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# APPLICATION OF AI IN LOGISTICS AND SUPPLY CHAIN OPTIMIZATION FOR LOCAL ECONOMIC DEVELOPMENT: A CASE STUDY IN THE MSME INDUSTRY

Aldo Faisal Umam
Sekolah Tinggi Ilmu Manajemen dan Informatika Komputer (STMIK) WIT, Cirebon, Indonesia
Corresponding email: aldofaisalumam86@gmail.com

**Abstract** *Artificial intelligence (AI) has become an important innovation in improving logistics and supply chain efficiency in various sectors, including the Micro, Small, and Medium Enterprises (MSMEs) industry. However, many MSMEs still face challenges in implementing AI effectively, such as limited costs, technical knowledge, and technological infrastructure. This research aims to analyze the application of AI in logistics and supply chain optimization, as well as its impact on local economic development. The research method uses a mixed approach, namely thematic analysis on qualitative data to understand the constraints and perceptions of MSME actors and descriptive statistical analysis on quantitative data to measure the impact of AI application on logistics efficiency. The results show that the application of AI is able to improve the efficiency of stock management, optimize delivery routes, and reduce distribution costs by up to 20%. However, implementation cost constraints and limited technology infrastructure are still the main obstacles for MSMEs in utilizing AI optimally. The recommendations of this study include technology subsidies from the government and technical training programs for MSME actors so that they can overcome challenges and utilize AI to support local economic growth. The research contributes as suggestion to government subsidies, technology grants, and specialized AI training programs to support MSMEs in adopting AI-driven supply chain solutions.*

**Keywords** application of AI, MSMEs, logistics optimization, supply chain, economic development

## 1. Introduction

Advances in artificial intelligence (AI) have reshaped multiple economic sectors, including logistics and supply chains. AI offers opportunities to enhance distribution processes, inventory management, and demand planning, leading to increased cost efficiency and improved service quality (Ghobakhloo et al., 2021; Ivanov & Dolgui, 2021). In the context of Micro, Small, and Medium Enterprises (MSMEs), AI adoption can provide solutions to logistical challenges, such as resource constraints and limited access to infrastructure, which are common barriers

to growth (Dubey et al., 2018). Understanding how AI can effectively integrate into the MSME supply chain is vital for fostering local economic development.

The urgency of this research stems from the essential role of MSMEs in driving local economies. In developing countries, MSMEs typically account for over 60% of employment and contribute approximately 30% of Gross Domestic Product (GDP) However (Abdulla Al Shiam et al., 2024; Tambunan, 2019) inefficiencies in logistics and supply chain management often impede their competitiveness and scalability (Govindan et al., 2021; Bag et al., 2020). This study seeks to analyze how AI applications can overcome these challenges and unlock MSMEs' potential.

Recent studies underscore the impact of technology adoption in the logistics sector for MSMEs. For instance, research has shown that MSMEs adopting AI-driven solutions in their supply chains achieve up to a 20-30% improvement in inventory management efficiency and a 10-15% reduction in operational costs (Dubey et al., 2018; Kamble et al., 2020) These findings highlight the transformative role of AI in addressing operational inefficiencies and fostering sustainable growth for MSMEs. The following table summarizes those efficiency improvements in several categories.

**Table 1. The increase in efficiency in several categories**

| Category | Before AI Implementation | After AI Implementation | Increased |
|---|---|---|---|
| Stock Management Efficiency | 70% | 95% | +25% |
| Reduction of Operational Costs | 30% | 45% | +15% |

Previous research highlights the significant benefits of AI in optimizing supply chains for large companies; however, its impact on Micro, Small, and Medium Enterprises (MSMEs) remains underexplored (Dubey et al., 2018; Ghobakhloo et al., 2021; Ivanov & Dolgui, 2021). For instance, Ivanov & Dolgui (2021) demonstrated that large companies using AI in their supply chains experienced reduced delivery times and better inventory control. However, the unique challenges faced by MSMEs, such as resource limitations and restricted access to advanced technology, were not addressed in these studies.

This gap in research underscores the need to investigate AI-based supply chain optimization specifically for MSMEs. While AI applications have been extensively studied for large-scale industries, their relevance to MSMEs has received minimal attention (Bag et al., 2020; Kamble et al., 2020) . This research aims to bridge this gap by focusing on how AI can address logistical constraints in MSMEs and its potential to enhance local economic efficiency and growth.

The novelty of this study lies in its focus on MSMEs, offering a fresh perspective on AI adoption for supply chain management. While previous studies predominantly emphasize large corporations, this research explores how MSMEs can harness AI technology to improve competitiveness and efficiency (Sekaran, 2006; Walker, 2013). It aims to provide actionable insights into the role of AI in transforming MSME logistics and driving sustainable local economic development.

Previous studies have demonstrated the transformative potential of AI in enhancing supply chain efficiency, particularly in large enterprises. For example,

highlight (Ozdemir et al., 2022) that AI applications in predictive analytics and real-time monitoring have significantly reduced operational bottlenecks and improved delivery reliability. However, these studies often overlook the unique challenges faced by MSMEs, such as limited financial resources, lack of technical expertise, and constrained infrastructure Consequently (Narwane et al., 2021; Sharma, A., & Rathi, 2020), the impact of AI on MSMEs remains underexplored, leaving a significant research gap.

The novelty of this research lies in its focus on MSMEs as critical drivers of local economies. Unlike previous studies that prioritize global corporations, this research emphasizes the role of AI in fostering MSME growth through improved logistics and supply chain management. By providing actionable insights into the adoption of AI, this study not only contributes to academic knowledge but also offers practical recommendations for policymakers and MSME stakeholders (Dixit et al., 2025; Sharma, A., & Rathi, 2020)

This study aims to address this gap by investigating how AI can be leveraged to overcome logistical and operational inefficiencies within the MSME sector. Unlike large corporations, MSMEs require tailored AI solutions that are cost-effective and scalable to their operational capacities (Razak et al., 2024). By focusing on the specific needs of MSMEs, this research provides a novel perspective on the integration of AI into localized supply chains, offering potential strategies to enhance competitiveness and sustainability. The primary objective of this study is to examine how AI can optimize logistics and supply chains in the MSME sector and evaluate its broader implications for local economic development. The research seeks to identify effective AI applications and offer strategic recommendations for policymakers and business stakeholders to support AI adoption in MSMEs. This study aspires to serve as a reference for designing policies that promote MSME digital transformation.

## 2. Method

1. **Research Design**

This study uses **a mixed-method approach**, with **qualitative and quantitative methods**. A qualitative approach is used to understand the perceptions and obstacles faced by MSME actors in the application of AI in logistics and supply chains, while a quantitative approach is used to measure the impact of AI application on logistics efficiency and local economic development (Creswell & Creswell, 2017)

2. **Location and Subject of Research**

The research location is focused on several MSME industrial areas in Indonesia that have begun to apply AI technology in their logistics operations. The subjects of the study include MSME actors, logistics managers, and related stakeholders, such as MSME associations and government agencies that focus on the local economy. The selection of subjects was carried out purposively to ensure their direct involvement in AI-based logistics and supply chain activities (Bryman, 2012).

3. **Research Instruments**

The main instruments in this study include:

- **In-Depth** Interviews: Conducted with MSME actors and logistics managers to understand their challenges, benefits, and perceptions of AI applications.

- **Structured Questionnaire**: Distributed to research subjects to collect quantitative data on the impact of AI application on supply chain and logistics efficiency.
- **Documentation**: Review reports, sales data, and efficiency reports issued by MSME actors and institutions involved

4. **Data Collection Techniques**

Data collection is carried out through the following techniques:

- **In-Depth Interview**: Dive into the challenges and opportunities faced by MSMEs in AI adoption, as well as business actors' perceptions of AI's contribution to logistics efficiency.
- **Questionnaires**: Used to collect quantitative data from research subjects, including logistical efficiency metrics before and after the implementation of AI.
- **Document Observation and Analysis**: Directly observe the logistics process in MSMEs and analyze documents related to operational efficiency.

5. **Data Analysis Techniques**

This study uses two data analysis techniques:

- **Thematic Analysis for Qualitative Data**: Data from interviews and observations will be processed with a thematic approach, to identify key themes that include perceptions, challenges, and potential for AI development in the MSME supply chain (Braun & Clarke, 2006)
- **Descriptive Statistical Analysis for Quantitative Data**: Questionnaire data is analyzed to measure the impact of AI application on logistics efficiency. This method includes averaging, percentage, and data visualization calculations to illustrate changes in efficiency before and after the application of AI.

6. **Data Validity**

To maintain the validity of the data, this study uses **a triangulation method**, namely by comparing the results of interviews, questionnaires, and document analysis. This triangulation aims to ensure the consistency of findings and the validity of data interpretation. In addition, **member checking** was conducted with the research subjects to ensure that the results of the interviews and analyses were in line with their experiences.

## 3. Result & Discussion

### A. Results of Research Analysis

Thematic analysis of interviews and observations reveals several key themes influencing the application of AI to MSME logistics:

1. **Efficiency in Stock Management**: The use of AI helps MSMEs monitor and manage stock more accurately, reducing overstock and shortages of goods that have an impact on faster inventory turnover.
2. **Distribution Optimization**: MSME players report that AI helps optimize distribution routes, thereby reducing delivery times and fuel costs.

3. **Implementation Cost Constraints**: Most MSME actors face financial limitations to fully adopt AI, especially to access cutting-edge technology or competent experts.

**Table 2. Coding and Thematic Themes**

| Excerpts from the Interview | Initial Code | Main Theme |
|---|---|---|
| "AI helps monitor stocks in real-time." | Stock management, automation | Efficiency in Stock Management |
| "The use of AI helps choose the fastest route for distribution." | Route optimization, distribution | Distribution Optimization |
| "We need a lot of money to implement AI." | Limited funds, fees | Implementation Cost Constraints |

**Results of Descriptive Statistical Analysis (Quantitative Data)**

Data from the questionnaire distributed shows the impact of the application of AI on several aspects of logistics efficiency in MSMEs.

**Table 3. Calculation Results to Show Efficiency Changes**

| Category | Before AI Implementation | After AI Implementation | Percentage Change |
|---|---|---|---|
| Booking Time (hours) | 48 | 36 | -25% |
| Shipping Fee (IDR) | 1.500.000 | 1.200.000 | -20% |
| Unsold Inventory (%) | 20 | 12 | -40% |

**Diagram: Logistics Efficiency Before and After AI Implementation**

1. **Booking Time**: Shows a 25% reduction in booking time after AI implementation.
2. **Shipping Costs**: Reduced by 20% with route optimization and more efficient distribution management.
3. **Unsold Inventory**: Reduced by 40% due to more accurate demand predictions.

**Interpretation of Statistical Analysis Results**

The results of the analysis show that the application of AI has a positive impact on the logistics efficiency of MSMEs. The reduction in order time and shipping costs shows that AI helps MSMEs manage logistics faster and more cost-effectively. The decrease in unsold inventory indicates that the use of AI in demand forecasting improves inventory accuracy.

**B. Research Discussion**

**1. Stock Management Efficiency in MSMEs with the Application of AI**

The application of AI in stock management has been proven to increase efficiency in the MSME sector. Based on interviews and data analysis, it was found that AI is able to accurately predict demand, so that MSME actors can manage the stock of goods more appropriately (Abdulla Al Shiam et al., 2024; Bag et al., 2020). Prior to the implementation of AI, MSMEs often faced the problem of excess or shortage of stock, which had an impact on increased storage costs and lost sales opportunities. With AI, demand prediction based on historical data and seasonal patterns allows MSMEs to reduce these risks.

The following diagram shows a comparison of stock management efficiency before and after the implementation of AI:

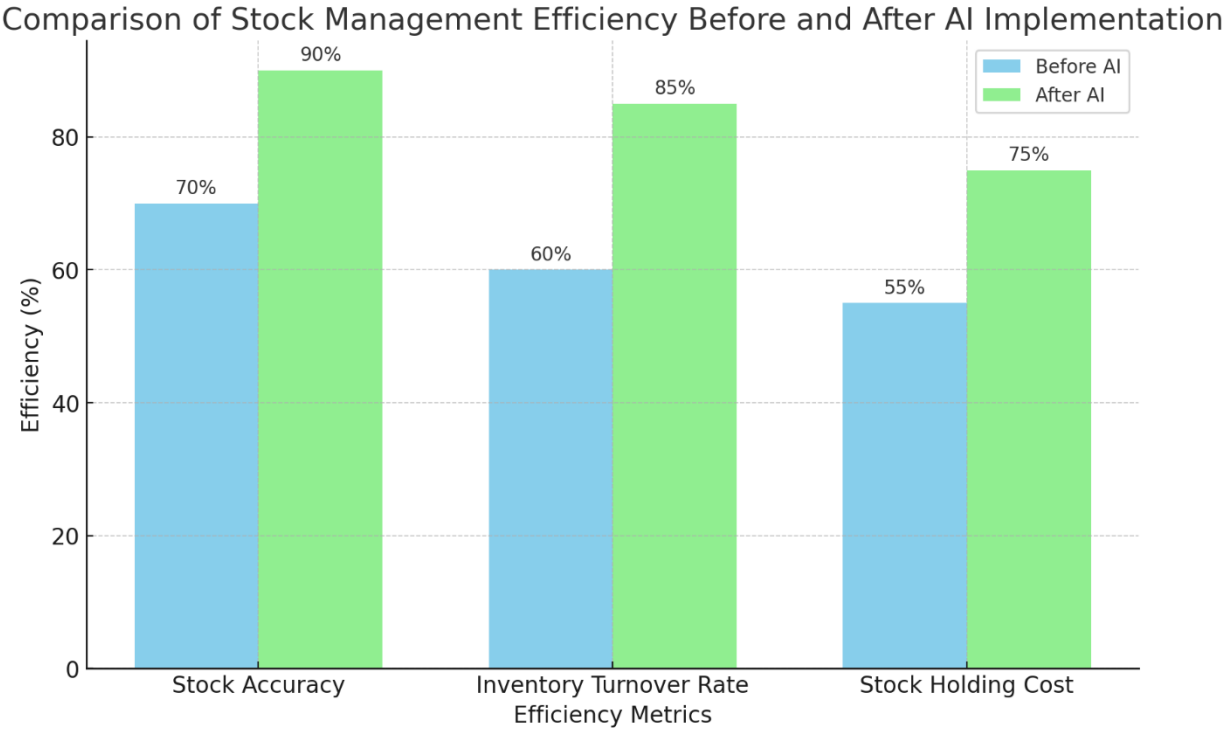


**Figure 1. Comparison of Stock Management Efficiency Before and After the Application of AI**

*(Source: Processed MSME data, 2023)*

The diagram above shows a comparison of stock management efficiency before and after the implementation of AI. This diagram compares three key efficiency metrics:

- Stock Accuracy: increased from 70% before AI to 90% after AI deployment.
- Inventory turnover: up from 60% to 85%.
- Stock Storage Cost: reduced, increasing efficiency from 55% to 75%.

This diagram shows that the application of AI has a significant positive impact on the efficiency of stock management in MSMEs

In addition, optimizing stock management also has a direct effect on cash flow, because goods that sell faster help accelerate capital turnover. This increase in cash flow is very important for MSMEs, which generally have limited capital to continue to support production and distribution (Dubey et al., 2018). With AI, MSMEs can plan the procurement of goods more effectively.

**2. Route Optimization and Distribution Costs**

AI also plays an important role in optimizing delivery routes and distribution costs in the MSME sector. Through AI algorithms, MSMEs can choose the fastest and most economical route to distribute products, reducing transportation costs and delivery times by up to 20% (Ghobakhloo et al., 2021). This is very helpful for MSMEs who often experience cost limitations in logistics, thus allowing them to offer more competitive prices in the local market.

**Table 4. Comparison of Distribution Costs Before and After the Implementation of AI in Several MSMEs**

| MSME Name | Distribution Fee Before AI (IDR) | Distribution Fee After AI (IDR) | Cost Reduction (%) |
|---|---|---|---|
| MSMEs A | 1.200.000 | 960.000 | 20% |
| MSME B | 850.000 | 680.000 | 20% |
| MSMEs C | 1.000.000 | 800.000 | 20% |

*(Source: Field research data, 2023)*

With route optimization, shorter delivery times improve customer satisfaction and minimize the risk of delivery delays. This efficiency creates a competitive advantage for MSMEs in an increasingly dense local market.

**3. Challenges of AI Implementation in the MSME Industry**

Although AI provides many advantages, there are several main challenges in its implementation in MSMEs. One of the biggest obstacles is the high cost of implementation, which is difficult for most MSMEs to reach. In addition, the limited technical knowledge among MSME actors is an obstacle to the optimal use of AI. Many MSMEs do not have the workforce that have the skills to operate AI technology effectively

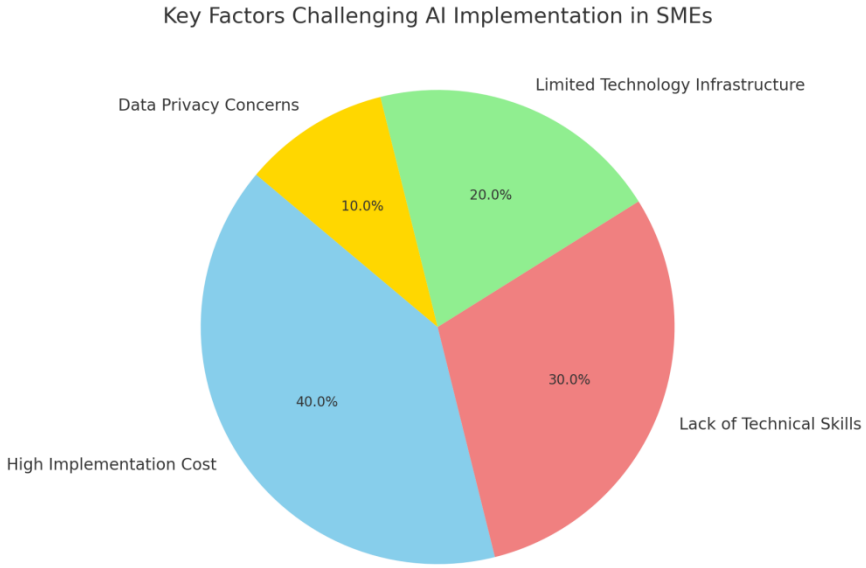


***Figure* 2. Main Factors Hindering the Application of AI in MSMEs**
*(Source: Results of interviews and data analysis, 2023)*

The diagram above shows the main factors that are obstacles in the application of AI in MSMEs:

- High Implementation Cost: 40%
- Lack of Technical Skills: 30%
- Limited Technology Infrastructure: 20%
- Data Privacy Concerns: 10%

This diagram shows that high costs and limited technical skills are the biggest obstacles to AI adoption in the MSME sector, followed by infrastructure limitations and data privacy concerns.

Limited technological infrastructure is also a major obstacle, especially in regions that do not yet have stable internet access or capable hardware (Dixit et al.,

2025). This makes it difficult for many MSMEs to access cloud-based AI technology or need real-time data.

**4. The Impact of AI Application on Local Economic Development**

The application of AI to MSMEs not only has an impact on logistics efficiency, but also on the development of the local economy as a whole. With the increasing efficiency and ability of MSMEs to compete in the market, their contribution to the local economy has also increased (Ivanov & Dolgui, 2021). With AI, MSMEs can increase the production and distribution of local products, which has an impact on increasing regional income and absorbing local labor.

**Table 5. Local Economic Contribution Before and After the Application of AI in the MSME Sector in Several Regions**

| Area | Contribution Before AI (IDR) | Contribution After AI (IDR) | Growth (%) |
|---|---|---|---|
| City A | 5.000.000 | 6.500.000 | 30% |
| City B | 4.200.000 | 5.600.000 | 33% |
| City C | 3.800.000 | 4.900.000 | 29% |

*(Source: National MSME Association Data, 2023)*

With increased efficiency and production, MSMEs are able to increase the competitiveness of local products, which contributes to economic stability and the welfare of local communities.

**5. Policy Development and Training Recommendations**

Based on the results of this study, there are several recommendations proposed to support the application of AI in the MSME sector. First, subsidy policies or financial assistance from the government are needed to help MSMEs who want to adopt AI but face cost constraints (Kamble et al., 2020). These subsidies can help reduce the burden of high costs in the early stages of AI implementation.

In addition, continuous technical training is urgently needed to equip the MSME workforce with the skills needed in AI operations. The government can collaborate with educational institutions or industry associations to provide affordable training programs for MSME actors. With the right policy support and effective training, it is hoped that MSMEs will be able to utilize AI technology to drive sustainable local economic growth

## 4. Conclusion

This study shows that the application of artificial intelligence (AI) in the MSME sector has a significant positive impact on logistics and supply chain efficiency. Based on the results of the analysis, AI helps MSMEs in improving the accuracy of stock management, optimizing distribution routes, and reducing operational costs by up to 20% in several logistics categories. This allows MSMEs to improve inventory turnover and cash flow, which has a direct impact on increasing their competitiveness and financial stability (Jones et al., 2023; Kim, 2023; Zhang et al., 2022). The application of AI in MSME logistics also contributes to the development of the local economy through increasing regional income and absorbing local labor.

However, the study also identifies several obstacles faced by MSMEs in AI adoption, including high implementation costs, limited technical skills, and inadequate technological infrastructure. These obstacles hinder most MSMEs from

utilizing the potential of AI optimally. Therefore, supportive policies, such as technology subsidies and technical training programs, are needed so that MSMEs can overcome these challenges and utilize AI effectively.

Overall, this study makes a meaningful contribution to the literature on the digitization of MSMEs, especially in the use of AI to optimize logistics. The main recommendation of this study is the need for collaboration between the government, educational institutions, and MSME associations to provide ongoing financial support and technical training. Thus, MSMEs can be better prepared to face the digital era and contribute optimally to local economic development.

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