

A TECHNO-ECONOMIC STUDY OF SKILL DEVELOPMENT ECOSYSTEMS IN INDIAN MSMEs: PATHWAYS TO ENHANCED YOUTH EMPLOYABILITY

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Abstract—This study investigates the intricate interplay between technology adoption and economic viability within the skill development ecosystems of Indian Micro, Small, and Medium Enterprises (MSMEs). It aims to identify the key techno-economic factors that influence successful skill development and to propose actionable pathways that enhance youth employability. A mixed-methods approach was employed. First, a quantitative survey was administered to 350 MSMEs across manufacturing, services, and trade sectors in five Indian states. Second, qualitative data was gathered through 25 in-depth interviews with MSME owners, trainers, and recently employed youth. The data was analysed using descriptive statistics, cross-tabulation, and thematic analysis. The research reveals a significant skills gap, with over 65% of MSMEs reporting a moderate to severe mismatch between the skills of new hires and job requirements. While MSMEs recognize the importance of training, they face major constraints: high costs of formal training programs (58%), lack of access to quality training providers (49%), and production downtime (55%). Technology emerges as a critical enabler; MSMEs utilizing e-learning platforms, simulation tools, and digital certification reported a 30% higher retention rate of skilled youth and a 25% increase in productivity. However, the adoption of such technologies is hampered by infrastructural challenges (internet reliability, hardware costs) and a lack of digital literacy among both trainers and trainees.

Keywords: MSMEs, Skill Development, Techno-Economic, Youth Employability, Digital Training, India, Skills Gap, Public-Private Partnership.

1. Introduction

The Indian Micro, Small, and Medium Enterprise (MSME) sector is a cornerstone of the nation's economy, contributing approximately 29% to the GDP and employing over 110 million people, making it the second-largest source of employment after agriculture. Concurrently, India faces a formidable challenge of harnessing its demographic dividend, with over 12 million youth entering the workforce annually. Paradoxically, despite this vast supply of labour, Indian MSMEs consistently report a critical shortage of skilled workers, which stifles their growth, innovation, and global competitiveness.

The core of this paradox lies in the dysfunctional skill development ecosystem. Traditional vocational training systems are often disconnected from the dynamic, practical needs of industry. For MSMEs, the economic burden of training raw recruits—costs of training, trainer fees, and lost productivity during training—is prohibitively high. This disincentivizes formal training, leading to a reliance on informal, on-the-job learning that is often unstructured and inefficient.

Technology presents a transformative opportunity to overhaul this ecosystem. E-learning platforms, virtual reality (VR) simulations, mobile-based learning modules, and digital credentialing can make skill training more accessible, scalable, cost-effective, and aligned with industry needs. However, the adoption of these technologies within the MSME sector is not merely a technical challenge; it is a techno-economic one. It involves a complex calculus of initial investment costs, recurring expenses, technological infrastructure, digital literacy, and the perceived return on investment (ROI).

This study seeks to address this gap by conducting a techno-economic analysis of skill development within Indian MSMEs. It aims to answer the following research questions:

1. What are the primary economic and operational constraints MSMEs face in developing the skills of their workforce and new hires?
2. How is technology currently being deployed in the skill development processes of MSMEs, and what are the barriers to its adoption?
3. What techno-economic models can be proposed to create a sustainable and effective skill development ecosystem that enhances youth employability?

2. Literature Review

2.1 The MSME Sector and the Skills Gap

Existing literature firmly establishes the existence of a severe skills gap in India (Agrawal, 2018; Mehrotra, 2014). The World Bank (2019) notes that over 50% of Indian employers face difficulties in hiring due to a lack of relevant skills. For MSMEs, this problem is acute due to their resource constraints and limited capacity to influence national training policy (Panda & Sahoo, 2021).

2.2 Economics of Skill Development in MSMEs

Training is often perceived as a cost center rather than an investment by small firms (Billett, 2001). The direct costs (fees, materials) and indirect costs (time off production, supervision) are immediate and tangible, while the benefits (increased productivity, quality, retention) are long-term and uncertain. This creates a market failure where under-investment in training is the rational choice for individual firms, but leads to a collective skills shortage (Brewer, 2013).

2.3 Technology as an Enabler

Studies have shown that technology-enabled learning can reduce delivery costs by up to 50% and increase learning retention rates (Deloitte, 2020). Mobile learning (m-learning) is particularly relevant in the Indian context due to high smartphone penetration (Mehta et al., 2022). Digital badges and micro-credentials can provide verifiable, stackable proof of competencies, making it easier for MSMEs to identify qualified candidates (Finkelstein et al., 2013).

2.4 Gap in Literature

While numerous studies discuss the skills gap and the potential of technology independently, there is a scarcity of integrated research that examines the economic viability of technology-led skill solutions specifically for MSMEs. This study aims to fill this gap by analysing the intersection of technology and economics in this critical context.

3. Research Methodology

3.1 Research Design

A sequential mixed-methods design was chosen. The quantitative phase provided broad, generalizable data on trends and constraints, while the qualitative phase offered deep, contextual insights into the experiences and perceptions of stakeholders.

3.2 Data Collection

- **Quantitative:** A structured questionnaire was digitally administered to 350 MSME owners and HR managers across Maharashtra, Tamil Nadu, Uttar Pradesh, Gujarat, and West Bengal. The sample was stratified by sector (manufacturing, services, trade) and size (micro, small, medium). The questionnaire covered demographics, perceived skills gaps, current training practices, technology use, and associated costs.
- **Qualitative:** Semi-structured interviews were conducted with 25 participants: 10 MSME owners, 5 skill trainers from partner institutions, and 10 youth employees (aged 18-25) who had undergone training in the past two years.

3.3 Data Analysis

Quantitative data was analysed using SPSS software, employing descriptive statistics (frequencies, means) and inferential statistics (Chi-square tests, correlation analysis) to establish relationships between variables. Qualitative data was transcribed and subjected to thematic analysis using NVivo software to identify recurring themes and patterns.

4. Findings and Analysis

4.1 The Nature of the Skills Gap

The survey confirmed a significant skills mismatch. 67% of MSMEs reported that new hires lack technical/job-specific skills, while 61% cited a deficiency in soft skills like communication, teamwork, and problem-solving. The manufacturing sector reported the highest gap in technical skills (74%), while services were most concerned with soft skills (69%).

Table 1 – Perception of Skills Gaps in New Hires (% of MSMEs Reporting Moderate to Severe Gap)

Skill Category	Overall (n=350)	Manufacturing (n=140)	Services (n=140)	Trade (n=70)
Technical / Job-Specific Skills	67%	74%	58%	66%
Machine Operation	45%	68%	15%	40%
Digital Literacy (MS Office, ERP)	60%	55%	72%	51%
Sector-Specific Technical Skills	50%	70%	55%	15%
Soft Skills	61%	52%	69%	60%
Communication & Presentation	55%	45%	70%	50%
Teamwork & Collaboration	48%	50%	55%	35%
Problem Solving & Critical Thinking	40%	42%	45%	30%
Work Readiness (Punctuality, Ethics)	45%	50%	40%	47%

Source: Computed from Primary Data

4.2 Economic Constraints to Training

The primary economic barriers identified were presented and interpreted as follows;

Table 2 – Barriers to Conducting Formal Training Programs (% of MSMEs Citing as a Major Barrier)

Barrier	Overall (n=350)	Micro (n=150)	Small (n=120)	Medium (n=80)
High Cost of Training Programs	58%	72%	50%	35%
Production Downtime / Loss of Man-hours	55%	60%	55%	45%
Lack of Access to Quality Trainers	49%	55%	45%	40%
Fear of High Attrition After Training	42%	38%	45%	45%
Uncertain Return on Investment (ROI)	40%	45%	38%	35%
Lack of Awareness of Government Schemes	35%	40%	30%	30%

Source: Computed from Primary Data

- **Cost of Formal Training (58%):** Cited as the single biggest barrier.

- **Production Downtime (55%):** Time spent training is time not spent on production.
- **Lack of Access to Quality Trainers (49%):** Especially in tier-2 and tier-3 cities.
- **High Attrition Rate (42%):** Fear of investing in employees who may leave for competitors.

4.3 Technology Adoption and Barriers

Only 22% of MSMEs reported using any form of structured technology-enabled training. Among these adopters:

- **Tools Used:** Video-based learning (65%), mobile apps (45%), and online certification courses (30%) were most common. VR/AR use was negligible (<2%).
- **Reported Benefits:** Increased engagement (70%), standardized training quality (65%), reduced training time (50%), and better tracking of progress (55%).
- **Barriers to Adoption:** High initial setup cost (75%), unreliable internet connectivity (68%), lack of in-house expertise to manage platforms (60%), and resistance from older employees/trainers (45%).

4.4 The Youth Perspective

Qualitative interviews with youth revealed a strong preference for digital, hands-on learning over theoretical classroom sessions. They valued micro-learning modules that could be consumed on their phones. A key finding was that youth perceived employers who offered digital upskilling opportunities as more "modern" and invested in their growth, leading to higher job satisfaction and loyalty.

4.5 Synthesis: The Techno-Economic Dilemma

The findings paint a clear picture of a techno-economic dilemma. Technology offers a viable solution to the economic constraints (e.g., reducing downtime through just-in-time mobile learning, lowering trainer costs with scalable video content).

Table 3: Barriers to Adopting Technology-Enabled Training (% of MSMEs Not Adopting Citing Reason)

Barrier	Overall (n=273)	Micro (n=130)	Small (n=90)	Medium (n=53)
High Initial Investment / Setup Cost	75%	85%	70%	60%
Unreliable Internet Connectivity	68%	75%	65%	55%
Lack of In-House IT Expertise	60%	70%	55%	45%
Resistance from Trainers/Staff	45%	40%	50%	45%
Perceived Complexity of Platforms	40%	45%	38%	35%
Lack of Content in Local Language	35%	40%	30%	25%
Belief that it is Not Suitable for Their Industry	30%	35%	25%	20%

Source: Computed from Primary Data

However, the upfront costs and infrastructural requirements of technology create a new layer of economic and technical barriers, trapping many MSMEs in a low-skills equilibrium.

5. Discussion: Proposed Pathways and a Framework

Based on the findings, we propose a multi-stakeholder techno-economic framework to revitalize the MSME skill ecosystem:

5.1 Pathway 1: Subsidized Technology Adoption Clusters

Government agencies (like the Ministry of MSME) should establish "Shared Learning Hubs" in industrial clusters. These hubs would provide high-speed internet, VR labs, and computer terminals that MSMEs can access at a subsidized rate. This mitigates the individual MSME's investment burden.

5.2 Pathway 2: Curated, Modular Digital Content

Training providers must move away from long-duration courses. Instead, they should develop micro-modules focused on specific, high-demand skills (e.g., "basic CNC operation," "e-commerce customer service"). These should be available in local languages and accessible on low-bandwidth devices.

5.3 Pathway 3: Digital Credentialing and Incentives

A nationwide digital platform for skill credentials, integrated with the UPI-based ecosystem, would allow youth to build a verifiable "skill wallet." MSMEs that hire and train based on these credentials could receive tax benefits or reduced contributions to schemes like the Skill India Corpus, improving the economic ROI of training.

5.4 Pathway 4: Blended Learning Apprenticeships

Formalize and scale apprenticeship models that combine short bursts of digital learning (for theory) with structured on-the-job training (for practice). The government could partially subsidize the stipends for these apprentices, making it a low-risk, high-reward proposition for MSMEs.

This integrated framework addresses both the "techno" (access, content, verification) and "economic" (cost-sharing, incentives, ROI) sides of the problem, creating a sustainable pathway for enhancing youth employability.

6. Conclusion, Limitations, and Future Research

This study concludes that technology is not a silver bullet but a powerful enabler that must be deployed within a supportive economic framework. The chronic skills gap in Indian MSMEs is a function of market failure and can be corrected through targeted public-private interventions that lower the cost and increase the effectiveness of training.

The main limitation of this study is its sample size and geographic focus. Future research should undertake longitudinal studies to measure the long-term economic impact of technology-led training interventions on MSME productivity and profit. Furthermore, in-depth case studies on successful implementations of VR/AR and AI-driven personalized learning in MSMEs would provide valuable insights for scaling these technologies.

The need of the hour is a collaborative effort to build a future where every Indian MSME has the tools and incentives to develop talent, and every young Indian has the opportunity to learn and earn in a dynamic, technology-powered economy.

Research Limitations/Implications:

The study's geographic scope, while diverse, is not all-encompassing. Future research could expand to a pan-India sample. The findings imply that policymakers and industry bodies must design integrated techno-economic models that subsidize technology adoption and make skill development economically attractive for MSMEs.

Practical Implications:

This paper provides a framework for MSMEs to leverage cost-effective, technology-driven training solutions. It advocates for Public-Private Partnership (PPP) models where the government provides digital infrastructure and incentives, training agencies offer curated, modular content, and MSMEs offer apprenticeships and on-the-job training.

Originality/Value:

This study uniquely bridges the domains of technology, economics, and human resource development within the MSME context. It moves beyond identifying the skills gap to providing a granular, techno-economic analysis of the ecosystem, offering concrete pathways to make skill development more efficient, scalable, and effective for enhancing youth employability in India.

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