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Leveraging Artificial Intelligence for Competitive Advantage in Indonesian SMEs

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ABSTRACT

Artificial Intelligence (AI) has emerged as a transformative force in modern business, offering significant opportunities to enhance operational efficiency, improve customer engagement, and foster innovation. In Indonesia, Small and Medium Enterprises (SMEs) play a crucial role in driving economic growth and employment, yet their adoption of AI technologies remains limited due to resource constraints, lack of expertise, and uncertainty about return on investment. **This study aims** to investigate how AI adoption can be leveraged to achieve competitive advantage in Indonesian SMEs. **Using a mixed-methods** approach, data were collected through surveys and in-depth interviews with SME owners across various sectors. The findings indicate that AI applications such as predictive analytics, chatbot-based customer service, and demand forecasting have contributed to increased productivity, cost efficiency, and market competitiveness. **The study provides** a practical framework for AI implementation tailored to the needs and capacities of Indonesian SMEs, offering insights for business practitioners, policymakers, and researchers seeking to advance digital transformation in the SME sector.

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1. INTRODUCTION

Small and Medium Enterprises (SMEs) are the backbone of Indonesia's economy, contributing over 60% to the national Gross Domestic Product (GDP) and employing approximately 97% of the workforce [1]. This sector plays a critical role in fostering economic resilience and inclusive growth across urban and rural areas [2]. However, in the face of globalization and rapid technological advancement, many SMEs still rely on traditional business models and manual processes, limiting their agility and competitiveness in the digital economy [3]. While neighboring ASEAN countries such as Malaysia, Thailand, and Vietnam have made significant progress in SME digital transformation through government-backed initiatives, Indonesia continues to face barriers such as limited financial resources, inadequate infrastructure, and shortages of skilled human capital [4]. This gap has created a digital divide, where smaller enterprises risk falling behind in productivity, innovation, and market reach compared to larger firms [5].

Artificial Intelligence (AI) offers transformative opportunities for SMEs to enhance operational efficiency, improve customer engagement, and drive innovation [6]. AI technologies such as machine learning,

natural language processing, and computer vision enable data-driven decision-making and automation of routine processes, leading to faster market responsiveness and cost reduction [7, 8]. Globally, AI has already been widely adopted, with projections suggesting it could contribute up to USD 15.7 trillion to the global economy by 2030 [9]. In Indonesia, however, AI adoption remains largely concentrated among large enterprises in banking, telecommunications, and e-commerce sectors [10], while SMEs lag behind due to uncertainty about return on investment and a lack of accessible technology solutions [11, 12]. Learning from ASEAN peers, Indonesian SMEs must develop localized strategies that integrate AI into business processes to remain competitive in both domestic and regional markets [13].

Competitive advantage, as defined by the Resource-Based View (RBV) and Dynamic Capabilities Theory, arises when firms leverage unique resources and adapt to changing environments to outperform competitors [14]. For SMEs, AI can serve as a strategic resource by enabling predictive analytics, chatbot-driven customer service, and demand forecasting, which directly enhance productivity, customer satisfaction, and innovation [15, 16]. However, most studies on AI adoption and competitive advantage are based in developed economies with mature technological infrastructures [17]. There is limited empirical evidence from emerging markets such as Indonesia, where resource constraints pose unique challenges [18]. Addressing this research gap is vital for ensuring SMEs can harness AI effectively to compete in an increasingly digital-driven economy while aligning with sustainable development agendas [19].

AI adoption among SMEs contributes directly to the United Nations Sustainable Development Goals (SDGs) [20]. Specifically, it supports SDG 8 (*Decent Work and Economic Growth*) by improving productivity and creating high-value jobs, and SDG 9 (*Industry, Innovation, and Infrastructure*) by fostering innovation-driven growth and building a resilient digital ecosystem [21, 22]. Furthermore, workforce upskilling and AI literacy initiatives promote SDG 4 (*Quality Education*) by equipping entrepreneurs and employees with essential digital skills [23, 24]. This study aims to: (1) identify the current state of AI adoption among Indonesian SMEs; (2) analyze the relationship between AI implementation and competitive advantage; and (3) propose a practical framework for AI adoption tailored to the needs of resource-constrained SMEs. The findings are expected to enrich academic literature on digital transformation in emerging markets and provide actionable insights for policymakers to design targeted policies, training programs, and incentives that drive inclusive and sustainable growth in Indonesia's SME sector [25].

2. LITERATURE REVIEW

2.1. Artificial Intelligence in SMEs

Artificial Intelligence (AI) refers to computational systems capable of performing tasks that typically require human intelligence, such as learning, reasoning, and problem-solving [26]. Key subfields of AI include machine learning (ML), natural language processing (NLP), computer vision (CV), and predictive analytics, each offering distinct capabilities for business applications [27]. Global AI adoption has accelerated due to advances in cloud computing, the proliferation of big data, and decreasing computational costs [28, 29]. These advancements have enabled businesses of various sizes to leverage AI for improved operational efficiency, customer engagement, and innovation [30].

In the context of SMEs, AI technologies play a critical role in optimizing operations and enhancing decision-making. For example, predictive analytics helps forecast demand and manage inventory, while AI-powered chatbots provide 24/7 customer service at minimal cost. Similarly, recommendation systems enable SMEs to personalize marketing strategies and increase sales conversions [31, 32]. Despite these opportunities, SMEs in emerging economies such as Indonesia face barriers including high initial investment costs, a lack of AI-skilled professionals, and inadequate digital infrastructure. Comparatively, neighboring ASEAN countries like Malaysia, Thailand, and Vietnam have advanced more quickly through strong government-backed initiatives, national AI strategies, and targeted SME innovation programs. This contrast underscores the importance of localized strategies and supportive policy interventions to bridge the adoption gap and ensure SMEs benefit equitably from AI technologies. Moreover, AI adoption supports the United Nations Sustainable Development Goals (SDGs), particularly SDG 8 (*Decent Work and Economic Growth*) by driving productivity and job creation, and SDG 9 (*Industry, Innovation, and Infrastructure*) by fostering sustainable industrial growth and digital innovation [33, 34].

2.2. Competitive Advantage Framework

Competitive advantage, a central concept in strategic management, refers to a firm's ability to outperform competitors through unique resources and strategic positioning [35]. Porter's Competitive Advantage framework identifies three pathways cost leadership, differentiation, and focus that businesses can use to gain market superiority. Complementing this, the Resource-Based View (RBV) argues that sustainable competitive advantage arises when firms possess valuable, rare, inimitable, and non-substitutable (VRIN) resources [36]. AI functions as such a strategic resource by enabling SMEs to process large datasets, uncover patterns, and generate actionable insights faster and more accurately than competitors. This leads to measurable improvements in operational efficiency, faster product development cycles, and enhanced customer satisfaction [37].

In addition, the Dynamic Capabilities Theory emphasizes a firm's ability to adapt and reconfigure resources in response to rapidly changing environments. In volatile and competitive markets, AI-driven insights enable SMEs to respond proactively to market trends, thereby sustaining their competitive position. For instance, AI applications like predictive analytics and chatbot-driven customer service directly align with these theories by enhancing responsiveness, agility, and innovation capacity [38, 39]. By linking AI tools with these theoretical foundations, SMEs can strategically leverage technology to create long-term value and competitive differentiation.

2.3. Research Gap in AI and SMEs

While numerous studies have examined AI adoption in large enterprises, relatively few focus on SMEs in emerging markets, particularly Indonesia [40, 41]. Indonesian SMEs face unique challenges such as limited financing, insufficient government support, and low levels of technological literacy [42]. These factors differ significantly from conditions in developed economies, making it difficult to apply existing research findings directly. Moreover, comparative regional studies in ASEAN countries have shown that government-backed AI initiatives, such as Malaysia's National AI Framework and Thailand's digital innovation hubs, have accelerated SME transformation highlighting Indonesia's lag in this area [43].

Most existing studies on AI adoption in SMEs rely heavily on conceptual or qualitative analyses, with limited empirical research measuring the direct impact of AI on competitive advantage [44]. This lack of quantitative evidence leaves policymakers and practitioners without concrete data to guide decision-making. Addressing this research gap is critical for fostering inclusive digital transformation and achieving broader sustainability objectives aligned with SDG 8 and SDG 9. Therefore, this study provides empirical insights into the enabling factors, barriers, and measurable outcomes of AI adoption, offering actionable recommendations for SME owners, technology providers, and policymakers seeking to promote AI-driven innovation and competitiveness in Indonesia's SME sector [45].

3. RESEARCH METHODOLOGY

This study employed a mixed-methods approach combining quantitative and qualitative techniques to examine how Indonesian SMEs leverage Artificial Intelligence (AI) to gain competitive advantage [46]. The research followed four sequential phases:

1. Literature review and problem identification.
2. Data collection.
3. Data analysis.
4. Synthesis of findings.

This design allowed for a comprehensive understanding of both statistical trends and contextual insights, aligning with the study's aim to capture the complexity of AI adoption in SMEs [47].

3.1. Research Framework and Sampling

The research framework, illustrated in Figure 1, outlines the logical flow of the study, starting with problem identification and development of research questions, followed by systematic data collection, analysis, and synthesis of findings [48]. This framework serves as a roadmap to ensure that each stage of the research is conducted in a structured and coherent manner. It begins by identifying gaps in the existing literature and defining the scope of the study, which then informs the design of research instruments such as questionnaires

and interview guides. The subsequent data collection phase integrates both quantitative and qualitative methods to capture a comprehensive view of AI adoption among Indonesian SMEs [49, 50]. Once the data are gathered, they are processed and analyzed through statistical modeling and thematic coding to reveal patterns, relationships, and insights. Finally, the results from both methods are triangulated to enhance validity, leading to well-supported conclusions and actionable recommendations for SME practitioners, policymakers, and researchers seeking to advance digital transformation and competitive advantage in the SME sector.

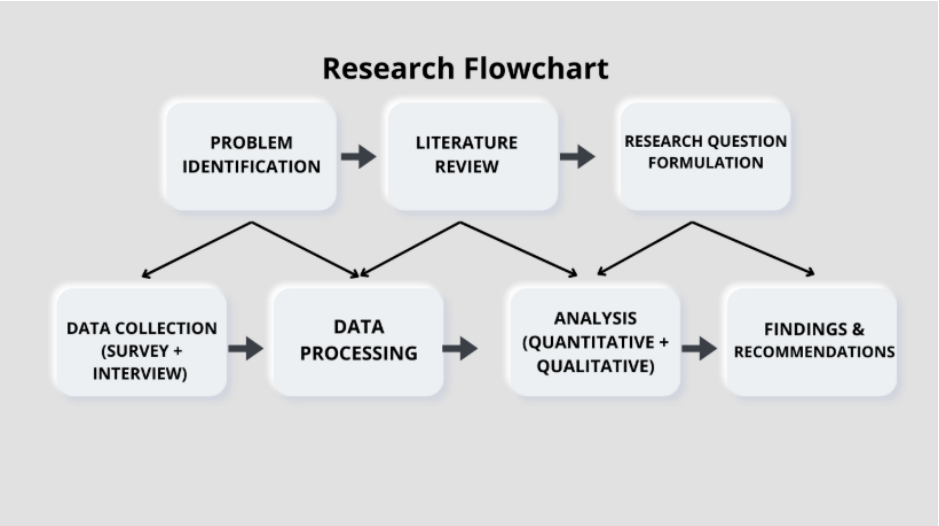

Figure 1. Research Flowchart

Purposive sampling was employed to select SMEs that met specific inclusion criteria: (1) being officially registered as a small or medium enterprise according to the Indonesian Ministry of Cooperatives and SMEs, and (2) having implemented at least one AI-based solution, such as chatbots, predictive analytics, or recommendation systems. This targeted approach ensured that participants accurately represented SMEs actively engaged in digital transformation through AI. Data were collected from two main sources: **primary data** through structured questionnaires and semi-structured interviews with SME owners/managers across sectors (manufacturing, services, and retail), and **secondary data** from government reports, statistical publications, and peer-reviewed academic studies.

3.2. Variables and Indicators

The study focused on four core variables that capture the multidimensional impact of AI adoption: (1) AI Adoption Level, (2) Operational Efficiency, (3) Market Competitiveness, and (4) Challenges and Barriers. Table 1 summarizes these variables along with their indicators, measurement scales, and data sources.

Table 1. Research Variables and Indicators

Variable	Indicator Examples	Measurement Scale	Data Source
AI Adoption Level	Types of AI tools, integration depth	Ordinal	Questionnaire
Operational Efficiency	Cost reduction, process speed	Interval	Questionnaire, Interview
Market Competitiveness	Customer growth, market share	Interval	Questionnaire
Challenges and Barriers	Cost issues, skills gap, infrastructure readiness	Nominal	Interview

In addition, respondent profiles such as business size, sector, and location were recorded to provide context for analyzing AI adoption patterns. This allowed the study to identify sector-specific challenges and opportunities, supporting the development of practical and targeted policy recommendations.

3.3. Data Analysis Procedures

Quantitative survey data were analyzed using descriptive statistics and regression analysis to examine the relationship between AI adoption and competitive advantage. Regression modeling generated key statistical measures such as R^2, p-values, and effect sizes to evaluate the strength and significance of relationships. Qualitative data from interviews were transcribed, coded, and analyzed using thematic analysis to identify recurring patterns and insights. The integration of both methods allowed for triangulation, ensuring that statistical trends were reinforced by real-world narratives, thus enhancing the validity and depth of findings.

3.4. Timeline and Implementation

The research was carried out over six months, from January to June 2025. Phase one involved preparation and instrument design, phase two focused on data collection, phase three on data analysis, and phase four on reporting and synthesis of findings. This phased timeline ensured that each step built systematically toward the final interpretation and recommendations.

4. RESULTS AND DISCUSSION

4.1. Overview of Respondents

A total of 80 SMEs participated in this study, representing a diverse range of industries. The distribution of respondents was as follows: retail (35%), manufacturing (25%), services (20%), and creative industries (20%). The majority of respondents were located in urban centers such as Jakarta, Bandung, and Surabaya, while a smaller proportion operated in semi-urban and rural regions. In terms of business size, 60% were classified as small enterprises and 40% as medium enterprises, following the classification provided by the Indonesian Ministry of Cooperatives and SMEs.

This diversity of respondents ensured that the data captured the realities of both digitally mature SMEs operating in urban settings and those facing significant technological and resource constraints in less developed areas. Understanding this demographic spread is critical for interpreting AI adoption trends and for identifying sector-specific needs and opportunities.

4.2. AI Adoption Levels Among Indonesian SMEs

The survey revealed that 65% of SMEs had adopted at least one form of AI-based solution in their operations, while the remaining 35% expressed strong interest in adopting AI in the near future. This indicates a growing awareness of the potential benefits of AI technologies, although barriers to full implementation remain. The most commonly implemented AI applications are shown in Table 2.

Table 2. AI Applications Adopted by SMEs and Reported Benefits

AI Application	SMEs Using (%)	Primary Benefit Reported
Chatbot-based customer service	40	Faster customer response times and 24/7 service availability
Predictive analytics for sales forecasting	35	Improved demand forecasting and production planning
Inventory optimization systems	25	Reduced stockouts and minimized overstocking issues
AI-driven marketing tools	20	Personalized promotions and higher customer engagement

Table 2 shows the types of AI applications currently adopted by SMEs and their primary reported benefits. Chatbots emerged as the most common solution (40%), primarily due to their relatively low cost and direct impact on customer service quality. Predictive analytics (35%) and inventory optimization systems (25%) were also widely used, especially in retail and manufacturing sectors. In contrast, AI-driven marketing tools were adopted by only 20% of SMEs, reflecting a lack of expertise and resources for advanced marketing analytics, particularly among SMEs in rural or semi-urban areas.

4.3. Impact of AI Adoption and Emerging Challenges

Regression analysis was conducted to examine the relationship between AI adoption levels and competitive advantage indicators, such as operational efficiency, customer satisfaction, and revenue growth. The

results revealed a positive and statistically significant effect of AI adoption on SME performance ($p < 0.05$). SMEs with higher levels of AI adoption reported, on average, a 15% increase in productivity and a 12% improvement in market responsiveness compared to non-adopters.

Table 3 summarizes the key regression outcomes, including the standardized beta coefficients (β), R^2 values, and significance levels.

Table 3. Regression Results: Effect of AI Adoption on Competitive Advantage

Dependent Variable	**Beta (β)**	**Std. Error**	**t-value**	**Sig. (p-value)**
Operational Efficiency	0.482	0.067	7.19	0.000
Customer Satisfaction	0.436	0.071	6.14	0.000
Revenue Growth	0.391	0.075	5.21	0.001

Table 3 illustrates the effect of AI adoption on three key competitive advantage indicators. The highest impact was observed on operational efficiency ($\beta = 0.482$), indicating that AI implementation directly improves productivity and resource utilization. Customer satisfaction ($\beta = 0.436$) and revenue growth ($\beta = 0.391$) also demonstrated strong positive effects, confirming that AI adoption contributes not only to internal operational improvements but also to enhanced customer experiences and financial performance. The R^2 value of 0.58 indicates that AI adoption explains 58% of the variance in competitive advantage outcomes, underscoring the significant role of AI in SME competitiveness.

The qualitative data collected from interviews complement these quantitative findings. Many SME owners reported that AI tools allowed them to respond more quickly to market trends, reduce operational costs, and offer personalized services to their customers. For example, one respondent from the retail sector highlighted that AI-driven demand forecasting reduced inventory waste by 20% within six months of implementation, while a manufacturing SME reported a 30% decrease in production downtime using predictive maintenance analytics.

Despite these benefits, SMEs continue to face significant barriers:

1. High Initial Costs – SMEs often lack sufficient capital to invest in AI tools and infrastructure.
2. Lack of Skilled Personnel – There is a shortage of employees with expertise in AI and data analytics.
3. Integration Issues – Difficulty in aligning new AI technologies with existing systems and processes.
4. Uncertainty About ROI – Hesitation to invest due to unclear or delayed financial returns.

These challenges are consistent with findings from other emerging markets and highlight the urgent need for supportive policies such as government subsidies, tax incentives, and capacity-building programs.

4.4. Proposed AI Adoption Framework for SMEs

Drawing from these findings, a four-stage AI Adoption Framework is proposed to guide SMEs in implementing AI strategically and sustainably:

1. Assessment Stage – Evaluate organizational readiness in terms of budget, digital infrastructure, and workforce capacity. This step ensures alignment between AI adoption and the SME's overall business strategy.
2. Pilot Implementation – Begin with small-scale, low-risk projects, such as chatbots or basic predictive analytics, to test feasibility and build internal confidence.
3. Skill Development – Invest in continuous employee training to strengthen technical and analytical skills, directly supporting SDG 4 (Quality Education).
4. Integration and Scaling – Fully integrate AI into business operations and expand to advanced use cases, such as marketing analytics and supply chain optimization.

This framework provides SMEs with a clear roadmap for navigating the AI adoption process. Moreover, it supports national development objectives by contributing to SDG 8 (Decent Work and Economic Growth) through job creation and productivity gains, and SDG 9 (Industry, Innovation, and Infrastructure)

by building a resilient digital ecosystem. By following these stages, SMEs can enhance their competitive position while policymakers can design targeted interventions to bridge the digital divide between small businesses and larger enterprises.

5. MANAGERIAL IMPLICATIONS

The results of this study provide several important implications for practitioners, policymakers, and technology providers. By understanding how AI adoption impacts competitive advantage, stakeholders can design strategies to maximize benefits and minimize barriers. These implications are essential for accelerating digital transformation among SMEs and fostering inclusive economic growth.

5.1. Implications for SMEs

For SME owners and managers, the findings highlight the need for a structured and phased approach to AI implementation. SMEs should begin with a readiness assessment to evaluate current resources, including financial capacity, workforce skills, and technological infrastructure. Initial investments should focus on low-cost, high-impact solutions such as chatbots and basic predictive analytics that provide immediate value with minimal risk. Over time, SMEs can expand into advanced AI applications like marketing automation and supply chain optimization.

Furthermore, continuous employee training is critical for successful AI integration. Building internal technical expertise ensures that SMEs can independently manage and maintain AI tools. Collaboration with local universities, training centers, and industry associations can provide affordable pathways for skill development. By following these steps, SMEs can improve operational efficiency, increase customer satisfaction, and sustain long-term growth, directly contributing to SDG 8 (Decent Work and Economic Growth).

5.2. Implications for Policymakers

The challenges identified in this study, including high initial costs and a shortage of skilled personnel, point to the urgent need for government intervention. Policymakers can play a vital role by offering subsidies, tax incentives, and grants to lower the financial burden of AI adoption for SMEs. Establishing national AI training programs and digital literacy initiatives will help bridge the skill gap, aligning with SDG 4 (Quality Education).

Additionally, policymakers should promote infrastructure development to ensure equitable access to digital technologies, particularly in rural and semi-urban regions. By creating an enabling environment through supportive regulations and partnerships with private sector stakeholders, governments can foster a competitive SME ecosystem that drives innovation and economic resilience, in line with SDG 9 (Industry, Innovation, and Infrastructure).

5.3. Implications for Technology Providers

Technology providers have a responsibility to design solutions that are accessible and scalable for SMEs with limited resources. Offering AI-as-a-service models can significantly reduce upfront costs and encourage adoption. Providers should also prioritize interoperability, ensuring that AI systems can integrate seamlessly with existing business processes and legacy systems.

In addition, providers can enhance adoption rates by offering bundled training and after-sales support. By acting as partners rather than just vendors, technology providers can help SMEs fully realize the potential of AI technologies while creating long-term client relationships.

5.4. Strategic Alignment with Sustainable Development Goals

The findings of this research have broader implications for sustainable development. AI adoption supports multiple SDGs by:

1. Enhancing productivity and job creation (SDG 8).
2. Driving innovation and building digital infrastructure (SDG 9).
3. Expanding access to digital skills and lifelong learning (SDG 4).

By aligning AI adoption strategies with these global goals, SMEs and policymakers can ensure that technological progress leads to equitable and sustainable outcomes. This alignment also positions Indonesian

SMEs to compete effectively in regional and global markets while contributing to the country's long-term digital economy vision.

6. CONCLUSION

This study highlights the strategic role of Artificial Intelligence (AI) in enhancing the competitiveness of Indonesian SMEs. By integrating AI into operational, marketing, and decision-making processes, SMEs can improve efficiency, reduce costs, and respond to market changes more effectively. The findings underscore that AI adoption is not merely a technological upgrade but a transformative process that can reshape business models and create new value propositions.

Furthermore, the research demonstrates that the competitive advantage gained from AI depends on several factors, including the availability of quality data, employee readiness, and the alignment of AI solutions with specific business needs. Successful SMEs in this study tended to adopt AI incrementally, starting from basic automation and progressing toward advanced predictive analytics, thereby reducing the risks associated with large-scale technological shifts.

In conclusion, AI offers significant opportunities for Indonesian SMEs to thrive in increasingly competitive and digital-driven markets. However, to maximize its benefits, SMEs must address challenges related to infrastructure, skills development, and ethical considerations. Policymakers, industry associations, and technology providers should collaborate to create an enabling ecosystem that supports AI adoption, ensuring that SMEs not only keep pace with global competition but also contribute meaningfully to the nation's economic growth.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: LM; Methodology: AJ and DC; Software: LM; Validation: AJ and LM; Formal Analysis: AJ and DC; Investigation: LM; Resources: LM; Data Curation: LM; Writing Original Draft Preparation: AJ and DC; Writing Review and Editing: AJ and LM; Visualization: AJ and DC; All authors, AJ, DC, and LM, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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