

## Transforming India's Human Capital for Industry 5.0: Comparative Analysis of National and Rajasthan Skill Development Ecosystems (2025–2030)

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### ABSTRACT:

The rapid emergence of Industry 5.0 technologies, digital transformation, and the global transition toward a green economy require significant restructuring of vocational education and training systems. This study examines the transformation of India's skill development ecosystem under the Ministry of Skill Development and Entrepreneurship (MSDE), focusing on the transition from the *Make in India* initiative (2014) to the recently introduced *Pradhan Mantri Skilling and Employability Transformation through Upgraded ITIs (PM-SETU)* programme.

The scheme represents a national investment of approximately INR 60,000 crore to modernize 1,000 Industrial Training Institutes (ITIs) through a hub-and-spoke institutional model aimed at improving industry alignment and employability outcomes.

The research adopts a mixed-methods approach combining policy analysis, sector-wise workforce demand projections across regional industrial clusters, and application of the Skill Gap Index (SGI) to evaluate alignment between vocational training supply and industrial demand.

Findings indicate that integration of digital platforms such as the Skill India Digital Hub (SIDH) and credit mobility enabled by the National Credit Framework (NCrF) significantly enhance pathways for certification and lifelong learning. However, notable skill gaps persist in emerging sectors such as renewable energy (SGI 0.44) and AI-enabled manufacturing.

The study recommends strengthening state skill ecosystems through digital public infrastructure, industry-embedded faculty models, and AI-integrated vocational curricula to improve workforce adaptability by 2030.

**Keywords:** Skill India Mission, Vocational Education and Training (VET), PM-SETU, Rajasthan Skill Development Policy 2025, Employability, Industry 5.0, National Credit Framework (NCrF), Skill Gap Index (SGI), Digital Public Infrastructure (DPI).

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### I. INTRODUCTION

India's demographic dividend has reached a critical juncture in 2026. The Ministry of Skill Development and Entrepreneurship (MSDE) has shifted from enrolment-heavy metrics to Outcome-Based Financing (OBF). A landmark achievement of this period is the successful integration of the National Credit Framework (NCrF). This enables ITI students to earn transferable academic credits towards a B.Tech degree., effectively bridging the academic-vocational divide. For a technocrat-administrator, the challenge now lies in managing the Employability Paradox while 21.3% of the

workforce is formally skilled, the rapid disruption by Generative AI requires a shifting baseline for technical competency.

### II. OBJECTIVE OF THE STUDY

The study aims to:

1. Analyze the transformation of India's national skill development ecosystem under the Ministry of Skill Development and Entrepreneurship (MSDE).
2. Evaluate Rajasthan Skill Development Policy 2025–2030.

3. Apply Skill Gap Index to measure mismatch between skill demand and supply and

4. Identify priority sectors for Industry 5.0 workforce development.

### III. METHODOLOGY: SKILL GAP INDEX (SGI) FRAMEWORK

#### 3.1 Research Design –

This study adopts a mixed-methods research design combining quantitative analysis and qualitative policy evaluation to examine the alignment between vocational training supply and industrial skill demand in India, with a focused regional case study of Rajasthan. Mixed-methods approaches are widely used in skill-gap research because the phenomenon involves both measurable workforce indicators and institutional or policy factors that require qualitative interpretation. The methodology integrates three major components: Policy Analysis: Examination of national and state skill development initiatives implemented under the Ministry of Skill Development and Entrepreneurship (MSDE) and the Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill, Employment and Entrepreneurship (DSEE), Government of Rajasthan. Sectoral Skill Demand Assessment: Estimation of workforce demand in key industrial clusters such as renewable energy, manufacturing, and petrochemicals. Skill Gap Quantification: Application of a Skill Gap Index (SGI) to measure the disparity between available skilled workforce supply and industry demand. This integrated framework enables both macro-level policy evaluation and micro-level institutional assessment.

#### 3.2 Conceptual Framework of Skill Gap Analysis –

Skill gap analysis is defined as a systematic process used to determine the difference between the skills required by industry and the skills currently possessed by the workforce. In labour market

studies, the skill gap is typically conceptualized as the difference between required competencies (demand) and existing workforce capabilities (supply). For vocational training policy evaluation, this concept is operationalized by comparing: \* Projected industry demand for skilled labour \* Output of certified trainees from vocational institutions. The difference between these two indicators represents the skill shortage or surplus within a particular sector or region. To quantify the magnitude of workforce mismatch across sectors, this study introduces the Skill Gap Index (SGI) as a normalized indicator. The Skill Gap Index (SGI) is calculated as:

$$SGI = 1 - \left( \frac{\sum \text{Certified Candidates}}{\sum \text{Industrial Demand}} \right)$$

Where: \* Certified Candidates = Number of individuals completing recognized vocational training programs in a given sector. \* Industrial Demand = Estimated number of skilled workers required by industries within the same sector. Skill gap measurement indicators are widely used in labour economics to quantify mismatch between labour supply and industry demand (McGuinness et al., 2018). Competency-based qualification frameworks align training outcomes with labour market requirements and support evidence-based workforce planning (Allais, 2020; Wheelahan, 2021). Cluster-based analysis enables regional identification of sector-specific skill shortages, improving training resource allocation (Porter, 1998). The index provides a standardized measure that enables comparison across sectors, regions, and time periods.

**Table 1. Interpretation of Skill Gap Index (SGI)**

Sl. No.	SGI Value	Interpretation
1.	SGI = 0	Perfect balance between skill supply and demand
2.	0 < SGI ≤ 0.25	Low skill gap
3.	0.25 < SGI ≤ 0.50	Moderate skill gap
4.	SGI > 0.50	Severe skill gap

#### 3.3 Data Sources –

The analysis utilizes secondary datasets from national and state skill development institutions, including: - Government and Institutional Sources \* Ministry of Skill Development and Entrepreneurship (MSDE) policy reports \* National

Skill Development Corporation (NSDC) sector skill gap studies \* Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill, Employment and Entrepreneurship (DSEE), Government of Rajasthan. Directorate of Technical Education (Training) Jodhpur/ RCVET Jodhpur /

RSLDC Jaipur program reports \* Skill India Digital Hub (SIDH) training and certification databases-\* Industrial cluster reports and labour market statistics These datasets provide information on: \* Number of trained candidates \* Sector-wise workforce demand

### 3.4 Sampling and Regional Scope –

The empirical analysis focuses on five industrial clusters in Rajasthan, selected based on their economic significance and technological transformation. 1. Jodhpur Renewable energy (Solar & Wind), 2. Bhiwadi AI-Augmented, 3. Barmer Petrochem, 4. Jaipur IT & Electronics and 5. Udaipur Mining & Metallurgy The selection allows examination of both traditional and emerging industries, providing a balanced perspective on evolving skill requirements.

### 3.5 Analytical Techniques –

The study employs several analytical techniques: 1. Descriptive Statistical Analysis -Used to analyse sector-wise workforce demand, training capacity, and employment outcomes. 2. Cluster-Based Workforce Mapping Industrial clusters are analysed to identify regional variations in skill demand.3. Comparative Policy Analysis Evaluation of national initiatives (MSDE programs) and state-level skill policies. 4. SGI-Based Skill Gap Measurement. The Skill Gap Index is calculated for each industrial cluster and sector to identify critical shortages.

### 3.6 Limitations of the Study –

While the SGI framework provides a useful quantitative indicator, several limitations exist: 1. Skill demand projections may vary depending on economic conditions. 2. Training completion does not always guarantee employment or competency. 3. Informal sector employment is difficult to measure accurately. Despite these limitations, the SGI approach offers a practical tool for policymakers to identify priority sectors requiring skill development interventions.

## IV. LITERATURE REVIEW: THE GLOBAL EVOLUTION (2021-2026)

The global landscape of vocational education and workforce development has undergone significant transformation between 2021 and 2026. Rapid partnerships. Countries such as Germany, Singapore, and South Korea have implemented advanced skill ecosystems that integrate apprenticeship programs, industry collaboration, and lifelong learning initiatives. These models demonstrate the effectiveness of combining academic education with practical industrial training, often referred to as the dual system.

\* Institutional training capacity \* Employment outcomes. National skill-gap studies often estimate workforce shortages by subtracting projected labour supply from sector-wise demand projections, enabling sectoral planning for training programs. technological advancement, the rise of Industry 5.0, and the transition toward sustainable economies have reshaped the nature of skills required by modern industries. This section reviews key scholarly contributions and policy developments that highlight the evolving relationship between technology, education, and employability.

### 4.1 Transition from Industry 4.0 to Industry 5.0

– Recent academic literature identifies Industry 5.0 as the next phase of industrial transformation, emphasizing human-centric production systems that combine advanced technologies with human creativity and ethical considerations. Unlike Industry 4.0, which focused primarily on automation, robotics, and cyber-physical systems, Industry 5.0 introduces concepts such as human-machine collaboration, digital twins, and sustainable production models. Studies by Rejeb (2025) and other scholars demonstrate that Industry 5.0 integrates technologies including artificial intelligence (AI), the Internet of Things (IoT), collaborative robotics, and advanced data analytics into human-centered manufacturing systems. This shift requires workers not only to possess technical competencies but also to develop higher-order skills such as creativity, complex problem-solving, and interdisciplinary collaboration. Consequently, vocational education systems worldwide are restructuring curricula to incorporate digital literacy, automation skills, and sustainability awareness.

### 4.2 Global Trends in Vocational Education and Skills Development –

International research highlights a growing recognition of vocational education as a critical instrument for economic growth and workforce preparedness. Bibliometric studies analysing global vocational training trends indicate that modern vocational systems are increasingly integrating digital learning platforms, competency-based certification, and industry

Furthermore, contemporary literature emphasizes the role of lifelong learning and continuous upskilling in preparing workers for rapidly changing technological environments. Workforce training models are increasingly adopting modular certification structures, micro-credentials, and digital skill platforms to ensure flexibility and accessibility.

### 4.3 Emerging Skill Demands in Industry 5.0

A significant body of research suggests that Industry 5.0 will reshape labour markets by creating demand for hybrid skill profiles that combine engineering knowledge with digital competencies. Studies identify key emerging competencies including: \* Artificial intelligence and machine learning \* Robotics and automation maintenance, \* Data analytics and digital manufacturing \* Cyber-physical systems management, \* Green energy technologies. Industry 5.0 also emphasizes sustainability, resilience, and human well-being as central pillars of industrial development. As a result, workforce training programs must integrate environmental awareness, resource efficiency, and sustainable engineering practices into vocational curricula. Researchers also highlight the growing importance of skills-based hiring, where employers prioritize specific competencies rather than formal degrees. Empirical studies analysing millions of job postings show that demand for AI-related skills has increased substantially, often offering higher wage premiums than traditional academic qualifications.

### 4.4 Digital Platforms and the Transformation of Skill Ecosystems –

Digitalization has emerged as a key driver of modern skill development systems. Governments and international organizations are increasingly adopting digital platforms to expand access to training and improve labour market matching. In India, the Skill India Digital Hub (SIDH) represents a major initiative aimed at creating a unified digital ecosystem for skill development, integrating training providers, certification systems, and employment opportunities. Digital platforms enable: \* Online skill training programs, \* Real-time labour market information systems \* Digital certification and credit transfer mechanisms \* Career guidance and job matching services. These innovations

support the transition toward lifelong learning ecosystems, enabling individuals to continuously upgrade their skills throughout their careers.

### 4.5 Policy Reforms and Institutional Transformation –

The global shift toward knowledge-based economies has prompted governments to undertake large-scale policy reforms in vocational training systems. In India, recent initiatives such as the Pradhan Mantri Skilling and Employability Transformation through Upgraded ITIs (PM-SETU) aim to modernize vocational training infrastructure and strengthen industry collaboration. The scheme proposes the upgradation of 1,000 Government Industrial Training Institutes through a hub-and-spoke institutional model comprising 200 hub institutes and 800 spoke institutes, equipped with modern laboratories, digital learning tools, and industry-aligned training programs. The objective is to transform ITIs into state-of-the-art skill development institutions capable of producing industry-ready graduates and supporting India's long-term economic development goals.

### 4.6 Research Gaps –

Despite significant progress in vocational education research, several gaps remain:

1. Limited studies examining state-level implementation of national skill policies.
2. Insufficient empirical research on cluster-based vocational training models.
3. Lack of integrated frameworks connecting Industry 5.0 technological changes with regional workforce planning. This study addresses these gaps by analysing the implementation of national and state skill development initiatives through a regional institutional case study of RCVET Jodhpur, linking policy frameworks with local industrial demand.

## V. DATA ANALYSIS: RAJASTHAN CLUSTER PERFORMANCE

This section evaluates the sector-wise skill demand and workforce supply across major industrial clusters in Rajasthan using the Skill Gap Index (SGI). Rajasthan's economic growth is increasingly driven by renewable energy, manufacturing, petrochemicals, and MSME-based industrial clusters, which collectively generate significant

employment opportunities. The state has also emerged as India's leading renewable energy hub, with an estimated 142 GW solar energy potential and extensive wind resources, creating large future workforce requirements in the green-energy sector. The analysis focuses on five major industrial clusters representing emerging and traditional sectors.

### 5.1 Industrial Cluster Overview –

Industrial Cluster Major Sector Key Economic Drivers 1. Jodhpur Barmer Solar and Wind Energy Renewable energy parks, solar manufacturing 2.

Bhiwadi-Neemrana Manufacturing and Automation Auto components, electronics, industrial robotics 3. Barmer Petrochemicals Refinery and petrochemical investment region 4. Jaipur IT & Electronics IT &

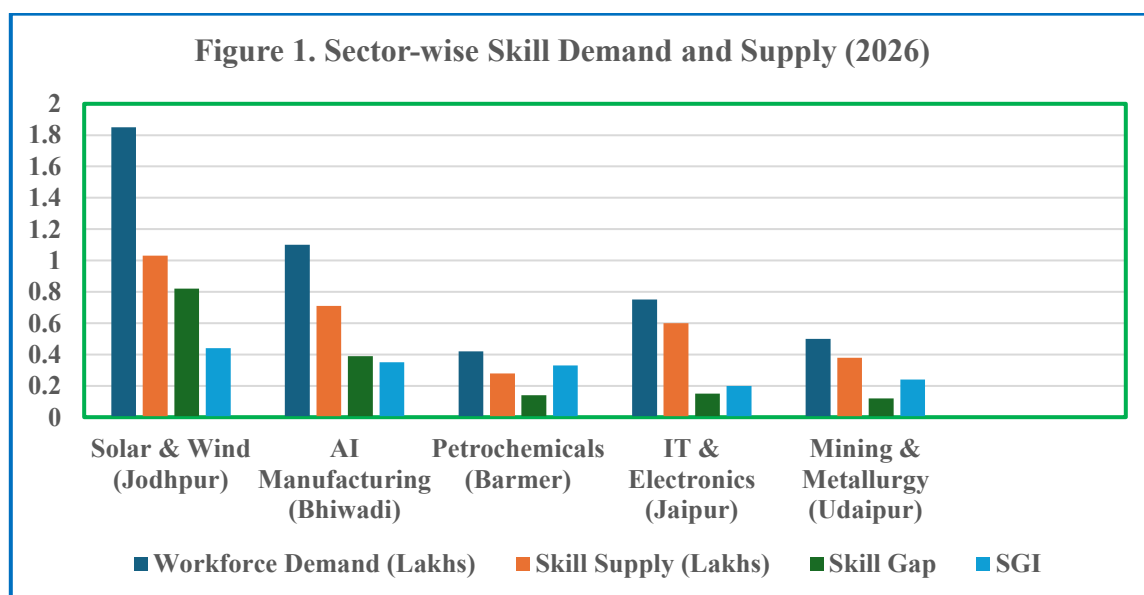
Electronics Digital services, startup ecosystem 5. Udaipur Mining & Metallurgy Mineral processing and metal industries Rajasthan hosts several sector-specific industrial zones and clusters including the Khushkhera-Bhiwadi-Neemrana investment region and the Barmer petrochemical investment region, which attract large-scale investments and generate employment opportunities.

### 5.2 Workforce Demand vs Skill Supply and Skill Gap Index (SGI) Calculation –

To analyse the mismatch between workforce demand and training output, data from training institutions, skill programs, and industrial employment projections were compared.

**Table 2. Sector-wise Skill Demand and Supply in Year 2026**

Sl. No.	Industrial Cluster	Workforce Demand (Lakhs)	Skill Supply (Lakhs)	Skill Gap	SGI
1.	Solar & Wind (Jodhpur)	1.85	1.03	0.82	0.44
2.	AI Manufacturing (Bhiwadi)	1.10	0.71	0.39	0.35
3.	Petrochemicals (Barmer)	0.42	0.28	0.14	0.33
4.	IT & Electronics (Jaipur)	0.75	0.60	0.15	0.20
5.	Mining & Metallurgy (Udaipur)	0.50	0.38	0.12	0.24



The results indicate that renewable energy and advanced manufacturing sectors show the largest workforce shortages, reflecting the rapid expansion of green-energy infrastructure and automated production systems. The study employs a mixed-methods research approach integrating quantitative labour market indicators with qualitative policy analysis, a methodology widely used in workforce planning and skill mismatch research (Creswell & Plano Clark, 2018; McGuinness et al., 2018). Skill gap measurement models compare projected industry demand with vocational training supply to identify sectoral workforce shortages (OECD, 2017; Cappelli, 2015). Cluster-based economic frameworks further support regional skill planning

by linking industrial concentration with workforce specialization (Porter, 1998; Delgado et al., 2014).

$$SGI = 1 - \left( \frac{\sum \text{Certified Candidates}}{\sum \text{Industrial Demand}} \right)$$

The Skill Gap Index provides a normalized measure of mismatch between industrial demand and trained workforce supply

### 5.3 Interpretation of SGI Results –

High Skill Gap Sectors. Clusters with SGI > 0.30 indicate major workforce shortages. \* Renewable Energy (Jodhpur-Barmer) \* Advanced Manufacturing (Bhiwadi). The rapid growth of solar parks such as Bhadla Solar Park, one of the largest

in the world with a capacity of over 2,245 MW, has accelerated demand for technicians specializing in solar installation, grid management, and maintenance. Moderate Skill Gap Sectors Clusters with SGI between 0.20 and 0.30 include mining and IT sectors, where vocational training capacity is improving but still insufficient. Low Skill Gap Sectors Industries with SGI below 0.20 show relatively balanced workforce supply and demand. SGI value 0.44 indicates severe shortage in

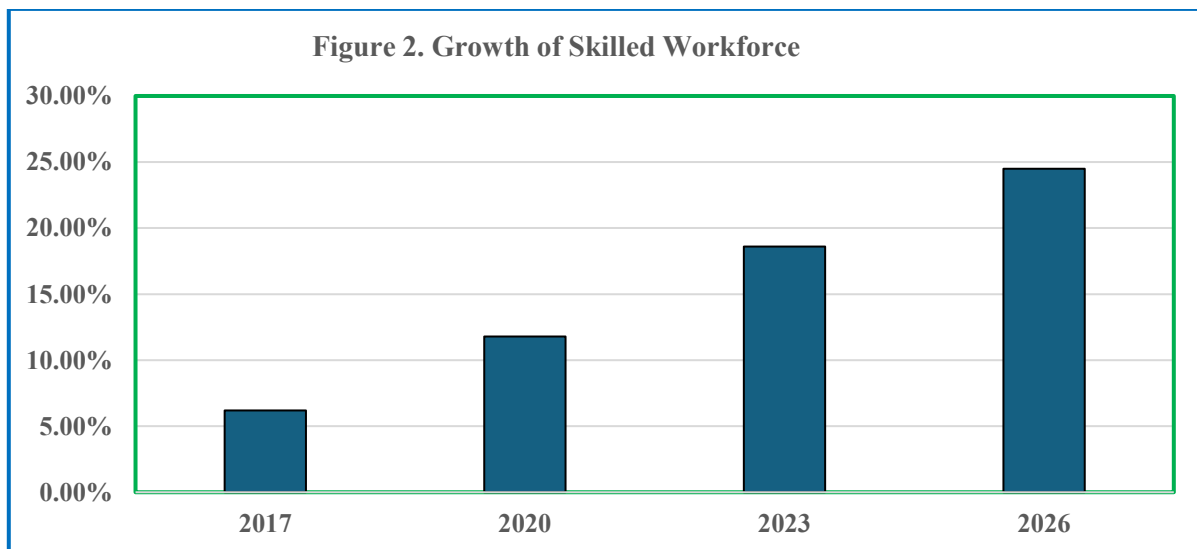
renewable energy technicians due to rapid solar infrastructure expansion.

**5.4 Skill Penetration Growth in Rajasthan –**

Over the past decade, skill development initiatives have significantly improved workforce training coverage. Government initiatives such as Skill India, PM-SETU, and Rajasthan Skill Development Policy have expanded institutional training capacity and improved certification mechanisms.

**Table 3. Growth of Skilled Workforce**

Sl. No.	Year	Growth of Skilled Workforce
1.	2017	6.2%
2.	2020	11.8%
3.	2023	18.6%
4.	2026	24.5%



**5.5 Key Findings from Data Analysis –**

1. Renewable energy clusters show the largest workforce shortage due to rapid solar and wind energy expansion.
2. Advanced manufacturing hubs require AI-enabled technicians and robotics specialists.
3. Industrial clusters linked with Delhi-Mumbai Industrial Corridor (DMIC) show strong employment potential and
4. Skill supply is increasing but still insufficient to meet projected industrial demand by 2030.

Employment and Entrepreneurship (DSEE), Government of Rajasthan, has introduced several institutional reforms.

**6.1 Institutional Background –**

Government of Rajasthan functions as a regional institutional framework supporting vocational training, skill development programs, and technical education initiatives aligned with national skill policies. The Directorate of Technical Education (Training) Jodhpur/ RCVET Jodhpur operates under the broader skill development ecosystem connected to Department of Skill, Employment and Entrepreneurship (DSEE), Government of Rajasthan and national regulatory bodies such as the National Council for Vocational Education and Training (NCVET), which establishes quality standards and regulatory norms for vocational

**VI. SKILL PROGRAMS UNDER RAJASTHAN SKILL DEVELOPMENT POLICY**

The Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill,

education in India. The Directorate of Technical Education (Training), Jodhpur and RCVET Jodhpur play an important role in facilitating training infrastructure development, institutional coordination, and implementation of skill development programs across Rajasthan's. Its administrative headquarters is located in the Jodhpur, a strategic location near major industrial

and manufacturing clusters. Within the context of national initiatives such as Skill India and PM-SETU, the Directorate of Technical Education (Training) Jodhpur and RCVET Jodhpur and RSLDC Jaipur contributes to strengthening Vocational education, promoting industry-aligned training, and expanding vocational opportunities for youth in both urban and rural districts.

**Table 4. Number of candidates trained/ assessed State wise – Long Term Courses (RCVET)**

Sl. No.	State /UT	Year	No of affiliated training providers / ITIs	Year wise total no. of candidates trained last 5 years		Year wise total no. of candidates certified last 5 years		Placement ensured no's	
			Govt and Private ITIs	Govt ITIs	Private ITIs	Govt ITIs	Private ITIs	Govt ITIs	Private ITIs
1.	Rajasthan	2023-24	1584	23689	108519	20520	51714	5046	956
2.		2022-23	1552	27183	78140	23406	85794	3115	4036
3.		2021-22	1555	26424	75311	21864	56591	3609	6758
4.		2020-21	1397	21857	78615	14863	36950	1726	6381
5.		2019-20	1576	20771	115143	14125	54117	4924	9949

**6.2 Institutional Reform under Skill Development Policies –**

Recent skill development reforms in Rajasthan aim to align vocational education with emerging industrial requirements such as renewable energy, advanced manufacturing, and digital technologies. Institutional reforms undertaken at Directorate of Technical Education (Training) Jodhpur and RCVET Jodhpur focus on three key areas: 1. Modernization of training infrastructure, 2. Industry-aligned curriculum development and 3. Expansion of regional skill clusters. These reforms are consistent with national efforts to modernize vocational institutions and improve employability outcomes.

**6.3 Hub-and-Spoke Institutional Model –**

One of the major reforms implemented in Rajasthan's vocational ecosystem is the Hub-and-Spoke training model, which aims to optimize resource utilization across multiple ITIs. Structure of the Model -Component Role Hub Institute Advanced training facilities and Centres of Excellence Spoke Institutes Local skill training centres connected to the hub Digital Platform Shared learning resources and skill databases in this model: \* Government ITI Jodhpur functions as the regional hub with advanced equipment and laboratories. \* Nearby rural ITIs such as Osian, Bilara, Phalodi, and Bhopalgarh operate as spokes, providing training access to students from rural and semi-urban regions. This cluster approach enables: \* Shared

use of high-cost equipment, \* Standardized training quality, \* Improved instructor training, \* Better placement coordination.

**6.4 Upgradation of Technical Workshops –**

To support emerging industrial sectors, several technical workshops have been upgraded at institutions associated with Directorate of Technical Education (Training) Jodhpur.

**1. CNC Machining and Digital Manufacturing Lab**–The modernization of the machining workshop includes the installation of: \* CNC turning centres, \* CNC vertical milling machines, \* CAD-CAM simulation software. These facilities enable trainees to develop competencies in computer-controlled manufacturing, precision machining, and automated production systems.

**2. Renewable Energy Training Laboratory-** – Given Rajasthan's leadership in solar energy production, specialized training facilities have been established for renewable energy technologies. Training modules include: - \* Solar photovoltaic system installation, \* Wind turbine maintenance, \* Hybrid solar-wind microgrid systems, \* Smart grid technologies, these programs prepare technicians for employment in the rapidly expanding solar and wind energy sectors.

**3. Robotics and Industrial Automation Lab**– Industrial automation training has been introduced to support the growing demand for advanced manufacturing skills. Equipment includes: \* Industrial robotic arms, \* Programmable logic

controller (PLC) kits, \* Sensor-based automation systems, \* Industrial control panels. The lab supports training in: \* Robotics maintenance, \* Automation system programming and \* Smart factory operations.

**4. Mechatronics and Digital Systems Workshop–**

The mechatronics workshop integrates mechanical, electrical, and digital technologies to support Industry 4.0 and Industry 5.0 training requirements. Training modules include: \* Pneumatics and hydraulics systems, \* PLC-controlled conveyor systems, \* Digital twin simulations, \* IoT-enabled monitoring systems. These interdisciplinary training programs prepare students for AI-assisted manufacturing environments. Directorate of

Technical Education (Training) Jodhpur and RSLDC Jaipur supports implementation of state skill development programs such as the Mukhya Mantri Kaushal Vikas Yojana (MMKVY), which focuses on enhancing employability and entrepreneurship. The scheme includes three major program categories. Training Categories under MMKVY- Program Focus Area RAJKViK Industry-led large-scale training SAKSHM Wage employment-oriented programs SAMARTH Inclusive training for marginalized groups These programs aim to expand training opportunities for youth, women, and economically disadvantaged groups.

**Table 5. Details of Admission Capacity in Industrial Training Institutes in Session 2025–26**

Sl. No.	Govt.		Private		Total Govt. and Private ITIs	Total Admission in Govt. and Private ITIs
	ITIs	Admission Capacity	ITIs	Admission Capacity		
1.	314	63,960	1,385	2,12,624	1,699	2,76,584

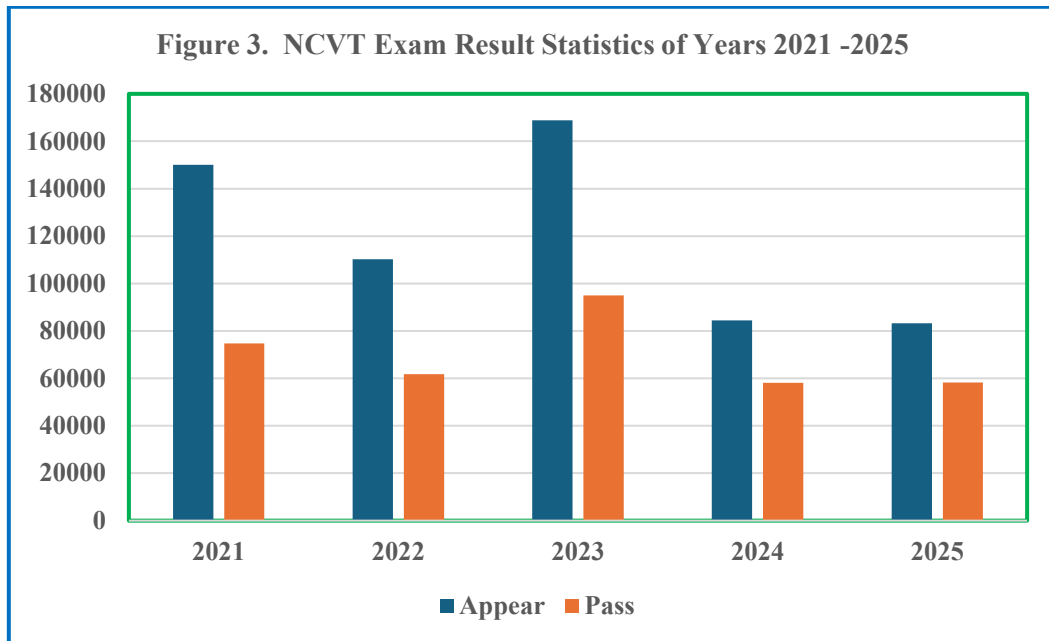
**1. Apprenticeship Training –**

Under the Apprentices Act, 1961, apprenticeship training programs are implemented. Establishments employing 30 or more workers in Central/State Government departments, public sector undertakings and private sector establishments are required to engage apprentices. Training duration

ranges from six months to three years depending on the trade and qualification. As per Section 27(1) of the Act, the State Government appoints Apprenticeship Advisers and Assistant Apprenticeship Advisers to supervise implementation.

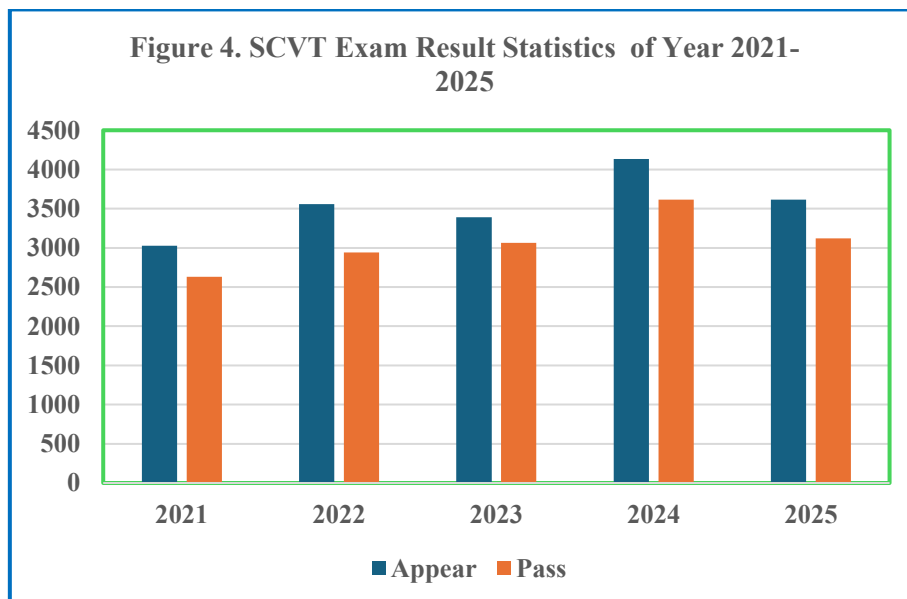
**Table 6. NCVT Exam Result Statistics of Year 2021 -2025**

NCVT Exam Result Statistics of Year 2021 -2025				
Sl. No.	Year	Number of candidates		
		Appear in Examination	Pass out	Pass out percentage
1	2021	150103	74684	49.75
2	2022	110295	61804	56.03
3	2023	168882	94927	56.20
4	2024	84505	58112	68.77
5	2025	83223	58313	70.07



**Table 7. SCVT Exam Result Statistics of Year 2021-2025**

SCVT Exam Result Statistics of Year 2021-2025				
Sl. No.	Year	Number of candidates		
		Appear in Examination	Pass out	Pass out percentage
1	2021	3025	2632	87.00
2	2022	3559	2941	82.63
3	2023	3392	3065	90.35
4	2024	4132	3614	87.46
5	2025	3616	3120	86.28



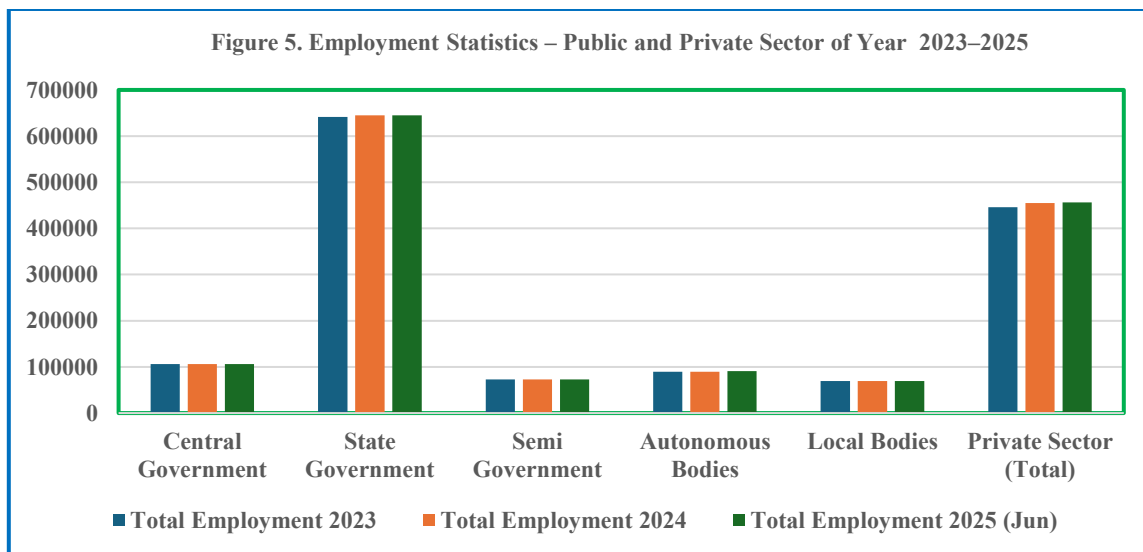
**Table 8. Employment Department – Major Activities and Achievements of Year 2023-2025**

Sl. No.	Activity	2023	2024	2025
1.	Registrations	173972	107686	133430
2.	Notified Vacancies	5594	19626	6391
3.	Placements	6813	37268	25977
4.	Live Register	1975558	2083244	2216674
5.	Employment Assistance Camps	89	195	167

**Table 9. Employment Statistics – Public and Private Sector of Year 2023–2025**

Sl. No.	Sector / Category	Total Employment		
		2023	2024	2025 (Jun)
1.	Central Government	105896	105969	106023
2.	State Government	641577	645280	644833
3.	Semi Government	72632	72757	72821
4.	Autonomous Bodies	89410	89559	91126
5.	Local Bodies	69668	69619	69623
Total		979183	983184	984426

**Figure 5. Employment Statistics – Public and Private Sector of Year 2023–2025**



**Table 10. Industry-wise Employment Analysis of Year 2023-2025**

Sl. No.	Industry	Employers			Total Employment		
		2023	2024	2025 (Jun)	2023	2024	2025 (Jun)
1.	Agriculture, Forestry and Fishing	262	254	254	13400	13013	12838
2.	Mining	184	161	161	16532	14016	14026
3.	Manufacturing	1926	1958	1965	246225	253698	253881
4.	Electricity and Gas Supply	890	896	893	43224	44198	44423
5.	Water Supply and Waste Management	504	546	546	29063	30760	30756
6.	Construction	737	702	703	25934	26675	26722
7.	Trade and Motor Repair	499	483	483	24786	23704	23842
8.	Transport and Storage	176	188	188	83490	84270	84296
9.	Hotels and Restaurants	536	649	660	19445	20441	20462

10.	Information and Communication	157	160	160	24029	24097	24107
11.	Finance and Insurance	3473	3489	3492	70269	76542	77046
12.	Real Estate Activities	3	3	3	223	166	166
13.	Professional, Scientific and Technical Activities	404	442	442	24053	26250	26288
14.	Administrative & Support Services	819	435	435	37108	26530	26536
15.	Public Administration and Defence; Social Security	1790	1827	1826	248137	246811	248401
16.	Education	9134	9183	9200	380090	381666	378028
17.	Human Health and Social Work	916	1146	1147	123341	131661	135099
18.	Arts, Entertainment and Recreation	132	123	123	1986	1822	1823
19.	Other Community, Social and Personal Services	45	46	46	12697	10615	10638
20.	Activities of Private Households as Employers	4	4	4	123	122	122
21.	Activities of Extraterritorial Organizations	13	13	13	972	974	978
Total		22604	22708	22744	1425127	1438031	1440478

**Table 11. Youth Trained under Skill Development Programs by RSLDC**

Sl. No	Scheme	Total Trained (till 31 Dec 2025)	2022-23	2023-24	2024-25
1	DDU-GKY	93644	6092	7232	5457
2	EDP	1065	0	600	465
3	ELSTP	275483	237	0	0
4	MNSKSY	15256	1840	10540	120
5	MMYKY	9910	2556	2473	2766
6	MMKVY Cat-I Rajkvik	64007	10072	14275	23540
7	MMKVY Cat-II Saksham	32635	4563	7614	14176
8	MMKVY Cat-III Samarth	32087	2688	7798	15562
9	MMKVY Cat-I Rajkvik RTD	90	0	30	60
10	MMYSY	22262	532	11638	0
11	PMKVY	36682	527	0	0
12	PMKVY RPL	9715	0	0	0
13	PM Daksh	376	0	0	0
14	RSTP	59569	0	0	0
15	OPB RKCL	184	0	184	0
16	Soft Skill	215000	0	215000	0
17	WSSO	38868	0	0	0
Total		906833	29107	277384	62146

## VII. IMPACT OF INDUSTRIAL REFORMS

Institutional reforms at Directorate of Technical Education (Training) Jodhpur and RSLDC Jaipur have produced several positive outcomes: Improved Training Capacity, Modern laboratories and

upgraded workshops have increased institutional training capacity. Enhanced Industry Linkages, Collaboration with renewable energy companies, manufacturing units, and MSMEs has strengthened placement opportunities. Regional Skill

Development-The hub-and-spoke model has expanded access to vocational training across western Rajasthan. Increased Employability Training programs aligned with industrial demand have improved employment outcomes for graduates.

### **VIII. CHALLENGES AND FUTURE OPPORTUNITIES**

Despite significant progress, several challenges remain: \* Shortage of industry-experienced instructors, \* Limited adoption of AI-based training technologies, \* Need stronger apprenticeship ecosystem, \* Insufficient integration of digital learning platforms. Addressing these challenges will require continued investment in faculty development, digital infrastructure, and industry partnerships.

### **IX. ROLE OF DIRECTORATE OF TECHNICAL EDUCATION (TRAINING), JODHPUR AND RSLDC JAIPUR IN FUTURE SKILL ECOSYSTEM**

Looking ahead to 2030, Directorate of Technical Education (Training) Jodhpur and RSLDC Jaipur is expected to play a critical role in: \* Supporting renewable energy workforce development, \* Training technicians for smart manufacturing systems, \* Implementing digital learning platforms such as Skill India Digital Hub, \* Strengthening collaboration between industry and vocational institutions. Through these initiatives, the institution can contribute significantly to bridging the regional skill gap and supporting Rajasthan's industrial growth.

### **X. CONCLUSION AND STRATEGIC ROADMAP-2030**

The transformation of India's skill development ecosystem over the past decade reflects a fundamental shift toward integrated, technology-driven, and industry-aligned vocational education systems. National initiatives implemented under the Ministry of Skill Development and Entrepreneurship (MSDE), combined with state-level policy frameworks such as the Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill, Employment and Entrepreneurship (DSEE), Government of Rajasthan through Directorate of Technical Education (Training) Jodhpur/ RCVET Jodhpur / RSLDC Jaipur have expanded the reach of vocational training and improved the institutional capacity of Industrial Training Institutes (ITIs). A

critical structural reform in this transformation has been the implementation of the National Credit Framework (NCrF), which integrates credits earned through school education, higher education, and vocational training into a unified system. This framework enables horizontal and vertical mobility across academic and vocational pathways, allowing learners to accumulate and transfer credits throughout their education and professional careers. By recognizing multiple forms of learning including academic, vocational, and experiential learning the framework supports a flexible lifelong learning ecosystem aligned with the objectives of the National Education Policy (NEP) 2020. At the same time, the development of digital platforms such as the Skill India Digital Hub (SIDH) has introduced a new dimension to India's skill development architecture. SIDH functions as a digital public infrastructure for the skilling ecosystem, providing access to training courses, job opportunities, apprenticeship programs, and verified digital credentials through a unified online interface. These reforms collectively represent a shift from traditional training-centered models toward digital, competency-based, and demand-driven skill ecosystems. However, despite these institutional advancements, the analysis of industrial clusters in Rajasthan highlights several persistent challenges. The Skill Gap Index (SGI) calculated in this study identifies the renewable-energy sector, particularly The Directorate of the solar cluster in Jodhpur is the most critical workforce bottleneck, with an SGI value of 0.44. This indicates that the supply of trained technicians is significantly lower than projected industrial demand.

Given Rajasthan's position as one of India's leading renewable energy states, this skill shortage could potentially constrain future industrial growth if not addressed through targeted training interventions. Furthermore, the emergence of The Directorate of Industry 5.0 technologies, including artificial intelligence, collaborative robotics, and cyber-physical production systems requires vocational education institutions to rapidly modernize their curricula and training infrastructure. The institutional case study of Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill, Employment and Entrepreneurship (DSEE), Government of Rajasthan through Directorate of Technical Education (Training) Jodhpur/ RCVET Jodhpur / RSLDC Jaipur demonstrates how regional administrative leadership can translate national policy frameworks into effective local implementation. Through infrastructure modernization, cluster-based training systems, and industry partnerships, the institution has begun to

align vocational training programs with emerging industrial requirements.

Nevertheless, achieving a globally competitive workforce by 2030 will require sustained coordination between national policy initiatives, state governments, vocational institutions, and industry stakeholders.

### **Strategic Roadmap for 2030-**

Based on the findings of this research, a multi-dimensional strategy is proposed to strengthen India's vocational skill ecosystem and address emerging workforce gaps. 1. Digital Public Infrastructure Integration- A fully integrated digital ecosystem for skill development should be established by ensuring complete synchronization of Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill, Employment and Entrepreneurship (DSEE), Government of Rajasthan through Directorate of Technical Education (Training) Jodhpur/ RCVET Jodhpur / RSLDC Jaipur training databases with the Skill India Digital Hub (SIDH) using APAAR-linked digital learner identities. Such integration would enable: \* real-time monitoring of training programs, \* Digital verification of certifications, \* Improved tracking of employment outcomes, \* Data-driven workforce planning. A unified digital infrastructure would significantly enhance transparency, efficiency, and accessibility within the skill development ecosystem. 2. Industry-Embedded Faculty and Professors of Practice- To strengthen the practical relevance of vocational training programs, institutions should introduce industry-embedded faculty models through the recruitment of regional industrial cluster strategies to ensure that training programs correspond directly to local employment opportunities. Cluster-based workforce planning would allow policymakers to: \* Identify sector-specific skill shortages, \* Optimize training capacity across institutions, \* Improve placement outcomes for graduates. 6. Lifelong Learning and Micro-Credential Systems- The evolving technological landscape requires workers to continuously upgrade their skills. Therefore, vocational education institutions should expand short-term modular courses and micro-credential programs that allow workers to reskill and upskill throughout their careers. Digital platforms such as SIDH can play a key role in delivering flexible, online, and hybrid learning programs.

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Professors of Practice. These professionals could be drawn from: \* Jodhpur handicraft manufacturing sector, \* Renewable energy companies, \* Manufacturing industries, \* Digital technology firms. Such collaboration would facilitate: \* Technology transfer from industry to training institutions, \* Practical exposure for students, \* Stronger industry-academia partnerships. 3. AI-Augmented Workforce Training- As Industry 5.0 technologies become increasingly integrated into industrial processes; vocational training institutions must incorporate Artificial Intelligence (AI) and digital technologies into their curricula. A mandatory 40-hour AI literacy module should be introduced across all technical trades, covering topics such as: \* AI fundamentals and industrial applications, \* Data analytics for manufacturing systems, \* Digital manufacturing technologies, \* Robotics and automation integration. This initiative would prepare trainees for AI-assisted production environments and smart factories. 4. Renewable Energy Skill Development Mission- Given the rapid expansion of renewable energy infrastructure in Rajasthan, specialized Green Skill Training Centres should be established in solar and wind energy clusters. These centres should provide advanced training programs in: \* Solar photovoltaic installation and maintenance, \* Wind turbine operation and servicing, \* Battery storage and grid integration, \* Green hydrogen technologies, such programs would directly address the workforce shortages identified in the SGI analysis. 5. Cluster-Based Skill Planning-Skill development initiatives should be aligned with

### **Final Perspective –**

The convergence of Industry 5.0 technologies, renewable energy expansion, and digital learning systems is fundamentally reshaping workforce requirements across the world. India's evolving skill development ecosystem supported by frameworks such as NCrF, SIDH, and PM-SETU provides a strong foundation for addressing these challenges. However, the successful realization of India's demographic dividend will depend on the ability of institutions to rapidly adapt to technological change, strengthen industry partnerships, and expand access to high-quality vocational training. If effectively implemented, the strategic roadmap outlined in this study can enable institutions such as Rajasthan Skill Development Policy (2025–2030), implemented by the Department of Skill,

Jodhpur / RSLDC Jaipur to emerge as regional centres of excellence in vocational education and contribute significantly to India's long-term vision

of building a globally competitive, innovation-driven workforce by 2030 and beyond. Based on the empirical findings, the following four pillars are proposed for implementation by 2030:

1. Mandatory AI Literacy –Introduction of a 40-hour AI module across all technical trades to prepare the workforce for smart factory operations.
2. Industry-Embedded Faculty – Scaling the "Professors of Practice" model, specifically drawing experts from the Barmer petrochemical and Jodhpur handicraft sectors.
3. Green Skill Mission – Establishing specialized training centres in solar/wind clusters to directly lower the 0.44 SGI in the renewable sector. Specialized training

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centres in Jodhpur and Barmer for solar PV installation and green hydrogen.

4. Digital Public Infrastructure –Full synchronization of training databases with the Skill India Digital Hub (SIDH) using APAAR-linked digital identities.

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