learning and skill development in adapting to technological change. The low rating in this dimension suggests that SMEs in the BARMM region may face challenges in building the internal competencies required for sustained digital transformation (Zhang & Chen, 2023).

Overall, the findings indicate that while organizational structures and leadership support are moderately established, the lack of skilled human resources remains a critical constraint. Strengthening workforce

capabilities through training and capacity-building initiatives is therefore essential to enhance AI readiness among SMEs.

Table 2 Level of Organizational Readiness of SMEs on Artificial Intelligence

Indicator	Survey Statements	Mean	Interpretation
Organizational Support	13. Our management fully supports the adoption of AI technologies.	3.00	Moderate
	14. We allocate sufficient resources (financial, technical) for AI projects.	3.20	Moderate
	15. Our company has a clear vision or roadmap for AI implementation.	3.10	Moderate
	Sub-Mean	3.10	Moderate
Sustainable Human Capital	16. Our employees are skilled or trained to work with AI tools.	2.50	Low
	17. We provide regular training on digital and AI technologies.	2.00	Low
	18. There is a culture of innovation and learning in our company.	2.80	Moderate
	Sub-Mean	2.43	Low
	Overall Mean	2.76	Moderate

Legends

Range of Mean	Description	Interpretation
4.20-5.00	Very High	Organizational Readiness is always manifested.
3.40-4.19	High	Organizational Readiness is often times manifested.
2.60-3.39	Moderate	Organizational Readiness is fairly manifested
1.80-2.59	Low	Organizational Readiness is rarely manifested.
1.00-1.79	Very Low	Organizational Readiness is not manifested at all.

Status on environmental readiness of small and medium enterprises on Artificial Intelligent in BARMM Region, Philippines in terms of:

The study reveals that environmental readiness is low (overall mean = 2.25), indicating that external conditions are not yet conducive to widespread AI adoption among SMEs in the BARMM region. This finding highlights the limited role of external drivers such as market demand, competitive pressure, and institutional support.

In terms of market and customer demand, the results suggest that SMEs perceive relatively weak pressure from customers to adopt AI technologies. While there is some recognition of evolving customer expectations, the overall demand for AI-driven products and services remains limited. This aligns with research indicating that technology adoption is often slower in regions where digital awareness and market sophistication are still developing (OECD, 2021).

The findings also show that government support is insufficient, particularly in terms of financial incentives, training programs, and technical guidance. This observation is consistent with recent studies emphasizing that government intervention plays a crucial role in fostering innovation ecosystems and enabling SMEs to adopt advanced technologies (Mhlanga, 2023). In the absence of strong institutional support, SMEs may lack the motivation and resources necessary to invest in AI.

Within the TOE framework, environmental factors serve as external pressures or enablers that influence organizational decisions. The weak environmental readiness observed in this study suggests that SMEs operate in a context where external support mechanisms are underdeveloped. This limits the diffusion of AI technologies and slows the pace of digital transformation.

Overall, the results underscore the need for stronger collaboration among government agencies, industry stakeholders, and academic institutions to create a more supportive innovation ecosystem. Enhancing policy frameworks, financial assistance, and digital infrastructure is critical to improving environmental readiness and promoting AI adoption.

Table 3 Level of Environmental Readiness of SMEs on Artificial Intelligence

Indicator	Survey Statements	Mean	Interpretation
Market and Customer Demand	19. Our customers expect faster and smarter services powered by AI.	2.60	Moderate
	20. There is strong market demand for AI-driven products/services.	1.85	Low
	21. AI adoption helps us meet evolving customer expectations.	2.50	Low
	Sub-Mean	2.32	Low
Government Support	22. Government programs support the use of AI in SMEs.	2.80	Moderate
	23. There are incentives (e.g., tax breaks, grants) for AI adoption.	1.90	Low
	24. We receive guidance or assistance from local agencies in implementing AI.	1.85	Low
	Sub-Mean	2.18	Low
	Overall Mean	2.25	Low

Legends

Range of Mean	Description	Interpretation
4.20-5.00	Very High	Environmental Readiness is always manifested.
3.40-4.19	High	Environmental Readiness is often times manifested.
2.60-3.39	Moderate	Environmental Readiness is fairly manifested
1.80-2.59	Low	Environmental Readiness is rarely manifested.
1.00-1.79	Very Low	Environmental Readiness is not manifested at all.

Status of micro-small and medium enterprises performance on Artificial Intelligent in BARMM Region, Philippines in terms of:

The findings indicate that SMEs report a moderate level of business performance (overall mean = 3.00), suggesting that AI adoption contributes to improvements in both operational and economic outcomes, albeit at a developing stage. This result reflects the gradual nature of digital transformation, where benefits from AI adoption emerge progressively over time (Dwivedi et al., 2023).

In terms of operational performance, AI adoption moderately improves efficiency, workflow optimization, and service quality. This is consistent with existing research demonstrating that AI technologies enhance operational processes through automation, data analytics, and improved decision-making (Ransbotham et al., 2022). SMEs that adopt AI are better able to streamline operations and reduce inefficiencies.

Similarly, economic performance shows moderate improvement, with AI contributing to revenue growth, cost reduction, and long-term sustainability. However, the relatively lower rating for profitability suggests that financial benefits may not be immediately realized. Prior studies indicate that the economic impact of AI adoption often materializes over time as firms develop digital capabilities and integrate technologies into their strategic processes (Verhoef et al., 2021).

Overall, the findings suggest that SMEs are in the early stages of leveraging AI for performance improvement. While initial benefits are evident, the full potential of AI has not yet been fully realized due to existing technological, organizational, and environmental constraints.

Table 4 Level of Business Performance of SMEs

Indicator	Survey Statements	Mean	Interpretation
Operational Performance	25. AI has improved the efficiency of our operations.	2.80	Moderate
	26. AI helps in optimizing our workflow and reducing waste.	3.20	Moderate
	27. AI enables us to deliver better quality products/services.	2.90	Moderate
	Sub-Mean	2.97	Moderate
Economic Performance	28. AI has led to increased revenues or cost savings.	3.10	Moderate
	29. We have gained higher profitability since implementing AI.	2.80	Moderate
	30. AI contributes to our long-term financial sustainability.	3.20	Moderate
	Sub-Mean	3.03	Moderate
	Overall Mean	3.00	Moderate

Influence of AI in the Business Performance of micro-small and medium enterprises in BARMM Region, Philippines:

The correlation analysis confirms that AI adoption readiness is positively and significantly related to business performance, supporting the assumptions of the TOE framework. Among the three dimensions, organizational readiness exhibits the strongest relationship ($r = 0.63$), followed by technological readiness ($r = 0.55$), and environmental readiness ($r = 0.41$).

The strong influence of organizational readiness highlights the importance of internal capabilities, leadership support, and human capital in driving successful AI adoption. This finding is consistent with prior studies emphasizing that organizational factors play a critical role in translating technological investments into performance outcomes (Zhang & Chen, 2023).

Technological readiness also demonstrates a significant relationship with performance, reinforcing the idea that compatibility, perceived usefulness, and technological capability are essential for effective digital transformation (Troise et al., 2022). Meanwhile, the weaker relationship of environmental readiness reflects the limited external support observed in the region.

Overall, the results suggest that SMEs primarily rely on internal factors to achieve performance improvements through AI adoption. However, strengthening external support systems will be essential to sustain and scale these gains in the long term.

Table 5 Correlation Matrix between AI Adoption Readiness and Business Performance

Variables	Technological Readiness	Organizational Readiness	Environmental Readiness	Business Performance
Technological Readiness	1.00			
Organizational Readiness	0.58**	1.00		
Environmental Readiness	0.46**	0.49**	1.00	
Business Performance	0.55**	0.63**	0.41**	1.00

SUMMARY OF FINDINGS

This study examined the readiness of small and medium enterprises (SMEs) in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) to adopt artificial intelligence (AI) and analyzed its relationship with business performance using the Technology–Organization–Environment (TOE) framework. The findings provide several important insights into the current state of AI adoption and its implications for SME development in a transitioning regional economy.

First, the results revealed that SMEs demonstrate a moderate level of technological readiness for AI adoption. This indicates that while firms are aware of the potential benefits of AI and recognize its compatibility with existing business processes, they continue to face challenges related to cost considerations, system complexity, and technical integration. These findings suggest that SMEs are in the early to intermediate stages of digital transformation, where technological awareness is present but full operational implementation remains limited.

Second, SMEs exhibited a moderate level of organizational readiness, highlighting that internal support structures—such as leadership commitment and resource allocation—are somewhat established. However, the findings also showed that human capital readiness is relatively weak, particularly in terms of employee skills, training, and digital competencies. This indicates that although management may be open to adopting AI technologies, the lack of adequately trained personnel may hinder effective implementation and utilization.

Third, the study found that environmental readiness is low, suggesting that external conditions are not yet conducive to widespread AI adoption. Specifically, SMEs perceive limited market demand for AI-driven solutions and insufficient institutional support, including government incentives, policy frameworks, and technical assistance. This indicates that the broader innovation ecosystem in the BARMM region remains underdeveloped, thereby constraining the diffusion of advanced technologies such as artificial intelligence.

Fourth, SMEs reported a moderate level of business performance, reflecting that AI adoption contributes to improvements in both operational and economic outcomes, but these benefits are not yet fully maximized. The findings suggest that SMEs experience gradual gains in efficiency, workflow optimization, and financial sustainability; however, the impact on profitability and long-term competitive advantage is still emerging.

Finally, the correlation analysis demonstrated that AI adoption readiness is significantly and positively related to business performance. Among the three dimensions of the TOE framework, organizational readiness showed the strongest relationship, followed by technological readiness, while environmental readiness exhibited the weakest but still significant association. This implies that internal organizational capabilities particularly leadership support and human capital play a more critical role in driving performance improvements than external environmental factors.

Overall, the findings suggest that SMEs in the BARMM region are progressively developing their readiness to adopt AI technologies, but remain constrained by limitations in human capital and external support systems. Strengthening both internal organizational capacities and the external innovation environment is therefore essential to fully realize the potential of AI in enhancing SME performance and competitiveness.

CONCLUSION

This study examined the readiness of small and medium enterprises (SMEs) in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) to adopt artificial intelligence (AI) and its influence on business performance using the Technology–Organization–Environment (TOE) framework. The findings reveal that SMEs are in a transitional stage of digital transformation, characterized by moderate levels of technological and organizational readiness but low environmental readiness.

The results indicate that while SMEs recognize the potential value of AI technologies and demonstrate a certain degree of internal preparedness, their capacity to fully implement AI remains constrained by technological complexity, limited digital infrastructure, and insufficient human capital. In particular, the lack of employee skills and structured training programs emerges as a critical barrier, suggesting that organizational readiness is uneven and still evolving.

Furthermore, the study highlights that external environmental conditions are not yet sufficiently supportive of AI adoption. Limited market demand for AI-driven solutions and inadequate government support mechanisms—such as incentives, policy frameworks, and technical assistance—restrict the ability of SMEs to invest in and sustain advanced technological innovations. This underscores the importance of strengthening the broader innovation ecosystem to facilitate digital transformation in the region.

Despite these constraints, SMEs report moderate improvements in both operational and economic performance, indicating that AI adoption is already generating tangible benefits. However, these gains remain incremental, suggesting that the full potential of AI has yet to be realized. The correlation analysis further confirms that AI adoption readiness is significantly associated with business performance, with organizational readiness emerging as the most influential factor, followed by technological readiness, while environmental readiness exerts a comparatively weaker effect.

Overall, the study concludes that internal organizational capabilities—particularly leadership support and human capital play a central role in translating AI adoption into performance outcomes. However, the long-term success and scalability of AI adoption among SMEs in the BARMM region will depend on the simultaneous development of both internal capacities and external support systems. Strengthening these dimensions is essential to enhance SME competitiveness, foster innovation, and promote sustainable economic development in the region.

RECOMMENDATION

Based on the findings and conclusions of the study, the following recommendations are proposed for key stakeholders:

For SME Owners and Managers

SMEs should prioritize the development of internal capabilities necessary for AI adoption by investing in employee training, digital skills development, and organizational learning. Establishing a clear strategic roadmap for AI implementation and fostering a culture of innovation can enhance the effective integration of AI technologies into business operations. Strengthening human capital is particularly critical to ensure that technological investments translate into measurable performance improvements.

For Government and Policymakers

Government agencies should strengthen the regional innovation ecosystem by designing and implementing policies that support AI adoption among SMEs. This includes providing financial incentives such as grants and tax breaks, developing digital infrastructure, and offering accessible training and capacity-building programs. Policymakers should also enhance coordination among institutions to ensure that support mechanisms are effectively delivered and aligned with the needs of SMEs in the BARMM region.

For Academic Institutions and Training Providers

Higher education institutions and training organizations should play an active role in bridging the skills gap by offering specialized programs in artificial intelligence, data analytics, and digital transformation. Collaborative partnerships between academia and industry can facilitate knowledge transfer, provide practical training opportunities, and support SMEs in building the technical competencies required for AI adoption.

For Industry Stakeholders and Development Organizations

Private sector organizations, industry associations, and development agencies should support SMEs through technical assistance, advisory services, and access to innovation networks. Encouraging public-private partnerships can help accelerate the diffusion of AI technologies and create a more supportive business environment for digital transformation.

For Future Researchers

Future studies should consider employing longitudinal research designs to better capture the causal relationship between AI adoption and business performance over time. Expanding the scope of research to include comparative regional or sectoral analyses, as well as integrating qualitative methods such as case studies and interviews, would provide deeper insights into the contextual factors influencing AI adoption. Additionally, the

use of advanced analytical techniques, such as structural equation modeling (SEM), is recommended to further validate the relationships among variables within the TOE framework.

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