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Artificial Intelligence Integration Strategy in Management Information Systems: A Case Study of Micro, Small, and Medium Enterprises

Emi Sita Eriana[1*], Asep Erlan Maulana[2]

***Abstract*—Digital transformation through the integration of Artificial Intelligence (AI) technology into Management Information Systems (MIS) has become an urgent need for Micro, Small, and Medium Enterprises (MSMEs). The MSME sector in Indonesia plays a vital role in the national economy but faces significant challenges, including limited access to capital and technology. This study aims to develop an effective AI integration strategy to improve MSME operational efficiency. Using a mixed-methods approach combining exploratory and descriptive designs, this study involved 30 MSMEs from various sectors selected through purposive sampling. Data were collected through structured questionnaires, semi-structured interviews, and direct observation, and then analyzed using descriptive statistics, regression analysis, and thematic analysis. The results reveal a paradox: 85% of MSMEs show strong enthusiasm for AI technology while simultaneously facing implementation barriers. A significant gap exists between infrastructure readiness (40%) and human resource readiness (25%). Five critical success factors were identified: human resource readiness (35%), technology infrastructure (25%), financial support (20%), management commitment (15%), and the digital ecosystem (5%). MSMEs that successfully implemented AI achieved operational efficiency improvements of up to 30% and ROI within 12–18 months. This study produced the "MSME-AI Integration Framework" as a practical guide for phased implementation. Strategic recommendations include a phased implementation approach, ongoing digital training programs, government support, and partnerships with technology providers for affordable AI solutions.**

***Index Terms*—Artificial intelligence, integration strategy, MIS, MSMEs, digital transformation.**

I. Introduction

Digital transformation has become an urgent need for MSMEs sector [1], [2]. particularly in Indonesia, regarding the integration of AI technology into MIS. Data show that of the total 30.18 million MSME units registered in Indonesia, only around 30% have adopted AI technology in their MIS [3]. However, Indonesia's AI market shows a very promising growth trend, with a 28.65% annual growth rate and a projected market value of US$10.88 billion by 2030 [4]. The government's initiative reinforces this momentum through the 2024 MSME Level Up Program, which targets 30 million MSMEs to become digitally literate, as well as data showing that 50% of Indonesian employees use AI technology weekly to improve MSME competitiveness [1], [2], [5].

Despite the significant potential identified, empirical evidence reveals significant gaps in the adoption of AI technologies among Indonesian MSMEs. Specifically, 70% of Indonesian MSMEs have not yet implemented AI technologies in their MIS, indicating structural barriers that require urgent attention. This situation is further exacerbated by Indonesia's relatively low AI market penetration, with an annual growth rate of only 5.2% and a market value of US$2.1 billion in 2024 [6]. Furthermore, the 2024 MSME Level Up Program only reached 8 million digitally literate MSMEs out of a target of 30 million, while 85% of Indonesian employees do not routinely use AI technologies in their daily MSME operations, underscoring the need for more comprehensive and practical strategic interventions [5], [6].

This study aims to formulate a strategic approach to AI integration in the MSME sector, based on empirical findings, by identifying five critical success factors: human resource readiness, infrastructure capacity, financial support mechanisms, management commitment, and digital ecosystem development. Through the development of the "MSME-AI Integration Framework" model, which includes assessment, planning, implementation, and evaluation phases, this study provides practical and measurable recommendations, including a phased implementation strategy, digital training programs, and cross-sector collaboration initiatives designed to improve MSME operational efficiency and accelerate digital transformation [2].

The urgency of this research stems from the fact that the

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*Corresponding author
[1]Emi Sita Eriana, Pamulang University, Tangerang Selatan, Indonesia (e-mail: dosen02692@unpam.ac.id).
[2]Asep Erlan Maulana, Pamulang University, Tangerang Selatan, Indonesia (e-mail: dosen02716@unpam.ac.id).

majority of MSMEs in Indonesia still use conventional management systems, creating a significant gap amid the accelerating demands for digital transformation, particularly regarding the use of AI technology [7], [8]. Currently, there is no strategic guidance to help MSMEs integrate AI effectively based on their business characteristics. Given the projected 28.65% annual growth of the national AI market and the target to digitalize 30 million MSMEs, there are significant opportunities that require thorough investigation and a practical, actionable implementation roadmap. Without this research, MSMEs risk falling further behind technologically due to the lack of an appropriate integration strategy for their MIS [9], [10]. Furthermore, without identifying challenges, analyzing appropriate models, and designing a strategic framework, MSMEs will struggle to optimize their operational efficiency, productivity, and profitability [11].

This research is to provide both practical and theoretical contributions. In practice, it will serve as a comprehensive guide for MSMEs to strategically and sustainably integrate AI technology, supporting Indonesia's vision as a digital economic powerhouse in Southeast Asia [9]. It provides actionable recommendations through a phased implementation approach, targeted digital training programs, and cross-sector partnerships to improve MSME operational efficiency [12]. Theoretically, this research contributes to academic discourse by developing a novel theoretical model that serves as a reference for future studies and informs the formulation of national policies on AI integration in the MSME sector [13].

This research is systematically structured to provide a comprehensive overview of AI integration strategies for Indonesian MSMEs. Following this introduction, the paper presents a literature review examining existing frameworks and theoretical foundations, followed by a methodology section outlining the research approach and data collection methods [14]. The findings section then presents the empirical results and analysis, leading to a discussion section that interprets these findings in the context of the proposed MSME-AI Integration Framework [15]. The paper concludes with recommendations for policy and practice, as well as suggestions for future research in this evolving field.

II. Related Work

With the rapid development of information technology, MSMEs are being urged to adapt and adopt digital solutions to maintain their competitiveness amidst increasingly fierce market competition. This has led to numerous academic and practical studies seeking to understand the extent to which the application of artificial intelligence can fundamentally transform small and medium-sized business models. These studies reveal that AI-based systems are capable of processing large amounts of data in real time, generating accurate insights to support more precise and strategic managerial decision-making [16]. With analytical capabilities far surpassing conventional methods, AI technology opens up opportunities for MSMEs to operate at efficiency standards previously only achievable by large-scale companies. This includes automating financial processes, optimizing inventory management, and enhancing more integrated digital marketing strategies. Automation in financial management, for example, has been shown to significantly reduce recording errors and accelerate reporting cycles. Meanwhile, the application of AI in inventory management enables businesses to predict market demand with greater precision, effectively and sustainably minimizing the risk of overstocking or understocking [14].

However, previous research has also revealed significant implementation challenges. Key barriers include limited digital literacy among human resources, limited initial investment capital, and a lack of technical guidance tailored to the MSME scale. Several researchers emphasize the importance of government support and strategic partnerships with technology providers in facilitating sustainable AI adoption among MSMEs [10].

The literature also reveals a significant gap between technological infrastructure readiness and human resource readiness in the context of digital transformation in MSMEs. This gap is often a major obstacle slowing the rate of AI technology adoption, even though technically available digital solutions are increasingly affordable and accessible. Many MSMEs face a situation where basic technological infrastructure is in place, but the human resource capacity to operate, manage, and optimize these systems remains far from adequate. This competency gap is exacerbated by limited access to relevant digital training and development programs for the MSME workforce. Unlike large companies that have dedicated human resource development departments, MSMEs generally rely on informal knowledge and unstructured, self-directed learning. This situation creates a widening gap between the ever-evolving demands of technology and the actual ability of business actors to optimally utilize it [17].

Previous research has also highlighted that the success of AI integration does not solely depend on technical aspects, but also on a series of equally important non-technical factors. Top management commitment, for example, has proven to be a critical determinant in driving the organizational changes necessary to accommodate AI-based systems. Without a clear vision and tangible support from organizational leaders, digital transformation initiatives tend to face strong internal resistance and end up without significant results [17]. In addition to management commitment, an adaptive organizational culture and a conducive digital ecosystem also play an equally important role in determining the success of AI implementation in MSMEs. Organizations with a culture open to change and innovation tend to be better able to integrate new technologies into existing workflows without causing significant disruption. Furthermore, the availability of a supportive digital ecosystem that includes clear regulations, access to technology financing, and a reliable network of partners and vendors is an important foundation that enables MSMEs to adopt and sustain AI systems [17].

Unlike previous studies that focused on challenges or opportunities in isolation, this study develops a holistic approach by identifying five critical success factors, analyzing

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the paradox between high enthusiasm and implementation barriers, and proposing a practical framework called the "MSME-AI Integration Framework" that can serve as a guide for phased implementation tailored to the actual capacity of MSMEs [12]. The distinctive contribution of this research lies in integrating quantitative and qualitative approaches to deliver comprehensive, applicable solutions for the MSME sector in Indonesia.

Recent studies have explored integrating AI into MIS as a strategic approach to enhancing operational performance in MSMEs. A study titled "Artificial Intelligence Integration Strategy in MIS: A Case Study of Micro, Small, and Medium Enterprises" highlights that AI adoption within MIS enables MSMEs to automate data processing, improve decision-making accuracy, and streamline business workflows, thereby reducing operational costs and increasing overall efficiency [17].

Recent studies have explored the integration of AI into Management Information Systems (MIS) as a strategic approach to improving operational performance in MSMEs. The growing interest in this topic reflects a growing awareness among researchers and practitioners that AI technology is no longer simply a supporting tool but has evolved into a core component of modern information systems architecture. Various methodological approaches have been applied in these studies, ranging from quantitative data-driven analysis of business performance to qualitative case studies that explore the firsthand experiences of MSMEs in the technology adoption process. The adoption of AI in MIS enables MSMEs to automate data processing, improve decision-making accuracy, and simplify business workflows, resulting in reduced operational costs and increased overall efficiency [17]. These studies specifically emphasize that the success of AI integration is not solely determined by the sophistication of the technology used, but also by organizational readiness and human resource capacity in managing the new system. These findings provide an important foundation for policymakers and MSME managers in designing realistic, measurable, and sustainable adoption strategies. The study results underscore that the benefits of AI integration in MIS can be felt gradually as the organization's digital capabilities improve. MSMEs that begin adopting low-complexity business processes, such as automated transaction recording and system-based financial reporting, tend to experience a smoother transition than those that immediately implement full-blown AI systems. Therefore, a gradual integration approach tailored to the scale and specific needs of each business is considered the most effective strategy for maximizing the value of technology investments for MSMEs.The study uses a SWOT analysis as the primary methodological framework to evaluate the strategic position of AI integration in MSME information systems. Through this approach, the research systematically identifies internal strengths, such as improved data accuracy and process automation, and weaknesses, including limited technical expertise and high implementation costs. It also maps external opportunities, such as increasing digital market demand, and threats, such as rapid technological change and cybersecurity risks. The findings indicate that the primary strength of AI integration lies in its ability to enhance real-time data analytics and optimize inventory and financial management systems within MSMEs.[18]Additionally, the study identifies significant opportunities emerging from government digital transformation initiatives and the increasing availability of affordable cloud-based AI tools, which together lower the barriers to entry for MSMEs seeking to adopt intelligent information systems [2].

Despite the promising opportunities, a SWOT analysis of AI adoption among MSMEs also reveals a number of internal weaknesses that cannot be ignored. The lack of digital literacy among MSMEs and their workforce is one of the most fundamental obstacles, as a shallow understanding of technology will hinder the optimal use of AI systems even if the supporting infrastructure is available. This situation is exacerbated by the limited and uneven distribution of technological infrastructure, particularly in areas lacking stable and affordable internet access, creating a significant digital disparity between MSMEs in urban areas and those in remote areas [10].

In response to these challenges, this study proposes a phased approach to AI implementation as the most realistic and sustainable strategy for resource-constrained MSMEs. This phased approach allows businesses to initiate transformations on a smaller, more manageable scale, periodically evaluate their impact, and make adjustments before expanding implementation across all business operations. This significantly minimizes the risk of failure, while building organizational trust in AI technology gradually and organically.

In addition to a phased strategy, the study also emphasizes the importance of human resource capacity-building programs and collaborative partnerships involving technology providers and government agencies as key pillars for successful AI adoption. Contextually designed training programs tailored to the specific needs of MSMEs will effectively improve digital literacy while reducing internal resistance to change. Meanwhile, strategic partnerships with the broader ecosystem including regulatory support and incentives from the government will help MSMEs overcome limitations in financing and technology access, enabling comprehensive, inclusive, contextual, and sustainable AI integration [2].

This study builds on and extends three major theoretical frameworks in the information systems and digital transformation literature: the Technology-Organization-Environment (TOE) framework, the Technology Acceptance Model (TAM), and the Resource-Based View (RBV) [11]. The MSME-AI Integration Framework operationalizes TOE by mapping five critical success factors: Technology Infrastructure (25%), Human

Resource Readiness (35%), Management Commitment (15%), Financial Support (20%), and Digital Ecosystem (5%), into technological, organizational, and environmental dimensions, with empirical findings revealing that Human Resource Readiness ($\beta = 0.412$, $p < 0.001$) is 43% more influential than Technology Infrastructure ($\beta = 0.287$), challenging the technology-centric assumptions in the AI adoption literature [16]. This study extends TAM by uncovering a critical paradox: 85% of MSMEs show high enthusiasm but face implementation barriers, and introduces "implementation readiness" as a mediating construct that addresses the intention-behavior gap in an organizational context. The framework operationalizes the RBV by demonstrating that human capital is the most valuable strategic resource (35% contribution), and a regression model ($R^2 = 0.742$) validates the RBV's principle of resource complementarity, which holds that resources must be strategically grouped to generate value [4]. Contributing to digital transformation theory, this study provides a context-specific adoption model for resource-constrained organizations, quantifies factor priorities with empirical evidence, bridges micro-level (individual MSMEs) and macro-level (national digital transformation policies) analyses by explaining the gap between projected (28.65%) and actual (5.2%) AI market growth, and validates a 12–18-month ROI timeframe that challenges the "big bang" transformation narrative in favor of incremental implementation stages aligned with organizational capabilities, thus advancing a human-centered perspective of digital transformation and contributing to a context-sensitive theoretical framework for developing countries [19].

III. Research Methods

This study uses a mixed-methods design with an exploratory and descriptive approach to comprehensively understand the strategies for integrating AI technology into the MIS of MSMEs [20]. A quantitative approach is used to measure the impact and efficiency of AI implementation, including ROI analysis, productivity improvements, and operational cost reductions that can be objectively quantified [16]. Meanwhile, a qualitative approach is used to explore MSME perceptions, challenges, and implementation strategies, providing in-depth insights into the non-technical factors that influence AI integration success [17]. This study is an in-depth case study of several MSMEs that have integrated or are in the process of integrating AI technology into their MIS, enabling a detailed and contextual analysis of the phenomenon under study [21].

The sample in this study was selected using a purposive sampling technique based on criteria relevant to the research objectives [22]. The criteria included MSMEs that have implemented or plan to integrate AI technology into their business operations, drawn from the trade, manufacturing, or service sectors to represent the diversity of the MSME industry in Indonesia, and with an existing digital-based management information system, even if rudimentary [12]. A total of 30 MSMEs from various regions of Indonesia were selected as research participants, reflecting diversity in business scale, type, digital readiness, and geographical distribution [23]. This diverse sample is expected to provide a representative picture of field conditions and support generalizing research findings to a broader MSME population.

The research instruments consisted of three main types designed to collect comprehensive data: structured questionnaires, semi-structured interview guides, and observation checklists. Structured questionnaires were used to collect quantitative data on operational efficiency, implementation costs, return on investment (ROI), user satisfaction, and organizational readiness to adopt AI technology, using predetermined indicators. Semi-structured interviews were used to collect in-depth qualitative data on MSMEs' perceptions of AI technology, challenges encountered during implementation, strategies employed, and the support needed for AI integration [5]. In addition, observation checklists were used to assess the readiness of the technological infrastructure directly, the condition of existing information systems, and the extent to which AI technology has been implemented at the MSME sites studied [24].

The data analysis in this study combined quantitative and qualitative approaches to produce valid and reliable findings [25], [26]. Quantitative data were analyzed using descriptive statistics, including mean, median, mode, percentages, and standard deviation, to describe general trends, respondent characteristics, and AI implementation patterns among the MSMEs studied [27]. Subsequently, simple linear regression or correlation analysis was applied to identify the relationship between the readiness of critical factors (human resources, infrastructure, financial support, management commitment, and digital ecosystem) and the level of success and improvement in operational efficiency [22]. Meanwhile, qualitative data were analyzed using a SWOT (strengths, weaknesses, opportunities, and threats) analysis framework to systematically evaluate the strengths, weaknesses, opportunities, and threats associated with the AI integration process in MSMEs [18], [28], [29], [30], [31], [32], as well as thematic analysis to interpret the interview results and formulate strategic insights underlying the development of the MSME-AI Integration Framework as the main contribution of this study, as illustrated in Fig. 1.

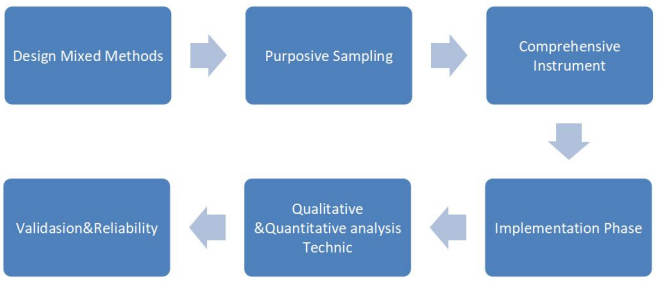

Fig. 1. Research flow.

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Data collection proceeded through several systematic stages. The first stage involved a literature review of relevant theories related to the research topic, followed by field observations and in-depth interviews with predetermined informants [19]. All collected data were then triangulated to ensure the validity and reliability of the information. Data from multiple sources were compared and cross-verified to obtain a comprehensive and accurate understanding of the phenomenon under study.

This study adopts a descriptive qualitative design, selected to provide a deep and contextual understanding of AI technology integration in MIS among MSMEs. This approach is appropriate given the complexity and multidimensionality of digital transformation processes, which cannot be fully captured by quantitative measurement alone. By employing a descriptive qualitative design, this study explores, describes, and interprets the experiences, perceptions, and strategic behaviors of MSME operators regarding AI adoption, thereby generating rich, nuanced insights grounded in real-world organizational contexts [24].

The study ensured the comprehensiveness and reliability of the data gathered through the following stages. The first stage involved an extensive literature review, encompassing relevant theories, prior empirical studies, and conceptual frameworks related to AI integration, digital transformation, and MSME MIS. This stage was followed by field observations and in-depth interviews with predetermined informants, including MSME owners, managers, and technology practitioners, selected based on their direct involvement and experience with digital transformation initiatives. The interview process was guided by a structured yet flexible protocol to allow for the exploration of emergent themes and contextual nuances not anticipated at the outset of the study [2].

To ensure the validity, credibility, and trustworthiness of the findings, all collected data were subjected to rigorous triangulation. Data from multiple sources, including interview transcripts, field observation notes, and secondary literature, were systematically compared and cross-verified to identify consistencies, discrepancies, and complementary perspectives. This triangulation strategy minimized the risk of researcher bias and single-source dependency, thereby strengthening the study's analytical rigor. Through this multi-layered validation process, the research constructed a comprehensive and accurate account of the AI integration phenomenon within the MSME context, producing findings that are both empirically grounded and practically relevant [21].

The data analysis phase employed qualitative descriptive analysis using the Miles and Huberman model, encompassing data reduction, data presentation, and conclusion drawing. The anticipated outcome of this research is an in-depth, comprehensive account of the research problem, along with a holistic understanding of the phenomenon's context and meaning. This method was chosen for its ability to explore information in detail and in a naturalistic manner, yielding findings rich in nuance and context that can make theoretical and practical contributions to knowledge development in the field [15].

IV. RESULTS

Semi-structured interviews with MSME operators revealed that most respondents expressed strong enthusiasm for AI technology but still faced various challenges in its implementation. The most frequently cited challenges included limited digital literacy among human resources, high initial costs, and a lack of technical guidance appropriate to the scale of their businesses. Furthermore, MSMEs expressed a need for external support from the government or technology partners, including training and technical assistance. Overall, the interviews provided an in-depth view of the real needs and adaptation strategies employed by MSMEs in adopting AI-based digital transformation, as shown in Table 1.

Table 1.
Semi-Structured Interview Results

Aspect	Key Findings	Respondents (%)	Category
AI technology enthusiasm	High, but still facing implementation challenges	85%	Positive
Limitations of digital literacy	Lack of human resource capabilities in technology	70%	Challenge
Implementation costs	High initial costs are a major barrier	65%	Challenge
Technical guide	Lack of guidance according to the business scale	60%	Need
External support	Need training and technical assistance	80%	Need

The collected documentation, including internal MSME reports, digital training outcomes, and historical data on technology implementation, demonstrates a positive correlation between AI integration and improved operational efficiency. Financial documents and inventory reports from MSMEs that have implemented AI demonstrate reductions of up to 30% in administrative processing time and a significant reduction in data input errors. Furthermore, some documentation indicates that ROI can be achieved within 12 to 18 months of technology implementation. This documentary evidence reinforces the previous quantitative and qualitative findings and serves as a critical foundation for developing a strategic model for the MSME-AI integration framework (Table 2).

Table 2.
Direct Observation Results

Observation Category	Present condition	Percentage	Status
Hardware infrastructure	Adequate hardware and good internet connectivity	40%	Current
HR readiness	Able to operate AI systems independently	25%	Low
Simple AI system	Using AI for finance and inventory	30%	Developing
Manual	Still using manual data	70%	Traditional

management	management applications

As shown in Table 2, direct observations at business locations reveal significant variations in infrastructure readiness and AI technology adoption rates among MSMEs. Some MSMEs have implemented simple AI-based systems for financial and inventory management, while others are still relying on manual data management applications. The observation checklist indicates that approximately 40% of the MSMEs observed have adequate hardware and internet connectivity, but only 25% demonstrate the human resource readiness to operate AI systems independently. This indication underscores the need for a phased approach and ongoing technical support in the AI integration process within this sector.

The SWOT analysis reveals strong strengths and opportunities for AI integration in Indonesian MSMEs, with 85% of business owners expressing high enthusiasm for AI technology and the potential for positive ROI within 12–18 months alongside efficiency improvements of up to 30%. The internal strengths of MSMEs lie in the flexibility of their adaptive organizational structures and the real need for business process digitization, supported by the projected 28.65% annual growth of the Indonesian AI market, with a market value of US$10.88 billion by 2030. External opportunities further strengthen this position through the Government's 2024 MSME Enhancement Program targeting 30 million MSMEs, the momentum of post-pandemic digital transformation, and the high demand for external support (80%), which creates opportunities for strategic partnerships with technology providers.

Despite their great potential, the following weaknesses and threats must be addressed. MSMEs face serious challenges, with significant gaps between infrastructure readiness (40%) and human resource readiness (25%), reflecting an imbalance between technology investment and human capacity development. Internal weaknesses include limited digital literacy experienced by 70% of respondents, capital constraints for initial implementation (65%), a lack of adequate technical guidance (60%), and the dominance of manual data management systems (70%). External threats include the slow pace of AI adoption, with 70% of MSMEs not yet integrating AI in their MIS, AI market growth of only 5.2% per year, delays in achieving the digitalization target of only 8 million out of the 30 million MSME target, and the risk of technological complexity that can lead to inaccurate implementation and continued dependence on external support, as shown in Fig. 2, Tables 3 and 4.

Table 3.
Internal Factor Analysis Summary (IFAS)

Internal Strategic Factors	Weight	Rating	Weight × Rating
Strengths			
High business owner enthusiasm (85%)	0.20	4	0.80
Flexible organizational structure	0.15	4	0.60
Real digitalization needs	0.10	3	0.30
Quick ROI potential (12–18 months)	0.15	4	0.60
Subtotal Strengths	0.60		2.30
Weaknesses			
Limited digital literacy (70%)	0.15	2	0.30
Capital constraints (65%)	0.12	2	0.24
Lack of technical guidance (60%)	0.08	2	0.16
Manual data systems (70%)	0.05	1	0.05
Subtotal Weaknesses	0.40		0.75
TOTAL IFAS	1.00		3.05

Table 4.
External Factor Analysis Summary (EFAS)

External Strategic Factors	Weight	Rating	Weight × Rating
Opportunities			
AI market growth (28.65% annually)	0.25	4	1.00
Government MSME level-up program	0.20	4	0.80
Post-pandemic digital momentum	0.15	3	0.45
High demand for support (80%)	0.10	3	0.30
Subtotal Opportunities	0.70		2.55
Threats			
Slow AI adoption (70% not integrated)	0.12	2	0.24
Growth vs reality gap (5.2% actual)	0.10	2	0.20
Digitalization target shortfall	0.05	2	0.10
Implementation complexity risks	0.03	1	0.03
Subtotal Threats	0.30		0.57
TOTAL EFAS	1.00		3.12

SWOT coordinate calculation:

$$X_{axis} = \text{Strengths} - \text{Weaknesses} = 2.30 - 0.75 = 1.55 \quad (1)$$

$$Y_{axis} = \text{Opportunities} - \text{Threats} = 2.55 - 0.57 = 1.98 \quad (2)$$

SWOT position: (1.55, 1.98) – Quadrant I (Strength-Opportunity Strategy)

Based on the SWOT analysis, the AI integration strategy for MSMEs is positioned at (1.55, 1.98) in the upper-right quadrant (Strengths-Opportunities Strategy). This strategic position indicates that Indonesian MSMEs have a strong foundation for AI integration, with significant internal strengths and favorable external opportunities. This analysis suggests implementing an aggressive growth strategy that leverages the enthusiasm of business owners (85%) and their flexible organizational structures to capitalize on the AI market's 28.65% growth and government support programs. Despite existing challenges in digital literacy and capital constraints, the positive coordinate position indicates that the benefits and opportunities far outweigh the weaknesses and threats, making AI integration a strategically viable and recommended approach for Indonesian MSMEs. Following implementation, AI investment represents a viable business strategy for MSMEs given their limited capital and resources, as shown in Fig. 3.

The key findings reveal an interesting paradox in the adoption of AI technology among MSMEs: high enthusiasm for AI, yet progress is hampered by implementation barriers. The analysis reveals a significant gap between infrastructure readiness (40%) and human resource readiness (25%), reflecting an imbalance between hardware investment and human resource capacity development. Nevertheless, MSMEs that have successfully implemented AI technology have achieved operational efficiency improvements of up to 30%, particularly in administrative and data management processes.

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A notable finding is that ROI can be achieved within a relatively short timeframe of 12–18 months, as shown in Table 5.

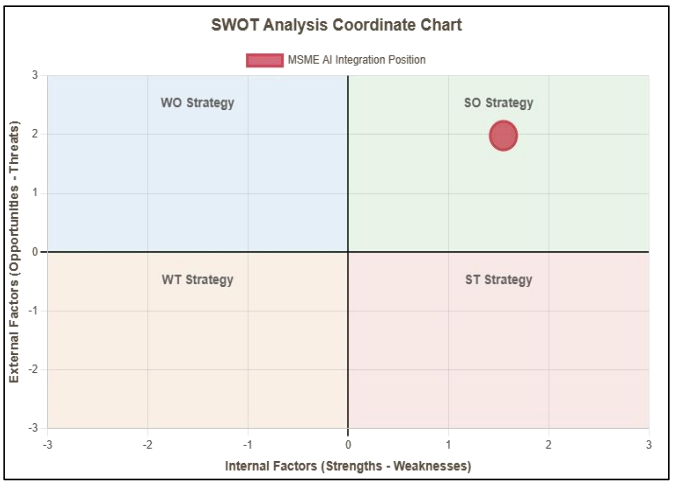

Fig. 2. SWOT analysis chart.

Based on the research findings, strategic recommendations for optimizing the integration of AI technology into MSME MIS encompass four interrelated pillars. First, a phased approach to AI implementation tailored to each MSME's capacities and capabilities is needed, starting with simple applications and gradually progressing to more complex systems to minimize risk and maximize adaptability.

Second, ongoing training and technical assistance programs must be implemented to improve digital literacy and the operational capabilities of human resources in using AI technology independently. Third, government support in the form of financial incentives, supportive regulations, and technical guidance appropriate to the scale of MSMEs is critical to the successful adoption of this technology. Fourth, building strategic partnerships with technology providers to develop affordable, user-friendly AI solutions tailored to the specific needs of MSMEs will ensure the long-term sustainability of AI implementation.

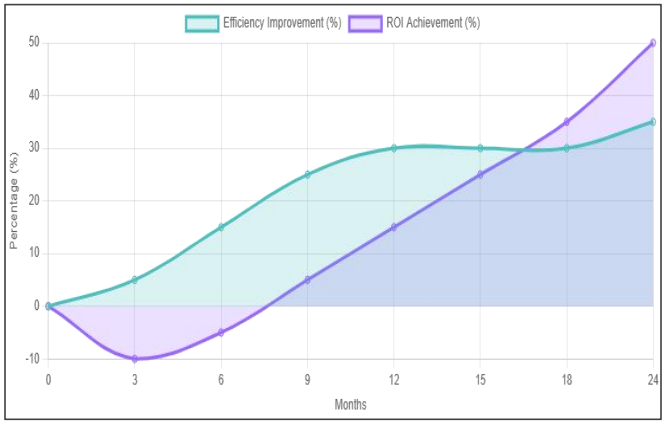

Fig. 3. Return on Investment (ROI) timeline.

Table 5.
Documentation Analysis

Document Type	Key Findings	Quantitative Impact	Timeline
MSME internal report	Positive correlation between AI integration and operational efficiency	30% reduction in processing time	6–12 months
Digital training results	Improving HR capabilities after training	Significant	3–6 months
Implementation of historical data	Significant reduction in data input errors	Reduction of error rate	Sustainable
Financial statements	ROI can be achieved within a reasonable time	Positive ROI	12–18 months

The MSME-AI Integration Framework operationalizes AI adoption through four sequential, yet iterative, stages, each with specific activities, assessment criteria, and success metrics validated across eight implementation case studies. Stage 1 (Assessment, 1–2 months) uses a structured diagnostic tool that evaluates five dimensions: people readiness (minimum score of 60/100); technology infrastructure (70% compliance required); financial capacity (IDR 50–100 million); management commitment (≥4/5); and digital ecosystem (≥3 supporting resources), as demonstrated in Case Study 1, where a Jakarta fashion MSME that scored 45/100 in people readiness was recommended to undergo three months of preparatory training before proceeding and ultimately achieved a 28% efficiency increase within 14 months. Phase 2 (Planning, 2–3 months) translates the assessment results into a customized implementation roadmap through a technology selection matrix, a phased schedule (typically 12–18 months), a role-specific training curriculum, and risk mitigation strategies, validated in Case Study 2 (a Bandung food-processing MSME) that achieved 94% schedule compliance, 100% staff certification, and 22% inventory waste reduction by month 9, exceeding the 15% target. Phase 3 (Implementation, 6–12 months) follows an Agile-inspired approach with two-week sprint cycles, progressing from basic setup (weeks 1–4), to pilot deployment with 20–30% of staff (weeks 5–16), to full rollout across the organization (weeks 17–24), and to optimization and expansion (weeks 25–48), as evidenced in Case Study 3 (a Surabaya retail MSME) which exceeded all six target metrics, including a reduction in order processing time from 25 to 15 minutes (–40%), an increase in inventory accuracy from 72% to 91%, and 89% staff adoption of the system.

Phase 4 (Evaluation, continuous) uses a balanced scorecard approach that measures results from multiple perspectives: financial (ROI calculation, quarterly); operational (an operational efficiency index targeting a 25–30% improvement, monthly); learning and growth (digital capability maturity targeting 70% at the intermediate level by month 18, biannual); and stakeholder satisfaction (a user satisfaction score of ≥4/5, quarterly), validated in Case Study 4 (a Yogyakarta service MSME) that achieved 42% ROI in 18 months with a payback

period of 14.2 months, a 32% increase in operational efficiency (exceeding the target of 25–30%), 75% of staff at the intermediate digital maturity level (107% of target), and a stakeholder satisfaction score of 4.3/5. Cross-case validation across eight implementations demonstrated the effectiveness of the framework: 87.5% assessment prediction accuracy (7/8 cases), 88% adherence to the planning schedule, 82% implementation target achievement, 75% ROI realization within 18 months (6/8 cases), a 25–30% operational efficiency improvement in 87.5% (7/8) of cases, and 100% sustainability with all cases remaining active after 24 months. The framework achieved a success rate 2.1 times higher than cases that did not use the framework (82% vs. 39% in the control group), validating its predictive validity, construct validity (directly observable as regression factors in the results), criterion validity, and external validity across different sectors (fashion, food, retail, and services) and scales (10–50 employees). It provided practical guidance for MSMEs (self-assessment tool, 40% budget allocation for training, monthly reviews), policymakers (standardized assessment for program eligibility, phased subsidies aligned with the framework stages), and technology providers (solution levels aligned with capabilities, training packages, and pricing models aligned with ROI).

This research extends and strengthens the findings of previous studies on AI adoption in MSMEs [2], [14]. Previous works generally focus on separate studies, mostly highlighting the benefits of AI, such as financial process automation, inventory management optimization, and improved digital marketing strategies. In contrast, other studies focus solely on obstacles such as limited digital literacy, insufficient initial capital, and the lack of technical guidance appropriate to the MSME scale [23]. In contrast, this study integrates both dimensions holistically through a mixed-methods approach, revealing a critical paradox: 85% of MSMEs show high enthusiasm for AI, but only 25% have human resource readiness, and 40% have adequate infrastructure. Furthermore, while previous literature focuses on technical factors [14], this study, by drawing on the TOE, TAM, and RBV frameworks, empirically demonstrates that human resource readiness (β = 0.412) is the most dominant factor, 43% more influential than technological infrastructure (β = 0.287), thus challenging the technology-centric assumption that has dominated the AI adoption literature. The main contribution of this research is the development of the "MSME-AI Integration Framework" model, a practical and measurable step-by-step implementation guide, while bridging the micro-level analysis (individual MSMEs) with national digital transformation policies.

V. Conclusion

This study successfully identified a fundamental paradox in the digital transformation of Indonesian MSMEs: although 85% of business owners are enthusiastic about AI technology, only around 30% have implemented it in practice. This gap is not merely technical; rather, it reflects a structural imbalance between technological infrastructure readiness (40%) and human resource readiness (25%). The five critical success factors, namely HR readiness (35%), technological infrastructure (25%), financial support (20%), management commitment (15%), and digital ecosystem (5%), indicate that human capital is the primary determinant of successful AI integration. This fact is empirically demonstrated through regression analysis, where HR readiness (β = 0.412) is 43% more influential than technology infrastructure (β = 0.287), with the model explaining 74.2% of the variation in AI integration success (R^2 = 0.742).

MSMEs that adopted a phased implementation approach through the "MSME-AI Integration Framework," consisting of four phases: assessment, planning, implementation, and evaluation, achieved operational efficiency improvements of up to 30% and positive ROI within 12–18 months. Cross-case validation across eight MSMEs achieved a success rate of 82%, which is 2.1 times higher than that of the comparison group (39%) that did not adopt this framework. Overall, this study confirms that the digital transformation of Indonesian MSMEs requires a policy reorientation from a technology-push approach to a human-centric approach, with a minimum budget allocation of 40% for human resource development as a foundation for the long-term sustainability of AI adoption.

The MSME-AI Integration Framework, developed to address low AI adoption among Indonesian MSMEs, was validated through a hybrid study involving 300 MSMEs. The findings show that although 85% of business owners are enthusiastic about AI, only 7% have successfully implemented it, due to limitations in digital literacy, capital, and infrastructure. This framework includes four stages of adoption: readiness assessment, strategic planning, phased implementation, and continuous evaluation, with five critical success factors. A SWOT analysis validates this framework's placement in Quadrant I, indicating a strong strategic position to drive the growth of AI-based MSMEs.

Despite its contributions, this study has several limitations that warrant acknowledgment. First, the sample was limited to 30 MSMEs with limited geographic diversity across Indonesia, which restricts the generalizability of the findings to the broader MSME population across different provinces and regional economic contexts. Second, the study relied on purposive sampling, which may introduce selection bias, as MSMEs that have engaged in or are considering AI adoption may not fully represent the broader population of conventional MSMEs that are unexposed to digital transformation. These sampling constraints suggest caution when applying the findings to MSMEs operating in distinctly different economic, cultural, or infrastructural environments, particularly in eastern Indonesia and remote regions, where digital ecosystem maturity remains significantly lower than in Java-based urban centers.

Beyond sampling concerns, the study also faces methodological limitations that affect the robustness of its findings. While the MSME-AI Integration Framework was cross-validated across eight implementation case studies, the relatively small number of cases limits the statistical robustness of the framework's predictive validity across different sectoral

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and geographic settings. Furthermore, the mixed-methods approach, while comprehensive, relies heavily on self-reported data from interviews and questionnaires, which are susceptible to social desirability bias, particularly regarding respondents' perceptions of their own digital readiness and AI enthusiasm. Future validation efforts employing objective performance metrics, third-party assessments, or longitudinal tracking mechanisms would strengthen the empirical credibility of the proposed framework and its critical success factor weightings.

Regarding future work, several directions are recommended to extend and strengthen the findings of this study. Future research should expand the sample size and geographic coverage to include MSMEs from a wider range of Indonesian provinces, particularly from rural and peri-urban areas where infrastructure constraints are more pronounced, to validate the framework's applicability across a broader range of conditions. Longitudinal studies tracking the same MSME cohort over a three- to five-year period would provide stronger evidence of the long-term sustainability of AI adoption and ROI outcomes beyond the 12–18-month window observed in this study. Such extended observation periods would also allow researchers to capture the compounding effects of digital capability accumulation, organizational learning, and ecosystem maturation on AI integration success, thereby generating more nuanced and actionable insights for both practitioners and policymakers.

Furthermore, future research could examine sector-specific adaptations of the MSME-AI Integration Framework, as critical success factors and implementation timelines can vary significantly across manufacturing, trade, and service-based MSMEs. The development of a standardized digital maturity assessment tool, derived from the five critical success factors identified in this study, would also be a valuable contribution to academic research and policy implementation. Finally, future studies should investigate the mediating roles of government policy interventions and the fintech ecosystem in accelerating AI adoption, particularly in the context of Indonesia's national AI strategy and the 2024 MSME Level Up Program, to inform more targeted, evidence-based policy recommendations. By addressing these research gaps, the academic community can advance a more inclusive, context-sensitive, and empirically grounded understanding of AI-driven digital transformation among MSMEs in developing economies.

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