Role of AI in Empowering MSMEs at the Contemporary Stage

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Abstract

Micro, Small and Medium Enterprises (MSMEs) play a significant role in employment generation, innovation, income creation and regional economic development. In the contemporary digital environment, Artificial Intelligence (AI) is emerging as an important technology for improving the efficiency and competitiveness of MSMEs. AI enables small businesses to automate routine activities, analyse business data, understand customer preferences, improve marketing, forecast demand, manage inventory and support financial decision-making. AI-based tools can also help MSMEs reduce operational costs, improve productivity and reach wider markets through digital platforms. However, challenges such as limited financial resources, lack of technical skills, inadequate digital infrastructure, data privacy concerns and resistance to technological change may restrict AI adoption. This paper conceptually examines the role of AI in empowering MSMEs at the contemporary stage and highlights how AI can contribute to operational efficiency, innovation, customer engagement, decision-making and sustainable business growth. The study also identifies the major challenges and suggests the need for digital skills, affordable AI solutions and institutional support to encourage responsible AI adoption among MSMEs.

Keywords: Artificial Intelligence, MSMEs, Digital Transformation, Innovation, Productivity, Business Growth

1. Introduction

Micro, Small and Medium Enterprises (MSMEs) constitute an important part of the business ecosystem and contribute significantly to employment, entrepreneurship, income

generation and economic development. MSMEs operate across manufacturing, services, trading and emerging digital business activities. However, in the contemporary business environment, they face increasing competition, changing customer expectations, rapid technological development, rising operating costs and the need for faster decision-making. These changes have created a greater need for MSMEs to adopt appropriate digital technologies.

Artificial Intelligence (AI) has emerged as one of the major technologies transforming modern business practices. AI refers to technologies that enable computer systems to perform tasks that normally require human intelligence, such as learning from data, identifying patterns, making predictions, understanding language and supporting decision-making. For MSMEs, AI can provide opportunities to perform business activities more efficiently without requiring large-scale resources.

AI can support MSMEs in several functional areas. In marketing, AI can help identify customer preferences and personalise promotional activities. In finance and accounting, AI can assist with transaction analysis, financial forecasting and detection of unusual transactions. In operations, AI can support inventory management, demand forecasting and process automation. In customer service, AI-powered chatbots and virtual assistants can provide faster responses to routine customer enquiries. AI can also support entrepreneurs in analysing market trends and identifying new business opportunities.

The contemporary stage of AI adoption is particularly important because many AI-enabled tools are becoming more accessible through cloud-based platforms and digital applications (Kramarenko, 2025). This creates possibilities for smaller enterprises to access technological capabilities that were previously associated mainly with large organisations. However, adopting AI is not simply a technological decision. MSMEs also need appropriate skills, financial resources, reliable digital infrastructure, data management practices and awareness of ethical and privacy issues (Schwaeke et al., 2024).

Therefore, understanding the role of AI in empowering MSMEs is important for examining how technology can contribute to productivity, innovation, competitiveness and

sustainable growth. This conceptual study focuses on the potential contribution of AI to MSME development while also recognising the challenges associated with its adoption.

Contribution of the Study

This study makes three contributions to the literature. First, it integrates fragmented findings on AI adoption in MSMEs into a unified conceptual framework linking AI adoption, operational efficiency, and MSME empowerment. Second, it applies the Technology–Organisation–Environment framework and the Resource-Based View to explain both the antecedents and consequences of AI adoption in MSMEs, thereby providing a stronger theoretical foundation than previous descriptive accounts. Third, it advances six testable propositions to guide future empirical research on AI adoption in MSMEs, particularly in developing economies such as India.

2. Theoretical Foundation

This study draws on two established theories to explain how Artificial Intelligence (AI) adoption leads to MSME empowerment: the Technology–Organisation–Environment (TOE) framework and the Resource-Based View (RBV).

The **Technology–Organisation–Environment (TOE) framework** (Tornatzky & Fleischer, 1990) explains that technology adoption is shaped by three interacting forces. The **technological context** refers to the characteristics of the technology itself, including its cost, complexity, compatibility with existing systems, and perceived usefulness. The **organisational context** refers to internal characteristics of the firm, including its size, financial resources, employee skills, and organisational culture. The **environmental context** refers to external factors such as government policy, competitive pressure, infrastructure, and industry support.
The relevance of the TOE framework to AI adoption in MSMEs is well supported by recent systematic reviews. Aylnaddis (2025), in a review of 78 peer-reviewed articles, identified the TOE framework as the dominant theoretical model for explaining AI adoption dynamics across firm sizes. Similarly, a qualitative case study of Korean SMEs found that AI adoption is shaped by the interaction of technological, organisational, and environmental factors, including CEO problem recognition, data management capabilities, AI talent availability, and policy accessibility (Kwon, 2026).

The **Resource-Based View (RBV)** (Barney, 1991) explains how firms achieve and sustain competitive advantage through the possession of valuable, rare, inimitable, and non-substitutable resources and capabilities. Applied to this study, RBV explains how AI capabilities — when developed and integrated into business processes — become a source of competitive advantage for MSMEs that competitors cannot easily replicate. AI-enabled capabilities in demand forecasting, customer analytics, inventory management, and decision-making are difficult for smaller competitors to imitate because they require data, skills, and organisational learning. Empirical work demonstrates that AI capability functions as a dynamic capability contributing to sustained competitive advantage, particularly when combined with organisational learning and strategic implementation (Wamba et al., 2026).

3. Objectives of the Study

1. To explain the role of Artificial Intelligence in empowering MSMEs in the contemporary business environment.
2. To look the major applications of AI in MSME operations.
3. To describe the major challenges faced by MSMEs in adopting AI, such as cost, skills, infrastructure, data privacy and technological awareness.
4. To suggest measures for promoting effective and responsible AI adoption among MSMEs.

4. Review of Literature

This review is organised thematically to identify patterns, gaps, and the need for a conceptual framework.

4.1 Drivers of AI Adoption in MSMEs

Research consistently identifies competitive pressure, customer expectations, and cost reduction as primary drivers of AI adoption. Hansen and Bøgh (2021) examined the use of Artificial Intelligence (AI) and Internet of Things (IoT) in small and medium-sized manufacturing enterprises. Their study highlighted that AI and IoT can support SMEs in adopting Industry 4.0 technologies and improving competitiveness. However, the authors identified lack of knowledge and technological capabilities as important challenges.

Ulrich, Frank and Kratt (2021) investigated AI adoption among German SMEs and highlighted the importance of employee qualifications and organisational preparedness. Their

findings indicated that insufficient employee knowledge and skills can become a major obstacle to implementing AI technologies. This suggests that human-resource development is an important component of AI-enabled SME empowerment.

4.2 Barriers to AI Adoption

Schwaeke et al. (2024) conducted a systematic literature review of 106 peer-reviewed studies on AI adoption in SMEs. They identified eight major dimensions affecting AI adoption: compatibility, infrastructure, knowledge, resources, organisational culture, competition, regulation and ecosystem. Their study demonstrates that AI adoption is not merely a technological decision but is influenced by organisational and environmental conditions.

Kasigit, Akhlaghpour and Karanasios (2025) reviewed 32 peer-reviewed studies on AI adoption by SMEs in developing countries. Their review found that SMEs use AI for market engagement, innovation, operations and strategic decision-making. At the same time, financial limitations, technological barriers, knowledge gaps, cultural rigidity and ethical concerns restrict adoption.

4.3 AI Applications and Business Outcomes

Hamid and Artha (2026) reviewed 50 peer-reviewed studies published between 2019 and 2025 concerning AI adoption, implementation barriers and business impacts in SMEs. Their review examined AI applications adoption and easing importance of AI in SME business operations. Additional studies indicate that AI applications in marketing, customer service, inventory management, and financial analysis are consistently associated with improved operational efficiency and customer satisfaction (Davenport & Ronanki, 2018; Mikalef & Gupta, 2021).

Recent empirical evidence supports the operational benefits of AI for small businesses. A study of 305 SME owners and managers found that AI adoption positively impacts economic, social, and environmental performance, with employee capability, relative advantage, and top management support emerging as the most influential predictors of adoption (Ebuka et al., 2025). Federal Reserve Bank data shows that among small businesses using AI, 71% reported productivity increases, with the most common uses being writing and marketing (79%), individual productivity tasks (56%), and planning or analysis (51%) (Federal Reserve Bank of Philadelphia, 2026).

4.4 AI Adoption in Developing Economies

Research on AI adoption in developing economies reveals both opportunities and persistent barriers. A study of SMEs in Nigeria, Ghana, and Senegal found that cloud computing and AI enhance scalability, support process automation, and improve decision-making, yet overall adoption remains limited due to digital literacy gaps, unreliable internet connectivity, and the perceived high cost of digital solutions (Kramarenko, 2025). A study of Malaysian SMEs proposed a conceptual framework integrating TOE and the Technology Acceptance Model (TAM), identifying eight factors influencing AI adoption: top management support, employee adaptability, organisational preparedness, business operation support, competitive pressure, partner support, perceived usefulness, and perceived ease of use (Othman et al., 2025). In the Indian context, the TCS-CII report (2024) documents that while AI-powered fintech solutions became crucial for financial inclusion among Indian MSMEs, affordability and talent gaps remained significant challenges, with many small businesses still struggling to access affordable AI tools and cloud computing solutions.

4.5 Research Gap

Despite growing research on AI adoption in SMEs, three gaps remain. First, most studies examine adoption drivers or barriers in isolation, without integrating them into a unified framework. Second, few studies apply established theories such as TOE or RBV to explain AI-enabled empowerment. Third, there is a lack of testable propositions to guide future empirical research, particularly in developing economies. This study addresses these gaps by proposing a theory-driven conceptual framework and six testable propositions.

5. Research Methodology

The study uses a conceptual and descriptive research design based on secondary data. A systematic search was conducted in Scopus, Web of Science, and Google Scholar using the search terms "artificial intelligence" AND "MSMEs" OR "SMEs" AND "adoption" AND "developing countries". The search covered the period 2016–2025. Studies were included if they were peer-reviewed, written in English, focused on AI adoption in SMEs, and published between 2016 and 2025. After applying these criteria, 45 studies were selected for review. The collected literature is analysed using thematic content analysis (Braun & Clarke, 2006) to identify common themes related to AI adoption in MSMEs. The findings are then synthesised into a conceptual framework grounded in the TOE framework and RBV.

6. Terminology Used

Term	Meaning
Artificial Intelligence (AI)	Technology that enables machines and software to perform tasks that normally require human intelligence.
MSMEs	Micro, Small and Medium Enterprises that operate on a relatively small scale and contribute to employment, production and economic development.
AI Adoption	The process of introducing and using AI technologies in MSME business activities.
AI Empowerment	The use of AI to improve the capabilities, efficiency, innovation and competitiveness of MSMEs.
Digital Transformation	The integration of digital technologies into business processes and operations.
Automation	Use of technology to perform tasks with reduced manual effort.
Business Analytics	Use of data and analytical techniques to support business decisions.
Productivity	The efficiency with which MSMEs use resources to produce goods or services.
Innovation	Development or improvement of products, services, processes or business models.
Content Analysis	A systematic method of analysing published literature to identify and categorise important themes, concepts and findings.

7. Features of Artificial Intelligence

Artificial Intelligence (AI) is a technology that enables machines and computer systems to perform tasks that normally require human intelligence. AI can learn from data, identify patterns, analyse information, make predictions and support decision-making. In the business environment, these features help organisations automate activities, improve efficiency and provide better services. The major features of AI are as follows:

- **Learning Ability** – AI can learn from available data and improve its performance.
- **Automation** – AI can perform routine and repetitive tasks with less human intervention.
- **Data Analysis** – AI can process and analyse large amounts of data quickly.
- **Decision Support** – AI provides useful information for making business decisions.
- **Prediction** – AI can predict future trends, sales and customer demand.
- **Problem-Solving** – AI can analyse problems and identify possible solutions.

8. AI Applications in MSMEs

Artificial Intelligence (AI) is becoming an important tool for Micro, Small and Medium Enterprises (MSMEs) because it enables businesses to use data, automation, and intelligent systems to improve their daily operations. Earlier, many MSMEs depended heavily on manual processes and personal experience for activities such as accounting, inventory control, marketing, customer service, and business decisions. AI can complement this traditional approach by providing faster analysis, automation, forecasting, and decision support.

8.1 Marketing and Sales

By analyzing customer and sales data, AI assists MSMEs in comprehending consumer preferences and purchasing patterns. It can help with social media marketing, product recommendations, customer segmentation, and targeted advertising. This makes it possible for small enterprises to use their marketing resources really effectively and reach the right clientele.

8.2 Customer Service

Chatbots and virtual assistants with AI capabilities can respond to often asked queries, offer product details, manage simple grievances, and help clients after regular business hours. This can speed up response times while freeing up staff to focus on more intricate client needs.

8.3 Demand Forecasting

AI can analyse historical sales, seasonal patterns, customer behaviour, and other relevant information to estimate future demand. For example, a small retailer can use demand information to determine how much stock may be required during a festival or seasonal period.

8.4 Inventory Management

AI can help MSMEs monitor stock levels and identify products that are moving quickly or slowly. This can help reduce unnecessary inventory and avoid situations where important products are unavailable. Better inventory planning can also improve the use of working capital.

8.5 Accounting and Finance

Repetitive accounting tasks including processing invoices, classifying transactions, tracking expenses, reconciliation, and financial reporting can all be aided by AI. Although crucial financial choices still need to be properly reviewed by humans, it can also assist business owners in analyzing cash flows and spotting odd activities.

8.6 Production Management

For manufacturing MSMEs, AI can analyse production data and identify inefficiencies in production processes. It can support production scheduling, resource allocation, and process optimization, helping enterprises make better use of machinery, labour, materials, and time.

8.7 Quality Control

AI-based systems can assist in identifying defects and inconsistencies in products. In manufacturing, computer-vision systems can examine products during production and identify visible quality problems. This can contribute to more consistent quality and reduced wastage.

8.8 Supply Chain Management

AI can support supplier evaluation, procurement planning, logistics management, and delivery forecasting. By analysing purchasing and transportation information, MSMEs can make better decisions regarding suppliers, inventory, and distribution.

8.9 Human Resource Management

AI can assist MSMEs in activities such as recruitment, employee scheduling, training recommendations, and workforce analysis. It can reduce some administrative work and provide managers with useful information for workforce planning.

8.10 Business Decision-Making

One of the important applications of AI is data-driven decision-making. AI can analyse large amounts of business information and identify patterns and trends. Entrepreneurs can use these insights while making decisions related to pricing, sales, inventory, marketing, and expansion.

8.11 Fraud Detection and Cybersecurity

AI can identify unusual patterns in transactions and digital activities that may indicate potential fraud or security threats. This can be particularly useful as MSMEs increasingly use online banking, digital payments, e-commerce, and cloud-based business systems.

8.12 Product and Service Innovation

AI can analyse customer feedback, market trends, and competitor information to identify emerging customer needs. MSMEs can use these insights to improve existing products or develop new products and services.

9. Present Situation of MSMEs

Micro, Small and Medium Enterprises (MSMEs) play an important role in economic development by generating employment, encouraging entrepreneurship and supporting local and regional business activities. At present, MSMEs are operating in a rapidly changing business environment influenced by digitalisation, e-commerce, technological development and changing customer preferences. Digital payments, online marketing and e-commerce platforms have created new opportunities for MSMEs to reach customers and expand their markets. At the same time, MSMEs face challenges such as limited finance, shortage of skilled manpower, increasing competition, technological barriers and difficulties in adopting advanced digital technologies. The growing use of Artificial Intelligence (AI) provides new opportunities for MSMEs to improve productivity, reduce costs, analyse data, forecast demand and enhance customer service. However, effective adoption of AI requires adequate infrastructure, financial

resources, digital skills and awareness. Therefore, the present situation of MSMEs reflects both significant opportunities from digital and AI-based technologies and continuing challenges related to resources, skills and technology adoption.

10. Challenges in AI Applications in MSMEs

- **High Initial Cost** – AI software, hardware and implementation may require significant investment.
- **Lack of Skilled Employees** – MSMEs may have limited employees with AI and digital skills.
- **Limited Technical Knowledge** – Business owners and employees may not have sufficient knowledge about AI tools.
- **Inadequate Digital Infrastructure** – Poor access to suitable technology, internet and digital systems can affect AI adoption.
- **Data Availability** – AI requires sufficient and relevant business data for effective functioning.
- **Poor Data Quality** – Inaccurate or incomplete data can reduce the usefulness of AI results.
- **Employee Resistance** – Employees may hesitate to accept new technologies and changes in work practices.
- **Cybersecurity Risks** – AI systems may create concerns related to data security and cyber threats.
- **Privacy and Ethical Issues** – Handling customer and business data requires proper privacy and responsible use.
- **Difficulty in Integration** – Integrating AI with existing accounting, production or management systems can be challenging.
- **Lack of Awareness** – Some MSME owners may have limited awareness of the benefits and applications of AI.
- **Maintenance and Upgradation** – AI systems require continuous maintenance, training and technological updates.

These challenges are well documented in recent literature. A case study of Korean SMEs found that AI adoption begins with CEO problem recognition and strategic judgment, while data accumulation and management capabilities function as essential prerequisites for

effective utilisation; AI talent availability, the maturity of the external solution provider ecosystem, and policy accessibility significantly influence the scope and pace of adoption (Kwon, 2026). Research on West African SMEs confirms that digital literacy gaps, unreliable internet connectivity, and the perceived high cost of digital solutions remain the primary barriers to AI adoption in developing economies (Kramarenko, 2025).

11. Conceptual Framework

Based on the theoretical foundations and the literature reviewed, this study proposes a conceptual framework of AI-enabled MSME empowerment. The framework consists of three core components: AI adoption (independent variable), operational efficiency (mediator), and MSME empowerment (dependent variable), with four moderating variables.

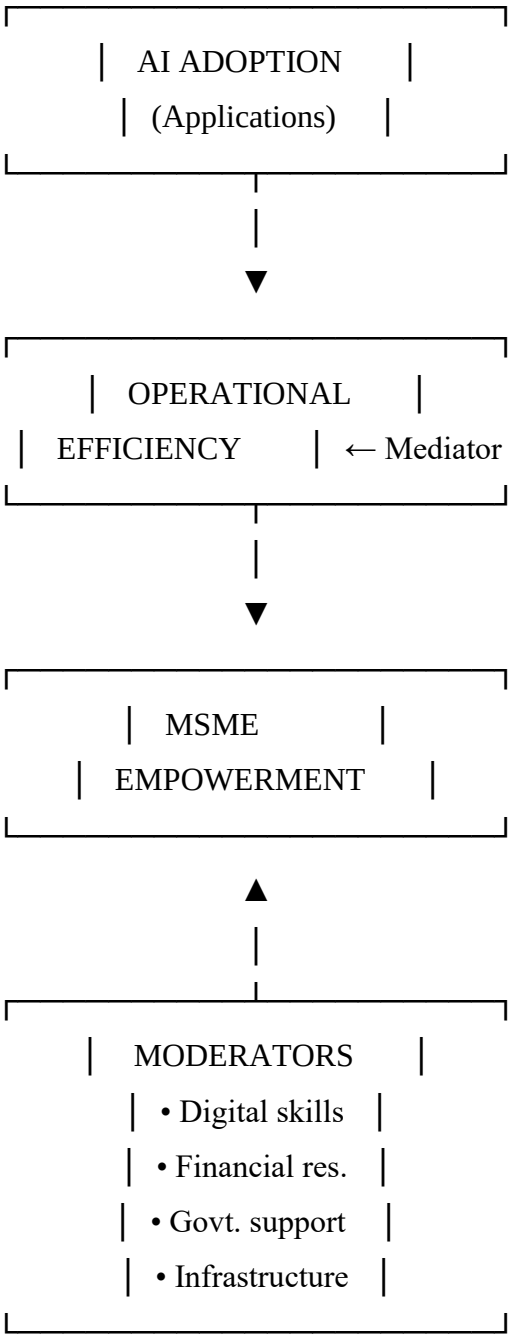
AI Adoption refers to the integration of AI technologies into MSME business activities, including marketing, customer service, demand forecasting, inventory management, accounting and finance, production, quality control, supply chain management, human resource management, decision-making, fraud detection, and product innovation.

Operational Efficiency refers to the improvement in the use of organisational resources — time, labour, materials, and capital — resulting from AI adoption. It functions as the mediating mechanism through which AI adoption translates into broader MSME empowerment.

MSME Empowerment refers to the enhanced capacity of MSMEs to compete, innovate, grow sustainably, and create value, reflected in improved productivity, reduced costs, expanded market reach, stronger customer relationships, and increased resilience.

Moderating variables influence the strength or direction of these relationships. **Digital skills** determine how effectively employees can use AI tools. **Financial resources** determine whether MSMEs can afford AI implementation and maintenance. **Government support** — through subsidies, training, and infrastructure — shapes the external environment for adoption. **Digital infrastructure** — including internet access, cloud services, and digital payment systems — determines whether AI tools can function reliably.

Fig. 1 Conceptual framework of AI-enabled MSME empowerment text



The framework proposes that AI adoption improves operational efficiency, which in turn contributes to MSME empowerment. The strength of these relationships depends on digital skills, financial resources, government support, and digital infrastructure. The framework is grounded in the TOE framework and RBV, integrating antecedents (TOE) and consequences (RBV) of AI adoption.

12. Propositions

Based on the conceptual framework and theoretical foundations, the following propositions are advanced for future empirical testing:

Proposition 1: AI adoption is positively associated with operational efficiency in MSMEs.

Proposition 2: Operational efficiency mediates the relationship between AI adoption and MSME empowerment.

Proposition 3: Digital skills positively moderate the relationship between AI adoption and operational efficiency, such that the relationship is stronger when digital skills are higher.

Proposition 4: Financial resource availability positively moderates the relationship between AI adoption and MSME empowerment, such that the relationship is stronger when financial resources are greater.

Proposition 5: Government support positively moderates the relationship between AI adoption and MSME empowerment, such that the relationship is stronger when government support is higher.

Proposition 6: Digital infrastructure positively moderates the relationship between AI adoption and MSME empowerment, such that the relationship is stronger when digital infrastructure is more developed.

These propositions provide a foundation for future empirical research using survey data, structural equation modelling, or comparative case studies across MSME sectors and regions.

13. Implications for Overcoming Challenges In Empowering MSMEs Through AI

The adoption of Artificial Intelligence (AI) can significantly strengthen the competitiveness, productivity, innovation, and sustainability of MSMEs. However, challenges such as high implementation costs, lack of skilled employees, limited digital infrastructure, data-security concerns, and resistance to technological change need to be addressed systematically.

1. **Affordable AI solutions** – Develop low-cost, scalable, and cloud-based AI tools that MSMEs can adopt according to their financial capacity.

2. **AI skill development** – Provide training programmes, workshops, and certification courses to improve employees' digital and AI-related skills.
3. **Government support** – Strengthen financial assistance, subsidies, credit facilities, and technology-support programmes for MSMEs adopting AI.
4. **Digital infrastructure** – Improve access to reliable internet, cloud services, digital payment systems, and modern computing facilities, particularly for rural MSMEs.
5. **Data management** – Encourage MSMEs to maintain accurate, structured, and secure business data because quality data is essential for effective AI applications.
6. **Cybersecurity and privacy** – Introduce appropriate security practices, employee awareness programmes, and data-protection mechanisms to reduce cyber risks.
7. **Industry–academic collaboration** – Universities and research institutions can support MSMEs through AI training, consultancy, student projects, technology demonstrations, and innovation centres.
8. **AI awareness** – Conduct awareness programmes to demonstrate practical applications of AI in accounting, marketing, customer service, inventory management, forecasting, and decision-making.
9. **Gradual implementation** – MSMEs can begin with simple AI applications such as chatbots, automated accounting, demand forecasting, and digital marketing before moving to advanced systems.
10. **Human–AI collaboration** – AI should support employees and entrepreneurs rather than completely replace human decision-making. Human judgement remains important for strategic and ethical decisions.

14. Conclusion

Artificial Intelligence (AI) is emerging as an important technological enabler for the empowerment and transformation of Micro, Small and Medium Enterprises (MSMEs) in the contemporary business environment. AI applications in areas such as marketing, customer service, accounting, inventory management, demand forecasting, finance, and decision-making can improve operational efficiency and help MSMEs respond more effectively to changing market conditions. At the same time, challenges including high adoption costs, limited technical skills, inadequate digital infrastructure, data-quality issues, and cybersecurity concerns may restrict AI adoption. Therefore, effective AI empowerment requires affordable and accessible technologies, continuous skill development, supportive government policies,

digital infrastructure, and collaboration among MSMEs, educational institutions, technology providers, and other stakeholders. This study contributes a theory-driven conceptual framework grounded in the TOE framework and the Resource-Based View, linking AI adoption, operational efficiency, and MSME empowerment, with digital skills, financial resources, government support, and digital infrastructure as moderating variables. Six testable propositions are advanced to guide future empirical research. Overall, the strategic adoption of AI can strengthen the productivity, innovation, competitiveness, resilience, and sustainable growth of MSMEs at the contemporary stage.

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