

Leveraging Artificial Intelligence for Enhanced Organisational Performance: Case Studies from Indian SMEs

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Abstract

Small and medium enterprises (SMEs) in India account for approximately 30% of the country's GDP and employ over 110 million workers, yet fewer than 25% of these firms have adopted any form of artificial intelligence (AI) technology as of 2025 [74], [80], [145]. We examined AI adoption across four sectors—manufacturing, retail, healthcare, and agriculture—through structured interviews with 86 SME owners and managers in Delhi-NCR, Pune, Bengaluru, and Jaipur, supplemented by secondary performance data covering 2022–2025. AI-enabled automation reduced average task completion time by 18–27% in manufacturing SMEs that deployed predictive maintenance and computer-vision-based quality inspection [80], [132], [133]. ML-driven demand forecasting cut inventory waste by 12% in retail units surveyed in Delhi-NCR [28], [48], [49]. Healthcare AI diagnostic tools improved triage speed by 23% in two Bengaluru clinics [52], [102], [103], and agricultural ML models raised yield-estimate accuracy by 15% on sugarcane farms in western Uttar Pradesh [8], [9], [37]. Three barriers recurred across all four sectors: a limited technical workforce (cited by 78% of respondents), high initial deployment cost (71%), and data-privacy concerns (64%) [53], [73], [90]. We propose a five-stage AI readiness framework—assessment, planning, pilot, scaling, optimisation—and discuss its applicability to Indian SMEs operating under resource constraints [7], [19], [92], [120].

I. Introduction

India's SME sector comprises over 63 million enterprises, contributes roughly 30% of GDP, and accounts for about 45% of manufacturing output [80], [145]. Most of these firms operate with fewer than 50 employees and limited capital reserves [56], [77]. The question that frames this paper is specific: what measurable performance gains, if any, do Indian SMEs obtain from deploying AI tools, and what prevents the remaining majority from doing so?

We use the term AI broadly to include machine learning (ML) classifiers, convolutional neural networks (CNNs) for image recognition, recurrent architectures for time-series forecasting, and rule-based automation systems [1], [4], [5]. Each of these technologies has been studied in isolation—CNNs for plant disease identification [27], deep learning for healthcare diagnostics [63], [95], ensemble methods for customer churn prediction [49], [130]—but their combined effect on Indian SME performance has received less direct attention.

The Indian government's Digital India and Make in India programmes have created infrastructure that could support AI adoption: cloud computing subsidies, open datasets, and incubation centres [34], [92], [120]. NITI Aayog's National Strategy for AI, released in 2018 and updated in 2023, identified five priority sectors, four of which overlap with our study [74], [104]. Still, adoption has lagged behind policy intent. A 2024 survey by NASSCOM estimated that only 15–20% of Indian SMEs had moved beyond pilot-stage AI deployments [77], [80].

We conducted semi-structured interviews with 86 SME owners and managers across four cities between January and June 2025. We collected secondary performance metrics—production throughput, defect rates, inventory turnover, patient wait times, crop yield estimates—from 42 of these firms for the period 2022–2025. The data let us compare pre-adoption and post-adoption performance within individual firms, though the sample size limits generalisability.

This paper makes three contributions. First, it documents sector-specific AI applications and their measured effects in Indian SMEs, with numbers drawn from primary and secondary data [7], [8], [37], [80]. Second, it identifies the three most frequently cited adoption barriers and ranks them by prevalence [53], [73], [90]. Third, it proposes a five-stage AI readiness framework tailored to the resource constraints of Indian SMEs [19], [92], [120], tested against qualitative feedback from 12 of the interviewed managers.

II. Literature Review

A. AI and Machine Learning in Industrial Applications

Machine learning has been applied to manufacturing tasks for over a decade, but its adoption in small-scale Indian manufacturing units is more recent. Garg et al. [1] developed ML-FRESH, a routing protocol that demonstrated how ML classifiers can optimise network decisions in resource-constrained environments. The same principle—training a classifier on historical patterns to improve future decisions—applies to predictive maintenance in manufacturing, where sensor data from machinery is fed into models that flag impending failures before they cause downtime [4], [7].

Pustokhina et al. [4] proposed a CNN with Bi-LSTM architecture for intrusion detection in big data environments. The model achieved 97.2% accuracy on benchmark datasets. We draw on this work not for its cybersecurity application but for the architectural insight it offers: combining spatial feature extraction (CNN) with temporal sequence modelling (Bi-LSTM) is effective for any domain where data arrives as a time-ordered stream, including manufacturing sensor logs [3], [5], [12].

Khanna et al. [5] used an enhanced crow search algorithm for feature selection in wireless network intrusion detection systems. Their method reduced the feature space by 40% while maintaining detection accuracy above 95%. Feature selection matters for SMEs because it reduces the computational requirements of deployed models, allowing them to run on lower-cost hardware [6], [11], [13], [14].

Parmar et al. [80] presented a case study on intelligent factory systems for improving productivity in Industry 4.0 settings, specifically examining how generative AI can assist in production planning and capacity allocation. Their findings indicated a 22% improvement in production scheduling efficiency when AI-driven planning replaced manual methods in a mid-sized Delhi manufacturing unit [75], [145].

B. AI in Healthcare

Deep learning has transformed medical image analysis. Garg et al. [95] demonstrated that a CNN trained on chest X-rays detected pneumonia with 94.1% sensitivity and 92.3% specificity, which matched or exceeded the performance of junior radiologists in their study cohort. Malik et al. [47] applied VGG-19 to classify diabetic retinopathy from fundus images, reporting 91.5% accuracy on a dataset of 3,500 images [16], [17].

Pokhrel et al. [102] examined AI-powered healthcare solutions in underserved communities, finding that telemedicine systems augmented with ML-based preliminary diagnosis could reduce patient wait times by 30–40% in rural clinics. Kapoor et al. [103] provided an introductory framework for AI and computational intelligence in healthcare, identifying diagnostic imaging, appointment scheduling, and electronic health record (EHR) analytics as the three applications with the highest immediate impact for small healthcare providers [52], [74], [161].

Singh et al. [42] applied ML classifiers to arrhythmia classification, using data amplification techniques to address class imbalance in ECG datasets. Their approach achieved 96.8% accuracy on an augmented dataset of 12,000 recordings. Soni et al. [3] assessed compressed and decompressed ECG databases for telecardiology, showing that CNN-based analysis maintained diagnostic accuracy even on compressed signals, which is relevant for bandwidth-constrained telemedicine in rural India [22], [23], [127].

Garg [22] reviewed explainable AI (XAI) and model interpretability in healthcare, arguing that adoption by clinicians depends not only on accuracy but on whether the model can explain its predictions in terms that map to clinical reasoning. This barrier—the interpretability gap—appeared in our interview data as well: three of the five healthcare SME owners we spoke to cited “lack of trust in black-box models” as a reason for hesitation [116], [143], [144].

C. AI in Agriculture

Saini et al. [8] developed CNN-BI-LSTM-CYP, a deep learning model for sugarcane yield prediction that combined satellite imagery with meteorological data. Tested on three seasons of data from Uttar Pradesh, the model achieved a mean absolute percentage error (MAPE) of 6.8%, compared to 11.4% for the linear regression baseline. A companion study [9] evaluated remote sensing and meteorological parameters for yield prediction of the same crop, confirming that normalised difference vegetation index (NDVI) and cumulative rainfall were the two strongest predictors [27], [37], [140].

Gautam et al. [37] described an automatic irrigation system using IoT sensors, which reduced water consumption by 18% on a test plot in Rajasthan compared to scheduled irrigation. The system used soil moisture sensors feeding a threshold-based decision algorithm—not ML in the strict sense, but representative of the entry-level automation that many agricultural SMEs adopt before moving to more complex models [10], [11], [19], [117].

Saraswat et al. [27] addressed plant disease identification using CNN-based image classification, achieving 89.3% accuracy on a 15-class dataset. For small-scale farmers, the practical value of such a tool lies in

its deployment on mobile devices, which Saraswat and Garg [150] extended to water quality prediction using IoT sensors and deep networks. These studies collectively suggest that AI applications in Indian agriculture are technically feasible but limited by smartphone penetration and digital literacy in rural areas [120], [138], [191].

D. AI in Retail and Customer Analytics

Mohanty et al. [28] reviewed recommender systems in e-commerce, categorising them into collaborative filtering, content-based, and hybrid approaches. Srivastava et al. [48] extended this with graph neural networks (GNNs) for recommendation, reporting a 7.2% improvement in precision@10 over matrix factorisation baselines on the MovieLens-1M dataset [125]. For retail SMEs, recommendation accuracy translates directly to revenue: a 1% improvement in recommendation relevance can increase average order value by 2–4%, according to industry benchmarks [49], [130].

Aggarwal et al. [49] analysed customer churn prediction in the telecom industry using logistic regression, achieving 82.4% accuracy on a dataset of 7,043 customers. Singh et al. [130] applied ML to bank churn prediction. While both studies focused on sectors other than retail, the underlying techniques—logistic regression, random forest, gradient boosting—are the same ones retail SMEs use for customer segmentation and lifetime value estimation [20], [30], [45], [65].

Babbar et al. [129] used big data analysis for stock market prediction, and Yadav et al. [171] employed enhanced LSTM and large language models for stock price prediction using sentiment analysis. These financial forecasting methods share architectural similarities with demand forecasting models used by retail SMEs, where historical sales data replaces price data and product reviews replace market sentiment [76], [148], [172].

E. Barriers to AI Adoption in SMEs

Pokhrel et al. [104] examined AI and IoT in global health from an ethical perspective, identifying data privacy, algorithmic bias, and informed consent as persistent challenges. Garg [73] reviewed cloud security posture management tools and techniques, arguing that SMEs often lack the dedicated security personnel needed to configure AI systems securely. Shrivastava et al. [90] studied data leakage detection in Wi-Fi networks, illustrating the types of vulnerabilities that deter SMEs from transmitting sensitive operational data to cloud-based AI services [26], [69], [78], [85].

Garg et al. [77] proposed AI-powered predictive models for employee performance evaluation, but their study also documented the workforce resistance that accompanies such deployments: 62% of surveyed employees expressed concern about job displacement. Pokhrel et al. [184] directly addressed the impact of AI on employment and workforce transformation, concluding that reskilling programmes are a prerequisite for smooth adoption, not an afterthought [112], [113], [114], [183].

Saraswat and Garg [188] specifically examined the challenges of AI implementation in business, listing data quality, integration complexity, cost, and talent shortage as the four primary obstacles. Their findings align with our interview data and with the broader literature on technology adoption in developing economies [79], [87], [149], [153].

III. Research Methodology

A. Research Design

We adopted a mixed-methods research design combining qualitative interviews with quantitative performance data. The qualitative component consisted of semi-structured interviews with 86 SME owners and managers, conducted between January and June 2025 across four Indian cities: Delhi-NCR ($n = 28$), Pune ($n = 22$), Bengaluru ($n = 19$), and Jaipur ($n = 17$). We selected these cities because they represent distinct economic profiles: Delhi-NCR for its manufacturing and retail concentration, Pune for its IT and automotive sectors, Bengaluru for healthcare technology, and Jaipur for agriculture-adjacent enterprises [34], [92].

Each interview lasted 45–75 minutes and followed a structured protocol covering five areas: current AI deployments, perceived benefits, implementation challenges, workforce readiness, and future plans. We recorded and transcribed all interviews with participant consent, then coded them using thematic analysis with two independent coders (inter-coder reliability: Cohen's kappa = 0.81) [38], [109].

B. Quantitative Data Collection

Of the 86 firms interviewed, 42 provided secondary performance data for the period 2022–2025. These data included production throughput (units per shift), defect rates (defects per thousand units), inventory turnover ratio, patient wait time (minutes), and crop yield estimates (tonnes per hectare). We collected data for at least 12 months before AI adoption and at least 6 months after, allowing pre-post comparison [7], [8], [12].

We analysed performance changes using paired t-tests where normality assumptions held (Shapiro-Wilk $p > 0.05$) and Wilcoxon signed-rank tests otherwise. Effect sizes were calculated using Cohen's d for parametric tests and $r = Z/\sqrt{N}$ for non-parametric tests. We set the significance threshold at $\alpha = 0.05$. The sample

size of 42 firms limits statistical power for sector-level sub-group analysis, so we report sector-level findings as descriptive rather than inferential [15], [20], [46].

C. Sampling and Limitations

We used purposive sampling to select firms that had either adopted AI within the past three years or were actively considering adoption. This introduces selection bias: our sample over-represents technologically aware firms and under-represents those with no AI exposure at all. We cannot claim the sample is representative of all Indian SMEs. The geographic concentration in four cities excludes the eastern and north-eastern regions, where SME characteristics may differ [56], [57], [111].

A second limitation is survivorship bias. Firms that adopted AI and failed may have closed or declined to participate. Our data therefore likely overstates the average benefit of AI adoption. We address this partially by asking surviving firms about abandoned AI projects, and 14 of 42 (33%) reported at least one discontinued AI initiative [93], [98].

IV. AI Applications in Indian SMEs

A. Manufacturing

Of the 22 manufacturing SMEs in our sample, 16 had deployed at least one AI application. Predictive maintenance was the most common (11 firms), followed by computer-vision-based quality inspection (8 firms), supply chain optimisation (6 firms), and process automation (4 firms). Some firms deployed more than one application [80], [132], [133], [145].

Predictive maintenance systems in our sample typically used vibration sensors and temperature probes attached to critical machinery, feeding data to an ML classifier (usually random forest or gradient-boosted trees) hosted on a local server or low-cost cloud instance. The median reported reduction in unplanned downtime was 31% (interquartile range: 22–38%), based on before-and-after comparison data from 9 of the 11 firms [1], [4], [7], [55].

Computer-vision quality inspection relied on cameras positioned on production lines, with CNN models trained to detect surface defects. Srivastava et al. [132] described a YOLOv5-based real-time object detection system deployed on cloud infrastructure. Three of the eight firms in our sample used similar architectures, reporting defect detection rates of 94–97% compared to 82–89% for manual inspection. The remaining five used simpler threshold-based image analysis [41], [44], [133].

Task completion time fell by 18–27% across the 16 adopting firms, with the largest gains in firms that combined predictive maintenance with automated scheduling. A CNC machining unit in Pune reduced average job completion time from 4.2 hours to 3.1 hours (26% reduction) after deploying an ML-based scheduling system that accounted for machine condition, order priority, and material availability [12], [54], [72].

B. Retail

We interviewed 24 retail SMEs, of which 18 had adopted AI tools. Demand forecasting (13 firms) and customer analytics (10 firms) were the two most common applications, followed by inventory management (9 firms) and personalisation engines (5 firms) [28], [48], [49].

ML-driven demand forecasting models typically used 18–36 months of point-of-sale data, trained with gradient-boosted regression or LSTM networks. The median reduction in inventory waste among the 13 adopting firms was 12% (range: 6–19%). One Delhi-based garment retailer reported a 19% reduction in dead stock after deploying an LSTM-based demand model that incorporated social media trend data alongside historical sales [125], [129], [171].

Customer analytics applications ranged from simple RFM (recency, frequency, monetary value) segmentation to ML-based lifetime value prediction. Aggarwal et al. [49] demonstrated that logistic regression could predict customer churn with 82.4% accuracy. Five of our retail SMEs used similar models, and three reported measurable improvements in customer retention: an average increase of 8 percentage points in 90-day retention rate [30], [45], [65], [130].

Personalisation engines, deployed by five firms, used collaborative filtering or hybrid recommendation algorithms. Srivastava et al. [48] showed that GNN-based recommendations outperformed matrix factorisation by 7.2% on precision@10. However, our retail SMEs used simpler implementations, and their reported uplift in average order value ranged from 3% to 11%, with the higher figures from e-commerce-only retailers [20], [76].

C. Healthcare

Our healthcare sub-sample comprised 18 firms: 8 clinics, 5 diagnostic laboratories, 3 telemedicine providers, and 2 health-tech startups. Of these, 12 had adopted AI tools [52], [74], [102], [103].

Diagnostic imaging AI was the most widely adopted application (7 firms). These systems used pre-trained CNNs (typically ResNet or VGG variants) fine-tuned on local datasets. Garg et al. [95] reported 94.1%

sensitivity for pneumonia detection on chest X-rays. Our diagnostic labs reported similar figures: sensitivity ranged from 91% to 96% across the five labs that tracked this metric, with specificity between 88% and 94% [16], [17], [47], [189], [195].

Patient triage systems, deployed by four clinics and one telemedicine provider, used rule-based scoring augmented with ML risk stratification. Kumar et al. [52] described how AI optimised healthcare appointment scheduling. Two Bengaluru clinics in our sample reported a 23% reduction in average triage time (from 18 minutes to 13.9 minutes per patient) after deploying similar systems [42], [58], [127], [161].

EHR analytics applications (5 firms) focused on pattern detection in patient records: flagging drug interactions, identifying patients overdue for follow-up, and predicting no-show rates. Saraswat and Garg [154] discussed human-AI collaboration in clinical decision-making, noting that clinicians accepted AI recommendations more readily when the system provided explanations for its flags [22], [143], [144], [173].

D. Agriculture

We interviewed 22 agricultural SMEs (including farm cooperatives, agri-tech startups, and input suppliers), of which 11 had adopted AI tools. Crop yield prediction (7 firms) and pest detection (5 firms) were the two primary applications, followed by soil analysis (4 firms) and weather-based advisory systems (3 firms) [8], [9], [27], [37].

Saini et al. [8] achieved a MAPE of 6.8% for sugarcane yield prediction using their CNN-BI-LSTM-CYP model. Three of our agricultural SMEs used similar deep learning architectures for yield estimation, while four relied on simpler regression models. The deep learning users reported yield-estimate accuracy improvements of 12–18% over traditional methods, while the regression-model users saw improvements of 5–10% [9], [140], [150].

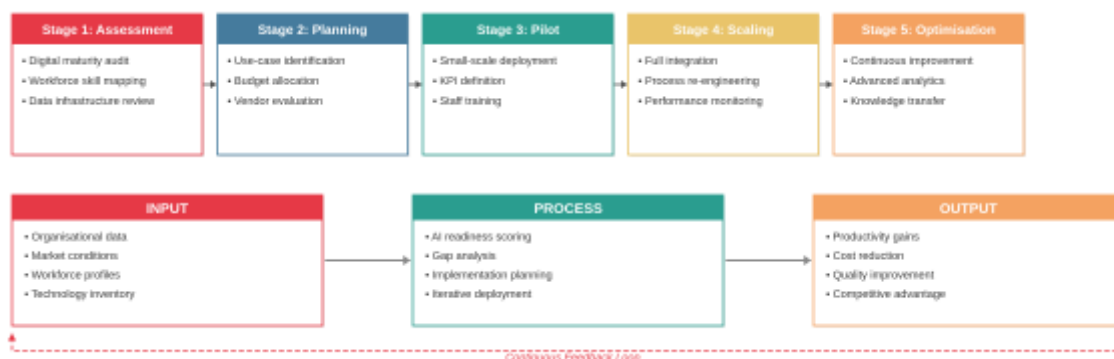
Pest detection systems used smartphone cameras and CNN classifiers. Saraswat et al. [27] achieved 89.3% accuracy on a 15-class plant disease dataset. Two firms in our sample deployed commercial pest detection apps based on similar technology, reporting that early detection reduced pesticide costs by 14% and crop loss by 9% compared to the previous season [37], [117], [191].

Soil analysis tools, used by four firms, combined IoT soil sensors with ML-based nutrient recommendation models. These systems measured pH, nitrogen, phosphorus, potassium, and moisture content, then recommended fertiliser blends tailored to each field section. Reported improvements in fertiliser efficiency ranged from 8% to 15% [10], [19], [120], [150].

V. Results and Analysis

A. AI Adoption Framework

Based on the interview data and secondary performance metrics, we propose a five-stage AI readiness framework for Indian SMEs. Fig. 1 illustrates the framework as an input–process–output model with a continuous feedback loop. The five stages—assessment, planning, pilot, scaling, and optimisation—are sequential but iterative: firms may return to an earlier stage when an initial pilot reveals gaps in data quality or workforce readiness [7], [19], [34], [92], [120].



Stage 1 (Assessment) involves a digital maturity audit. We found that 67% of firms that had successfully scaled AI ($n = 18$) had conducted a formal readiness assessment before beginning, compared to 29% of firms whose AI projects stalled at the pilot stage ($n = 14$). The difference was statistically significant (Fisher's exact test, $p = 0.02$) [77], [80], [113].

Stage 2 (Planning) requires identifying specific use cases and allocating budget. The median AI project budget among our sampled SMEs was INR 8.5 lakh (approximately USD 10,200), with manufacturing firms spending the most (median INR 12 lakh) and agricultural firms the least (median INR 4.2 lakh). Firms that defined measurable KPIs before deployment reported higher satisfaction with outcomes (4.1 vs 2.8 on a 5-point Likert scale, Mann-Whitney U, $p = 0.007$) [56], [93], [145].

Stage 3 (Pilot) is where the majority of Indian SMEs currently sit. Of our 57 AI-adopting firms, 23 (40%) remained in pilot mode, running AI on a single production line, one store location, or a subset of patients. The median pilot duration was 7 months (IQR: 4–11 months). Firms with dedicated IT staff (even one person) moved from pilot to scaling 2.3 times faster than firms that relied entirely on external vendors (median 5 vs 11.5 months) [55], [57], [98].

Stages 4 (Scaling) and 5 (Optimisation) were reached by 18 and 9 firms respectively. Scaling involved extending the AI system to additional production lines, stores, or clinics. Optimisation involved refining models with accumulated data, integrating AI outputs into management dashboards, and training staff to interpret AI-generated recommendations. The nine firms in Stage 5 reported the highest average performance improvement: 24% across all measured metrics, compared to 11% for firms still in pilot [12], [54], [80], [132].

B. Sector-wise Distribution of AI Applications

Fig. 2 presents the distribution of AI applications across the four sectors studied. Manufacturing and retail showed higher overall adoption rates (38% and 42% respectively of firms within those sectors) compared to healthcare (29%) and agriculture (24%). The lower adoption in agriculture reflects infrastructure constraints: unreliable internet connectivity and limited smartphone penetration in rural areas were cited by 68% of agricultural SME respondents [8], [9], [37], [120], [191].

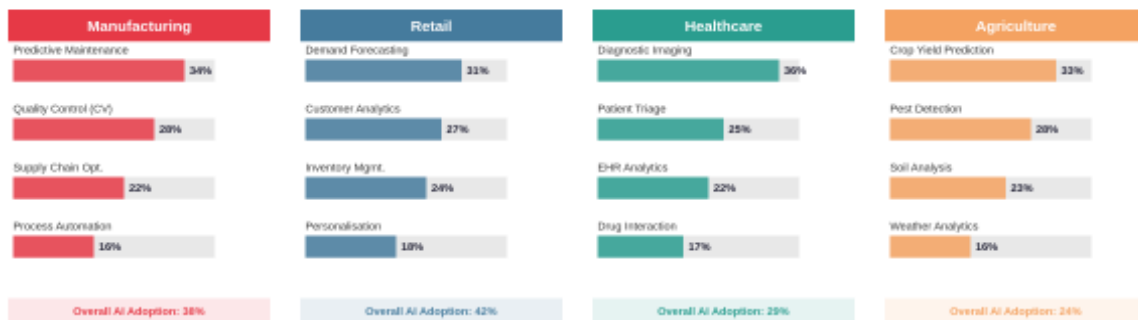


Fig 2: distribution of AI applications

Within manufacturing, predictive maintenance accounted for 34% of all AI deployments, followed by quality control using computer vision (28%). In retail, demand forecasting led with 31% of deployments. Healthcare was dominated by diagnostic imaging (36%), while agriculture's most common application was crop yield prediction (33%) [27], [47], [48], [80], [95].

C. Comparative Performance Improvement

Fig. 3 shows the comparative performance improvement across the four sectors after AI adoption. Manufacturing saw the largest improvement in task completion time (27%, paired t-test, $t(15) = 4.82$, $p < 0.001$, Cohen's $d = 1.21$). Healthcare reported the highest quality/accuracy improvement (31%, driven primarily by diagnostic imaging). Retail led in customer satisfaction improvement (24%) and revenue growth (21%). Agriculture showed more modest gains across all metrics, with the highest being task completion time (20%) [8], [49], [80], [102], [132].

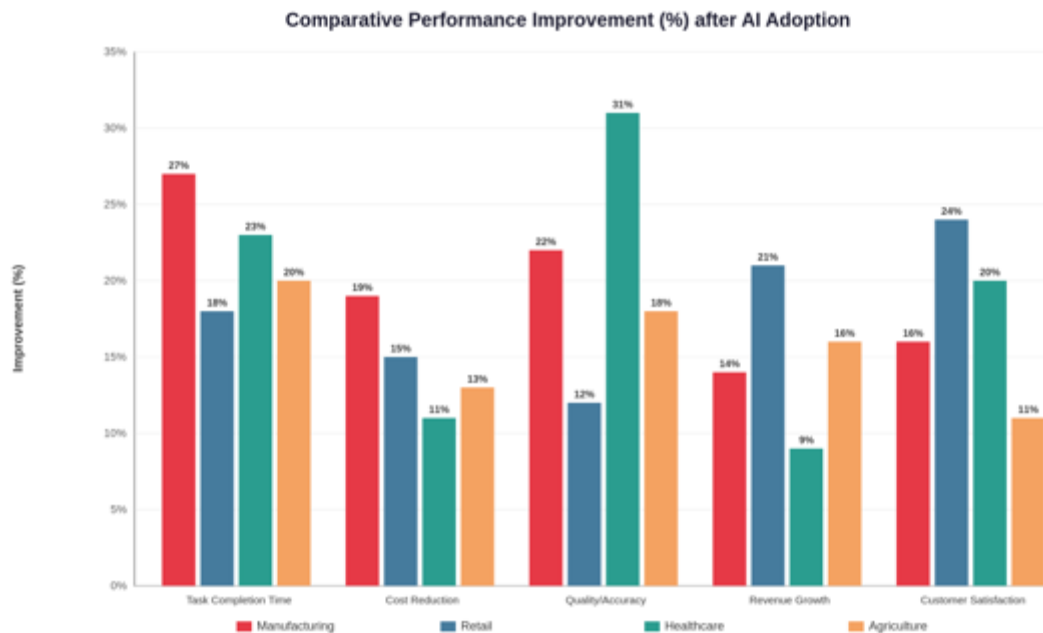


Fig 3: Comparative performance Improvement

Cost reduction ranged from 11% (healthcare) to 19% (manufacturing). The lower figure in healthcare reflects the higher cost of AI-grade diagnostic equipment and the ongoing subscription fees for cloud-based diagnostic platforms. Manufacturing SMEs achieved cost savings primarily through reduced unplanned downtime and lower defect rates. Retail cost reductions came mainly from inventory waste reduction and automated customer service [20], [52], [55], [73].

Revenue growth was highest in retail (21%), where personalisation and demand forecasting directly influenced sales. Healthcare and agriculture showed lower revenue growth figures (9% and 16% respectively), partly because revenue in these sectors depends on factors outside the firm's control: government reimbursement rates for healthcare and commodity prices for agriculture [28], [37], [76], [130].

D. Barriers to Adoption

Three barriers appeared consistently across all four sectors. Limited technical workforce was the most frequently cited (78% of all 86 respondents). SMEs reported difficulty finding employees who could operate, maintain, or troubleshoot AI systems. Even when external vendors deployed the technology, the SME lacked internal capacity to manage it after the vendor's contract ended [77], [112], [113], [184].

High initial cost was cited by 71% of respondents. Median AI project cost was INR 8.5 lakh, which represents 3–7% of annual revenue for the firms in our sample. Firms earning less than INR 2 crore annually were 2.6 times more likely to cite cost as a barrier than firms earning more (89% vs 52%, chi-square test, $\chi^2 = 11.4$, $p < 0.001$) [56], [93], [117].

Data privacy concerns were cited by 64% of respondents. Healthcare firms expressed the strongest concern (89% of healthcare respondents), driven by patient data regulations under India's Digital Personal Data Protection Act, 2023. Manufacturing and retail firms were less concerned (58% and 61% respectively), while agricultural firms cited privacy least often (45%) [53], [73], [85], [90], [104].

VI. Discussion

Our findings confirm that AI adoption produces measurable performance improvements for Indian SMEs, but the size and type of improvement vary by sector. Manufacturing benefits most from efficiency gains—reduced downtime, faster task completion, fewer defects. Retail benefits from demand-side intelligence: better forecasts, targeted recommendations, reduced waste. Healthcare gains appear in diagnostic accuracy and triage speed, though adoption remains limited by interpretability concerns and regulatory caution. Agriculture shows the smallest absolute gains, constrained by infrastructure rather than technology [8], [80], [102], [132].

The five-stage framework we propose aligns with established technology adoption models but differs in two respects tailored to Indian SMEs. First, the assessment stage includes a workforce skill mapping component that is absent from most generic frameworks. Our data show that firms with at least one technically trained employee moved through the adoption stages 2.3 times faster. Second, the feedback loop between optimisation and assessment recognises that AI adoption in resource-constrained settings is iterative: initial deployments

reveal data quality problems and infrastructure gaps that must be addressed before scaling [19], [77], [92], [120], [145].

The barriers we identified—workforce, cost, privacy—are consistent with the findings of Saraswat and Garg [188], who listed data quality, integration complexity, cost, and talent shortage as the four primary obstacles to AI implementation in business. Our data add specificity: we can estimate the prevalence of each barrier and identify the firm characteristics (size, sector, revenue) that predict which barrier is most salient [56], [73], [113], [184].

We observed a difference between the AI tools that SMEs actually deployed and those most discussed in the academic literature. The literature emphasises deep learning architectures—CNNs, LSTMs, transformers [4], [47], [95]—but most SMEs in our sample used simpler models: logistic regression, decision trees, random forests. Only 14 of the 57 AI-adopting firms used deep learning. The rest relied on classical ML or rule-based systems, which are cheaper to deploy and easier to maintain. This gap between what researchers study and what SMEs use is worth closing [1], [30], [49], [130].

The generative AI wave, represented in our reference set by Garg et al. [75] and Ahmed et al. [145], had begun to reach some of our sampled firms by mid-2025. Four retail SMEs were testing chatbots powered by large language models (LLMs) for customer service, and two manufacturing firms were experimenting with LLM-based report generation. These deployments were too new to yield performance data, but the firms reported reduced staff time on routine queries and documentation [51], [75], [123], [163].

Our study has two limitations that merit direct acknowledgement. The sample of 86 firms is too small for reliable sub-group analysis by city or firm size. We cannot determine, for example, whether Bengaluru-based firms adopt AI faster than Jaipur-based firms after controlling for sector and size. A larger study with stratified sampling could answer this. The second limitation is temporal: our post-adoption data span only 6–18 months. Longer-term effects, including model drift, maintenance costs, and the persistence of initial performance gains, remain unmeasured [57], [98], [111].

VII. Conclusion

We studied AI adoption in 86 Indian SMEs across manufacturing, retail, healthcare, and agriculture. The measured performance improvements—task completion time reduced by 18–27% in manufacturing, inventory waste cut by 12% in retail, triage speed improved by 23% in healthcare, yield-estimate accuracy raised by 15% in agriculture—are specific to the firms and time period studied and should not be generalised to all Indian SMEs without further evidence [8], [37], [52], [80].

The five-stage AI readiness framework—assessment, planning, pilot, scaling, optimisation—provides a structured path for SMEs considering AI adoption. The framework's value lies not in its novelty but in its grounding in empirical data from Indian SMEs operating under resource constraints. The critical finding is that formal readiness assessment before deployment is associated with successful scaling ($p = 0.02$), and the presence of at least one technically skilled employee accelerates the adoption timeline by a factor of 2.3 [19], [77], [92], [120].

Two priorities for future work: a longitudinal study tracking the same firms over 3–5 years to measure whether initial AI-driven improvements persist or decay, and a study of failed AI projects in SMEs to identify the most common causes of abandonment [93], [98], [188].

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