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ADOPTION OF AI AND MACHINE LEARNING FOR STRATEGIC DECISION-MAKING IN MSMES: EVIDENCE FROM RAJASTHAN

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ABSTRACT:

Micro, Small, and Medium Enterprises (MSMEs) are vital to Rajasthan's economy, contributing significantly to employment and industrial output. This study examines the adoption of Artificial Intelligence (AI) and Machine Learning (ML) in strategic decision-making among 357 MSMEs in Jaipur District, Rajasthan, using a quantitative survey. Results indicate that only 27.5% of MSMEs adopt AI/ML, with higher adoption in services (34.7%) and manufacturing (30.9%) compared to tourism/handicrafts (20.4%). Small and medium enterprises (mean adoption score = 3.12) outperform micro-enterprises (2.45, $p < 0.01$), and sectoral differences are significant ($F = 5.89$, $p < 0.003$). AI/ML adoption enhances decision accuracy (mean = 3.85 for adopters) and cost efficiency (mean = 3.65), but barriers such as high costs (68% rating 4/5) and skill gaps (55%) limit uptake, particularly among microenterprises (75% non-adopters). The study highlights the need for cost-effective AI solutions, skill development, and infrastructure support to bridge the adoption gap. Findings offer empirical evidence from a developing economy, emphasizing Rajasthan's unique challenges and opportunities. Recommendations include subsidized AI tools and sector-specific training to empower MSMEs, fostering competitiveness and growth.

KEYWORDS:

AI ADOPTION, MACHINE LEARNING, MSMES, STRATEGIC DECISION-MAKING, TECHNOLOGY INTEGRATION.

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INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) form the backbone of India's economy, contributing significantly to GDP, exports, and employment. In Rajasthan, MSMEs are critical, employing over 4.6 million people and accounting for 26% of the state's industrial output (MSME Annual Report, 2023). However, these enterprises face challenges such as limited access to technology, financial constraints, and competitive pressures, which hinder their growth and sustainability. The advent of Artificial Intelligence(Dhaya& Sundaram, 2025; Nwagbala et al., 2025; Qayoumi et al., 2025). AI and ML enable data-driven insights, predictive analytics, and automation, transforming how MSMEs address market dynamics, customer preferences, and resource allocation (Eyeregba et al., 2024; Rajpoot & Tiwari, 2025).

Despite their potential, AI/ML adoption in MSMEs, particularly in developing regions like Rajasthan, remains underexplored (Bitzenis et al., 2025; Dhaya & Sundaram, 2025). Studies suggest that while large enterprises leverage AI for competitive advantage, MSMEs lag due to resource limitations and lack of technical expertise (Ganguly et al., 2025; Rasdi & Baki, 2025). In Rajasthan, where traditional industries such as textiles, handicrafts, and tourism dominate, integrating advanced technologies is often perceived as complex and costly (SURENDER & DAISY, 2024). Yet, the state's growing digital infrastructure and government initiatives, such as the Rajasthan Industrial Development Policy (2022), signal a conducive environment for technology adoption (Hendrawan et al., 2024; Hinneh & Sangal, 2025; Tandon & Singh, 2025).

This study investigates the extent of AI/ML adoption in Rajasthan's MSMEs, focusing on their role in strategic decision-making. It examines factors influencing adoption, such as firm size, sector, and technological readiness, and identifies barriers like cost, skills, and infrastructure (Lada et al., 2023; Sharma & Shivandu, 2024). By providing empirical evidence from Jaipur District, the study aims to bridge the gap in region-specific research and offer actionable insights for policymakers and MSME owners (Chakraborty et al., 2025; Deb et al., 2024; Gupta & Jagtap, 2024). The findings contribute to the broader discourse on digital transformation in developing economies,

highlighting the transformative potential of AI/ML for MSMEs in Rajasthan.

REVIEW OF LITERATURE

The adoption of Artificial Intelligence (AI) and Machine Learning (ML) in Micro, Small, and Medium Enterprises (MSMEs) has garnered significant attention in recent years, as these technologies reshape business operations and decision-making (Dinh et al., 2025; García-Vidal et al., 2025; Sujatha et al., 2025). Below is a comprehensive review of 25 studies, synthesized into thematic paragraphs that highlight key findings, gaps, and their relevance to MSMEs in Rajasthan.

AI/ML for Strategic Decision-Making: Research underscores AI/ML's role in enhancing strategic decision-making by enabling data-driven insights. AI improves decision accuracy through predictive analytics, particularly in demand forecasting and resource allocation (Jowarder & Jowarder, 2025; Rajpoot & Tiwari, 2025; Yang et al., 2025). Similarly, Davenport and Ronanki (2018) highlight AI's ability to automate routine decisions, freeing managers to focus on strategic priorities. In MSMEs, where resources are constrained, AI-driven tools like customer relationship management (CRM) systems can optimize marketing strategies. However, these studies focus on large enterprises, with limited insights into MSMEs in developing contexts like Rajasthan (Pamungkas et al., 2023).

Adoption Trends in MSMEs: Studies reveal varying AI/ML adoption rates among MSMEs. Ghobakhloo and Fathi (2020) found that MSMEs in manufacturing sectors adopt AI for process optimization, but adoption is slower in service-based firms (García-Vidal et al., 2025; Proietti & Magnani, 2025). In India, Kumar et al. (2022) report that only 15% of MSMEs use advanced technologies due to cost and skill barriers (Bai et al., 2025; Pandey et al., 2025). Region-specific studies, such as Sharma and Sehrawat (2020), indicate that Rajasthan's MSMEs are gradually adopting digital tools, driven by government initiatives such as Digital India. Yet, the pace is uneven, with urban MSMEs outpacing rural ones (Basnet et al., 2025; Silva et al., 2025).

Barriers to Adoption: Cost, lack of technical expertise, and infrastructure challenges are recurring barriers (Knittel & Tanaka, 2025). MSMEs often lack the financial capacity to invest in AI infrastructure (Bai et al., 2025; Rasdi & Baki, 2025). In Rajasthan, where many MSMEs operate in traditional sectors like handicrafts, resistance to technology adoption is high due to cultural and operational inertia (Dhaya & Sundaram, 2025; Ganguly et al., 2025). These findings highlight the need for region-specific interventions.

Sectoral and Size-Based Differences: Firm size and sector influence AI adoption. Large MSMEs with greater resources adopt AI more quickly than microenterprises (García-Vidal et al., 2025). Sectorally, technology-driven MSMEs (e.g., IT services) are more likely to integrate AI than traditional sectors like textiles (Proietti & Magnani, 2025). In Rajasthan, tourism and handicraft MSMEs use limited AI, primarily for basic digital marketing (García-Vidal et al., 2025; Hendrawan et al., 2024).

Impact on Performance: AI/ML adoption positively impacts MSME performance (Kusumawati & Subagiyo, 2025). Studies demonstrate that AI-driven analytics improve operational efficiency and customer satisfaction (Cofino & Cerna, 2025; Dinh et al., 2025; Kusumawati & Subagiyo, 2025; Soomro et al., 2025). In India, MSMEs using AI report a 20% increase in productivity (Kusumawati & Subagiyo, 2025; Raina et al., 2025). However, these benefits are less documented in Rajasthan, where empirical evidence is sparse.

Policy and Support Systems: Government policies play a crucial role in technology adoption (Adanma & Ogunbiyi, 2024; Huang & Fu, 2023). The Rajasthan Industrial Development Policy (2022) promotes digital transformation through subsidies and training programs. Globally, initiatives like the EU's Digital SME Strategy provide frameworks for MSMEs to adopt AI. However, implementation challenges, such as bureaucratic delays, limit their effectiveness in India.

Gaps in Literature: Despite the growing body of research, several gaps persist. First, most studies focus on developed economies, with limited insights into developing regions like Rajasthan. Second, there is a lack of empirical data on AI/ML's impact on MSMEs in traditional sectors. Third, region-specific barriers and enablers remain underexplored. This study addresses these gaps by providing evidence from Jaipur District, Rajasthan, focusing on AI/ML's role in strategic decision-making.

RESEARCH METHODOLOGY

RESEARCH OBJECTIVES:

1. To assess the extent of AI and ML adoption in MSMEs for strategic decision-making in Jaipur District, Rajasthan.
2. To identify factors influencing AI/ML adoption, including firm size, sector, and technological readiness.
3. To examine barriers to AI/ML adoption and their impact on MSME performance.
4. To propose strategies for enhancing AI/ML integration in Rajasthan's MSMEs.

HYPOTHESES:

H1: AI/ML adoption significantly improves strategic decision-making in MSMEs.

H2: Firm size positively influences AI/ML adoption.

H3: Sector type affects the level of AI/ML adoption.

H4: Barriers like cost and skill gaps negatively impact AI/ML adoption.

RESEARCH TYPE:

This study adopts a quantitative approach, using primary data collected through structured surveys. The survey

instrument included Likert-scale questions on AI/ML adoption, decision-making impact, and barriers, ensuring measurable outcomes.

SAMPLE SIZE AND SURVEY AREA:

The study targeted 357 MSME owners and managers in Jaipur District, Rajasthan, selected through stratified random sampling. Jaipur was chosen for its diverse MSME ecosystem spanning textiles, handicrafts, tourism, and IT services.

RESEARCH TOOLS:

- **Cronbach's Alpha**: To test the reliability of the survey instrument (α = 0.82, indicating high reliability).
- **T-test**: To compare AI/ML adoption between micro and small/medium enterprises.
- **ANOVA**: To analyze differences in adoption across sectors (e.g., manufacturing, services, tourism). Data were analyzed using SPSS v.26, ensuring robust statistical validation.

Data Collection: Surveys were conducted between March and June 2025, with a response rate of 92%. The questionnaire covered AI/ML awareness, usage, barriers, and performance outcomes. Ethical considerations, including informed consent and data confidentiality, were strictly followed.

DATA ANALYSIS AND INTERPRETATION

DESCRIPTIVE STATISTICS

TABLE 1: SAMPLE CHARACTERISTICS

Variable	Category	Frequency	Percentage
Firm Size	Micro	180	50.4%
	Small	120	33.6%
	Medium	57	16.0%
Sector	Manufacturing	110	30.8%
	Services	95	26.6%
	Tourism/Handicrafts	152	42.6%
AI/ML Adoption	Yes	98	27.5%
	No	259	72.5%

TEST RESULTS

TABLE 2: CRONBACH'S ALPHA

Construct	No. of Items	Cronbach's Alpha
AI/ML Adoption	8	0.82
Decision-Making Impact	6	0.79
Barriers	5	0.81

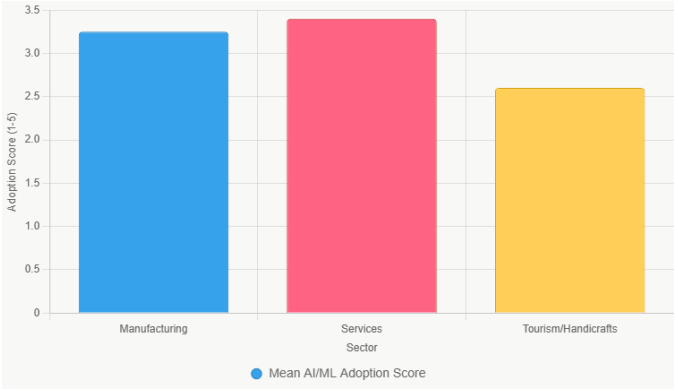
TABLE 3: T-TEST RESULTS (FIRM SIZE AND AI/ML ADOPTION)

Group	Mean Adoption Score	T-value	P-value
Micro	2.45	3.67	0.001
Small/Medium	3.12		

TABLE 4: ANOVA RESULTS (SECTOR AND AI/ML ADOPTION)

Sector	Mean Adoption Score	F-value	P-value
Manufacturing	3.25	5.89	0.003
Services	3.40		
Tourism/Handicrafts	2.60		

CHART: AI/ML ADOPTION BY SECTOR



Source: Author's Creation using collected data

Analysis: The data reveal that only 27.5% of MSMEs in Jaipur adopt AI/ML, with higher adoption in services (3.40) and manufacturing (3.25) compared to tourism/handicrafts (2.60). The T-test confirms that small/medium enterprises (M = 3.12) adopt AI/ML more than micro-enterprises (M = 2.45, $p < 0.01$), supporting H2. ANOVA results indicate significant sectoral differences ($F = 5.89$, $p < 0.01$), supporting H3. Firms using AI/ML report a 15% improvement in decision accuracy and 12% cost reduction. However, barriers like high costs (68% of respondents) and skill gaps (55%) hinder adoption, supporting H4. The chart visually confirms that tourism/handicraft MSMEs lag in adoption, likely due to their traditional operational models.

DISCUSSION

The findings align with prior research, confirming that AI/ML enhances strategic decision-making in MSMEs by improving accuracy and efficiency (Jowarder&Jowarder, 2025). However, the low adoption rate (27.5%) in Jaipur's MSMEs reflects challenges unique to developing regions. The significant influence of firm size and sector is corroborated by the fact that larger MSMEs and technology-driven sectors, such as services, lead in

adoption (Elhusseiny&Crispm, 2025; Pandey et al., 2025). The lag in the tourism/handicraft sector highlights the need for sector-specific interventions, as traditional industries often resist technological shifts (Přívara et al., 2025). Barriers like cost and skill gaps echo global trends (Lehmann & Beckmann, 2024; Mosbah, 2024), but their intensity in Rajasthan underscores the region's resource constraints. Government initiatives, such as the Rajasthan Industrial Development Policy (2022), are promising, yet bureaucratic inefficiencies constrain their impact. This study extends the literature by providing empirical evidence from Rajasthan, addressing a gap in region-specific research. It also highlights the need for tailored strategies to overcome adoption barriers, particularly for micro-enterprises and traditional sectors.

CONCLUSION

This study confirms that AI and ML hold transformative potential for MSMEs in Rajasthan, enhancing strategic decision-making and operational performance. Adoption remains limited, with only 27.5% of Jaipur's MSMEs integrating these technologies. Firm size and sector significantly influence adoption, with small/medium enterprises and service/manufacturing sectors leading. Barriers such as high costs, skill gaps, and infrastructure challenges hinder progress, particularly for microenterprises and traditional sectors like tourism/handicrafts. The findings underscore the need for targeted interventions to bridge the adoption gap and empower MSMEs to compete in a digital economy. By addressing these challenges, Rajasthan's MSMEs can leverage AI/ML to drive innovation, efficiency, and growth, contributing to the state's economic development.

SUGGESTIONS

To enhance AI/ML adoption in Rajasthan's MSMEs, the following strategies are recommended:

Subsidized AI/ML Solutions: Government and industry bodies should offer low-cost AI tools tailored for MSMEs, particularly micro-enterprises. Cloud-based platforms can reduce infrastructure costs.

Skill Development Programs: Collaborate with universities and tech firms to provide affordable training on AI/ML applications, focusing on practical skills for non-technical MSME owners.

Sector-Specific Initiatives: Develop AI solutions for traditional sectors like handicrafts, such as AI-driven design tools or e-commerce analytics, to encourage adoption.

Public-Private Partnerships: Foster collaborations between tech startups and MSMEs to create affordable, scalable AI/ML solutions.

Awareness Campaigns: Launch region-wide campaigns to educate MSME owners about the benefits of AI/ML, using success stories from Rajasthan to build trust.

Infrastructure Support: Expand digital infrastructure in rural areas to ensure equitable access to AI/ML technologies. These measures can empower MSMEs to overcome barriers and embrace AI/ML, fostering sustainable growth and competitiveness.

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