AI-Driven Strategies for Enhancing MSME Sales and Business Sustainability in the Digital Era

Zahra Dinul Khaq*[1], Vivi Kumalasari Subroto[1], Edy Susanto[1]
Email: zahradinul@stekom.ac.id (Z. D. K.), viviks@stekom.ac.id (V. K. S.), edy224324@gmail.com (E. S.)
Orcid: https://orcid.org/0009-0001-3072-5825 (Z. D. Q), https://orcid.org/0009-0005-3141-6249 (V. K. S.), https://orcid.org/0009-0004-7864-2772 (E. S)
[1]*Dept. Management, Universitas Sains dan Teknologi Komputer, Semarang, Indonesia, 50192*

*Corresponding Author

Abstract

This research is motivated by the challenges faced by Micro, Small, and Medium Enterprises (MSMEs) in Indonesia in adopting artificial intelligence (AI) technology to enhance sales and business sustainability. The objective of this study is to examine the impact of AI adoption on the operational efficiency and sales of MSMEs, as well as to identify the challenges encountered in implementing this technology. The research methods used include in-depth interviews with ten MSME owners and a questionnaire survey involving 50 MSME participants. The findings indicate that AI implementation, particularly through the use of chatbots and data analytics for marketing, significantly enhances operational efficiency and sales, with approximately 70% of respondents reporting increased sales. However, the study also identifies key challenges such as high implementation costs, limited technological literacy, and uneven digital infrastructure. The conclusion emphasizes the importance of support from the government and relevant institutions in providing financial incentives and training programs to encourage broader AI adoption among MSMEs.

Keywords*: AI Adoption, Digitalization Challenge, MSMEs, Operational Efficiency, Technological Innovation.*

I. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a vital role in Indonesia's economy. According to data from the Ministry of Cooperatives and Small, and Medium Enterprises (SMEs), MSMEs contribute over 60% of the Gross Domestic Product (GDP) and employ around 97% of the workforce in Indonesia. In today's digital era, MSMEs face significant challenges in remaining competitive in an increasingly digital market. One potential solution that offers great promise for improving MSME performance is the adoption of Artificial Intelligence (AI). This technology can help businesses enhance efficiency, strengthen customer service, and develop more effective marketing strategies. However, the adoption of AI by MSMEs in Indonesia remains relatively low. According to (Arief, 2022), many MSMEs have yet to fully understand the benefits of AI in improving their business performance. Additionally, barriers such as high implementation costs, lack of digital literacy, and limited access to technological infrastructure, particularly in rural areas, are major obstacles to the adoption of this technology by MSMEs.

Several studies have highlighted the significant potential of AI for MSMEs. AI technology not only enhances customer service through the use of chatbots, but it also allows for deeper data analysis to improve marketing strategies. With the help of AI, MSMEs can more effectively

collect and analyze customer data, which can then be used to develop more targeted strategies. In the study by (Bagale et al., 2023), the implementation of AI in the MSME sector was shown to increase operational efficiency by up to 20%, demonstrating the substantial potential of this technology in improving business performance. Meanwhile, research by (Alfarizi et al., 2024) indicated an average sales increase of 15% following the adoption of AI technology by MSMEs, further underscoring AI's positive impact on business growth. In Indonesia, several MSMEs that have adopted AI have reported improvements in productivity and efficiency in supply chain management (Cahyono et al., 2023), which ultimately strengthens their competitiveness in the market. These improvements not only reflect short-term benefits but also contribute to the long-term sustainability of the business.

Despite the proven benefits of AI for MSMEs, there is still a gap in its widespread implementation, particularly in Indonesia. (Suryani et al., 2022) pointed out that limited digital literacy and the lack of technological infrastructure are the main barriers to AI adoption by MSMEs in developing countries. A study by (Elgendy et al., 2022) showed that large companies gain significant benefits from AI implementation, especially in terms of operational efficiency and data-driven decision-making. However, the adoption of AI in the MSME sector is often hindered by resource limitations and a lack of understanding of this technology. (Suryani et al., 2022) identified that MSMEs in developing countries, including Indonesia, face difficulties in adopting AI due to low levels of digital literacy and limited technical support. Meanwhile, (Arief, 2022) highlighted the high costs of AI implementation as a major barrier for MSMEs, which often lack access to adequate funding sources to invest in advanced technologies. (Alfarizi et al., 2024) added that uneven digital infrastructure, particularly in rural areas, slows down AI adoption by MSMEs, which heavily rely on fast and stable internet access. Research by (Sharma et al., 2022) in developed countries, such as South Korea, indicates that supportive government policies, including incentives and training, accelerate AI adoption by MSMEs. However, there has been no in-depth study examining how similar policies could be adapted and implemented in Indonesia to address these various challenges.

This research aims to explore how AI can enhance the sales and business sustainability of MSMEs in Indonesia in the face of digitalization challenges. Additionally, this study will identify the main obstacles to AI adoption and offer practical solutions to overcome the challenges faced by MSMEs, particularly about implementation costs, low digital literacy, and inadequate technological infrastructure. By addressing these challenges, this research is expected to make a significant contribution to the development of government policy strategies and other stakeholders in supporting the digital transformation of MSMEs in Indonesia. This study also aims to provide new insights into how AI technology can be optimally utilized to improve the competitiveness of MSMEs, both in local and global markets. Furthermore, this research will explore the potential of AI in helping MSMEs navigate the increasingly fierce competition in the digital era. Ultimately, the findings of this study are expected to serve as an important reference for policymakers in formulating strategic steps to accelerate AI technology adoption among MSMEs.

II.   LITERATURE REVIEW

A. *Theory of Technological Innovation*

According to (Opazo-Basáez et al., 2022), technological innovation refers to efforts to develop and apply new concepts, methods, devices, or processes aimed at improving or transforming the way a system operates, whether in the form of products, services, or operations. (Farida & Setiawan, 2022) state that technology serves as a driver of change by providing added value

through increased efficiency, quality, and productivity in various sectors, including business, science, healthcare, and education. (Azzaakiyyah, 2023) adds that technological innovation not only introduces new ideas but also enables significant changes in human life. These changes affect how people interact with their environment and open up opportunities for future development. The implementation of new technology often enhances competitiveness within industries, making companies more responsive and adaptive to changing market demands, thus fostering the emergence of new ideas that can support growth across different fields. (Bailey et al., 2022) emphasize the importance of understanding how new technologies are introduced and accepted by individuals or groups. (Giua et al., 2022) explain that communication and adoption processes are critical aspects of the dissemination of these technologies. (Taques et al., 2021) also argue that innovation is not limited to the introduction of new products but also includes the development of production methods, the opening of new markets, and changes in organizational structures, all of which contribute to economic growth and increased productivity.

In the context of AI, this technology enables the automation of various tasks that previously required human involvement and provides the capability to deeply analyze data to understand consumer behavior and market trends. The implementation of AI-driven automation has great potential, particularly in reducing operational costs and increasing efficiency. (Azzaakiyyah, 2023) highlights that one of the most common applications of AI is chatbots, which can provide continuous customer service. These chatbots are equipped with advanced algorithms that enable them to answer common questions, handle complaints, and provide product recommendations tailored to customer preferences. Many MSMEs in the retail sector have utilized chatbots to simplify transaction processes and enhance customer interactions. By using chatbots, MSMEs can reduce the need for additional staff, directly lowering costs associated with salaries and training. Furthermore, chatbots can quickly and accurately handle customer inquiries, ensuring that each question is addressed efficiently. Beyond chatbots, AI is also used in marketing personalization. AI allows companies to analyze customer data to generate recommendations that match individual preferences. Through machine learning algorithms, companies can analyze shopping behavior and consumption patterns, helping MSMEs design more effective marketing campaigns.

For example, if a customer purchases coffee, the AI system can recommend snacks that are often bought together with coffee, based on the purchasing patterns of other customers. This personalized approach helps MSMEs tailor their offers and marketing communications to be more relevant to specific audience segments. In addition to enhancing the customer experience by providing appropriate recommendations, this approach also has the potential to increase sales and customer loyalty. The theory of technological innovation demonstrates that the adoption of new technologies such as AI can have a significant impact on MSMEs. According to (Mahardhani, 2023), the implementation of automation in business processes and personalization in marketing enables MSMEs not only to improve operational efficiency but also to strengthen their marketing strategies. Ultimately, this helps MSMEs enhance their competitiveness in the market.

B. Theory of Sustainability in Business

(Ordonez-Ponce et al., 2021) explain that sustainability is a concept encompassing three key dimensions: economic, environmental, and social. They emphasize the importance of collaboration between stakeholders, such as the business sector and local governments, in effectively achieving sustainability goals. The synergy between these parties is crucial in addressing complex social and environmental challenges while simultaneously creating equitable benefits for all involved. (Baldassarre et al., 2020) also highlight that sustainability in the business world requires the integration of economic, social, and environmental elements. By adopting

sustainable approaches in designing products and services, companies can minimize negative environmental impacts while enhancing social welfare. Collaboration with stakeholders allows companies to play a more active role in achieving broader sustainability objectives. Technology, particularly AI, holds significant potential in supporting business sustainability. AI can be used to project product demand and optimize supply chains, ultimately reducing resource waste and improving energy efficiency. Additionally, AI enhances transparency in business processes. By tracking the origin of raw materials and measuring the environmental impact at each stage of production, companies can not only comply with stringent environmental regulations but also build consumer trust. Today's consumers are increasingly inclined to choose products from transparent and socially responsible companies. Therefore, implementing AI that supports sustainability not only strengthens brand image but also boosts market competitiveness. (Jamwal et al., 2021) add that AI can drive innovation in creating more environmentally friendly products by identifying opportunities to design more efficient and recyclable products.

In the context of energy management, AI serves as a crucial tool in supporting sustainability. AI algorithms enable real-time monitoring and management of energy usage, identifying areas for improvement, and planning the use of renewable energy. As a result, companies can reduce their carbon footprint while also lowering long-term operational costs. On the operational side, AI helps improve environmentally friendly production efficiency by reducing waste and defects in production. AI systems also enable predictive maintenance, ensuring equipment functions optimally and minimizing operational disruptions. (Kulkarni et al., 2024) emphasize that AI also facilitates better collaboration between companies and stakeholders. AI-based platforms allow for real-time sharing of sustainability information between suppliers, customers, and other partners, creating an ecosystem that is more responsive to environmental challenges. This collaboration accelerates the development of innovative and sustainable solutions while strengthening relationships between companies and their communities. AI-based data analysis also provides valuable insights for managers in evaluating the social and environmental impacts of business decisions, aiding in the development of balanced long-term strategies.

Consumer demand for environmentally responsible companies continues to rise, and AI can be a critical tool in meeting these expectations. Companies that adopt sustainability-driven technologies, especially with AI support, will not only strengthen their reputation in the eyes of consumers but also have a positive impact on the industry as a whole. (Ordonez-Ponce et al., 2021) note that businesses that proactively integrate sustainable technologies will be better positioned to compete in a global market increasingly demanding environmentally friendly business practices. However, to maximize the benefits of AI, companies must invest in employee skill development. Employees need to be trained to adapt to evolving technologies so that they can effectively leverage AI in day-to-day operations. From improving operational efficiency to developing more eco-friendly products, AI offers comprehensive solutions that help companies achieve global sustainability goals. With proper implementation, AI enables businesses to make significant contributions to sustainability, yielding positive benefits for both the environment and society worldwide.

C. AI Adoption in MSMEs

The adoption of AI in the MSME sector has garnered significant attention in various studies, both in Indonesia and globally. MSMEs in Indonesia play a vital role in the economy, contributing more than 60% to the GDP. However, research on AI adoption in this sector remains relatively new, particularly when compared to studies conducted on larger enterprises. Early studies indicate that MSMEs face numerous challenges in adopting new technologies such as AI. These challenges include limited financial resources, restricted access to technology, and a lack of

understanding regarding the long-term benefits that AI can offer in enhancing business competitiveness. In operational contexts, AI presents opportunities for MSMEs to process large volumes of data automatically and in real-time. By utilizing technologies such as machine learning and predictive analytics, MSMEs can identify market trends, forecast consumer behavior, and develop more effective marketing strategies. In the realm of digital marketing, AI enables companies to target more specific market segments and create personalized experiences for consumers, ultimately enhancing customer loyalty and increasing sales conversions. The application of AI also has a significant impact on the operational efficiency of MSMEs. According to (Santosa & Surgawati, 2024), AI can be implemented to optimize supply chains and inventory management, forecast product needs, and reduce waste. In doing so, MSMEs can respond more swiftly to market demand fluctuations, thereby minimizing the risk of stockouts or overstocking.

AI also plays a crucial role in customer service. By utilizing chatbots and virtual assistants, MSMEs can provide responsive customer service 24/7 without requiring direct human involvement. This not only enhances the customer experience but also helps businesses reduce operational costs. Globally, the adoption of AI in MSMEs has become a significant focus. Research by (Mukherjee et al., 2024) conducted in developed countries such as the United States and the United Kingdom reveals that while AI holds great potential for improving efficiency and fostering innovation, there remains hesitation among MSMEs to embrace this technology. These concerns generally relate to the high implementation costs, uncertain benefits, and a lack of technical expertise within the workforce. However, some studies indicate that government support and easier access to resources could accelerate AI adoption among MSMEs. Such support enables MSMEs to better optimize data analysis, supply chain management, and more effective digital marketing. (Sharma et al., 2022) affirm that further research is necessary to understand the factors influencing MSMEs' decisions to adopt AI, both in Indonesia and globally. Key elements in this process include perceptions of AI, the level of digital literacy, and access to technological resources.

Moreover, this study will examine the role of government policies and institutional support in influencing the rate of AI adoption in the MSMEs sector. (De Simone et al., 2023) highlight that in countries such as South Korea and Singapore, governments actively promote AI adoption in SMEs through financial incentives and technology training programs.

D. AI Adoption in MSMEs in Developing Countries

The adoption of AI in MSMEs in developing countries has become an increasingly discussed research topic due to its potential to enhance business competitiveness and efficiency. AI enables MSMEs to automate processes, improve customer experiences, and make more data-driven business decisions. (Haleem et al., 2023) argue that AI holds significant potential to ease daily operations in MSMEs by automating tasks such as inventory management, customer service, and market trend analysis. Consequently, AI allows MSMEs to become more efficient and competitive, particularly in rapidly changing markets. However, the challenges faced by MSMEs in developing countries regarding AI adoption are quite complex. According to (Belgaum et al., 2021), the primary barriers often encountered include inadequate technological infrastructure, such as limited access to high-speed internet and uneven digital infrastructure. In many developing countries, especially in rural areas, access to technology remains constrained, impeding MSMEs' ability to adopt AI effectively. These challenges are further exacerbated by the low level of digital literacy among MSME entrepreneurs, which slows and hinders the optimal adoption of AI.

The skills gap is another significant barrier to AI implementation in MSMEs in developing countries. (Ingalagi et al., 2021) highlight that low technological skills among MSME workers

are one of the main obstacles to adopting digital technologies, including AI. The lack of comprehensive training programs on AI technology operations and management prevents many MSMEs from fully leveraging the potential of this technology. To address these challenges, (Anatan & Nur, 2023), recommend broader training programs and initiatives from both government and private institutions to improve digital literacy among MSMEs. Additionally, government policy and regulatory factors play a crucial role in promoting AI adoption by MSMEs. (Lihong, 2023) emphasizes that strong policy support, including fiscal incentives and tax relief, is essential to help MSMEs overcome the financial challenges associated with adopting new technologies. In many developing countries, MSMEs' investment in AI technology is often hampered by limited financial resources. Therefore, policy support that encourages the development of digital infrastructure and provides access to financing is critical in accelerating AI adoption.

Despite these significant challenges, several case studies demonstrate that MSMEs in developing countries that have adopted AI have achieved substantial improvements in operational efficiency and competitiveness. (Rizvi et al., 2021) illustrate that some MSMEs in India have successfully used AI to manage supply chains and expedite production processes, ultimately enhancing productivity and reducing operational costs. This study underscores the vast potential of AI in supporting MSMEs in developing countries, provided that infrastructure, skills, and policy challenges are addressed with the right approach. The overall literature shows that AI adoption by MSMEs in developing countries is essential to enhancing competitiveness in the digital era, but it requires a holistic approach involving infrastructure development, workforce skill enhancement, and government policy support. With the right efforts, AI can become a highly valuable tool in fostering MSME growth in developing countries.

III.   RESEARCH METHOD

This study adopts a mixed methods approach, combining both qualitative and quantitative methods, to provide a comprehensive understanding of the adoption of AI by MSMEs in Indonesia. This approach was chosen to explore the experiences of MSMEs in adopting AI in depth while also measuring the quantitative impact of the technology on business performance. In the selection process, this study employed purposive sampling to select MSMEs that have used AI for at least one year. A total of 50 MSMEs from various sectors, including trade, services, and manufacturing, were involved in this research. The selection criteria included two main aspects. First, the chosen MSMEs must have implemented at least one type of AI technology, such as chatbots, product recommendation systems, or business process automation. Second, the businesses must meet the official classification of MSMEs in Indonesia based on the number of employees and turnover, ensuring that the study's findings are relevant within the national context.

The selection of MSMEs from various sectors aims to understand the variation in AI adoption across sectors with different operational characteristics. For example, in the trade sector, AI is widely used to enhance customer interactions through chatbots, while in manufacturing, AI is more commonly applied for automating production processes and predicting product demand. By including this sectoral variation, the study is expected to produce more general conclusions on AI adoption while still accounting for the differences in industry characteristics. However, it is important to note that the study's findings may have limitations in terms of generalization, particularly when applied to sectors not covered. The varying technical capacities and operational needs in each industry can affect the effectiveness of AI implementation.

Data collection was conducted through two main methods: in-depth interviews and online questionnaires. Interviews were conducted with ten MSME owners selected purposively to

understand their experiences in adopting AI, the challenges faced during implementation, and the perceived impact after using AI. These interviews were conducted either in-person or online, depending on the respondents' preferences, using a semi-structured format that allowed for a deeper exploration of AI adoption in each MSME. On the other hand, the questionnaire was distributed to 50 MSME actors via *Google Forms*. The questionnaire consisted of 20 closed and open-ended questions, covering aspects such as the type of AI technology used, frequency of use, level of AI knowledge, and the impact of implementation on sales growth and operational efficiency. To ensure the validity and reliability of the instrument, the questionnaire underwent expert review and a pilot test with a sample of 10 MSMEs, followed by adjustments based on the feedback received. The internal consistency was assessed using Cronbach's alpha, resulting in a coefficient of 0.82, indicating acceptable reliability. A Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) was used for scoring closed-ended questions, allowing for quantitative analysis of the respondents' perceptions. Additionally, MSMEs were asked to provide quantitative data comparing their business performance before and after adopting AI, including sales growth rates, time efficiency, and operational cost savings.
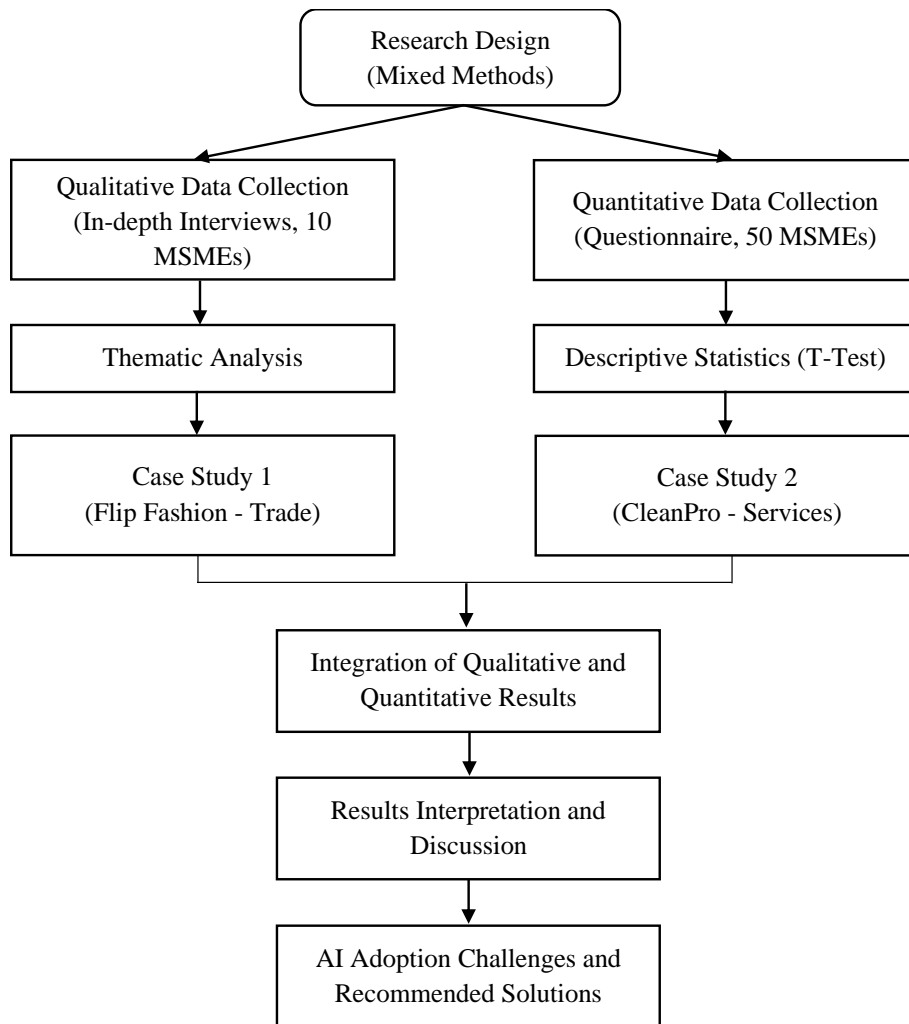

Figure 1. Research Flowchart

The data obtained from this study were analyzed using both qualitative and quantitative approaches. Interview results were analyzed through thematic analysis, aimed at identifying key emerging themes, such as operational efficiency improvement, cost challenges, and the impact of AI on customer service. Respondent answers were then categorized into relevant themes to provide a clearer structure in the analysis. For the data collected through the questionnaire, the

analysis was conducted using the statistical software SPSS. The quantitative analysis began with Descriptive Statistical Tests, which were used to observe the frequency distribution of variables such as the type of AI technology adopted, sales levels, and operational efficiency. Next, Linear Regression Tests were applied to measure the relationship between AI adoption and sales growth, operational efficiency, and business sustainability. Finally, a t-test was conducted to compare the performance of MSMEs before and after AI adoption, focusing on variables such as sales growth and customer satisfaction. The research methodology flow can be seen in Figure 1.

IV. RESULT

A. AI Adoption Rates among MSMEs

Based on a survey of 50 MSMEs that have adopted AI, approximately 68% of respondents reported the active use of AI in their business operations. The most commonly utilized AI technology is chatbots for customer service, with 33% of MSMEs having adopted this technology. In addition to chatbots, 24% of MSMEs use data analytics for marketing activities to enhance the effectiveness of their marketing strategies. Moreover, 18% of the surveyed MSMEs reported using product recommendation systems designed to improve the personalization of customer experiences. Business process automation has also begun to be adopted by 13% of MSMEs, aimed at increasing operational efficiency and reducing manual intervention. Additionally, 12% of MSMEs use machine learning to support deeper market analysis, which can assist in strategic decision-making. Table 1 presents a complete summary of the types of AI technologies adopted by MSMEs and their respective usage percentages. The most commonly utilized technologies, including chatbots for customer service and data analytics for marketing, indicate a focus on enhancing customer interaction and marketing strategies.

Table 1. AI Technology Adoption by MSMEs

AI Technology Type	Usage Percentage
Chatbots for customer service	33%
Data analytics for marketing	24%
Product recommendation systems	18%
Business process automation	13%
Machine learning for market analysis	12%

This data indicates that MSMEs in Indonesia tend to adopt AI technologies that focus on customer interaction and marketing data analysis, such as chatbots and data analytics for marketing. These technologies facilitate faster and more responsive communication with customers, allowing MSMEs to better understand market behavior and preferences. By utilizing chatbots and product recommendation systems, MSMEs can provide a more personalized and effective customer experience. Additionally, data analytics for marketing helps MSMEs develop more targeted strategies, which positively impacts sales growth. In contrast, technologies like machine learning for market analysis and business process automation showed lower adoption rates. Possible reasons for this include the higher complexity and cost associated with implementing these technologies, which may require more advanced technical skills and resources that many MSMEs currently lack. Furthermore, the benefits of machine learning and process automation may not be immediately apparent to smaller businesses, which may prioritize solutions with more direct and visible impacts, such as customer service enhancements. Despite lower adoption, these technologies still hold significant potential for improving operational efficiency and reducing costs, especially as MSMEs gradually enhance their digital capabilities.

B. Impact of AI Implementation on Sales and Operations

The findings of this study reveal that the implementation of AI has a significant impact on improving sales and operational efficiency among MSMEs. According to the survey, 70% of respondents reported an increase in sales after adopting AI technology, while 65% stated that AI has helped enhance the efficiency of their business processes. AI technology enables the automation of various tasks, which not only accelerates workflow but also reduces the potential for human errors in daily operations. Additionally, AI plays a critical role in improving customer experience, with 45% of respondents reporting increased customer satisfaction, particularly due to the capability of chatbots to provide quick and accurate responses to inquiries. AI also offers MSMEs flexibility in adjusting their services in real-time, allowing businesses to be more responsive to market demands. Table 2 provides a comprehensive summary of the impact of AI on MSMEs' sales and operations, showing the crucial role of AI in enhancing business performance. The data demonstrates significant improvements in areas such as customer satisfaction, sales conversion, time efficiency, and operational cost reduction.

Table 2. Impact of AI Implementation on Sales and Operations

Impact Criteria on Sales	Percentage of Respondents
Increased customer satisfaction	45%
Increased sales conversion	25%
Time efficiency in the sales process	15%
Reduction in operational costs	15%

This data demonstrates that AI technology offers direct benefits, particularly in enhancing customer interactions, optimizing sales, and improving operational efficiency. These improvements occur because AI allows businesses to respond to customer needs more swiftly and accurately, especially through the use of chatbots and product recommendation systems. Additionally, AI helps MSMEs manage data more efficiently, enabling deeper analysis and more informed decision-making.

C. T-Test: Comparison of Performance Before and After AI Adoption

To analyze the performance changes of MSMEs before and after AI adoption, a paired T-Test was conducted on two primary variables: sales and operational efficiency. The objective of this analysis is to evaluate whether there is a significant improvement in these variables following the adoption of AI. The paired T-Test was chosen because this method enables a direct comparison between the conditions before and after AI implementation, providing a more accurate understanding of the technology's impact on MSME performance. The results of this test not only offer quantitative data but also indicate the extent of changes in each variable analyzed. Furthermore, this analysis helps identify areas where AI may not have had a significant impact, offering a foundation for further strategy development. Consequently, these findings are expected to provide a robust empirical basis for strategic decision-making in the MSME sector, particularly in navigating the challenges and opportunities of the rapidly evolving digital era.

In the analysis of sales performance before and after AI adoption, the T-Test revealed a significant increase. Average sales rose from 20% before AI adoption to 35% afterward, with a p-value of less than 0.05, indicating that this increase is statistically significant. This improvement demonstrates that AI adoption has a substantial positive impact on MSME sales performance, both in terms of sales volume and the quality of customer service. Table 3 presents a detailed comparison of sales data, offering a nuanced view of the increase in sales across various business categories. This data illustrates how AI adoption can be tailored to the specific characteristics and needs of different sectors. These findings also reinforce the hypothesis that AI not only enhances operational efficiency but also strengthens the competitive advantage of MSMEs in increasingly

competitive markets. As such, AI is viewed as a critical tool for MSMEs to remain competitive in the digital age, which increasingly prioritizes technological innovation.

Table 3. T-Test for Sales Before and After AI Adoption

Variable	Average Before AI	Average After AI	T-Value	P-Value
Sales	20%	35%	3.45	5.002

The interpretation of these results indicates a significant difference in sales after AI adoption, where this increase is not merely coincidental but represents a tangible impact of AI adoption. The p-value of less than 0.05 confirms that this change is statistically significant, validating the conclusion that AI contributes to a substantial improvement in MSME sales. This outcome supports the view that AI directly influences sales growth, whether through optimizing business processes, utilizing data more effectively, or enabling smarter decision-making. Therefore, the adoption of AI is a vital strategy for MSMEs to enhance both efficiency and competitiveness. Overall, these findings provide a solid empirical foundation for advocating AI as an integral part of long-term MSME performance enhancement strategies, both in terms of sales and business sustainability.

In addition to sales, operational efficiency was also analyzed using the paired T-Test, and the results show that AI plays a significant role in improving MSME operational efficiency. Average operational efficiency increased from 30% before AI adoption to 50% afterward, with a p-value of less than 0.05, indicating that this improvement is statistically significant. This increase in efficiency reflects AI's ability to reduce waste, improve productivity, and accelerate operational processes. It also suggests that AI can help MSMEs manage resources more effectively, minimize human errors, and ensure smoother and more structured business operations.

Table 4. T-Test for Operational Efficiency Before and After AI Implementation

Variable	Average Before AI	Average After AI	T-Value	P-Value
Operational Efficiency	30%	50%	4.12	0.001

Table 4 presents a detailed comparison of operational efficiency before and after AI implementation, further supporting these findings and demonstrating AI's positive impact on a broader scale. The interpretation of these results indicates that the implementation of AI plays a significant role in driving substantial changes in the operational efficiency of MSMEs. The considerable increase in efficiency, supported by strong statistical results, demonstrates that AI can deliver a tangible positive impact on various operational aspects of a business. This improvement in efficiency also contributes to reducing manual errors and accelerating workflow, ultimately enhancing overall productivity. Therefore, these findings support the argument that AI is an effective strategic tool for promoting efficiency in the MSME sector. AI implementation is expected to boost the competitiveness and sustainability of MSMEs amid the rapid advancement of digital technology, making it a crucial factor in long-term business strategies for MSMEs aiming to survive and grow in an ever-evolving economic landscape.

D. Case Study of AI Adoption in MSMEs

"Flip Fashion" is an MSME in the trade sector, focusing on the sale of clothing and accessories. Before utilizing an AI-based chatbot, Flip Fashion faced challenges in responding to customer inquiries promptly, negatively impacting customer satisfaction. However, after implementing the chatbot, response times were reduced by up to 80%, significantly improving customer satisfaction levels. Additionally, the company recorded a 15% increase in sales within the first three months following AI implementation. This growth was attributed to the reduced workload on customer service staff, contributing to greater efficiency in handling customer requests. Meanwhile, "CleanPro" is an MSME in the service sector, offering cleaning services. Before adopting AI

technology, CleanPro experienced various issues with labor scheduling, often resulting in overbooking and lack of coordination, which led to decreased customer satisfaction. However, after implementing an AI-based predictive algorithm for schedule management, CleanPro improved scheduling efficiency by 25%, reduced operational costs by 20%, and increased company profitability by 25%.

These case studies demonstrate that AI adoption can be an effective solution for addressing various operational challenges faced by MSMEs, both in the trade and service sectors. The use of technology such as chatbots in the clothing trade has proven to not only enhance customer satisfaction through faster response times but also drive significant sales growth. In the service sector, the use of predictive algorithms for schedule management has optimized operational efficiency and reduced company expenses. This indicates that AI not only aids in process improvement but also has a direct impact on increasing MSME profitability. These findings provide quantitative evidence that strengthens the significant benefits of AI implementation in micro, small, and medium enterprises. Furthermore, the study illustrates that AI has great potential to help MSMEs become more competitive in an ever-evolving market.

E. Challenges in AI Adoption by MSMEs

Although many MSMEs have experienced the benefits of AI implementation, this research also identifies several challenges that hinder the broader adoption of the technology. One of the main barriers is the high cost of implementation. The majority of respondents stated that the initial costs of AI adoption remain an obstacle, particularly for MSMEs in the manufacturing and trade sectors, as they often lack sufficient budgets to invest in this technology. Additionally, limited technical knowledge is also a hindering factor. Most respondents admitted to facing difficulties related to digital literacy. Many MSME actors still lack a sufficient understanding of how AI works and its potential, making it challenging for them to fully utilize it.

Another challenge relates to inadequate digital infrastructure, especially in rural areas. In these regions, many MSMEs report that limited internet infrastructure poses a significant barrier to AI adoption. Restricted access to high-speed internet hampers the use of AI-based applications that require stable and reliable connectivity. Based on these challenges, it can be concluded that although AI offers great opportunities for MSMEs, barriers related to cost, technical knowledge, and infrastructure remain obstacles to its widespread implementation. To address these issues, the study recommends that the government provide financial incentives, such as subsidies or technical assistance, to encourage AI adoption among MSMEs. Additionally, more intensive digital literacy training programs and more equitable internet infrastructure development across Indonesia are necessary.

V. DISCUSSION

The results of the T-Test analysis reinforce the findings that the adoption of AI has a significant impact on increasing sales and operational efficiency in MSMEs. These findings are consistent with the study by (Suryani et al., 2022), which also indicated that AI plays a critical role in enhancing business performance, particularly in the trade and service sectors. This empirical evidence supports the notion that investment in AI technology by MSMEs is an effective strategy for strengthening competitiveness in the digital era. The findings also align with the research by (Santosa & Surgawati, 2024), which revealed that the challenges faced by MSMEs in Indonesia are highly dependent on local conditions, especially regarding the limitations of digital infrastructure in certain rural areas. This contrasts with MSMEs in developed countries like South Korea, where AI adoption is more easily achieved due to adequate infrastructure and strong government policies (Park & Chang, 2022).

This research makes a significant contribution both practically and theoretically. Practically, the findings can serve as a basis for formulating more effective policies to encourage AI adoption among MSMEs. The government and related institutions can use these findings to provide optimal support, such as through technology training and financial incentives. Academically, this study enriches the literature on AI implementation in the MSME sector, particularly in developing countries like Indonesia, where research on AI is still limited. Moreover, this research offers a new perspective on the specific challenges faced by MSMEs in a local context, which can serve as a reference for future studies.

The research also underscores that AI can assist companies in adapting their strategies more flexibly based on shifting market patterns. Thus, AI implementation not only enhances operational efficiency but also provides long-term competitiveness for MSMEs in the digital era.

Although this research shows that AI adoption has a significant positive impact on the operational efficiency and sales growth of MSMEs, there are several limitations to consider. One limitation is the potential bias in respondent selection. The use of purposive sampling to select MSMEs that have implemented AI for at least one year may limit the representativeness of the sample. More successful MSMEs in AI implementation may be more inclined to participate, while those struggling with technology adoption may not be represented, making the results less reflective of the broader MSME population. Additionally, the study's focus on the use of chatbots and AI systems as case studies has limitations. While these technologies have proven effective in enhancing customer interactions and operational efficiency, not all MSMEs have the resources or technical capacity to adopt the same technologies. Differences in technical capabilities and operational needs across various MSME sectors can affect the success of AI implementation. Furthermore, the results obtained from questionnaires and interviews may be influenced by respondents' subjective perceptions of AI's impact, potentially leading to less objective outcomes.

Another limitation is that this research was conducted in the local context of Indonesia, so the results may not be generalizable to other countries with different economic conditions and technological infrastructures. Therefore, further research is needed to examine the experiences of MSMEs in other sectors and regions with different economic and technological characteristics. This will provide a more comprehensive understanding of the dynamics of AI adoption in various contexts. Given these limitations, it is important to conduct a more in-depth evaluation of the policies and strategies that support AI adoption among MSMEs. Additionally, the development of more inclusive research methodologies would greatly help in obtaining a more representative and objective view of AI adoption by MSMEs in the future.

VI. CONCLUSION AND RECOMMENDATION

This research examines the impact of AI adoption on sales growth and business sustainability of MSMEs in Indonesia, as well as the challenges encountered in its implementation. Through a survey involving 50 MSMEs and two case studies, the findings reveal that the use of AI significantly enhances operational efficiency and sales. As many as 70% of respondents reported an increase in sales, while 65% noted improvements in efficiency, particularly in customer service and inventory management. The case studies of Flip Fashion and CleanPro affirm that AI adoption plays a critical role in improving customer satisfaction, with t-test results showing a significant increase in faster and more responsive interactions (p-value < 0.05), indicating that the improvements are statistically significant showing a significant increase in faster and more responsive interactions. Furthermore, operational efficiency improvements were evident in both MSMEs' ability to manage resources more effectively, ultimately supporting their sustainable business growth.

Future research should focus on an in-depth analysis of the long-term impact of AI adoption on MSME performance, particularly in various industrial sectors and regions with differing geographical characteristics. Such studies could provide a more comprehensive understanding of how AI contributes to increased productivity and competitiveness of MSMEs under diverse conditions. Additionally, further exploration of the effectiveness of technology literacy training programs is crucial to ensure that MSME operators possess adequate understanding to optimize the use of AI. An evaluation of government policies supporting AI adoption is also needed to ensure that such policies align with the needs and challenges faced by MSMEs on the ground. Finally, analyzing the experiences of MSMEs that have successfully implemented AI will provide practical insights for other MSMEs seeking to adopt this technology more broadly and effectively.

Conflict of Interest

The authors declare no conflict of interest regarding the publication of this paper.

Acknowledgment

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