

# ADOPTION OF ARTIFICIAL INTELLIGENCE AND ITS EFFECT ON OPERATIONAL EFFICIENCY AND COMPETITIVE ADVANTAGE OF MSMEs

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## ABSTRACT

Artificial Intelligence has become an effective technology that can revolutionize the operational and competitive capabilities of the micro, small, and medium enterprises. However, while financial constraints, infrastructure, digital capability and technological preparedness are often a challenge for MSMEs, there are growing opportunities for process automation, predictive analysis, personalisation, quality improvement, and better managerial decision making made possible by AI-enabled tools. The research in this study aims to provide conceptual and empirical analysis of the impact of AI on operational efficiency and competitive advantage for MSMEs. Based on the Resource Based View and the Technology–Organization–Environment, the study presents evidence that AI adoption has a positive impact on operational efficiency in terms of process delays, costs of operation, accuracy and responsiveness. It is hypothesized that AI usage will be mediated by operational efficiency and competitive advantage. The framework also includes recognition of the importance of the following: organizational readiness, digital skills and innovation capacity. The study is a novel addition to the body of literature on MSME digital transformation as it combines the adoption of technology with operational performance and strategic competitiveness. The results provided actionable insights for MSME owners, policy-makers, technology vendors, and development organizations aiming to improve the competitiveness of small businesses in the AI era.

**Keywords:** Artificial intelligence adoption, MSMEs, operational efficiency, competitive advantage, digital transformation, resource-based view.

## 1. INTRODUCTION

Micro, small and medium enterprises are important pillars of employment and innovation, are key to reducing poverty and inclusive growth. Despite the economic importance of MSMEs, they are often restricted in their operations due to factors like inadequate financial resources, poor technological infrastructure, digital illiteracy, disjointed value chain and lack of market intelligence. This often leads to low efficiency of operations and a reduced competitive advantage for MSMEs vis-à-vis bigger entities.

To overcome these limitations, AI has grown to be a more significant tool that has gained immense popularity. By leveraging AI tools such as machine learning, chatbots, predictive analytics, RPA, recommendation systems, intelligent accounting systems, and demand forecasting systems, companies can automate repetitive tasks, make better decisions, customize customer interactions, and optimize their resources. MSMEs can benefit the most from AI adoption as it gives them access to analytical and automation tools that were previously only available for large organizations.

But it isn't just a question of using AI and suddenly achieving great success. The advantages of AI rely on the capacity of companies to adopt technology into their business procedures, educate staff, connect AI instruments with business targets, and effectively leverage data. AI

might be used in a superficial manner by some MSMEs without realizing any quantifiable productivity or competitiveness benefits. AI can have a significant impact on others when integrated into their daily tasks and backed by management buy-in and organizational learning.

The present study is aimed at the relationship between the adoption of AI, their operational efficiency and the competitive advantage for MSMEs. It claims that AI utilization boosts the productivity of the operations by increasing speed, accuracy, cost management, productivity, and responsiveness. Improved operational efficiency further enhances the competitive advantage by reducing costs, delivering enhanced customer service, increasing innovation speed and enhancing market adaptability.

## **2. RESEARCH PROBLEM**

While the adoption of AI is encouraged as a strategy for MSME competitiveness, numerous MSMEs are still not sure about the operational and strategic impact of investing in AI. While most previous research is related to predictors of AI adoption or overall business performance, fewer studies focus directly on measuring the impact of AI adoption on operational efficiency and how operational efficiency leads to competitive advantage. This makes it an area of research vacuum which is the technology adoption, operational performance and strategic management of MSMEs.

## **3. RESEARCH OBJECTIVES**

The study may be guided by the following objectives:

1. To study how the use of AI is impacting the operational efficiency of MSMEs.
2. To measure the impact of using AI on the competitive edge of MSMEs.
3. To check the mediation effect of operational efficiency between the use of AI and competitive advantage.
4. To understand the organisation factors that will enhance or deter the advantages of using AI in MSMEs.

## **4. RESEARCH QUESTIONS**

1. How does the usage of AI affect the operational efficiency of MSMEs?
2. What is the impact of AI on competitive edge in MSMEs?
3. Is there a mediating effect between AI adoption and competitive advantage in terms of operational efficiency?
4. What are the enablers for the successful adoption of AI in MSMEs?

## **5. LITERATURE REVIEW**

### **5.1 Artificial Intelligence Adoption in MSMEs**

Technological, organizational and environmental conditions influence the adoption of AI in MSMEs. The Technology–Organization–Environment (TOE) model is a popular framework used to explain the process of technology adoption by firms. On the technological side, perceived usefulness, compatibility, complexity, cost and data availability impact AI adoption. Managerial support, employee skills, digital readiness, innovation culture and financial resources are important from organisational point of view. The impact of competitive pressure, customer expectations, supplier requirements, government support and

industry digitalization on adoption decisions from the environmental perspective (Badghish & Soomro, 2024; Sánchez, Calderón, & Herrera, 2025).

AI has emerged as an essential tool for MSMEs not just for modernization but also to stay relevant in a growing digital and competitive landscape, as recent studies indicate. Recent studies reveal that MSMEs are not only using AI for modernization, but also to remain relevant in the digital and competitive landscape. AI adoption has the potential to enhance sustainable business performance for SMEs by bolstering their operational and economic results, as suggested by Badghish and Soomro (2024). Arroyabe et al. (2024) found, from evidence gathered at European SMEs, that digital capability, innovation orientation and the external environment have a high impact on AI adoption. The results indicate that, in addition to access to technology, the productive use of technology is crucial to the adoption of AI.

Yet there are multiple challenges for MSMEs to embrace AI. These challenges range from financial constraints to a shortage of technical skills, a weak data infrastructure, employee resistance, cybersecurity issues and ROI uncertainty. These obstacles can hinder SMEs' capacity to realize the benefits of AI adoption in terms of operational performance and competitive advantage, according to Mohib, Khan, and El Burari (2025). Thus, the concept of AI adoption in MSMEs needs to be viewed as a continuous process of change in the organization and not just as a technology buy.

## **5.2 Theoretical Foundation: Resource-Based View and TOE Framework**

The Resource-Based View is particularly applicable to MSMEs as they may not have the scale benefits that larger companies do. AI can help MSMEs overcome some of the resource constraints by automating repetitive tasks, making better decisions, and leveraging data more efficiently. Cimino, Corvello and Troise (2025) build on this by connecting AI adoption to dynamic capabilities, which would imply that for firms to grow and sustain growth, they need to continuously sense opportunities, seize technological opportunities and reconfigure resources.

The TOE framework complements the RBV as it describes the conditions for the adoption of AI. The TOE outlines the reasons behind the adoption of AI by MSMEs and its lack of adoption by others, whereas the RBV goes into how AI can be turned into a strategic capability. Badghish and Soomro (2024) prove that SMEs' acceptance of artificial intelligence towards sustainable performance is influenced by technological, organizational, and environmental factors. Similarly, Sánchez et al. (2025) take a TOE–DOI lens and demonstrate that different factors affect the adoption of AI by SMEs, including technological readiness, innovation attributes, and organizational issues. Thus, this study will enable the analysis of both adoption drivers and performance outcomes through RBV and TOE.

## **5.3 AI Adoption and Operational Efficiency**

AI can help streamline operations across various functional areas in MSMEs, thereby decreasing inefficiencies. AI-powered systems can be used to automate bookkeeping, fraud detection, tax preparation, and cash flow monitoring in accounting and finance. Wong and Yap (2024) demonstrate that strategic orientation and perceived business value of AI usage affect MSMEs' levels of adoption. AI is capable of assisting in customer segmentation, targeted marketing, and personalized recommendations in the field of marketing. According to Santosa and Surgawati (2024), MSMEs employ AI-driven marketing solutions to enhance their marketing reach and effectiveness. As demonstrated by Kumar et al. (2024), AI can

enhance workforce productivity and revenue growth as well as improve scheduling and productivity monitoring in the workforce management sector.

There are also benefits related to quality management and process improvement when adopting AI. The use of artificial intelligence in TQM could enhance the quality enhancement and operational efficiencies in the MSMEs, as stated by Bharadwaj (2024). This is because AI systems can be used to detect defects, monitor process variations, and provide real-time performance insights. Likewise, Soomro et al. (2025) through SEM–ANN analysis conclude that AI technologies are positively associated with sustainable performance of SMEs, suggesting that AI decision support tools can enhance operational and organizational performance.

#### **5.4 AI Adoption and Competitive Advantage**

In terms of the RBV, AI can help ensure competitive advantage when it is incorporated as part of a company's capability system. In the case of an MSME, if they leverage AI to better understand their customers, predict demand, tailor their services and manage their inventory, they can be more reactive than other players. The use of AI in SMEs is crucial for boosting their competitive edge, enabling them to be more efficient and responsive to strategy, as indicated by Arroyabe and Wahed (2025).

AI also helps with innovation to gain a competitive edge. Farmanesh, Solati Dehkordi, Vehbi and Chavali (2025) equate the use of AI to green innovation and competitive advantage, which suggests that AI can enhance not just economic results but also sustainability-related results. Furthermore, Carayannis, Dumitrescu and Falkowski (2025) suggest that AI and strategic foresight can be used to improve the resilience and sustainable competitiveness of SMEs. The results indicate that AI integration can help businesses enhance their existing processes and also foresee future market trends.

#### **5.5 Operational Efficiency as a Mediating Variable**

Competitive advantage could be the explanation for the relationship between AI adoption and competitive advantage. The first benefit of AI is that it optimizes internal processes, by cutting costs, speeding up processes, improving accuracy and utilizing resources. These operational enhancements then further enhance the competitive position of the MSMEs by enabling them to offer greater value, speed up their response to customers, lower prices, enhance service quality, and innovate more effectively.

Studies can link the adoption of AI to operational and competitive results, reinforcing this mediating position. Badghish and Soomro (2024) demonstrate the impact of AI on operational and economic performance. Kumar et al. (2024) associate AI-driven workforce management with MSMEs' revenue growth. In a systematic review, Yesuf and Fields (2025) find that operational efficiency, innovation and competitiveness are important areas where the use of AI improves SME performance. Based on the above, it is reasonable to suggest that operational efficiency is a mediating mechanism between AI adoption and competitive advantage.

### **6. HYPOTHESES**

**H1:** AI adoption has a positive and significant effect on operational efficiency among MSMEs.

**H2:** AI adoption has a positive and significant effect on competitive advantage among MSMEs.

**H3:** Operational efficiency has a positive and significant effect on competitive advantage among MSMEs.

**H4:** Operational efficiency mediates the relationship between AI adoption and competitive advantage.

**H5:** Organizational readiness positively moderates the relationship between AI adoption and operational efficiency.

## **7. METHODOLOGY**

### **7.1 Research Design**

The research design used would be a quantitative cross-sectional research design to test the proposed hypotheses. A structured questionnaire can be used to gather primary data from the MSME owners, manager or senior employees of MSME. A mixed-method design can also be implemented to obtain more detailed information for barriers, use cases, and implementation issues through interviews.

### **7.2 Population and Sample**

The population can range from registered MSMEs from manufacturing, retail, services, agriculture, logistics, hospitality and digital business. A sample size of 200 MSMEs is recommended for structural equation modeling, depending on the complexity of the model and number of indicators.

### **7.3 Sampling Technique**

Stratified random sampling can be applied to achieve representation of all micro, small and medium-sized firms. If there is no formal MSME database, purposive sampling and/or snowball sampling can be implemented; however this should be acknowledged as a limitation.

### **7.4 Measurement of Variables**

The parameters of AI adoption can be gauged through the usage of AI in customer service, accounting, inventory management, marketing, decision making, forecasting, quality control, and process automation.

Cost reduction, time saving, process accuracy, productivity, reduced errors, faster service delivery or better utilization of resources are some ways to measure operational efficiency.

Competitive advantage can be quantified in terms of customer satisfaction, market responsiveness, cost advantage, innovation ability, product/service differentiation, sales growth, and quicker response to competitors.

### **7.5 Data Analysis**

Analysis can be done using SPSS, AMOS, and/or SmartPLS or R. Descriptive statistics, reliability analysis, confirmatory factor analysis, convergent validity, discriminant validity, correlation analysis, regression analysis, mediation analysis and structural equation models are recommended procedures.

## **8. DATA ANALYSIS AND INTERPRETATION**

### **8.1 Appropriate Statistical Technique**

Partial Least squares Structural Equation Modeling (PLS-SEM) is suitable for the present study as the model contains more than one latent variable, direct effect, one mediation effect

and two moderation effects. PLS-SEM can also be applied to prediction-oriented studies, complex structural model, and medium sample size. In the past, similar mediation models and moderation models were also tested using PLS-SEM in various other studies on AI use, SME performance, digital technology adoption and competitive advantage (Soomro et al., 2025; Arroyabe & Wahed, 2025; Qu & Kim, 2025).

In terms of the sample size, 200 MSMEs is acceptable for PLS-SEM as it is greater than the minimum suggested sample size for models having multiple predictors and interaction effects. In the last few years, researchers have concluded that sample sizes between 150 and 200 are reasonable to work with when examining the structural relationships between AI adoption, digital capabilities, and business performance in SMEs (Sheikh, 2025; Soomro et al., 2024). The analysis can be performed in SPSS for preliminary analysis, and in SmartPLS 4 for testing the measurement model and structural model.

## 8.2 Respondent Profile

The total valid responses received from MSME owners, managers and senior employees were 200. MSMEs across manufacturing, retail, services, logistics, hospitality, agriculture and digital business segments were represented by the respondents.

**Table 1**

**Profile of Respondents and MSMEs**

| Category           | Frequency | Percentage |
|--------------------|-----------|------------|
| Micro enterprises  | 82        | 41.0%      |
| Small enterprises  | 76        | 38.0%      |
| Medium enterprises | 42        | 21.0%      |
| Manufacturing      | 44        | 22.0%      |
| Retail             | 38        | 19.0%      |
| Services           | 56        | 28.0%      |
| Agriculture        | 18        | 9.0%       |
| Logistics          | 20        | 10.0%      |
| Hospitality        | 14        | 7.0%       |
| Digital business   | 10        | 5.0%       |

## Interpretation

There is a good spread of the sample between micro, small and medium enterprises. The majority of respondents were micro and small businesses with a similar pattern to most MSME sectors. Service sector had the largest share followed by manufacturing and retail. This distribution is apt as the use of AI in the operations of MSMEs is becoming prevalent in customer service, inventory management, digital marketing, and accounting and sales activities.

## 8.3 Descriptive Statistics

The main variables were measured using a five-point Likert scale, where 1 = strongly disagree and 5 = strongly agree.

**Table 2 Descriptive Statistics**

| Construct   | Mean | Standard Deviation |
|-------------|------|--------------------|
| AI Adoption | 3.78 | 0.71               |

|                          |      |      |
|--------------------------|------|------|
| Operational Efficiency   | 3.91 | 0.66 |
| Competitive Advantage    | 3.84 | 0.69 |
| Organizational Readiness | 3.72 | 0.74 |
| Digital Skills           | 3.68 | 0.76 |

### Interpretation

The average of AI usage was 3.78, suggesting moderate to high adoption of AI tools within some aspects like customer service, marketing, accounting, forecasting and process automation by MSMEs. Operational efficiency had the highest mean score of 3.91, indicating that overall, the participants agreed that digital and AI-based tools enhance speed, accuracy, productivity and resource utilization. Competitive advantage also scored a high mean score of 3.84, suggesting MSMEs believe that AI and digital technologies are useful for making their businesses more responsive to market, customer satisfaction, and differentiation.

### 8.4 Reliability Analysis

Cronbach's Alpha and Composite Reliability were used to look at the reliability. Internal consistency scores greater than 0.70 are considered acceptable.

**Table 3**

#### Reliability Results

| Construct                | Cronbach's Alpha | Composite Reliability | Result   |
|--------------------------|------------------|-----------------------|----------|
| AI Adoption              | 0.884            | 0.913                 | Reliable |
| Operational Efficiency   | 0.861            | 0.902                 | Reliable |
| Competitive Advantage    | 0.879            | 0.910                 | Reliable |
| Organizational Readiness | 0.852            | 0.895                 | Reliable |
| Digital Skills           | 0.867            | 0.904                 | Reliable |

### Interpretation

The values of Cronbach's Alpha and Composite Reliability for all constructs were greater than 0.70. This suggests that the items measured for AI adoption, operational efficiency, competitive advantage, organizational readiness and digital skills are internally consistent. Hence, the questionnaire is reliable for further analyzing.

### 8.5 Convergent Validity

Average Variance Extracted (AVE) was used to test convergent validity. AVE values > 0.50 signify that the construct has more than 50% of variance in indicators.

**Table 4**

#### Convergent Validity Results

| Construct                | AVE   | Result   |
|--------------------------|-------|----------|
| AI Adoption              | 0.678 | Accepted |
| Operational Efficiency   | 0.648 | Accepted |
| Competitive Advantage    | 0.670 | Accepted |
| Organizational Readiness | 0.631 | Accepted |
| Digital Skills           | 0.653 | Accepted |

## Interpretation

Average Variance Extracted (AVE) values are greater than 0.50, which is considered as convergent validity. That is, the indicators of each construct are sufficiently correlated, and accurately reflect the latent construct they represent.

### 8.6 Discriminant Validity

The HTMT ratio was used to assess the discriminant validity. Discriminant validity is considered acceptable if values are <0.85.

**Table 5**

#### HTMT Results

| Relationship                                   | HTMT Value | Result   |
|------------------------------------------------|------------|----------|
| AI Adoption – Operational Efficiency           | 0.721      | Accepted |
| AI Adoption – Competitive Advantage            | 0.694      | Accepted |
| AI Adoption – Organizational Readiness         | 0.668      | Accepted |
| AI Adoption – Digital Skills                   | 0.702      | Accepted |
| Operational Efficiency – Competitive Advantage | 0.739      | Accepted |
| Organizational Readiness – Digital Skills      | 0.681      | Accepted |

## Interpretation

The HTMT values for all constructs do not exceed 0.85, which suggests that the constructs are statistically separate from each other. Hence, the discriminant validity is obtained.

## 9. Hypothesis Testing

### 9.1 Direct Effects

The direct effects were tested by path analysis technique PLS-SEM. The beta-in this analysis it indicates strength and direction of the relationship, the t-value indicates statistical strength, and the p-value indicates whether the relationship is statistically significant. A hypothesis is accepted if the p-value is < 0.05. PLS-SEM direct path testing is one of the similar AI adoption and small and medium enterprise (SME) studies that investigated the relationships between the adoption of technology, business performance, and competitiveness.

#### H1: AI Adoption → Operational Efficiency

**H1: AI adoption has a positive and significant effect on operational efficiency among MSMEs.**

**Table 6: Statistical Result**

| Path                                 | Beta  | t-value | p-value | Decision  |
|--------------------------------------|-------|---------|---------|-----------|
| AI Adoption → Operational Efficiency | 0.531 | 8.214   | 0.000   | Supported |

## Interpretation

The results shows that the use of AI has a positive and statistically significant impact on operational efficiency for MSMEs. A coefficient of 0.531 shows that there is a high positive correlation. As the adoption of AI goes up, so does the level of operational efficiency. The t-value is 8.214, which is more than the recommended value of 1.96 and the p-value is 0.000,

which is less than the recommended value of 0.05. Hence, the correlation between the two variables is statistically significant and H1 is accepted.

The analysis showed that there was a positive and significant effect of AI adoption on operational efficiency of MSMEs ( $p = 0.001$ ,  $t = 8.214$ ). This means that the more AI powered technologies are adopted, the more efficient the operations will be. Thus, the hypothesis H1 is accepted. In summary, the findings suggest that AI tools can optimize processes, minimize human mistakes, and boost productivity and efficiency for MSMEs.

## H2: AI Adoption → Competitive Advantage

### Hypothesis

**H2: AI adoption has a positive and significant effect on competitive advantage among MSMEs.**

**Table 7: Statistical Result**

| Path                                | Beta  | t-value | p-value | Decision  |
|-------------------------------------|-------|---------|---------|-----------|
| AI Adoption → Competitive Advantage | 0.286 | 4.103   | 0.000   | Supported |

### Interpretation

As can be seen from the results, the use of AI has a positive and significant effect on competitive advantage. The correlation value for "beta" is 0.286, which is positive but very weak. This indicates that greater the implementation of AI, higher the competitive edge for MSMEs. The t-value of 4.103 is above 1.96, and the p-value of 0.000 is below 0.05. Thus, the result is statistically significant and H2 is accepted.

The findings suggest that the use of AI significantly and positively influences competitive advantage of MSMEs ( $\beta = 0.286$ ,  $t = 4.103$ ,  $p < 0.001$ ). Hence, H2 is supported. The discovery indicates that MSMEs with AI-based technologies are more likely to become more market responsive, satisfy customers, innovate and differentiate. Yet, the moderate beta value suggests that the use of AI could not be the sole basis for achieving significant competitive advantage without operational efficiency, digital skills, and the readiness of the organization.

## H3: Operational Efficiency → Competitive Advantage

### Hypothesis

**H3: Operational efficiency has a positive and significant effect on competitive advantage among MSMEs.**

**Table 8: Statistical Result**

| Path                                           | Beta  | t-value | p-value | Decision  |
|------------------------------------------------|-------|---------|---------|-----------|
| Operational Efficiency → Competitive Advantage | 0.429 | 6.337   | 0.000   | Supported |

### Interpretation

As evident in the result, operational efficiency has a positive and significant influence on competitive advantage. It is clear that the beta value of 0.429 is in the moderate range of positive correlation. This indicates that the more efficient the MSME, the greater the competitive advantage they are likely to enjoy.

The t-value of 6.337 is greater than 1.96, and the p-value of 0.000 is below 0.05. Hence, relationship is statistically significant and H3 is accepted.

The results indicate that the operational efficiency positively and significantly influences the competitive advantage of MSMEs ( $\beta = 0.429$ ;  $t = 6.337$ ;  $p < 0.001$ ). So, H3 is supported. These findings suggest that efficient MSMEs are more likely to improve their competitive positioning via cost reduction, better service delivery, productivity and customer responsiveness.

### Hypothesis

**H4: Operational efficiency mediates the relationship between AI adoption and competitive advantage.**

### Test Applied

### Mediation Path

**AI Adoption → Operational Efficiency → Competitive Advantage**

**Table 9: Statistical Result**

| Hypothesis | Indirect Path                                                | Beta  | t-value | p-value | Decision  |
|------------|--------------------------------------------------------------|-------|---------|---------|-----------|
| H4         | AI Adoption → Operational Efficiency → Competitive Advantage | 0.228 | 5.476   | 0.000   | Supported |

### Decision Rule

The mediation effect is significant when:

The p-value is less than 0.05.

The t-value is greater than 1.96.

The indirect beta coefficient is positive or negative based on direction of the hypothesis.

In this result, the t-value is 5.476, which is greater than 1.96, and the p-value is 0.000, which is below 0.05. Thus, mediation effect is statistically significant.

### Interpretation

This beta value of 0.228 shows that there is a positive indirect relationship between AI adoption and competitive advantage via operational efficiency. This is because, operational efficiency is enhanced when adopted with AI, and operational efficiency then gets to boost the competitive edge.

The p-value is significant thus H4 is supported. The findings support the mediating effect of operational efficiency between the adoption of AI and the achievement of competitive advantage.

### Type of Mediation

The direct effect of AI adoption on competitive advantage was also significant:

**AI Adoption → Competitive Advantage:  $\beta = 0.286$ ,  $t = 4.103$ ,  $p = 0.000$**

Since both the direct effect and indirect effect are significant, the result indicates **partial mediation**.

The bootstrapping approach was applied to perform mediation analysis in PLS-SEM. The results showed that AI adoption indirectly positively influenced the competitive advantage via operational efficiency by a value of 0.228 ( $t = 5.476$  and  $p < 0.001$ ). So, H4 is supported. The results showed that operational efficiency is the mediator between the adoption of AI and competitive advantage in MSMEs. The mediation is also partial, as the direct impact of the adoption of AI on competitive advantage was also high. This means that the use of AI not only contributes to competitive advantage directly but also indirectly through their ability to improve the efficiency of operations.

**H5: Organizational readiness positively moderates the relationship between AI adoption and operational efficiency.**

**Test Applied**

A moderation test was conducted using an **interaction term** in SmartPLS.

**Interaction Path**

**AI Adoption × Organizational Readiness → Operational Efficiency**

**Table 10: Statistical Result**

| Hypothesis | Interaction Path                                                | Beta  | t-value | p-value | Decision  |
|------------|-----------------------------------------------------------------|-------|---------|---------|-----------|
| H5         | AI Adoption × Organizational Readiness → Operational Efficiency | 0.174 | 2.911   | 0.004   | Supported |

**Decision Rule**

The moderation effect is significant when:

The p-value is less than 0.05.

The t-value is greater than 1.96.

The direction of the interaction beta coefficient is as expected.

In this result, the t-value is 2.911, which is greater than 1.96, and the p-value is 0.004, which is below 0.05. Thus the moderating effect is statistically significant.

**Interpretation**

A positive interaction effect is suggested by the beta value of 0.174. This means that the readiness of organizations enhances the correlation between AI adoption and operational efficiency. This implies that MSMEs with greater organization readiness have a more positive impact on operational efficiency when they employ AI. So, H5 is supported.

The result of moderation revealed that the relationship between AI use and organizational readiness with operational efficiency was positive and significant, with  $\beta = 0.174$ ,  $t = 2.911$ ,  $p = 0.004$ . So, H5 is supported. This finding suggests that when organizations are prepared to embrace AI, the positive link between AI use and operational efficiency becomes more robust. MSMEs that are better equipped to transform AI adoption into operational efficiencies have high levels of managerial support, digital infrastructure, financial preparedness, employee acceptance, and change readiness.

## 11. DISCUSSION

The results indicate that the use of AI has a positive impact on the operational efficiency of MSMEs. AI-powered firms likely will experience quicker processes, fewer manual errors, quicker customer response, better demand forecasting, and better cost management. The study can also reveal that the implementation of AI can contribute to a company's competitive edge, especially in the domain of customer analytics, customized marketing, process innovation, and strategic decision making.

The impact of the relationship between AI adoption and competitive advantage is expected to be mediated by operational efficiency. It is not a given that AI implementation equates with competitive advantage – it needs to first enhance internal business processes. The benefits of AI can be weaker if the MSMEs do not properly integrate the AI, train employees in its use, or prepare the data for the AI.

The proposed study builds on the existing body of literature on the digital transformation of MSMEs, highlighting the need to view the use of AI as an operational and strategic process. From an operational perspective, AI can streamline operations, reduce errors, enhance predictive capabilities, and aid in real-time decision-making. From a strategy point of view, AI enhances competitiveness through cost leadership, customer responsiveness, innovation and differentiation.

The results were likely to bolster the Resource-Based View, as AI is seen as most useful when integrated into the organization's processes and leveraging the firm-specific resources. The study would also be helpful to the TOE framework as it would demonstrate that the three factors of technological readiness, organizational stance and environmental pressure are essential to successful AI adoption.

In the context of MSMEs, the message is that AI should be adopted to solve business issues, not for technology's hype. It is crucial for MSMEs to understand where AI can help cut costs, enhance customer experience, boost productivity, or aid in decision making. The study underscores the importance of digital training, low-cost infrastructure and technology support, financial assistance and technology advisory for MSMEs for policy makers.

## 12. CONCLUSION

This study analyzed the use of AI and its impact on operational efficiencies and competitive positioning of MSMEs. The results derived from the proposed model and hypothesis testing showcase the impact of the use of artificial intelligence on the performance of MSMEs. In particular, there was a positive and significant relationship between the use of AI and operational efficiency and competitive advantage. The study also revealed that operational efficiency can have a significant impact on competitive advantage and partially acts as a mediating variable between AI adoption and competitive advantage.

The highest direct correlation was found between the adoption of AI and the operational efficiency. This implies that the foremost use of AI for MSMEs is optimizing their internal business procedure. AI-powered tools enable MSMEs to streamline mundane tasks, minimize human mistakes, forecast with greater accuracy, deliver better customer service, streamline decision-making, and maximize resource use. These operations enhancements are significant for MSMEs, particularly, who usually have restricted financial, human and technological resources available.

The study also revealed that direct competitive advantage is attainable by using AI. Companies using AI have a greater chance of increasing customer responsiveness, customer

service, customer satisfaction, innovation, and cost savings, and also being more agile to market changes, which benefits MSMEs. The direct impact of AI on competitive advantage was less strong than the impact on operational efficiency, however. That means that the initial competitive value of AI relates to its internal efficiency improvements.

This mediation finding showed that there is an indirect effect from AI adoption to competitive advantage, through the mediator of operational efficiency. This translates to better competitive advantage, both through direct and indirect means via operational efficiency from AI adoption. MSMEs are not only able to leverage AI tools for business intelligence, they also have a competitive edge when they use those tools to boost productivity, minimize delays, optimize process accuracy, and deliver better services.

The moderation results also highlighted the need for AI to have conditions—such as organizational readiness and digital skills—if it is going to be successful. Relationships between AI adoption and operational efficiency were more robust with organizational readiness, suggesting that MSMEs with supportive leadership, the necessary infrastructure, financial readiness, employee acceptance, and readiness to change are more likely to be able to achieve efficiency benefits from AI.

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