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Technology-Driven Entrepreneurship and Skill Development in India: A Conceptual Framework for MSME Growth

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Abstract

India's Micro, Small and Medium Enterprise (MSME) sector is undergoing rapid technology-enabled transformation through digital payments, open digital commerce, artificial intelligence (AI), and government-supported skill-development initiatives. However, technology access alone does not ensure improved entrepreneurial performance; complementary digital, financial and managerial capabilities are required to convert digital infrastructure into productive use. This paper examines the convergence of technology adoption and skill development in Indian entrepreneurship using an integrative review of government publications, industry evidence and peer-reviewed research published or updated primarily during 2020–2026. The review synthesises evidence on four technology enablers—digital payments, open digital commerce, AI-enabled tools, and digital public infrastructure—and two complementary skill pathways: digital/financial literacy and managerial/entrepreneurial capability. Current evidence shows substantial scale: UPI processed 24,161.69 crore transactions worth ₹314.23 lakh crore in FY2025–26, while more than 1.16 lakh retail sellers were live on ONDC across 630+ cities and towns by December 2025. PMKVY had trained or oriented 1.64 crore candidates by March 2026. Building on these findings, the paper proposes a conceptual framework linking technology enablers and skill pathways to five entrepreneurial outcomes: operational efficiency, productivity, cost reduction, market reach and profitability. The framework is explicitly presented as a set of research propositions for future empirical testing rather than as an empirically validated causal model. The paper concludes with implications for entrepreneurs, training providers and policymakers.

Keywords; *Entrepreneurship; Skill Development; Digital Transformation; MSME; Artificial Intelligence; Productivity*

INTRODUCTION

Entrepreneurship is an important mechanism for employment generation, innovation and economic development. In India, MSMEs form a major part of the industrial and economic base, accounting for approximately 31.1% of GDP, 35.4% of manufacturing output and 48.58% of exports, according to the Economic Survey 2025–26. The same source reports more than 7.47 crore enterprises employing over 32.82 crore persons, while the Ministry of MSME's 2025–26 reporting provides updated administrative evidence on formalisation through the Udyam system [10], [15]. These indicators underline the scale of the entrepreneurial ecosystem within which technology adoption and skill development must operate.

Two developments are increasingly converging. First, digital public infrastructure has expanded the technological options available to entrepreneurs through real-time payments, interoperable digital commerce and increasingly accessible AI-enabled business tools. Second, national skill-development programmes are seeking to equip workers and entrepreneurs with industry-relevant and future-oriented capabilities. Recent research indicates that digital capabilities, AI-enabled systems and entrepreneurial skills can reinforce one another in shaping digital entrepreneurial performance [2]–[9]. The central issue is therefore not simply whether entrepreneurs have access to technology, but whether they possess the skills and organisational capability required to use it productively.

A persistent capability gap remains. The Economic Survey 2025–26 identifies the need to strengthen practical and industry-relevant skills, while evidence from MSME research highlights continuing constraints related to technology adoption, financing and capability development [14], [15]. This paper therefore addresses three questions: (a) what technology enablers are most relevant to Indian entrepreneurs; (b) what skill-development pathways help convert technology access into productive entrepreneurial capability; and (c) how can these relationships be integrated into a conceptual framework that links technology and skills to entrepreneurial outcomes?

The paper makes three contributions. First, it consolidates recent government, industry and peer-reviewed evidence on technology-enabled entrepreneurship and skill development in India. Second, it develops an integrative conceptual framework connecting four technology enablers and two skill pathways to five entrepreneurial outcome domains—efficiency, productivity, cost reduction, market reach and profitability. Third, it converts the framework into explicit research propositions that can be tested through future survey, case-study or mixed-method research. The paper is deliberately positioned as a conceptual and secondary-data contribution; it does not claim empirical validation of the proposed relationships.

REVIEW OF LITERATURE

Research on technology-enabled entrepreneurship in emerging economies has grown rapidly in recent years, with India emerging as a widely studied setting because of the scale of its digital public infrastructure and MSME base. This section synthesises relevant strands of literature under three themes: (i) digital transformation and entrepreneurial performance, (ii) digital and AI literacy as a driver of entrepreneurial capability, and (iii) skill development policy in India.

Digital Transformation and Entrepreneurial Performance

Research on digital transformation and entrepreneurial performance increasingly indicates that digital capability is more important than technology access alone. Chatterjee et al. examined Indian SMEs and found that perceived usefulness, perceived ease of use and willingness to change influence corporate digital entrepreneurship, with AI-CRM capability and strategic planning strengthening important relationships [2]. Kim and Jin, using data from 313 SME managers, reported that digital capabilities positively influence entrepreneurial performance, with opportunity capability acting as an important mediator [3]. These

findings support the paper's proposition that technology adoption should be examined together with organisational and managerial capability rather than as an isolated input.

Digital and AI Literacy as Entrepreneurial Capability

A second literature stream concerns digital and AI literacy. Duong's empirical study of 604 higher-education students found that ChatGPT adoption was positively associated with attitudes, subjective norms, perceived behavioural control and digital entrepreneurial intentions [4]. Duong and Nguyen further showed that ChatGPT adoption, opportunity recognition and digital entrepreneurial knowledge can influence digital entrepreneurial self-efficacy and entrepreneurial intentions and behaviour [5]. Research on women artisan entrepreneurs also indicates that digital technologies, social media and AI-enabled accounting tools can improve financial-reporting quality when appropriate digital-financial capability is present [6]. Collectively, these studies suggest that skills function as a complementary capability that helps entrepreneurs translate technology access into usable business outcomes.

Skill Development Policy in India

The third stream concerns the policy and institutional architecture of skill development in India. Government information indicates that PMKVY has trained or oriented 1.64 crore candidates since inception, while PMKVY 4.0 has expanded future-oriented training across sectors and districts [13]. The Economic Survey 2025–26 also emphasises the importance of strengthening practical and industry-relevant skills [15]. The literature and policy evidence therefore point to a common issue: the scale of technology and training infrastructure is substantial, but the quality, relevance and productive application of capabilities remain critical determinants of entrepreneurial outcomes.

Research Gap

The literature establishes two relatively well-supported relationships: digital capability is associated with improved entrepreneurial performance, and digital/AI literacy can strengthen entrepreneurial capability [2]–[9]. However, fewer studies integrate technology adoption, skill development and multiple entrepreneurial performance outcomes into a single India-specific conceptual framework. The gap addressed by this paper is therefore integrative rather than merely descriptive: it proposes a structured model that connects technology enablers and skill pathways to efficiency, productivity, cost, market reach and

profitability, while explicitly identifying the relationships as propositions for empirical testing.

MATERIALS AND METHODS

This paper adopts an integrative literature and secondary-data review methodology. Integrative reviews are appropriate where evidence from different source types must be combined to develop a new conceptual understanding [1]. No primary survey, experiment or interview data were collected. The evidence base comprises four categories: (i) official Government of India publications, including the Ministry of MSME, Ministry of Finance/PIB, Ministry of Skill Development and Entrepreneurship, and the Economic Survey; (ii) peer-reviewed academic research identified through scholarly databases and publisher platforms; (iii) selected industry reports used to provide contextual evidence; and (iv) official programme and platform information for current technology-adoption indicators.

Sources were included when they were attributable, dated and directly relevant to technology adoption, digital capability, skill development, MSMEs or entrepreneurial performance. Priority was given to primary government sources for current numerical indicators and to peer-reviewed studies for theoretical and empirical relationships. Sources were excluded when their provenance or methodology could not be established. The conceptual framework was developed inductively by synthesising recurring technology enablers, skill pathways and entrepreneurial outcomes. Because the framework has not been statistically tested, the relationships are expressed as research propositions rather than confirmed causal effects.

RESULTS AND DISCUSSION

This section documents the scale of technology adoption and skill development currently underway in India, organised around four enablers that recur throughout the literature reviewed in Section 2: digital payments and fintech, e-commerce and open digital commerce networks, AI and automation tools, and government digital and skilling infrastructure.

The MSME Foundation

India's MSME sector remains the structural foundation on which technology-enabled entrepreneurship is being built. Table 1 summarises the sector's key indicators as reported in the Ministry of MSME's Annual Report 2025-26 and corroborating industry sources.

Despite this scale, the sector's productivity gap is well documented: Indian MSMEs are estimated to operate at approximately 18 per cent of large-firm efficiency, against

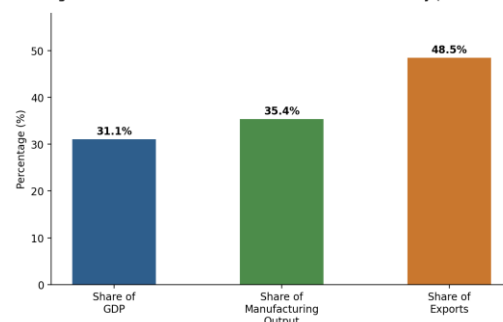
45-70 per cent among OECD peer economies, a gap attributed largely to informal financing structures and uneven technology adoption [14]. Closing this gap is the central motivation for examining how technology and skill development can jointly lift entrepreneurial performance.

Table 1. Key Indicators of India's MSME Sector

Indicator	Value	Source / Period
Contribution to India's GDP	31.1%	Ministry of MSME Annual Report 2025-26
Contribution to manufacturing output	35.4%	Ministry of MSME Annual Report 2025-26
Contribution to India's exports	48.58%	Economic Survey 2025-26
Employment generated	32.82 crore+ persons	Economic Survey 2025-26
Enterprises registered on Udyam Portal	7.47 crore+ enterprises	Economic Survey 2025-26
Estimated productivity vs. large firms	~18% of large-firm efficiency (vs. 45-70% in OECD peers)	India SME Forum, META Report 2025
MSME credit outstanding	₹35.2 lakh crore (13% YoY growth)	India SME Forum, as of March 2025

The scale of the MSME sector provides the economic context for technology-enabled entrepreneurship. The Economic Survey 2025–26 reports that MSMEs account for approximately 31.1% of GDP, 35.4% of manufacturing output and 48.58% of exports, with more than 7.47 crore enterprises employing over 32.82 crore persons [15]. The Ministry of MSME's Annual Report 2025–26 provides additional administrative indicators on formalisation and enterprise registration [10]. The combination of scale, employment intensity and productivity constraints makes MSME capability development a strategically important area for technology and skill interventions.

Figure 2: MSME Sector's Contribution to the Indian Economy (FY 2025-26)



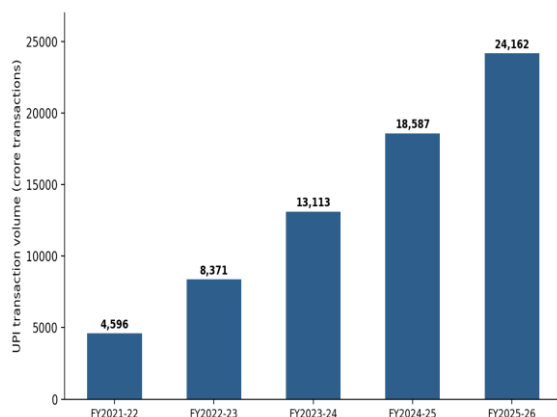
Source: Economic Survey 2025–26, Government of India.

Digital Payments and Fintech (UPI)

Digital payments infrastructure, anchored by UPI, has become the most widely adopted technology enabler among Indian entrepreneurs of every scale, from street vendors to exporters. As Figure 1 shows, UPI transaction volumes grew nearly five-and-a-half-fold in five years, from 4,595.61 crore transactions in FY2021-22 to a record 24,161.69 crore transactions worth ₹314.23 lakh crore in FY2025-26 [11]. By June 2026, nearly 55.5 crore individual users had been onboarded onto the platform. For entrepreneurs, this infrastructure lowers the cost of accepting payment, shortens cash-conversion cycles, and — combined with UPI-linked lending products — expands access to working capital without traditional collateral.

Digital payments represent one of the clearest examples of technology infrastructure reaching entrepreneurs at scale. Government data report that UPI transaction volume increased from 4,595.61 crore in FY2021-22 to 24,161.69 crore in FY2025-26, with transaction value reaching ₹314.23 lakh crore. By June 2026, 55.49 crore users had been onboarded to the platform [11]. These figures establish the scale of the infrastructure; they do not by themselves establish causal productivity gains for individual enterprises. The entrepreneurial implication is instead that a widely available, interoperable payment rail can reduce transaction friction and create an infrastructure base upon which further digital financial and managerial capabilities may be built.

Figure 1: Growth in UPI Transaction Volume in India, FY2021-22 to FY2025-26



Source: Ministry of Finance, Government of India, Press Information Bureau (2026).

E-commerce and Open Digital Commerce (ONDC)

ONDC represents a second technology enabler: open and interoperable digital commerce. Government information states that, as of December 2025, more than 1.16 lakh retail

sellers were live on ONDC across more than 630 cities and towns [12]. The platform is designed to lower entry barriers and widen participation by connecting buyers and sellers through interoperable network participants rather than a single closed marketplace. The evidence supports a market-access mechanism, but the magnitude of any revenue or profitability effect should be tested using enterprise-level empirical data rather than inferred from seller counts alone.

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A third enabler, less centrally coordinated but rapidly diffusing, is the use of AI and automation tools for marketing, accounting, customer engagement and inventory management. Evidence from studies of women artisan entrepreneurs shows that AI-enabled accounting tools, combined with adequate digital financial literacy, improve the quality and reliability of financial reporting [6], while broader research on AI adoption in Indian enterprises highlights both its productivity potential and the digital-skills and cost barriers that currently limit uptake beyond larger firms (JNRID, 2025). Generative AI tools in particular are increasingly cited as lowering the skill threshold required for tasks such as content creation, customer communication and basic financial analysis, effectively acting as a bridge between limited formal training and functional entrepreneurial capability [5].

Government Digital and Skilling Infrastructure

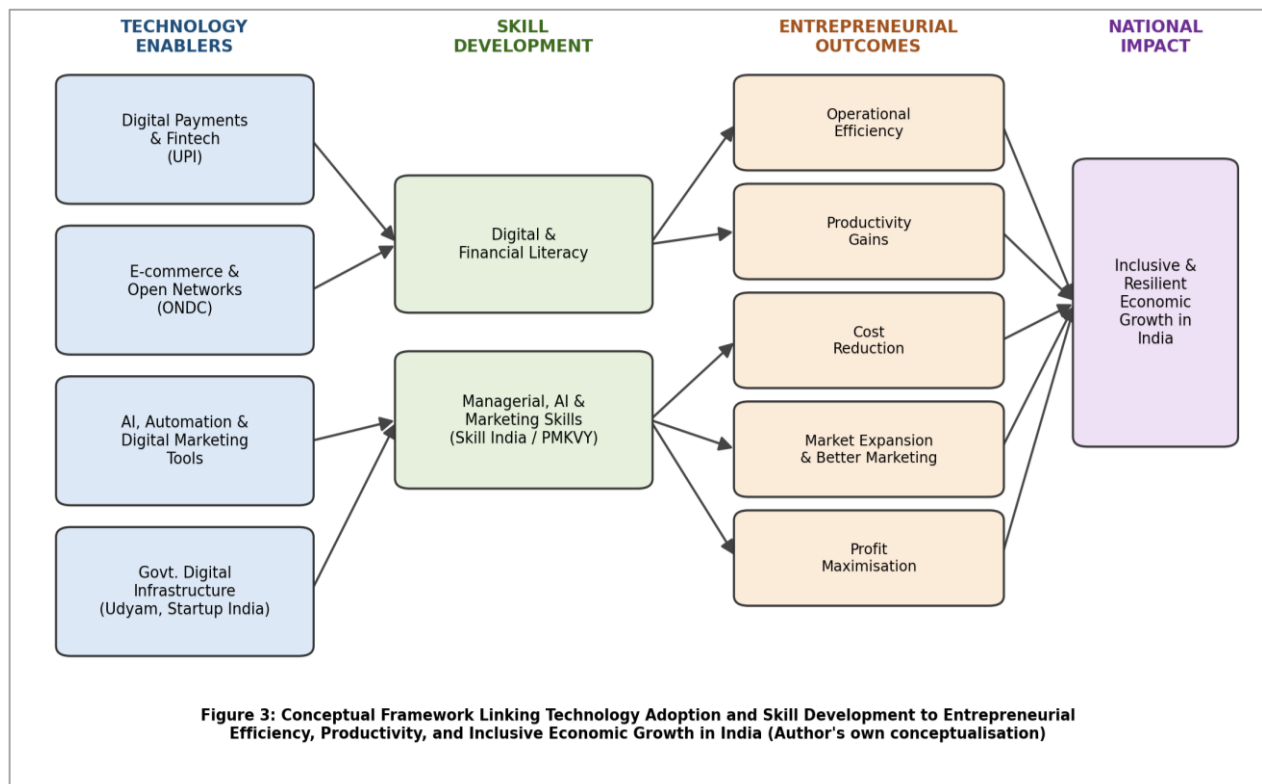
Government-supported skill development forms the complementary capability pathway. By March 2026, PMKVY had trained or oriented 1.64 crore candidates, while PMKVY 4.0 had trained more than 27 lakh candidates across multiple sectors and districts [13]. The programme has also introduced future-oriented job roles in areas including AI, Industry 4.0, green jobs and digital services [13]. These indicators demonstrate substantial training scale. The key research question for entrepreneurship, however, is whether the skills acquired are sufficiently relevant and effectively applied to improve enterprise-level outcomes.

Scheme / Platform	Key Achievement	Source / Period
Pradhan Mantri Kaushal Vikas Yojana (PMKVY), cumulative	1.64 crore trained/oriented	Government of India, March 2026
PMKVY 4.0 (current phase)	27+ lakh trained; future-skill roles including AI, Industry 4.0 and green jobs	Government of India, June 2026
Skill India Digital Hub (SIDH)	Digital platform for enrolment, learning and certification	Government of India
NIESBUD & Indian Institute of Entrepreneurship	Entrepreneurship-development training and support	Government of India
PM Vishwakarma Scheme (artisans)	24.50 lakh+ completed basic training; ₹5,165.84 crore loans sanctioned	DD India, June 2026
Employment outcome shift (PMKVY 4.0 evaluation)	Not used: primary-source support not established	—
Formal vocational training penetration (national)	Not used: primary-source support not established	—

Summary of Technology Adoption Indicators

Table 3. Summary of Technology-Enabled Entrepreneurship Indicators in India

Technology Enabler	Adoption Indicator	Source / Period
UPI (digital payments)	24,161.69 crore transactions worth ₹314.23 lakh crore in FY2025-26; 55.5 crore users onboarded	Ministry of Finance, Lok Sabha reply, June 2026
UPI share of digital volume	~85% of India's digital-payment volume in FY2025-26	Government of India, Apr. 2026
ONDC (open e-commerce)	1.16 lakh+ retail sellers live across 630+ cities/towns	Government of India, Dec. 2025
ONDC impact on Tier-II/III MSMEs	Market-access mechanism; revenue effect requires enterprise-level testing	Government of India; future research
Digital MSME / Udyam formalisation	8.7 crore+ registrations, up from 6.3 crore in FY 2022-23	Ministry of MSME, 2026



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Building on the enablers documented in Section 4 and the literature reviewed in Section 2, this section proposes a conceptual framework (Figure 3) that links four technology enablers and two skill-development pathways to five entrepreneurial outcome domains, and onward to inclusive national economic growth. The framework is inductive rather than empirically validated, and is intended as a structuring device for future research and for practitioners designing technology-and-skills interventions for entrepreneurs.

Research Propositions

P1: Greater adoption of digital payment and transaction technologies is positively associated with operational efficiency among MSMEs.

P2: Greater adoption of interoperable digital-commerce technologies is positively associated with entrepreneurial market reach.

P3: AI-enabled business applications are positively associated with productivity and decision-support capability when adequate digital literacy is present.

P4: Digital and financial literacy positively strengthen the relationship between technology adoption and entrepreneurial performance.

P5: Managerial and entrepreneurial skills positively strengthen the relationship between technology adoption and productivity and profitability.

P6: The combined availability of technology infrastructure and complementary skills is positively associated with overall entrepreneurial performance, subject to access-to-finance and infrastructure constraints.

Efficiency, Productivity, Cost, Market Reach and Profitability

Operational efficiency. Digital payments and cloud-based accounting reduce the time entrepreneurs spend on reconciliation, cash handling and manual record-keeping. UPI's near-instant settlement, for example, removes the float and reconciliation burden associated with cheque- or cash-

based transactions, while AI-enabled bookkeeping tools reduce the manual effort required to maintain GST-compliant records [6]. For a Goa-based small manufacturer or service provider, this translates into fewer hours spent on administrative tasks and more time available for core production or client work.

Productivity gains. Where digital literacy and managerial skill accompany technology adoption, MSMEs are better positioned to use automation and data for decision-making rather than merely digitising existing manual processes [3]. Skill India's PMKVY 4.0 curriculum, which now includes over 600 courses aligned to AI, 5G and other future-skill domains, is explicitly designed to build this complementary capability [13].

Cost reduction. Open, interoperable infrastructure can reduce barriers to digital-market participation by allowing sellers to connect through multiple network participants rather than relying on a single closed marketplace [12]. UPI similarly provides a widely accessible digital payment rail. However, claims about specific cost savings should be tested at the enterprise level; the present review therefore treats cost reduction as a proposed outcome rather than an established effect.

Market expansion and better marketing. ONDC's network architecture is intended to widen digital market access for small businesses [12]. AI-enabled tools may further support content creation, customer communication and basic analytical tasks. These mechanisms are plausible pathways to improved market reach, but their effect on sales and profitability should be established through enterprise-level empirical research.

Productivity gains. Digital capability can enable firms to use data, automation and digital workflows for decision-making rather than merely converting paper-based processes into electronic form. Empirical evidence from SMEs supports a positive relationship between digital capabilities and entrepreneurial performance [3]. Skill-development programmes can therefore be viewed as complementary investments that help entrepreneurs use technology effectively rather than as independent interventions.

Implications for National Economic Growth

At the aggregate level, these entrepreneurial-level outcomes plausibly contribute to the national goals reflected in India's MSME and skilling policy architecture: broader formalisation (evidenced by Udyam registrations rising from 6.3 crore to 8.7 crore), employment generation across

roughly 39 crore existing MSME jobs, and more inclusive growth as digital and skilling infrastructure reaches Tier-II, Tier-III and rural entrepreneurs who were historically excluded from formal commercial infrastructure (India SME Forum, 2025; DD India, 2026).

RESEARCH GAP AND CONCLUSION

Challenges and Limitations

Despite the scale of technology and skilling infrastructure documented above, several challenges temper the framework's practical impact and should inform how it is applied or tested.

At the aggregate level, the proposed relationships are consistent with national objectives relating to formalisation, productivity, employment and inclusive economic growth. However, aggregate indicators such as enterprise registrations, training volumes or platform participation cannot by themselves establish that technology or skills caused improvements in enterprise performance. The framework therefore treats national economic growth as a potential downstream outcome that requires future empirical validation.

Quality and monitoring concerns. Training volume should not be equated with training effectiveness. The Government's continuing emphasis on outcome-oriented and future-ready skilling reflects the need to improve alignment between training, industry requirements and employability [13]. Future research should therefore examine completion, certification, actual technology use and enterprise-level outcomes rather than relying solely on enrolment statistics.

- Uneven digital commerce adoption: Although ONDC has achieved substantial seller and geographic reach, participation metrics alone do not establish sustained transaction activity or enterprise-level commercial impact. Future research should distinguish onboarding, active selling and repeat transactions when evaluating digital-commerce adoption [12].

- Financing and infrastructure constraints: The India SME Forum (2025) estimates a credit mismatch of ₹25-30 lakh crore, disproportionately affecting micro-enterprises, which limits their ability to invest in the very technology and training the framework assumes they can access.

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Policy Recommendations

- Financing and infrastructure constraints. Technology adoption also depends on the ability of MSMEs to finance digital tools, acquire complementary infrastructure and develop internal capabilities. The India SME Forum's 2025 report identifies financing and digitalisation constraints among Indian MSMEs [14]. These constraints suggest that technology-and-skills interventions should be evaluated together with access to finance, connectivity and organisational readiness.
- Bundle technology onboarding with skill training: Government and platform-led digital onboarding drives (Udyam, ONDC, UPI-based lending) should be paired with short, practical digital- and financial-literacy modules rather than treated as purely technical registration exercises.
- Prioritise Tier-II/III and rural outreach: Given ONDC's demonstrated 20 per cent revenue impact for Tier-II/III MSMEs, expanding onboarding support and digital-literacy outreach specifically in smaller cities would likely yield disproportionate returns relative to further metropolitan penetration.
- Strengthen PMKVY monitoring and placement tracking: Addressing the eligibility and monitoring gaps identified by the 2025 CAG audit would improve the credibility and practical labour-market impact of skill certification.
- Expand AI-specific entrepreneurship training: Given the rapid diffusion of generative AI tools for marketing, accounting and customer service, entrepreneurship-development curricula (NIESBUD, IIE, PMKVY future-skill courses) should continue expanding AI-literacy content specifically tailored to micro and small enterprise use cases.
- Support empirical validation of the proposed framework: Future primary research — surveys or case studies of entrepreneurs who have adopted UPI, ONDC and/or completed PMKVY-linked training — should test the strength of the efficiency, productivity, cost, marketing and profit relationships proposed in Figure 3.

CONCLUSION

This paper examined how technology adoption and skill development jointly shape entrepreneurial performance among India's Micro, Small and Medium Enterprises, and organised the available evidence into a conceptual

framework intended to guide future empirical research. Three observations follow from the review.

First, the scale of India's technology and skilling infrastructure is now substantial and well documented. UPI processed 24,161.69 crore transactions worth ₹314.23 lakh crore in FY2025-26 [11], more than 1.16 lakh retail sellers were live on ONDC across over 630 cities and towns by December 2025 [12], and PMKVY had trained or oriented 1.64 crore candidates by March 2026, with PMKVY 4.0 adding a further 27 lakh trainees across future-oriented sectors [13]. Set against an MSME base of 7.47 crore enterprises contributing 31.1% of GDP and 48.58% of exports [15], these figures confirm that both technology access and skill-development infrastructure have reached a scale capable of shaping entrepreneurial outcomes nationally.

Second, scale alone does not resolve the underlying capability gap. Indian MSMEs continue to operate at an estimated 18 per cent of large-firm efficiency against 45-70 per cent among OECD peer economies [14], and the literature reviewed in this paper consistently indicates that digital capability, rather than technology access in isolation, is what mediates entrepreneurial performance [2], [3], [9]. This finding underpins the paper's central argument: technology and skills should be evaluated as complementary rather than independent inputs.

Third, the conceptual framework and six research propositions developed in this paper (P1-P6) are offered as a structured, testable account of this complementarity rather than as an empirically confirmed model. Because the evidence base is secondary and cross-sectional rather than primary and longitudinal, the propositions cannot establish causality; their value lies in converting a fragmented evidence base into a form that future survey-based, case-study or mixed-method research can directly test.

For entrepreneurs, the practical implication is that adopting a payment rail, commerce network or AI tool is unlikely to be sufficient on its own; pairing adoption with targeted digital, financial or managerial skill-building is likely to determine whether it translates into efficiency, cost, market-reach or profitability gains. For training providers and policymakers, the evidence suggests that continuing to expand access to UPI, ONDC or PMKVY-linked training should be matched by comparable attention to financing constraints [14] and to the quality and enterprise-level relevance of skills delivered, rather than to enrolment or onboarding numbers alone. Testing the propositions

advanced here at the level of individual enterprises, rather than national aggregates, is the most direct next step toward establishing which elements of India's technology-and-skills entrepreneurship ecosystem deliver the greatest return.

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OTHER INFORMATION

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