Human Resource and Skill Requirement in the Mining Sector in India 2019-2025

Final Report

Skill Council for Mining Sector (SCMS)

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pwc

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List of Abbreviations

Abbreviation	Full form
CAGR	Compound Annual Growth Rate
CCI	Chamber of Commerce and Industry
CIL	Coal India limited
CMNA	Coal Mine Nationalization Act
DAMM	Drone Application in Mine Monitoring
DGMS	Directorate General of Mines Safety
DMF	District Mineral Foundation
EIA	Environmental Impact Assessment
EMZ	Exclusive Mining Zone
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GMDC	Gujarat Mineral Development Corporation Limited
GSDP	Gross State Domestic Product
GSI	Geological Survey of India
GSVA	Gross State Value Added
GVA	Gross Value Added
HEMM	Heavy Earth Moving Machinery
HGSS	Heliborne Geophysical Survey System
IBM	Indian Bureau of Mines
ICEM	International Center of Excellence in Mining Safety and Automation
IICM	Indian Institute of Coal Management
INMF	Indian National Mineworkers Federation
JGMTRTC	Jharkhand Government Mini Tool Room Training Centre
JNARDDC	Jawaharlal Nehru Aluminium Research Development and Design Centre
JNTVTI	JN Tata Vocational Training Institute
JORC	Joint Ore Reserves Committee
MCDR	Mineral Conservation and Development Rules
MECL	Mineral Exploration Corporation Limited
MGB	Mines and Geosciences Bureau
MIHR	Mining Industry Human Resources Council
MMDR	Mines and Minerals (Development and Regulation)
MoEFCC	Ministry of Environment, Forest and Climate Change
MoSDE	Ministry of Skill Development & Entrepreneurship
MSS	Mining Surveillance System
MTPA	Million Ton Per Annum
MTS	Mining Tenement System
MVTR	Mines Vocational Training Rules
NALCO	National Aluminum Company Limited
NGM	National Geochemical Mapping
NIC	National Informatics Centre
NIIT	National Institute of Information Technology

Abbreviation	Full form
NIMH	National Institute of Miner's Health
NIRM	National Institute of Rock Mechanics
NLC	Neyveli Lignite Corporation
NMEP	National Mineral Exploration Policy
NMET	National Mineral Exploration Trust
NMP	National Mineral Policy
NSDC	National Skill Development Corporation
NSQC	National Skills Qualifications Committee
OGP	Obvious Geological Potential
OITDS	Operator Independent Truck Dispatch System
PAPs	Project Affected Persons
RFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement
SCMS	Skill Council for Mining Sector
SDF	Sustainable Development Framework
SETA	Sector Education and Training Authority
SME	Society for Mining, Metallurgy & Exploration
TOASS	Twin Otter Airborne Survey System
UAV	Unmanned Ariel Vehicles
UMPP	Ultra-Mega Power Projects
UNFC	United Nations Framework Classification
UOW	University of Wollongong
VTC	Vocational Training Centres

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Executive summary

Background

PricewaterhouseCoopers Private Limited (PwC) was engaged by Skill Council for Mining Sector (SCMS) through a competitive procurement process to carry out "Human Resource and Skill Requirement Study for the Indian Mining Sector (2019-25)". The study was commissioned with the overall objective of providing a labour market outlook and assessing skill gap for the Indian Mining sector (2019-25), which in turn would lay the foundation for developing the strategy and action plan in order to address key human resource challenges and create potential employment opportunities. The study was carried out across 13 mineral rich States in the country including Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and West Bengal. **These States account for about 87% of the total economic output and 94% of the employment generated by the mining and quarrying sector in India[1]**.

The study adopted a consultative and participatory approach to interact and seek inputs from a wide spectrum of stakeholders, including the Project Steering Committee (PSC) and SCMS. The study was further aided by desk review/secondary research and interaction with over 1,300 participants (including 18 training partners, 5 assessment agencies, 16 central/apex bodies and mining associations including Directorate General of Mines Safety, 83 employers by mineral type, 166 employers in ancillary units, 701 mining workers, 52 faculty members, 250 students from education institutes, 26 people from 12 State Mining and Geology Departments and 6 Directorates of Technical Education) using quantitative and qualitative research instruments.

In line with the study objectives, the scope of work and suggestions from SCMS, the study was undertaken using a phased approach. **The four distinct but interlinked phases of delivery were broadly categorized as 'Assess and Design', 'Discover', 'Analyze' and 'Finalize'**. The 'Assess and Design' phase focussed on developing a holistic understanding of the sector, mapping and shortlisting of stakeholders, finalizing the scope of work, sampling plan, analytical framework and stakeholder-wise tools/questionnaires. In the 'Discover' phase of the project, stakeholder consultations and primary survey of employers and employees across the study States was carried out. The third phase of the project, i.e. 'Analyze' focussed on collating primary data in structured form and arriving at findings and estimates as per study requirements. The last phase of the project was about sharing the study findings, estimates and forecasts with SCMS.

Industry overview

The mining sector plays an important role in the Indian economy and is considered as the backbone of the manufacturing sector, be it steel, cement, power, high-tech ceramics for spacecraft, etc. Raw materials such as iron, limestone, bauxite, chromite, manganese, rare earth elements are mined to support these crucial sectors of the economy. The country is endowed with large deposits of fuel minerals and other mineral resources in metallic, non-metallic, atomic and minor minerals and occupies a prominent position among valuable minerals such as manganese, chromite, iron ore, coal, and bauxite. Currently, India produces as many as 95 minerals which includes 4 fuel, 10 metallic, 23 non-metallic, 3 atomic and 55 minor minerals (including building and other materials)[2]. The Mining Industry is broadly categorized across 4 sub-sectors: (i) Prospecting, Exploration and Mine Planning, (ii) Mining Operations, (iii) Engineering Services and (iv) Mineral Beneficiation[3].

In addition to major and minor minerals, the study focussed on **ancillary activities** which can be primarily divided across two broad categories: (i) activities/sectors that provide intermediate input (such as energy, service, material) and capital (such as construction, transport equipment, machinery) to the mining and quarrying sector and ii) activities/ sectors that function near the periphery of mines or quarries and are dependent on mining and quarrying for material inputs (such as cutting and finishing of stone, manufacture of bricks and other non-metallic mineral products).

[1] Ministry of Statistics and Programme Implementation, Govt. of India; Statistics of mines in India: Vol I and II (DGMS) 2015
[2] Annual Report 2017-18: Ministry of Mines
[3] SCMS occupation map

The key strengths characterizing the country's mining sector include: (i) abundant availability of mineral deposits (India ranked 3rd in the world in terms of coal, lignite, steel and zinc production, 4th in chromite, iron ore and lead, 5th in bauxite and 6th in copper[4]), (ii) high FDI in the sector which rose from USD 129 million to USD 247 million during 2014 to 2019, as per the RBI database, has resulted in increase in capital inflow in terms of money and material thereby boosting overall economic growth (iii) government's push for regulatory reforms to propel the sector's growth (Mineral Laws (Amendment) Ordinance 2020, MMDR Act 2015, announcement of various structural reforms in coal and mineral sector as a part of 'AtmaNirbhar Bharat' initiative of the government[5]), (iv) availability of low-cost skilled manpower. It will be critical for the sector to take cognizance of its strengths and significantly contribute to the country's GDP.

The mining sector in India faces some challenges which include: (i) regulatory delays (time taken to get all the clearances required for commencement of mining operations such as environmental, forest, wildlife, mining plan approval along with mine closure plan, pollution, etc has been relatively high), (ii) slow paced adoption of latest technologies (on the one hand, big mining giants have adopted state of the art technologies for mining operations, relatively smaller mining units are still working with conventional mining methods), (iii) lack of coordination between different stakeholders (relationship with internal stakeholders, coordination with nearby communities, regular interactions with government bodies have not been very effective) (iv) lack of infrastructure to curb illegal mining (mining with unscientific methods, illegal transportation of minerals and mining without necessary approvals and permission), (v) lack of gender diversity (currently as per DGMS estimates, average daily employment of women in mines is only 4% which is lower than their employment in other sectors such as agriculture and allied (57%), manufacturing (12.5%), education (6%) and construction (5%)[6]), (vi) high cost of capital and debt sources.

In addition, the **sector is currently faced with the pressure from** (i) **increased impetus towards renewable sources of energy** (in a longer run, renewable energy sources would impact thermal energy production and thus coal production)**,** (ii) **non-cooperation from communities residing in the proximity of mines** (issues pertaining to private land acquisition and job allocation to rehabilitated community has historically affected mine operations adversely)**,** (iii) **limited availability and utilization of skilled workforce**, (iv) **outbreak of COVID-19 pandemic** (combined market value of top 50 mining companies has come down from USD 1 trillion to USD 282 billion in first 3 months of FY21[7], delay in operationalization of newly auctioned mineral blocks, fall in demand from end user industries like power, steel, aluminium, cement, etc., reduction in offtake of minerals from mines due to restrictions imposed on logistics and transportation and limited availability of labour) which are likely to have negative impact on the sector.

There are numerous factors which provide opportunities for propelling the sector's overall growth rate. Some of these factors include (i) the **government's intent of increasing mining sector's contribution to the country's GDP**, (ii) **promoting underground mining operations** (in future, near surface coal deposits are likely to reduce sharply and extraction of coal by opencast mining method would no longer be economically viable)**,** (iii) **leveraging on latest technologies** (more advanced technology such as internet of things, artificial intelligence, machine learning and use of big data has made their cases for the future technologies of mining sector)**,** (iv) **increased impetus towards boosting minor mineral segment** (many Indian States have already formulated concession rules and actively auctioning minor mineral leases), (v) **country's demographic dividend advantage** (till 2055, India's working age population will remain larger than its dependent population[8]. Indian mining sector can take advantage of young workforce and train them), (vi) impetus towards innovative cost-cutting measures such as slurry pipelines (as part of the National Infrastructure Pipeline, the recent investment of Rs 8,000 crore by the Ministry of Steel to develop four slurry pipelines to move ores such as coal, iron or mining waste over long distances until 2025[9] is a step towards achieving cost-effectiveness), (vii) **push towards scrap-based steel making** (Ministry of Steel has come up with a draft 'Steel Scrap Policy' in the year 2019 promoting the principles of Reduce, Reuse, Recycle, Recover, Redesign and Remanufacture[10])**,** (viii) **skilling migrants (in**

[4] World mineral production data compiled from World Mineral Production, 2013-2017; British Geological Survey
[5] https://pib.gov.in/PressReleasePage.aspx?PRID=1624536
[6] Periodic Labour Force Survey (PLFS), 2017-18
[7] https://www.northernminer.com/news/COVID-19-19-cuts-us280bn-swathe-through-top-50-mining-companies/1003815682/; Mining.com
[8] Based on Census data 2001 and 2011 estimates
[9] https://www.business-standard.com/article/pti-stories/steel-ministry-identifies-4-slurry-pipeline-projects-worth-rs-8k-cr-for-implementation-by-fy25-120043001122_1.html
[10] https://steel.gov.in/sites/default/files/Draft%20Scrap%20Policy%2028_6_2019.pdf

mining rich states through reskilling, upskilling or RPL certifications) returning home due to COVID-19 pandemic, (ix) **government of India's vision of making the country USD 5 trillion economy by the year 2024-25. These factors are expected to positively impact the sector's growth trajectory.**

The mining industry across the globe is constantly evolving, with new technologies entering the arena of mining operations. Considering that India is a labour-intensive economy, achieving labour productivity in the mining sector will be crucial for absorbing current and future investments, new technologies and achieving sustained development. For the mining sector to earn global recognition, leveraging on strengths, opportunities and the factors driving the sector's competitiveness would be critical.

The key policy initiatives impacting the sector's competitiveness include: MMDR Amendment Act 2015 streamlining processes and ensuring transparency through e-auctions, progressive policies such as National Mineral Policy 2019, National Mineral Exploration Policy 2016, structural reforms announced by the government amid the COVID-19 pandemic as a part of 'AtmaNirbhar Bharat' such as introduction of commercial mining, enhancing private investments, measures for Ease of Doing Business, no distinction between captive and non-captive mines, etc[11]., promotion of positive competition with privatisation of coal, push towards increased FDI and investments and government's plan of auctioning 500 minerals blocks are positive steps for boosting the overall growth of the sector.

India needs to increase expenditure as well as encourage the role of private sector players in exploration activities. In addition, the prime focus of the sector should be towards utilization of low-grade ores and mineral rejects by developing the process and the know-how for processing and beneficiation; increased adoption of latest technologies and equipping the youth with employable skills relevant for the sector.

Labour market trends in the mining sector

Total employment in the Indian mining sector has been estimated across three broad categories- core, ancillary and induced**.** Thus, **total employment (core, ancillary and induced) generated by the mining sector has been estimated to be 11.7 million in the year 2018-19.** With an employment elasticity of 0.52, the mining and quarrying sector also emerges as the third largest next to Construction (1.13) and Finance and real estate (0.66) in terms of generating jobs per unit increase in the sectoral GDP[12]. The split across each category is as follows:

Employment type	Definition	Estimated employment in 2018-19
Core employment	Workers directly employed whether onsite or offsite across 4 sub-sectors of mining, i.e. prospecting, exploration and mine planning, mining operations, engineering services and mineral beneficiation.	**2.3 million**
Ancillary activities	Workers involved in activities/sectors that provide intermediate input (such as energy, service, material) and capital (such as construction, transport equipment, machinery) to the mining and quarrying sector and activities/ sectors that function near the periphery of mines or quarries and are dependent on mining and quarrying for material inputs (such as cutting and finishing of stone, manufacture of bricks and other non-metallic mineral products).	**5 million**

[11] https://pib.gov.in/PressReleasePage.aspx?PRID=1624536
[12] RBI working paper series "Estimating Employment Elasticity of Growth for the Indian Economy (2014)

Employment type	Definition	Estimated employment in 2018-19
Induced employment	Income that mining workers directly employed in mining and their households spend on goods and services generate employment in the local community.	**4.4 million**

With respect to core employment in the year 2018-19, the **Mining Operations sub-sector dominates in terms of employment with nearly 86.9% of the workforce** engaged in this sub-sector followed by **Engineering Services (rendering mining support services) employing 9.9% of the total sectoral workforce and Prospecting, Exploration and Mine Planning employing 2.5% of the workforce. Mineral Beneficiation sub-sector accounts for a relatively lower proportion employing 0.7% of the workforce**. Of the total core workforce employed in the mining sector, majority (60%) is engaged in extraction of minor minerals (which represents the unorganized sector) followed by mining of coal and lignite (25%), metallic minerals (10%) and non-metallic (2.3%) minerals[13].

Based on stakeholder consultations and the field survey, key job roles across which people are employed in the minor mineral sector include: Wire saw operator, Loader, Mine Mate, Helper, Dumper Operator, Mine Manager and some associated job roles such as Welder, Fitter, Machinist and Electrician. In addition, some prominent job roles that exist in major mineral segment include: Timberman, Assistant Support Person (Open casts / Underground), HEMM Operators, Rig mounted Drill operator, Mining Engineer, Blaster, Explosives Handler, Mining Supervisor, Mining Mate, Mine Foreman, etc.

With respect to **ancillary activities which exist in the periphery of mines** based on field survey, it has been noted that about **53% people are employed in job roles that fall under skilled category, 30% under jobs that fall in semi-skilled category and the remaining 17% under unskilled category jobs[14]**.

Based on stakeholder consultations and field survey, the key job roles in which people are employed in the ancillary activities include: Driver, Cleaner/Helper, Stone Cutter, Gardner, Machinist, Gangsaw Operator, Fabricator, Water tanker operator, Explosives handler and carrier, Driver (Sprinkler and Explosives van), Sales executives, Security guard, etc.

Analysing the State wise share in the sector's total employment shows that States of Jharkhand, Chhattisgarh, Rajasthan, Odisha and Madhya Pradesh together account for 41% of the total sectoral employment. Other major mining States of Maharashtra, Telangana, Andhra Pradesh and Gujarat constitute 21% of the sectoral employment. Therefore, it can be inferred that a significantly large proportion of mining activities are undertaken in States with per capita income lower than the national average, i.e. relatively poor and backward areas[15].

Considering the pivotal role played by the mining industry for economic growth and the declining aspiration of youth in developed countries to join the sector, mineral rich countries such as **Australia and Canada offer opportunities for the skilled resources from other countries, including India**. Some of the **key job roles in demand for immigrants[16] include, Mine Closure Specialist, Bomber/Relief Operator, Shotfirer, HSE Advisors, Excavator Operators, Geotechnical Engineer, Rock Mechanic Engineer, Material Handler, Water engineers, Contaminated land specialists**, etc.

[13] SCMS skill gap report 2015-16, PwC Analysis
[14] PwC Survey data analysis
[15] Per capita income in INR (2015-16): Jharkhand (44524), Chhattisgarh (61504), Rajasthan (68596), Odisha (58165), Madhya Pradesh (47763), India (77435)- MOSPI
[16] 2018 Employment Projections - for the five years to May 2023, Australian Govt. Department for Jobs and Small Business LMIS; https://www.careermine.com/jobs/?pg=4; Canadian Mining Labour Market Outlook, Canadian Mining Industry Human Resources Council, 2019; https://www.jobs4mining.com/browse-jobs/]

Given that a significant proportion of workforce employed in the mining sector have not undergone any form of formal training and RPL Certifications with respect to their current job role and that 56% have expressed their desire towards additional skills training, building a skilled workforce with equal focus on soft skills will be critical. However, to interlink skills development and engaging the workers in gainful employment, it is important to undertake an analysis of the existing education, training and skill development ecosystem in the country, i.e. number of institutes, their seating capacity and seat utilization, courses offered, etc. and identify the key gaps.

Source: PwC Survey findings

Education, training and skill development ecosystem

Currently, the mining sector absorbs its workforce from three major categories of educational institutions-

- **Schools:** mainly comprising of school dropouts, working as support staff in organised and unorganised mining sector.
- **Vocational Institutes:** candidates from Industrial Training Institutes and short-term training programs working across major job roles such as sampler, mechanic/fitter, mine electrician and in job roles across ancillary units.
- **Colleges:** including potential workforce mainly from polytechnic and engineering colleges working across mining sectors as mining engineers, material engineers, geologists, mineral processing engineers amongst others.

These educational institutions offer courses that are either directly (courses where students are trained primarily for mining sector such as mining engineering, metallurgy, etc.) or indirectly (such as mechanical engineering, electrical engineering amongst others are the courses which are not exclusive to mining sector) related to job roles in the mining sector.

Since there will be requirement of about 82,000 people to be employed across job roles falling under NSQF levels 1 and 2 during 2019-25-year period, vocationally trained school pass outs will be the potential target for the mining sector. Thus, to equip young people (i.e. school pass not pursuing higher education) with employable skills, centrally sponsored scheme of vocationalisation at school level- the Rashtriya Madhyamik Shiksha Abhiyan (RMSA) which was introduced under the umbrella of Ministry of Human Resource and Development (MHRD) can be leveraged. RMSA would also help reduce drop-out rates, increase enrolments in schools and also provide for diversification of educational opportunities to enhance individual employability, reduce the mismatch between demand and supply of skilled manpower and would provide an alternative for those pursuing higher education.

Of the total 18 vocational courses offered at school level, there are no courses primary to mining sector, thus in the current scenario where mining is not an aspirational sector for employment, awareness generation about career opportunities in the mining sector at an early age will be crucial in ensuring higher uptake.

There are 6,446 institutions offering 2.8 million seats across various engineering and technology courses in the country. The average seat utilization across these institutions was 48% (~1.34 million students) in 2017-18. Additionally, of the total enrolled candidates, only 0.5 million have been placed across various sectors.[17]. **Of these there are 168 institutes offering courses directly related to mining sector comprising of only 0.5% of the total intake capacity**. Some of the key challenges identified in engineering and technology colleges include lack of industry buy-in in terms of curriculum development, lack of on the job training opportunities, inadequate laboratory facilities in several institutions, limited placement opportunities, etc.

The **vocational training institutes** mainly contributing to mining sector are Industrial Training Institutes (ITIs) and training partners affiliated with National Skill Development Corporation (NSDC) for short-term training

[17] AISHE 2017-18 and JoSAA

programs. **India currently has 14,850 NCVT affiliated ITIs accounting for a total intake capacity of 3.5 million with seat utilization of 66%. However, there are 2 courses that are directly related to mining.** With respect to mining, this pool typically gets employed across NSQF levels 1 to 4 both in organised and unorganised sectors.

Four key ministries that oversee skill development and vocational training in the mining sector in India are the Ministry of Mines, Ministry of Skill Development and Entrepreneurship, Ministry of Coal and Ministry of Steel. In addition, skill development activities are also undertaken by various mining States, private players and Public Sector Undertakings (PSUs).

With a window of demographic opportunity and boost provided by various policy reforms, the Indian mining sector stands at a crucial juncture. Therefore, keen focus in training across industry relevant skill sets, improving and increasing existing training infrastructure and employer buy-in through the skilling ecosystem will be required. These measures will also have a positive impact on workers' wages and lead to increased aspiration of working in the sector.

Technologies: Drivers for change in future occupations

The technological advancements in **Prospecting, Exploration and Mine Planning** sub-sector will lead to growing demand for **Geologists, Imaging Technologist, R&D Engineer, Satellite Imaging Technician, Automation Specialist and technical personnel** with understanding of geology, geophysics, surveillance, remote operations and earth science, Also, personnel with **skills in data analytics, data visualizations and understanding of information technology are expected to rise in demand (such as Data Analyst, Database Management Supervisor) to gauge better inference from pre-competitive geoscience data and implementation of newer technologies (such as Advanced Airborne Gravity Gradiometer, 3D imaging, and modelling, automated drilling**, etc.)

Technologies have exponentially affected each part of the **Mine Development and Extraction** process, from drilling and blasting to ore transportation and processing. For example, pre-blast analysis using software packages, post-blast analysis of fragment distribution to study the effect of explosives and plan for future more efficiently, individual blast holes are now being georeferenced using GPS and to control blast and increase efficiency laser range finder and face profiler is getting common. Such technological advancements will create demand for personnel with understanding of **IT infrastructure, Application Developers, Data Engineers, Data Scientists, Drone Operators, Machine Learning Engineer**, **personnel with good understanding of mathematical analysis, tools and software for analysis and understanding of mining sector** as well[18].

Skill gap assessment

The overall incremental employment[19] in core mining and ancillary activities is estimated to be 0.85 million over the 2019-25-year period.

Of the total incremental manpower requirement, 0.27 million (32%) account for core mining and the remaining 0.58 million (68%) account for ancillary activities.

[18] PwC Analysis
[19] Includes demand for skilled, semi-skilled and unskilled human resources

Incremental human resource demand

The incremental human resource demand across four mining sectors shows that Mining Operations sub-sector accounts for the largest share (86.9%) of the additional manpower demand followed by Engineering Services (9.9%), Prospecting Exploration & Mine Planning (2.5%) and Mineral Beneficiation (0.7%)[20].

In terms of share of the total incremental manpower requirement in core mining over the 2019-25 period, minor minerals account for 45% share followed by metallic minerals (31%), fuel minerals (19%) and non-metallic (3%) minerals[21]. With recent policy reforms (aimed at ensuring ease of doing business), shift of 31 major minerals into minor mineral category coupled with increased impetus on exploration activities, Mineral Extraction, Prospecting and Exploration and Associated Services are projected to contribute the most to the incremental demand. Thus, skills enhancement programs across these three sub-sectors in the form of fresh skilling, upskilling and RPL certifications will be crucial. In addition, the human resource requirement in sectors ancillary to the mining sector has been estimated to be to 5.6 million in 2025.

Total core increment demand across NSQF levels shows that maximum incremental demand (43.7%) will be at NSQF level 4, i.e. people having diploma/ITI equivalent certificate holders. The second highest share is estimated at NSQF level 1 and 2 accounting for 30.4% of the total incremental human resource demand, i.e. school dropouts/pass outs not enrolled in higher/technical education followed by 15.5% of incremental demand at NSQF level 5, i.e. Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders. NSQF level 3 (i.e. skill certification of short and medium term) and NSQF levels 6 and above (i.e. Doctorate/Postgraduate or equivalent degree holders) account for relatively lower proportion of the total incremental human resource demand with 6.7% and 3.7% share respectively.

With respect to geographical spread, the States of Jharkhand (13.2%), Karnataka (10.9%), Odisha (10.6%), Gujarat (9.9%), Rajasthan (9.6%) and West Bengal (6.4%) account for 61% share of total core incremental demand. The key occupations which are estimated to account for the maximum share of total incremental demand for manpower include-Mazdoor/Helper (30.4%), Loading and Hauling-Opencast (20.2%), Drilling/Cutting (14.7%), Others in mining operations (7.5%) which includes Mining Engineer, Material Engineer, Geotechnical Engineer, Mining Supervisor, Mining Mate/Mining Sirdar, Overman, Mine-Foreman and Loading and Hauling-Underground (6.4%), Specialized Operations (5.1%), Short firing Blasting (4.9%) and Mechanical Services (3.8%).

With respect to ancillary activities, the States of Uttar Pradesh (12%), Rajasthan (11%), West Bengal (9%), Gujarat (7%), Madhya Pradesh (7%), Tamil Nadu (7%), Jharkhand (6%), Karnataka (6%) account for 65% share of total incremental demand generated by ancillary activities.

Incremental human resource supply

The human resource supply has been projected across NSQF levels, basis three main supply sources, which include; vocationally trained school pass outs, those having diploma/ITI equivalent certificates or have trade specific certificate and university degree holders.

The incremental human resource supply of workers is estimated to be 77.7 million over the 2019-25 period. Further, this supply pool is available for sectors such as construction, manufacturing, etc., thus leading to a low trickle of skilled workforce in the mining sector.

Disaggregating the total incremental supply across NSQF levels/education levels show that highest share (84.5%) is expected at NSQF levels 1 and 2. Thus, a significant proportion of supply comes from schools which could be attributed to Gross enrolment ratio at school level being much higher as compared to higher education.

[20] India KLEMS database, NSSO 68th round on Employment & Unemployment Situation in India, PLFS Annual report 2017-18, Central Statistical Organization data, PwC Analysis
[21] PwC Analysis

Analysing supply across other NSQF levels show that nearly 9.5% of the incremental human resource is anticipated at NSQF level 5 followed by 3.4% at NSQF level 6 and above and 1.6% at NSQF level 4. With respect to NSQF level 3, a relatively lower proportion (1%) is expected to contribute to the overall incremental human resource supply.

The incremental supply of workers exclusive to mining sector (across the primary sources) is 64,000 constituting only 0.1% of the total incremental supply over the 2019-25 period. Considering the primary/direct sources, about 51.6% of the incremental supply is anticipated at NSQF level 5 suggesting that about 32,500-33,000 Advanced Diploma/Bachelors degree holders in courses directly relevant to the mining sector will participate in the sector over 2019-25 year period. Nearly 36.2% of the incremental manpower supply is projected at NSQF level 4 suggesting that nearly 22,500-23,000 trade specific certificate holders will enter the sector per annum by 2025. Approximately, 12.2% of the incremental supply is expected to come from NSQF level 6 and above.

Incremental human resource demand-supply gap

The skill gap in the mining sector has been mapped as difference between the total core requirement of skilled manpower and the primary supply of workforce in the country. This analysis is in line with the study objective to facilitate informed decisions and develop a holistic skilling plan and implementation roadmap.

Considering the primary supply at NSQF level 4 and above, the incremental demand-supply of the mining sector is estimated to be a deficit of ~0.11 million during the 2019-25 period which is higher than the deficit of 0.06 million over the 2014-22 period as estimated during the SCMS's skill gap study conducted in 2015-16 . This suggests that the mining sector faces a shortage of talent supply directly relevant for the sector. This necessitates the need to attract manpower from auxiliary sources through appropriate skilling (fresh skilling, upskilling, reskilling) measures to close the demand-supply gap. The key highlights of the incremental human resource demand-supply gap across NSQF levels are as follows:

- **Human resource deficit at NSQF level 6 and above i.e. Doctorate/ Postgraduate or equivalent degree holders:** Over the 2019-25 period, a deficit of about 2250 people is anticipated for job roles that require specialists/sector experts such as Geological Mapping, Exploration, Mineral Estimation, Ore Pressing, Instrumentation and Control Systems and performing managerial level functions. With advanced technologies being used in exploration activities, building a skilled manpower in line with recent technologies will be critical.
- **Human resource deficit at NSQF level 5**, **i.e. Bachelor's/ Advanced Diploma (Polytechnic) equivalent degree holders:** Over the 2019-25 period, a deficit of ~9,000 people is anticipated for job roles related to engineering, supervisory, geology and plant operations. With advanced technologies being used in exploration activities, building a skilled manpower in line with recent technologies will be critical. Based on stakeholder consultations it was found that manpower engaged at this NSQF level are not adequately skilled, especially in light of technological advancements necessitating the need for upskilling and reskilling.
- **Human resource deficit at NSQF level 4 i.e. Diploma/ITI equivalent certificate holders:** Over the 2019-25 period, a deficit of ~95,000 people is anticipated for job roles such as Mine Driller, Dumper/Tipper Operator, Blaster, SDL & LHD Operator, HEMM Mechanic, Mine-Machinist, Roof Bolter, Loader, etc. The deficit may be addressed through upskilling and RPL Certifications of the existing workforce engaged at NSQF levels 3 and below. In addition, attracting workers from other competing sectors and reskilling them as per DGMS's statutory compliances will also help address the expected shortage.
- **For NSQF levels 3 and below the talent pool may be sourced from auxiliary supply:** The key job roles that exist at these NSQF levels include, Mazdoor/Helper, Technical Helper: Mechanical and Electrical, Mechanic/Fitter, Assistant Support Persons, etc. These job roles do not require any trade specific skills owing to their repetitive/routine-based and labour-intensive nature and thus this pool of workforce can be extracted from other competing sectors of the economy.

Table 1: Human resource demand supply gap by NSQF levels (in '000) 2019-25

Particulars	2019-21	2022-25	2019-25
Total Incremental Human Resource Demand (for all levels)	80.7	190.0	270.8
Incremental Human Resource Demand (level 4 and above)	50.8	119.6	170.3
NSQF level 6 and above (*Doctorate/Postgraduate or equivalent degree holders*)	3.0	7.0	10.0
NSQF level 5 (*Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders*)	12.6	29.6	42.1
NSQF level 4 (*Diploma/ ITI equivalent certificate holders*)	35.2	83.0	118.2
NSQF level 3 (*Skill certification of medium term duration – 6 months to 1 year and short term – less than 6 months*)	5.4	12.7	18.2
NSQF level 1 & 2 (*School dropouts and pass outs who are not enrolled in higher/ technical education*)	24.5	57.7	82.3
Incremental Human Resource Supply (level 4 and above)	27.4	36.6	64.0
NSQF level 6 & above (*Doctorate/ Postgraduate or equivalent degree holders*)	3.3	4.5	7.8
NSQF level 5 (*Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders*)	14.2	18.9	33.0
NSQF level 4 (*Diploma/ ITI equivalent certificate holders*)	9.9	13.2	23.2
NSQF level 3 (*Skill certification of medium term duration – 6 months to 1 year and short term – less than 6 months*)	*About 66 million people will join the labour force at NSQF level 3 & below during the period 2019-25. They will be available for employment in all sectors of the economy*.*		
NSQF level 1 & 2 (*School dropouts and pass outs who are not enrolled in higher/ technical education*)			
Incremental Human Resource Demand Supply Gap (level 4 and above)	23.4	83.0	106.4
NSQF level 6 & above (*Doctorate/ Postgraduate or equivalent degree holders)*	-0.3	2.6	2.2
NSQF level 5 (*Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders*)	-1.6	10.7	9.1
NSQF level 4 (*Diploma/ ITI equivalent certificate holders*)	25.3	69.7	95.0
NSQF level 3 & below	*To be sourced from 66 million incremental labour supply in the economy.*		

**Total Incremental supply in the economy in 2019-25 period is estimated to be 77.7 Million, of which 66 million supply will be at NSQF level 1,2&3.*
**36,574 people are provided RPL and Short-term training in mining related trades between year 2016-20.*
Source: PwC Analysis

Key recommendations

This section provides a summary of the recommendations based on secondary research, estimations for demand and supply over the period of 2019-2025 and consultations with stakeholders like employers, government authorities, training service providers and industry associations. Findings from the worker survey also shed light on training needs and expectations related to employment. The recommendations are also based on an assessment of the impacts of COVID-19 pandemic on commodity markets, mining sector and the general labour market.

Training/ skilling needs

With Industry 4.0 technologies, slowly making their way in the Indian mining sector, building a skilled workforce equipped with expected technological advancements (such as real time data analytics, understanding of information technology, data visualizations, blast design and pre-blast analysis software packages, blockchain, etc.) will be of paramount importance. Thus, training programmes should focus on such future skill set requirements. SCMS can develop QPs for the priority job roles and premier institutions can be leveraged to do a 6-month upskilling course around newly introduced tech and innovation in mining. It can also collaborate with major mining companies which have taken initiatives towards training manpower on latest technologies. In addition, equal impetus must be laid on soft skills such as- inter-personal skills, teamwork, critical thinking, etc. to supplement the technical capabilities. SCMS through partnerships with employers and relevant Sector Skill Councils can design soft-skills modules which can be introduced into refresher trainings and several certification programmes. To tackle the problem of sexual harassment of women at workplace, sessions on Prevention of Sexual Harassment (POSH) can be organised as a part of soft skills training. Immersive language workshops can also be conducted to provide language trainings.

Further, simulation-based training sessions on operating various machines on mines can be conducted in engineering and polytechnic colleges and ITIs to give essential hands-on experience to students which will increase operator safety and improve productivity by giving 3-D representation of actual mining operations. In addition, e-learns will be critical to help overcome illiteracy and language barriers and develop a trained and skilled manpower which can perform roles that blend traditional mining disciplines with new digital applications. Large companies can set up such training facilities on their premises for re-skilling and up-skilling of their workers or set up professional development programs for their staff. Additionally, SCMS can collaborate with/ adapt models of mining companies such as GMDC, Bharat Earth Movers Limited and skill development bodies in Australia and South Africa to establish Centres of Excellence to promote up-to-date facilities.

Since facilities for practical sessions in engineering colleges, polytechnic colleges and industrial training institutes are of low quality, it will be critical to identify the infrastructure and human resource needs for practical sessions and implement solutions in collaboration with employers (provision of new labs, equipment, trainers, etc.). Further, in light of technology initiatives in the classroom, colleges, ITIs and polytechnics can avail funding under various schemes: the Ministry of Human Resource Development's Rashtriya Ucchatar Shiksha Abhiyan (RUSA), Department of Science and Technology, Govt. of India's Fund for Improvement of S&T Infrastructure (FIST), Directorate General of Training's Skills Strengthening for Industrial Value Enhancement (STRIVE) and upgradation of existing ITIs into model ITIs. In addition, education institutions can also make use of online knowledge repositories such as National Programme on Technology Enhanced Learning (NPTEL), IIT-BombayX and Swayam. These can be utilized to facilitate online and at-home learning as well.

Since mining causes displacement of communities in adjoining areas, there lies a potential of having more youth from mining affected areas by equipping them with requisite skills. Thus, youth living in mining dominant areas can be trained in allied trades such as industrial grade electrician, welder, etc. and exposure visits can also be facilitated for them by mining companies. The use of DMF funds can be explored for their training programmes.

Apart from PSUs and a few large private sector employers, other employers lack institutions/ programs for continuous professional development of their employees critical for their career progression. SCMS can work with such employers to develop training programs and employers can incentivize technical workers to take up management roles through offering upskilling/ re-skilling programs on management-oriented activities. SCMS can also work with PSUs to offer online Continuous Professional Development programs for other employers and collaborate with universities to offer executive management education courses. Further, due to political, regulatory and environmental concerns, trainings in environmental management and community development for those in supervisory and management roles should be replicated by small and micro sized industries involved in mining operations.

Currently, beneficiation processes for coal washeries, iron ore, zinc, manganese and chromite ores are undertaken by a workforce which does not have formal, standardized training. Thus, training providers should be encouraged to undertake courses relevant to refining/ beneficiation of ore by linking them with key employers in beneficiation to enable them to capture demand right from source and ensure that their trainings are aligned to the requirements of employers.

SCMS can undertake job roles mapping in minor mineral segment and ancillary activities and set up Vocational Training Centres (VTCs) with support from employers and local industry associations using DMF or CSR funds to meet skilling needs of smaller and unorganized mining clusters.

Further, majority of the existing workforce, especially in unorganized sector and ancillary activities have not undergone any form of skills training in their field of operation; it is either hereditary learning or training under the supervision of the seniors. In light of absence of formal certifications/qualifications, existing workers face issues in migrating to other decent, high paying jobs and accessing further education despite having necessary knowledge and skills. Thus, formally recognizing and certifying the current competencies (as per NSQF levels) of workers through Recognition of Prior Learning (RPL) certifications will be critical.

Increasing the number of courses and seating capacity of institutes offering Diploma/ITI equivalent certificates directly related to the mining sector will be critical[22]. In addition, for encouraging more TPs to take up mining specific job roles, it will be crucial to make mining one of the priority sectors in the 13 States, provide capital expenditure support in form of subsidized loan/ grant, develop TP rating framework and support in leveraging funds through District Mineral Foundation (DMF) and undertaking skill development under Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) should be considered. Additionally, SCMS should collaborate with State governments of mineral bearing districts which fall under 'Aspirational Districts' to run training programmes leveraging on the funds allocated under 'Transformation of Aspirational Districts' programme. Further, in view of overseas employment opportunities in the mining sector, SCMS should collaborate with training partners in major mining countries such as Canada, South Africa, Australia, etc. to develop transnational standards for key job roles. Country specific MoUs can be signed to ease transition of workers as well as ensure their well-being.

Due to the outbreak of COVID-19 pandemic, it will be important for mining companies to undertake review of health and safety measures such as availability of Personal Protective Equipment (PPE) for workers, medical supplies for treating workplace accidents, availability of manpower and resources in clinics near the mines and overall adherence to health and safety standards, including trainings on health and safety. Re-skilling of laid-off workforce in digital technology and upskilling of workers at supervisory levels and above in new-age technologies will be critical given the changing workplace landscape.

Further, in order to manage migrant labourers and provide them with employment/livelihood opportunities, demand-supply mapping of available workforce in covid-19 impacted areas will be critical. On the demand side, details of mining activities (ongoing projects, required manpower, skill sets in demand, current workforce, etc.) in the districts can be captured from industry associations and employers. On the supply front, labour skill wise / location wise details can be collated and analysed. Additionally, labour supply in the areas near mines can be identified with support from district/block authorities. Once the details have been collated, existing skill sets should be matched with job roles required for the mining sector and those engaged in allied trades can be made suitable for the sector through basic upskilling.

Industry-Institute linkages

While premier engineering institutions have strong industry linkages, others tend to have limited partnerships. Thus, Mining Industry Institute Partnership Cells can be set up in premier engineering institutions, with successful

[22] Maximum incremental demand (43.7%) will be at NSQF level 4, i.e. people having diploma/ITI equivalent certificate

institutions used as models for adoption. A capacity building module can be designed for training HODs and key staff of institutions in designing effective employer engagement strategies. Industry can support institutions by providing space for training and internship programs similar to the Corporate Skilling Centres program of the Ministry of Skill Development and Entrepreneurship, and Institute of Natural Resources (INR) by the Indian Institute of Skill Development (IISD) for providing simulation training.

Local and national industry associations should be brought on board to identify and shortlist private employers who are willing to contribute to funding and infrastructure, and develop pilot training centres, following which larger VTCs can be established. Employers who already have VTCs can be supported in expansion of their facilities/ intake to accommodate more trainees. SCMS can also seek support from industries towards skilling where basic training (which is theory oriented) can take place at training centres followed by On-the-Job Training (OJT) at employer's premise. This can be done with a view to aiding smaller employers in getting quality skilled resources. SCMS can facilitate linkages between FIMI and Polytechnics and colleges for designing Training of Trainer (ToT) and faculty development programs. It can also engage with industry players for quality trainers, who can be deployed to training providers.

Further, it will be imperative to collaborate with industry associations and large employers to facilitate apprenticeships and placement opportunities in mining companies (core and ancillary) and bring graduates from smaller colleges to larger placement drives. PSUs can be encouraged to offer more apprenticeships to engineers as well as diploma and ITI graduates to reduce the need for on the job training after placement. Apprenticeships can also be used to impart health and safety training and soft skills to trainees.

Awareness generation programmes

Considering the limited aspiration of the youth towards joining the sector, targeted awareness generation programmes should be initiated across mining dominant regions. Pan India digital campaign by key PSUs and employers as well as by the ministry can be developed to attract interest of the young population. The campaign should highlight benefits of working in the sector.

In addition, to increase awareness levels regarding QPs and increase their uptake amongst employers, horizontal sector groups, recruitment agencies and assessment agencies, SCMS can consider devising a Go-To Market strategy and an institutional framework. It can also explore establishing of SCMS cells in Academia to popularize and evangelize the adoption of QPs, obtaining regular feedback from industry on overall experience with QP trained candidates and constitution of a Special Knowledge Group (SKG) comprising of large, medium, small and micro industries across 4 sub sectors with adequate representation from academia and other stakeholders to provide timely inputs from industry while developing QPs.

SCMS can conduct regional awareness workshops among unorganized and minor mineral units to promote skill development. Additionally, awareness generation programmes for the local communities on precaution measures for environment hazards, occupational health and safety should be organized. District Mineral Funds may be leveraged for organising such programmes as well as for designing and implementing interventions in case of socio-environmental fallout in collaboration with state governments and mining lease holders..

Gender diversity

Women are employed in a lower share in the sector (around 4%) as compared to their employment in other sectors such as agriculture and allied (57%), manufacturing (12.5%), education (6%) and construction (5%)[23]. Thus, they can be incentivized to join the sector in popular job roles such as Machine Operators, Geologists, Specialist Operations, Data Entry Operators, Skilled Helper, etc. through targeted skill development, gender-

[23] Periodic Labour Force Survey (PLFS), 2017-18

friendly infrastructure and benefits such as transportation facilities to and from mining clusters, women's restrooms and changing rooms in mining clusters, paid maternity leave, creches, etc. These provisions can be government-funded and SCMS can help facilitate the abovementioned benefits and infrastructure support.

Further, a study on workers in mining and related sectors can be undertaken with a gender focus to understand the challenges faced by women and devise appropriate policy solutions. Awareness programs can be conducted on the employment potential for women in mining. However, possibilities for inclusive career progression must be highlighted to ensure continuous participation of women. Further, Mining majors like NMDC, CIL, Vedanta etc. should be encouraged to lead and drive the change through mentorship programmes, digital series on their experience to encourage younger women to join the sector.

Robust demand aggregation exercise

In light of Industry 4.0 technologies, demand-supply analysis can be undertaken more frequently, with a view to changing Qualification Packs (designing new ones, retiring or merging updating existing ones). The process can tentatively have the following components: demand assessment to understand skills which are required by employers, supply assessment to understand the output of skilled graduates from technical institutions/ TSPs, employability assessment of graduates, demand-supply gap assessment, mapping of QP-NOS/ trainings with industry job profiles, and assessment of scope for modification/ retirement. The above analysis can be done with small samples of employers and TSPs to enable SCMS to finish the analysis in a short period.

SCMS in order to facilitate the above process would have to collaborate with employers to develop employability assessment frameworks. SCMS can aid in the capacity-building of TSPs to administer employability assessments. Further, with respect to unorganized sector, employment is not directly quantifiable, thus regular tracking surveys can be undertaken in mining clusters to understand the number of workers, job profiles and skilling needs. The tracking surveys can have a tentative design comprising of: frequency of once a year, duration of 4 weeks for conducting site visits to understand dominant processes and associated job profiles, employer interviews to understand challenges in recruitment/ training/ retention. SCMS can empanel multiple agencies for conducting surveys at regular intervals. As an alternative to surveys, Ministry of Mines can consider giving a mandate to all mine lease holders to update manpower related details (such as job role headcount, educational qualification, skilling needs, etc.) on a portal/dashboard using their login credentials or a system-generated link as is done in Canada, Australia, etc. This process of assimilating demand will be more useful and time effective.

Other recommendations

Following trends in other sectors, contractual employment is increasing in the sector, pointing to reduced levels of job security as is seen in PSUs and some large private mining companies as well. Thus, social protection support for contractual workers especially for accident and health insurance and provident fund should be introduced. This support should be provided by employers with rigorous monitoring and audit by FIMI with support from local industry associations. Additionally, all QPs undergo National Skills Qualifications Committee (NSQC) approval which is time consuming, however job roles that have limited and immediate demand (such as longwall, draglines machines) in the country should be considered for a quicker approval channel to meet demand.

1. Introduction

1.1. Context and Background

India is rich in a variety of minerals with the mining sector playing a critical and catalytic role in the overall development of the country's economy. Being one of the key sectors of the economy (considered as the backbone of all other sectors), mining provides basic raw material and drives many important industries like power generation (thermal), iron and steel, cement, petroleum and natural gas, petro-chemicals, fertilizers, precious & semi-precious metals/stones, electrical & electronics equipment, glass and ceramics, amongst others.

Over the past 8 years, unfazed by challenges, India has retained its position amongst the top 10 global producers of many minerals and the value generated by exports has also increased over the years[24].

For the share of the mining and quarrying sector to increase from the current 3% of GDP to 5% of GDP over the next 20 years, the mining sector needs to grow at 10.5% per annum on average (assuming the economy grows at 8% on average). The government is undertaking several policy reforms aimed at propelling the sector forward. In addition, India must leverage on its demographic dividend and the high employment elasticity potential of the mining sector (~ 0.52 between 1990-00 to 2010-11) which is well above the elasticity of other sectors such as agriculture (0.04) and manufacturing (0.09). This will enhance labour productivity as well as employment generation opportunities that will in turn impact the growth of the mining sector as well of the overall economy.

Policy reforms such as the Mines and Minerals (Development and Regulation) Act Amendment in 2015 and 2016, commercial mining of coal, transparency in auctions, 100% Foreign Direct Investment (FDI) (though still in implementation phase), government's plan of auctioning 500 minerals blocks through an open and transparent auction process as a part of its 'AtmanirbharBharat' vision amongst others will enhance the competitiveness of the sector and enable higher investments. The National Mineral Policy 2019 is expected to significantly reform the sector by introducing strengthened regulatory framework to limit leakages, encouraging use of advanced mining technologies across the value chain, adopting international best practices including in the area of human resource development and holistic long-term export promotion. It is expected that implementation of the policy will enable 200% increase in production of Mineral Conservation and Development Rules minerals, leading to a 50% reduction in trade deficit[25].

As the sector finds itself on the cusp of transformation and growth, focus on enhancing the productivity of its workforce to adequately adapt and propel growth will be critical. The mining sector in India is largely labour intensive with a relatively high employment elasticity at 0.52[26] **i.e. the third highest after construction and finance and real estate sectors.** Further, it is interesting to note that **India's growth story in terms of talent supply will also gain from its demographic dividend[27] compared to western economies of the world where there is a burden of ageing population.** With the people in the productive age group (15-59) expected to approach its peak by 2030 in India, investing in the youth through skill development and equipping them with industry-relevant skills will be critical.

To ride the growth wave, it is pertinent for the sector to leverage on India's demographic dividend, ensure adequate skilling and upskilling of the workforce in the organized and unorganized segments and enhance labour productivity to achieve fast and sustainable growth.

Further, it must be realized that the mining industry is not monolithic and has several moving pieces such as dominance of unorganized sector in terms of employment, ancillary activities, and presence of mines in highly remote and diverse areas. In addition, the skill requirement varies widely across mineral and mine types, mining activities and the kind of machines/equipment used for mining.

[24] Domestic policy around regulations, challenges related to sustainability, non-acceptance of UNFC by international players, ban on iron ore exports in 2012 and cancellation of 204 coal mining permits in 2014, have further contributed to the inertia in the sector.
[25] National Mineral Policy 2019
[26] RBI working paper series "Estimating Employment Elasticity of Growth for the Indian Economy (2014)
[27] higher share of working age population vis-à-vis total population

However, considering the intense technical, environmental and health related skill requirements, the sector is facing shortage of an appropriately skilled workforce. Despite key policy frameworks (such as the Mines Vocational Training Rules) and schemes/institutions (such as Pradhan Mantri Kaushal Vikas Yojna, Industrial Training Institutions, Polytechnics, etc.) and other State level schemes, as well as initiatives by large corporations driving skill development and vocational training in the sector, the country has limited infrastructure for training in the sector.

Skill Council for Mining Sector (SCMS) promoted by FIMI and supported by Ministry of Mines was established in the year 2013 as an apex body for building skilled workforce and meeting skilling requirements of the mining sector. The council's vision is to meet skill requirements in the sector by ensuring and promoting skill development and vocational education in the mining sector thereby contributing to the overall human capital development in the country. In addition, the sector as a whole is undergoing rapid transformation due to recent legislative policy changes, technological advancements, increased focus on sustainable mining practices, shift of about 31 major minerals into minor minerals category, introduction of e-auctions, etc.

All the above-mentioned factors have a significant impact on human resources and skill requirements in the country's mining sector. Taking cognizance of such factors and limited availability of skilled manpower in the sector, SCMS commissioned the present study, 'Human Resource and Skill Requirement in the Mining Sector in India (2019-2025).

1.2. Requirement for the study

The SCMS had commissioned a similar study in 2015-16 to estimate the demand over the period 2014-17 and 2017-22. The study adopted a mix of secondary and primary research methods and estimated the manpower requirement and skill gap for a period of 8 years, up to FY 2022. Given the recent changes in the sector, to get updated industry analysis and provide estimations of the human resource and skill requirements beyond 2022 period, there was a need for a fresh assessment of the mining sector. In addition, there was also a need felt to understand the minor mineral scenario and ancillary activities (sectors that provide intermediate input and capital to the mining sector and activities that exist in the periphery of mines) which have significant employment generation and skilling potential. A contemporary estimation, using both quantitative and qualitative analysis would reveal relevant insights and findings related to the workforce characteristics, type of technological advancements and emerging job roles, skill sets and job roles in demand.

In order to factor-in the recent legislative policy changes and cover minor mineral and ancillary activities, Ministry of Skill Development and Entrepreneurship (MoSDE) through National Skill Development Corporation (NSDC) suggested a comprehensive skill gap study for the sector. Thus, SCMS, through a competitive procurement process engaged PricewaterhouseCoopers Private Limited (PwC) to carry out "Human Resource and Skill Requirement Study for the Indian Mining Sector (2019-25). The study was carried out across 13 mineral rich States in the country i.e. Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and West Bengal.

In order to get updated analysis of the sector and fresh demand-supply estimates with impetus on minor mineral segment and ancillary activities, the study was commissioned across the 13 States in the country. The study was carried out with the objective of providing overview of labour market trends in the sector and assessing the skill gap from 2019 to 2025.

1.3. Objectives and Scope of work

The overall objective of the study was to provide a labour market outlook and undertake skill gap assessment for Indian Mining sector (2019-25) which in turn would lay the foundation for developing the strategy and action plan in order to address key human resource challenges and create potential employment opportunities.

The study covered all sub-sectors of Mining Sector, excluding Oil & Gas and Sea-bed mining and included following project components:

- **Enhance and update the industry overview and labour market trends**
  - Key guiding framework, broad level sectoral definitions and industry standards outlining coverage of the study
  - Geographic, Economic overview and mining industry trends
  - Regulatory environment – Key Institutions, Acts and Policy level initiatives
  - Labour market patterns – Employment, Geographical distribution, Demographic & Workforce characteristics (gender, education attainment, occupation etc.)
  - Overseas employment opportunities
  - Projects and investments anticipated up to 2025
  - Competitiveness of the sector
  - SWOT Analysis of the sector
- **Carry out situation analysis for critical success factors of SCMS**
  - Educational infrastructure (related to mining) – capacity, quality, geographical distribution and challenges
  - Assessment and Certification – capacity, key organisations, occupation and challenges
  - Key skill development initiatives – Central/ State government, public/ private sector organisations
  - Standard operating procedure for ensuring relevance of qualification packs
  - Existing mechanism to encourage training providers for mining specific occupations
  - Future occupations anticipated in mining sector with rapid changes in technology
- **Study the potential of employment and skilling needs of ancillary sectors that can be directly attributed to mines/ related activities**
  - Mapping of the sectors/ occupations influencing the HR demand and supply aspects including mining skilling and training center.
  - Outline the key geographical clusters where employment generation in ancillary sector is primarily through mining operations
  - Assess the potential of employment in ancillary sectors that arise due to mines/ related activities
  - Identify the skilling needs in ancillary sectors influenced through mines/ related activities
- **Study minor mineral scenario in India**
  - Industry overview – Major clusters, Production, Key industries etc.
  - Policy & regulations – State/ Cluster wise
  - Employment profile – Size, Demographic & Workforce characteristics, Occupations etc.
  - Current skilling scenarios and requirements – Geography, Occupations, Skilling Initiatives, Skill level requirements
- **Ascertain the human resource and skill requirement forecast over a period of 2019-22 and 2022-25**
  - Forecast to be developed keeping two scenarios – Conservative (e.g. considering current trends and AS-IS State) and Expansionary Views (e.g. any policy/ regulatory shift, enabling positive implication on the mining sector)[28]

[28] PwC in agreement with SCMS used only expansionary views (i.e., business after investment scenario, e.g. any policy/ regulatory shift, technological advancements, positive implication on the mining sector) and took cognizance of the COVID-19 outbreak's impact on employment while making forecasts/projections.

- Human resource demand forecast – sub-sector wise, organised and unorganised, education and experience levels (i.e. NSQF levels), geography, primary (directly linked to mining) and ancillary sectors, key occupation/ Job roles
- Human resource supply forecast - education and experience levels (i.e. NSQF levels), primary and ancillary sectors
- Hiring requirement forecast for Indian mining sector – primary and ancillary sectors, key organisation specific (if available)

- **Develop strategic roadmap and action plans**
  - Identify and prioritise the top 3 challenges/ problem areas emerged from findings of each of the project components
  - Conduct key stakeholder consultation and expert interviews for preparing the roadmap to address the key challenges/ problem areas
  - Develop 3-year action plan outlining the approach to implement the roadmap

Given the study's overall objective and the broad scope of work (as outlined in the ToR), it was important to adopt a holistic approach and methodology for the study with key milestones and timelines defined. Thus, a consultative and participatory approach was adopted to seek inputs from various stakeholders and finalize the sample design, scope of work, study tools, etc.

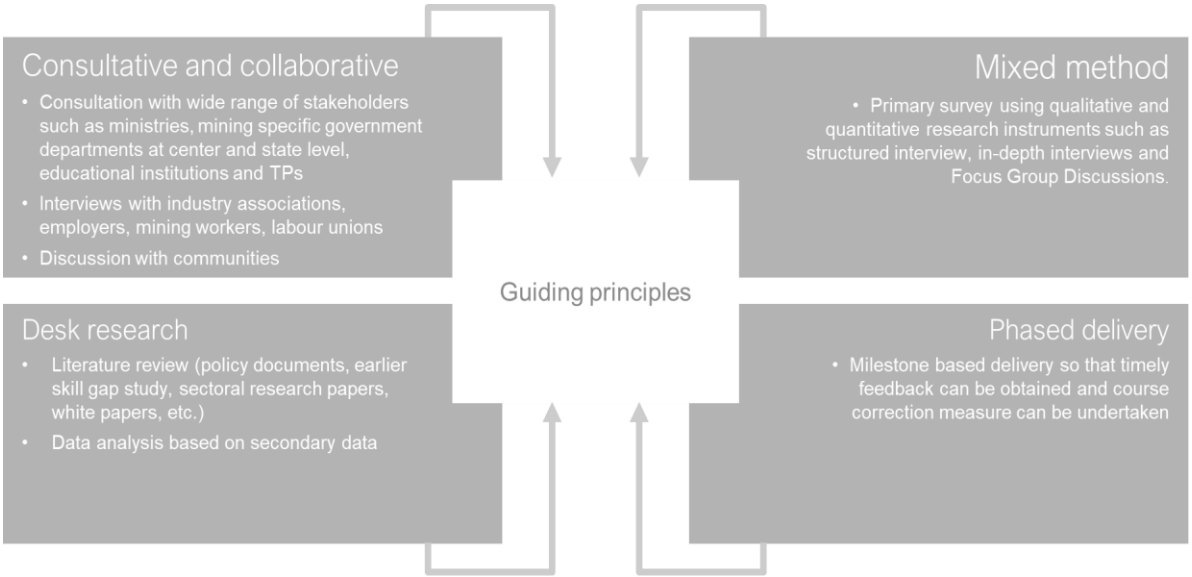
The next chapter delves into the Approach and Methodology adopted for achieving the study objectives.

2. Approach and methodology

2.1. Project approach

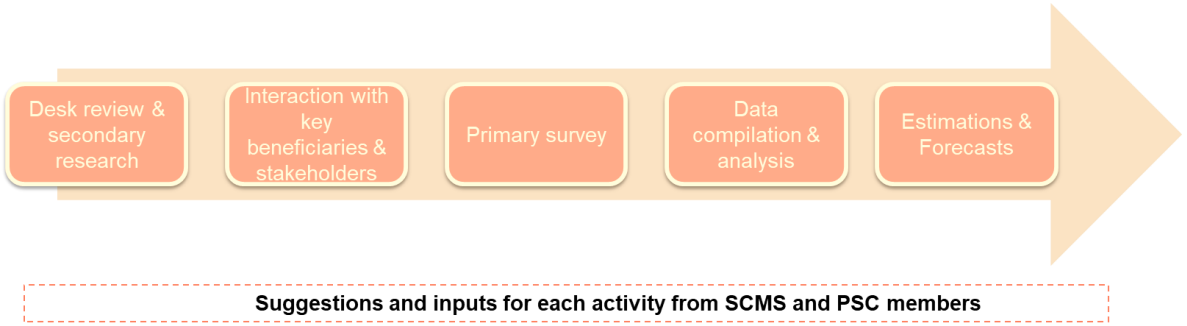
The overall approach adopted for 'Conducting Human Resource and Skill Requirement Study for Indian Mining Sector (2019-25) study was in line with the requirements, objective and scope of work as outlined in the Terms of reference (ToR) published by SCMS on 29th Jan 2019. The study was guided by four key **approach principles** which are highlighted in the figure below:

Figure 1: Approach principles for the study



The study adopted a consultative and participatory approach in order to interact and seek inputs from relevant stakeholders, including the Project Steering Committee (PSC) and SCMS. The study was further aided by extensive desk review/secondary research utilizing information available in the public domain and a primary survey. Additionally, rigorous data analysis was undertaken to arrive at the estimates and forecasts of human resource demand and supply and skill gaps prevalent in the sector. The figure below illustrates the overall approach for the study:

Figure 2: Approach for the study



In line with the above, following activities were undertaken to meet the objective of the project:

- **Desk review and secondary research**: Based on identified sources of information such as Annual reports of Ministry of Mines, IBM's Minerals Yearbook and State-wise reviews, DGMS Annual reports, data from MoSPI, MoLE, AICTE, NCVT, etc. desk review of the mining sector was undertaken. This review was undertaken to develop a holistic understanding of the sector such as its growth trajectory, education and

skilling infrastructure, prevalent ancillary activities, technological advancements driving future occupations and other aspects as highlighted in the ToR.

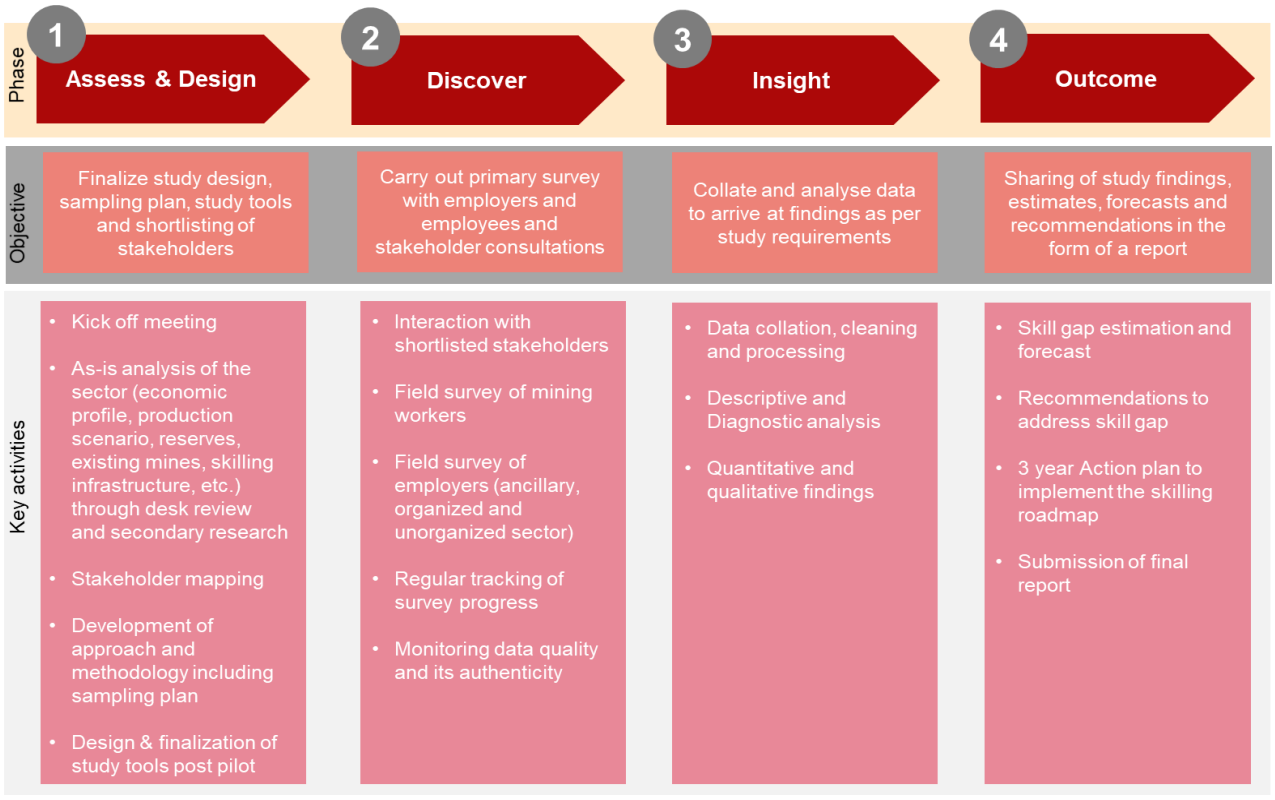
- **Interaction with key beneficiaries and stakeholders**: The study involved interaction with key stakeholders shortlisted across various categories such as Central ministries, apex bodies/organisations, State mine departments, mining associations, education institutes (faculty and students) offering mining courses, training providers (both mining and non-mining), State Directorates of Technical Education, etc. The stakeholders were interviewed to seek their inputs and suggestions on mining and related aspects.
- **Primary survey**: This was a critical activity of the study which targeted mining employers (including employers in ancillary activities category) and workers (both organized and unorganized). The survey was carried out using structured and semi-structured questionnaires keeping in view the study requirements.
- **Data compilation and analysis**: Once the employer and worker survey were completed, the primary data captured from the survey was compiled and the codified. The codified data was extracted in a manner compatible to MS Excel/SPSS/STATA. The collated data was then cleaned and analysed.
- **Estimations and forecasts**: Once both primary and secondary data were collated, a model was developed to estimate and forecast manpower demand and supply, make growth projections, demand-supply gap, etc. using expansionary views (i.e. Business after Investment Scenario, e.g. any policy/ regulatory shift, technological advancements, positive implication on the mining sector) and taking cognizance of the COVID-19 outbreak's impact on employment.

In addition to this, inputs from the Project Steering Committee and SCMS were taken at various stages of the project in order to ensure adherence to their expectations.

2.2. Project methodology

In line with the study objectives, understanding of the scope of work and suggestions from SCMS, the study was undertaken using a phased methodology. The four distinct but interlinked stages of delivery were broadly categorized as Assess and Design, Discover, Insight and Outcome. The exhibit below represents these phases.

Figure 3: Methodology for the study



Each of the abovementioned phases are explained in detail below:

- ***Phase 1: Assess and design***

  This phase began with a kick-off meeting with SCMS and the Project Steering Committee (PSC) on 15th April 2019 with the objective of finalizing scope of the study, approach and methodology for the project, timelines and key milestones. This phase was critical as it guided activities to be undertaken in the next 3 phases of the project. Post the kick-off meeting, detailed secondary research was undertaken based on identified sources of information to develop a holistic understanding of the sector (such as its economic profile, growth trajectory, demographic profile, labour market situation, training and skill development ecosystem, etc.) and deliver project components outlined in the scope of work. In addition, stakeholder mapping exercise was carried out to ensure no critical stakeholder group was missed and the mode of interaction with each of the stakeholder group was identified as shown in the table below:

Table 2: Stakeholders/Respondents shortlisted for the study

Stakeholder category	Research method
Directorate General of Mines Safety (DGMS)	In-depth interview
Central ministries and apex institutes/organisations	In-depth interview
State Departments of Mines and Geology (DMGs)	In-depth interview
Directorates of Technical Education	In-depth interview
Departments of Industries and Commerce	In-depth interview
Employers	Structured interview
Mining workers	Structured interview
Communities (Youths/Gram Panchayat members/households)	Focus Group Discussion (with a group of 10-15 members)
Training Service Providers (Mining and Non- Mining)	In-depth interview
Assessment Agencies	In-depth interview
Faculty members from educational institutions (ITI/Polytechnic/Engineering)	In-depth interview
Students from educational institutions	Focus Group Discussion (with a group of 10-15 members)
Industry Associations	In-depth interview

This phase also focused on development of the sampling plan, survey design and data collection tools for the shortlisted stakeholders. Based on secondary research, key probe areas and questions in line with study objective were determined, reviewed and finalized. Further, as a part of the employer (across mineral type and ancillary activities in the periphery of mines) and mining workers survey across organized and unorganized sectors, following sample was achieved:

- A sample size of **83 employers[29] across mineral type** (fuel, metallic, non-metallic and minor minerals) was achieved
- For employers across **ancillary units, a sample size of 166[30]** was covered

[29] 90% confidence interval at 8% margin of error
[30] 90% confidence interval and 6% margin of error

- For **mining workers survey, a sample size of 701**[31] was estimated and achieved

Once the target sample and tools to be administered to various stakeholders were finalized with SCMS's affirmation, pilot exercise across two States, i.e. Rajasthan and Gujarat were carried out to test the tools/questionnaires adequacy. The pilot study focused on testing the following:

- If the tool had to exclude any area of enquiry or include new ones
- If questions needed to be rephrased
- If the sequence and flow of the questions was correct

Post the pilot exercise, the study tools were finalized to be executed in the next phase of the project. The study tools for all the stakeholders identified in the table above are attached in Annexure A.2. This phase concluded with the submission of finalized scope of work, approach and methodology, sample size and sampling plan, study tools and detailed workplan with timelines and key milestones.

- ***Phase 2: Discover***

This phase commenced with the objective of carrying out stakeholder consultations and execution of primary survey of employers and employees. The questionnaires/tools developed and finalized in the previous phase were administered across all shortlisted stakeholder groups. In order to gain information as per study tools, face to face consultations with above listed informants (Table 2) was carried out and the insights (both qualitative and quantitative) captured from consultations were consolidated and well documented for future reference and further analysis.

Given that significant proportion of study was underpinned by primary data collection, trained quality field staff were important for ensuring quality and accuracy of data. Hence, 2 classroom-based trainings (Chennai and Jaipur) was imparted to the field investigators. Once the survey agency was boarded, questionnaire piloted and field investigators trained, the survey was rolled out to the target sample across the study States. Further, given the sensitivity of primary data and paucity of time, backend checks on the field team by connecting with market research agency's SPOC on a daily basis to discuss performance, making telephonic calls to some of the respondents and seek affirmation on their responses to avoid possibility of fabrication were also carried out. A total of ~1,350 participants were covered and interviewed through a mix of structured and semi-structured interactions as shown in the table below:

Table 3: Summary of stakeholder interactions

	Stakeholder category	Total sample covered
Central Ministries/Apex Organizations	Ministry of Mines, Ministry of Coal, DGMS, National Skill Development Corporation (NSDC), Geological Survey of India (GSI), Department of Industries and Commerce, Indian Chamber of Commerce.	10
Demand Side	Employers (such as Hindustan Zinc, SAIL, RSMML, NMDC, MECL, TATA Steel, Neyveli Lignite Corporation, Wolkem India, Northern Coalfields, Odisha Mining Corporation, etc.)	Mineral type: 83 Ancillary: 166
	Mining workers	701
	Mining Associations	6
	Communities (Youths/Gram Panchayat members/households)	25
Supply Side	Training Service Providers (Public and private)	18
	Assessment Agencies	5

[31] 95% confidence interval and 4% margin of error

	Faculty members from educational institutions (ITI/Polytechnic/Engineering)	52
	Students from educational institutions	250
	Directorates of Technical Education	6
Regulators	State Departments of Mines and Geology	26
Total		1,348

The primary survey was spread across 26 districts in the selected 13 states for the study. This phase culminated with the completion of sample based primary survey and interaction with the stakeholders and beneficiaries identified for the study. The qualitative information from the primary interactions that complemented the quantitative analysis were considered during the following phase of the project. The list of stakeholders interacted with during the study is attached in Annexure A.1.

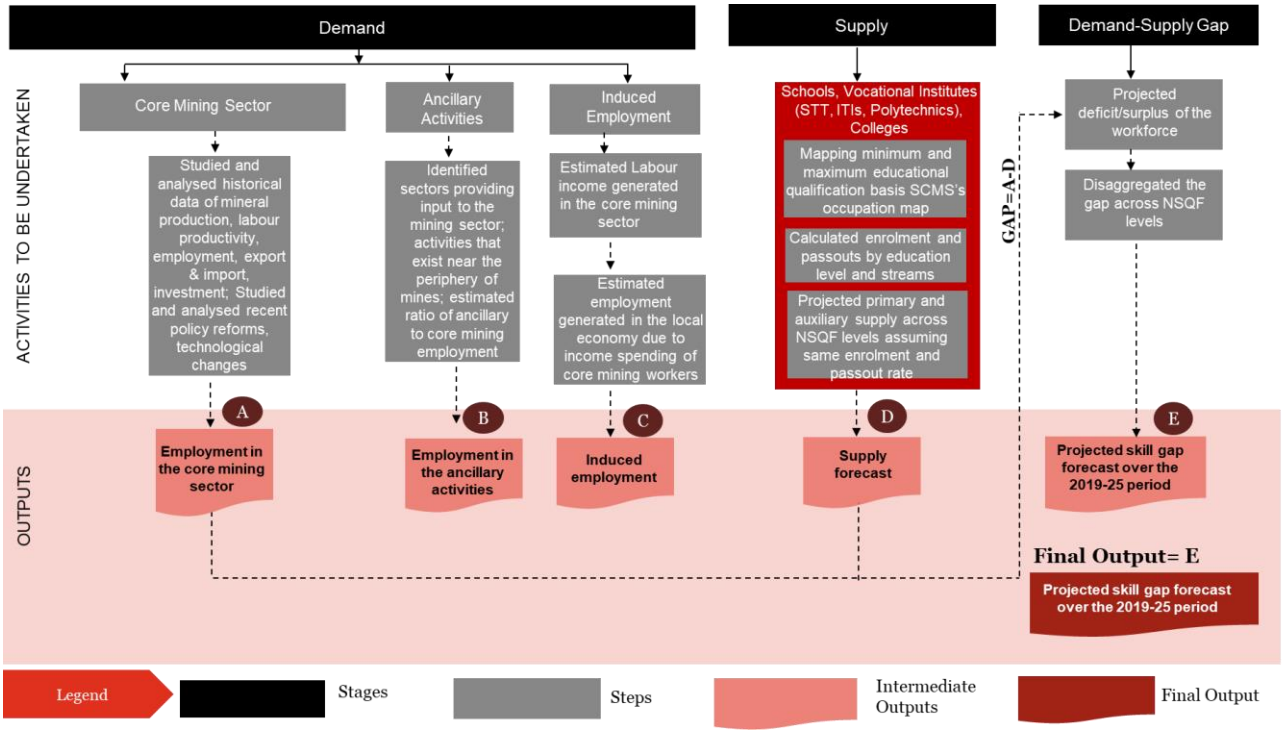
- ***Phase 3: Insight***

  The objective of this phase was to collate the primary data in structured form and arrive at findings and skill-gap estimates as per study requirements. The structured data and information collected from primary survey as well through consultations and secondary sources was cleaned and analysed in detail to arrive at overall human resource and skill requirement estimates and forecasts. The data was cleaned and analysed basis an analytical framework which comprised of descriptive, diagnostic and predictive analysis. While descriptive and diagnostic analysis allowed us to summarize data and identify key correlation among variables, predicative analysis provided us with future outcome based on the current and past data sets as illustrated below:

Figure 4: Analytical framework adopted for the study

In addition, a methodology was developed in this phase of the project to ascertain supply and demand estimates and forecasts for the period 2019-2025. The illustrative below shows the methodology adopted for estimation of human resource and skill requirements vis-à-vis supply across various sub-sectors of mining.

Figure 5: Methodology for estimation of human resource demand supply gap



Source: PwC Analysis

- ***Phase 4: Outcome***

  This phase was carried with the objective of arriving at study findings, estimates and forecasts and sharing the same with SCMS and Project Steering Committee in the form of report. The key activities undertaken in this phase include making human resources and skill requirement estimates and projections over the 2019-2025 period, identifying the issues and challenges and making recommendations through a 3-year action plan for implementing the skilling roadmap. This phase culminated with finalization of the draft report, presentation to SCMS and Project Steering Committee, incorporation of feedback received, submission of action plan and final report on "Human Resource and Skill Requirements Study for the Indian Mining Sector 2019-2025 to SCMS.

The study was guided by a phased approach consisting of four different but interlinked stages of delivery with outcome mapped across each stage. The activities undertaken as a part of the project methodology and interactions with nearly 1350 people provided an overall understanding of the country's Mining sector, its contribution to the economy, employment potential, geographical spread and the sector's importance in driving the growth of other sectors of the economy.

The next chapter provides a detailed overview of the sector in line with the scope of work outlined in the ToR and agreed with SCMS.

3. Overview of the mining sector in India

Indian mining sector on the global stage

India is known to be rich in a wide variety of mineral resources and possesses a favourable geological environment, which can be easily compared with mineral rich countries such as Australia, South Africa and Canada. Globally, the country is ranked 3rd in coal and lignite production, 4th in production of chromite, lead and iron ore.

The mining sector is an important segment of the Indian economy. It is considered as the backbone of the manufacturing sector, be it supply of steel, cement, power, high-tech ceramics for spacecraft, energy efficient equipment for combating climate change, smart phones, TVs, etc. Raw materials such as iron, limestone, bauxite, chrome, manganese, rare earth elements are mined to support crucial sectors making 'Mining in India' a critical contributor to 'Make in India'. Further, mining has also been an equal partner and responsible for the progress, development and poverty alleviation in the remote and tribal areas.

The country boasts of large deposits of fuel minerals as well as other metallic, non-metallic, atomic and minor minerals resources. At the global level, India occupies a prominent position (as shown in the table below) in terms of mineral production. India ranks amongst one of the top producers of valuable minerals such as coal, chromite, iron ore, lead, bauxite and manganese. With recent reforms, India is at the cusp of leveraging on its geological advantage to support future economic growth.

Table 4: Contribution and rank of India in world production of principal minerals & metals, 2017

Commodity	Unit of quantity	Production		Contribution	Global rank
		World	India		
Fuel Minerals					
Coal & lignite	Million tonnes	7,860	683	8.13%	3rd
Petroleum (crude)	Million tonnes	4,225	37	0.88%	23rd
Metallic Minerals					
Bauxite	'000 tonnes	3,03,800	22,313	7.34%	5th
Chromite	'000 tonnes	37,500	3,481	9.28%	4th
Iron ore	Million tonnes	3,332	201	6.03%	4th
Manganese (Ore)	'000 tonnes	51,600	2,589	5.02%	7th
Industrial Minerals					
Magnesite	'000 tonnes	28,700	195	0.68%	14th
Apatite and rock phosphate	'000 tonnes	2,53,000	1,534	0.61%	16th
Metals					
Aluminum	'000 tonnes	60,100	3,401	5.65%	3rd
Copper (refined)	'000 tonnes	23,600	830	3.52%	6th
Steel (crude/liquid)	Million tonnes	1,689	102.34	6.06%	3rd
Lead (refined)	'000 tonnes	11,300	565	5%	4th
Zinc (slab)	'000 tonnes	13,700	791	5.77%	3rd

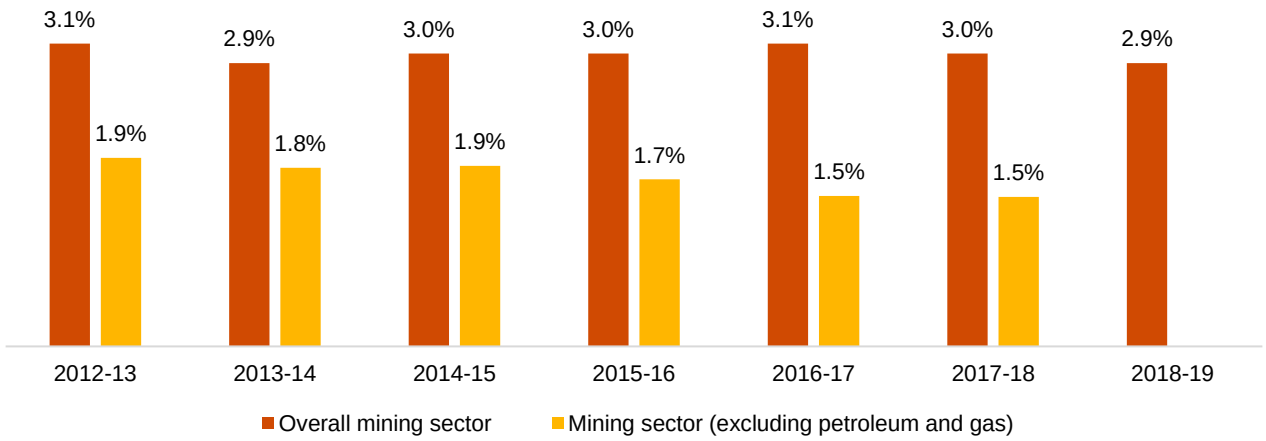
**Note: (i)Data in respect of World Mineral Production is on calendar year basis, however the data on India's production is based on financial year; (ii) Due to non-availability od data on production of minor minerals, they have not been included in the above table; (iii) Ranking for coal and lignite, petroleum, steel is for the year 2015-16 due to unavailability of data for 2018*
Source: World mineral production data compiled from World Mineral Production, 2013-2017; British Geological Survey.

3.1. Economic profile

3.1.1. Economic contribution of the mining sector in India

The overall mining sector grew at a Compound Annual Growth Rate (CAGR) of 3.2% (in value terms) from INR 2,610 billion in 2011-12 to INR 3,700 billion in 2018-19 with its overall contribution to Gross Value Added (GVA) remaining constant at about 3% over these seven years.

Figure 6: Contribution of the mining sector to Gross Domestic Product (GDP) at 2011-12 constant price



** Note: Coal and lignite: Due to unavailability of ex-mine price for coal and lignite in 2017-18, figures have been updated for the previous year (2016-17); Share of mining sector (excluding petroleum and natural gas) is not available for the year 2018-19*

Source: Annual report 2016-17, 2017-18 Ministry of Mines, Reserve Bank of India, Central Statistical Office, Indian Bureau of Mines

For the share of mining and quarrying to increase from current 3% of GDP to 5% of GDP over next 20 years, the mining sector shall grow at 10.5% per annum on average with the overall economy growing at 8% per annum.[32]

In comparison, the sector's contribution in other mineral rich economies such as Australia (7%) and Canada (10%) has been significantly high as these countries have leveraged their vast mineral wealth propelling their GDP growth. Moreover, these economies are amongst the world's largest exporters of minerals with Canada supplying approximately 60 different mineral commodities to over 100 countries globally[33].

The catalyst for the adequate usage of mineral wealth in these countries includes:

- Extensive green to brown-field exploration
- Increased Foreign Direct Investment (FDI)
- Smooth licensing and permitting processes
- Government-investor feedback mechanism

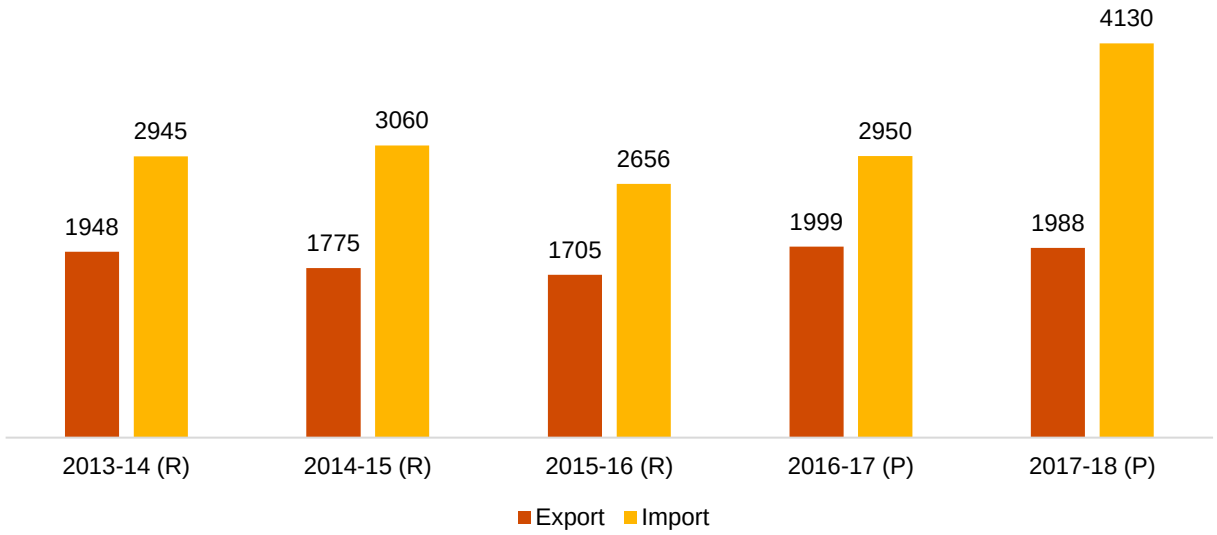
[32] Assuming the economy grow at 8% on average
[33] How Canada's Mining Sector Impacts the Economy: Nicholas LePan 2018

Import-Export Scenario

Even though India has vast reserves of various minerals, its imports are higher as compared to its exports. This trend has remained the same over the past five years.

- The country exported major metallic, non-metallic and minor minerals valued at INR 1,988 billion (including coal exports worth INR 8.7 billion) at the end of 2017-18.
- Imports, on the other hand, stood at INR 4,130 billion with diamond and gold contributing nearly 80% of the total value of imported minerals.
- The country is self-sufficient in terms of fuel minerals (coal and lignite) except coking coal which is primarily required by steel industry. Further, as per National Steel Policy 2017, India would require 161 million tonnes of coking coal to achieve the steel production target of 300 million tonnes by 2030. Thus, India will need to import more of this mineral.
- India also imports ores and concentrates of copper (7%), emerald (2%), coke (2%) and rock phosphate (1%).

Figure 7: Trend in value of mineral export and import of India 2013-14 to 2017-18 (in INR billion)



**Note: Imports and Exports exclude petroleum and natural gas*
P: Provisional; R: Revised
Source: Annual Report 2018-19, Ministry of Mines

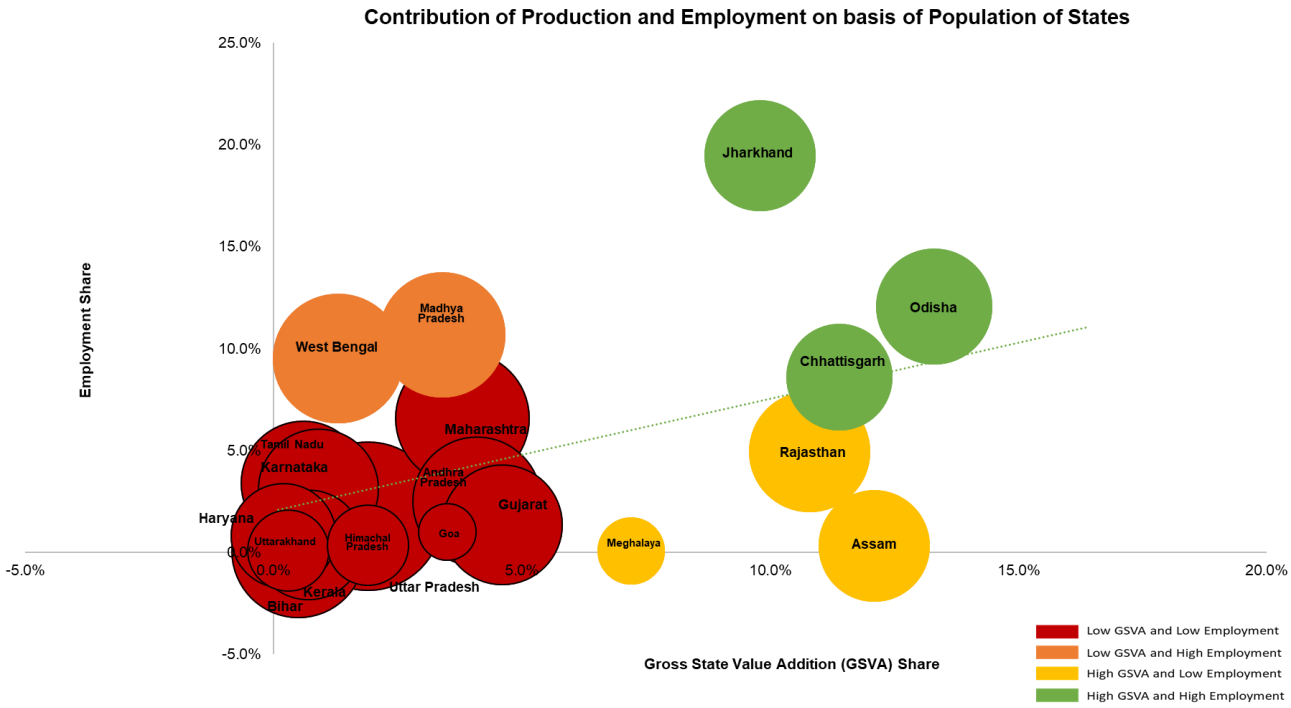
With much of the mineral wealth below the ground remaining untapped, ***attracting investments and greater private sector participation in the exploration of deep-seated deposits will be the key factor towards improving the sector's trade.*** The same is expected to be achieved through the National Mineral Exploration Policy, 2015 and improved technology in exploration of minerals.

State-wise contribution to the sector

Post Mines and Minerals (Development and Regulation) Act, 2015, State governments are being given key role in promotion of the mining sector. From auctioning of exploration and mining leases to collection of various funds like NMET, etc., to monitoring of mining operations, States now have a larger role to play for the growth of this sector.

- **13 States (as shown in figure below) account for about 87% of the total economic output and 94% of the employment generated by the mining and quarrying sector in India.**
- **Despite the geologically rich nature of the States such as Odisha, Rajasthan, Chhattisgarh and Jharkhand[1], these States have per capita income lower than the national average. Therefore, a boost to mining and quarrying sector of these States will in turn impact the growth of not just State but the National economy.**
- **While the States of Jharkhand and Odisha contribute largely both to GSVA and employment, States such as Rajasthan and Assam contribute 10.8% and 12.2% respectively towards GSVA but provide fewer opportunities for employment.**
- **On the other hand, Madhya Pradesh generates large employment but the contribution to GSVA is less as compared to other States.**

Figure 8: Contribution of mining and quarrying sector (including fuel, major and minor minerals) to State's GSVA (2017-18) and total employment (2015) (in %)



**Note: GSVA for Andaman & Nicobar, Assam, Goa, Gujarat, Haryana, Jammu & Kashmir, Kerala and Nagaland is for the year 2016-17 due to unavailability of data for 2017-18; the graph does not show employment % for States with employment close to 0%.*

State level employment and GVA Includes the share of petroleum and natural gas

Source: Ministry of Statistics and Programme Implementation, Govt. of India; Statistics of mines in India: Vol I and II (DGMS) 2015

The mining sector is considered as the backbone for various sectors of the economy (such as construction, manufacturing, etc.) with raw materials such as iron ore, limestone, copper, phosphate, etc. being in great demand. The sectors also boast of vast mineral deposits by occupying a prominent place across the globe in terms of production (quantity) of various minerals.

The next section provides an overview of the mineral reserves and their production scenario both in terms of quantity and value.

3.2. Mineral reserves and production scenario

Currently, India produces as many as 95 minerals which includes 4 fuel, 10 metallic, 23 non-metallic, 3 atomic and 55 minor minerals (including building and other materials)[34].The broad categories of minerals under the purview of this study are[35]:

Fuel Minerals

- Fuel minerals are primarily useful for their calorific value; there are four types of fuel minerals in India, comprising of coal, lignite, petroleum and natural gas.
- Within fuel minerals, coal and lignite are considered as part of the mining sector, whereas petroleum and natural gas are considered under oil & gas sector.

Metallic Minerals

- Metallic minerals are those that can be melted to make new products.
- India produces 10 such minerals, comprising of iron ore, zinc, chromite, silver, manganese, aluminium, copper, gold, lead and tin.

Non-metallic Minerals

- Non-metallic minerals are those that do not undergo chemical or mineralogical change while being processed for final end-use and comprises of minerals such as rock phosphate, garnet, fluorite, mica amongst other.

Minor Minerals

- India produces 55 minor mineral such as building stones, ordinary clay, limestone used for manufacturing cement and bentonite
- In contrast to fuel and major minerals, these minerals fall under the purview of State Governments.

[34] Annual Report 2017-18: Ministry of Mines
[35] Annual Report 2017-18: Ministry of Mines

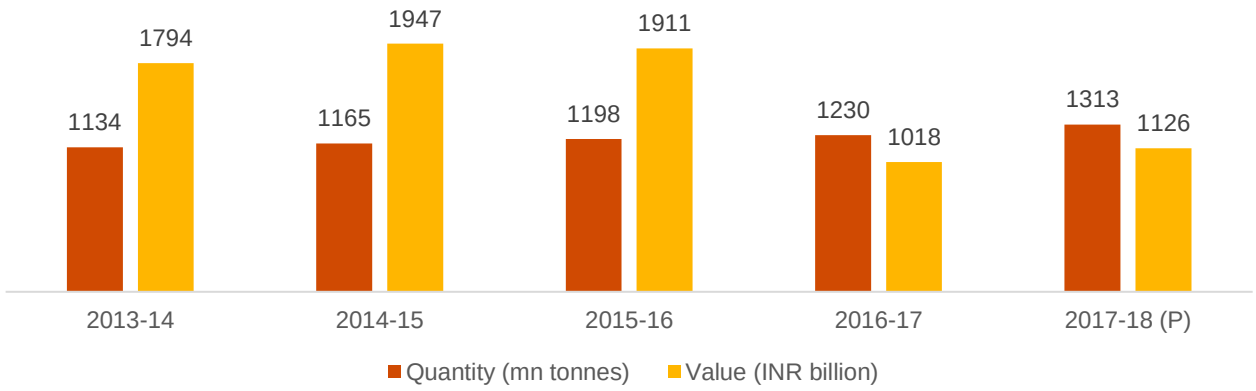
Mineral reserves and resources of a country are directly linked to its level of exploration. India has about 630 billion tonnes of total reserves of which 57% are of fuel minerals. Geological Survey of India (GSI) has delineated, in 2009, an area of about 0.571 million sq. km as Obvious Geological Potential (OGP) area where prospectivity is relatively higher for deposits of minerals listed in Part C of First Schedule of MMDR Act and coal & lignite. To cover the entire OGP area systematically, an area of 0.813 million sq km is to be mapped for acquiring baseline data.

Accordingly, OGP is being covered by geochemical, geophysical and Aero-geophysical survey programmes. The entire OGP has been surveyed through geochemical survey by March 2019 whereas 72% of OGP area has been covered by NGPM by March 2020 and it is expected that the entire OGP will be covered by March 2021. Aero-geophysical survey with uniform height (80m) & uniform line spacing (300m) has been completed over 0.266 million sq. km OGP area and it is envisaged that the entire OGP area will be covered by 2021. Therefore, the importance of the National Mineral Policy 2019, which speaks about private sector with technological uptrends, is critical and the intent of the policy should be implemented accurately.

With the current mineral reserve base in India and given that production is a function of demand, it is imperative to understand the annual production quantity and value across minerals and geography.

It can be noted from the graph below that the quantity of minerals produced has increased from 1,134 million tonnes to 1,313 million tonnes during the 2013-14 to 2017-18 period.

Figure 9: Production quantity and value (2013-14 to 2017-18)



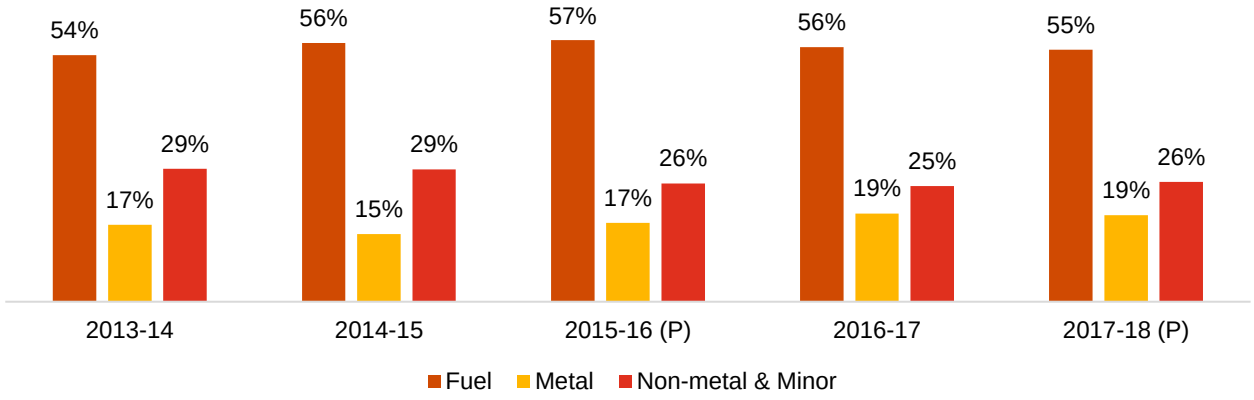
**Note:*

- *Excludes production of petroleum, natural gas*
- *Excludes the data of 31 minerals for February and March 2015, declared as minor minerals vide notification dated 10th February 2015*
- *Production value of minor minerals is repeated from 2014-15 onwards as 31 non-metallic minerals were transferred to minor minerals category and hence there is no data available.*
- *Production values for coal and lignite are unavailable for 2016-17 and 2017-18*
- *P: Provisional*

Source: Indian Minerals Yearbook 2016, 2017, 2018, IBM

In terms of total production quantity, 55% has been contributed by fuel minerals (excluding oil and natural gas), 19% by metallic minerals and 26% by non-metallic and minor minerals in the year 2017-18.

Figure 10: Category-wise presentation of mineral production quantity (in %)



**Note:*

- *Excludes production of petroleum, natural gas*
- *Excludes the data of 31 minerals for February and March 2015, declared as minor minerals vide notification dated 10th February 2015*
- *Production value of minor minerals has been maintained at same level from 2014-15 onwards as 31 non-metallic minerals were transferred to minor minerals category and hence there is no data available.*
- *Production values for coal and lignite are unavailable for 2016-17 and 2017-18*
- *P: Provisional*

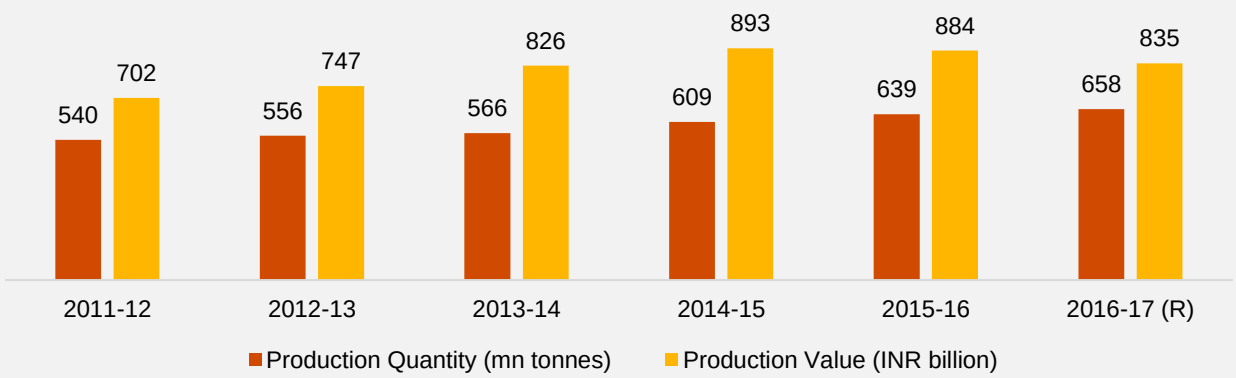
Source: Indian Minerals Yearbook 2016, 2017, 2018, IBM

Thus, it indicates that fuel group of minerals have dominated in terms of production quantity over the past 5 years driving the mining sector in India forward. The increased focus on minor minerals that occupy 80% of the mineral reserves will provide further impetus to the sector.

Trend of coal production

Given that fuel minerals, particularly coal records the maximum production in terms of quantity and value generated, it becomes imperative to analyse the mineral's growth over the last few years. As shown in figure below, the quantity of coal produced has grown at a CAGR of 3% from 540 million tonnes to 658 million tonnes. The value generated has also grown at a CAGR of 3% from INR 702 billion to INR 835 billion during 2011-12 to 2016-17.

Figure 11: Trend in coal production quantity and value (2011-12 to 2016-17)



R: Revised
Source: Indian Minerals Yearbook 2016, 2017, 2018, IBM

State-wise mineral production in India

Owing to the geological nature of the eastern belt, State-wise distribution of total reserves (including fuel and non-fuel) shows that Jharkhand and Odisha have the largest mineral reserves in the country with a share of 14% each.

The presence of Singhbhum Shear zone in Jharkhand, Odisha and adjoining States makes them rich in metal and non-metallic minerals and the sediment deposits like Talchir, Mahanadi basin are rich in coal. In case of non-fuel minerals, Karnataka has highest reserves (24%) which can be attributed to its significant reserves of limestone (~84% of the total non-fuel reserves).

Figure 13: Top 10 States accounting for more than 95% of fuel mineral reserves quantity in India

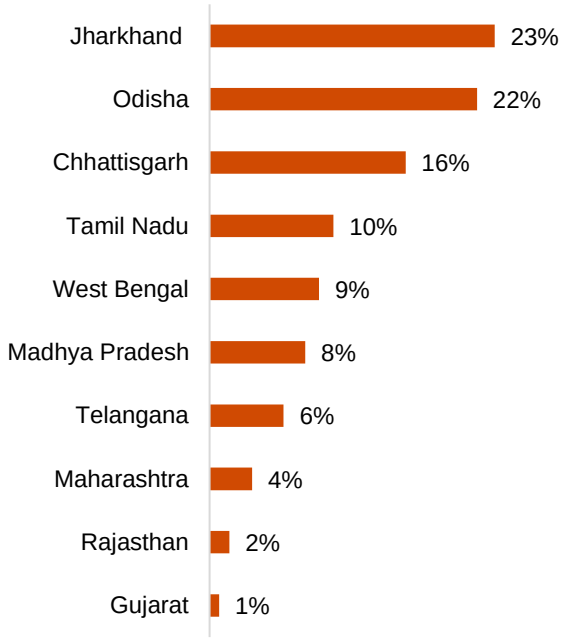
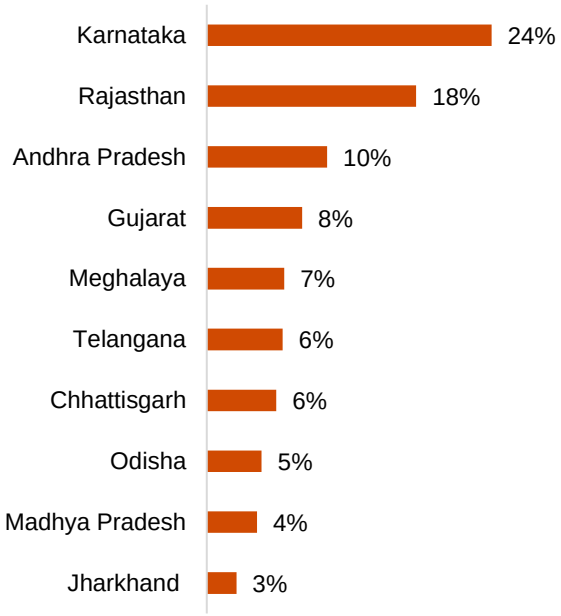


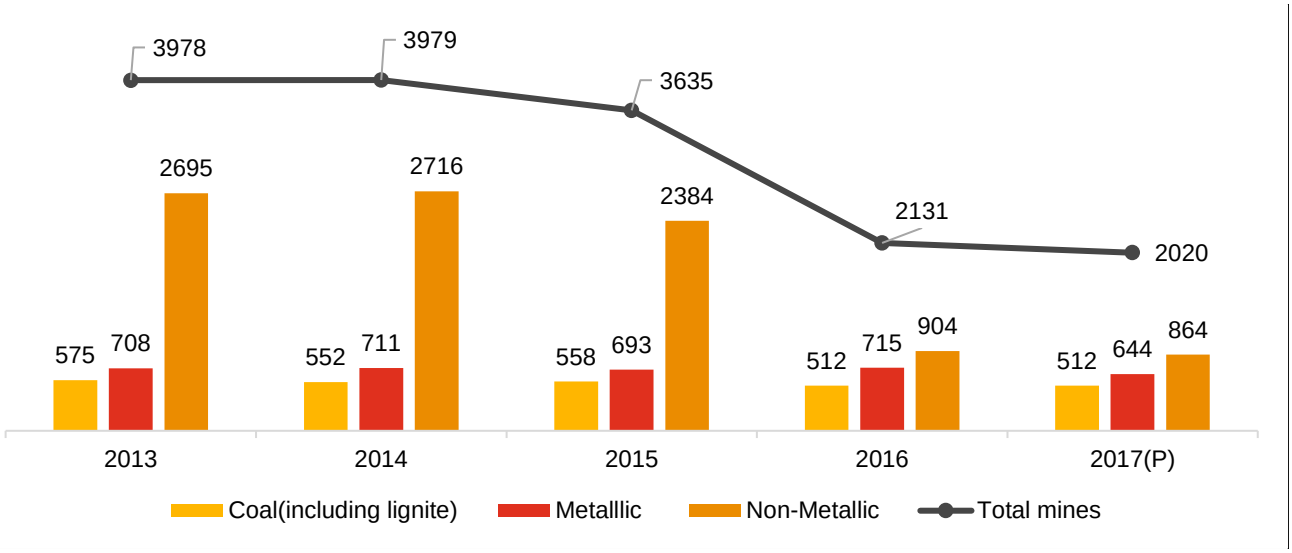
Figure 12: Top 10 States accounting for more than 90% of non-fuel mineral reserves quantity in India



Note: For fuel category data is reported as on April 1, 2018 and it includes 'proven', 'indicated' and 'inferred' reserves*
For non-fuel reserves (covering 'proven' and 'probable' reserves and 'measured', 'indicated, 'inferred' and 'reconnaissance' remaining resources) data is considered for April 1, 2015.
Source: Indian Minerals Yearbook 2018, State-wise reviews- IBM

India currently has 2020 active mines as reported by IBM. As shown in figure below, the number of non-metallic mines has been the highest in India across all mineral types over the past 5 years. However, there is a sharp decline in reported number of non-metallic mines post 2015 as 31 non-metallic minerals were transferred to minor minerals category during the same year bringing their reporting under the purview of respective State governments.

Figure 14: Total number of reported mines in the country (excludes minor minerals)



P: Provisional
Source: Indian Minerals Yearbook 2017, IBM

It can be noted from the table below that only 27% of leases fall between 50-500 hectares and above with high degree of mechanization, whereas 73% of leases of major minerals in the country are less than 50 hectares in size and tend to be labour intensive with low level of mechanization.

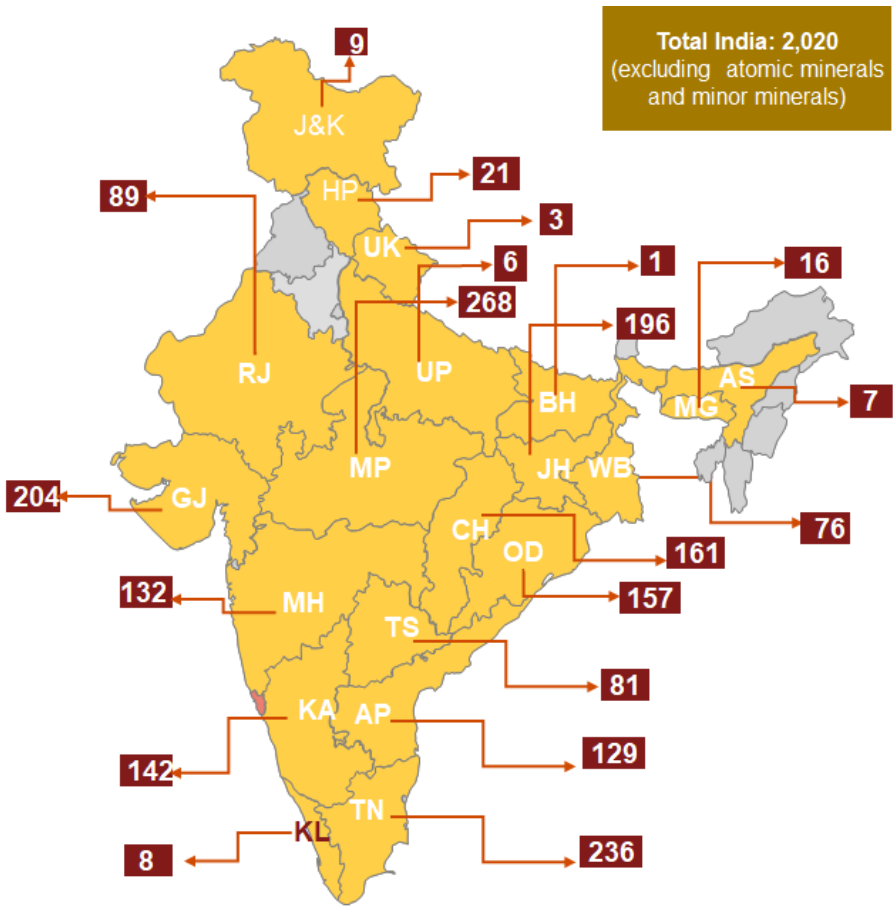
Table 5: Area wise distribution of mining lease* as on 31/03/2017 (all India)

Frequency Group (Area in Hect.)	Number of Mining Leases	Percentage of Total Leases	Area in Hectare. (rounded off)	Percentage of Total Area
All Groups	4,382	100	3,66,010	100
0 to 10	2,035	57	15,565	4
10 to 20	508	12	7,486	2
20 to 50	648	15	21,318	6
50 to 100	533	12	40,182	11
100 to 200	252	6	35,538	9
200 to 500	224	5	72,182	20
Above 500	182	4	1,80,965	49

Note: Excluding coal, lignite, petroleum, natural gas, atomic & minor minerals.*
Source: Annual Report 2018-19 Ministry of Mines

From the reported 2020 mines in 2016-17, 96% are concentrated in the 13 States with Madhya Pradesh (13%) having the highest number of reported mines followed by Tamil Nadu (12%), Gujarat (10%) and Jharkhand (10%).

Figure 15: Number of coal (including lignite), metallic, non-metallic mines in each State in 2016-17



Source: IBM, Annual Report, 2016-17

In terms of total production quantity, fuel minerals (excluding oil and natural gas) dominate with more than 50% contribution followed by non-metallic and minor minerals (26%) and metallic minerals (19%) in the year 2017-18. However, with respect to number of mines, non-metallic minerals dominate. With the 2015 notification shifting 31 major minerals into minor minerals category, it is critical to understand the similar scenario (exploration level, deposits, employment, etc.) across these two categories of minerals.

The next sections provide a detailed overview of major and minor minerals in the mining sector.

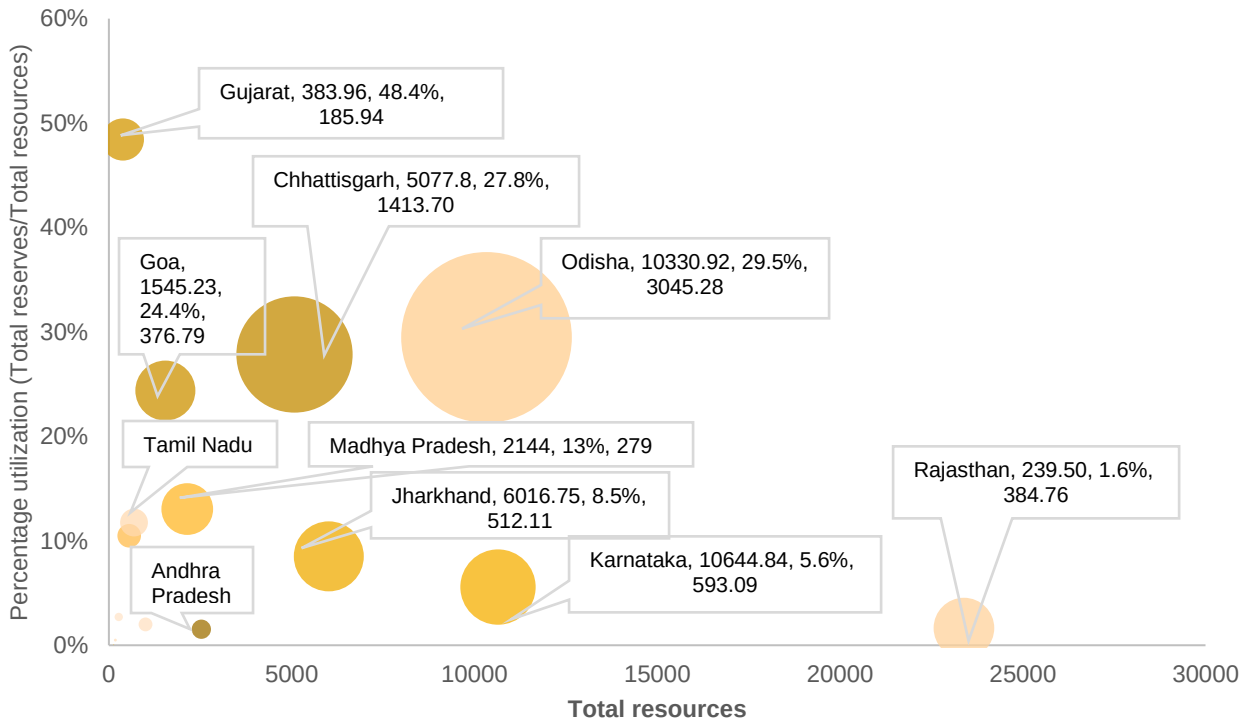
3.3. Major mineral scenario in India

As per the Indian Minerals Yearbook 2018, the total resources of major minerals in the country stand at 65,521.04 million tonnes. Out of this, the total reserves stand at 6,997.35 million tonnes and therefore the remaining resources of major minerals are 58,523.69 million tonnes implying that only 10.7% of the total resources have been explored till date.

85% of the major mineral reserves are concentrated in five States viz. Odisha, Chhattisgarh, Karnataka, Jharkhand and Rajasthan. Odisha contributes maximum to the major mineral reserves in India (~44%). These five States have the potential to generate highest number of core and ancillary activities related jobs, thus necessitating the need of preparing a pool of skilled manpower in these States.

Exploration[36] of resources and potential of different States

Figure 16: Trends in total major mineral resources and reserves (The size of the bubble represents total reserves in million tonnes)

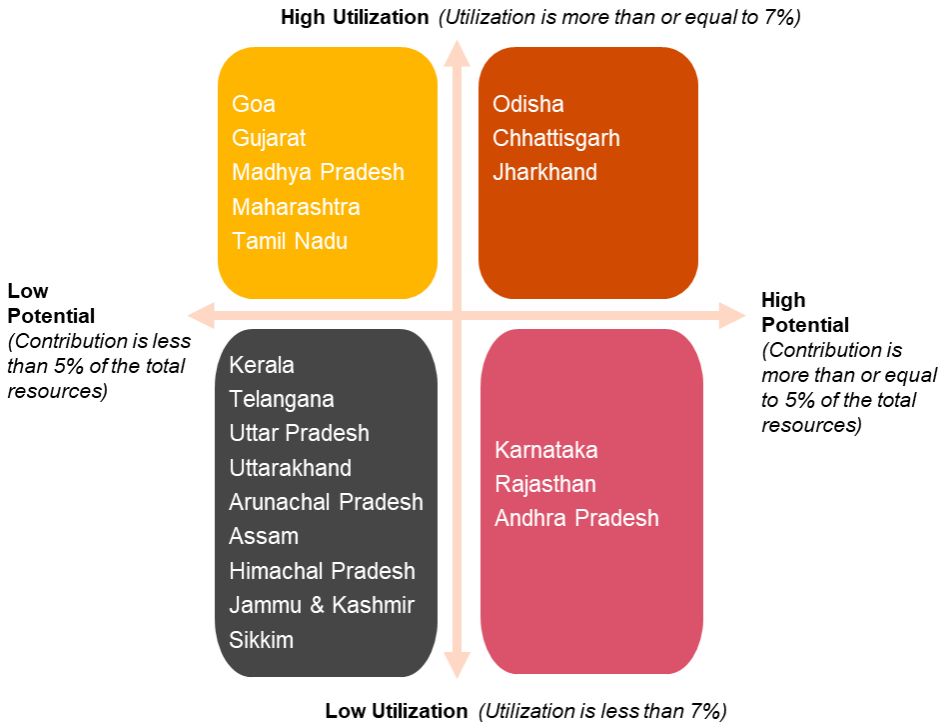


Note:
-The data labels include state name, total resources, percentage utilization and reserves in the same order.
-It includes data for 20 major minerals; States such as Uttarakhand, Uttar Pradesh, Sikkim, Arunachal Pradesh, Jammu and Kashmir, Himachal Pradesh, Kerala, Assam have less resources and reserves and have low utilization and thus their bubble is close to zero and not visible in the figure above.

Source: Indian Minerals Yearbook 2018, IBM

The above illustration shows distribution of total major mineral resources across key States and the extent to which these resources have been explored/utilized. The States can be classified as:

[36] Exploration is termed as utilization which is defined as Total reserves/Total or Inclusive resources



- ***High Potential and High Utilization:*** This constitute States which have large resources (contribute to more than or equal to 5% of the total resources in the country) and have a high percentage of these resources (utilization is more than or equal to 7%) as utilized/explored. The States of Odisha, Chhattisgarh and Jharkhand together contribute to 33% of the total resources and have a significant proportion (66%) of their resources explored. **These three States emerge as key players in the major mineral segment and will continue to have a large contribution both in terms of production value and employment.**

- ***High Potential and Low Utilization:*** These States contribute more than or equal to 5% of the total resources in the country but have a low utilization. Karnataka, Andhra Pradesh and Rajasthan, falling under this category collectively contribute to 56% of the total resources in the country but have only a small percentage of it as explored viz. 5.6%, 1.5% and 1.6% respectively. The low percentage of exploration (utilization) in Karnataka can be attributed to the Supreme Court's directive capping the iron ore output to 35 million tonnes and allowing miners to sell only via the e-auction platform making the customer base poor. Thus, with limited demand the degree of utilization remains low in the State. In case of Rajasthan, the Supreme Court has banned illegal mining in the Aravalli region due to environmental concerns resulting in low utilization. **Overall, despite their current challenge, these States have a potential to contribute more to the output of major minerals and can generate increased employment (both direct and indirect).**

- ***Low Potential and High Utilization:*** This includes Goa, Gujarat, Madhya Pradesh, Maharashtra and Tamil Nadu. These States together contribute to 8% of the total resources in the country; however, their average utilization (percentage of reserves to resources) is around 22%, which is higher than the national average of 10.7%. T**hese States have a sizable amount of explored resources and thus contribute significantly to the overall employment in the sector. Further, technological advancements in mining and prospecting would enable these States to enhance their overall mining output. Thus, they may require large scale upskilling and re-skilling interventions to enhance the productivity of the manpower engaged in mining activities.**

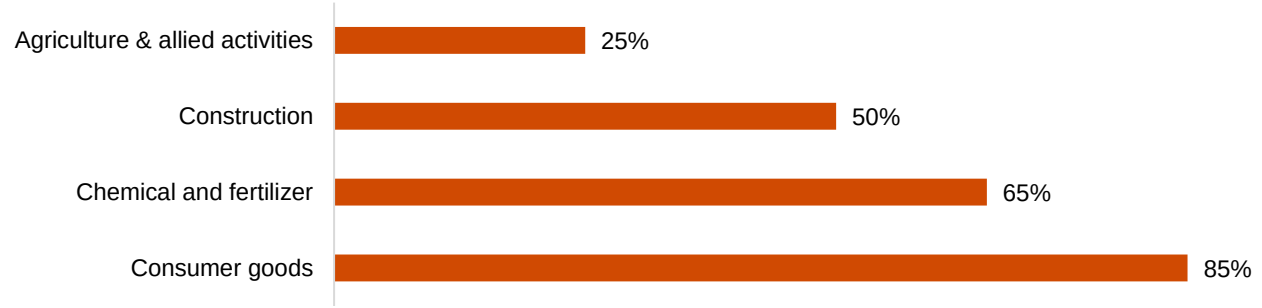
- ***Low Potential and Low Utilization:*** This category includes States, which contribute little to the total major mineral resources and are less utilized i.e. only a small percentage of the resources have been explored. Uttar Pradesh has the largest share in resources amongst these states i.e. 1.5% followed by Uttarakhand at 0.4%. All other States have less than 0.4% of the total resources in the country and together contribute ~1.4%. **These States' contribution to the overall major mineral output is limited and therefore scope for exploration of major minerals needs to be studied.**

Three major minerals contribute to 90% of the total major mineral resources. These include Iron Ore, Bauxite and Copper. In addition, three major minerals contribute to 90% of the total reserves in India. These include Iron Ore, Potash and Bauxite. The highest among these is Iron Ore (79% of the total resources and 51% of the total reserves).

Industrial use of major minerals

Major minerals, both metallic and non-metallic are used as raw materials across many industries. The major mineral based industries include agriculture, chemicals and fertilizers, consumer goods and construction sector. These industries make the maximum use of mined major minerals thereby driving the growth and development of their respective industries.

Figure 17: Percentage use of major minerals across key sectors



Source: Indian Minerals Yearbook 2018, IBM

The sectors depicted in the above graph are a combination of one or more industries and it can be noted that consumer goods sector makes use of 85% of the major minerals. The distribution of industries across these sectors is as follows:

Table 6: Industries using major minerals

Sector	Industry	Relevant minerals
Agriculture and allied activities	• Agriculture • Soil preparation • Horticulture • Hay preparation • Animal feed supplements	• Apatite • Rock phosphate • Salt • Magnesite • Vermiculite
Construction sector	• Building material (Bricks, cement, tiles) • Construction (Iron and steel) • Mortar • Paint	• Asbestos • Bauxite • Iron ore • Kyanite, Sillimanite and Andalusite • Magnesite • Manganese ore • Vermiculite

Sector	Industry	Relevant minerals
		• Wollastonite
Consumer goods	• Ceramic • Electrical and Electronics • Glass • Jewelry • Leather • Food preservatives • Paper • Personal care • Packing material • Refractory • Rubber • Textile and fabrics • Food processing	• Apatite • Rock phosphate • Asbestos • Bauxite • Chromite • Diamond • Garnet • Graphite • Emerald • Iron ore • Kyanite, Sillimanite and Andalusite • Magnesite • Manganese ore • Potash • Salt • Wollastonite • Zircon
Chemical and fertilizer	• Chemical and fertilizer	• Apatite • Rock phosphate • Asbestos • Graphite • Kyanite, Sillimanite and Andalusite • Magnesite • Manganese ore • Potash • Salt • Vermiculite • Zircon

Source: Indian Minerals Yearbook 2018, IBM

Apatite and Rock phosphate

Most of the mined rock phosphate throughout the world is used to make phosphate fertilizer and animal feed supplements. This mineral also finds its use in consumer products such as detergents, soft drink, toothpaste, glass, photographic films, matches, fireworks, anti-corrosion agents, food preservatives, etc. Apatite with green, blue, yellow or pink colour, on the other hand, is often used to make gemstones. Apatites are also used as a proposed host material for storage of nuclear waste. The States of West Bengal, Andhra Pradesh, Rajasthan, Jharkhand and Madhya Pradesh account for bulk of the apatite and rock phosphate mineral.

Iron Ore

Iron ore are rocks from which metallic iron is extracted and haematite and magnetite are the most important iron ores in the country. About 79% of haematite and 93% of magnetite ore deposits are found in the Eastern (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh) and Southern (Andhra Pradesh, Goa, Karnataka, Kerala and Tamil Nadu) belts of India. India is endowed with 8,100 million tonnes of crude ore and 5,200 million tonnes of iron content reserves contributing 5% of the world's total production of iron ore.

Commercially, iron ore is an important metal which is primarily used for manufacture of iron and steel, pig iron, and sponge iron. Iron and Steel (83.6%) and Sponge Iron industries (15.7%) are the major consumers of iron ore and accounted together for 99.3% of the consumption in the year 2016-17. The ore used in steel making is in turn used to make automobiles, locomotives, beams used in buildings, etc. The ore also finds its application in Cement, Coal Washeries, Ferroalloys, Foundry, Vanaspati and Glass Industries[37]. Thus, iron ore forms an

[37] Indian Minerals Yearbook 2017: Iron ore

integral part of not only the Indian economy but the global economy as a whole owing to its application across almost all sectors critical for pushing the growth trajectory.

Bauxite

According to Indian Minerals Yearbook 2018, India has 3,896 million tonnes of Bauxite reserves with Odisha alone accounting for 51% of the total resources followed by Andhra Pradesh, Gujarat and Jharkhand. Globally, India accounts for 7% of world production of bauxite, which is an aluminous rock comprising of hydrated aluminium oxide iron oxide, Silica and Titania.

This aluminous rock finds its primary usage in Alumina/Aluminium Industry accounting for 90% consumption followed by Cement (8%) and Calcination (1%). The mineral is also used as a raw material for making various products in industries such as chemical, refractory, abrasive, steel, building material and road aggregates and petrol. Additionally, this industry mineral has wider application in sectors like rubber, plastic, glass cutting tools, paint and cosmetics.

Asbestos

Asbestos comprising of six different fibrous silicate minerals are mainly found in Rajasthan, Karnataka, Jharkhand, Odisha and Andhra Pradesh. Industrial use of asbestos is dependent on its type. For example, Chrysotile asbestos is used in the manufacture of asbestos fabrics, pipes, cement sheets and other allied products. This type of asbestos also finds its use in insulation and fireproof clothing. Amphibole asbestos, on the other hand, is used in heat insulation and acid treatment, filler in paints and numerous asbestos moulded articles.

Chromite

Chromite, chemically known as iron chromium oxide is an important alloying metal in ferrous metallurgy next to manganese. Owing to its ability of imparting strength, toughness and hardness, this mineral is used in the manufacture of alloys along with other metals, such as, nickel, cobalt, copper, etc. Thus, ferro-alloys is the major consumer of chromite accounting for 97% of the total mineral consumption[38]. Some of the varieties of chromium steel which drives the importance of this mineral include stainless steel, high-speed tool steel and corrosion and heat-resistant steel. In addition, chromite is consumed by refractory and health industry.

Graphite

Graphite are found in various States of the country, but the deposits of economic importance are majorly located in Chhattisgarh, Jharkhand, Odisha and Tamil Nadu. Traditionally, graphite has been used in pencils, foundries, crucibles, etc. accounting for 56% of the mineral's total consumption[39]. Refractories that are used in the manufacture of steel, cement and glass make more sophisticated use of graphite. The mineral also finds its application in the nuclear industry, soil conditioning and graphite foils (which is used for sealing in the Chemical and Petrochemical industries), Energy, Engineering and Automotive industries. Graphite accounts for only 2% of consumption across sectors such as dry cell battery, cement, Iron and steel, paint, paper, etc.

Garnet

According to Indian Minerals Yearbook 2018, India has total reserves of 56.16 million tonnes of granite with States of Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan, Tamil Nadu and Telangana having garnet deposits of use. Garnet in the form of garnet sand is used as an abrasive which is the most important industrial use of this mineral. About 90% production of abrasive garnet is used in the manufacture of garnet-coated papers, clothes and discs, belts, covers for drums, discs, etc. The remaining 10% of the garnet deposits is used in surfacing and polishing soft stones such as marble, slate, soapstone, etc., polishing glass and TV tubes and sand blasting.

Manganese Ore

Manganese ore both in the ore form and as ferro-manganese is an important material used in iron and steel metallurgy due to its property of improving the strength, toughness, hardness and workability of iron and steel so much so that 90 to 95% world production of manganese ore is used in metallurgy of iron and steel. This ore is also used in manufacture of dry cell batteries, chemicals such as potassium permanganate, manganese chloride, etc. According to Indian Minerals Yearbook 2018, total consumption of this mineral stood at 2.65 million tonnes with ferro-alloys industries contributing 94% to total consumption followed by Iron and steel (5%) and remaining 1% by battery, electrode, chemical and alloy steel industries.

[38] Indian Minerals Yearbook 2018
[39] Indian Minerals Yearbook 2018

Wollastonite

According to Indian Minerals Yearbook 2018, India with 0.15 million tonnes is one of the major producers of this mineral after China. Major deposits of wollastonite are found in the districts of Ajmer, Dungarpur, Pali, Sirohi and Udaipur in Rajasthan. A few deposits are also found in the States of Gujarat and Tamil Nadu; however, the entire production was reported from private sector mines located in Rajasthan only in the year 2017-18. This mineral is predominantly used in automobile brakes, ceramics, metallurgical processing, paper, paint, plastic, cosmetics and adhesives. Interestingly, ceramic industry (especially floor and wall tiles) in the year 2017-18 accounted for 100% consumption of this mineral.

Consumer goods industry-driver for major mineral growth

Consumer goods industry is the 4th largest sector of the Indian economy where growing awareness, easier access and changing lifestyles have been the key growth drivers for the sector.

Source: IBEF

Majority of the major minerals (85%) find their use in the consumer goods sector. The sector's market size is expected to grow at 20- 25% per annum, which is likely to boost revenues of consumer goods companies. In addition, government initiatives such as 100% FDI in the sector, new Consumer Protection Bill, taxation of personal care goods at 18% against the previous 23-24% are likely to propel the sector's growth story[40].

In order to capture this growth opportunity, India needs to act swiftly to increase the productivity of major minerals so that they can meet the growing demand of the consumer goods sector.

About 20 major minerals find their use across 4 major sectors of the economy with nearly 85% of major minerals being used by consumer goods industry alone. It can therefore be concluded that growth in consumer goods sector will drive the demand for major minerals in the country and subsequently the overall output of this mineral segment.

The next section provides similar analysis for the minor minerals which typically fall under the unorganized sector owing to the relatively small lease sizes.

[40] IBEF (https://www.ibef.org/industry/fmcg.aspx)

3.4. Minor mineral scenario in India

Historically, the first mention of minor minerals was made in the rules promulgated by Resolution No. 7552-7581-121 dated the 15th September 1913. These rules, referred to 'minor minerals' as ones which will be regulated by the local government as per its own requirements and circumstances. Since then minor minerals have found explicit mention in multiple legislations of the government, and they continue to be the subject of the States. The term 'minor mineral' means building stones, gravel, ordinary clay, ordinary sand other than sand used for prescribed purposes, and any other mineral which the Central government may, by notification in the Official Gazette, declare to be minor minerals.

India enjoys rich minor mineral reserves and is one of the leading countries in terms of wealth, production and exports of key minor minerals. The government of India had initially notified 24 minor minerals[41]. This list was further expanded to 55 minerals through Ministry of Mines notification dated 10th February 2015. The addition of 31 minerals[42] was done from the major mineral list. **These 31 minerals account for over 55% of the total number of leases and nearly 60% of the total leased area.** This was done with an intention to give more power to the States and consequently expedite the mineral development in the country. Considering the low investment requirement, limited use of technology and small lease holding nature of minor mineral segment, minor minerals generate maximum employment[43].

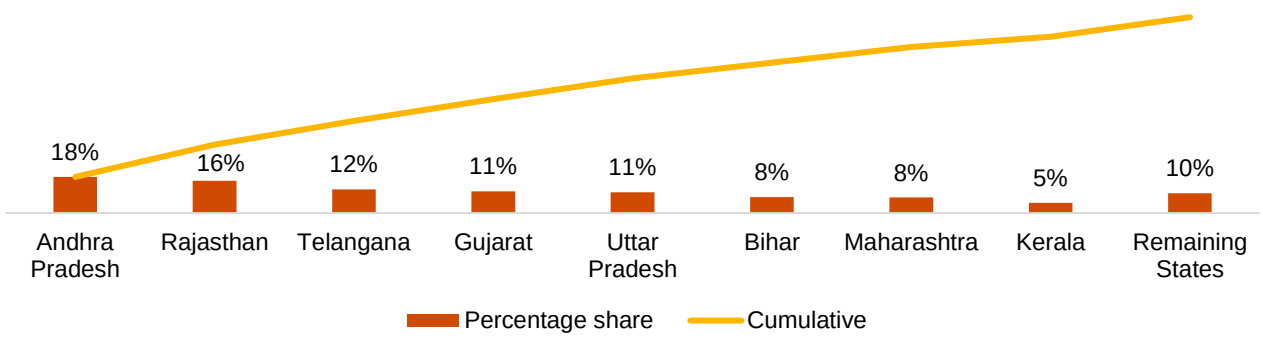
3.4.1. Economic profile

3.4.1.1. Contribution of minor minerals to the mining sector

Minor minerals have been the second largest contributor to the overall mining output. However, 'minor minerals' contribution in the total value of production has seen a small decline from 2011-12 (29%) to 2016-17 (26%). During the same time, the value of production of minerals has grown at a CAGR of 2% and minor minerals production value has grown by INR 3.2 billion[44].

Between 2013-14 and 2014-15, the total production value grew at a CAGR of 9%. The total value of minor minerals during this period increased from INR 409.76 billion to INR 528.10 billion. Implementation of legislative reforms and curbing illegal mining can ensure that minor minerals' contribution to the overall output of the sector increases over time.

Figure 18: State wise share in total production value of minor minerals (2016-17)

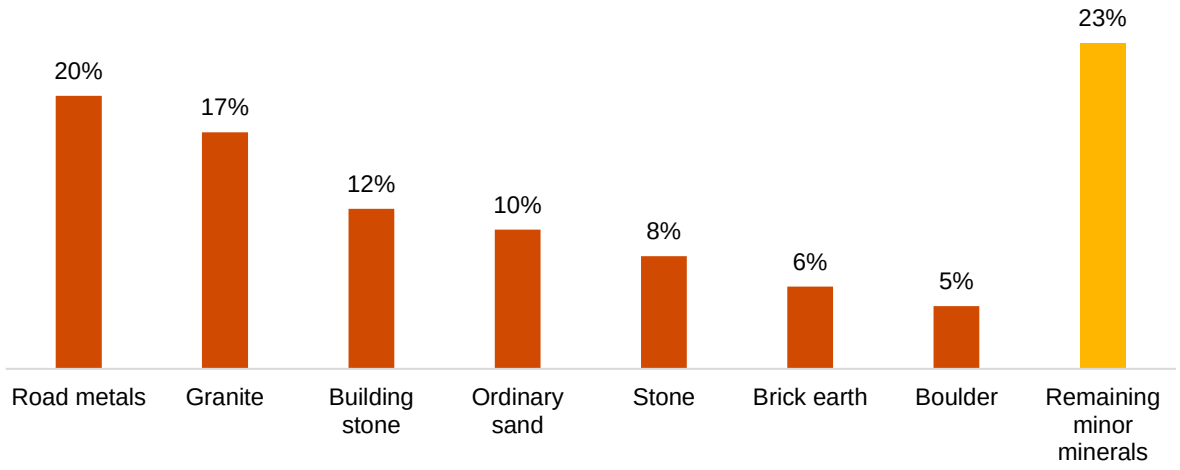


Note: The individual state wise share in production value is not available for the remaining states
Source – Annual Report 2017-18 Ministry of Mines

[41] List of 24 minor minerals is provided in Annexure A.3
[42] List of newly added 31 minor minerals is provided in Annexure A.4
[43] PwC Analysis and consultations with FMAR
[44] Indian Minerals Yearbook 2016, 2017, 2018, IBM

Eight States (i.e. Andhra Pradesh, Rajasthan, Telangana, Gujarat, Uttar Pradesh, Bihar, Maharashtra and Kerala) contribute to almost 90% of the total production value of minor minerals in the country. Thus, indicating that they drive the overall economic scenario for minor minerals in the country.

Figure 19: Mineral wise share in total production value (2016-17)



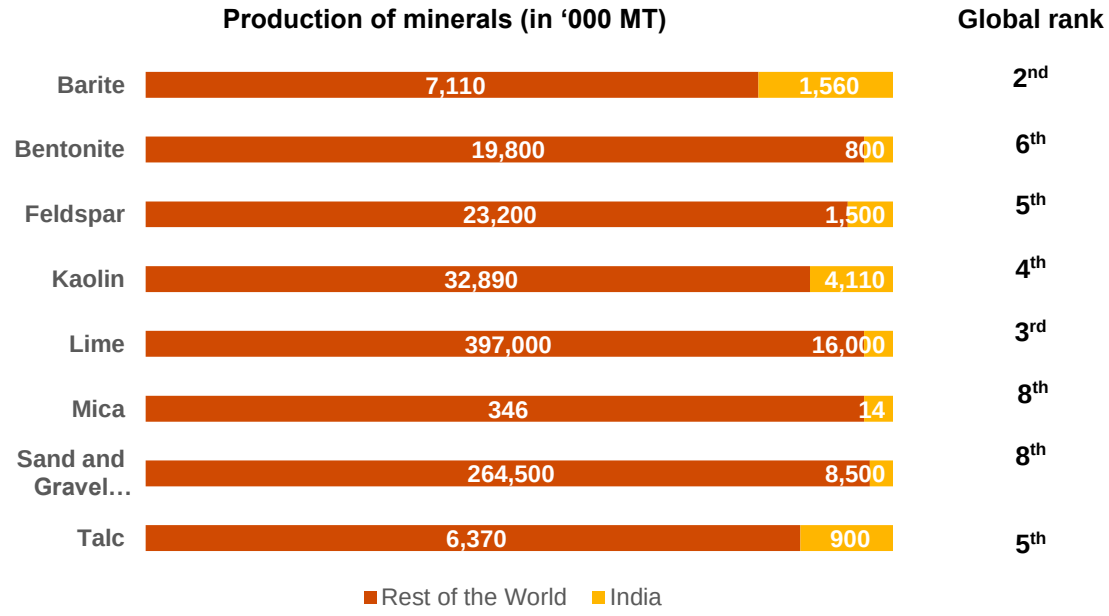
Note: The individual share of remaining minerals is less than 4% which together contribute 23%
Source – Annual Report 2017-18 Ministry of Mines

The major share in production value (77%) comes from seven minor minerals. The highest contributors are road metals (20%) followed by Granite at 17%.

3.4.1.2. India's global standing in minor minerals

India is amongst the global leaders in both reserves and production of minor minerals. The vast geographical expanse and abundant reserves puts India in a strong position to become the global leader for key industrial minerals. The illustration below displays India's global ranking in minor minerals.

Figure 20: India's global ranking in key industrial minerals



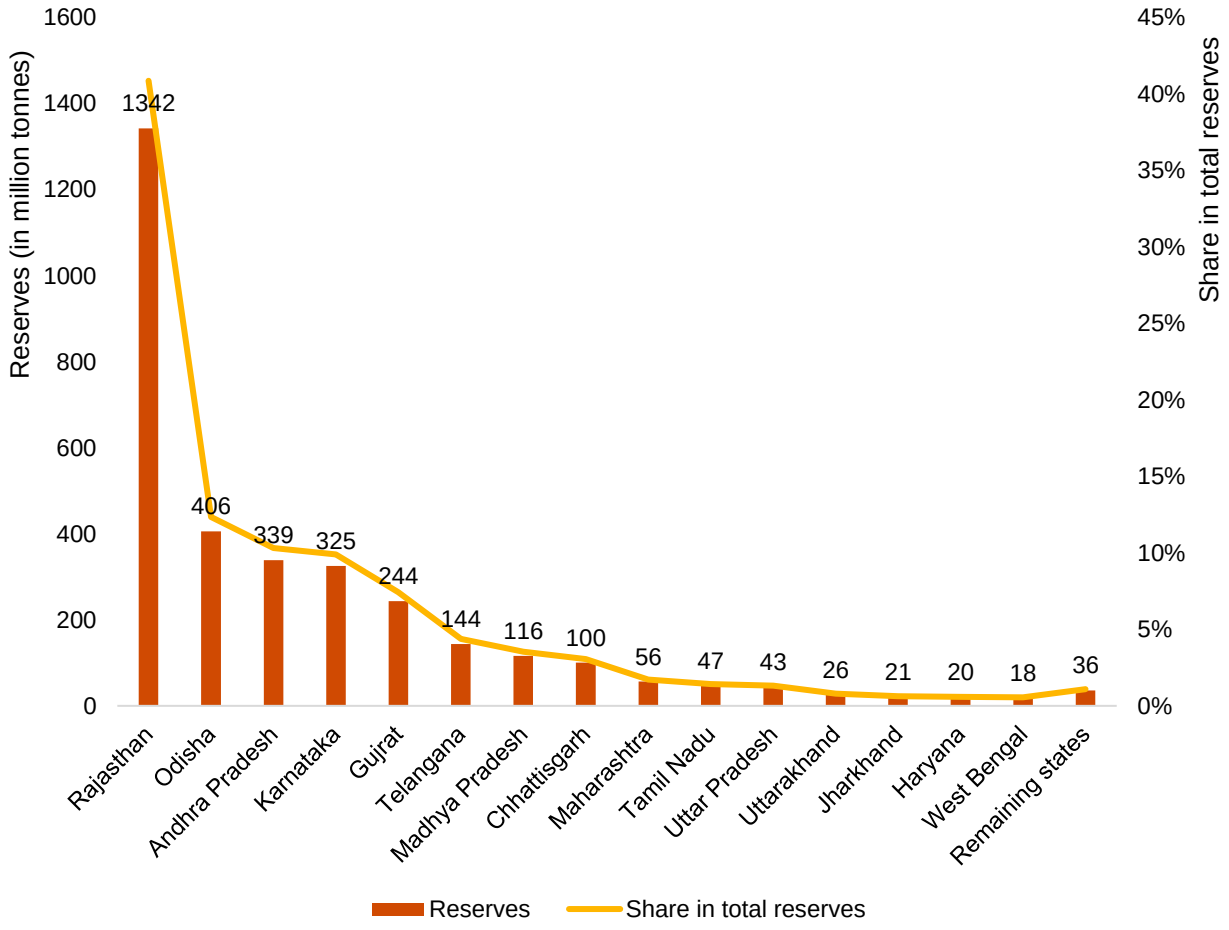
Source – Mineral Commodity Summaries 2019, U.S. Geological Survey

3.4.2. Mineral reserves and production scenario

As per the Indian Minerals Yearbook 2017, the total resources of minor minerals stand at 1,45,559.08 million tonnes. Out of this, the total reserves stand at 3,284.13 million tonnes and therefore the remaining resources of minor minerals are 1,42,274.95 million tonnes[45], spread across 30 States and Union territories in India. Rajasthan has reserves of 20 minor minerals, followed by Andhra Pradesh (19), Madhya Pradesh (18), Gujarat (14), Maharashtra (14) and Telangana (14)[46].

92% of the minor mineral reserves are concentrated in eight States viz. Rajasthan, Odisha, Andhra Pradesh, Karnataka, Gujarat, Telangana, Madhya Pradesh and Chhattisgarh. Rajasthan contributes most to the minor mineral reserves in India (41%). Strategic skill development for mining workforce in these States can contribute immensely to growth of the minor mineral segment.

Figure 21: State wise minor mineral reserves (in million tonnes)

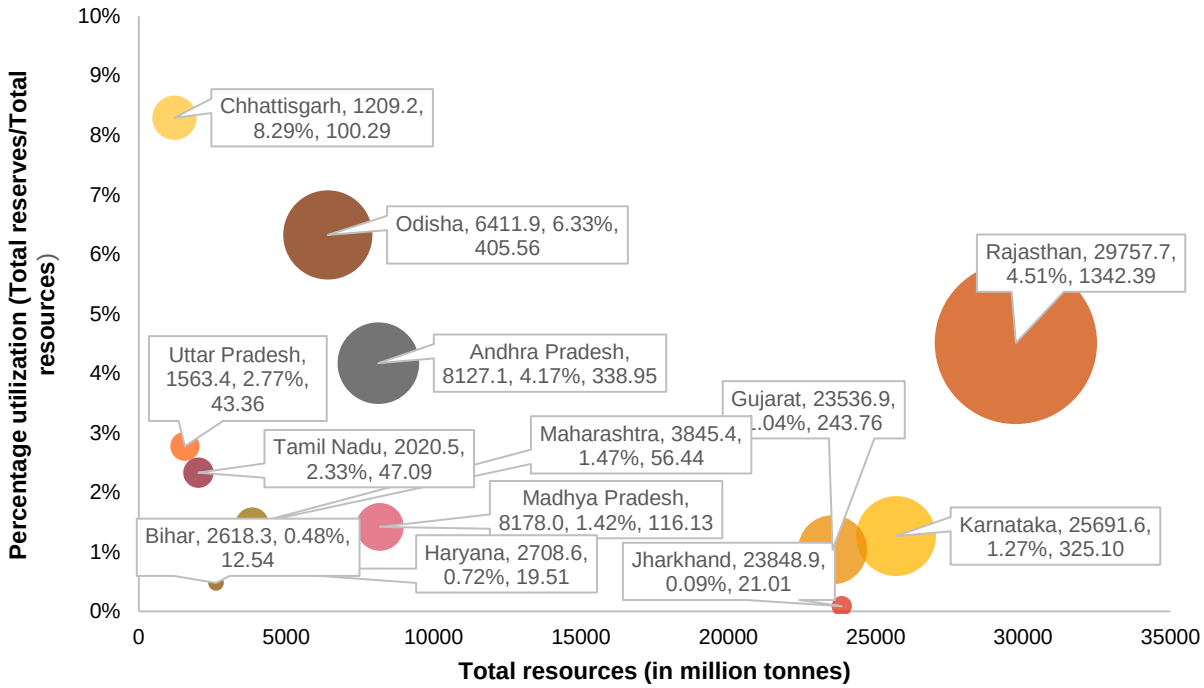


**Note: It includes data for 22 minor minerals. The remaining states include Jammu & Kashmir, Bihar, Kerala, Himachal Pradesh, Assam, Meghalaya, Arunachal Pradesh, Sikkim and Goa each of whose share in total reserves is nearly 0%.*
Source – Indian Minerals Yearbook 2017

[45] It includes data for 22 minor minerals. Source – Indian Minerals Yearbook 2017
[46] It includes data for 22 minor minerals. Source – Indian Minerals Yearbook 2017

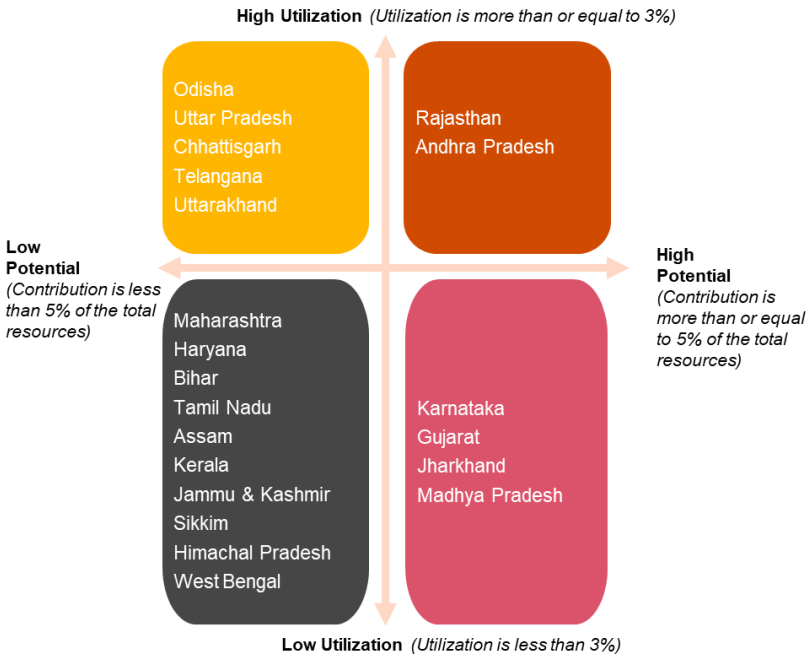
Exploration[47] of resources and potential of different States

Figure 22: Trends in total minor mineral resources and reserves (The size of the bubble represents total reserves in million tonnes)



Note: The data labels include state name, total resources, percentage utilization and reserves in the same order.
It includes data for 22 minor minerals
Source – Indian Minerals Yearbook 2017

The above illustration shows distribution of total minor mineral resources across key States and the extent to which these resources have been explored/utilized. The States can be classified as:



[47] Exploration is termed as utilization which is defined as Total reserves/Total or Inclusive resources

- ***High Potential and High Utilization:*** This constitute States which have large resources (contribute to more than or equal to 5% of the total resources in the country) and have a high percentage of these resources (more than or equal to 3%) explored/utilized. The States of Rajasthan and Andhra Pradesh together contribute to 26% of the total resources and 9% of their resources have been explored. **Rajasthan and Andhra Pradesh will be the focus of economic activity in minor mineral segment and will continue to have a large contribution in both production value and employment.**

- ***High Potential and Low Utilization:*** These States contribute to more than or equal to 5% of the total resources in India but have a low utilization. They have a sizable amount of unexplored resources. This includes Gujarat, Karnataka, Madhya Pradesh and Jharkhand, which collectively contribute to 56% of the total resources in the country but have only a small percentage of it as its reserves viz. 1%, 1.3%, 1.4% and 0.1% respectively. **They have the potential to contribute more to the output of minor minerals and can generate more employment- both directly and indirectly.**

- ***Low Potential and High Utilization:*** This includes Odisha, Uttar Pradesh, Chhattisgarh, Telangana and Uttarakhand. These States together contribute to 7% of the total resources in the country; however, their average utilization (percentage of reserves to resources) is around 11%, which is higher than the national average of 3%. **These States would have major contribution to the present employment in the sector. Further, technological advancements in mining and prospecting would enable these States to enhance their overall mining output. Thus, they may require widespread upskilling and re-skilling interventions to enhance the productivity of the manpower engaged in mining activities.**

- ***Low Potential and Low Utilization:*** This category includes States, which contribute little to the total minor mineral resources and are less utilized i.e. only a small percentage of the resources have been explored. Maharashtra has the largest share in resources amongst these States i.e. 3% followed by Bihar and Haryana with 2% each. All other States have 1% or less than 1% of the total resources in the country and together contribute 8%. **These States' contribution to the overall minor mineral output will be limited and therefore they may not contribute much to employment generation.**

Ten minor minerals contribute to 99% of the total minor mineral resources and 89% of the total reserves in India. These include Granite, Dolomite, Quartz, China Clay, Quartzite, Marble, Gypsum, Fireclay, Laterite and Feldspar.

Table 7: Minor minerals – trend in reserves and total resources (in million tonnes)

Minor Minerals	Total Resources	Reserves	Share in Total Reserves	Percentage Explored
Granite	1,21,821	694	21%	1%
Dolomite	8,415	678	21%	8%
Quartz and Silica Sand	4,000	739	23%	18%
China Clay	2,941	229	7%	8%
Quartzite	1,659	83	3%	5%
Marble	1,458	5	0%	0%
Gypsum	1,330	37	1%	3%
Fireclay	723	27	1%	4%
Laterite	707	125	4%	18%

Feldspar	634	320	10%	50%
Remaining minor minerals	3,213	348	11%	19%
Total	1,45,559	3,284	100%	3%

**Note: It includes data for 22 minor minerals*
Source – Indian Minerals Yearbook 2017

Granite has the largest resources in the country. Quartz has the largest reserves among all minor minerals followed by Granite. Feldspar has the highest utilization amongst the top 10 minor minerals, with 50%-explored resources and Marble has the lowest at 0.3%.

3.4.3. Foreign trade scenario

Table 8: Trends in Export of Minor Minerals (2012-13 to 2016-17) (Value in INR Billion)

Minerals[48]	2012-13	2013-14	2014-15	2015-16	2016-17
Granite	79.42	98.69	98.32	92.72	93.65
Sandstone	5.16	7.58	8.52	10.16	9.12
Barytes	11.92	8.70	4.53	6.52	7.68
Marble	5.43	5.70	5.99	6.00	7.07
Limestone	2.70	3.43	4.67	4.69	4.94
Bentonite	3.16	3.86	4.00	4.81	4.80
Mica	3.46	3.76	4.26	4.23	4.57

Source: Indian Minerals Yearbook 2017, IBM

- According to Indian Minerals Yearbook 2018, large reserves and availability of different varieties of Granite has pushed the exports for this minor mineral and has helped India secure 2nd position globally. The USA is the biggest consumer of granite in the world and its demand is met by China, India and Brazil. India is also a key player in export of natural stones and has a substantial share in the market.

- Only 1% of the total Granite resources have been explored in India so far. Further, mechanization and automation in exploration and mining can reduce wastage in Granite and thus increase the total production. This can help meet both local and global demand for the mineral[49].

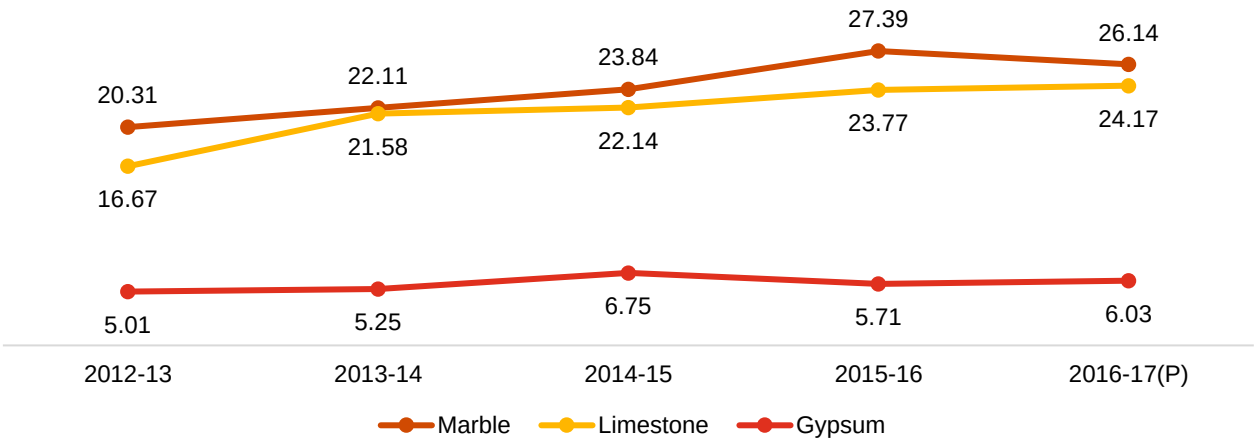
- According to Indian Minerals Yearbook 2018, India is the second largest producer of Barytes, which is primarily used in the petroleum industry. Barytes have seen a slump in exports over the years. From an export value of INR 11.92 billion, this mineral has come down to INR 7.68 billion in 2016-17. The increasing domestic demand for the mineral could be responsible for the slump in exports.

- According to Indian Minerals Yearbook 2018, marble, limestone and bentonite have seen consistent growth in value of exports over the years. They have growth at a CAGR of 7%, 16% and 11% respectively.

- Bentonite is used extensively across the globe in industries like foundry and iron ore palletisation. India has high grade resources of Bentonite and can therefore look at fulfilling the global demand.

[48] Annual Report 2017-18 Ministry of Mines
[49] Indian Minerals Yearbook 2018

Figure 23: Trends in Import of key Minor Minerals (2012-13 to 2016-17) (Value in INR Billion)



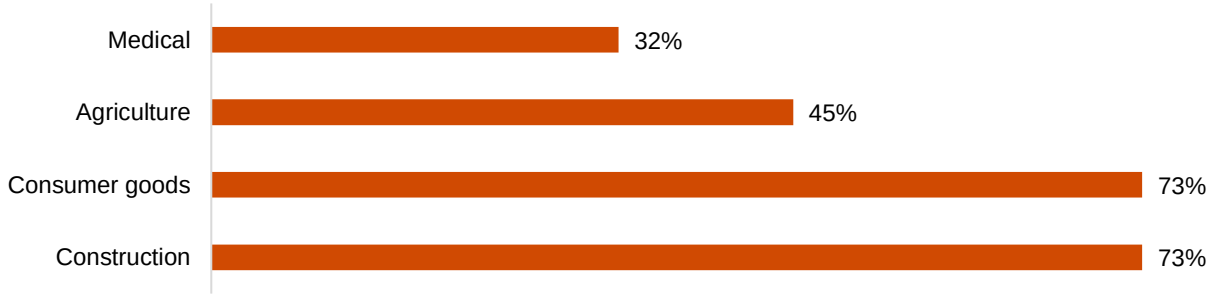
P: Provisional
Source: Indian Minerals Yearbook 2018, IBM

- India has seen a steady growth in imports of key minor minerals which find use across multiple industries.
- Major exporting countries of marble in the world are Turkey, Italy, Greece, Spain and Iran. The import of crude marble/ building stone has been restricted by the Government. However, the government has come up with a new policy in September 2016 which has made it easy for anyone who wants to import marble blocks and set up processing facility in the country. This policy is expected to have far-reaching effects and would support the development of marble industry in India.

3.4.4. Industrial use

Minor minerals are industrial minerals and find their uses across many industries. The construction and consumer goods sectors are heavily dependent upon minor minerals and each make use of 73% of minor minerals (as shown in the figure below).

Figure 24: Percentage use of minor minerals across key sectors



Source: Indian Minerals Yearbook 2018, IBM

The sectors depicted in the above graph are a combination of one or more industries. The distribution of industries across these sectors is as follows:

Table 9: Industries using minor minerals

Sector	Industry	Relevant minerals
Agriculture	• Agriculture	• Bentonite • Calcite • Diaspore • Dolomite • Fuller's earth • Gypsum • Marble • Chalk • Pyrophyllite • Talc
Construction sector	• Building material • Construction • Mortar • Paint • Paints	• Barytes • Calcite • Dunite • Felspar • Fireclay • Granite • Gypsum • China Clay • Laterite • Marble • Mica • Chalk • Pyrophyllite • Quartz • Natural/ Sandstone • Talc
Consumer goods	• Ceramic • Electrical and Electronics • Glass • Jewelry • Leather • Optical • Paper • Personal care • Pyrotechnics • Refractory • Rubber • Textile • Toys and statues	• Barytes • Bentonite • Calcite • Corundum • Diaspore • Dolomite • Dunite • Felspar • Fuller's earth • Gypsum • China Clay • Marble • Mica • Pyrophyllite • Quartz • Talc
Medical sector	• Healthcare • Medicine (Radiodiagnosis) • Pharmaceuticals • Scientific instruments	• Barytes • Bentonite • Calcite • Corundum • Dolomite • Gypsum

Source: Indian Minerals Yearbook 2018, IBM

The different uses of minor minerals across various industries has been summarized in subsequent section based on Indian Minerals Yearbook 2018.

Road metals

Road metal(s) is not a metal rather is a dark-coloured, fine-grained, non-granitic intrusive or extrusive igneous rock which is known as Black Trap. Road metal is a non-geological term. It is a construction industry term used for dark-coloured igneous rocks used to make crushed stone. Road metal is majorly used in road and housing construction as a concrete aggregate and asphalt aggregate. In addition, steel slag and overburden removed from coal mines is crushed to make substitutes for road material and sand. However, in India crushing overburden to act as an alternative for sand is still in R&D phase and it is expected that technological advancements will improvise use of overburden and steel slag as alternatives for sand and road metals.

Road metal is also used as ballast for railroad track bed because of its insensitivity to chemical influences, resistance to mechanical stress, high dry relative density, frost resistance, and sea water resistance. This mineral has currently found its usage in preparation of manufacturing sand also which could be an alternative to riverine sand in near future. The road metals sector drives its demand with growth in rail and road network across the country as India has the one of largest road network across the world, spanning over a total of 5.8 million km[50].

Further, in the coming years, significant amount of road development plans, including National and State Highways will be taken, increasing the demand for Road metals. Additionally, significant amount of demand will also be generated with growth in railway connectivity and tracks to be laid, that consume Road metals.

Mostly, the road metal is sourced locally as this mineral is low in value, and in terms of consumption a high-volume commodity. The demand is driven by upcoming or existing infrastructure projects and hence with the upcoming initiatives of Government of India the consumption of road metals is further going to grow which in turn has a potential to bring socio-economic gains in the rural areas as well.

Granite

Granite is the most sought after amongst building stones. Granite stones are used in flooring, cladding, making garden furniture, cobblestone, kerbstone, road sidings and other decorative purposes.

India has one of the largest deposits of granite in the world with multiple varieties consisting more than 200 shades. Granite resources in India account for over 20% of the world resources. The dimension stones market in India is expected to grow at around 15% CAGR and similar growth can also be attained in exports with the help of suitable policy framework[51].

Dolomite

Dolomite is grouped under flux and construction minerals and is important for iron & steel and ferro-alloys industries. It is consumed by iron & steel, ferro-alloys, fertilizer, glass, alloy steel and other industries. Iron & steel industry was the major consumer of dolomite accounting more than 80%, followed by sponge iron (about 8%) and cement & ferro-alloys (about 2% each). The remaining quantity is consumed by other industries, such as alloy steel, glass, fertilizer, paint, refractory, etc.

Limestone

Limestone often contains magnesium carbonate, either as dolomite CaMg (CO3) or magnesite (MgCO3) mixed with calcite. Cement is the major consuming industry accounted for 93% consumption followed by iron & Steel industry (4%). The remaining consumption is reported in chemical foundry, sugar, and paper and glass industry[52].

China Clay (Kaolin)

Kaolin finds its use across different industries. The major use of crude kaolin is in the cement industry, whereas processed kaolin is extensively used in ceramics. Other industries where kaolin is used include sealants, paper coatings, fibre glass, paints, rubber, plastic, cosmetics, pharmaceuticals and textiles. Certain types of kaolin are also used in manufacturing of insecticides, water filters, candles, soaps and detergents and explosives. Out of the total reserves in India, 26% falls under ceramic/ pottery grade, 4% under chemical and 70% under mixed grade.

Quartz and other silica material

[50] Ministry of Road Transport and Highways, NHAI website, Press Information Bureau (PIB)
[51] Indian mineral yearbook 2017
[52] E book on mineral sector, Ministry of Mines

Quartz and silica sand are vastly used in glass, refractory, foundry, ceramic, cosmetic electrical, abrasives, paint and building material industries.

Foundry and moulding grade reserves are 19%, glass 17%, ceramic and pottery 11% and ferro-silicon grade is 5% of the total reserves in the country.

Construction sector-driver for minor mineral growth

Rapid urbanization supported by government policies has driven the growth of construction sector in the country. This sector has grown at CAGR of 4% between 2011-12 and 2018-19, with its GVA increasing from INR 7,773 billion to INR 10,539 billion.

Majority of the minor minerals (73%) find their use in the construction sector. Furthermore, the overall production value of minor minerals is driven by seven minerals which are extensively used in this sector (i.e. road metals, granite, building stone, ordinary sand, stone, brick earth and boulder contribute to 77% of the total production value). It can therefore be concluded that growth in construction sector will drive the demand for minor minerals in the country and subsequently the overall output of this mineral segment.

India's construction sector is expected to become the 3rd largest globally by 2025. This means that the sector is expected to grow at an average of 7.1% each year and will reach $738.5 billion by 2022[53]. Government policies on smart cities, industrial corridors, mega ports, affordable housing and development of railway network is going to fuel the growth in this sector.

In order to capture this growth opportunity, the States rich in minor mineral reserves should act swiftly to increase the productivity of minor minerals so that they can meet the growing demand of the construction sector. Rapid technological advancement and enabling policies can ensure that India is self-sustainable in raw materials required for construction. Further, growth of the mining sector needs to be well managed with it social and environmental externalities.

3.5. Ancillary activities in the mining sector

Ancillary activities can be primarily divided across two broad categories: (i) activities/sectors that provide intermediate input and capital to the mining and quarrying sector and ii) activities/ sectors that function near the periphery of mines or quarries and are dependent on mining and quarrying for material inputs. Intermediate inputs to the mining and quarrying sector can be further classified into three types: -

- Energy input to the mining and quarrying sector includes:
  - Petroleum products
  - Electricity
- Service input to the mining and quarrying sector includes:
  - Water supply
  - Transport services (railway, land, water and air transport; other supportive and auxiliary transport activities)
  - Storage and warehousing
  - Communication services
  - Trade (wholesale and retail trade)

[53] https://www.investindia.gov.in/sector/construction

- Financial services; Insurance services
- Education and research
- Legal services
- Medical and health
- Computer related services
- Other business services
- Renting of machinery and equipment
- Other services

- Material Input- All other intermediate inputs that are not part of energy and service input are classified as material input. Some of the key material input to the mining & quarrying sector include-
  - Manufacture of explosive and detonators
  - Manufacture of chemicals and chemical products
  - Parts and accessories of motor vehicles
  - Miscellaneous metal products
  - Repair and maintenance of fabricated metal products, machinery and equipment
  - Installation of industrial machinery and equipment
  - Wood and products of woods
  - Paper products
  - Rubber and Plastic products etc.

Further, Capital input to the mining and quarrying sector are classified into 3 broad categories based on asset type, i) construction ii) transport equipment and iii) machinery (ICT i.e., Information and communication technology equipment and non-ICT)

In addition to the activities/sectors mentioned above, following activities near the periphery of mines are also considered part of ancillary activities:

- Cutting, shaping and finishing of stone
- Manufacture of bricks and other clay products near clay quarries
- Manufacture of other non-metallic mineral products near mines or quarry
- Wholesale of construction materials (sand, gravel etc.)

The overall structure of ancillary activities depends upon the mineral type, i.e. major and minor as the major minerals are of much higher economic value as compared to the minor minerals. For the major minerals, the ancillary setup is primarily available near the mines itself catering to the entire mining value chain. This is feasible in case of major minerals only as the infrastructure setup cost of ancillary activities is viable for economically higher value minerals. However, for minor minerals, the ancillary activities are usually carried out by contracting it to local vendors or industries.

While the economic profile of the sector in terms of its contribution to country's GDP, analysis of mineral reserves and production scenario with focus on major and minor minerals and ancillary activities associated with the sector provide an overview of the Indian mining and quarrying sector's growth trajectory and employment generation potential, however, it will be critical to take a deep-dive into the current legislations governing the sector.

The next section delves into the policy and regulatory framework governing the mining sector in India.

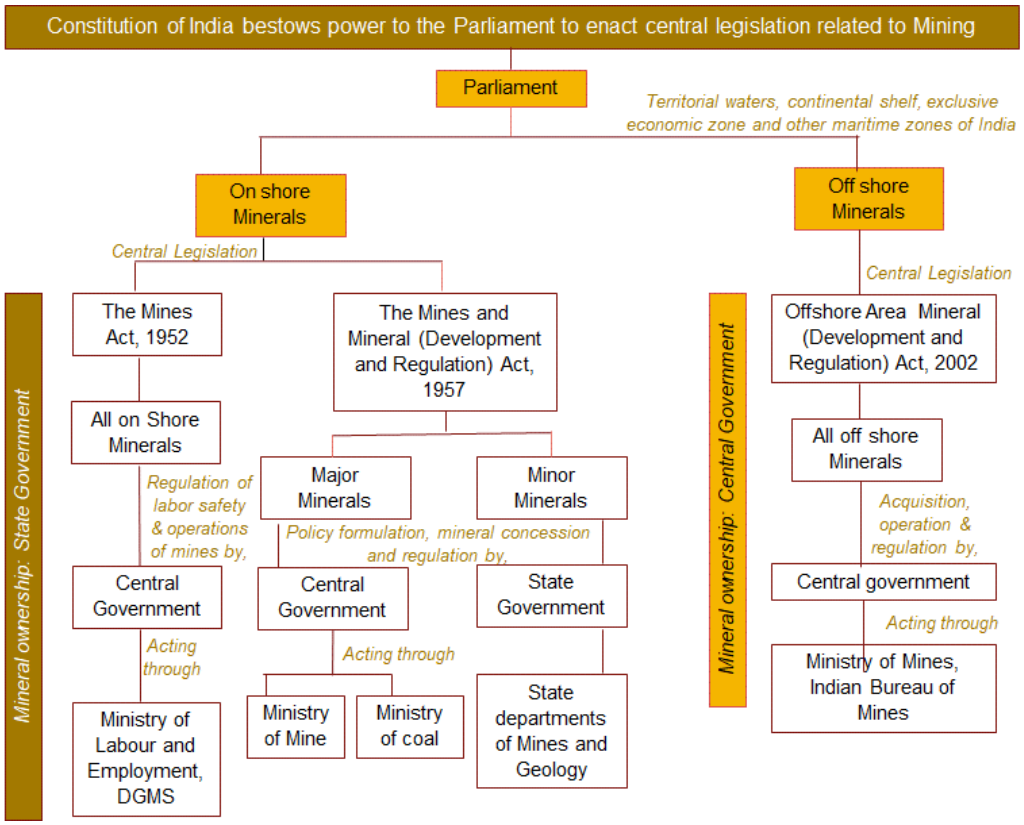
3.6. Policy and regulatory framework in the mining sector

The attractiveness of any country for investors/ potential investors largely depends on the policy regime (tax system, regulatory framework, quality of infrastructure, etc.) of that country. Mired with challenges pertaining to the tax regime, land acquisition, environmental clearances, etc. the National Mineral Policy 2019 has been envisaged to boost the investment (both domestic and international) in the sector driving the competitiveness.

3.6.1. Current regulatory structure in the mining sector in India

The mining and mineral sector in India operates under a federal structure wherein the Central government formulates the legislation for all minerals (except minor minerals) and the various State governments formulate legislations for minor minerals. Mineral resource management is considered as the responsibility of both the Central and State governments in terms of entry 54 of the Union List (List I) and entry 23 of the State List (List II) of the seventh schedule of the Indian constitution. Further, State governments hold the ownership rights for onshore minerals occurring within their State boundaries, whereas the ownership rights of offshore minerals reside with the Central government.

Figure 25: Overview of the mining sector's regulatory framework



Key government stakeholders are:

- ***Ministry of Coal (MoC):*** The ministry looks after the policy framing and strategy for exploration and development of coal and lignite reserves. It carries out its functions through PSUs such as Coal India Limited and its subsidiaries along with Neyveli Lignite Corporation.
- ***Ministry of Steel (MoS):*** The ministry formulates policies and strategies (relating to production, distribution, pricing and import –export) for the overall growth and development of the iron and steel industry. It conducts all its iron and steel development activities through the 10 PSUs (such as SAIL, NMDC, etc.) which fall under its purview.
- ***Ministry of Mines (MoM):*** The ministry is responsible for survey and exploration of all minerals, other than natural gas, petroleum and atomic minerals. The ministry is also responsible for the administration of Mines and Minerals (Regulation and Development) Act. Moreover, mining and metallurgy of non-ferrous metals (such as copper, aluminum, zinc, nickel, etc.) falls under the purview of the ministry. The ministry comprises of 1 attached office (Geological Survey of India) and 1 subordinate office (Indian Bureau of Mines), 3 PSUs (NALCO, HCL, MECL) and 3 research institutes (National Institute of Rock Mechanics (NIRM), National Institute of Miners' Health (NIMH), Jawaharlal Nehru Aluminum Research Development and Design Centre (JNARDDC)) which are autonomous bodies of the ministry.
- ***Ministry of Labour and Employment (MoLE):*** The ministry's responsibility is to safeguard the workers interest as well as those belonging to the lower and disadvantaged sections of the society creating a healthy work environment and develop vocational skill training and employment services. One of the subordinate offices of the ministry that directly deals with mining is the 'Directorate General of Mines and safety' (DGMS). It is the regulatory agency under the Ministry of Labour and Employment, in matters relating to occupational safety, health and welfare of all the persons employed in mines.
- ***State Department of Mines and Geology (DMG):*** The State DMGs are responsible for survey and assessment of the mineral deposits of their respective States, their exploitation, enforcement measures for preventing illegal mining and smuggling of minerals and administration of mines and mineral concession, assessment and collection of mining revenue.

3.6.2. Major acts and legislations governing and regulating the sector

The Mines Act, 1952

This act is administered by Directorate General of Mines Safety (DGMS)[54] and lays down provisions for the safety, health and welfare of workers in coal, metalliferous and oil mines. Additionally, it specifies the owner's duties for mine operations, number of working hours in mines, minimum wage rates, amongst others. The act also charts statutory requirement of specific manpower at each mine[55]. It further limited the role of women, which was overturned by a notification dated 20th January 2019.

[54] DGMS is the regulator and key controller for mine safety and works with a mission to reduce the risk of occupational diseases and injury to persons employed in mines and to continually improve safety and health standards, practices and performance in the mining industry.
[55] Manpower statutorily required is: Manager, under manager, underground manager, assistant manager, ventilation officer, safety officer, mining engineer, electric engineer, mechanical engineer, mechanical foreman, electric foreman, electric supervisor, surveyor, assistant surveyor, medical officer, chemist, assayer, metallurgist, welfare and personnel officer

Application of The Mines Act, 1952

It should be noted that the Mines Act, 1952, lays down provisions for the safety, health and welfare of workers and also applies to minor minerals (with certain exceptions). The act is administered by the Ministry of Labour and Employment which acts through the Directorate General of Mines and Safety (DGMS).

Directorate General of Mines Safety (DGMS)

DGMS is a regulatory body under the Ministry of Labour and Employment, regulating aspects pertaining to occupational safety, health and wellness of workforce employed in the mines. Its key roles and functions include:

- Inspection of mines
- Investigation into -
  - Accidents
  - dangerous occurrences - emergency response
  - complaints & other matters
- Grant of:
  - statutory permission, exemptions & relaxations
  - approval of mine safety equipment, material & appliances
- Interactions for development of safety equipment, material and safe work practices through workshop etc.
- Development of Safety Legislation & Standards
- Safety Information Dissemination
- Conduct of examinations for grant of competency certificates.
- Safety promotional initiatives including:
  - Organisation of Conference on Safety in Mines, National Safety Awards and Safety Weeks & Campaigns.
  - Promoting safety education and awareness programmes and workers' participation in safety management through workmen's inspector, safety committee and tripartite reviews.

The Mines and Mineral (Development and Regulation) Act (MMDR) 1957

MMDR Act, 1957 aims at scientific development of the mineral sector in India. It lays down the provisions for prospecting, exploration and mining leases. The act was amended in the year 2015. Some of the key features of the amendments are listed below:

- An E-Auction process was charted for major mineral block auctions with the purpose of bringing more transparency to the process and encouraging private sector participation.
- The mining lease period for all minerals except for coal, lignite and atomic minerals was increased from 30 to 50 years after which the mining areas will be put for auctions[56]. This shall encourage participation from more companies that have longer term plans in mining projects.
- The State governments have been given power to grant mining leases and prospecting cum mining leases for both notified and other minerals with permission from Central government. The leases will be granted through competitive bidding auction as well as e-auction.
- The mining or prospecting cum mining lease can be transferred to another person eligible[57] to hold it as per provisions of the act with the approval of the State government as prescribed by the Central government. The full transfer of the mining lease or prospecting cum mining lease was done to encourage more companies to participate as they would have increased flexibility to enter and leave at any point of the mining value chain.

[56] Mines and Minerals (Development and Regulation) Act 1957, chapters 1-7, Ministry of Mines

[57] The Mineral Concession Rules, 2016 were introduced and the process for granting mineral concession for different scenarios were stated in detail. Under Mineral Concession Rules, 2016 the grant of composite prospecting cum Mining Lease is made through Auction process as per rules specified in Mineral Auction Rules, 2015.

- The maximum area limit for which prospecting license/ mining license is granted was made flexible where the government holds the prerogative to increase the leased area, if required. This would encourage more companies to be involved with the mining activities who were earlier skeptical about certain restrictions.
- District Mineral Foundations (DMF) were recommended to be established in each mineral bearing district for local area development for the benefit of the people and areas affected by the mining projects.
- The National Mineral Exploration Trust (NMET) was created to use the funds from the miners paid as 2% of the royalty as defined in the 2nd schedule, for carrying out regional and detailed exploration activities along with capacity building of the State Government exploration wings.
- In Section 11 (A) (1) (b) of the MMDR, the Central Government may, for the purpose of granting RL, PL or ML for any area containing Coal or Lignite through auction, select a company or joint venture that carry on coal mining operations in India either for its own consumption, sale or any other purpose. However, auction by competitive bidding shall not be applicable for such areas that are considered for allocation to Government companies for mining and any other specified end use.
- The Central Government has also notified the following rules for implementation of provision of MMDR Act, 2015:
    - Minerals (Evidence of Mineral Contents) Rules, 2015
    - Mineral (Auction) Rules, 2015
    - Mineral (Non-exclusive Reconnaissance Permits) Rules, 2015
    - National Mineral Exploration Trust Rules, 2015

Mines Vocational Training (MVT) Rules, 2019

Anchored by DGMS, the Mines Vocational Training (MVT) Rules, 2019 drive vocational training in the sector. It charts that mines, under Mines Act, 1952, have to abide by the rules of training laid down by MVTR, wherein various training schemes have been outlined including the following:

- Initial training for the persons to be employed in the mines and refresher training for the persons already employed.
- Training in case of introduction of new technology, equipment or change in work procedure.
- Assessing the training need of persons working in mines for the safe performance of the mining operations

For the purpose of the application of these Mines Vocational Training rules and maintaining quality of training, a Vocational board is to be constituted. The major functions of the board recommended by the MVTR include:

- Establishing a committee that prescribes certain standards of training to be imparted at mines and making sure that uniform standards are maintained, and all trainings conform to the standards.
- Decide the manner of ascertaining the competency of the Instructors, training officers, trainers along with the manner of ascertaining quality of the training provided, proper assessments for granting certificates.
- Define the scope and standards of the general and refresher training to be provided accordingly.

Provisions of MVTR 2019 further suggests every mine to provide a training centre that is adequate to impart training required to the persons who are employed or to be employed in that mine. Flexibility has been provided to have a common training centre in respect of (i) two or more mines of the same owner; (ii) or a group of owners of more than one mine. Such provisions are important for small and medium mine owners, including the minor mineral segment, in terms of having shared infrastructure for common training needs.

As guided by the MVTR 2019 a large proportion of vocational training in the sector is undertaken by PSUs and other apex institutions such as DGMS and IBM. They typically focus on providing trainings on health and safety measures, up-skilling workers with new techniques and process, up-gradation of skills increasing productivity, HEMM maintenance operators, shovel operator amongst others In order to properly fulfil the set goal for skill development, organisations are developing centre of excellence, institutes and offering vocational trainings, RPL, providing certifications etc.

Vocational Training initiatives outlined under the rules can benefit the small and medium mine owners, especially in the minor mineral segment, as it provides structures guideline for various training needs outlined above. It is therefore important for organisations in the minor mineral segment to take up training of their in-service staff and contribute in developing skilled workforce for their growth.

Coal Mine (Nationalization) Act 1973 (CMNA) and Coal Mines (Special Provisions) Act, 2015

Introduction of CMNA led to the nationalization of coal blocks in India, allowing only the State or Central government (or any other organisation with a sub-lease from the government) to mine coal[58]. Further, it only allowed private companies to mine coal if they are engaged in production of iron and steel, generation of power, washing of coal obtained from a mine, cement manufacturing, amongst others.

In 2014, the Supreme Court cancelled allocations of all coal blocks barring 4 blocks. To ensure continuity of mining operations the Coal Mines (Special) Provisions Act, 2015 ("Act") was notified in March 2015. It provides provisions for allocation of deallocated coal mines and introduced the transfer of right of land and mining infrastructure to successful bidder selected through competitive auctioning[59].

National Mineral Exploration Policy (2016)

The National Mineral Exploration Policy was notified in 2016 charting out several measures for comprehensive and accelerated mineral exploration in the country. The policy encouraged private sector participation in exploration in addition to the government-owned Geological Survey of India (GSI) Limited and Mineral Exploration Corporation Limited (MECL). One of the major initiatives of this policy was the government taking responsibility of making available the pre-competitive geoscience data, which can be provided to potential exploration agencies. The data generation will be totally funded by the Government and will be available free of charge.

Further, the government will also collaborate with research bodies, universities and industry for scientific and technological access required for exploration. Currently GSI is conducting a National Aero-geophysical Mapping Program which will be completed by 2020-21. GSI is planning to maintain a National Geoscience data Repository which will contain the geological, geochemical, geophysical and mineral exploration data. Further, a National Centre for Mineral Targeting, a non-profit organisation, is proposed to be established for deep exploration of the minerals which as a stand-alone activity may not be profitable for public and private agencies[60].

The National Mineral Policy, 2019

The National Mineral policy was first introduced in 1993 with the idea of optimum utilization of the mineral reserves in the country. It was later amended in 2008 with the objective of achieving the twin goals of large-scale prospecting with optimal mining and attracting investment with the latest technology. Recently, the NMP was revised in the year 2019 basis Supreme Court directive dated 2nd August 2017. The National Mineral Policy 2019 aims at carrying forward the key rules of the previous policy along with strengthening the regulatory framework with penetration of the e-governance systems to prevent illegal mining and value leakage. It is anticipated that implementation of the policy will enable 200% increase in production of MCDR (Mineral Conservation and Development Rules) minerals along with a trade deficit reduction in minerals sector by 50% in 7 years. *Key features of the policy are mentioned in Annexure A.15.*

[58] Default Lessees are Coal India Limited (CIL), Singareni Collieries Company Limited (SCCL) and Neyveli Lignite Corporation (NLC) enjoy the status of central agencies for coal mining; Subsidiaries of CIL have statuary rights for mining of coal which falls within the areas of respective subsidiaries; SCCL have mining rights for coal mining in Godavari Valley coalfields (State of Andhra Pradesh); NLC have mining rights for lignite mining in India.

[59] The Central Government has also amended certain Sections of the CMNA and MMDR in the manner provided in Schedule IV of the Coal Mines Special Provision Act 2015.

[60] Several other critical policies and legislations chart various aspects such as mines safety, environment protection, sustainability and rehabilitation of those displaced. These have been further elaborated in Annexure A.5.

The National Mineral Policy, 2019 – Carving a promising way forward

NMP- 2019's implications on transparency of allocation processes will ensure time-bound processes for clearances and enable ease of doing business. Key reforms proposed in the policy are:

- Setting up a unified authority at the national level to fulfill objective of the policy will certainly enable better implementation.
- NMP also mentions strengthening of IBM and State directorate of mines and geology to enforce mine planning and make processes more seamless with an emphasis of strengthening of E-Governance, including satellite and remote sensing technology.
- In order to develop the mineral production, strategy stated in NMP is to focus on upgradation of mining technology, recovery of metals through recycling and to put efforts allotting merchant mining leases expiring in 2020 and captive mines in 2030. Insight in Section 2.5 on technological trends detail out existing and expected technologies upgrading.
- NMP advocates improving gender balance in the mining industry with an emphasis on mechanisation, computerisation, automation and adoption of state-of-the-art technology of the existing and new mining units. With growth of the sector, need of mining engineer, geologist, geo-physicist, geo-chemist, geo-instrumentation specialist, IT professional will be more and facilities for basic and specialised training shall be constantly reviewed and upgraded from time to time.
- While local evacuation networks will be encouraged to be built in an integrated manner along with developing the mineral blocks, dedicated mineral corridors shall be planned to facilitate transport of minerals from mining areas in hinterland, development and installation of innovative, eco-friendly and efficient modes of evacuation like slurry pipelines and close loop conveyors shall be promoted and encouraged.
- An enabling environment will be created to allow mining companies to undertake construction of such infrastructure including construction of conventional transportation networks like rail and road for their own usage in coordination of State/Central agencies.
- Use of coastal water ways and inland shipping shall also be promoted as per NMP. To promote investment in the mining sector special incentives or priority movement by railways/port/coastal shipping must be encouraged.
- Steps shall be taken to facilitate financing of mine development and also of exploration integral to the mining project and efforts shall be made to grant mining the status of industry.

Impact of NMP on Minor minerals

The following initiatives under the National Mineral Policy, 2019 will support mining of minor minerals and boost the overall production and value for this segment.

- **Steps to ease financing of prospecting, exploration and mine development for mining projects,** which do not have a substantial component of machinery, equipment and buildings, will support operations in small mining projects. Further, granting mining the status of industry will ease access to capital for small mine owners, thereby giving a push to minor mineral sector.
- **Focus on mechanization of mines** will not only streamline mining operations but will also improve the working environment for mineworkers. Incentivizing availability of mining machinery and mineral beneficiation equipment and promoting indigenous manufacturing of such equipment will have a positive impact on the minor mineral sector, which is predominantly a labour-intensive industry.

- **Emphasis on mechanisation, automation and adoption of technology** in mining will need continuous skilling, re-skilling and up-skilling of human resource. Promotion of facilities for training will ensure that adequate manpower is available across all levels. Such initiatives will support minor mineral sector, which faces a challenge of inadequate manpower due to seasonal and unorganized employment.
- **Infrastructure development** initiatives such as dedicated mineral corridors, use of inland water ways and creating an enabling environment to allow mining companies to undertake construction of infrastructure, will provide the necessary thrust to the minor mineral segment.
- **Promotion of small mineral deposits** and adopting a cluster approach to for granting lease for such deposits will help create the necessary infrastructure for mining of minor minerals.

Overall, with the effective NMP-2019, future looks promising, and the government needs to ensure a practical implementation of the policy to get the maximum outcome.

Annexure A.13 presents a snapshot of the features of National Mineral Policy 2008 and 2019

District Mineral Foundation (DMF)

The MMDR Act, 1957 was amended by the MMDR Amendment Act, 2015. The amendment provides for establishment of District Mineral Foundation (DMF) in any district, which is affected by mining. The objective of the DMF is to work in the interest of people and areas affected by mining and related activities.

The DMFs come under the jurisdiction of the State Governments. Lease owners contribute to DMF funds in addition to the royalty paid for mining leases. The lease owners have to contribute 10% of royalty in respect of mining leases granted on or after 12th January 2015 and 30% of royalty in respect of mining leases granted before 12th January 2015. The DMFs are also supposed to implement Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY), which was on 17th September 2015. At least 60% of PMKKKY are used for:

- Drinking water supply
- Environment preservation and pollution control measures
- Health care
- Education
- Welfare of women and children
- Welfare of aged and disabled people
- Skill development
- Sanitation

The rest of the funds are utilized for undertaking works like physical infrastructure, irrigation, energy and watershed development and any other measures for enhancing environmental quality in mining district[61].

The DMF funds are treated as extra-budgetary resources for the State Plan. Further, as per sub-section (3) of section 9B of MMDR Act, 1957, the State Government prescribes the composition and functions of the DMF. Therefore, the State decides the structure of DMF, including representation of various stakeholders, under its legislative and administrative jurisdiction.

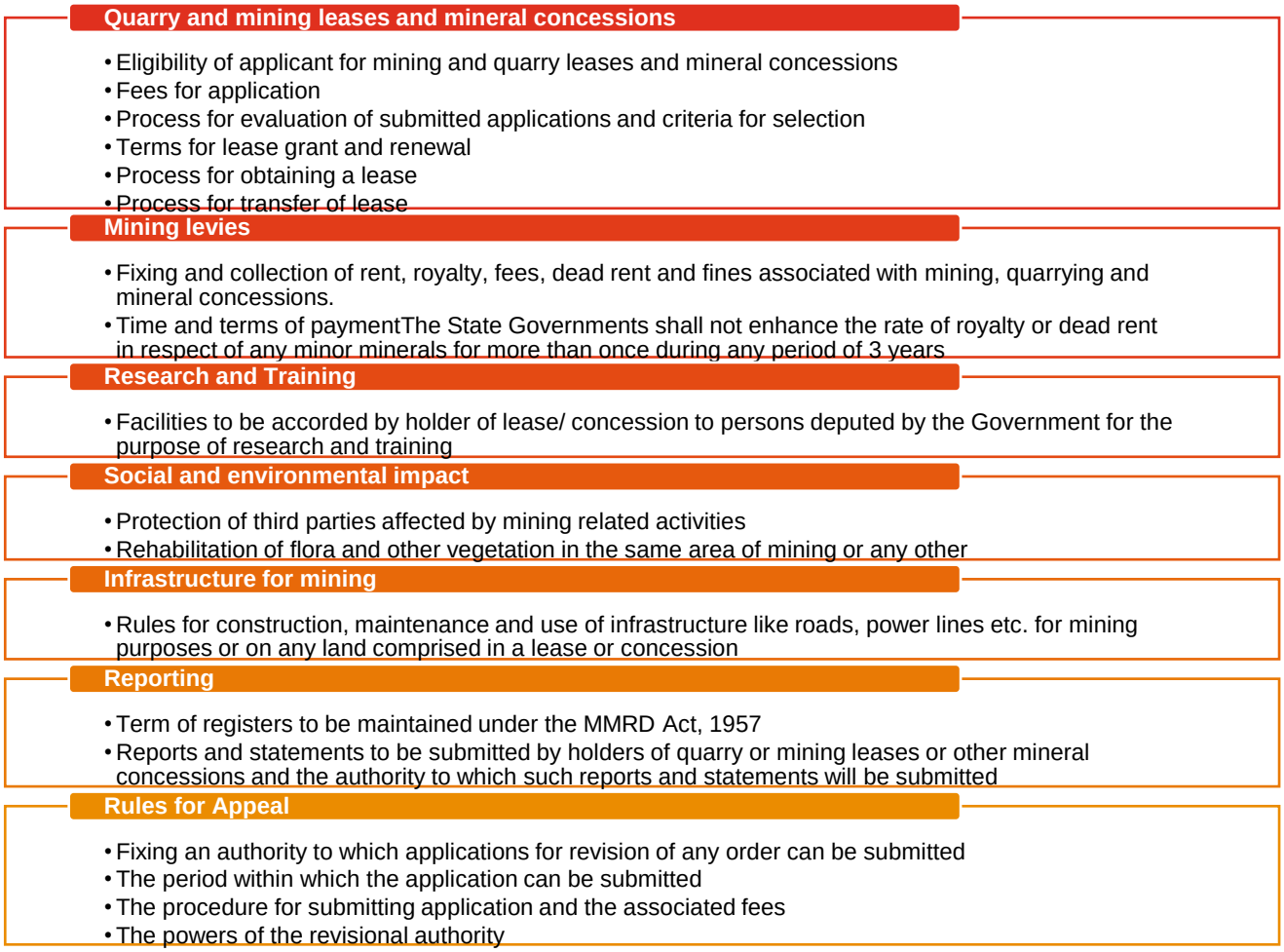
3.6.3. Role of State governments in minor minerals

The State governments are responsible for formulating legislations for the minor mineral segment. However, the Central government notifies 'minor minerals' in exercise of powers under section 3(e) of the MMDR Act, 1957.

MMDR Act, 1957, provides for legislation for all minerals, including minor minerals. Section 15 of the MMDR Act, 1957, empowers the State government to make rules in respect of minor minerals. Each State has its own set of Minor Mineral Concession Rules for regulation of minor minerals in their respective geography. The illustration below shows the matters that are dealt in Minor Minerals Concession Rules.

[61] Introduction of District Mineral Foundation Levy, Press Information Bureau, Government of India, Ministry of Mines, 28th November 2016

Figure 26: Jurisdiction of the State government in formulating minor mineral rules



Minor mineral concession rules

The State Governments grant concessions to all minerals located within the boundary of the State. Each State draft its own minor mineral concession rule, under the provisions of the MMDR Act, 1957 and Mineral Concession Rules (MCR), 1960 framed thereunder[62].

Two types of minor mineral concessions are made in the country viz. Reconnaissance Permit (RP), Prospecting License (PL) and Mining Lease (ML).

- **Mining Lease (ML)** is granted for undertaking operations for any minor mineral. A ML for any minor mineral or prescribed group of associated minor minerals can be granted for different durations depending upon the State Mineral Concession Rules. A ML can be renewed for periods not exceeding 20 years each[63].
- **Mining Permit (MP)** is granted to extract a specified quantity of minor mineral in a stipulated period mentioned in the permit. These permits specify the quantity, area and time for which the mining activity can be carried out. The duration of MPs is less than the MLs issued by respective States.

Guidelines for the following aspects are covered under the minor mineral concession rules:

i. Rights of existing holders of mineral concessions.

[62] A comparative of different State minor mineral concession rules is given in annexure A.6.
[63] Mineral Concession System, https://mines.gov.in/

   a. Rights of the holder of a reconnaissance permit
   b. Renewal of a prospecting licence
   c. Rights of a holder of a prospecting licence to obtain a mining lease
ii. Mineral concessions granted through auction
   a. Composite licence and mining lease granted through auction
   b. Renewal of a prospecting licence of the composite licence
iii. Terms and conditions of mineral concessions
   a. Terms and conditions of a prospecting licence
   b. Terms and conditions of a mining lease
iv. Preparation of the mining plan and system of certification
v. Expiry of a mining lease
vi. Lapse, surrender or termination
vii. Transfers
viii. Procedure for obtaining a prospecting licence or mining lease in respect of land in which the minerals vest in a person other than the government
ix. Minerals valuation
   a. Sale Value
   b. Payment of royalty
   c. Provisional Assessment and Adjustment
   d. Royalty chargeable on dry basis
   e. Computation of average sale price
   f. Average sale price in respect of run-of- mine
   g. Power to issue directions by Controller General
x. Payments
xi. Compensation
xii. Penalty
xiii. Repeal and saving
xiv. Amalgamation of leases
xv. Extent of area granted under a mineral concession
xvi. Copies of licences and leases and annual returns to be supplied to Government
xvii. Facilities for training of students

The State-wise minor mineral concession rules are attached in Annexure A.6

Apart from the State Minor mineral concession rules, there are mineral specific policies to ensure sustainable mineral extraction and zero waste. The Granite Policy 2002 and Marble Policy 2002 are two such policies for minor minerals. The focus of these policies is to ensure conducive framework of procedural, regulatory, fiscal and legal aspects to promote investment in these minor minerals. This, additionally, helps in employment generation and creates the need to upskill existing workforce to bring technological advancements in mining and exploration.

The overall impact of several of the new policies, reforms and amendments in the mining sector is expected to be positive. It is believed that these policy changes and amendments would lead to increased participation of the private sector, ensure sustainable and scientific mining, bring greater transparency in the auction process and lead to an increase in exploration activities and total mineral production as the laws become more flexible and business friendly for the existing and prospective players in the mining industry. Thus, investments will be boosted accelerating the overall growth of the mining sector in India.

The next section undertakes an analysis of the factors that will drive the investments in the sector.

3.7. Investments in the mining sector

Driven by the growing demand from high growth sectors such as infrastructure and automation, recent policy announcements by the government, cabinet's approval for allowing 100% FDI in the sector (though still in implementation phase) and a stable GDP contribution of 2.9% in FY 2018-19, the sector is well positioned to attract new investments.

Going forward, key drivers that will attract investments in the mining industry in India are:

Geological potential

- India has huge mineral potential with its geological setting similar to that of countries like Australia and Canada, especially in minerals like bauxite, coal, iron ore and heavy minerals.
- To boost the discovery and development of mineral resources, Government's key objective is to double the explored OGP area from 10% to 20%[64].
- Such targeted growth will need to be complimented by introduction of multiple exploration agencies and technologies.
- Thus, the sector is expected to attract significant investments, given the vast mineral wealth and the Government's focus on pushing the sector's growth.

Huge opportunity for exploration

- With limited reserves mined combined with the capability to produce 95 minerals (including large reserves of Iron ore, Bauxite, Chromium, Manganese ore, Baryte, Rare Earth and Mineral salt), India presents a huge opportunity for investors.
- Recently, GSI has undertaken several initiatives such as geological mapping, national geo-chemical mapping, geo-physical mapping and geo-chronological studies and aero geophysical surveys to strengthen its baseline data base and enhance attractiveness for the private sector.

Cost of business

- Labour is still considered as one of the most important factors of production in the mining sector. As per the recent PwC Mines Report 2018, a survey of top 40 global mining companies revealed that 32% of the operating cost was still being spent on labour force[65].
- India's low-cost manpower has supported a number of industries and has also led to low cost of production and low cost of conversion for aluminium and steel in mining industry as well.

[64] Strategy for New India @ 75, NITI Aayog
[65] Mines Report 2018, PwC

- Therefore, India's demographic advantage combined with a quality skill training with enable low cost, high return production in the sector over the coming years.

Increased foreign direct investment

- Government of India in March 2018 approved 100% FDI in exploration, mining, minerals processing of metals and non-metal ores under the automatic route[66] for all fuel and non-atomic minerals including diamonds and precious stones. Though still in implementation phase, 100% FDI is likely to create an open, efficient and competitive market by attracting global miners to invest in India resulting in increased capital inflow and gradually reducing the country's dependency on imports (especially thermal coal).
- New policy initiatives, investor friendly ecosystem as reflected in progression made by India on the ease of doing business index (jump of 79 positions to 63 in 2019 from 142 in 2014 in World Bank's Doing Business rankings), will help the country to attract more investments from foreign players.

Growth in other allied sectors

Growth of automobile, infrastructure, and power sectors, which form part of the downstream industries of the mining sector, is expected to boost the mining of minerals like iron ore, coal, limestone, manganese, bauxite, amongst others.

- There has been a considerable amount of growth in the automobile sector; both production and sales have grown at 7% CAGR between 2013 and 2018, indicating higher demand for iron-ore and other industrial minerals as well[67]. A recent slump in the sector for last 2 years has slightly affected the steel demand (thereby impacting the upstream industry minerals), however, on a medium to long-term basis, growth is expected, thereby having a positive impact on raw material demand.
- Coal based power generation has been forecasted to grow at a CAGR of 6.5% during the period 2017-2018 to 2022-2023. About 86%, of the total power generation was through thermal power plants highlighting the need for coal as an important mineral[68].
- The year on year growth in the GVA of the Indian construction sector stands at 8.8%[69] (between 2016-17 to 2017-18), indicating a boost to the sector, which in turn will lead to increase in the demand for cement and steel.
- Additionally, policies like National Steel Policy 2017 and DMI&SP, significant increase in domestic steel production and per capita consumption, aided by domestic manufacturing and use of advanced technology in order to create a globally competitive steel industry, etc. will in turn lead to increased domestic demand of mining of iron ore and other minerals.

[66] This does not require approval of the government or the RBI
[67] IBEF 2019
[68] IBEF 2019
[69] IBEF 2019

Policies driving investments

The policies governing the mining sector play an important role in attracting investors for various projects in different countries.

- The annual mining survey conducted by Fraser Institute considers the policy environment as one of the key factors for attracting investments in a country. While India ranked 88th in Policy Perception Index in 2016[70], in the recent years, it has made several policy reforms to create a conducive business environment in the mining sector.
- Further, the replacement of the old licence system with e-auctions and initiatives such as setting up of Inter-ministerial Group, Post Auction Mining Clearances and Approvals Facilitator (PAMCAF) have enabled transparency and expedited the requisite clearance processes to ensure early start of mining activities.
- As a result, from 2015-2016 to 2019-March 2020, 97 mineral blocks were auctioned (as indicated in tables below) earning a revenue of INR 8,255.82 billion[71].

Table 10: Mineral block allocation summary 2016- March 2020

State	Limestone	Gold	Iron ore	Diamond	Bauxite	Manganese	Graphite	Chromite	Iron ore & Manganese	Copper	Total
Odisha	2	-	15	-	-	3	1	3	6		30
Andhra Pradesh	4	1	-	-	-	-	-	-	-	-	5
Chhattisgarh	4	1	-	-	-	-	-	-	-	-	5
Gujarat	3	-	-	-	-	-	-	-	-	-	3
Jharkhand	2	2	1				2	-	-	-	7
Karnataka	-	-	18	-	-	-	-	-	-	-	18
Maharashtra	2	-	1	-	6	2	-	-	-	2	13
Madhya Pradesh	3	-	1	2	-	-	2	-	-	-	8
Rajasthan	8	-	-	-	-	-	-	-	-	-	8
Total	**28**	**4**	**36**	**2**	**6**	**5**	**5**	**3**	**6**	**2**	**97**

**Note: - Data not available*
Source: Ministry of Mines

[70] Survey of Mining Companies 2016, Fraser Institute 2017
[71] https://www.mines.gov.in/writereaddata/Content/Yearwise%20Auction%20Summary.pdf

Table 11: Year-wise auction summary at end of 2018-2019

Year	2015-16	2016-17	2017-18	2018-19	2019-20	Total
No. of blocks auctioned	**6**	**15**	**14**	**19**	**43**	**97**
Mineral	4-Limestone 1-Iron Ore 1-Gold	7-Iron Ore 5-Limestone 1-Manganese 1-Diamond 1-Gold	10-Limestone 2-Iron Ore 1-Gold 1-Bauxite	9-Iron Ore 5-Limestone 3-Graphite 1-Manganese 1-Gold	17-Iron Ore 6-Iron Ore & Manganese 5-Bauxite 3-Manganese 4-Limetsone 3-Chromite 2-Copper 2-Graphite 1-Diamond	28-Limestone 36-Iron Ore 4-Gold 5-Graphite 5-Manganese 6-Bauxite 2-Diamond 6- Iron Ore & Manganese 2-Copper
Values in INR billion						
Estimated value of the resources	298.18	633.73	901.36	426.71	5761.29	8021.27
Additional Contribution through Auction	130.32	445.02	538.50	320.04	5488.16	6922.05
Royalty	45.65	95.64	148.95	67.03	833.58	1190.87
DMF	4.57	9.56	14.90	6.70	83.35	119.08
NMET	0.91	1.91	2.98	1.34	16.67	23.81
Total of Royalty + DMF + NMET (Statutory Payments)	**51.13**	**107.12**	**166.83**	**75.08**	**933.61**	**1333.77**
Total revenue to the Government over 50 years	**181.46**	**552.14**	**705.34**	**395.12**	**6421.77**	**8255.82**

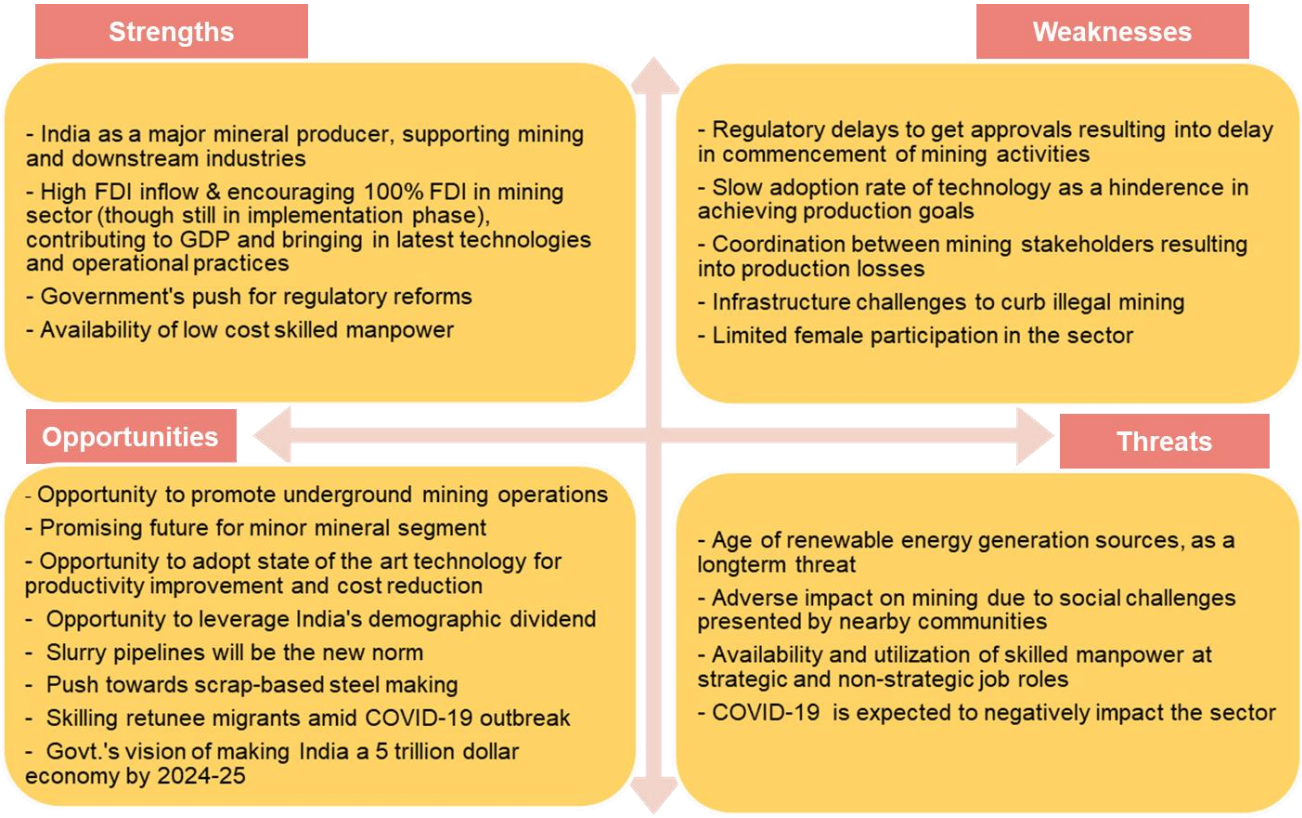
Source: Ministry of Mines, Year Wise Auction 2019

In addition to past auctions, several new auctions and re-auctions are planned, giving a reasonable indication of potential investment flows in the industry. Some of the highlights for future investments are:

- 500 mineral blocks (major and minor) in several States have been identified by the Government for auction; of which the auction process of 41 coal blocks have already been initiated in light of govt. of India's vision of 'AtmaNirbhar Bharat.
- By end of March 2020, leases of 325[72] mines were scheduled to expire, out of which 104 potential mines including 49 working mines will be put on auction.
- Under the newly announced National Mineral Exploration policy, 2016, about 100[73] blocks have been identified by GSI for auctioning for regional exploration based on revenue sharing model. The exploration will fuel further new investments in mineral extraction, processing and other ancillary activities.
- 6 new major project opportunities worth USD 3.7 billion across 5 State is planned under Government of India's Make in India and Invest in India initiatives[74].

[72] Report of the committee chaired by Dr. K Rajeswara Rao to investigate the issues related to seamless operationalization of the mining leases expiring on 31 March 2020
[73] Make in India - Mining sector
[74] Invest India-Mining Sector

3.8. SWOT analysis of the mining sector



Strengths:

The key strengths of the mining sector in the country include: (i) abundant availability of mineral deposits, (ii) high FDI inflow and encouraging 100% FDI for coal mining and related activities (though still in implementation phase), (iii) government's push for regulatory reforms to propel the sector's growth, (iv) availability of low-cost skilled manpower. It will be critical for the sector to take cognizance of its strengths and significantly contribute to the country's GDP.

- **India as major mineral producer,** contributing to Indian economy and supporting downstream industries**.**

  Today India is one of the key mineral producers globally. In 2017, according to data from World Mineral Production, 2013-2017; British Geological Survey, India ranked 3rd in the world in terms of coal, lignite, zinc (slab), aluminum and steel (crude/liquid) production. During the same period, it secured 4th rank in production of chromite, iron ore and lead (refined); 5th in bauxite; 6th in copper (refined); 7th in manganese ore; 14th in magnesite and 16th in apatite & rock phosphate.

  Apart from these, India has nearly 25% of world thorium reserves[75]. These promising production figures have helped India to make its presence felt amongst global mineral players. It has also helped India by contributing towards national economy and employment generation. Looking at the future demand and availability of

[75] Atomic Minerals Directorate for Exploration and Research (AMD), a constituent Unit of the Department of Atomic Energy (DAE), Government of India and U.S. Geological Survey

reserves, India has painted a promising future to bring impact to Indian mining sector as well as associated downstream businesses.

- **FDI (Foreign Direct Investment),** contributing to GDP, bringing in latest technologies and contributing to employment generation with increased avenues. Government has allowed 100% FDI for coal mining and all downstream industries under the automatic route, as per various ordinances made to the existing CMSPA 2015 and MMDR Act 1957 during 2019-20. Though still in implementation phase, 100% FDI is likely to increase private sector participation, attract global miners to invest in India and ramp up coal production gradually reducing the country's dependence on imports (especially thermal coal). The sector will be benefited in the longer run through increased technology adoption and mechanization leading to improved operational efficiency. FDI inflows in mining sector rose from USD 129 million to USD 247 million during 2014 to 2019[76] at a CAGR of approximately 90%, as per RBI estimates. The step has opened new possibilities for global mining giants to invest in Indian mining sector and is expected to increase FDI in the sector.

  Apart from promoting mining sector and all associated industries, high FDI has resulted in increase in capital inflow in terms of money and material. Influx of FDI has boosted economic growth resulting from fresh investments. Introduction of state-of-the-art technologies with help of FDI has potential to improve technological adaptability of Indian mining sector while implementing industry best practices. This will additionally, improve the downstream industries' efficiency levels and is likely to have a positive impact on avenues for employment generation on a medium to long term basis.

  Quantity and cost effectivity of fuel production could be enhanced due to end to end coal mining of allocated blocks by global mining giants working with lower cost of capital. FDI in mining sector has already shown positive impacts on the mining sector and is bound to promote the sector even further after removal of end use restrictions for coal mining activities with the Mineral Laws (Amendment) Ordinance 2020.

- **Government's push for regulatory and policy reforms,** can promote mining activities as a prime driver of sectorial growth. In recent times, Indian mining sector has observed number of reforms which have already started showing benefits. All such policy and regulatory reforms demand for governmental push and clear vision for the future of mining sector. Some of the most impactful reforms are mentioned below:

  - The Mines and Mineral (Development and Regulation) Act 2015 has introduced transparent, fair, timely and competitive auction process for grant of mineral concessions.
  - Allowing 100% FDI for coal mining and all related processing activities under the automatic route.
  - Establishment of the National Mineral Exploration Trust (NMET) with objective to expedite mineral exploration activities in the country.
  - Establishment of District Mineral Foundation (DMF) for the development and welfare projects in mining affected areas.
  - The Mineral Laws (Amendment) Ordinance 2020 have removed end use restrictions for coal mining activities promoting mining sector for greater possibilities of investment. According to the ordinance, successful bidder of expiring mining leases will be deemed to have acquired all valid rights/approval/clearances/licenses etc. for a period of two years and can start mining operation without loss of time.
  - Announcements related to trade, taxes, investments, R&D and skill development, coupled with various policy interventions taken by the Government of India in recent years, as till February 2020, such as National Steel Policy 2017 (NSP), Domestically Manufactured Iron & Steel Products (DMI&SP), Steel Scrap Policy, etc. will act as enablers for the growth of Indian mining and downstream sectors.

  In addition, as a part of 'AtmaNirbhar Bharat' initiative of the government of India amid outbreak of COVID-19 pandemic, structural reforms which were in consideration across both coal and mineral sector were announced as a part of the economic stimulus package which are listed as below:

[76] As per RBI

- Diversified opportunities (incentivizing Coal Gasification / Liquefication will be through rebate in revenue share, evacuation of enhanced coal production from CIL and private blocks through infrastructure development of INR 50,000 crore)
- Liberalized regime (auction of Coal Bed Methane from CIL's coal mines, measures for 'Ease of Doing Business' will be undertaken, CIL consumers to be given concessions in commercial terms: relief worth INR 5,000 crore offered)
- Introduction of commercial mining (entry norms will be liberalized and about 40 Blocks will be offered immediately in tranche 1, exploration-cum-production regime for partially explored blocks). This will be on revenue sharing model.
- Enhancing private investments (introduction of a seamless composite exploration-cum-mining-cum-production regime, open and transparent auction of 500 mining blocks, bauxite and coal will be auctioned jointly to reduce aluminium industry's electricity cost)
- Policy reforms (distinction between captive and non-captive mines shall be eliminated for better efficiency, Ministry of Mines is in the process of developing a Mineral Index for different minerals and stamp duty payable at the time of award of mining leases will be rationalized)

Recent policy level changes in mining sector has provided much needed hope and encouragement for mining organizations. Government's efforts behind these decisions has been the key driver to these changes.

- **Availability of low-cost skilled manpower,** employing large number of skilled workforce.

  Due to relatively slow adoption rate of technology, low cost manpower availability and socio-economic factors, mining industry has shown promising future for employment generation. Government initiatives such as the MMDR Amendment Act, 2015 and minor mineral block auctions at State level has created significant amount of job opportunities within the sector.

  As per Federation of Indian Mineral Industry (FIMI), with help of government support and reforms, Indian mining sector shows potential to create about 5 million direct jobs resulting into about 50 million of indirect/ancillary activities job opportunities in mining sector. India has historically been producing eligible engineers for strategic jobs and experienced skilled manpower for non-strategic jobs. If leveraged effectively, this availability of low-cost skilled manpower can be considered as one of the prime strengths of the sector.

Weakness:

The Mining sector in India faces some challenges which include, (i) slow adoption of latest technologies, (ii) lack of coordination between different stakeholders, (iii) regulatory delays, (iv) lack of infrastructure to curb illegal mining, (v) Financing sources and high cost of capital and debt sources (vi) underrepresentation of women in the sector. These challenges result in the sector's underperformance.

- **Slow adoption of advanced technology serves** as a hindrance in achieving ambitious production targets. India has shown relatively slower adoption rate of technology when compared to global mining players. Use of advanced mine planning, scheduling and forecasting software has not been very common amongst smaller miners. On the one hand, big mining giants have adopted state of the art technologies for mining operations, relatively smaller mining units are still working with conventional mining methods. Following branches of mining sector have specifically suffered due to lower adoption rate of advanced technology:
  - Small scale miners/contractors focusing on production growth usually missing out on opportunities offered by advanced technology to increase operational efficiency.
  - Indian underground mining sector functioning with relatively older equipment, mining methods and operational practices resulting into restriction for mass production.

- Administrative processes related to mining activities still relying on conventional processes to get approvals, missing out on time saving potential by going digital.

In a nutshell, mining industry in India has shown low adoptability appetite for technology due to high associated cost, longer time to get return on investment and limited exposure to advanced technical trainings which in turn has resulted into loss of productivity and increase in associated costs for the sector.

- **Coordination gap between mining stakeholders,** resulting in productivity losses**:** Indian mining sector has always observed conflict between different stakeholders associated with mining operations. Close and careful coordination could go a long way to anticipate and even avoid any potential conflict which can have an adverse effect on mining activity. Some conflict and associated risks have been identified below:

  - Relationship with internal stakeholders: Employees have always been one of the most important group of stakeholders. Regular coordination with employees to know more about their aspirations and expectations could result into prevention of conflict between employees and employer. Indian mining organization has observed formation of employee unions and conflict with unions has turned into protests and production losses.

  - Coordination with nearby communities: Lapses in regular connections with nearby community has affected Indian mining companies adversely. Knowing needs and concerns of community could be helpful to take preventive action against objections which can impact mining operations.

  - Sync with regulator: Regular interactions with government bodies to fulfill statutory needs associated with mining activities has been one of the key aspects of mining organization for continuous production. Indian mining organizations have suffered due to non-compliance with statutory requirement of governing bodies.

  Indian mining sector has not been very effective to establish effective coordination with all concerned stakeholders. Often, Indian mining companies have suffered due to lack of communication and conflict of interest between stakeholders associated with mining activities.

- **Regulatory delay to get approvals/licenses,** resulting into delays in mine commencement.

  Time taken to get all the clearances required for commencement of mining operations has been relatively high. Some of the major clearances/licenses involve environmental clearance, forest clearance, wildlife clearance, mining plan approval along with mine closure plan, pollution clearance, explosive license etc. These licenses involve multiple agencies resulting into higher time loss in seeking such approvals. Comprehensive and robust infrastructure and policy support has been primarily lacking in process of getting approvals for commencement of mining operations. For instance, land acquisition has historically been challenging in India and it has become more difficult with the latest amendment to land acquisition bill 2013. Increased requirement for consent (80% for private players and 70% for public players) can lead to delays.

  Government efforts to boost mining sector have shown limited success when it comes to small scale mining business i.e., after MMDR Amendment Act 2015, leases for minor mineral blocks has been provided through auctions only. These amendments have brought transparency and fairness to the block allocation process. Government's efforts to encourage minor mineral auctions has been restricted by the long waiting time to get all the approvals to start mining operations once the block is auctioned. Investments of small-scale miner has been blocked for a long period of time resulting into discouragement amongst potential bidders to take part in auction regime.

  As older minor mineral concessions are expiring and new blocks are being allocated by auctions only, if time taken to get approvals for mining commencement increases further, it poses risks associated with demand and supply gaps in minor mineral segment i.e., demand and supply gap in sand could impact all concerned downstream businesses. In short, time taken to get approval for commencement of mining operations has impacted mining sector adversely. Developing robust and effective clearance mechanism has potential to help the sector in a big way.

Further, delayed auction of mining blocks in India – auction of new coal and other major mineral mines (including iron ore blocks in Odisha, Karnataka) is behind schedule and can result in a possible supply disruption in the domestic market.

- **Infrastructure challenges to curb illegal or unregulated mining,** resulting in losses in government revenue**:** Indian mining sector has witnessed major scams related to illegal or unregulated mining practices in recent times. With continuous growth of mining industry, it becomes crucial to develop infrastructure that can monitor ongoing mining activities and can support enforcement activities. Following are the major areas where illegal or unregulated mining activities are impacting the sector adversely:

  - Illegal mining operations: Mining with unscientific method, over-extraction of the pit, illegal transportation of minerals and mining without necessary approvals and permission resulted into direct loss of government revenue.

  - Mining from abandoned sites: Extraction from already closed mines resulted into safety hazards, subsidence and subsequent mine fire.

  - Unregulated sand mining: Erosion of riverbanks due to un-regulated sand mining has resulted into flooding and a threat to biodiversity.

  Indian mining sector has shown limitations when it comes to conceptualize, develop and use enforcement infrastructure. Limited availability of such infrastructure has resulted into increase in illegal mining activities and government loss in terms of revenue. Development and implementation of enforcement mechanism is the need of the hour for Indian mining sector.

- **High Cost of Capital and Debt Sources**

  Major mining countries like Australia and South Africa have interest rates in the range of 1-4%. While in India, interest rate is as high as 11-14%. With incidental charges additionally, the net effect of interest even reaches 15-16%[77]. Further, banks have been burdened with high NPAs and the incidences of such NPAs are still high, especially in the downstream industries, having a negative impact on the growth of mining sector. Though, there has been a general reluctance in extending loans to the sector and in case the same was extended, the mortgages on such loans were considerably high, which in turn increases the cost of finance.

  With Government's focus on initiatives like Make in India and to increase domestic raw material availability, that are clearly visible from recent policy and regulatory developments, huge amount of capital investment will be required to be made by the industry players. Given such a financing regime, coupled with issues on lack of investors, growth in the mining sector can be inhibited due to these reasons.

- **Limited female participation in the sector,** as a roadblock in bringing gender disparity within the sector

  Historically, mining sector has been male dominated sector across the globe and India is not an exception. Women account for around 4% of the total employment in the mining sector[78], which is lower than their employment in other sectors such as agriculture and allied (57%), manufacturing (12.5%), education (6%) and construction (5%)[79]. Mining regulations in India have restricted female participation in the sector related activities. However, in 2019, amendment in these rules enabled female participation in opencast as well as underground mining after taking written permission from female participants.

  Even after the amendment, women participants carry out only technical, supervisory and managerial jobs within the mine. Apart from occupational liberties, educational institutions have started promoting female participation in their mining programs i.e., IIT (ISM) Dhanbad has recently started enrolling female participants. Despite promotional efforts, female enrollment in the course remains on the lower side due to lower awareness and harsh perception about the mining sector (<10% female seat occupancy in mining programs across major institutes). In order to increase female participation, Indian mining sector has faced challenges to establish gender specific infrastructure which can facilitate female participants. At present, it

[77] Atomic Minerals Directorate for Exploration and Research (AMD), a constituent Unit of the Department of Atomic Energy (DAE), Government of India and U.S. Geological Survey
[78] Statistics of mines in India: Vol I and II, DGMS (2015), PwC Survey
[79] Periodic Labour Force Survey (PLFS), 2017-18

can be said that a lot of work with respect to encouragement, promotion and awareness needs to be carried out in order to make mining industry gender neutral.

Opportunities:

Factors such as government's intent of increasing the sector's contribution to GDP, promoting underground mining operations, leveraging on latest technologies, increased impetus towards boosting minor mineral segment, country's demographic dividend advantage, increased impetus towards slurry pipelines, push towards scrap based steel making, skilling returnee migrants due to COVID-19 and Government of India's vision of becoming a 5 trillion-dollar economy provide opportunities for propelling the sector's overall growth rate.

- **Government's intention of pushing mining sector's share in country's GDP**

  The Indian mining sector's contribution to GDP has been in the range of 2-3% over the past 5 years[80]. However, for the country's 'Make in India' dream to become a reality, 'Mine in India' will be crucial having positive implications on the manufacturing sector. Thus, for the country to transform to a double-digit growth rate economy and push other sector's growth rate, growth of mining sector will be imperative. The sector has the potential to contribute an additional $125 billion to India's output and $47 billion to India's GDP by 2025 as highlighted during a confluence of masterminds on mining including various government stakeholders[81]. It has been reiterated by various stakeholders interacted with during the study that the government is pushing to double the sectoral contribution to the GDP in next 7 years[82]. This intent of increasing the sector's contribution to the country's overall GDP brings opportunities in the form of employment generation, increasing production, increased thrust on exploration, etc.

- **Boost to minor mineral sector in India,** potential to encourage minor mineral mining in the country**.**

  Mines and Metals (Development and Regulation) Act 1957 empowers the State governments to make rules for grant of mineral concessions with respect to minor minerals. On the other hand, MMDR Amendment Act 2015 mandates grant of mining leases through auctions process only. Act also denied renewal of mineral concessions and classified 31 minerals as minor minerals which were not classified as minor mineral earlier.

  Amendments in said Acts provides an opportunity to improve India's minor mineral mining scenario as all mining leases will now be granted through transparent, timely and fair auctioning process. For minor minerals, States now have the responsibility to formulate minor mineral concession rules in order to promote minor mineral extraction. Rules pertaining to minor mineral auctioning, collection of royalties and associated funds, inspection of mineral leases to curb illegal mining activities must be formulated by the State to promote minor mineral mining scenario within the State.

  Many Indian States have already formulated concession rules and actively auctioning minor mineral leases i.e., State of Gujarat has put up 720 minor mineral blocks for auctioning in 2019. Due to business friendly and transparent auction process, small businesses are actively taking part in minor mineral auctioning and acting as a catalyst for State's aspiration for better economic growth.

- **Opportunity to promote underground mining operations,** is the need of the hour**.**

  Indian coal mining sector has been dominated by opencast mining historically, with coal production through underground mining showing negative growth. Annually, only 5-10% of total coal production comes from underground mining, as compared to Australia, USA and China that contribute approximately 20%, 34% and 86% through underground mining operations, respectively[83]. This is although nearly 25% of total coal assets in India being deep seated[84]. In future, near surface coal deposits are likely to reduce sharply and extraction

[80] Ministry of Statistics and Programme Implementation
[81] Unleashing India's Mineral Potential, Forbes India May 26, 2017
[82] National Mineral Policy 2019: A lost opportunity? Biplob Chatterjee, July 2019
[83] Provisional Coal Statistics, 2018-19, Coal Controller's Organisation, Ministry of Coal
[84] Geological Survey of India & Ministry of Coal

of coal by opencast mining method would no longer be economically viable even with low cost and highly productive state of the art technologies.

Most of the underground coal mines in India have been using conventional board & pillar with manual loading or side discharge loading/load haul dump loading methods. Longwall technology and continuous miner technology has been adopted for mechanized mass production through underground coal mining. However, equipment and practices associated with these mechanized mass production methodologies are relatively older and needs an upgradation in order to achieve desired targets of underground coal production. In addition to this, there are several mines in India that have limited size in terms of mineable area which constraints in adopting underground mass production technologies. Potential lies in amalgamating these small mining units and to provide a larger sized mine for adoption of such technologies, thereby also allowing positive impact on economies of scale, considering significant capital requirement for these technologies.

Government initiatives in terms of easing up FDI rules and Mineral Laws (Amendment) Ordinance 2020 would result into greater participation from merchant mining companies in India. Influx of multinationals has potential of infusion of sophisticated underground mining technologies. In future, huge potential can be estimated in terms of underground coal mining practices with help of state-of-the-art technologies and best in class practices.

- **Leveraging latest technology,** to enhance productivity and reduce cost is required.

  Indian mining industry has shown relatively slower rate of adoption of technological advancements due to higher associated cost and longer return on investment time. However, in recent times focus of average Indian miner has shifted from production growth to productivity growth, cost reduction and increase in operational efficiency.

  Technological development in mining sector has showcased how technology can be helpful in entire mining value chain to achieve greater productivity. Major Indian mining companies observed implementation of GPS based fleet management system for operations optimization which has created a lot of value for the organization. On the other hand, Enterprise Resource Planning software are creating value for business processes.

  More advanced technology such as internet of things, artificial intelligence, machine learning and use of big data has made their cases for the future technologies of mining sector. Considering increasing competition and awareness, average Indian miner has started thinking in terms for deployment of technology in order to reduce costs and achieve higher productivity. Promotion and deployment of technology in Indian mining sector shows promising and compelling future.

- **Leveraging India's demographic dividen**d for the mining sector will be crucial to boost the sector.

  According to United Nations Population Fund (UNFPS), demographic dividend is the economic growth potential that can result from shifts in population's age structure, mainly when the share of the working age population (15 to 64 years) is larger than the non-working age share of the population (14 years and younger, 65 years and older). India is currently leveraging its demographic dividend and will continue to do so till 2055.

  From 2018 to 2055, India's working age population will be larger than its dependent population. This period will observe a bulge of young people aspired to bring impact in the society. Demographic dividend of this magnitude has potential to convert India in an economic superpower which can supply skilled manpower to all major sectors within the country. Indian mining sector can leverage this influx of young workforce and train them to adapt to the rapidly advancing technology in mining sector. Leveraging young minds can be an opportunity as well as a necessity for mining sector in near future.

- **Slurry pipeline will be the new norm**

  Compared to other modes of transportation, slurry pipelines have proven to be feasible, environment friendly and economical method of transporting ores such as coal, iron and other finely divided particles over long distances. This alternative means of transporting raw materials through slurry pipelines will help in reducing the problem of transportation network in mines and its nearby areas. For instance, as part of the National

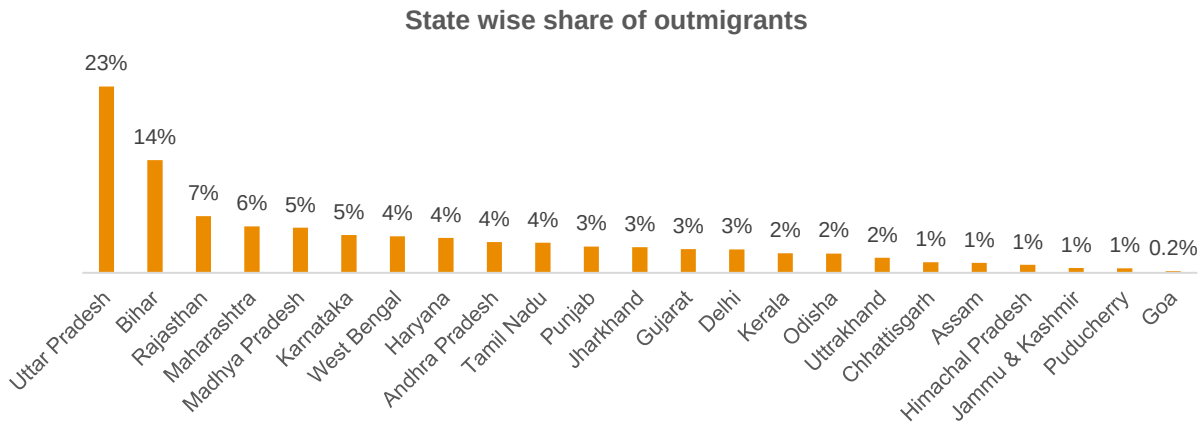
Infrastructure Pipeline, the recent investment of INR 80 billion by the Ministry of Steel to develop four slurry pipelines to move ores such as coal, iron or mining waste over long distances until 2025[85] is a step towards achieving cost-effectiveness. It will help reduce dependence on road and railway transport. Similarly, potential is expected from conveyor belts across forest areas that also cut down transportation time.

- **Push towards scrap-based steel making**

  National Steel Policy 2017 lays emphasis on promoting the use of scrap-based steel making technologies by increasing the availability of ferrous scrap with the overall objective of reducing greenhouse gas emissions intensity in the country. Owing to the commercial significance of scrap (input for electrical furnaces, equipment manufacturing, automobiles, construction and other downstream industries, etc.), reduce the burden on environment, promote sustainable development and make the country self-sufficient in steel production by the year 2030, a need was felt to ensure scrap segregation (quality-wise), collection, processing and recycling. In view of this, Ministry of Steel has come up with a draft 'Steel Scrap Policy' in the year 2019 promoting the principles of Reduce, Reuse, Recycle, Recover, Redesign and Remanufacture through scientific handling, processing and disposal of recyclable scraps through authorized centers / facility[86]. This policy is expected to make the steel making market more competitive with opportunities for many small and mid-tier companies who will be able to procure steel easily from the market.

- **COVID-19 induced reverse-migration will provide opportunity for skilling the returnee migrants in the mining rich states**

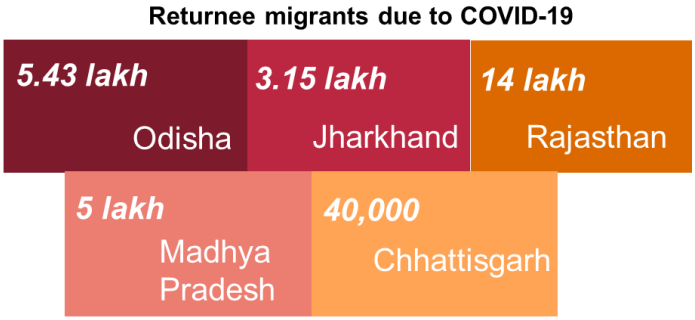
  It cannot be denied that amongst the worst hit are the millions of migrant labourers who provide muscle and power to the sectors driving the country's economy such as construction/infrastructure, agriculture, manufacturing, etc. They have been left unemployed as businesses closed forcing them walk hundreds of miles back to their home villages. These migrant workers typically work as daily wage labourers and are primarily engaged in transportation (mostly in rickshaw pulling or loading), factory, building and construction, domestic and farm workers, street vendors/hawkers[87], etc. Thus, they are engaged in sectors which require a large number of manual labourers, with low and sometimes no entry barriers. In addition, these sectors do not require workers to possess any special skill sets and neither pay in accordance to the number of years of experience. It can therefore be inferred that **migrants are predominantly employed in the lowest niches of the unorganized/informal sector**. **The 13 mineral rich states in the country constitute about 32% of the total outmigrant population** (people migrating out of the state to different states) as shown in the exhibit below:



Source: Census data 2011

[85] https://www.business-standard.com/article/pti-stories/steel-ministry-identifies-4-slurry-pipeline-projects-worth-rs-8k-cr-for-implementation-by-fy25-120043001122_1.html
[86] https://steel.gov.in/sites/default/files/Draft%20Scrap%20Policy%2028_6_2019.pdf
[87] Report of the Working Group on Migration (2017), Ministry of Housing and Urban Poverty Alleviation

As these migrants return home with fear of returning back to cities as well as psychological challenges, it will be critical to provide them with immediate livelihood opportunities in their native places to overcome financial constraints. **Since mining is a predominant activity in the states of about 32% of the returnee migrants, they can be adequately upskilled and reskilled to perform mining sector job roles at NSQF Levels 3 and below.**



- **Government of India's vision of becoming a 5 trillion-dollar economy**

  The government announced an ambitious target of a USD 5 trillion economy for the country by the year 2025 with the objective of making India a global economic powerhouse which if achieved will make the country third largest economy in the world. The impetus is towards increasing service sector contribution to USD 3 trillion, manufacturing and Agriculture to USD 1 trillion each with focus on increasing consumption and driving investments[88]. Since mining sector is the primary source of raw material to all sectors of the economy, it will be core to India's growth ambition. Activities such as exploration, extraction and management of minerals will have to be guided by national goals and perspectives by integrating them in the overall strategy of country's economic development. This also brings an opportunity for the sector to promote domestic industry and reduce import dependency.

Threats:

Currently, the sector is faced with the threat from renewable energy resources, non-cooperation from communities residing in the proximity of mines, limited availability and utilization of skilled workforce and the outbreak of COVID-19 pandemic.

- **Age of renewable energy sources,** as a future source of clean energy requirements**.**

  In recent times, India has witnessed rising awareness and willingness to promote renewable energy generation sources. In order to boost renewable energy sector, government has actively supported the sector to tackle legal, infrastructural, technological and policy level challenges. Sectors such as solar energy, wind energy, hydro energy, hybrid energy and bio energy are making their own case in future energy scenario of India.

  At present, India is investing USD11 billion annually in renewable energy sector and estimating around $30 billion ideal annual investment going forward. By 2022, India has planned to establish 175 GW of renewable based power capacity out of which, 100 GW through solar energy, 60 GW through wind energy, 5 GW through small scale hydro power and 10 GW through bio energy[89]. In order to achieve renewable energy generation targets, Government is actively encouraging the sector with various programs and policy reforms i.e., encouraging solar energy sector by providing subsidy for solar rooftops. Moving forward, renewable energy sector is bound to increase its share in energy requirement of the country.

  However, it does not present any immediate threat to coal and thermal energy production in the country but in a longer run, renewable energy sources would impact thermal energy production and thus coal production.

- **Social challenges associate with mining,** if not addressed, can cause production losses.

  It is of paramount importance for a mining company to operate in total synergy with the community it is surrounded by. Mining processes can have direct and indirect adverse effects on nearby community. Any

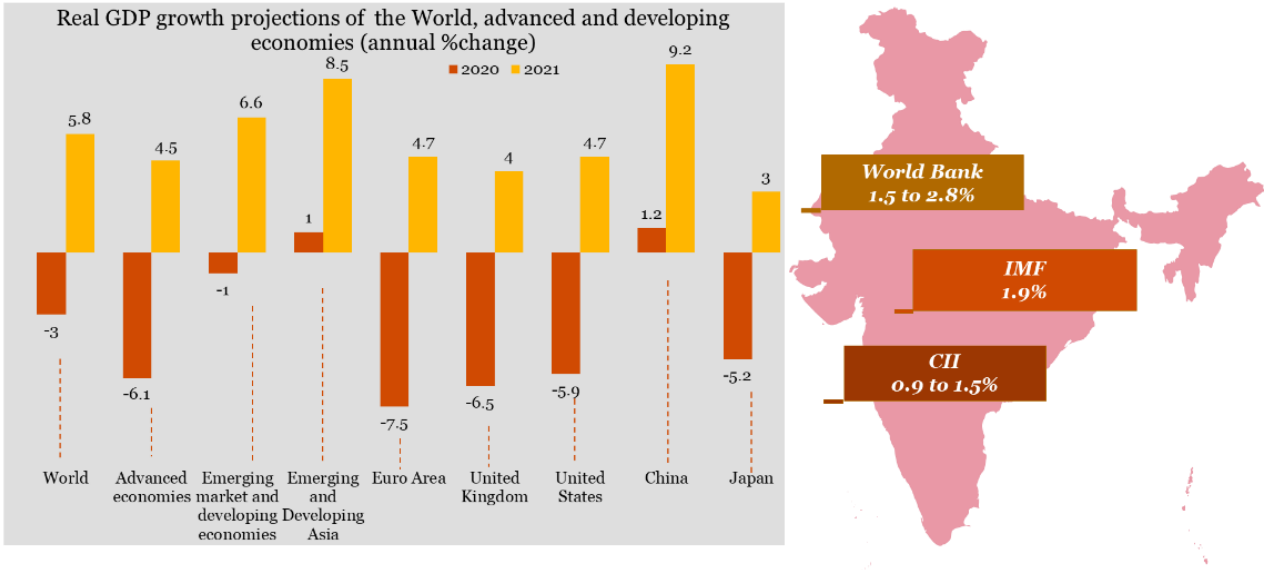
[88] https://www.mbauniverse.com/group-discussion/topic/business-economy/5-trillion-economy
[89] The Ministry of New and Renewable Energy, Government of India

social conflict with nearby community can have impact on mine operations and has potential to convert into legal challenges.

Issues pertaining to land acquisition, rehabilitation, depletion of ground water, higher vibration and air quality has been prime concerns of the community living in the proximity of mines. Specially in Indian mining scenario, issues pertaining to private land acquisition and job allocation to rehabilitated community has historically affected mine operations adversely. If remains unresolved, such issues can impact mining operations during any phase of the mining life and can even lead to partial or full closure.

- **COVID-19 pandemic is likely to impact not just mining sector but the economy as whole**

The coronavirus outbreak has impacted more than 185 countries across the globe. In order to contain the spread of virus and prioritise human health over economic activity, several countries (including India) announced nationwide lockdown closing their borders with movement of people coming to a screeching halt leading to disrupted global supply chains and reduced international trade. **An analysis by the UN Department of Economic and Social Affairs (DESA) shows that the global economy could shrink by up to 1% in 2020 due to the COVID-19** pandemic having spill over effects on developing countries including India via trade and investment channels. Besides an unprecedented loss of human lives, the pandemic has resulted in tremendous financial losses and economic slowdown across the globe as shown in the exhibit below:



Source: World Economic Outlook Report

In response to the threat of the coronavirus pandemic, India went into sudden lockdown on 24th March 2020. According to Asian Development Bank, the country's economy lost over $4.5 billion on a daily basis during the lockdown with the GDP growth of only 2% expected in FY21[90]. This downfall in economy can be attributed to the discontinued imports on domestic supply chains, domestic and external demand shock, production shutdowns and job losses in various sectors due to social distancing and national lockdown. Thus, **markets, supply chains, and employment got immediately impacted as government imposed sudden national lockdown restrictions to limit the virus spread**.

The top 50 mining companies across the globe had a combined market value of around USD 1 trillion at the end of 2019. However, with just three months into the new financial year, USD 282 billion has already been wiped out as the virus spreads with top 10 companies alone losing a combined USD 170 billion. While, the mining sector has been on the path of reform since the introduction of the Mines and Minerals (Development and Regulation) Act Amendment in 2015 and 2016, commercial mining of coal, transparency in auctions, National Mineral Policy 2019, increased focus towards mineral exploration amongst others, the mining sector's growth has been propelling and enabling higher investments, some of India's

[90] ICRA analysis

mining giants such as Vedanta dropped from 16th rank to 49th and Coal India is languishing in the mid-tier[91]. Moreover, prior to COVID-19, **Capex expenditure was projected to increase by 11% in 2020, however, with projects delayed and investments on hold, top 20 mining companies such as Glencore, Rio Tinto, Anglo American, etc. have announced significant reduction in their capex**[92].

Further, the sector is a key contributor not just to mining state's Gross State Value Added (GSVA) but also adds to government's revenue. The lockdown saw some immediate repercussions such as major ports like Gangavram, Vizag, Dhamra, Kandla, Hazira etc. got affected due to nationwide lockdown thereby impacting freight movement having serious implications on the flow of exports and imports. Even though mining was allowed to continue in all major mineral producing states except for Rajasthan (until April 20 2020[93]) during the lockdown period, the sector has been adversely affected due to fall in demand from end user industries like power, steel, aluminium, cement, etc., reduction in offtake of minerals from mines due to restrictions imposed on logistics and transportation and limited availability of labour. Falling demand, consumption and disrupted supply chains have forced miners to either run at lower capacity or temporarily shut down significantly impacting government exchequer.

The pandemic is also likely to delay the operationalization of newly auctioned mineral blocks due to delays in completion of field activities and processing the application at government level. The impact of COVID-19 pandemic on 'Minor minerals' also needs to be studied given its highly labour-intensive nature (due to low degree of mechanization) and the minerals uses across other sectors of the economy such as agriculture, consumer goods, construction[94]. It is expected that demand for minor minerals will be hit due to weakness in manufacturing and construction activity.

- **Availability and utilization of skilled resources,** if not addressed, can be a loss for the industry in terms of getting exceptional talent.

  Being labor intensive industry, skill set of working manpower would be extremely crucial for mining operations to function with best in class productivity. As mentioned below, Indian mining industry has presented with challenges pertaining to proper availability and utilization of skilled manpower for specialized job roles.

  Limited availability of specialized institutes providing skill training for specific job roles: In mining operations, majority of the workforce has inducted from regular training institutions that trains workforce for multiple sectors. Limited availability of role-based training centers in India is leading to inefficient job execution at ground level which will ultimately resulting into productivity losses and even potential of safety hazards.

  Utilization of mining graduates: On the one hand, engineering and research institutes produces exceptional mining professionals every year; on the other hand, absorption and utilization of engineers has been an area of concern for Indian mining industry. Leading institutes providing mining engineering courses such as IIT(ISM) Dhanbad, IIT Kharagpur and IIT (BHU) Varanasi has observed increase in numbers of students opting for non-mining career options. This trend presents alarming picture of students not being utilized for the job in which they can contribute best with their knowledge.

  In nutshell, availability and utilization of skilled manpower in strategic and non-strategic job roles presents immediate challenges for Indian mining industry.

Current Indian mining scenario has presented rewarding opportunities at the same time some important questions to look at. Decisions taken today would be so crucial for the future that it would result into drastic improvement or unfortunate decline.

Following important questions have been presented to Indian mining industry and are looking for answers.

[91] https://www.northernminer.com/news/COVID-19-19-cuts-us280bn-swathe-through-top-50-mining-companies/1003815682/; Mining.com
[92] GlobalData
[93] https://www.outlookindia.com/website/story/india-news-rajasthan-miners-worst-hit-among-labourers-during-COVID-19-19-lockdown/352944
[94] Indian Minerals Yearbook 2018, IBM

- **Are we exploiting our minerals sustainably while leveraging policy reforms, technology and skilled manpower?**
- **What are the steps we could undertake to address the following?**
  - **Speed up administrative approval process?**
  - **Increase adaptation of advanced technology?**
  - **Put a hold on illegal mining?**
  - **Ensure diverse gender participation in the industry?**
- **How we are planning to leverage following opportunities?**
  - **Recent amendments in the acts**
  - **Scope for underground mining**
  - **Demographic dividend**
- **What would be our roadmap to address socio-economic challenges faced by the mining industry?**

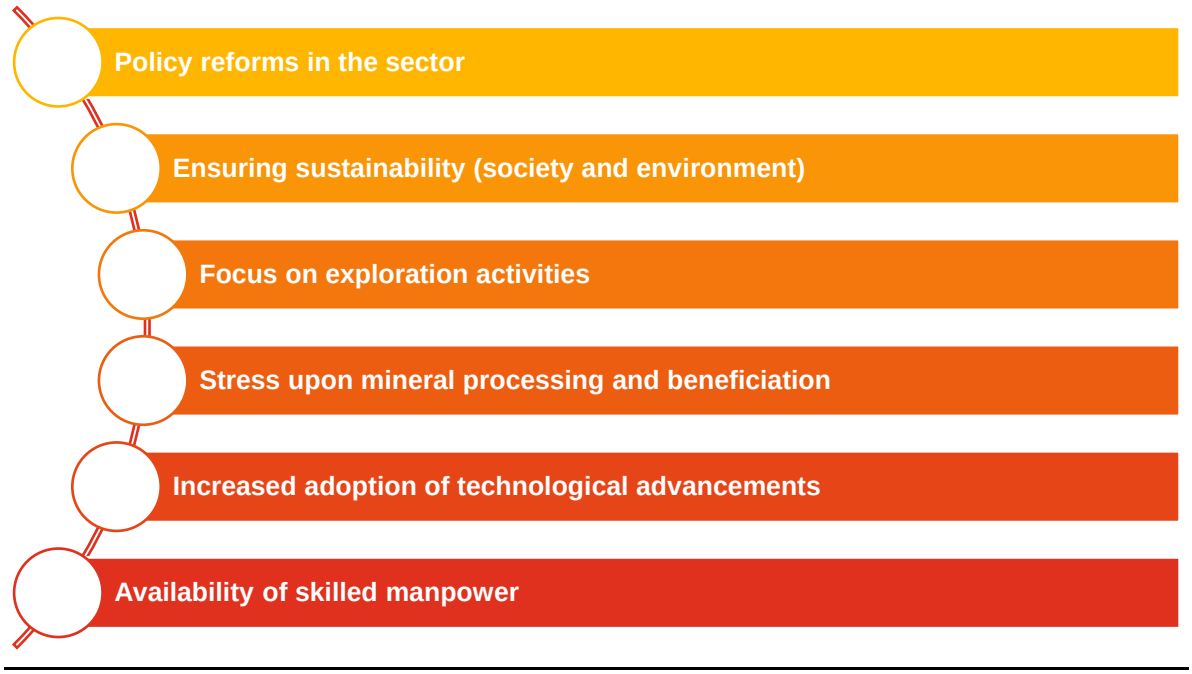
It is important to start looking at these important questions as it bears answers for the future of the mining industry.

The next section builds on the strengths and potential opportunities of the mining sector, laying out competitiveness the sector globally.

3.9. Competitiveness of the mining sector in India

Key parameters driving competitiveness of the sector have been delved into in this section. These are:

Figure 27: Parameters impacting the mining sector's competitiveness in India



3.9.1. Policy reforms in the mining Sector

As elaborated in the previous section, progressive policies such as the National Mineral Policy 2019, National Mineral Exploration Policy 2016, amongst others are streamlining processes and ensuring transparency through e-auctions, enabling positive competition with privatisation of coal and push towards increased FDI and increased investments are driving the sector's competitiveness

Measures for streamlining and introducing transparency in the mining Sector

The National Mineral Policy 2019 is a business-friendly policy ensuring ease-of-doing business for all miners and investors. Key highlights of the policy are:

- It is believed that the sector's competitiveness would be largely driven by certain provisions outlined in the mineral policy such as creation of 'Exclusive Mining Zones' that will come with in-principle statutory clearances for grant of mining lease.
- Emphasis on simplifying the clearance process and making it time-bound for commencement of mining operations.
- The policy also lays great stress on encouragement for merger and acquisition of mining entities and transfer of mining leases that have been granted in a transparent manner to ensure seamless supply of ores and scaling up of business.

Further, as per the 2015 amendments in the Mines and Minerals Development and Regulation (MMDR) Act, mineral blocks auctions for granting mining leases will be done through the e-auction processes. This would bring more transparency in the process and encourage private participation as well.

In addition, this method of auctioning mineral blocks would enable new entrants-small or less well-known businesses to compete in the e-Auction process pitching the suppliers directly against one another. The suppliers would be able to fetch better price for their minerals than the prices paid by regular customers.

Hence, mining sector's competitiveness would be significantly impacted with the introduction of e-auctions opening the market for all kinds of bidders.

Privatisation of coal

India is endowed with abundant coal reserves with Coal India Limited (CIL) being the dominant supplier, catering to the demands of industries varying from cement, steel to power plants. In line with the Government's policy of auctioning natural resources, the sector has now been opened for commercial miners[95]. Thus, with the entry of more players in the coal market, a transition from monopoly to competitive market has taken place, making the sector more competitive.

As per the new mandate, those allotted coal mines have to utilize a minimum of 75% of its actual production (ROM basis) for specified end use or own consumption and are allowed to sell up to 25% in open market with payment of additional premium on such sale under the Coal Mines (Special Provisions) Act, 2015 and the Mines and Minerals (Development and Regulation) Act, 1957.

This provision of allowing private sector's entry in the coal market is expected to attract greater private investment and FDI and will also help stabilising irregularities in coal supply and result in enhanced energy sufficiency and availability of power at low costs for the end user.

Further, it will pave way for thousands of jobs (both direct and indirect) and result in industry consolidation, emergence of numerous vertically integrated energy companies with interests in coal mining, generation, transmission and distribution to retail supply. Thus, the future growth in the sector will be realized through larger involvement of private sector.

Auction of 500 mineral blocks

With the government's plan of auctioning 500 minerals blocks through an open and transparent auction process as a part of its 'AtmanirbharBharat' vision, it is expected that more than 1 billion tonnes of mineral reserves will be unlocked. The auctioning will be done by repealing section 10A2(b) of MMDR Act which will not only bring

[95] Post cabinet's approval on 15th Feb 2019

resources into production but will also boost government's exchequer. The state of Odisha has already completed the auction process of its mining leases of iron ore, chromite ore and manganese ore which were about to expire on 31st March 2020.

Need for adoption of international standards

Recognizing the importance of reporting mineral resources and mineral reserves, countries across the globe, including India has developed a framework for reporting and estimating the same. United Nations Framework Classification (UNFC), National Instrument 43-101, Joint Ore Reserves Committee (JORC) and Society for Mining, Metallurgy & Exploration (SME) are some of the standards that are adopted for informing investors or potential investors, their advisors and exploration companies about mineral exploration results, mineral resources and reserves. India currently follows UNFC.

FDI inflows from 2003-04 to 2015-16 suggest that there has been volatility in the annual FDI flows so much so that last two financial years recorded an all-time low FDI post 2015-16. One of the possible reasons for low FDI in the sector could be non-acceptance of UNFC by financial institutions.

Other relevant international standards India should consider adopting are:

- The Australian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC) has high degree credibility and confidence to the investors and exploration companies ensure near accurate estimations as it's committee members can be held liable in court in case of wrong estimates.
- Another robust standard is SME-a professional society comprising of engineers, geologists, metallurgists, educators, students and researchers serving the mining, minerals and underground construction industries in more than 100 countries. One of the distinguishing feature of SME is the local and international involvement, in addition to global reach through its international online library with frequent information exchange.
- Canadian mineral resource classification scheme-National Instrument 43-101 is another critical standard of disclosing information about mineral properties. It requires qualified professionals for preparing reports, samples and conducting analysis for protecting investors.

Thus, India should consider adoption of such international standards will attract more investment and improve FDI inflows in the mining sector.

Policy reforms amid the COVID-19 pandemic

Recognizing the multi-faceted challenges posed by the COVID-19 pandemic not just on mining but other sectors of the economy, the government announced a **special package of INR 20,000 billion (equivalent to 10% of India's GDP)** on 12th May 2020[96] with the objective of making the country self-reliant, i.e. '**AtmaNirbhar Bharat'. Hon'ble Prime Minister's message for being 'Vocal for Local' and 'Self-reliability' is expected to help the country emerge from the shadows of COVID-19 paving the way for Make in India 2.0**[97]. The government recognizes mining as one of the focus areas during this unprecedented time so much so that the structural reforms which were in consideration in both coal and mineral sector were announced in fourth tranche of the economic stimulus package as shown in the exhibit below:

[96] https://pib.gov.in/PressReleasePage.aspx?PRID=1624536
[97] https://brandequity.economictimes.indiatimes.com/news/marketing/be-indian-buy-indian-vocal-for-local-campaign/75756859

Coal sector	Mineral sector
• **Introduction of commercial mining** ○ Revenue sharing mechanism instead of regime of fixed Rupee/tonne & any party can bid for a coal block and sell in the open market. ○ Entry norms will be liberalized and about 50 Blocks will be offered immediately. ○ Exploration-cum-production regime for partially explored blocks ○ Incentivizing production earlier than scheduled through rebate in revenue-share • **Diversified opportunities** ○ Incentivizing Coal Gasification / Liquefication will be through rebate in revenue share ○ Evacuation of enhanced coal production from CIL and private blocks through infrastructure development of INR 50,000 crore • **Liberalized regime** ○ Auction of Coal Bed Methane from CIL's coal mines ○ Measures for 'Ease of Doing Business' will be undertaken ○ CIL consumers to be given concessions in commercial terms (relief worth INR 5,000 crore offered	• **Enhancing private investments** ○ Introduction of a seamless composite exploration-cum-mining-cum-production regime. ○ Open and transparent auction of 500 mining blocks. ○ Bauxite and coal will be auctioned jointly to reduce aluminium industry's electricity cost. • **Policy reforms** ○ Distinction between captive and non captive mines shall be eliminated for better efficiency. ○ Ministry of Mines is in the process of developing a Mineral Index for different minerals. ○ Stamp duty payable at the time of award of mining leases will be rationalized.

Source: https://pib.gov.in/PressReleasePage.aspx?PRID=1624536

Even though the progression path of the global pandemic is still unknown, it is clear that as the virus is reasonably contained, economic activities will restart at full pace and the mining sector will start getting demand signals. Further, the economic stimulus package together with policy reform announcements is expected to bring the mining sector and the country's economy back on a positive growth path.

3.9.2. Ensuring sector sustainability

The Indian mining sector experiences issues pertaining to unscientific methods of mining leading to varied levels of environmental resource degradation and health hazards. With the introduction of policy reforms such as Star rating, District Mineral Fund, amongst others sustainable development of local communities and the environment has been given high priority.

Mining has been a direct cause of displacement of local communities. In the year 2017, Mineral Conservation and Development Rules (MCDR) were amended, making star rating of mines mandatory[98]. Additionally, the country has enacted numerous other environmental protection policies, rules and regulations[99].

Rising environmental and social concerns, in addition to poor track record of social and environment performance and numerous instances of illegal activities paved way for the National Mineral Policy (NMP), 2019 and it is expected to act as a guiding document to ensure the sector's utmost sincerity towards environmental and society.

Key features with respect to sustainability are:

- As per the policy, the Government will identify and classify ecologically fragile areas as 'no-go areas' where no mining activities can be undertaken

[98] As per the amendment, if any mining company fails to secure a rating of at least 4 within its two years of operations, Ministry of Mines will cancel their license and seize their operations.
[99] EIA under Environment Protection (Amendment) Act 2006, Sustainable Development Framework (SDF) under MMRD 2015, The Forest (Conservation) Act, 1980, Sustainable Sand Mining Guidelines, 2016, etc.

- The Government, will set a benchmark for evaluating performance of mining operations against the 'Sustainable Development Framework' proposed in the year 2011
- Introduction of consistent approaches for systematic and effective mine reclamation and rehabilitation through scientific closure of mines
- Companies are required to spend 2% of their profit-after-tax as a part of CSR (as per Companies Act, 2013) and contribute 10-30% of royalty to DMF ensuring that chain of sustainable operations is maintained.

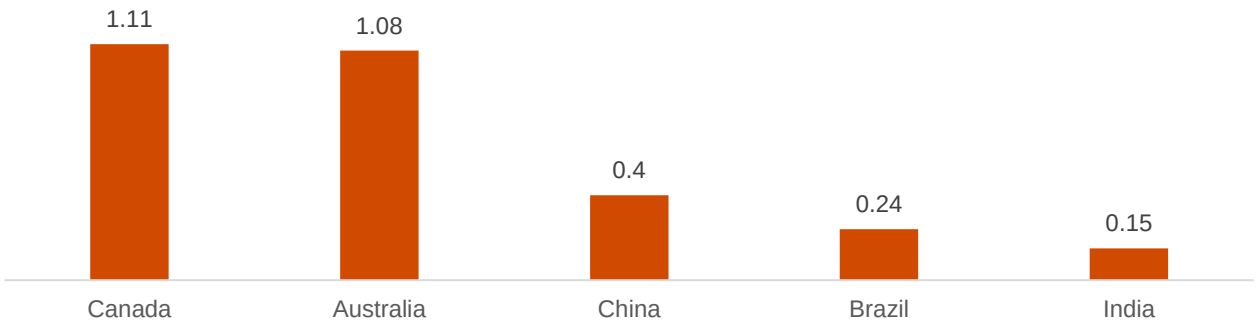
Further, considering international norms and recognizing that the sector's future outlook largely depends upon improving social conditions, a new mechanism for improving living standards and ensuring sustainable income for the affected communities has been proposed. This mechanism will be evolved by implementing all the provisions of rehabilitation and resettlement as outlined in Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (RFCTLARR) Act, 2013.

The launch of Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) in the year 2015 has given a big push towards improving the welfare of mining affected communities using the funds generated by District Mineral Foundations[100]. The scheme allocates 60% of the share to high priority welfare activities.

3.9.3. Focus on exploration activities

As recorded by Niti Aayog only 10% of the Obvious Geological Potential (OGP) area has been explored. With an annual expenditure ranging from 0.13 to 0.17 billion USD over the past 3 years, to leverage on its geological strength India needs to increase expenditure as well as encourage the role of private sector players in exploration activities.

Figure 28: Country-wise exploration budget in USD billion



Source: S&P Global Market Intelligence, 2018; Ministry of Mines India; Mining Matters (FIMI)

Key limitations pertaining to prospecting and exploration in India are:

- The sector faces the challenge of identifying new areas for locating deep seated and hidden ore bodies due to fast depletion of easily accessible and near surface ore bodies which in turn would require greater monetary support from the Government
- Low budgetary allocations for mineral exploration in the country (2% of overall budget) are leading to a stagnant reserve base as compared to other major mining economies[1]. This calls for greater financial support from the Government to augment the exploration activities. Learning from major mining economies, there is a need for India to invest significantly in detailed prospecting given that the countries past investments have been almost negligible.

[100] Miners granted mining leases before Jan 15th, 2015 are mandated to contribute 30% and those given mining leases must contribute 10% of the royalty

- Considering the risky nature of exploration (i.e. a success rate of 1:100), most countries depend on the private sector (either through Junior companies that comprise of specialist geologists or mining companies) to undertake prospecting and exploration[101], therefore, India needs to move towards encouraging private sector participation in this sub-sector.

As cited by some DMGs, mineral reserves located in forest areas cannot be explored and quantified easily due to issues of land acquisition and the disruption of the livelihoods of forest-based communities. Environmental concerns also dominate in this case.

The National Mineral Exploration Policy (NMEP) 2016, as an overarching policy reform in the sector mandates the Government to make the baseline data of high standard available to the public free of charge and launch a special initiative to probe deep-seated/concealed mineral deposits. The policy also requires the Government to carry out suitable models for incentivizing private sector explorers and simplify procedural requirements for them. This is expected to provide impetus to the exploration activities in the country along with increased private sector participation.

Highlights: Steps forward towards improving the scope for prospecting and exploration

- In the initial three months of the previous financial year, a total of 175 exploration projects worth INR 5.3 million have already been approved
- National Geochemical Mapping (NGM) programme was launched in 2001. The programme has created finest quality baseline geochemical database and is expected to provide a complete set of geochemical baseline maps for the country to assess regional mineral prospects and other geoscientific issues.
- GSI has completed 3.13 million sq km, 1.17 million sq km, 0.77 million sq km and 0.27 million sq km geological, geochemical, geophysical and aero-geophysical survey till March, 2020.
- GSI has taken up Multi-sensor Airborne Geophysical surveys by engaging Twin Otter Airborne Survey System (TOASS) and Heliborne Geophysical Survey System (HGSS) for exploring mineral resources, particularly base metals.
- GSI will be taking up about 900 Field Season Programmes (FSP) covering 390 mineral exploration programs during 2019-2020 and has also launched its Data Sharing and Accessibility Policy 2019, provisioning the freely downloadable baseline geoscience data (geological, geochemical and geophysical) from its web portal.

Source: Ministry of Mines: Major Highlights/Achievements, Geological Survey of India

3.9.4. Stress upon mineral processing and beneficiation

With changing mineral scenario and economies of mineral development and products, increased impetus must be laid on effective ore dressing and beneficiating operations (which includes washing or pulverizing). The prime focus of the sector should be to obtain saleable and useable products from low grade ores and mineral rejects by developing the process and the know-how for processing and beneficiation.

The Indian government came up with the National Mineral Policy in March 2019 replacing the earlier 2008 policy. One of the main outcomes envisioned from the policy is greater attention towards beneficiation and agglomeration techniques with a view to bring lower grades and finer size material into usable form. Also, majority of the stakeholders interacted during the study highlighted that increased emphasis towards this activity will have competitive implications for the sector. Currently, IBM's mineral processing division is undertaking R&D in the mineral beneficiation field and its R&D facility comprises of the following units:

[101] Mining Matters, FIMI

Table 12: R&D facilities of mineral processing division at IBM

Unit	Location	Key activities
Modern Mineral Processing Laboratory and Pilot Plant	Nagpur	• Ore Processing Laboratory to carry out bench scale beneficiation studies • Mineral beneficiation Pilot Plant with capacity ranging from 0.5 to 2 tonnes/ hour • Chemical Analysis Laboratory • Mineralogical Laboratory • Physical Characterisation Laboratory • Environmental Analysis Laboratory
Regional Mineral Processing Laboratory and Pilot Plan	Ajmer	• Ore Processing Laboratory and Pilot Plant • Chemical Analysis Laboratory • Mineralogical Laboratory
Regional Mineral Processing Laboratory and Pilot Plant	Bangalore	• Ore Processing Laboratory and pilot Plant • Chemical Analysis Laboratory including fire assay • Mineralogical Laboratory

Source: Indian Bureau of Mines

IBM has been actively undertaking mineral beneficiation test work on numerous ores and minerals and has completed over 2,200 investigations till date. The NMP 2019 promotes state-of-the art technology in the R&D activities and also emphasizes towards strengthening research activities targeted towards developing mineral processing and beneficiation processes by seeking cooperation and coordination among various public and private organizations engaged in this task. This will drive the sector's competitiveness by ensuring maximum economic recovery of the minerals and associated valuable metals. However, beneficiation processes for coal washeries, iron ore, Zinc, Manganese and Chromite ores are currently being undertaken by a workforce which does not have formal, standardized training.

In discussions with the study team, mining industry associations and employers believe that a lease allocation system based on improved exploration techniques, and more accurate studies on mineral reserves will drive the sector's competitiveness. They also felt that lease allocation should facilitate end-to-end mining activities (in terms of starting and finishing mining operations and restoring the land), as this would allow lease holders to ensure that mining is done efficiently, and environmental concerns are also appropriately addressed. In Goa, the industry representatives stated that environmental clearance processes could be streamlined to ensure that mining companies fully understand how to achieve compliance.

3.9.5. Increased adoption of technological advancements[102]

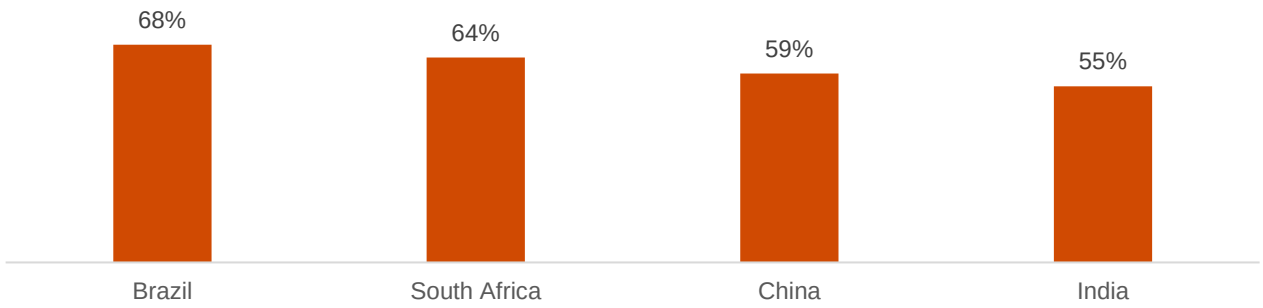
World Economic Forum projects that by 2025, digitization will create potential benefit of USD 190 billion for the mining sector by reducing operating costs and improving productivity. Thus, the need for technology development and adoption has become critical across the mining value chain.

The mining industry across the globe is undergoing digital transformation with technologies such as AI, robotics, 3D printing, etc. already making their way across major mining companies such as Rio Tinto, Anglo American, Newcrest Mining, Teck Resources, etc. Indian companies are also moving towards adoption of such technologies.

It must be noted that the rate of adoption of technology in India is relatively lower as compared other mining countries such China, South Africa, Brazil, etc. A fact that could be attributed to the country's income level, abundant supply of low-cost labour and expensive nature of modern technologies. Thus, it will be critical to ensure large scale adoption of technology by the entire mining industry which could be done by developing affordable technologies or subsidising them[103].

[102] Digital Transformation Initiative: Mining and Metals Industry; WEF report 2017
[103] Sustainable Mining in India: Overview of legal and regulatory framework, technologies and best process practices 2017-18

Figure 29: Rate of adoption of technology as noted by the World Bank Digital Dividends Index (2016)



Source: World Bank Digital Adoption Index

Going forward, India needs to focus on the fast pace adoption of innovative and advanced technologies (such as Mining Tenement System[104] (MTS), Drone Application in Mine Monitoring[105] (DAMM), Advanced Airborne Gravity Gradiometer technology for mineral exploration[106], Acid Mist Suppressants, Dust Control Systems, Electrostatic Precipitators, Scrubbers, Smart Sensors, advanced analytics, use of smart headwear) as widely used by some of the major mining companies across the world.

Mining companies leveraging technology

Some of the prominent players in India have already started employing the most relevant technologies as per their business needs. For instance:

- Hindustan Zinc has engaged Atlas Copco's advanced, semi-autonomous equipment to improve productivity and safety and significantly enhance its underground mining output
- Northern Coalfields plan to use 'Unmanned Ariel Vehicles' (UAVs) for survey and ground profiling of its mines and has also introduced 'Operator Independent Truck Dispatch System' (OITDS) and laser scanner for surveying and monitoring mines
- At the Central level, Ministry of Mines launched the Mining Surveillance System (MSS), a satellite-based system to check illegal mining via remote sensing activity.

3.9.6. Availability of skilled manpower

In light of the fast-paced evolving economy and nature of work due to technological changes with increasing number of mining companies moving from manual to semi/full degree of mechanization, zero waste mining, etc., it is critical to equip the workers with employable skills, thus stimulating a sustainable development process for the sector. Skilling of the existing workforce must also be stressed upon to further enhance their skills and competencies as per changing business environment and make them multi-disciplinary professionals.

Recognizing the importance of building a skilled workforce, the Government came up with Mines Vocational Training Rules (MVTR) in 1966, later revised in the year 2019 requiring every mine owner falling under the purview of Mines Act 1952 to set up Vocational Training Centres. However, given the pace of technological advancements, the sector's competitiveness would be largely driven by both conventional and digitally trained workforce.

The mining value chain, starting from prospecting, exploration to operations, supply chain (procurement and logistics) and sale of final product in market is being led by optimization currently, and eventful management of

[104] It involves automating the entire mineral concession lifecycle starting from identification of areas for mining / exploration and ending with closure of the mine, and connecting the various stakeholders for real-time transfer of electronic files and exchange of data
[105] Its objective is to inspect safety zones and lease boundaries, and monitor mining and reclaimed areas as well as quarry and dump profiling
[106] Advanced gradiometer known as VK1 airborne gravity gradiometer introduced to find a solution to exploration challenges

resources is being embodied through all the processes. Data from exploration, mine planning and operations – geoscience and geological data, data from drill and blast, load and haul, ore movement, or resource consumption – is getting to new system with more effective visibility, which, in turn, helps in decision making. Proper database to next step technological innovation is getting common and the innovation maturity is getting prolific. Companies are tending towards next steps for technology to maximize efficiency, resources, and investment. This trend is not only the nerves for the operation, but also is easily seen in other parts of mining value chain such as Prospecting, Exploration and Mine Planning, Mining Operations, Engineering Services (SHE, CSR etc.), Ancillary activities and Mineral Beneficiation.

For the Indian mining sector to enjoy rapid pace of growth, it will be critical to focus on the parameters that will drive the sector's competitiveness (as explained above). As the mining sector moves towards promising growth and considering that it is one of the largest employment generators after agriculture, owing to its labour-intensive nature, greater emphasis must be laid on improving labour productivity.

The next chapter elaborates on the current labour market trends in the sector disaggregated by employment across mining sub-sectors, mineral type, ancillary activities and geography. Given that gender has been the focus of National Mineral Policy 2019 and with the DGMS notification allowing women to work in underground mines, employment by gender has also been considered as a part of the subsequent analysis. The chapter also gives an overview of employment opportunities for Indians in countries like Australia, Canada and South Africa.

4. Labour market trends in the mining sector

Mining is an important economic activity generating employment in remote and tribal areas. The sector is recognized as a high user of labour and its impact on job creation can be considered in areas with limited potential for other economic activities.

The future outlook of the sector will be largely driven by the country's favourable demographic advantage (higher share of working age population vis-à-vis total population) owing to the labour intensive and laborious nature of work in the sector.

According to Census 2001 and 2011 estimates, in the year 2025, working age population (15-59 years) in the country will be 66% of the total estimated population of 1.5 billion suggesting that the country can leverage on its human capital thereby accelerating the growth momentum. It is believed that employment-intensive growth is the key towards ensuring a remarkable growth story and achieving a sustainable and inclusive growth and thus, it will be crucial to invest in the current and future workforce through skills training.

4.1. Sector's employment outlook

Total employment in the mining sector has been estimated across three broad categories-

- **Core employment**- people directly employed whether onsite or offsite across 4 sub-sectors of mining, i.e. prospecting, exploration and mine planning, mining operations, engineering services and mineral beneficiation.
- Employment in **ancillary activities**[107]- people involved in activities/sectors that provide intermediate input (such as energy, service, material) and capital (such as construction, transport equipment, machinery) to the mining and quarrying sector and activities/ sectors that function near the periphery of mines or quarries and are dependent on mining and quarrying for material inputs (such as cutting and finishing of stone, manufacture of bricks and other non-metallic mineral products).
- **Induced employment**- Employment generated due to income spending of mining workers (such as on purchase of groceries, other household stuff, spending in local eateries, etc.) in the local community.

Total employment in the **core mining sector has been estimated to be 2.3 million** in the year 2018-19[108]. However, employment in core mining has been falling over the years, for instance in the year 2000-01 labour income share in mining value added was 40% (and 60% capital income share), which fell to 27% in 2016-17. This can primarily be attributed to the growing capital-intensive nature of mining operations. Further, bans and restriction on mining activities in several States of the country has contributed to fall in employment in the core mining sector. (Supreme Court's directive in Karnataka capping the iron ore output to 35 million tonnes and allowing miners to sell only via the e-auction platform in view of environmental concerns and illegal mining practices, ban on all types of mining activities in Goa, ban on illegal mining in the Aravalli region in Rajasthan due to environmental concerns, etc.).

In addition, **employment generated by ancillary activities has been estimated to be 5 million** in the year 2018-19. **Total induced employment is estimated to stand at 4.4 million.** Thus, **total employment (core, ancillary and induced) generated by the mining sector has been estimated to be 11.7 million in the year 2018-19.**

[107] Refer to section 3.5 for detailed definition of ancillary activities

[108] Total employment in the mining and quarrying sector in 2016-17 is 2.45 million as per KLEMS. Of the total employment in the mining and quarrying sector, 4.8% are involved in oil and gas extraction (PLFS). Employment in the core mining sector is derived by deducting this number out of total.

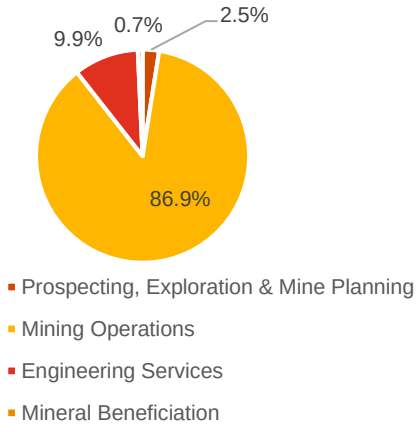
4.2. Current domestic employment in the mining sector

With the rise in country's population, there will be pressure on natural resources to cater to the increasing infrastructure requirements. This will spur the growth and employment of the mining sector. The subsequent sections delve into core employment in the industry in detail.

4.2.1. Employment by sub-sector

Mining Operations sub-sector (core mining) dominates in terms of employment with nearly 86.9% of the workforce engaged in this sub-sector followed by Engineering services (rendering mining support services) employing 9.9% of the total sectoral workforce. Prospecting, Exploration & Mine Planning accounts for 2.5% of the core mining workforce and Mineral Beneficiation sub-sector accounts for an insignificant proportion of 0.7%.

Figure 30: Employment by sub-sectors (2018-19)



Source: PwC Analysis

The table below summarizes core employment in the mining industry across sub-sectors:

Table 13: Employment by mining sub-sectors (2018-19)

SNo.	Sub-sectors	Employment 2018-19 (in '000)
1.	**Prospecting, Exploration & Mine Planning**	58.6
2.	**Mining Operations**	2,038.2
3	**Engineering Services**	231.2
4	**Mineral Beneficiation**	16.7
Total		**2344.8**

Source: India KLEMS database 2016, Employment & Unemployment Situation in India, NSS 68th round, PLFS Annual report, 2017-18, NIC 2008, PwC Analysis

4.2.2. Employment by mineral type

Fuel minerals (Coal & Lignite) are estimated to account for 25% of the mining workforce. Of which, coal account for 90% while lignite account for the rest 10% of employment. Metallic minerals constitute 10% of the mining workforce. Of which, iron ore account 50% and non-ferrous metal ores account for the rest 50% of employment. Non-metallic mineral and minor mineral constitute 2.3% and 60% of the mining workforce, respectively. Among non-metallic and minor minerals, quarrying of stone, sand and clay constitute 88% of the employment. Prospecting and exploration services provided to fuel, metal, non-metal and minor minerals account for 2.5% of the mining workforce. The table below summarizes core employment in the mining industry across mineral type:

Table 14: Employment by mineral type (2018-19)

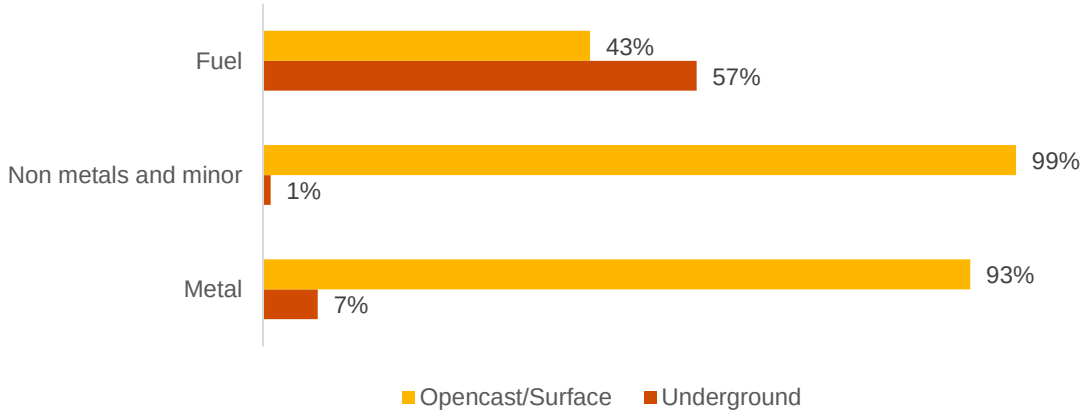
SNo.	Sub-sectors	Employment 2018-19 (in '000)
1	**Fuel minerals**	584.2
2	**Metallic minerals**	240.9
3	**Non-Metallic minerals**	55.1
4	**Minor minerals**	1,406.0
5	**Prospecting, Exploration and Mine Planning**	58.6
Total		**2344.8**

Source: India KLEMS database 2016, Employment & Unemployment Situation in India, NSS 68th round, PLFS Annual report, 2017-18, NIC 2008, PwC analysis

With mining activity involving extraction of minerals or some valuable geological material, workers in the sector could be engaged in two types of excavations: opencast and underground mining. This difference in mining methods is due to nature of mineral deposits and their depth of occurrence, which in turn depends on the mineral genesis.

As shown in figure below, currently, opencast/surface mining seems much more common employing nearly 83% of the workforce across all mineral types. Of the total workforce employed in non-fuel minerals, a significantly large proportion is engaged in opencast mines while in case of fuel minerals, majority of workers are employed in underground mines.

Figure 31: Distribution of workers by type of employment in mining (2015)



**Note: fuel minerals include coal and lignite only*
Source: Statistics of mines in India: Vol I and II, DGMS (2015); PwC Analysis

4.2.3. Employment in ancillary activities

Mining sector not only creates direct jobs but also induces numerous indirect jobs (ancillary and induced) suggesting the sector's potential to generate extensive employment opportunities. For example, for each direct job created in Ghana and Brazil, 28 and 13 additional jobs are indirectly generated. Thus, indirect job creation (ancillary and induced) through mining is of prime importance.

Source: Study conducted by the Ministry of Mines and Energy's Secretariat for Geology, Mining and Mineral Processing, IBRAM, 2012; IFC Jobs Study Jan 2013

Globally, mining industry contributes about 1-2% of the total employment in a country, however, this contribution increases to 3-15% when ancillary activities and induced employment are also included[109]. Mining sector is generally considered as labour-intensive accounting for relatively high level of employment and is characterized by extensive ancillary activities.

Factors influencing indirect job creation (ancillary and induced)

The number of indirect jobs (ancillary and induced) generated from mining depends on multiple factors which are listed below:

- **Size of the mine**: The scale of mining operation has significant impact on indirect (ancillary and induced) employment generation with small scale mines having higher employment multiplier than large scale mines. This job creation potential of small-scale mines can be attributed to their labour-intensive nature owing to limited use of technology with 150-170 million people across the globe indirectly dependent on small scale mines for their livelihood and this number is expected to reach to 200 million by the year 2020[110].
- **Degree of mechanization**: The extent of technology adoption in carrying out mining and ancillary activities will affect the sector's employment generation ability. Adoption of labour-intensive techniques of production will create a higher employment multiplier as more manpower will be required for extracting and processing minerals and carrying out ancillary activities as noted from primary consultations with employers.
- **Mining life cycle phase:** Indirect (ancillary and induced) employment levels are much higher during the mineral extraction and processing phase than mine closure phase[111]. Typically, when mines are in the production stage, ancillary activities such as overburden removal, transportation of extracted mineral to buyers or stone cutting units, maintenance of mining equipment, etc. are carried out in the periphery of mines at an on-going basis. However, when mine sites are being closed, there is limited extent to which abovementioned activities are undertaken.
- **Location of mine:** If mining reserves are found in an already urbanized/ commercial region, the ancillary activity and subsequent job creation will be higher when compared to reserves found in a remote/ forest region.
- **Type of mineral being extracted:** The job multiplier also depends on which minerals are being mined. For instance, stone cutting is an ancillary activity only for minerals such as granite, marble, sandstone and other stones.
- **Scale of operations:** There is a positive relationship between average daily output of mines and indirect employment with larger the output mined generating larger employment in ancillary activities[112].

The core Mining sector employed around 2.3 million people and about 9.4 million people gained employment in ancillary activities and through induced employment in 2018-19[113].

Table 15: Employment across various ancillary activities (2018-19)

Sector	Employment 2018-19 (in '000)
Intermediate Input (Energy, Material and Services)	1,090.9
Manufacture of Machinery for mining & quarrying	113.4
Construction of dwellings and industrial buildings	104.3
Cutting, shaping and finishing of stone	502.96
Manufacture of bricks	1,822.9
Manufacture of other non-metallic mineral products near periphery of mines	995.5
Wholesale of construction materials (sand, gravel etc.)	393.73
Total Ancillary	**5,023.7**

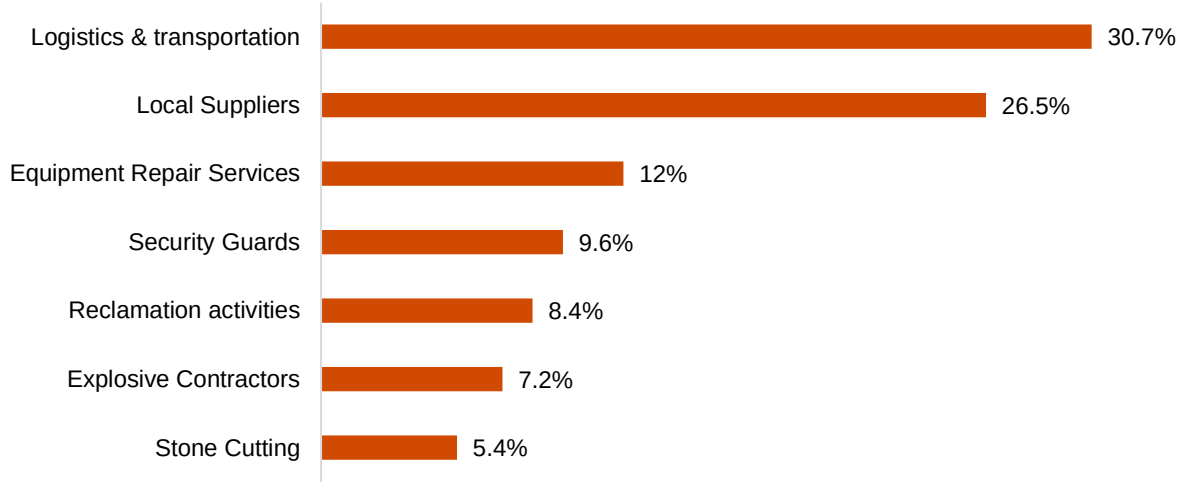
Source: Periodic Labour Force Survey (PLFS), 2017-18, PwC analysis

[109] Role of Mining in National Economies: ICMM 2016
[110] Extractive Industries and Sustainable Job Creation: 17th Africa Oil Gas Mine Trade and Finance Conference and Exhibition 2015
[111] Employment from Mining and Agricultural Investments: Columbia Center on Sustainable Investment July 2016
[112] Employment from Mining and Agricultural Investments: Columbia Center on Sustainable Investment July 2016
[113] PwC Analysis

Total employment in ancillary activities across States for the year 2018-19 has been attached in annexure A.18.

In addition, a short-structured questionnaire was designed to understand the job roles that exist in ancillary activities near the periphery of mines and skill levels of the workforce engaged in these activities. The sample constituted the following ancillary activities: logistics and transportation, local suppliers (of equipment such as computer, protective equipment, machines, excavators, bricks, material for blasting, etc.), equipment repair services security guards, explosive contractors, stone cutting and polishing. The figure below summarizes the distribution of surveyed employers by type of ancillary activities that they are engaged in:

Figure 32: Employers coverage by type of ancillary activities



Source: PwC Survey Data Analysis[114]

Across all ancillary activities shown in the figure above 96% males and 4% females are employed. **It is noteworthy that about 53% people are employed in job roles which fall under skilled category, 30% in job roles which fall under semi-skilled category and the remaining 17% in job roles under unskilled category**. In addition, 72% of the surveyed employers highlighted that workers stability is not a major concern since the workers are typically engaged with them for a period of 6-12 months. An indicative list of job roles across ancillary activities along with skilling needs is presented in the table below[115]:

Table 16: Skilling needs across ancillary activities

Type of ancillary activity	Job roles	NSQF Level	Skilling needs
Logistics and transportation	Driver	4	• RPL • Fresh skilling
	Cleaner/Helper	1	• RPL
	Loader	2	• RPL
	Backhoe Loader Operator	4	• RPL • Fresh skilling
	Dumper/Tipper Operator	4	• RPL • Fresh skilling
	Data Entry Operator	4	• Fresh skilling
Local supplier	Driver	4	• RPL • Fresh skilling
	Helper	1	• RPL
	Sales executives/ Individual Sales Professional	4	• Fresh skilling

[114] n=166
[115] *Source: PwC analysis based on field level survey and consultations*

Type of ancillary activity	Job roles	NSQF Level	Skilling needs
	Plumber	4	• RPL
	Water tanker operator	3	• RPL • Fresh skilling
Explosive contractor	Blaster	4	• Fresh skilling
	Explosives Handler & Carrier	3	• Fresh skilling
	Driver Special Vehicle (Explosive & Sprinkler)	4	• RPL • Fresh skilling
Security services	Security guard	4	• RPL
Equipment repair services	Welder	4	• RPL • Upskilling
	Machinist/Fitter	4	• RPL • Upskilling
	Electrician	4	• RPL • Upskilling
	Fabricator	4	• RPL • Upskilling
Stone cutting and polishing	Stone Processing Machine Operator	4	• RPL • Fresh skilling
	Stone cutter	3	• RPL • Fresh skilling
	Polisher	3	• RPL
	Gangsaw Operator	4	• RPL • Fresh skilling
	Helper/Assistant	1	• RPL
Reclamation and housekeeping activities	Gardner	4	• RPL
	Driver Special Vehicle (Explosive & Sprinkler	4	• RPL • Fresh skilling
	Reclamation Supervisor	5	• Fresh skilling

Source: PwC analysis based on field level survey and consultations

It can be noted that majority of the job roles identified across ancillary activities fall under NSQF levels 4 and below and thus, the target audience for training programmes shall be these job roles where RPL Certifications, fresh skilling and upskilling will be critical.

4.2.4. Employment in unorganized sector (minor minerals)

India is endowed with abundant of minor mineral resources and is one of the leading producers and exporter of various minor minerals. In view of limited scope of mechanization across minor mineral leases which are typically less than 5 hectares in size and have annual average production of over 10,000 tonnes, this unorganized segment requires lot of manual labour and is thus highly labour intensive. **Based on field survey, about 70% of the minor mineral lease holders are involved in extraction of marble, sandstone, dolomite, chalk and some other stone types. In addition, owing to the geological nature of minor minerals, about 90% of the mining is opencast with nearly same proportion of employees engaged in non-captive mines**.

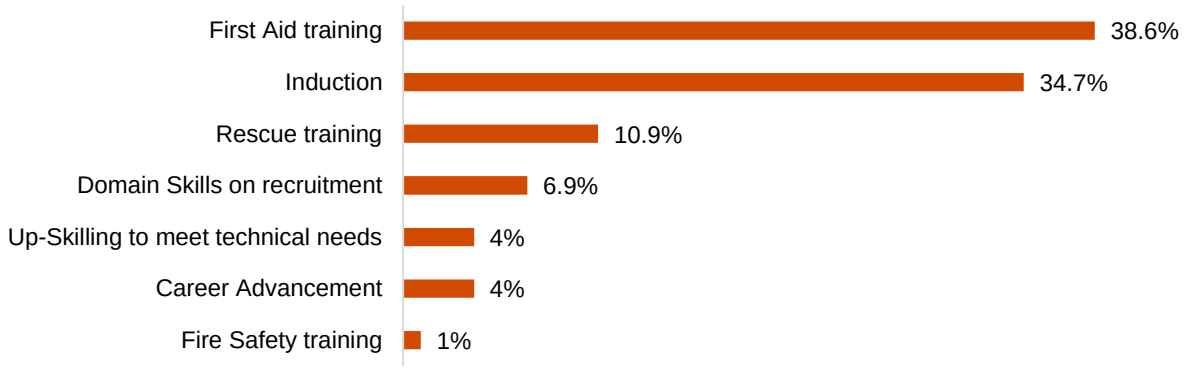
Currently, of the total people employed in the mining operations sub-sector, about 60.2% are engaged in the minor minerals (unorganized) where on an average, about 25 people* (based on survey) are employed on a minor mineral leases of size up to 5 hectares. Except for festivals and rainy season, the workers are engaged in mining operations throughout the year.

Based on stakeholder consultations and field survey, the key job roles in which people are employed in the minor mineral sector include: Wire saw operator, Loader, Mine Mate, Helper, Dumper Operator, Mine Manager and some associated job roles such as Welder, Fitter, Machinist and Electrician.

Thus, majority of the people are employed in job roles falling under NSQF level 4 and below. The Mine Manager is typically a close, trustworthy family member of the lease holder who is responsible for day-to-day activities for the uninterrupted functioning of mine. He makes payment to the contractor and workers, maintains financial books, arranges for the logistics and transportation, etc. In addition, about 28% employers reported that they hire migrants (from outside the district and State) primarily because of limited availability of skilled resources in the district and frequent absenteeism among the locals.

Mines Vocational Training Rules (MVTR) Rules drive vocational training in the sector mandating that all the firms falling under the purview of Mines Act 1952 shall provide and maintain a Vocational Training Centre (VTC) for the purpose of imparting training to all the workers who are employed or are to be employed in mining operations. These VTCs provide general training, refresher training and training of special categories of employees with focus on health and safety across all training types. As per DGMS data, **15 employers in the organized sector run 126 Vocational Training Centres**[116]. **However, of the total employers surveyed in the unorganized sector, only 13% reported having VTCs for the purpose of training the employees**. Regarding the workers vocational training status, about 63% employers have imparted some sort of training to their employees. **It can be noted from the figure below that majority of the workers received first aid training followed by induction-based training which primarily involves familiarizing the new workers to the firm's policies and procedures. Thus, little impetus is given towards upskilling and career advancement trainings.**

Figure 33: Skill sets on which training was given



Source: PwC Survey Data Analysis[117]

Worker survey findings indicated that around 60% of the respondents had not received training related to their job roles from their employers. Out of those who had received the training, 25% received classroom-based training, and 70% received classroom and practical sessions. 52% of the respondents had undergone health and safety training before commencing their jobs. Around 5% had received Recognition of Prior Learning (RPL) certifications. 56% respondents felt that they would need additional training for career progression.

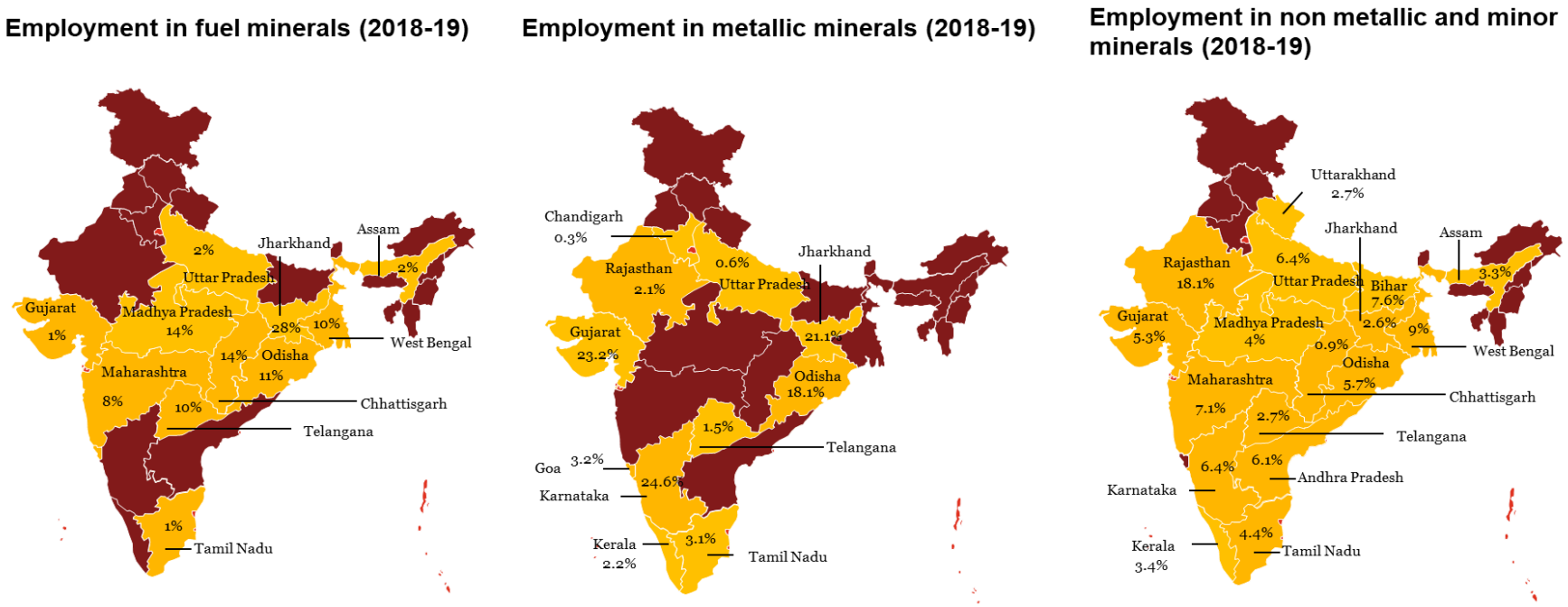
4.2.5. Employment by geography

Analysing the State wise share in the sector's total employment, the figure below shows that States of Jharkhand, Chhattisgarh, Rajasthan, Odisha and Madhya Pradesh together account for 41% of the total sectoral employment. Other major mining States of Maharashtra, Telangana, Andhra Pradesh and Gujarat constitute 21% of the sectoral employment. Therefore, it can be inferred that a significantly large proportion of mining activities are undertaken in States with per capita income lower than the national average, i.e. relatively poor and backward areas[118]. The remaining States contribution to total employment is insignificant as compared to the contribution by abovementioned States.

[116] Annual Report 2014, Directorate General of Mine Safety [http://www.dgms.gov.in/writereaddata/UploadFile/DGMS_Annual_Report_2014_Eng.pdf]
[117] n=41
[118] Per capita income in INR (2015-16): Jharkhand (44524), Chhattisgarh (61504), Rajasthan (68596), Odisha (58165), Madhya Pradesh (47763), India (77435)- MOSPI

The figure below shows the geographical spread of mining employees (coloured in yellow) in percentage, categorized by mineral types in the year 2015 across the country.

Figure 34: Geographical spread of employment in the mining sector



Source: PLFS Annual report, 2018-19; Manipur, Punjab, Haryana, Mizoram, J&K, Tripura, Arunachal Pradesh and Sikkim are not represented in the figure of non-metallic and minor mineral as their contribution in total employment is close to zero

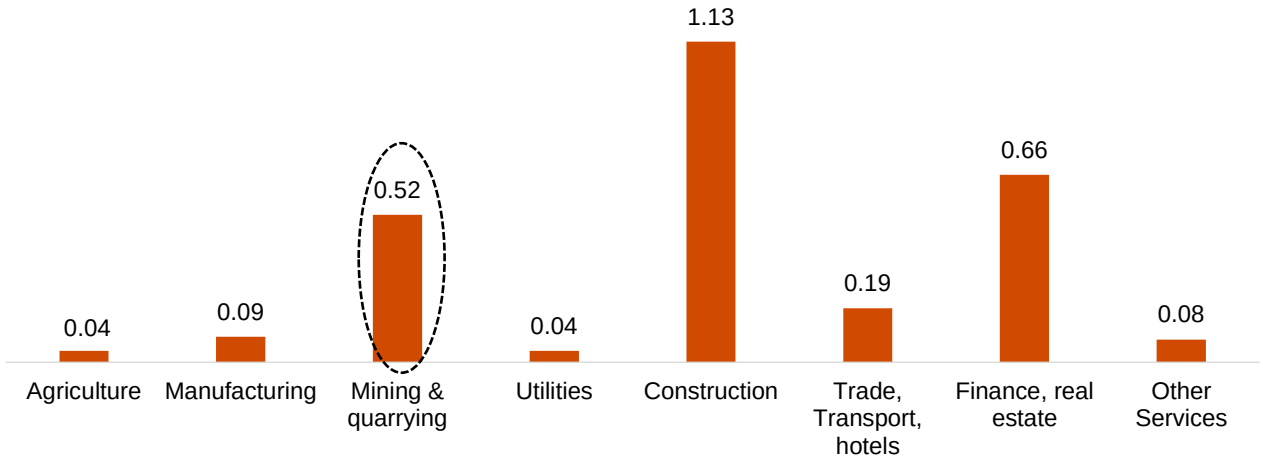
- **Fuel Minerals:** In the case of coal and lignite, 77% of labour force is employed across the States of Jharkhand (28%), Chhattisgarh (14%), Madhya Pradesh (14%), Odisha (11%) and West Bengal (10%)
- **Metallic Minerals:** In the case of metallic minerals, 87% of employment is constituted by the States of Karnataka (25%), Gujarat (23%), Jharkhand (21%) and Odisha (18%).
- **Non-Metallic and Minor Minerals**: 60% of the employment in this mineral type is contributed by the States of Rajasthan (18%), West Bengal (9%), Bihar (8%), Maharashtra (7%), Uttar Pradesh (6%), Karnataka (6%) and Andhra Pradesh (6%).

4.3. Employment elasticity

Employment elasticity is a measure of how employment changes due to one percentage point change in economic growth. It indicates an economy's ability of generating employment opportunities for its population as a percentage of its growth/ development process. The figure below shows estimated employment elasticity for different sectors of the economy including mining and quarrying for the period between 1900-00 and 2010-11.

Construction sector has the highest employment elasticity, while agriculture and utilities have the lowest of all. With an employment elasticity of 0.52, the mining and quarrying sector emerges as the third largest in terms of generating job per unit increase in the sectoral GDP. The elasticity coefficient of 0.52 implies that with every one percentage point growth in GDP, employment in the sector increases by 0.52% pointing towards relatively moderate employment generation ability of the sector.

Figure 35: Sectoral employment elasticity (1999-00 to 2010-11)



Source: RBI working paper series "Estimating Employment Elasticity of Growth for the Indian Economy (2014)

The sector stands third in terms of generating employment opportunities for the country's workforce and with recent policy reforms and technological advancements, there will be positive impact on employment, i.e. demand for new and existing jobs is expected to go up. However, Indians, especially the youth do seek employment in other mining economies across the world such as Canada, Australia, South Africa, etc. requiring skilled and highly skilled workforce.

The next section delves into the employment opportunities available for Indians in other mining countries.

4.4. Overseas employment for Indians in the mining sector

Past and current migration trends in the mining industry

For countries such as Australia and Canada, migration in the mining sector is typically of skilled and highly skilled migrants (such as geologists, geophysicists and mining engineers). For migrants from China and India, Australia has become a top destination. Australia has strong demand for skilled migrants to work in its booming mining and energy industry. Similarly, in OECD countries, high-skilled migration showed a significant increase of 70% between 2000 and 2013, where almost 20% of high-skilled migrants are from India, China and the Philippines[119].

[119] International Migrant Workers in the Mining Sector, ILO, 2016

Of the total migrant population in Qatar, nearly 0.5 million (~ 90%) of employees in the mining sector are Non-Qataris of which 37% are Indians and almost 75% of the workers are unskilled and semi-skilled[120].

Further, African mining and quarrying industry has traditionally had significant demand for Indian workers. In 2014, 50%[121] of the migrants working in African mines were Indians. They were primarily employed in countries such as Guinea, Nigeria, Mozambique, among others. In the 1990s, the mining companies in South Africa implemented massive layoffs due to economic slowdown and the introduction of technology in the mining industry[122]. This impacted local workers more than foreign workers. As a result, the proportion of migrants in the South African mines increased from 47% in 1990 to 57% in 2000[123]. Given significant presence of Indian miners in the South African mines, the skilling ecosystem prevalent in the country has been studied and summarized as below:

- The South African Minerals Council is responsible for ensuring skills development in the sector. The skills development includes theoretical training in technical vocational education and training (TVET) colleges, other universities, skills training in accredited training centres ensuring that workplace-based experience is also imparted to the trainees.
- Mining Qualifications Authority (MQA) administers and develops learning programmes for the sector mandating mining companies in the country to submit their skills development plans and annual training reports; and also pay 1% of their payroll as a skills development levy.
- The council issues certificates in Advanced Mine Surveying, Advanced Rock Engineering, Elementary Mine Sampling, etc.
- In the year 2018, 6 Billion Rand invested in skill development, 13,000 tertiary education learners and 10,000 apprenticeships supported by sector, 10,600 artisans enrolled in mining industry training and development

Source: Minerals Council, South Africa

Emerging global demand expected to drive migration in the sector

Considering the pivotal role played by the mining industry for economic growth and the declining aspiration of youth in developed countries to join the sector, mineral rich countries such as Australia and Canada offer opportunities for the skilled resourced from other countries by advertising the requirement for skilled manpower.

- **Australia:** Driven by the growth of the Western Australia (WA) economy, Australia is under acute pressure to fill its labour demand. In order to meet the growing demand, the WA chamber of Minerals and Energy has invested more than USD 2 billion to source skilled migrants from other countries[124]. Further, mining accounts for 2% of the nation's workforce in Australia, employing nearly 250,000 people full time or part time. In last five years, employment in the industry has decreased by 5%. Five year projections (2018 to 2023) shows that the mining sector in Australia will grow at 2.4% or addition of 5,600 individuals from to 239,900 in 2023[125]. Further, it is anticipated that demand will emerge in job roles such as drillers, miners and shot filters, metal fitters and machinists, truck drivers, building and engineering technicians and earthmoving plant operators, amongst others[126]. The below job roles are estimated to have high demand[127] for immigrants:
  - Mine Closure Specialist
  - Bomber/Relief Operator
  - Shotfirer

[120] Overseas migration patterns from India, Grant Thornton, 2016
[121] Overseas migration patterns from India, Grant Thornton, 2016
[122] Market Scene: A Gold Mining Slump Digs into South Africa: Layoffs and falling prices have pushed this key part of the economy into a crisis that could stall political reforms, July 10 1990
[123] International Migrant Workers in the Mining Sector, ILO, 2016
[124] All the international migrants in the mining sector are classified under the 457-visa category. This is a temporary work visa valid for 4 years and allows a skilled worker sponsored by an employer to live and work in Australia. Within the skilled migrants in the mining sector, mostly are professionals (50%) or technicians (27%) and make a higher salary than in other economic sectors. The average base salary (AUD USD1,17,000) in the mining industry was the highest of all sponsor industries in comparison with a total average of AUD USD85,400.
[125] 2018 Employment Projections - for the five years to May 2023, Australian Govt. Department for Jobs and Small Business LMIS
[126] 2018 Employment Projections - for the five years to May 2023, Australian Govt. Department for Jobs and Small Business LMIS
[127] [https://www.careermine.com/jobs/?pg=4]

- Heavy diesel mechanics
- Water engineers and contaminated land specialists
- Mechanical fitters
- Excavator operators
- HSE advisors

- **Canada:** Canada is another mineral rich country with emerging demand in the sector (that may require emigrants to migrate). With over 1,200 mineral exploration and mining companies, British Columbia is one of the largest mining State in Canada. As in 2019, it is estimated that about 200,000 individuals are employed in Canadian mining industry (an increase of 3% over previous year). The Canadian Mining Industry Human Resources Council (MiHR) projects that from 2019-29, workers in production occupations will be most in-demand (among the broad occupational categories)[128]. In 2029, the majority of mining employment in Canada is expected to be in the extraction & milling sub-sector (49%), followed by primary metal manufacturing (24%), support services (14%) and exploration (13%). It is expected that support services (33%) and extraction & milling (29%) will generate the maximum employment by 2029[129]. The below job roles are estimated to have great demand[130]:
  - Geotechnical Engineer
  - Paste Fill Coordinator
  - Heavy Equipment Technician
  - Mobile Cranes Supervisor
  - Rock Mechanic Engineer
  - Maintainer/operator carpenter
  - Material Handler
  - Geological Technician
  - Mine Technician
  - Soils Technician
  - Mine Maintenance Scheduler
  - Assay Technologist
  - Ventilation Technician
  - Environment Operations Lead, Water
  - Maintenance Engineer, Rotating Equipment
  - Maintenance Superintendent – Roving
  - Geoscientific System & Data Specialist
  - Metallurgist
  - Grade Control Geologist
  - Production Dozer Operator
  - Heavy Diesel Fitter
  - Welder - Stockpile and Ship loading
  - Welder Fitter
  - Industrial Mechanic
  - Underground Mine Supervisor
  - Mill Training Coordinator

- **United States of America:** Similarly, in the United States of America (USA), mining and construction are one of the fastest growing sectors. It is expected that mining will generate 90,000 new jobs over the next decade (2016-26)[131] employing about 700,000 people by 2026. In terms of occupations, maximum people are employed as roustabouts, oil and gas (45,000) followed by first-line supervisors/managers of construction trades and extraction workers (30,400) which is followed by operating engineers and other construction equipment operators (27,130), helpers-extraction workers (11,720) and lowest number of individuals were employed as mining and geological engineers, including mining safety engineers (2,490).

[128] MiHR projections under two scenarios between 2019-29 is as follows:
•The baseline scenario: Mining industry is expected to increase by 5% (an additional 11,930 workers) or a total of 2,28,970 workers by 2029. The industry will need to employ 2,540 more people in production occupations.
•The expansionary scenario: The industry's overall employment is expected to grow by 21% (an additional 45,210 workers) or a total of 2,62,250 workers by 2029. The industry will need 10,580 more workers in production occupations.
[129] Canadian Mining Labour Market Outlook, Canadian Mining Industry Human Resources Council, 2019
[130] [https://www.jobs4mining.com/browse-jobs/]
[131] Work in Focus: A U.S. Labor Market Overview, Fact Sheet 2016, Department for Professional Employees

- **Chile:** In Chile, the mining industry represents 2.9% of the total Chile's employment, given the multiplier effect, the industry creates on average 2.5 indirect jobs for each direct job[132]. It is estimated that mining industry of Chile had about 600,000 workers in 2015 and is expected to add 27,000 jobs between period 2014 and 2023[133]. According to the report published in 2014 by the Mining Skills Council of Chile, in 2014 there were 1,700 foreign workers, which is expected to increase.

Therefore, to conclude, there are multiple emerging opportunities for migrant workers in the mining sector globally. However, these are largely in the skilled and highly skilled category. Special recruitment agencies such as International Manpower Resource India support workers/youth in mining to migrate internationally. With requirement for skilled and highly skilled workforce in great demand in India and abroad, it is critical to understand the current characteristics of the workforce engaged in the sector.

The next section delves into the workforce characteristics based on field survey with the mining workers.

4.5. Workforce characteristics

This section presents data collected from the mining workers survey and qualitative insights from the various consultations conducted as part of field visits.

4.5.1. Respondent profile

A structured workers survey tool was administered among 701 mining workers (young men and women in the age group of 15-34 years) across 11 mineral rich States in the country. The survey had 57% and 43% representation from the organized and unorganized sectors respectively with more than 90% of the respondents covered engaged in opencast/surface mining. Owing to low participation of women in the mines, only 3% of the total 701 workers were covered as a part of the survey. Disaggregating respondents' coverage by geography, 20%, 15% and 14% of total sample of 701 were interviewed in the States of Rajasthan, Odisha and Tamil Nadu. The table below summarizes the respondent's profile:

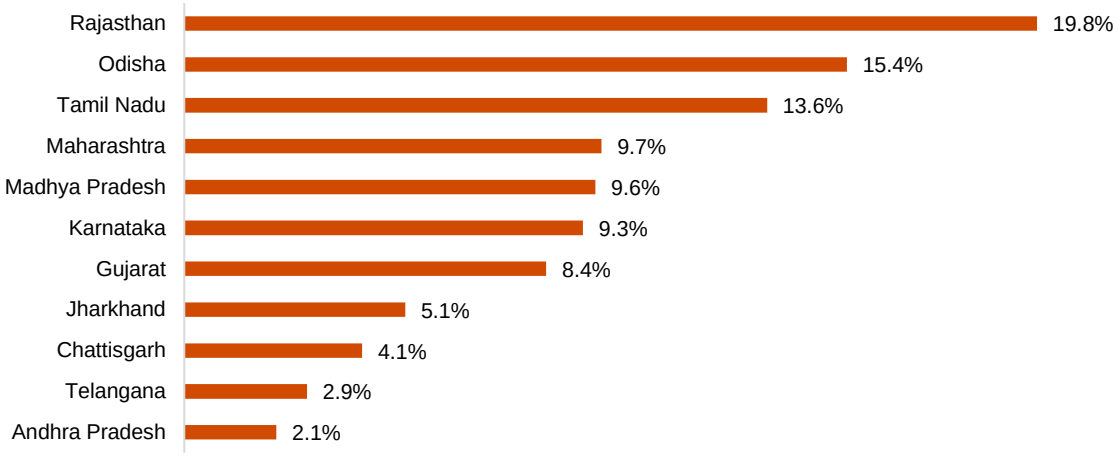
Table 17: Summary of respondent's profile

Profile	Details
Total workers surveyed	701
Sector	• Organized: 56.6% • Unorganized: 43.4%
Type of employment in mining	• Underground: 7.4% • Opencast: 92.6%
Mineral type	• Fuel: 9.6% • Metal: 28.5% • Non-metal: 30.1% • Minor: 36.2%
Gender	• Male: 97% • Female: 3%
Social group	• General: 21.5% • Scheduled Caste (SC): 11.4% • Scheduled Tribe (ST): 19.3% • Other Backward Classes (OBC): 45.5% • Unwilling to reveal: 2.3%
Geography	The State-wise coverage is summarized in the figure below.

Source: PwC Survey Data Analysis

[132] This is Chile.cl
[133] Mining Skills Council of Chile

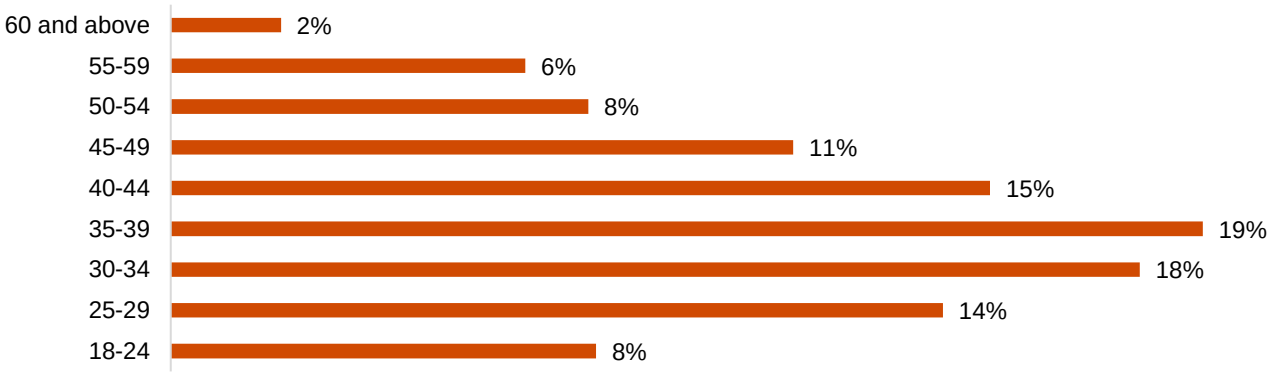
Figure 36: Distribution of workers by State



4.5.2. Age

As shown in the figure below the mining workforce as estimated from the survey has less than 10% of its workers in the 55 year and above age group.

Figure 37: Age distribution of workforce – Worker Survey



Source: PwC Survey Data Analysis[134]

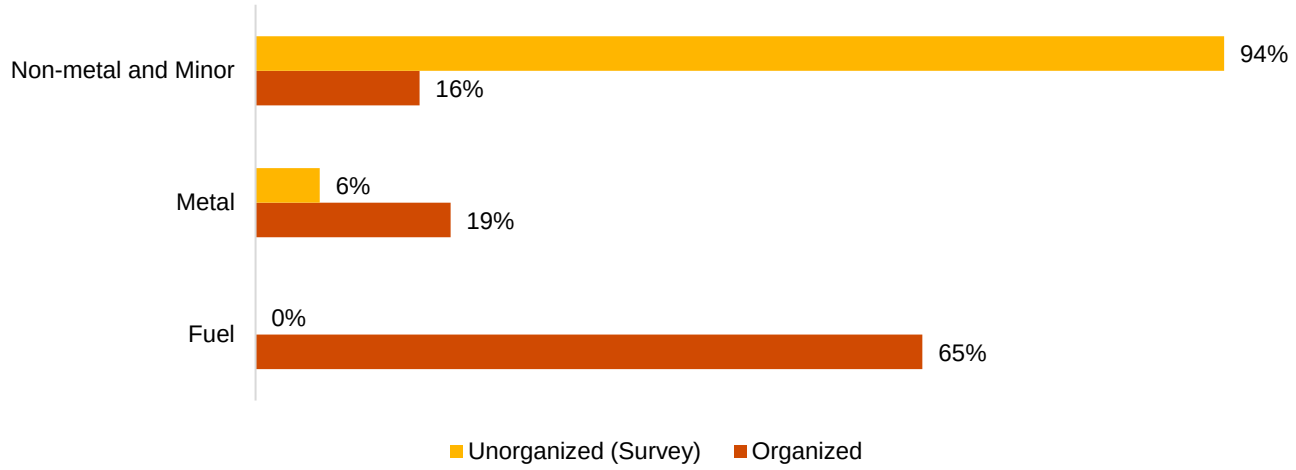
The survey data also suggests that with a smaller segment of the workforce being eligible for retirement within the next five years, the target groups for skill programs (fresh skilling, up-skilling, re-skilling, Recognition of Prior Learning) will be in the 25-44-year age group owing to 66% of the workforce currently falling under this age-group.

[134] n=701

4.5.3. Employment by mineral type

The below sections present a comparison of data taken from DGMS (2015) on organized sector and the findings of the workers survey based on respondents working in the unorganized sector. The distribution of workers across mineral type shows that in the organized sector, most of the mine workers (65%) are engaged in fuel minerals followed by metallic (19%) and non-metallic and minor minerals (16%). Compared to this, unorganized workers covered in the survey were mostly in non-metallic and minor minerals category.

Figure 38: Employment by mineral type (Organized vs Unorganized (Survey))

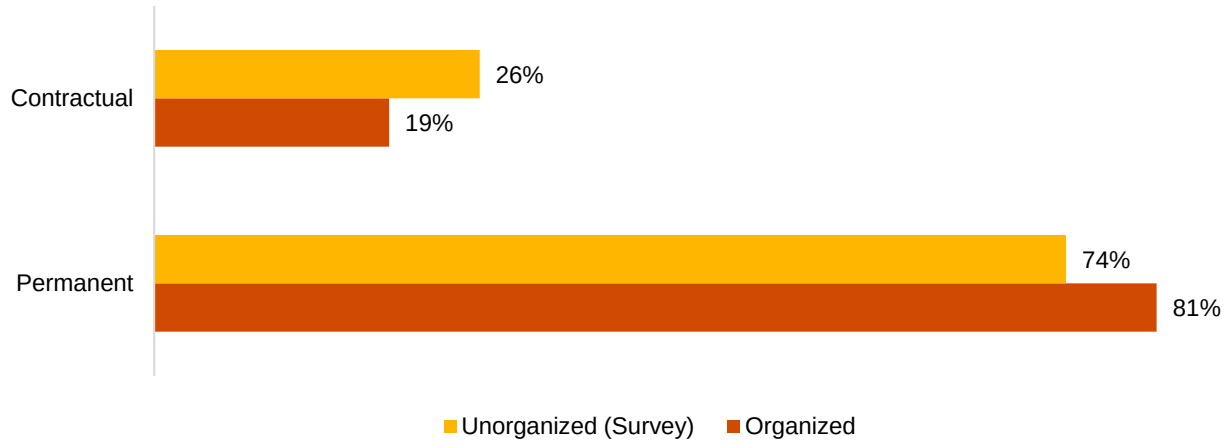


Source: DGMS (2015), PwC Worker Survey data[135]

4.5.4. Nature of Employment

According to DGMS data, the number of contract workers has always been less than regular/ permanent workers during the year 2011-15 suggesting a buoyant marketplace for permanent work in the sector. In the organized sector, contractual workers formed only 19% of the total employment. The worker survey finding indicates that 26% of the workers in unorganized sector were contractual, showing a similar pattern.

Figure 39: Nature of Employment (Organized vs Unorganized (Survey))

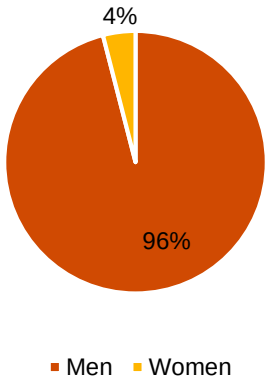


Source: DGMS (2015), PwC Worker Survey data[136]

[135] N=304 for survey
[136] N=304 for survey

4.5.5. Gender and project affected persons

Figure 40: Gender wise employment in the mining sector (2015)



Source: Statistics of mines in India: Vol I and II, DGMS (2015)

Gender diversity is one of the crucial social performance measures and women participation in the labour force is an important driver of a nation's growth and development. In India, women make up a substantial proportion (48%) of the working age population, however, they account for only 23% of the country's labour force[137].

- In the mining sector, the gender difference is significant with women forming around 4% of the total employment in the sector (average daily employment in mines), which is lower than their employment in other sectors such as agriculture and allied (57%), manufacturing (12.5%), education (6%) and construction (5%)[138].
- The representation of women in the sector has remained unchanged (ranging between 4-5%) since the last decade. Women are majorly engaged in backend office activities such as data entry, front office and in professions such as mining engineers, geologists and geophysicists[139].
- It is noteworthy that low women participation in the sector is a global phenomenon owing to the nature of the sector itself. Women are unwilling to be a part of the sector, particularly mineral extraction due to the remote location of mines, resistance from family, lack of proper housing and transportation facilities, etc. Mining sector is mired with perception of being male dominated, leading to lower participation rate among females. In 2018 women formed:
  - 16.1% of the mining workforce in Australia[140].
  - 12% of the mining workforce in South Africa[141].
  - 14% of the mining workforce in Canada[142].
  - 14% of the mining workforce in the United States[143].
  - 10% of the mining workforce in Chile[144].

In view of lower representation of women in the sector, DGMS issued a notification in February 2019 towards fostering equal employment opportunities for women by allowing them to be employed in underground mines.

The notification requires every mine owner to form Standard Operating Procedures (SOP) to be followed while employing women. The SOP covers aspects relating to:

- Infrastructural support for women
- work location and timings (for both open and underground mines)
- administration
- relaxations to be given, etc.

In addition, the National Mineral Policy 2019, recognizes need of ensuring gender sensitivity and balance in the mining sector at all levels. This increased focus towards increasing women participation in the sector is likely to boost women employment in the coming years leading to more inclusive sectoral growth. In unorganized employers covered in the survey, the average workforce in each unit was 6% female. Women were working in administrative support roles like data entry operators, accountants and other clerical roles.

[137] Periodic Labour Force Survey (PLFS), 2017-18
[138] Periodic Labour Force Survey (PLFS), 2017-18
[139] Basis stakeholder consultations in Rajasthan, Goa, Tamil Nadu, Gujarat, Odisha, West Bengal, Karnataka and Jharkhand
[140] "Women in mining: Dig the changing face of Australia's mining industry" Australian Broadcasting Corporation [https://www.abc.net.au/news/2018-05-22/dig-the-changing-face-of-mining-as-women-make-inroads/9786020]
[141] "Women in Mining", Mineral Council of South Africa [https://www.mineralscouncil.org.za/industry-news/publications/fact-sheets/send/3-fact-sheets/738-women-in-mining]
[142] Minerals Sector Employment, Natural Resources Canada [https://www.nrcan.gc.ca/mining-materials/publications/16739]
[143] Women in the Labor Force; A Databook, US Bureau of Statistics [https://www.bls.gov/opub/reports/womens-databook/2019/home.htm]
[144] "Employment of Women in the Mining Industry increases by 18.5%", InvestChile [http://blog.investchile.gob.cl/employment-of-women-in-the-mining-industry-increases-by-18.5]

Women and Project Affected Persons (PAPs) representation in the sector

Women are engaged in environmental measures, housekeeping and administrative support activities. Women who graduate from mining engineering courses also work in planning and operations. Due to heavy machinery-based activities and shift timings, women are not recruited in greater proportion. However, large employers provide incentives such as bathrooms, sick and maternity leave and transportation facilities. Technological developments have made certain job roles easier to perform for women, but their absorption into these job roles varies widely across States and employers.

Project-Affected Persons are rehabilitated differently in different States, In Tamil Nadu, they are compensated for giving land, and taken on as contractual workers, although their pay is significantly lower than permanent workers. In Goa, they are compensated for the land lost, but are not rehabilitated by the mining companies.

The detailed findings from the workers survey have been attached in Annexure A.11.

Given that a significant proportion of workforce employed in the mining sector have not undergone any form of formal training and RPL Certifications with respect to their current job role and that 56% have expressed their desire towards additional skills training, building a skilled workforce with equal focus on soft skills will be critical. However, to interlink skills development and engaging the workers in gainful employment, it is important to undertake an analysis of the existing education, training and skill development ecosystem in the country, i.e. number of institutes, their seating capacity and seat utilization, courses offered, etc. and identify the key gaps.

The current education, training and skill development scenario relevant to the mining sector is mapped in the next chapter.

5. Education, training and skill development ecosystem

Mining is the backbone of several crucial industries in India and is set to grow. Leveraging on the country's demographic advantage will be critical to aid growth in the sector. Therefore, a keen focus on building the workforce and developing relevant skills is a need of the hour. Limited capacity of the existing skilling and education ecosystem will require to be addressed to help leverage the demographic advantage for the mining sector in India.

5.1. As-is analysis of the existing skills and education infrastructure for the mining sector

Presently the mining sector absorbs its workforce from three major categories of educational institutions. These are:

- **Schools:** mainly comprising of school dropouts between class 9th and 12th, working at NSQF level 1 and 2 related roles in the organised and unorganised mining sector.
- **Vocational Institutes:** candidates from Industrial Training Institute and Short-Term Training programs, working across major job roles such as sampler, mechanic/fitter, mine electrician and in job roles across ancillary units.
- **Colleges:** including potential workforce mainly from polytechnics and engineering colleges, working across mining sectors as mining engineers, material engineers, geologist, mineral processing engineers amongst others. The highly skilled, analytical and managerial job roles across the hierarchy are taken up candidates from premium engineering colleges such as Indian Institutes of Technology, Indian School of Mines, Dhanbad, National Institute of Technology.

These educational institutions are either offering courses directly or indirectly related to job roles in the mining sector. In brief, these are:

- The **Direct courses** are the courses where students are trained primarily for the sector in occupations pertaining to mining engineering, metallurgy, etc.
- **Indirect courses** such as mechanical engineering, electrical engineering amongst others are the courses which are not exclusive to the mining sector, but students trained in these courses are available to be employed in mining.

Currently the number of direct and indirect courses offered at these educational institutions are mentioned in the table below:

Table 18: Number of direct and indirect courses offered by different type of vocational institutions

Type of Institution	Direct Courses (total)	Indirect Courses (total)
Vocational courses in schools (aligned to NSQF)	0	18
ITI[145]	2	37
STT (offered by SCMS)	45	0
College education	2	10

Source: U-DISE, NCVT MIS, AICTE, training data received from SCMS

The list of direct and indirect course offered at these education institutions is provided in Annexure A.7.

[145] These courses are: Mechanic Mining Machinery (NSQF) and Stone Mining Machine Operator (NSQF)

National Skill qualification Framework – a coherent framework for skilling across sectors

The National Skill Qualification Framework (NSQF)[146] organises qualifications according to a series of levels of knowledge, skills and aptitude. These levels are defined in terms of learning outcomes which the learner must possess regardless of whether they were acquired through formal or informal learning. In that sense, NSQF is a quality assurance framework. It is therefore, a nationally integrated education and competency-based skill framework that will provide both vertical as well as horizontal pathways. The table below provides the distribution of education levels across some of the job roles in mining sector.

Table 19: NSQF level mapping of the job roles in mining sector

NSQF Level	Professional knowledge	Professional skill	Core skill	Indicative Job Roles*
NSQF level 1	Familiar with common trade terminology, instructional words meaning and understanding	Routine and repetitive, takes safety and security measures	Reading and writing, addition, subtraction, personal financing, familiarity with social and religious diversity, hygiene and environment	*Mazdoor, Helper Mason*
NSQF level 2	Material tools and application in a limited context, understands context of work and quality	Limited service skill used in limited context, select and apply tools, assist in professional works with no variables, differentiates good and bad quality	Receive and transmit written and oral messages, basic arithmetic, personal financing, understanding of social, political and religious diversity, hygiene and environment	*Support Person (Open casts / Underground), Loader, Attendant (Silo, Crusher, Mill) Assistant Mason*
NSQF level 3	Basic facts, process and principle applied in trade of employment	Recall and demonstrate practical skill, routine and repetitive in narrow range of application	Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal financing, basic understanding of social and natural environment	*Assistant Geospatial Surveyor, Drilling Assistant (Operation), Explosives Handler & Carrier, Asst. Mine Electrician, Asst. Fitter, Packer Operator, Self-Picker, Mine Sampler Geospatial Technician*
NSQF level 4	Factual knowledge of field of knowledge or study	Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	Language to communicate written and oral, with required clarity, skill to basic arithmetic and algebraic principles, basic understanding of social, political and natural environment	*Geospatial Surveyor, Jumbo Operator, Mine Draft Man, Universal drill machine operator,* Blaster*,* Rig *mounted Drill operator Wire Saw Operator,* Excavator *Operator Loader Operator Dumper/Tipper Operator,* Mine-*Machinist, Welder, HEMM Mechanic, Timber man*

[146] The gazette notification with respect to NSQF dated 27th December 2013 has been attached in Annexure A.16.

NSQF Level	Professional knowledge	Professional skill	Core skill	Indicative Job Roles*
NSQF level 5	Knowledge of facts, principles, processes and general concepts in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication	*Asst. Geologist, Asst. Geophysicist, GIS Expert,* Asst. *Drilling Engineer,* Mining *Supervisor, Mining Mate, Mining Sirdar, Bucket wheel Excavator Operator, Winding Engine Operator, Rescue Supervisor, Reclamation Supervisor, Electrical Supervisor, Mechanical Supervisor – Workshop, Mechatronics Supervisor*
NSQF level 6	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Reasonably good in mathematical calculation, understanding of social, political and reasonably good in data collecting, organizing information, and logical communication	*Asst. Manager (Mines), Mine Forman/overman, Asst. Manager (Electrical, Mechanical, Electronics, Mineral Processing, Coal Handling), Senior Electrical Engineer, Electrical Engineer, Colliery Engineer(Excavation), Senior Mechanical Engineer, Mechanical Engineer, Sr. Mechatronics Engineer, Senior Mineral Processing Engineer, Sr. IT Engineer, Sr. Telecom Engineer, Sr. Officer(Accounts, Admin, Store)*
NSQF level 7	Wide ranging factual and theoretical knowledge in broad contexts within a field of work or study	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Good logical and mathematical skill, understanding of social, political and natural environment, good in collecting and organizing information, communication and presentation skill	*Sr. Geologist, Sr. Geochemist, Sr. Geophysicist, Senior Resource Geologist, Sr. Mine Planning Engineer, Sr. Mine Surveyor, Manager(Mines), Safety Officer (Mines), Sr. Environmental Engineer (Mines), Ventilation Officer, Manager (Electrical, Mechanical, Electronics, IT, Telecom), Manager(Mineral Processing), Manager(Coal Handling), Colliery*

NSQF Level	Professional knowledge	Professional skill	Core skill	Indicative Job Roles*
				Engineer(E & M), Colliery Manager (Excavation), Manager (Admin, Accounts, Store), Medical Official, Welfare Officer
NSQF level 8	Comprehensive cognitive, theoretical knowledge and practical skills to develop creative solutions, to abstract problems. Undertakes self-study, demonstrates intellectual independence, analytical rigor and good communication.		Exercise management and supervision in the context of work/study having unpredictable changes, responsible for development of self and others	*Head Mining Project, Department Heads- (Mining, HR, Electrical, Mechanical, Planning)*
NSQF level 9	Advanced knowledge and skill, critical understanding of the subject, demonstrating mastery and innovation, completion of substantial research and dissertation		Responsible for decision making in complex technical activities, involving unpredictable study/work situations	*Agent (Statutory), Corporate Manager - Mining / Engineering / HR/CMO(Chief Medical Officer)*
NSQF level 10	Highly specialized knowledge and problem-solving skill to provide original contribution to knowledge through research and dissertation		Responsible for strategic decisions in unpredictable complex situations of study/work.	*MD/ Business Head*
Source: NSQF Level descriptions have been given as per Gazette Notification of Ministry of Finance dated 27th Dec 2013 Note*: Job role wise mapping has been done as per SCMS's Occupation Map				

5.1.1. School education[147]

India had 1.5 million schools across all education levels with total enrolment of 251 million in the year 2016-17. Of which the total number of schools imparting education to cohorts from 9th to 12th standards are about 68,000, leading to a total enrolment of 20 million. The 13 key mining states (Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and West Bengal) account for 60% (~ 0.9 million) of the total schools and ~56% of total school enrolments in India.

Since there will be requirement of about 82,000 people to be employed across job roles falling under NSQF levels 1 and 2 during 2019-25-year period, vocationally trained school pass outs will be the potential target for the mining sector. Thus, to equip young people (i.e. school pass not pursuing higher education) with employable skills, centrally sponsored scheme of vocationalisation at school level- the Rashtriya Madhyamik Shiksha Abhiyan (RMSA) which was introduced under the umbrella of Ministry of Human Resource and Development (MHRD) can be leveraged. RMSA would also help reduce drop-out rates, increase enrolments in schools and also provide for diversification of educational opportunities to enhance individual employability, reduce the mismatch between demand and supply of skilled manpower and would provide an alternative for those pursuing higher education.

Of the total enrolments across various streams in the year 2016-17, 0.45 million people (pan India) were enrolled under various vocational education stream accounting for 1.84% of the total enrolments.

In 2016-17, 4,084 schools imparted vocational education with an enrolment of 266,746 (243,614 students at the secondary level and 23,132 students at the higher secondary level) across 18 sectors (list of courses provided in the Annexure A.7). This implies an increase in both number of schools (2550 in 2015-16) and enrolment (134,742 students at secondary and 16,022 at higher secondary in 2015-16) across vocational streams in the year 2016-17 as compared to the previous year.

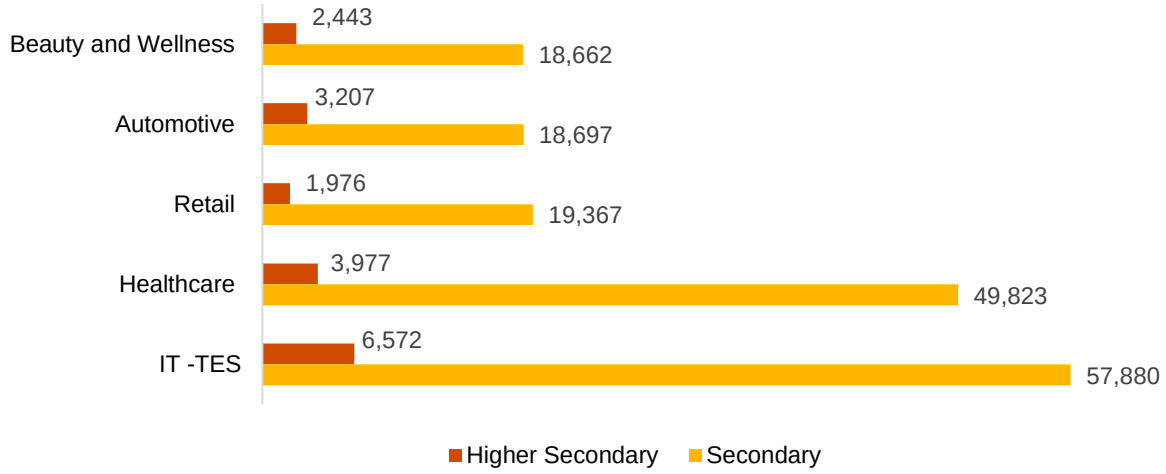
[147] U-DISE flash statistics 2016-17

It can be noted that in 2016-17, 1,173 schools accounted for 70% of the enrolment in vocational courses across the 13 major mining states. Of these, Tamil Nadu, Maharashtra, Telangana and West Bengal accounted for 87% of enrolment amongst the 13 states. While, vocationalisation of schools is a positive step forward but there is a crucial need to undertake efforts to raise the skill level amongst the youth of the country.

It can be noted from the figure below that in the year 2016-17 larger number of students were enrolled in vocation streams at the secondary level as compared to higher secondary level. This relatively lower number of student's enrolment at higher secondary level can be attributed to following reasons:

- Drop out from schools post-secondary education
- Long duration of vocational courses
- Lack of awareness building on future career prospects
- Mismatch in aspiration of students

Figure 41: Top 5 vocational streams in secondary and higher secondary in terms of enrolment

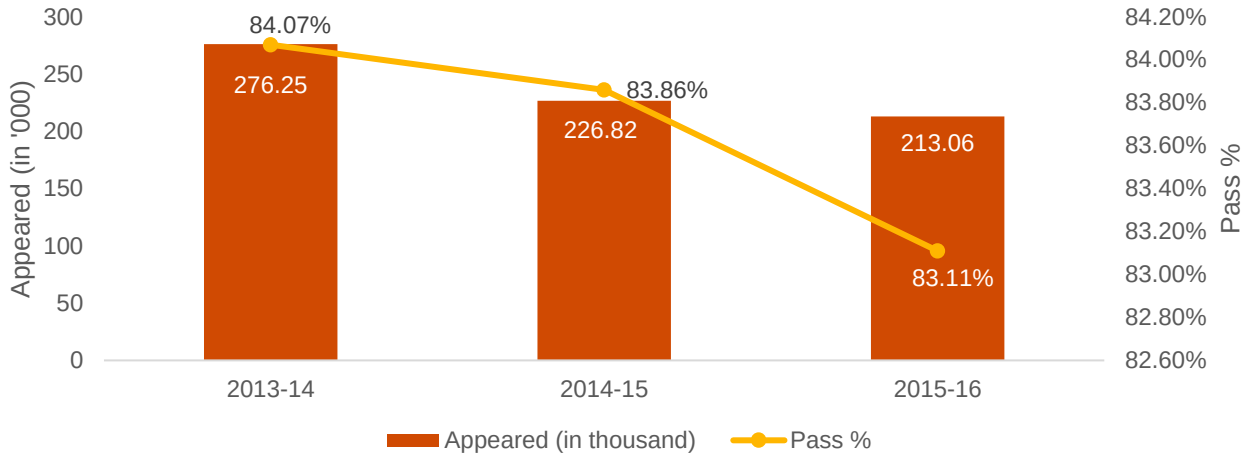


Source: U-DISE 2016-17

It is important to note that the list of 18 vocational courses do not include courses primary to mining sector, thus in the current scenario where mining is not an aspiration sector for employment, awareness generation about career opportunities in the mining sector at early age will be crucial in ensuring higher uptake.

The figure below shows that there has been a decline in the number of students appearing for vocational course exams since 2013-14. In addition, the pass percentage has also fallen from 84.07% in 2013-14 to 83.11% in 2015-16. This implies limited awareness, low levels of interest amongst the students as well as an indication to the quality of teaching.

Figure 42: Trend across appeared and pass % in vocational education



Source: U-DISE 2016-17

States such as Gujarat, Karnataka, Chhattisgarh and Madhya Pradesh with higher enrolments across secondary and higher secondary have higher potential to contribute towards the potential workforce from school levels.

Given that 84.5% of the incremental supply (primary and auxiliary) is estimated at NSQF levels 1 and 2 (school dropouts and pass outs who are not enrolled in higher/ technical education) and that these States will together account for 28% of incremental demand over the 2019-25 period, a significant pool of talent from these states can meet the manpower requirements at these levels.

The next sub-sections delve into supply pool from higher education institutes including Polytechnics, vocational institutes and other short-term training programmes.

5.1.2. College education (polytechnic and engineering institutions)

There are 6,446 institutions offering 2.8 million seats across various engineering and technology courses in the country. The average seat utilization across these institutions was 48% (~1.34 million students) in 2017-18. Additionally, of the total enrolled candidates, only 0.5 million have been placed across various sectors. It is noteworthy that the number of higher education institutes offering engineering and technology related courses have marginally declined from 6,596 in 2015-16 to 6,446 in 2017-18.

In addition, to the 6,446 institutions as of 2017-18 with a total capacity of 2.8 million students, only 168 institutes offer courses directly related to mining sector which is lower than 254 institutes that offered such courses in 2015-16. These 168 institutes comprise only 0.5% of the total intake capacity of the country. Thus, it is important that even in engineering institutions the intake capacity in primary courses related to mining across all States is increased to ensure continuous availability of skilled manpower for the sector.

Basis the occupation mapping of the job roles by SCMS, an analysis of job roles from NSQF level 5 to 7 shows that degree in Geology and Mechanical Engineering is prominent across job roles in exploration and resource management, degree in Mining Engineering and Environment is of priority across major job roles in mining operation. Similarly, degree across Mechanical and Electrical are most preferred in job roles across engineering services sub sector. Whereas, degree in mineral processing and manufacturing is of high requirement across job roles in mineral beneficiation. Therefore, the workforce from engineering colleges in the mining sector either has qualification in direct mining courses such as Mining Engineering and Metallurgy Engineering or in indirect courses such as Mechanical Engineering, Civil Engineering and Electrical Engineering amongst others. Candidates with engineering degree across different domains get employed at job roles from NSQF level 5 to 7 across different sub sectors in mining. of 2017-18[148].

[148] AISHE 2017-18 and JoSAA

Table 20: Mapping of engineering degree requirement to job roles across mining sector

Sub-Sectors	Occupations	Job Roles	Engineering Degree Requirement
Prospecting, Exploration & Mine Planning	Geological Mapping	Geologist	Bachelor's degree in Geology or Petroleum Engineering
		Assistant Geologist	
		Senior Geochemist	MSc or PhD in Chemistry, Geochemistry, Environmental science
		Senior Geologist	MSc or PhD in Geology/ Earth Sciences
		Geophysics Surveyor	Bachelor's or Master's degree in Geophysics
		Mine Sampler	Diploma/ B.Tech/B.E. Mechanical
		Geospatial Technician	Diploma/ B.Tech/B.E. Mechanical
	Geophysical Exploration	Geophysicist	Bachelor's or Master's degree in Geophysics
		Senior Geophysicist	M.Tech (Geophysics)
		Project Geophysicist	M.Tech (Geophysics)
		Drilling Engineer	B.Tech/B.E. Mechanical
		Asst. Geophysicist	M.Tech (Geophysics)
		Asst. Drilling Engineer	Diploma/ B.Tech/B.E. Mechanical
		Mine Driller (Exploration)	Diploma/ B.Tech/B.E. Mechanical
		Drilling Assistant (Exploration)	Diploma/ B.Tech/B.E. Mechanical
	Mineral Estimation	Resource Geologist	M.Sc. (Geo)
		Resource Geologist	M.Sc. (Geo)
		GIS Expert	Associate or Bachelor's degree in GIS technology, geomatics, environmental science
		GIS & Modelling Technician	Associate or Bachelor's degree in GIS technology, geomatics, environmental science
	Mine Planning	Sr. Mine Planning Engineer	Associate or Bachelor's degree in GIS technology, geomatics, environmental science
		Mine Planning Engineer	Associate or Bachelor's degree in GIS technology, geomatics, environmental science
Mining Operations	Mine Surveying	Surveyor	B.Tech/B.E- Civil
		Mine Surveyor-U/G	B.Tech/B.E- Mining
		Jr. Mining Engineer/ Jr. Geotechnical Engineer	B.Tech/B.E – Mining
		Sr. Mining Engineer/ Sr. Geotechnical Engineer	B.Tech/B.E along with M.Tech/ME – Mining
		Mine Surveyor-O/C	B.Tech/B.E- Mining
	Drilling & Cutting	Manager (Mines), Assistant Manager (Mines), Mining Supervisor, Mining Mate / Mining Sirdar, Overman, Mine-foreman	B-Tech/BE- Mining Certification and trainings from IBM, DGMS
	Shot firing/Blasting		
	Loading & Hauling - Opencast		
	Loading & Hauling - Underground		
	Specialist Operations - Underground		
	HSE Functions	Environmental Engineer, Reclamation Supervisor	B.Tech/B.E. – Environmental
		Sr. Environmental Engineer, Safety Officer	B-Tech/BE- Environmental

Sub-Sectors	Occupations	Job Roles	Engineering Degree Requirement
		Emergency Response & Rescue Specialist, Occupation Health Specialist, Safety Specialist, Environmental Specialist	Mining Engineer, Doctor, with HSE certification
Engineering Services	Electrical Services	Jr. Electrical Engineer, Colliery Engineer(E & M), Electrical Supervisor, Foreman (Electrical/Mechanical)	B.Tech/B.E – Electrical
		Electrical Engineer	B.Tech/B.E – Electrical
		Senior Electrical Engineer	B-Tech/BE along with Post Grad- Electrical
	Mechanical Services	Jr. Mechanical Engineer, Mechanical Supervisor - Workshop	B Tech/BE/Diploma Mechanical
		Mechanical Engineer, Colliery Engineer (Excavation)	B Tech/BE Mechanical
		Sr. Mechanical Engineer	B-Tech/BE along with Post Grad- Mechanical
	Instrumentation and Control Systems	Sr. Mechatronics Engineer	B-Tech/BE along with Post Grad- Mechanical
		Sr. Telecom Engineer, Sr. IT Engineer	B-Tech/BE along with Post Grad- ECE/IT
		Mechatronics Supervisor	B Tech/BE/Diploma Mechanical
Mineral Beneficiation	Ore Processing	Jr. Mineral Processing Engineer	B-Tech/BE Mineral Processing/Manufacturing
		Mineral Processing Engineer, Supervisor (Plant & Operations)	M- Tech/ME/MSc Mineral Processing/Manufacturing
		Sr. Mineral Processing Engineer	M- Tech/ME/MSc Mineral Processing/Manufacturing
	Coal Handling Plant	Senior Engineer (Coal handling)	M- Tech/ME/MSc Mineral Processing/Manufacturing/Mining
		Engineer (Coal handling)	

Source: naukri.com, shine.com for engineering degree requirement, PwC Analysis

In Odisha, the Biju Pattnaik University of Technology is supported by the Department of Industries, and hence benefits from industry inputs on curriculum.

Based on interactions with study team, stakeholders reported that mining engineering graduates get placed in both core and ancillary companies. They work across sub-sectors as management trainees. Women graduates work in operations planning and mine design. However, their proportion is small.

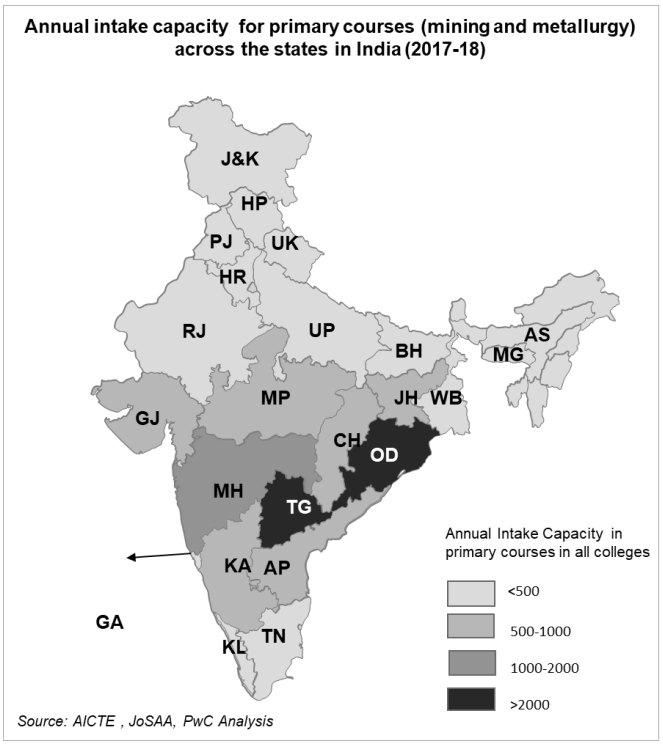
The distribution of training capacity of engineering and technology institutes offering primary courses related to the mining sector across the country is mapped in the figure below. The distribution across the States shows that Odisha and Telangana have highest annual intake capacity. The State of Maharashtra alone offers an annual intake capacity of 1,000-2,000 across engineering and technology institutions. But States such as Rajasthan, Tamil Nadu and West Bengal account for lowest intake capacity across mining and related courses[149].

[149] AICTE 2017-18

Challenges in engineering and technology institutions[150]:

- Enrolments in mining engineering in government institutions like Anna University, IICM Ranchi and Goa Engineering College are based on scores in board and entrance examinations. Many students do not enrol in mining engineering out of choice, and in institutions where placements do not cover enough students, they try to shift to other streams.
- Require industry buy-in in terms of curriculum development to ensure that the program is relevant job requirements. However, qualitative consultations reveal that large employers such as Vedanta, Fomento and Tata Steel actively partner with colleges to support mining departments.
- AICTE requires a component for internship, however, there is a lack of on the job training opportunities for the students from employers. Qualitative consultations in Anna University revealed that employers are wary of providing internships to students due to hazardous conditions in underground mining sites.
- Limited placement opportunities for students. Qualitative consultations reveal that while employers are willing to take students on industry visits, they are not as keen on providing placement. Student Focus Group Discussions revealed that lab facilities are inadequate. Due to recent trends in the sector, colleges are facing challenges in filling seat capacity in mining courses.

Figure 43: Annual intake capacity of institutions imparting mining and metallurgy courses



- Need for shorter courses other than degree programmes for students (such as diplomas in locally relevant job roles e.g. diploma in stone technology would be of great value in the Jodhpur/Jalore region)
- Findings from focus group discussions with students in degree and diploma courses revealed that laboratory facilities in several institutions were inadequate and needed to be replaced. Students also wished for better quality practical sessions, and for their faculty to familiarize themselves with the latest developments.
- Placement opportunities are not consistent – due to overall sector fluctuations, companies do not consistently visit campuses. Even when placement is satisfactory, only reputed institutions with industry linkages for curriculum and internships are favoured.
- While female participation in mining-related courses is increasing, educational institutions still lack gender-sensitive infrastructure.

[150] This section has been developed basis discussion with MBM Engineering College, Jodhpur. It shall be further honed based on the FGDs and IDIs that will be undertaken with other educational institutions during the skill gap study.

Case study: Career aspiration study highlighting the trends of Mining Engineering graduates

Name of the Institution: IIT-BHU, Varanasi

Of the batch of 2018-19 of 94 students that enrolled to pursue undergraduate degree in Mining Engineering ~20 people opted to work in mining sector, which is equivalent to 21% of the total enrolment number.
The remaining 45 students opted to pursuing career in non-core industry and 10 students choose to further their learning in mining sector and remaining students opted to study for competitive examination.

Name of the Institution: IIT-Chennai

A total of 61 candidates that registered placement for Metallurgy and Mechanical Engineering courses, 26 were from Bachelors of Technology course, 15 were from Dual Degree Program, 16 from Masters in Technology Program and 4 from Ph. D program.

Of the 57 candidates that registered from B-Tech, Dual Degree and M-Tech program 29 got placement with different organization such as Altisource Business Solutions, Tata Consultancy Services, Vivriti Capital Private Limited at profile such as Business Analyst, Data Scientist and Modelling, System Engineering, Data Miner, Manager amongst others. With almost none of the graduates and postgraduates opting for employment in core mining industry. The salary ranged from INR 0.4 million per annum to INR 1.7 million per annum.

Name of the Institute: National Institute of Technology, Warangal, Telangana

From the batch of 2017-18 a total of 38 candidates from metallurgical and Material Engineering registered for placement of which 25 candidates opted from placement and the remaining 13 candidates were unplaced. Organisations such as BALCO, Merylitics, Reliance Industries Limited, Vision 40, Microloand etc. The average salary for 25 candidates was reported to be INR 7.41 lakh per annum.

5.1.3. Vocational institutes

The vocational training institutes mainly contributing to mining sector are Industrial Training Institutes (ITIs) and training partners affiliated with National Skill Development Corporation (NSDC) for short-term training programs.

Industrial Training Institutes: [151]

The number of ITIs in the country have increased from 11,108 in February 2016 to 14,850 ITIs in August 2020. The seating capacity has also increased from ~1.7 million in February 2016 to ~3.5 million in August 2020 offering 106 trades across one year and two year programs. Of the total current seating capacity across Government and Private ITIs only 66% of the seats are utilised by candidates. Across the 13 mining dominant States[152], there are 8,484 ITIs across selected 13 States of which 1,919 are Government ITIs and 6,565 are Private ITIs offering a total of 1.96 million seats with a utilization percentage of 63%.

Table 21: Details on ITIs

Parameters	India
Total No. of ITI's	14,850
Total Capacity	3,461,131
No of trainees	2,300,118
Seat utilization (%)	66%

Source: NCVT MIS, PwC Analysis

[151] NCVT MIS
[152] Andhra Pradesh, Chhattisgarh, Goa, Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Telangana and West Bengal

There are 39 courses offered at ITIs that contribute to mining sector (37 indirectly and 2 directly) (list of courses is included Annexure A.7). These courses are being imparted across 2,624 Government ITIs and 11,104 Private ITIs (pan India) accounting for a total intake capacity of 2.65 million with utilisation rate of 71.8%.

Of the 37 courses that indirectly relate to mining sector job roles such as Fitter, Electrician, Welder and Electronic Mechanic account for the highest number as per seat occupancy[153].

Table 22: Mapping of job roles in mining to top five courses in ITI

SNo.	Top 5 courses	Key job roles
1.	Fitter	Mechanic/ Fitter: mostly working in ancillary sector at the vehicle maintenance workshops near mines
2.	Electrician	Mine Electrician
3.	Welder	Mine welder
4.	Electronic Mechanic	Mostly working as HEMM mechanic in mining sector and in ancillary activities at the vehicle maintenance workshops near mines

Source: NCVT MIS and PwC Analysis

An analysis of annual intake capacity of ITIs in 2019 (refer to the figure alongside) suggests that majority of mineral rich states have annual intake capacity of 100 per lakh population and above. States such as Andhra Pradesh, Goa, Jharkhand, Karnataka and Madhya Pradesh account for 200-300 seats per lakh population and States such as Chhattisgarh and West Bengal have less than 100 seats per lakh population at ITI.

Therefore, it can be noted that mineral dominant states tend to lack infrastructure for training and skilling for the sector. Key issues may include:

- limited seats per million population
- limited mining related courses in ITIs
- short term courses in mining sector along with industries for trainees at ITI.

The table below provides information across key indicators for ITIs across the country.

Figure 44: Mapping of annual intake capacity of ITI across 13 States

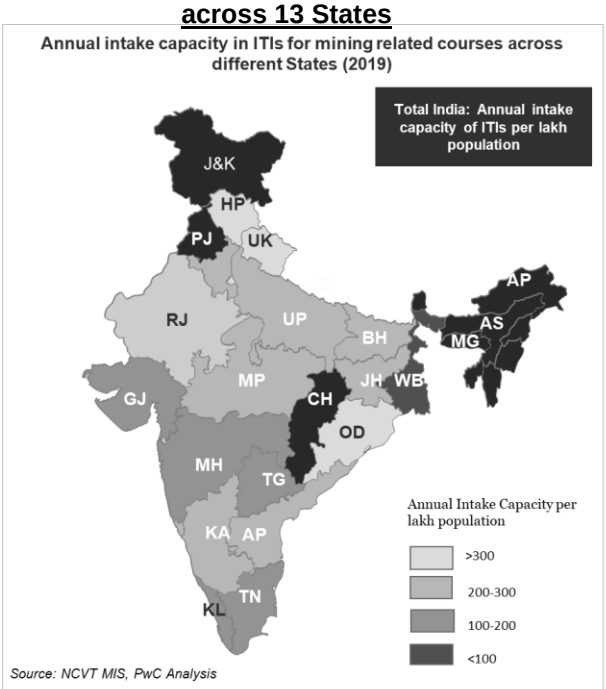


Table 23: District wise mapping of different States to key parameters related to ITIs 2019

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
Andhra Pradesh	Anantapur	39	8	8916	7598	85.2
	Chittoor	42	8	9168	7525	82.1
	Cuddapah	36	8	7660	6496	84.8
	East Godavari	37	9	10208	9182	89.9

[153] NCVT MIS

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Guntur	37	8	6700	5836	87.1
	Krishna	35	11	7164	6211	86.7
	Kurnool	35	7	7052	6105	86.6
	Nellore	30	8	5732	4531	79.1
	Prakasam	50	7	8404	7497	89.2
	Srikakulam	27	6	7336	7219	98.4
	Visakhapatanam	66	10	15556	14571	93.7
	Vizianagaram	31	10	8460	8047	95.1
Assam	Barpeta	1	4	152	74	48.8
	Biswanath	0	0	-	-	0.0
	Bongaigaon	1	5	212	133	62.5
	Cachar	1	8	256	178	69.6
	Charaideo	0	0	0	0	0.0
	Chirang	0	0	0	0	0.0
	Darrang	1	3	128	126	98.4
	Dhemaji	1	2	44	22	50.0
	Dhubri	1	1	20	0	0.0
	Dibrugarh	1	1	24	0	0.0
	Dima Hasao	1	3	68	40	58.3
	Goalpara	1	2	44	19	43.2
	Golaghat	1	1	20	18	90.0
	Hailakandi	1	2	44	0	0.0
	Hojai	0	0	0	0	0.0
	Jorhat	5	9	1,160	0	0.0
	Kamrup	2	9	460	319	69.4
	Kamrup Metro	1	1	24	0	0.0
	Karbi Anglong	1	4	172	0	0.0
	Karimganj	0	0	0	0	0.0
	Kokrajhar	1	1	20	0	0.0
	Lakhimpur	0	0	0	0	0.0
	Majuli	0	0	0	0	0.0
	Marigaon	1	3	112	81	72.7
	Nagaon	2	6	660	611	92.5
	Nalbari	1	2	60	41	67.5
	Sivasagar	2	5	432	389	90.2
	Sonitpur	1	5	296	197	66.4
	South Salmara Mancachar	0	0	0	0	0.0
	Tinsukia	3	8	552	435	78.8
	Udalguri	2	3	104	0	0.0
	West Karbi Anglong	0	0	0	0	0.0

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Araria	4	7	1,196	848	70.9
	Arwal	17	3	2,808	2,752	98.0
	Aurangabad	39	4	9,032	8,880	98.3
	Banka	17	3	2,784	2,568	92.2
	Begusarai	29	8	6,012	5,685	94.6
	Bhagalpur	37	10	8,032	7,096	88.3
	Bhojpur	54	3	9,464	9,166	96.9
	Buxar	25	8	4,964	4,575	92.2
	Champaran	9	2	2,280	2,278	99.9
	Chapra	13	4	2,316	2,047	88.4
	Darbhanga	21	9	3,584	2,994	83.5
	Gaya	87	9	17,972	17,096	95.1
	Gopalganj	21	7	3,984	3,882	97.4
	Jamui	23	4	4,592	4,013	87.4
	Jehanabad	34	4	5,376	5,161	96.0
	Kaimur (Bhabua)	11	2	2,140	1,969	92.0
	Katihar	10	8	2,768	2,484	89.7
	Khagaria	6	2	1,320	1,196	90.6
	Kishanganj	3	3	528	476	90.2
	Lakhisarai	7	3	1,048	902	86.1
	Madhepura	5	3	808	804	99.5
	Madhubani	20	6	3,572	3,256	91.1
	Motihari	2	2	320	320	100.0
	Munger	38	8	6,712	6,178	92.1
	Muzaffarpur	57	11	11,516	9,917	86.1
	Nalanda	86	4	17,012	16,028	94.2
	Nawada	30	9	6,380	5,803	90.9
	Pashchim Champaran	11	8	3,032	2,829	93.3
	Patna	227	13	43,416	39,348	90.6
	Purba Champaran	18	9	4,636	4,336	93.5
	Purnia	11	4	1,744	1,622	93.0
	Rohtas	65	7	13,844	12,763	92.2
	Saharsa	4	3	668	621	92.9
	Samastipur	38	4	8,048	7,750	96.3
	Saran	48	8	9,492	8,407	88.6
	Sheikhpura	11	2	2,000	1,958	97.9
	Sheohar	2	2	240	240	100.0
	Sitamarhi	15	8	3,164	2,859	90.4
	Siwan	26	3	5,576	5,397	96.8
	Supaul	5	8	1,116	901	80.7

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Vaishali	58	4	11,212	10,535	94.0
Chhattisgarh	Balod	2	4	332	296	89.2
	Baloda Bazar Bhatapa	7	4	752	615	81.8
	Balrampur	2	3	128	79	62.0
	Bastar	4	7	640	444	69.4
	Bemetara	5	3	424	370	87.3
	Bijapur	1	3	128	56	44.0
	Bilaspur	18	13	2,932	2,612	89.1
	Dantewada	2	4	280	229	81.8
	Dhamtari	3	3	372	296	79.7
	Durg	21	10	4,044	3,350	82.8
	Gariyaband	2	2	140	100	71.7
	Jagdalpur	0	0	-	-	0.0
	Janjgir-Champa	20	4	2,704	2,426	89.7
	Jashpur	2	1	100	90	90.0
	Kabirdham	2	2	160	144	90.0
	Kanker	5	3	408	313	76.6
	Kondagaon	3	3	384	260	67.6
	Korba	7	8	980	761	77.7
	Korea	8	3	848	782	92.2
	Mahasamund	5	4	412	378	91.9
	Mungeli	2	1	120	114	95.0
	Narayanpur	1	5	208	156	75.0
	Raigad	11	6	1,008	827	82.0
	Raipur	12	10	1,980	1,416	71.5
	Rajnandgaon	7	3	792	741	93.5
	Sukma	1	2	40	21	52.5
	Surajpur	3	3	168	143	85.2
	Surguja	4	7	732	580	79.2
Goa	North Goa	8	9	1,832	1,334	72.8
	South Goa	4	6	740	523	70.7
Gujarat	Ahmadabad	21	12	6,056	4,659	76.9
	Amreli	10	8	2,076	1,272	61.3
	Anand	24	10	2,732	2,189	80.1
	Arvalli	9	8	2,368	1,871	79.0
	Banas Kantha	18	9	3,464	2,415	69.7
	Bharuch	19	10	3,040	2,460	80.9
	Bhavnagar	11	7	2,444	1,789	73.2
	Botad	4	3	540	364	67.4
	Chhotaudepur	4	5	704	476	67.6

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Dang	1	3	144	103	71.3
	Devbhumi Dwarka	4	3	684	527	77.1
	Dohad	15	9	3,216	1,805	56.1
	Gandhinagar	6	10	2,192	1,586	72.4
	Gir Somnath	5	3	776	591	76.2
	Jamnagar	5	9	2,008	1,459	72.7
	Junagadh	16	10	2,944	1,923	65.3
	Kachchh	10	6	1,900	1,200	63.2
	Kheda	17	10	3,536	2,869	81.1
	Mahesana	24	11	5,144	4,092	79.6
	Mahisagar	6	4	1,048	924	88.2
	Morbi	8	7	1,252	589	47.0
	Narmada	6	4	360	246	68.2
	Navsari	13	11	3,156	2,539	80.4
	Panch Mahals	25	7	3,920	3,155	80.5
	Patan	14	5	2,276	1,749	76.9
	Porbandar	3	4	472	384	81.3
	Rajkot	15	11	3,716	2,254	60.7
	Sabar Kantha	11	8	1,756	1,268	72.2
	Surat	20	11	4,044	3,276	81.0
	Surendranagar	10	10	1,808	1,259	69.6
	Tapi	6	5	904	721	79.7
	The Dangs	0	0	-	-	0.0
	Vadodara	30	13	5,268	4,131	78.4
	Valsad	7	7	1,328	1,059	79.8
Haryana	Ambala	10	9	2900	2,424	83.6
	Bhiwani	43	12	6864	5,271	76.8
	Charki Dadri	2	3	160	136	85.0
	Faridabad	8	9	1424	921	64.7
	Fatehabad	20	8	3152	2,516	79.8
	Gurugram	9	16	2092	1,602	76.6
	Hisar	33	13	6632	4,685	70.6
	Jhajjar	13	11	2976	1,989	66.8
	Jind	24	12	4360	3,439	78.9
	Kaithal	19	10	2852	2,154	75.5
	Karnal	16	11	3024	2,356	77.9
	Kurukshetra	21	10	3360	2,498	74.3
	Mahendragarh	23	10	3800	3,212	84.5
	Mewat	8	12	2488	1,693	68.1
	Palwal	8	10	1728	1,407	81.4

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Panchkula	5	6	776	586	75.5
	Panipat	11	11	1912	1,439	75.3
	Rewari	20	11	3432	2,535	73.9
	Rohtak	17	16	3776	2,595	68.7
	Sirsa	17	13	3156	2,535	80.3
	Sonipat	12	12	2876	2,182	75.9
	Yamunanagar	14	10	2568	1,661	64.7
Himachal Pradesh	Bilaspur	16	4	2320	2,059	88.8
	Chamba	14	6	2108	1,838	87.2
	Hamirpur	26	7	3044	2,543	83.5
	Kangra	49	13	7520	6,508	86.5
	Kinnaur	2	3	176	132	75.0
	Kullu	11	8	1428	1,267	88.7
	Lahul And Spiti	2	2	128	30	23.2
	Mandi	38	9	5160	4,489	87.0
	Shimla	23	7	2492	2,077	83.3
	Sirmaur	16	7	1484	1,229	82.8
	Solan	22	8	3476	3,021	86.9
	Una	21	8	3136	2,635	84.0
Jharkhand	Bokaro	30	9	7,444	6,981	93.8
	Chatra	2	3	368	256	69.5
	Deoghar	22	7	6,572	5,782	88.0
	Dhanbad	47	11	16,772	14,928	89.0
	Dumka	11	9	3,140	2,811	89.5
	East Singhbum	35	8	8,976	7,542	84.0
	Garhwa	5	7	1,312	664	50.6
	Giridih	6	8	1,200	926	77.2
	Godda	8	4	2,072	1,846	89.1
	Gumla	4	7	652	451	69.1
	Hazaribagh	20	10	4,728	4,124	87.2
	Jamshedpur	0	0	-	-	0.0
	Jamtara	6	5	1,236	972	78.6
	Khunti	1	1	48	-	0.0
	Koderma	6	6	1,248	873	70.0
	Latehar	5	4	840	522	62.1
	Lohardaga	4	7	856	463	54.0
	Pakur	1	4	248	-	0.0
	Palamu	19	7	6,120	5,542	90.6
	Ramgarh	7	3	2,220	1,977	89.1
	Ranchi	53	13	17,372	13,948	80.3

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Sahebganj	2	5	320	210	65.6
	Saraikela Kharsawan	17	10	3,544	3,086	87.1
	Simdega	3	6	276	88	31.7
	West Singhbhum	7	9	1,704	1,272	74.6
Karnataka	Bagalkot	71	8	7,936	7,012	88.4
	Belgaum	120	8	13,260	11,495	86.7
	Bellary	89	8	10,604	9,449	89.1
	Bengaluru Rural	20	8	2,676	2,058	76.9
	Bengaluru Urban	54	11	8,124	5,612	69.1
	Bidar	73	7	7,456	6,300	84.5
	Bijapur	98	8	10,492	8,190	78.1
	Chamarajanagar	18	6	1,980	1,688	85.3
	Chikballapur	24	7	3,312	3,022	91.3
	Chikkamagaluru	24	6	2,712	1,713	63.2
	Chitradurga	64	8	6,200	5,626	90.7
	Dakshin Kannad	27	8	4,432	3,559	80.3
	Davangere	56	10	7,268	6,247	86.0
	Dharwad	49	13	6,188	5,225	84.4
	Gadag	41	6	5,068	4,278	84.4
	Gulbarga	82	9	9,464	7,596	80.3
	Hassan	69	9	8,304	5,678	68.4
	Haveri	53	7	5,664	4,997	88.2
	Kodagu	5	7	988	621	62.8
	Kolar	35	8	5,324	4,187	78.6
	Koppal	47	8	5,060	4,642	91.7
	Mandya	53	9	6,156	4,927	80.0
	Mysuru	50	15	6,552	5,000	76.3
	Raichur	40	7	3,648	2,840	77.9
	Ramanagara	27	7	3,404	2,863	84.1
	Shivamogga	40	9	5,684	3,812	67.1
	Tumakuru	71	8	8,364	7,204	86.1
	Udupi	14	6	1,864	1,430	76.7
	Uttar Kannad	24	8	4,088	3,251	79.5
	Yadgir	30	5	2,960	2,264	76.5
Madhya Pradesh	Agar Malwa	3	2	260	210	80.8
	Alirajpur	2	3	248	153	61.7
	Anuppur	12	5	1,728	1,250	72.4
	Ashoknagar	10	2	1,340	1,179	88.0
	Balaghat	42	6	8,368	7,374	88.1
	Barwani	6	4	768	649	84.5

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Betul	38	6	7,876	6,531	82.9
	Bhind	34	9	5,208	4,331	83.2
	Bhopal	50	11	9,340	7,078	75.8
	Burhanpur	7	2	800	600	75.0
	Chhatarpur	29	3	3,412	2,852	83.6
	Chhindwara	43	10	8,436	7,146	84.7
	Damoh	10	3	1,392	1,036	74.4
	Datia	23	2	2,820	2,628	93.2
	Dewas	14	6	2,340	1,822	77.8
	Dhar	12	8	1,972	1,348	68.3
	Dindori	4	3	520	357	68.6
	East Nimar	0	0	-	-	0.0
	Guna	13	3	1,668	1,620	97.1
	Gwalior	72	11	11,340	10,250	90.4
	Harda	11	3	1,728	1,423	82.4
	Hoshangabad	26	8	5,960	5,014	84.1
	Indore	27	11	4,728	3,510	74.2
	Jabalpur	37	12	6,664	5,366	80.5
	Jhabua	5	4	456	274	60.1
	Katni	24	3	3,548	3,094	87.2
	Khandwa	13	9	1,996	1,552	77.7
	Khargone	12	7	1,936	1,663	85.9
	Mandla	11	6	1,724	1,261	73.1
	Mandsaur	32	4	3,916	3,491	89.2
	Morena	52	5	7,348	6,712	91.3
	Narsinghpur	16	4	2,680	2,249	83.9
	Neemuch	13	8	2,100	1,752	83.4
	Panna	10	2	1,040	971	93.4
	Raisen	15	7	1,624	1,128	69.4
	Rajgarh	24	3	3,148	2,858	90.8
	Ratlam	15	10	2,248	1,877	83.5
	Rewa	36	11	5,228	4,331	82.8
	Sagar	31	8	4,244	3,674	86.6
	Satna	18	10	3,008	2,413	80.2
	Sehore	38	6	5,080	4,616	90.9
	Seoni	22	5	2,968	2,418	81.5
	Shahdol	18	9	2,864	1,942	67.8
	Shajapur	10	5	1,476	1,276	86.4
	Sheopur	10	2	1,440	1,329	92.3
	Shivpuri	29	9	4,260	3,671	86.2

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Sidhi	8	7	992	771	77.7
	Singrauli	12	2	1,760	1,385	78.7
	Tikamgarh	13	2	1,500	1,242	82.8
	Ujjain	13	9	2,648	2,069	78.1
	Umaria	10	3	1,288	1,114	86.5
	Vidisha	15	3	1,808	1,683	93.1
	West Nimar	0	0	-	-	0.0
Maharashtra	Ahmednagar	43	13	7,916	6,453	81.5
	Akola	10	10	2,404	1,803	75.0
	Amravati	31	10	6,068	5,120	84.4
	Aurangabad	17	13	2,692	2,062	76.6
	Beed	24	10	2,940	1,838	62.5
	Bhandara	45	8	6,040	4,785	79.2
	Buldhana	22	13	4,100	2,938	71.7
	Chandrapur	51	12	9,556	6,363	66.6
	Dhule	21	11	3,384	3,215	95.0
	Gadchiroli	15	12	1,880	1,267	67.4
	Gondia	18	8	2,932	1,945	66.3
	Hingoli	7	6	588	-	0.0
	Jalgaon	89	16	16,648	14,119	84.8
	Jalna	11	9	1,700	1,585	93.2
	Kolhapur	51	12	9,708	6,957	71.7
	Latur	18	12	3,436	2,915	84.8
	Mumbai	21	13	6,836	4,748	69.5
	Mumbai Suburban	8	9	1,736	1,045	60.2
	Nagpur	84	11	18,092	12,746	70.4
	Nanded	25	15	3,692	2,630	71.2
	Nandurbar	8	10	1,960	1,639	83.6
	Nashik	50	14	10,080	7,748	76.9
	Osmanabad	16	10	1,928	1,437	74.5
	Palghar	1	2	80	-	0.0
	Palghar	0	0	-	-	0.0
	Parbhani	13	13	2,552	2,035	79.8
	Pune	60	18	14,004	10,101	72.1
	Raigad	19	12	3,820	3,253	85.2
	Ratnagiri	16	10	3,080	-	0.0
	Sangli	24	13	5,188	3,844	74.1
	Satara	18	12	5,708	4,334	75.9
	Sindhudurg	9	9	800	545	68.2
	Solapur	37	12	6,844	5,353	78.2

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Thane	32	11	6,432	4,211	65.5
	Wardha	22	8	4,016	2,677	66.7
	Washim	6	7	860	-	0.0
	Yavatmal	21	12	3,908	2,967	75.9
Odisha	Anugul	29	10	8,844	7,632	86.3
	Balangir	11	5	2,068	1,728	83.6
	Balasore	53	9	13,552	12,473	92.0
	Baleshwar	0	0	-	-	0.0
	Bargarh	12	3	2,392	2,102	87.9
	Bhadrak	26	4	7,128	6,205	87.1
	Boudh	2	3	448	445	99.3
	Cuttack	39	11	11,800	9,546	80.9
	Deogarh	3	3	568	568	100.0
	Dhenkanal	19	4	4,420	3,711	84.0
	Gajapati	6	4	1,112	986	88.7
	Ganjam	40	10	11,700	11,024	94.2
	Jagatsinghapur	18	2	5,000	4,152	83.0
	Jajapur	29	5	7,012	5,092	72.6
	Jharsuguda	7	3	1,568	1,435	91.5
	Kalahandi	5	9	1,404	1,029	73.3
	Kandhamal	1	6	400	360	90.1
	Kendrapara	17	2	3,320	2,445	73.7
	Kendujhar	15	9	3,508	3,082	87.9
	Khordha	47	5	11,340	9,551	84.2
	Koraput	12	7	3,060	2,733	89.3
	Malkangiri	3	5	496	463	93.3
	Mayurbhanj	44	7	10,100	8,775	86.9
	Nabarangpur	7	4	840	550	65.5
	Nayagarh	10	4	2,032	1,680	82.7
	Nuapada	4	4	904	830	91.8
	Puri	20	6	2,984	2,436	81.6
	Rayagada	10	5	1,704	1,477	86.7
	Sambalpur	11	9	2,536	2,009	79.2
	Sonepur	1	1	120	-	0.0
	Subarnapur	1	3	528	414	78.4
	Sundargarh	33	10	10,992	9,668	88.0
Rajasthan	Ajmer	58	11	9,508	7,513	79.0
	Alwar	125	7	22,284	21,054	94.5
	Banswara	8	5	1,788	1,561	87.3
	Baran	39	4	5,228	4,856	92.9

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Barmer	28	7	3,400	2,959	87.0
	Bharatpur	96	7	14,380	13,555	94.3
	Bhilwara	37	8	5,804	5,051	87.0
	Bikaner	26	6	4,376	3,569	81.6
	Bundi	41	4	6,220	5,931	95.4
	Chittorgarh	26	7	4,668	3,679	78.8
	Churu	54	6	8,544	7,359	86.1
	Dausa	113	5	21,792	21,169	97.1
	Dholpur	43	5	5,068	4,754	93.8
	Dungarpur	8	5	796	606	76.1
	Ganganagar	39	6	5,608	4,862	86.7
	Hanumangarh	42	7	6,364	5,697	89.5
	Jaipur	294	11	48,204	44,771	92.9
	Jaisalmer	5	4	804	704	87.5
	Jalore	7	3	948	706	74.5
	Jhalawar	42	5	4,512	3,857	85.5
	Jhunjhunu	95	7	15,704	12,486	79.5
	Jodhpur	57	8	8,588	7,414	86.3
	Karauli	45	4	10,716	10,423	97.3
	Kota	78	9	13,612	12,438	91.4
	Nagaur	94	8	15,548	13,783	88.6
	Pali	17	6	2,308	1,736	75.2
	Pratapgarh	6	5	876	582	66.4
	Rajsamand	10	5	1,392	1,182	84.9
	Sawai Madhopur	34	3	7,332	7,080	96.6
	Sikar	151	8	22,024	19,361	87.9
	Sirohi	7	5	1,208	876	72.5
	Tonk	49	4	7,988	6,582	82.4
	Udaipur	20	9	3,408	2,877	84.4
Tamil Nadu	Ariyalur	6	7	912	776	85.1
	Chennai	13	9	2,884	1,736	60.2
	Coimbatore	18	11	3,064	2,013	65.7
	Cuddalore	24	8	4,996	3,398	68.0
	Dharmapuri	4	6	944	777	82.3
	Dindigul	12	6	1,808	1,187	65.6
	Erode	14	7	1,948	1,281	65.8
	Kanchipuram	16	10	3,016	2,515	83.4
	Kanniyakumari	15	7	2,624	1,281	48.8
	Karur	7	5	720	436	60.6
	Krishnagiri	5	7	1,008	880	87.3

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Madurai	13	9	2,932	2,012	68.6
	Nagapattinam	15	6	2,184	1,504	68.9
	Namakkal	10	6	1,840	1,119	60.8
	Perambalur	6	6	932	656	70.4
	Pudukkottai	15	10	2,124	1,652	77.8
	Ramanathapuram	7	8	1,128	804	71.3
	Saharsa	0	0	-	-	0.0
	Salem	17	9	3,036	2,183	71.9
	Sivaganga	11	10	1,644	1,147	69.8
	Thanjavur	19	11	3,724	2,690	72.2
	The Nilgiris	7	5	720	394	54.8
	Theni	10	8	1,600	1,125	70.3
	Thiruvallur	15	9	2,128	1,426	67.0
	Thiruvarur	12	5	1,344	774	57.6
	Thoothukkudi	15	9	1,960	1,331	67.9
	Tiruchirappalli	25	10	3,632	2,899	79.8
	Tirunelveli	28	7	4,504	2,802	62.2
	Tiruppur	7	8	1,120	755	67.4
	Tiruvannamalai	22	6	3,064	2,542	83.0
	Vellore	28	11	4,672	3,902	83.5
	Villupuram	29	9	3,568	2,967	83.1
	Virudhunagar	12	8	2,436	1,718	70.5
Telangana	Adilabad	15	6	3,196	2,889	90.4
	Bhadradri Kothagudem	5	3	1,384	1,337	96.6
	Hyderabad	21	11	3,936	3,347	85.0
	Jagitial	0	0	-	-	0.0
	Jangoan	1	3	532	489	91.9
	Jayashankar Bhupalapally	0	0	-	-	0.0
	Jogulamba Gadwal	0	0	-	-	0.0
	Kamareddy	0	0	-	-	0.0
	Karimnagar	25	7	5,608	5,329	95.0
	Khammam	29	9	7,232	6,449	89.2
	Kumuram Bheem Asifabad	0	0	-	-	0.0
	Mahabubabad	0	0	-	-	0.0
	Mahabubnagar	33	8	5,680	5,258	92.6
	Mancherial	0	0	-	-	0.0
	Medak	29	8	8,096	7,189	88.8
	Medchal Malkajgiri	0	0	-	-	0.0
	Nagarkurnool	2	3	368	360	97.9
	Nalgonda	29	6	5,876	5,117	87.1

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Nirmal	0	0	-	-	0.0
	Nizamabad	15	9	3,128	2,595	83.0
	Peddapalli	0	0	-	-	0.0
	Rajanna Sircilla	1	4	216	176	81.3
	Ranga Reddy	38	8	8,500	7,752	91.2
	Sangareddy	2	6	404	292	72.2
	Siddipet	1	3	432	382	88.5
	Suryapet	0	0	-	-	0.0
	Vikarabad	1	2	80	78	97.5
	Wanaparthy	0	0	-	-	0.0
	Warangal	35	7	7,928	7,348	92.7
	Yadadri Bhuvanagiri	2	4	440	416	94.5
Uttarakhand	Almora	9	8	696	479	68.8
	Bageshwar	3	3	164	85	51.9
	Chamoli	7	4	548	442	80.7
	Champawat	2	4	220	130	58.9
	Dehradun	22	7	3608	2,689	74.5
	Haridwar	50	8	9000	7,303	81.1
	Nainital	16	9	1836	1,345	73.3
	Pauri Garhwal	11	7	1132	892	78.8
	Pithoragarh	8	5	624	326	52.2
	Rudra Prayag	1	3	128	65	50.9
	Tehri Garhwal	7	5	592	350	59.2
	Udam Singh Nagar	17	9	2004	1,264	63.1
	Uttar Kashi	7	4	636	522	82.1
West Bengal	24 Paraganas North	21	8	4,464	4,063	91.0
	24 Paraganas South	19	8	4,292	3,392	79.0
	Bankura	17	8	3,460	3,061	88.5
	Barddhaman	38	13	9,860	8,904	90.3
	Birbhum	14	10	3,348	2,741	81.9
	Dakshin Dinajpur	7	6	1,676	1,282	76.5
	Darjeeling	6	8	948	843	88.9
	Haora	9	12	2,316	1,827	78.9
	Hooghly	18	11	4,284	3,762	87.8
	Jalpaiguri	7	6	1,424	1,174	82.4
	Koch Bihar	5	8	984	803	81.6
	Kolkata	8	12	3,576	3,075	86.0
	Maldah	4	7	952	817	85.9
	Medinipur East	12	5	2,172	1,947	89.6
	Medinipur West	22	10	5,460	4,735	86.7

State	Districts	ITIs Offering Mining related Courses	No. of Mining Trades (direct & indirect)	Total Capacity	Total Trainees	Utilization %
	Murshidabad	9	10	2,176	1,708	78.5
	Nadia	18	11	4,892	4,607	94.2
	Purulia	13	10	3,076	2,823	91.8
	Uttar Dinajpur	6	6	1,316	1,149	87.3

Source: NCVT MIS, PwC Analysis

Challenges with respect to vocational courses at Industrial Training Institutes:[154]

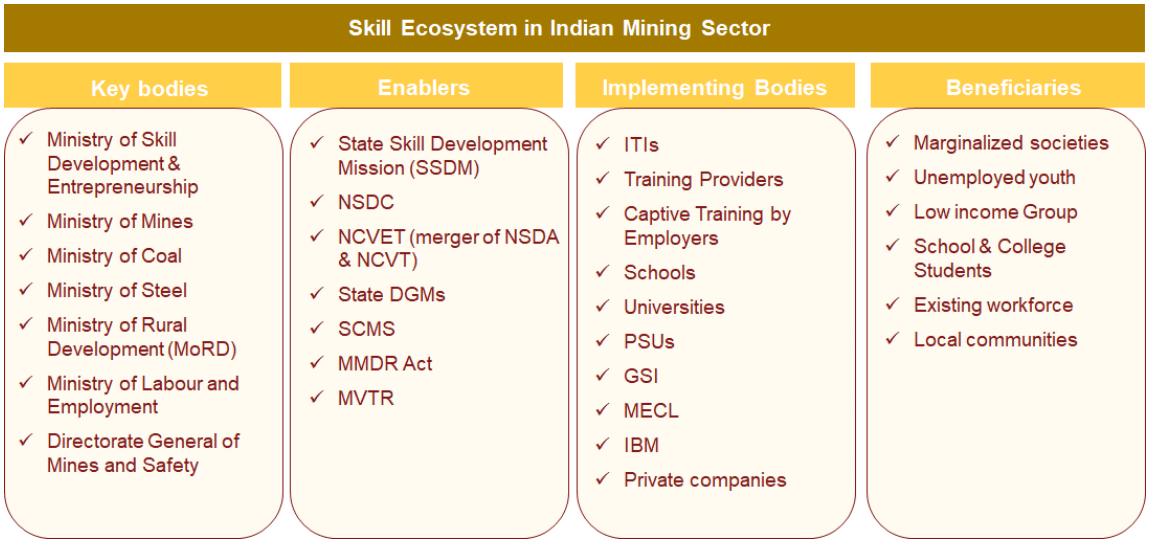
- Lack of direct mining related courses at ITIs across the country
- Limited ITIs in and around mining clusters
- Lack of participation of mining industry with ITIs to impart short term courses, create awareness and aspiration
- Low intake capacity of institute in mining rich States
- Dated curriculum at institute does not account for technological changes in mining sector
- Lack of counselling facility and mining mentors in mining industry with ITI background

Overall, it is important to understand that candidates from ITIs contribute to most of the job roles across NSQF level 1 to 4 both in organised and unorganised mining industry. Therefore, to make the workforce available for mining sector it is important that above mentioned challenges are resolved.

Short term training program: [155]

Four key ministries that oversee skill development and vocational training in the mining sector in India are the Ministry of Mines, Ministry of Skill Development and Entrepreneurship, Ministry of Coal and Ministry of Steel[156].

Figure 45: Overview of the skill and vocational training ecosystem in the Indian mining sector



[154] The challenges are based on secondary and shall be further strengthen after the primary consultations
[155] SCMS website and secondary data
[156] Skill Plan for the Mining Sector 2016-2022, Ministry of Mines

In order to attain the envisaged growth in the sector, apex institutions and the major private sector organisations in mining, recognised the need for streamlined and relevant skilling of the workforce.

On the short-term skilling front, MoSDE through National Skill Development Corporation (NSDC) and SCMS is imparting NSQF aligned training under the **Pradhan Mantri Kaushal Vikas Yojana (PMKVY), DDU-GKY, Industry Partnership and RPL.**

SCMS has been undertaking QP based training and upskilling people for the mining industry in the country. Between 2015-16 and 2018-19 SCMS trained 53,994 students under PMKVY scheme and 3,977 under non PMKVY scheme (CSR based training and special projects) across 22 QPs of NSQF level 4 and below.

Short Term Training programs aligned to National Skill Qualification Framework are imparted by training partner affiliated to National Skill Development Corporation through 37 Sector Skill Council. The partners for imparting vocational courses in mining sector are empanelled with Skill Council for Mining Sector (SCMS).

Currently there are 22 partners imparting training across the States of Maharashtra, Karnataka, Jharkhand, Gujarat, Odisha, Haryana, Kerala, Bihar, Madhya Pradesh, Rajasthan, Chhattisgarh, Uttarakhand and New Delhi[157]. The training is being offered across the broad categories-

- **Short term training ranging** from 200 to 600 hours across job roles identified in mining sector from NSQF level 1 to 5,
- **Recognition of Prior Learning** to assess and certify prior skills of existing workforce and to impart refresher training of a minimum of 80 hours to the candidates.
- **Long term trainings** in collaboration with industry partners under CSR initiatives is also being taken up by SCMS. A case study highlighting SCMS partnership with Hindustan Zinc to impart skill training across demand driven job role such as Jumbo Driller is mentioned below:

Case Study: Hindustan Zinc Mining Academy

Hindustan Zinc Mining Academy established in the year 2014 under the banner of HZL CSR is being run in partnership with IISD and under the guidance of Skill Council for Mining Sector (SCMS). The primary objective of the academy is to make the youth, particularly those in rural areas employable by delivering training on latest and most advanced equipment used in underground mining operations.

The academy has a residential training set-up across 3 centres at Bhilwara, Rajsamand and Zawar in Rajasthan and is currently training eligible youth[158] in 'Jumbo Drill Operations'. Key features of the programme are:

- In order to select candidates, the academy invites online applications and the shortlisted applicants undergo a 3 stage screening-written test, oral test and medical examination. The selected trainees (total of 100 students divided in a batch of 30 each across 3 centres) are awarded a stipend of INR10,500 per month and INR 2,000 is given as a top-up to all those who score 80-90% in the weekly tests.
- The trainees undergo soft skills training for a period of 1.5 months in Udaipur and, are rotated across three training domains- classroom based training, training using Simlog and training in mines (on the job training) on a weekly and monthly basis.

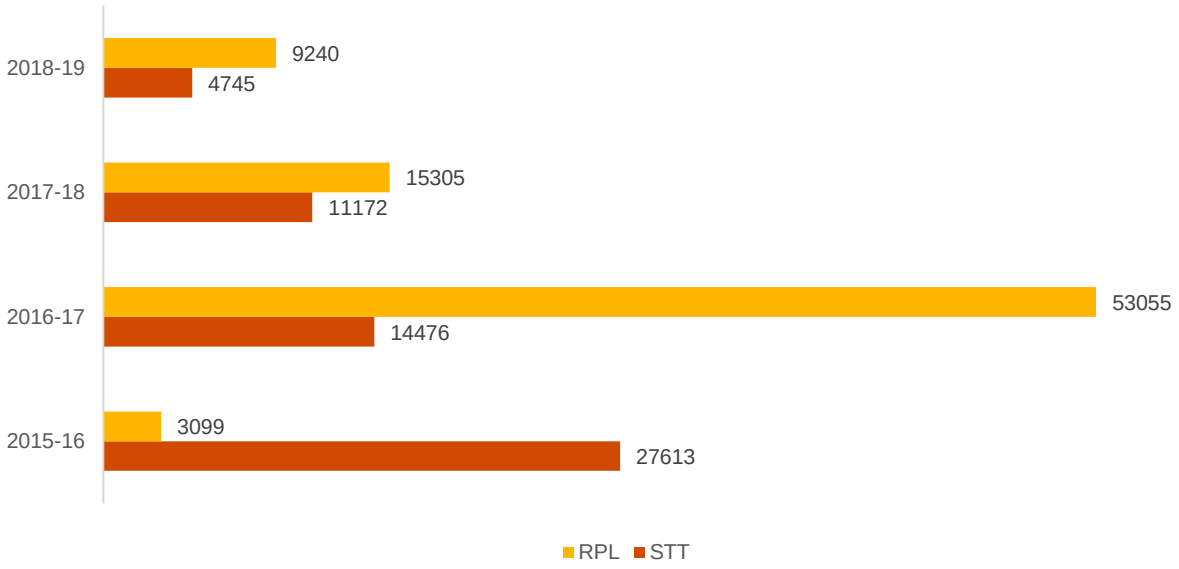
[157] http://skillcms.in/training-partners/
[158] Basic qualification from ITI/ Diploma holders, Height: 5'4", Weight: 50 kg, Eyesight: 6/6, Hearing ability: 85 decibels, Age: 20-30 years, State: Rajasthan (training program is only for the residents of Rajasthan)

- In order to monitor students' progress, SCMS conducts an evaluation every quarter through Skillsmantra. Students are assessed basis an oral and written test along with 1 hour test on machines and every student has to score at least 70% in the assessment.
- The pass-outs of each batch are placed within Hindustan Zinc with an average salary of INR 3,00,000/- per annum.

Thus, the academy is imparting training for a highly skilled, niche job role and is absorbing trained jumbo drill operators for their mining operations. It is also indicative of the fact that training on technological advancements, particularly those requiring high-tech skills should be industry-led.

The short-term trainings by SCMS across programs such as Pradhan Mantri Kaushal Vikas Yojna (PMKVY), special projects, industry funded CSR programs and Deen Dayal Upadhyay Grameen Kaushal Yojna (DDU-GKY) has been imparted to ~58,000 youth along with assessments and refresher training under RPL to 66,924 candidates from year 2015-16 to 2018-19.

Figure 46: No. of students trained and certified (PMKVY + Special Project+ Industry Funded+ Others)



Source: Data received from SCMS and PwC Analysis

The analysis trend over past four year highlights a decline in short term training but an increase in RPL training in comparison to Short Term Training focusing on accessing the current skills and certifying the workforce to enhance their employability and upgrading skills of current workforce. **In context of the RPL trainings undertaken for minor mineral workers in Jodhpur, feedback from key stakeholders suggests the need for generating awareness amongst employer to recognize the premium value carried by these certificates.**

The short term training currently being imparted by SCMS is at different competency levels (NSQF levels), with 34 of 45 courses/QPs concentrated at NSQF level 4. The table below shows QPs across sub-sectors and occupations as per SCMS's occupation map.

Table 24: Mapping of QPs vis-a-vis sub-sector and occupations

Sub-Sector	Occupation	No of Job roles	QPs Available
Prospecting, Exploration & Mine Planning	Geological Mapping	21	03
	Exploration		
	Mineral Estimation		
	Mine Planning		
Mining Operations	Mine Surveying	70	32
	Drilling/Cutting		
	Shot firing/ Blasting		
	Loading & Hauling - Opencast		
	Loading & Hauling - Underground		
	Specialized Operations		
	HSE Functions		
	Placer Mining		
Engineering Services	Electrical Services	37	08
	Mechanical Services		
	Instrumentation & Control Systems		
Mineral Beneficiation	Ore Processing	26	01
	Coal Handling Plant		
Administrative and Support Services	Administrative and financial Services	35	01
	Other Services (Horticulture, Security, Construction, Hostility)		
Metal Extraction and Refining	Extraction and Refining Process	18	NIL

Source: SCMS occupation map

Figure 47: The competency and job role mapping at NSQF level 4 across different work categories

Sub Category	Occupation	Job Role(NSFQ 4)	Job Roles Imparted by SCMS	Short Term Training in Past 3 Years	RPL in Past 3 Years
Exploration & Resource Management	Geological Exploration	Geological Assistant	NA		
	Geophysical Exploration	Geophysics Survey Operator	NA		
	Exploration Drilling	Mine Driller (Exploration)	Mine Driller (Exploration)		
	Resource Management	GIS & Modelling Technician	NA		
Mining Operations	Mine Surveying	Assistant Mine Surveyor	Assistant Mine Surveyor	198	201
	Drilling & Cutting	Rig mounted Drill operator, Wire Saw Operator, Jack-hammer Operator	Rig mounted Drill operator, Wire Saw Operator	116	2216
	Blasting	Blaster/Shot Firer, Explosive Van Operator	Blaster/Shot Firer, Explosive Van Operator		717
	Loading & Hauling - Opencast	HEMM Operators (Excavator, Loader, Dumper, Bulldozer, Sprinkler, Grader, Bucket Wheel Excavator, Surface Miner, etc), Stacker & Reclaimer Operator, Mobile Conveyor Belt Operator, Dragline Operator	Excavator, Loader, Dumper, Bulldozer and Grader operator, Surface Miner Operator	878	15598
	Loading & Hauling – Underground	SDL & LHD Operator, Track layer Operator, Long wall Operator, Haulage Operator	SDL & LHD Operator, Track layer Operator, Long wall Operator, Haulage Operator	17	2062
	Specialist Operations – Underground	Winding Engine Operator, Banksman, Roof Bolter, Gas Detector, Ventilation Adequacy Checker, Strata Monitoring Operator, Jumbo Operator, Road Header Operator, Scaler Operator	Winding Engine Operator, Banksman, Roof Bolter, Gas Detector, Ventilation Adequacy Checker, Strata Monitoring Operator, Jumbo Operator	301	3008
	HSE Functions	Safety Operator, Fireman	Safety Operator, Fireman	18122	1827
Engineering Services	Electrical Services	Mine Electrician, Auto Electrician	Mine Electrician	13270	7182
	Field Services – Mechanical	HEMM Mechanic	HEMM Mechanic	160	834
	Workshop - Mechanical	Mine-Machinist, Compressor Operator, Dewatering pump Operators, Mine Welder	Mine-Machinist, Compressor Operator, Dewatering pump Operators, Mine Welder	1092	3041
Mineral Beneficiation	Ore Processing	Ore Processing Operator	Ore Processing Operator		270
	Instrumentation & Control Systems	Mechatronics Incharge, Instrumentation Technician	Mechatronics Incharge		

No QP and No Training
0-1,000
1,000-10,000
Above 10,000

Note: The sub-sectors, occupations and job roles have been taken as per SCMSs training data
Source: SCMS Occupation map, PwC Analysis

Given that most of the training being imparted are at level 4 and below and that the required QP-NOSs are available to impart these training, it can be noted that training and upskilling by SCMS is currently focused on developing workforce for job roles such as dumper and tipper operator, jumbo operator, mazdoor, safety operator, mine electrician, etc. However, SCMS has the potential to further extend its training support across sub sectors of exploration and beneficiation.

In addition to the courses offered by SCMS, several short-term skilling programs relevant to job roles in ancillary and associated activities (such as in heavy vehicle driver in transport and logistics, welder, electrician in equipment maintenance, housekeeping related job roles, administrative and primary health care related job roles, amongst others) are undertaken across the SSC eco-system in India. These should be promoted collaboratively by SCMS and the relevant SSC.

Challenges across Short term training programs[159]

- The cost of imparting courses is too high as compared to service fee paid to training partner as per the common cost norms.

[159] The challenges are based on secondary and shall be further strengthen after the primary consultations

- The cost of training infrastructure for direct courses in the mining sector is high, which is not easily recoverable through the service fee paid under common cost norms. This becomes a deterrent in capacity creation for training in mining related courses.
- Experienced and qualified trainers are a key to deliver industry relevant training. The training partners for short-term training courses find it difficult to source such trainers from the industry.
- Capacity building of the trainers is also a challenge faced by training partners as they seek active industry engagement in short-term training courses.
- Training partners believe that students do not aspire to take up employment in the mining sector as it entails migrating to remote locations and working in conditions that they think are difficult.
- Industry believes that the training period for mining related courses should be more as compared to the usual 200 to 400 hours in order to impart quality skill training.
- Tracking of candidates employed in mining sector is a huge challenge.

5.2. Other facilities for skill development in mining sector

Anchored by DGMS, the Mines Vocational Training (MVT) Rules, 2019 drive vocational training in the sector. It charts that mines which comes under Mines Act 1952 Act, have to abide by the rules of training laid down by MVTR. For the purpose of the application of the Mines Vocational Training rules and maintaining quality of training, a Vocational board is to be constituted.

The major functions of the board recommended by the MVTR include:

- Establishing a committee that prescribes certain standards of training to be imparted at mines and making sure that uniform standards are maintained, and all trainings conform to the standards.
- Decide the manner of ascertaining the competency of the Instructors, training officers, trainers along with the manner of ascertaining quality of the training provided, proper assessments for granting certificates.
- Define the scope and standards of the general and refresher training to be provided accordingly.

As guided by the MVTR 2019 a large proportion of vocational training in the sector is undertaken by PSUs and other apex institutions such as DGMS and IBM. They typically focus on providing trainings on health and safety measures, up-skilling workers with new techniques and process, up-gradation of skills increasing productivity, HEMM maintenance operators, shovel operator amongst others In order to properly fulfil the set goal for skill development, organisations are developing centre of excellence, institutes and offering vocational trainings, RPL, providing certifications etc.

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For example, Coal India has established CETI in Barkakana for providing training. Further, training of management staff is another critical focus areas, for instance, Coal India has established the Indian Institute of Coal Management (IICM) in Ranchi that takes care of the management training needs of mid-level and senior staff in its subsidiaries as well as for several private players.

The table below delves into the key skilling and vocational training interventions undertaken by PSUs (such as CIL, HCL, NMDC, NALCO, etc.) and Government bodies (such as IBM, DGMS, etc.).

Table 25: Skill development initiatives across apex institution and PSUs

Government Body/ PSU	Initiative Details
Hindustan Copper Limited	• **Kaushal Vikas Yojna** - On 3rd March 2017, HCL signed MoU with NSDC to provide training including RPL for unskilled and semi-skilled employees and fresh skilling for youth. • **Establishing skill development institute** – Training institutes were established in Rajasthan. The 1st batch of 26 trainees undergoing training for the course of "Assistant Mine Surveyor" completed the classroom training on October 2017[160]. HCL plans to extend the training facilities to 1,100 trainees with estimated cost of around INR 70 million[161].
National Aluminum Company Limited	• NALCO has also signed MoU with NSDC and NSDF to provide skill development trainings to 1,620 candidates in 2016-17 and 2018-19, which included the RPL training to 420 workmen under various contractors at bauxite mines. • The firm provides training on mining sector related trades to 900 people per annum with INR 20 million of investment. It has planned to provide training to 6,000 participants between 2015-2016 to 2021-2022 with estimated budget of INR 200 million. • A corporate excellence center is being planned to be set-up using NALCO's CSR fund[162] .
Mineral Exploration Corporation Limited	• MECL has set a target of completing RPL certification of all 850 workers by 2020-21, engaged in mining sector activities[163].
Indian Bureau of Mines	• IBM has also planned framework for opening national level training centres 'Institute of Sustainable Development in Mining' at Kolkata and 'Institute of Sustainable Development Framework at Udaipur with capacity of conducting 15 courses per year. The estimated capital cost of these centres would be INR 10 million each[164]. • IBM also conducts various in-house trainings IBM officials, industry personnel etc[165].
Geological Survey of India	• Geological Survey of India has a training institute called the GSI Training Institute that is currently responsible for training its newly recruited geologists through several orientation courses by imparting field training at its different field centers located in 11 States for developing region specific geological knowledge of the professionals. • The institute is currently providing 16 distinct courses consonant with the policies of the Government. • It is currently providing induction training for different streams, training needs assessment, periodic in-service training and mid-career/promotion linked training for all streams and grades[166]. • Currently there are 6 regional training institutes catering to bridge the gap between changing mineral sector needs and current skills available.
Coal India	• CIL and its subsidiaries run several vocational and skill training programmes. It's training infrastructure includes[167]: o Indian Institute of Coal Management (IICM) in Ranchi which caters to the training needs of Coal India and other private companies as well. Employees of Coal India are imparted training in IICM during different phases in their career. o Vocational Training Centers (VTC) in each mining cluster that conducts work related training in regular intervals and houses simulation rooms / equipment.

[160] Hindustan Copper Limited, Annual Report 2017-18
[161] Skill Plan for the Mining sector (2016-22): Ministry of Mines
[162] NALCO 37th Annual Report 2017-18
[163] Skill Plan for the Mining sector (2016-22): Ministry of Mines
[164] Skill Plan for the Mining sector (2016-22): Ministry of Mines
[165] Course Calendar of the training sector 2018-19, Indian Bureau of Mines
[166] Geological Survey of India
[167] Coal India Limited career growth

Government Body/ PSU	Initiative Details
	○ Management Training Centers housed at the headquarter of each subsidiary for imparting professional and managerial training to the employees of the subsidiary during different phases of their career. ○ CETI/BETI – Different subsidiaries of Coal India also have dedicated training institutes for excavation/mining related training. • CIL has a Technical intern training programme (TITI) program that promotes international collaboration through transfer of skills, knowledge and technology amongst the participating countries thereby contributing to human resource development. It offers training to workers for a specific year of time like 3 to 5 years and in India it was signed in October 2017.
MOIL	• MOIL has signed an MoU with NSDC for imparting skill development training in its areas of operations. • As a part of the MoU, 670 participants (424 permanent, 127 contractual and 119 local youths residing in nearby villages of mines) were imparted skills training by NSDC training partners. • During 2017-18, total 68 training programmes were conducted at Munsar Training Centre Corporate Training Centre-Nagpur (24), outside training (20) and in-house training (24). The programmes imparted skills training to about 1272 employees. • It is also imparting training to apprentices under the Apprentices Act 1961.
NMDC	• NMDC in collaboration with CAP foundation has started 1-year diploma course with at least 70 percent successful trainees and all the expenditure on training, boarding and lodging is borne by NMDC • Skill development program has been started by NMDC for mining sector related skills. It is a 3-year programme in which 1200 local youth would be provided training. Till date 988 trainees have been covered
GMDC	• An 'International Center of Excellence in Mining Safety and Automation' (iCEM) in has been established by the Government of Gujarat in close collaboration with GMDC with the objective of accelerating mining activities. • The center gives emphasis to following sectors: Mine Automation, Mine Safety, Advanced Technological Mining Systems, Bulk Material Handling, Advanced Mapping Systems, Mine Planning, Robotics & Information System in Mining, Artificial Intelligence and Virtual Reality. • The center has been conducting capacity building programs such as Train the Trainer (ToT), skill development programs through workshops for upskilling of dumper operators, operations and maintenance personnel in mining Industry.
Survey of India	• Indian Institute of Surveying & Mapping (IISM) is recognized as a premier institute of training in the field of Surveying &Mapping in the country. • It offers refresher courses having duration of 3-12 weeks for GPS, Total Station, GIS and Digital Photogrammetry, Officer Surveyors; mid-career advancement courses lasting for 4 weeks for Control & Detail Survey by GPS and Total Station, GIS Applications, Digital Photogrammetry and Remote sensing; dual trade course on store and record management having duration of 6 weeks. • Very short-term courses having duration of 2-5 days are offered on Modern Survey Instruments and Techniques, Toponymy for Cartographers -awareness programme, Digital Photogrammetry and Remote Sensing for policy makers, etc. • In addition, courses on Geodesy, Digital Mapping and Geographical Information System, etc. fare offered for faculty specialization.

At the State level, skill development in mining is also a thrust area for key mineral producing States such as Chhattisgarh, Rajasthan, Jharkhand, etc. Industrial policies as well as mineral policies (of certain States) provide for skill training in the sector. The table below charts out the key skilling and training interventions undertaken across major mineral States in India.

Table 26: Skill development initiatives across States

State	Initiative Details
Rajasthan	• Launched in 2017, **PMKVY-2.0 – RPL** in Rajasthan for training of 5,000 in-service workers in Jodhpur district in trades of bulldozer operator, mazdoor/helper, excavator operator, mechanic/fitter and loader operator. Under second proposal of RPL Rajasthan got approval for **certifying 10,000 mine workers** from Rajsamand, Bhilwara, and Chittorgarh districts[168]. • RPL and fresh skilling programmes have also been conducted in (Khetri) Rajasthan as well as other States by under HCL-NSDF- NSDC Project. • In order to address shortfall of workforce in mining sector, **SCMS has entered into MoU with Hindustan Zinc Limited (HZL)** for training in soft skills and on the job training. 120 students have been recruited in 2016 from Rajasthan through training partner Indian Institute of Skill Development. • **Development of CoE (Centre for excellence)** - A skill development institute as an upgraded training center was established at Khetri Copper Complex, district Jhunjhunu (Rajasthan) by HCL[169]. • As per the Rajasthan Mineral Policy, 2015: ○ Organize national/international level training programmes via renowned universities for miners, workers, technocrats Along with Diploma course in mining, the department has also planned to provide vocational training cum skill development center in mining areas[170].
Odisha	• For industry-funded training, SCMS has collaborated with Odisha Mining Corporation Ltd. • **NALCO** has conducted various skill development program in Odisha. It has signed **MoU with NSDC and NSDF** for skill development and train 1,620 candidates during 2016-17 to 2018-19 with relevant qualification packs (QP) including RPL certification training to 420 workers engaged under various contractors at bauxite mines. The CoE has also been planned to set up at Gothpatna near Bhubaneswar with aim to train 15,000 youths in 2 years[171,172,173]. • NALCO also organises in-house trainings, as well as vocational trainings, apprenticeship etc. through renowned universities.

Chhattisgarh	• Under **NMDC- NSDF- NSDC Project**, certification of in-service workers has been carried out at Kirandul, Dantewada & Bacheli - Chhattisgarh for job roles of HEMM Mechanic, Mechanic /Fitter and Mine Welder (inclusive of other States).
	• According to Chhattisgarh State mineral policy 2008 the workers who are eligible and educated will be provided with the required amount of training to provide them employment in a better project as per their educational level in this sector.
	• The training will be provided by the Government itself so that they enhance skills and develop new ones as well and after that they can be employed in small projects initially.
	• In July'16, skill plan for mining sector was introduced at **National Conclave on Mines & Minerals at Chhattisgarh** with aim to develop, design and disseminate training modules required for scientific, sustainable and safe mining practices within the framework of National Policy of Skill Development and Entrepreneurship 2015.Some of the activities to be undertaken under skill plan are:
	  ○ Establishing CoE, one by each NALCO and HCL
	  ○ Enhancing the training facilities of PSUs, RPL
	  ○ Promoting apprenticeship etc. [174]

[168] Skill Development in Mining Sector, 32nd report (2016-17)
[169] Hindustan Copper Limited, Annual Report 2017-18
[170] Rajasthan Mineral Policy 2015, Govt. of Rajasthan
[171] NALCO Press Release 8th Jan 2017
[172] Odisha: Nalco dedicates three projects on its foundation day Times of India, 5th Jan 2018
[173] National Aluminum Company Ltd Management Discussions, Indiainfoline
[174] Skill Development in Mining Sector, 32nd report (2016-17)

State	Initiative Details
	• **MECL** has also committed to contribute ~2.6 million from CSR funds to NSDF through NSDC for providing training to 200 youth during 2015-16 and 2016-17. These will be used for training modules in Chhattisgarh as well as other States[175].

Jharkhand	• Capacity building by conducting trainings programmes:
	  ○ CCL (Central Coal Limited) helps in capacity building of the Project Affected Persons (PAPs) and other stakeholders - training programmes are being conducted in Mining Sirdar at BTTI, Bhurkunda. Candidates are prepared for appearing in Mining Sirdar exam conducted by DGMS.
	  ○ Multi Skill Development Centre is also opened at CETI by CCI, Barkakana and it has been affiliated as a "Training Partner" of Skill Council for Mining Sector for the National Skill Certification[176].
	• HCL has planned to contribute RPL to 279 unskilled and semi- skilled workers for 2016-17 across various States including Jharkhand. **RPL and fresh skilling programmes** have been conducted at Ghatshila (Jharkhand). Total 525 (including workers from other States) workers of Hindustan Copper Limited (HCL) including 32 new candidates have been trained & certified so far in mining job roles[177].
	• NTPC Pakri Barwadih Coal Mining Project and Jharkhand Government Mini Tool Room Training Centre (JGMTRC) signed MoU at Ranchi for running, operation and management of mining and industrial training institute at Barkagaon[178].

Gujarat	• Under Industry funded programme, **SCMS has conducted up-skilling and certification** of 36,935 in-service workers under RPL in the states of Rajasthan, Karnataka, Odisha, Gujarat, Jharkhand, West Bengal, Maharashtra, Chhattisgarh and Madhya Pradesh through its accredited training partners[179]. • Under Gujarat Industrial Policy, 2015, the Government of Gujrat will emphasis more on development of sector specific institutions that can impart vocational training in sectors like mining, marine & shipping, agri-business, food industry etc.[180]. • The State government has established 'International Center of Excellence in Mining Safety and Automation' (iCEM) in Ahmedabad with the objective of accelerating mining activities and mineral development. The center focuses on skill development, corporate training, education and training, R&D, technology incubation & entrepreneurship development in mining sector. It is being promoted by Government of Gujarat in close collaboration with GMDC, PDPU, IIT-Kharagpur & UoW, Australia[181]. The center will not only impact local economy but also mining industries in India and abroad through training, advise and research. • Gujarat State mineral policy 2003- according to this policy in order to improve the skills of miners, labourers, technicians of different major and minor minerals proper training and skill development programmes will be conducted in various country's well-known institutes • According to this policy the human resource department will also organise various national and well as international training programmes by various prestigious institutes in the country so as to improve awareness level of workers and enhance skills. • The human resource development department has also planned for a training programme for limestone and sandstone workers along with UNIDO under National Programme for Development of Stone Industries.
Madhya Pradesh	• Launched in 2017, **PMKVY-2.0 – RPL** Madhya Pradesh got approval for **certifying 10,000 mineworkers** from Gwalior, Morena and Datia districts in Madhya Pradesh. Trainings for Dumper Operator and Mine Electrician had started with 200 workers in four batches at Gwalior[182].

[175] Skill Development in Mining Sector, 32nd report (2016-17)
[176] Central Coal Fields Limited Updates
[177] Skill Development in Mining Sector, 32nd report (2016-17)
[178] PSU Connect: News updates on PSUs
[179] Skill Development in Mining Sector, 32nd report (2016-17)
[180] Snapshot of Industrial Policy 2015: Vibrant Gujarat
[181] Gujarat Mineral Development Corporation Ltd.
[182] Skill Development in Mining Sector, 32nd report (2016-17)

State	Initiative Details
	• Madhya Pradesh mineral policy 2010- according to this policy the technical educational institutions will be encouraged to start with the courses of mining engineering both at graduate and post graduate level so that students have a technical hand in the mining department. • Apart from this suitable training in Industrial Training Institutes of the State along with a certificate of efficiency and effectiveness for the jobs like Mines Foreman, Blaster etc will be provided. • Mining industry will ensure their active participation in the field of designing and conduct of courses in Industrial Training Institutes. • Under **HCL-NSDF- NSDC project,** RPL and fresh skilling has been conducted at Malanjkhand (Madhya Pradesh), including other States for 279 unskilled and semi- skilled workers for the year 2016-17.

Apart from the training at engineering and technology colleges Geological Survey of India has been training all its newly recruited geologists through orientation courses by imparting field training at many of its field centers distributed across the country. GSI Training Institute (GSITI) headquartered at Hyderabad has Field Training Centres (FTC) distributed across the country. These centers were specially created for advancing the training in region specific geological aspects are at Aishmuquaam (J&K), Aizwal (Mizoram), Bhimtal (Uttarakhand), Chitardurga (Karnataka), Kothagudem (Telangana), Kuju (Jharkhand), Raipur (Chhattisgarh), Saketi (Himachal Pradesh), Sukinda (Orissa), Wajrakarur (Andhra Pradesh) and Zawar (Rajasthan). The objectives of GSITI are to:

- To develop into a knowledge sharing institute for the department and other Government and private stakeholders including research institutes
- Training for all in consonance with the identified objective
- Training need assessment
- Induction training for streams under organized services
- Periodic in-service training.
- Mid-career training / promotion-linked training for all streams and grades
- Programmes for middle/higher level management
- Courses on scientific, administrative and management
- Training for support systems

List of courses at GSITI

- Induction level courses for geologists, geophysicists, chemists, engineers and administrative officers
- Refresher and advanced courses in geological disciplines
- Mineral Exploration
- Digital archival and dissemination of digital data
- Geochemical Mapping
- Geophysical Mapping
- Airborne and Marine Surveys
- Remote Sensing and Hyperspectral Mapping
- Active fault studies

Besides, running regular courses for the needs of Group-A Technical officers, the Technical Institute also conducts programs and capsule courses for the DGMs of different States keeping pace with the technological advancements, societal needs and also in tune with National Mineral Policy. Based on the training needs training institute devises curricula, for various layers of management in the fields of administration, financial matters,

personnel management, material management, information technology and conducts the training ensuring quality. In consonance with the identified thrust areas of the department and policies of Government of India, several programmes are on the anvil as listed alongside.

Similar to PSUs and govt. bodies, large private firms have also developed customized vocational training institutes and centres of excellence. Several of these interventions by private companies have been undertaken with the objective of developing integrated mining setups.

For instance, Tata Steel has set up at the JN Tata Vocational Training Institute (JNTVTI), which provides vocational training under various skill development schemes, offering 7 full industrial training courses for mining workers. Further, JNTVTI is a recognised as Training Provider by NSDC. Organisations such as HZL (Hindustan Zinc Ltd), Vedanta subsidiary have collaborated with the Government to enable youth across the country to access skill training courses through the Indian Institute of Skill Development (IISD). IISD is India's first intensive skill building training on underground mining. Several skilling interventions in the sector are driven by CSR activities of these companies (as well as for PSUs). Sandvik-leading supplier of mining tools and equipment and technical solutions through its mining training academy at Nagpur conducts 1-2 year training programme to cater to aftermarket and maintenance needs, who in turn are deputed in Sandvik's workshops and underground mines[183]. Further, Caterpillar-Mining equipment manufacturer and supplier organizes online training programmes through Caterpillar University across three areas: service fundamentals (tips and techniques of maintenance of cat equipment), safety training (over 250 Environmental Health and Safety training courses to build competencies required to safely perform their jobs) and operator training (about 18 courses to improve knowledge of equipment controls, maintenance, inspection, safety and operating procedures).

The table below charts key private sector interventions for skill development in the mining sector.

Table 27: Skill development initiatives across key private sector players

Name Company	Initiative Details
Tata Steel	• JN Tata Vocational Training Institute (JNTVTI), started in 2017, provides vocational training under various skill development schemes. A **MoU has also been signed between the Trust and The Government of India under the Flexi-MoU scheme** run by the latter[184]. • In 2018, JNTVTI, started offering 7 full industrial training courses viz - site safety supervisor, mechanical supervisor, crane operator-cum-rigger, hydraulic technician, mechanical fitter-cum-rigger, electrician and welder–cum-gas cutter to youth [185] • Tata Steel's Ore Mines and Quarries (OMQ) has developed skill development centres at Joda block as a part of CSR activity in partnership with NIIT Foundation in 2015. In 2017, it was also functional at Jurudih, which will cover Jalahari, Khondbond, Jurudi, Guruda, Joribar, Bamebari, Jajang, Hesabeda villages and other nearby areas.
Vedanta	• HZL (Hindustan Zinc Ltd), a subsidiary of Vedanta has collaborated with SCMS and Indian Institute of Skill Development (IISD) to start India's first intensive skill building training on underground mining. Currently 35 students of JDO 4th Batch (out of total 93) and 95 trainees of 5th Batch mainly from HZL's operational areas are undergoing 24 months (earlier 18 months) residential training at three Mining Academy Centres of HZL (Dariba, Agucha & Zawar)[186]. • Educational institute have been established in Sanquelim, Sesa Technical School, aims to train youth on mining operations with technical skills. The students specialize in the trades of Machinist, Fitter, Electrician and Instrument Mechanic with guaranteed placements.
Thriveni Earthmovers	• Thriveni Industrial Security Academy provides six weeks free training to the unemployed local youth in Keonjhar, Odisha. The training is imparted for industrial security duties. • Post completion of training they are given employment opportunities in Thriveni.
Sesa Goa Iron Ore	• The Goa College of Engineering started an undergraduate engineering course in mining (B.E in Mining Engineering) in 2011 with the support of Sesa Goa Iron Ore, who wished to impart

[183] https://www.fastcollab.com/careers/Sandvik/15929_ATS-Trainee-Program-for-Underground-Mining
[184] TATA Steel provides skill development opportunities for the youth: Press Release Aug 2017
[185] JNVTI scales new horizons in providing quality training and employment to the youth: TATA Steel Press Release Dec 27, 2018
[186] Vedanta: CSR

	mining-related skills like mine planning, operations and environmental processes to students within the State. • Sesa Goa participated in curriculum design, curriculum and assessment planning, and placement support for graduating students. It also provided subject instructors for the core courses. The students are given industry visits and internship opportunities throughout India, in States including Rajasthan, Odisha, Jharkhand, Karnataka, Maharashtra and Tamil Nadu. • Sesa Goa had also instituted a scholarship program for female students to promote women in the sector. However, due to mining activities being ceased in Goa, the program has stopped admissions. Similar initiatives are being undertaken by the Gujarat Mineral Indian Association (Gujmin).

The quantum of talent supply coming from the abovementioned sources including both primary and auxiliary sources depends on the assessment and certifications. These processes vary across the type of institutes with various Central/Apex/State bodies having responsibility of assessing and certifying the trained candidates.

The next section provides an overview of the bodies responsible for these processes, historical trend of assessments by SCMS and the challenges faced while carrying out the assessments of students.

5.3. Assessment and Certification

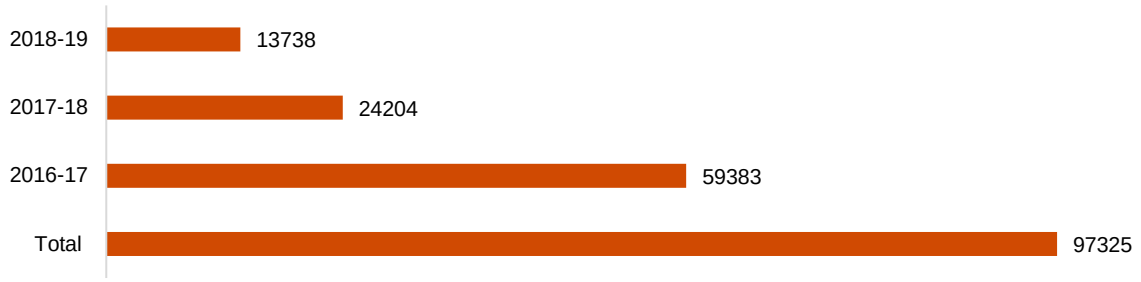
The stakeholders and process of assessment and certification for education institution such as for vocational courses in schools, Industrial Training Institute, Short Term Training courses and Engineering courses varies widely across the country.

Assessment and certification of vocational courses in schools: It is the responsibility of Ministry of Human Resource and Development under Rashtriya Madhyamik Shiksha Abhiyan (RMSA) to facilitate vocational programs across schools with support from respective Sector Skill Councils. A total number of 8,227 schools have been approved since 2011-12 till 2017-18 for implementation of vocational education of which 6,118 are implementing vocational education as of 2017-18. The program lists out a crucial role for NSDC and Sector Skill Councils (SSCs) in implementation of NSQF aligned vocational courses. The trainings conducted as part of the scheme are based on the National Occupational Standards set by NSDC through its SSCs. The scheme also mandates the SSCs to conduct assessments and provide joint certifications with the central/state board. SSC empanelled agencies conduct assessments based on the criteria defined in the respective QP-NOS documents. Currently, NSDC is working with the State Governments of Haryana, Himachal Pradesh, Karnataka, Punjab, Uttarakhand, Madhya Pradesh, Nagaland, Maharashtra, Chhattisgarh and Rajasthan for implementation of the scheme in their States through its approved and funded SSCs.

Assessment and certification in ITIs: Industrial Training Institutes have two frameworks for assessment and certification- State Council for Vocational Training (SCVT) and National Council for Vocational Training (NCVT). SCVT is regulated by specific State Technical Boards and NCVT is regulated by Directorate General of Training (DGT) at the national level. Assessment pattern varies based on SCVT or NCVT affiliation of the ITI. The assessment/examination at SCVT affiliated ITI is designed and conducted by Technical Board of each State. Whereas, at NCVT affiliated ITI DGT is responsible for designing and conducting assessment across 14,483 ITIs (both Government and Private) in the country. Upon successful completion of training, an ITI graduate is awarded a National Trades Certificate (NTC) by NCVT and at the State level, it is recognized by the respective State Council for Vocational Training (SCVT).

Assessment and certification of short-term training courses: The Short-Term Trainings imparted by NSDC affiliated training partners across 37 sectors in collaboration with SSCs: is assessed by assessment agencies empaneled with various SSCs. The assessment for each job role across NSQF level is carried out as per the assessment criteria defined in QP-NOS document. Broadly the assessment is across domain skills and soft skills for most of the job roles carried out through theory and practical component in both online and offline mode.

Figure 48: Assessment by SCMS for last three years



Source: Data received from SCMS, PwC Analysis

Specific to assessment of job roles across mining sector, Skill Council for Mining Sector is responsible for facilitating assessment of short-term trainings across 45 QPs ranging from NSQF level 1 to 5. The assessments across these job roles are carried out by 15 affiliated assessment agencies. In 2018-19 of the total 4745 trainees were trained across Short Term Trainings of which 4,494 trainees were assessed. Similarly, 8,450 assessment were carried out by SCMS affiliated assessment agencies for a total of 9,250 RPL Certifications in the year 2018-19. [187]

Given the capacity for assessment and geographic distribution of SCMS's assessment agencies there are certain challenges with respect to assessment as mentioned below:

- **Economics of assessment:** An assessment agency gets INR 600 per assessment for conducting assessment across various geographical locations and it was mentioned that although the payments are made for one day, the travelling, lodging and boarding cost incurred by assessment agencies due to remote location of mines leads to higher expenditure than earning for agencies.
- **Lack of mechanism for industry feedback:** Due to limited availability of student placement data at SCMS, there is no proper mechanism to link employer's feedback on the assessment carried out. This has resulted in lost opportunities to improve quality of assessments.
- **Operational challenges:** The assessment agencies have indicated that it is difficult to conduct RPL assessments as the entire batch is not available at the same time. Further, the candidates of RPL programme are already employed and therefore have limited time for assessment. This makes it difficult for the assessment agencies to conduct RPL assessments and often impacts the economics of assessment for them.
- **Lack of theoretical knowledge in RPL candidates:** The agencies shared that while the candidates of an RPL programme are proficient in practical, their theoretical knowledge is limited. This increases the time of assessment for RPL batches and impacts assessment economics.

Statutory Certifications: Along with this Directorate General of Mines Safety (DGMS) is the Regulatory Agency under the Ministry of labour and employment, Government of India in matters pertaining to occupational safety, health and welfare of persons employed in mines (Coal, Metalliferous and oil-mines). Under the Constitution of India, safety, welfare and health of workers employed in mines are the concern of the Central Government (Entry 55-Union List-Article 246). The objective is regulated by the Mines Act, 1952 and the Rules and Regulations framed there under. These are administered by the Directorate-General of Mines Safety (DGMS), under the Union Ministry of Labour & Employment. DGMS through various examinations offers certificates such as manager certificate, surveyor certificate, Foreman certificate and Mate certificate.

[187] SCMS secondary data

Table 28: Different kind of certifications under Director General of Mines Safety

S. No.	Kinds of certificates granted in the foreign country* or under the Metalliferous Mines Regulations, 1961	Similar kind of Exchange Certificate under the Coal Mines Regulations, 2017	Period, Nature & details of Practical experience necessary in coal mines in India
1.	**First Class Manager's Certificate**	First Class Manager's Certificate	One year: i. Not less than 06 Months of practical experience in a coal mine having below ground workings. ii. Not more than 06 Months of practical experience in a coal mine having opencast workings.
2.	**First Class Manager's Certificate Restricted to mines having opencast workings only**	First Class Manager's Certificate Restricted to mines having opencast workings only	Not less than 01 Year of practical experience in a coal mine having below ground / opencast workings.
3.	**Second Class Manager's Certificate**	Second Class Manager's Certificate	One year: i. Not less than 06 Months of practical experience in a coal mine having belowground workings. ii. Not more than 06 Months of practical experience in a coal mine having opencast workings.
4.	**Second Class Manager's Certificate (Restricted to mines having opencast workings only)**	Second Class Manager's Certificate (Restricted to mines having opencast workings only)	Not less than 01 Year of practical experience in a coal mine having belowground / opencast workings.
5.	**Surveyor's Certificate**	Surveyor's certificate	Not less than three months of practical experience in surveying in a coal mine having belowground workings.
6.	**Surveyor's Certificate (Restricted to mines having opencast workings only)**	Surveyor's certificate (Restricted to mines having opencast workings only).	Not less than three months of practical experience in surveying in a coal mine having belowground / opencast workings.
7.	**I Class / II Class Engine Driver's Certificate**	Engine Driver's Certificate	No
8.	**Foreman's Certificate**	Overman's certificate	06 Months: i. Not less than 03 Months of practical experience in a coal mine having belowground workings. ii. Not more than 03 Months of practical experience in a coal mine having opencast workings.
9.	**Foreman's Certificate (Restricted to mines having opencast workings only)**	Overman's certificate (Restricted to mines having opencast workings only).	Not less than Six months of practical experience in a coal mine having belowground / opencast workings.
10.	**Mate's Certificate**	Sirdar's certificate	One year: i. Not less than 06 Months of practical experience in a coal mine having belowground workings. ii. Not more than 06 Months of practical experience in a coal mine having opencast workings.
11.	**Mate's Certificate (Restricted to mines having opencast workings only)**	Sirdar's certificate (Restricted to mines having opencast workings only).	Not less than 01 Year of practical experience in a coal mine having belowground / opencast workings.
12.	**Gas Testing Certificate**	Gas Testing Certificate	No

Source: DGMS website

Given the minimum and maximum educational qualification (ranging from literates to Postgraduates and above) required for various job roles in the mining sector, talent supply is not just limited to technically certified/qualified candidates. Therefore, students from every stream (both technical and non-technical) constitute the potential talent pool. It is critical to understand demand vis-à-vis supply so that appropriate skilling measures can be adopted.

The next chapter undertakes skill gap assessment across NSQF levels, geography and sub-sectors.

6. Skill gap assessment

As per India KLEMS database 2016, core employment in the mining sector has contracted at annual rate of -1%, from 2.58 million in 2011-12 to 2.45 million in 2016-17 (including petroleum and natural gas). However, the current sluggishness in the mining sector is set to dissipate due to several factors which would have positive implications for the sector. These factors are delved in detail below:

- **Introduction of e-auctions:** As per the 2016 amendments in the Mines and Minerals Development and Regulation (MMDR) Act, mineral blocks auctions for granting mining leases will be done through the e-auction processes. This would bring more transparency in the process and encourage private participation as well. In addition, this method of auctioning mineral blocks would enable new entrants-small or less well-known businesses to compete in the e-Auction process pitching the suppliers directly against one another. The suppliers would be able to fetch better price for their minerals than the prices paid by regular customers. Hence, mining sector's future growth would be positively impacted with the introduction of e-auctions opening the market for all kinds of bidders.
- **Emphasis on increasing production:** The Indian government came up with the National Mineral Policy in March 2019 replacing the earlier 2008 policy. The major expected outcome from this new policy (which pertains to non-coal and non-fuel minerals) is to increase the production of MCDR (Mineral Conservation and Development Rules,2017) minerals (in value terms) by 200 % in seven years. The other main outcome envisioned from the policy is a significant increase in domestic mineral production and reduction of trade deficits in the sector in the next seven years. The NMP 2019 seems to be a business-friendly policy ensuring ease-of-doing business for all miners and investors.
- **Focus on exploration activities:** India is highly prospective for minerals given its geological evolution and this is being leveraged through continuous explorations to discover more minerals at greater depths. GSI has completed 98.75% of the geological mapping and about 37% of the geochemical mapping. Further, to locate prospecting areas of mineral deposits and target potential mineralized zones an area of about 3,20,000 sq. km on 1:25K scale has been mapped and 0.77 million sq. km area has been surveyed through gravity and magnetic techniques for deep mineral prognostication by March 2020. To scale up exploration activities, National Mineral Exploration Policy (NMEP) was introduced in the year 2016. In the initial three months of last financial year, a total of 175 exploration projects worth INR 5.39 billion have already been approved. In addition, GSI has implemented about 900 Field Season Programmes (FSP) covering 390 mineral exploration programs during 2019-20 and has also launched its Data Sharing and Accessibility Policy 2019, provisioning the freely downloadable baseline geoscience data (geological, geochemical and geophysical) from its web portal from 1st March 2019[188].
- **Boost to minor mineral sector:** MMDR Amendment Act 2015 provides an opportunity to improve India's minor mineral mining scenario as States now have the responsibility to formulate minor mineral concession rules in order to promote minor mineral extraction. Rules pertaining to minor mineral auctioning, collection of royalties and associated funds, inspection of mineral leases to curb illegal mining activities must be formulated by the State to promote minor mineral mining scenario within the State. Many Indian States have already formulated concession rules and actively auctioning minor mineral leases i.e., State of Gujarat has put up 720 minor mineral blocks for auctioning in 2019. Due to business friendly and transparent auction process, small businesses are actively taking part in minor mineral auctioning and acting as a catalyst for State's aspiration for better economic growth.
- **Thrust on mineral processing and beneficiation:** One of the main outcomes envisioned from the National Mineral Policy 2019 is greater attention towards beneficiation and agglomeration techniques with a view to bring lower grades and finer size material into usable form. Also, majority of the stakeholders interacted during the study highlighted that increased emphasis towards this activity will have positive implications for the sector. IBM has been actively undertaking mineral beneficiation test work on numerous ores and minerals and has completed over 2,200 investigations till date. The NMP 2019 promotes state-of-the art technology in the R&D activities and also emphasizes towards strengthening research activities targeted towards

[188] Ministry of Mines: Major Highlights/Achievements

developing mineral processing and beneficiation processes by seeking cooperation and coordination among various public and private organizations engaged in this task.

- **Vision 300 million tonne steel production by 2030-31:** Steel sector has been a major contributor to the country's manufacturing, especially capital goods industry with the steel production capacity expanding to 137.9 million tonnes in FY19[189]. Through continuous modernization, upgradation of existing plants and effective energy levels, India occupies 3rd place in the world in terms of crude/liquid steel production. Further, with acceleration in rural economy and infrastructure related projects, demand for steel is expected to go up. Thus, the National Steel Policy 2017 has envisaged 300 million tonnes of steel production by 2030-31. This is expected to lead to growth in employment opportunities in metallic mineral mines (since steel is an alloy of iron and copper) to achieve the intended outcome of the policy.
- **Auction of 41 coal mines to pave way for employment generation:** In line with the government of India's vision of making the country self-reliant in the energy sector, auction process for commercial mining of 41 coal mines has been initiated amid the covid-19 outbreak in the country. This move of increasing competition, boosting coal production and reducing dependence on imports is expected to create more than 0.28 million jobs in the sector, attract capital investment worth INR 330 billion and generate annual revenue of INR 200 billion for the State governments[190] having positive implications on the mining sector as a whole.
- **Technological advancements:** With industry 4.0 technologies (such as IoT, Robotics, 2D/3D imaging, etc.) already making their way all across the globe, technology has become an integral part of almost all mining and related operations starting from exploration, mineral extraction to closure of mines. Some of the prominent industries have already started employing the most relevant technologies as per their business needs. Going forward, the sector's productivity is expected to boost with fast pace adoption of innovative and advanced technologies which in turn will create demand for people equipped with skills compatible to advanced technologies.

The factors listed above will positively affect the mining and quarrying sector in the long run. However, in the short run we expect the production level and employment in the mining sector to be negatively affected by COVID-19. In order to account for the impact of this global pandemic on employment in mining sector, we have assumed that the incremental human resource requirement for the year 2020 to be zero. Fall in demand of labour will lead to fall in wage level, therefore increasing profit per unit output. This will lead to increased production in the post covid-19 period (supply-side effects). As highlighted above, the mining sector is experiencing many reforms including participation of private players, enhanced focus on exploration activities and thrust on mineral processing and beneficiation. These reforms are expected to catalyse growth in the sector and will offset the negative impact of COVID-19 to a large extent in the long run. Further, expansionary monetary and fiscal policy in the post covid-19 period will increase the demand in the overall economy, positively affecting the mining sector.

6.1.1. Incremental demand by sub-sectors

The incremental human resource requirement in the mining sector over the 2019-25 period has been estimated to be 0.27 million. Disaggregating the incremental human resource demand across four mining sectors shows that Mining Operations sub-sector accounts for the largest share (86.9%) of the additional manpower demand followed by Engineering Services (9.9%), Prospecting, Exploration and Mine Planning (2.5%) and Mineral Beneficiation (0.7%).

The table below shows incremental human resource requirement across the mining sub-sectors for the 2019-25 period:

[189] IBEF

[190] https://energy.economictimes.indiatimes.com/news/coal/auction-of-41-coal-mines-will-make-india-self-reliant-in-energy-sector-create-more-than-2-8-lakh-jobs-amit-shah/76455612; https://pib.gov.in/PressReleasePage.aspx?PRID=1632346

Table 29: Incremental human resource demand by mining sub-sectors (in '000), 2019-25

SNo.	Sub-sector	Total Employment (2018-19)	Incremental human resource demand			%share incremental demand (2019-25)
			2019-21	2022-25	2019-25	
1.	Prospecting, Exploration & Mine Planning	58.6	2.0	4.8	6.8	2.5%
2.	Mining Operations	2038.2	70.2	165.2	235.4	86.9%
3.	Engineering Services	231.2	8.0	18.7	26.7	9.9%
4.	Mineral Beneficiation	16.7	0.6	1.4	1.9	0.7%
Total (Core Mining)		2344.8	80.7	190.0	270.8	100%

Source: India KLEMS database 2016, NSSO 68th round on Employment & Unemployment Situation in India, PLFS Annual report, 2017-18

In terms of share of human resource demand, core mining accounts for about 32% of the total incremental demand whereas ancillary activities account for the remaining 68%. Further, of the total incremental manpower requirement in core mining over the 2019-25 period, minor minerals account for 45% share followed by metallic minerals (31%), fuel minerals (19%) and non-metallic (3%) minerals.

Table 30: Incremental human resource demand by minerals type (in '000), 2019-25

SNo.	Sub-sector	Total Employment (2018-19)	Incremental human resource demand			%share incremental demand (2019-25)
			2019-21	2022-25	2019-25	
1	Fuel minerals	584.2	15.3	34.8	50.1	6%
2	Metallic minerals	240.9	23.5	59.6	83.1	10%
3	Non-Metallic minerals	55.1	2.6	6.1	8.7	1%
4	Minor minerals	1,406.0	37.3	84.8	122.1	14%
5	Prospecting, Exploration & Mine Planning	58.6	2.0	4.8	6.8	1%
Total (Core Mining)		2,344.8	80.7	190.0	270.8	32%
Ancillary Activities		5,023.7	172.9	407.2	580.1	68%
Total		7,368.5	253.7	597.2	850.9	100%

Source: India KLEMS database 2016, NSSO 68th round on Employment & Unemployment Situation in India, PLFS Annual report 2017-18, Central Statistical Organization data
Note: Employment in Prospecting, exploration and mine planning is shown separately.

6.1.2. Incremental demand by NSQF levels

Disaggregating total increment demand across NSQF levels (basis the definitions given in SCMS's Occupation Map) shows that maximum incremental demand (43.7%) will be at NSQF level 4, i.e. people having diploma/ITI equivalent certificate holders. The second highest share is estimated at NSQF level 1 and 2 accounting for 30.4% of the total incremental human resource demand, i.e. school dropouts/pass outs not enrolled in higher/technical education followed by 15.5% of incremental demand at NSQF level 5, i.e. Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders. NSQF level 3 (i.e. skill certification of medium and short term) and NSQF levels 6 and above (i.e. Doctorate/Postgraduate or equivalent degree holders) account for relatively lower proportion of the total incremental human resource demand with 6.7% and 3.7% share respectively.

Table 31: Incremental human resource demand by NSQF levels (in '000), 2019-25

NSQF level	Description as per SCMS's Occupational matrix	Total Employment 2018-19	Incremental human resource demand			%share incremental demand (2020-25)
			2019-21	2022-25	2019-25	
NSQF level 6 & above	Doctorate/ Postgraduate or equivalent degree holders	87.0	3.0	7.0	10.0	3.7%
NSQF level 5	Bachelor's/ Advanced Diploma (Polytechnic) equivalent degree holders	364.6	12.6	29.6	42.1	15.5%
NSQF level 4	Diploma/ ITI equivalent certificate holders	1,023.5	35.2	83.0	118.2	43.7%
NSQF level 3	Skill certification of medium-term duration – 6 months to 1 year and short term – less than 6 months	157.2	5.4	12.7	18.2	6.7%
NSQF level 1 & 2	School dropouts and pass outs who are not enrolled in higher/ technical education	712.5	24.5	57.7	82.3	30.4%
Total (Core Mining)		2,344.8	80.7	190.0	270.8	

Source: PwC Analysis

The key highlights of the incremental manpower demand across the four sub-sectors are as follows:

- **The maximum incremental demand (43.7%) will be at NSQF level 4, i.e. people having diploma/ITI equivalent certificate:** A significant proportion of workers at this NSQF level are expected to be primarily engaged in activities related to Mining Operations sub-sector, i.e. core mining activities requiring skills specific to trade equipment/tools and machines. The share of incremental demand at this NSQF level has risen to 43.7% as compared to 38.6% of total incremental demand of 0.26 million people over the 2014-22 year period as estimated in SCMS's skill gap study conducted in the year 2015-16.
- **The second highest share of incremental demand (30.4%) will be at NSQF level 1 and 2 i.e. people who have dropped out of school and passouts not enrolled in higher/technical education:** The majority of this segment is anticipated to be a part of all mining sub-sectors given the nature of work that is assigned to these people having low educational background. The demand for people at these NSQF levels is likely to be augmented with the increased impetus on boosting minor mineral production in the country as this mineral type is less investment heavy and relies a lot on manual labour. These people typically get employed as Helpers/Mazdoor, Assistant Support Persons performing entry level roles. The share of incremental demand at NSQF levels 1 and 2 has fallen marginally to 30.4% as compared to 31.3% of total incremental demand of 0.26 million people over the 2014-22 year period as estimated in SCMS's skill gap study conducted in the year 2015-16.
- **About 15.5% of incremental demand is expected at NSQF level 5 i.e. people who have attained Bachelor's/ Advanced Diploma (Polytechnic) equivalent degrees:** These people are required across all sub-sectors performing supervisory, engineering and entry-level managerial functions. This pool of manpower is highly skilled with in-depth knowledge and expertise about their area of operations. The share of incremental demand at this NSQF level was 14% of total incremental demand of 0.26 million people over the 2014-22 year period in SCMS's skill gap study conducted in the year 2015-16.

- **About 6.7% of incremental demand is expected at NSQF level 3 i.e. people who have attained skill certifications of medium (6 months to 1 year) and short term (less than 6 months):** It is the Mineral Beneficiation and Engineering Services sub-sectors which will have maximum demand for people skilled in technician (mechanical/electrical) and ore processing job roles. The share of incremental demand at this NSQF level was 9.8% of total incremental demand of 0.26 million people over the 2014-22 year period in SCMS's skill gap study conducted in the year 2015-16.
- **The least share of incremental demand (3.7%) will be at NSQF level 6 and above i.e. Doctorate/ Postgraduate or equivalent degree holders:** The majority of this segment is anticipated to be a part of Prospecting, Exploration and Mine Planning and Engineering Services sub-sectors. These people are sectoral experts having thorough knowledge and understanding of the geology, geo-physics, environmental engineering, etc. In the SCMS skill gap report 2015-16, out of the total incremental demand of 0.26 million, 6.3% was estimated to be in NSQF level 6 category.

It can be noted from the above table that in the year 2018-19, about 0.71 million people are employed across job roles falling under NSQF Level 1 and 2. Thus, these workers will be eligible for RPL Certification programmes which can either be held at employers premise or in camp mode. Additionally, depending on the pass rate, specific skill sets can be taught through bridge courses under the RPL PMKVY programme.

Further, with the auctioning of mines going up (govt's plan of auctioning 500 mineral blocks), skilled manpower will be required to operationalize the leases. While blocks which have been auctioned for the first time will require freshly skilled manpower, those re-auctioned will have scope of mechanization resulting to use of big equipment and high technology and hence the workforce needs to be upskilled. In addition, of the total mining workers surveyed about 56% stated that they would require additional training for career growth. This implies that 56% of the total currently employed core mining workforce of 1.6 million post deducting RPL target of 0.71 million, about 0.9 million will be eligible for upskilling. Thus, the total RPL and Upskilling target will be ~1.6 million.

6.1.3. Incremental demand by geography (core mining and ancillary activities)

The incremental human resource demand across geography has been divided into 4 categories, i.e. High (>10% share), Medium (5-10% share), Low (1-5% share) and Lowest (<1% share).

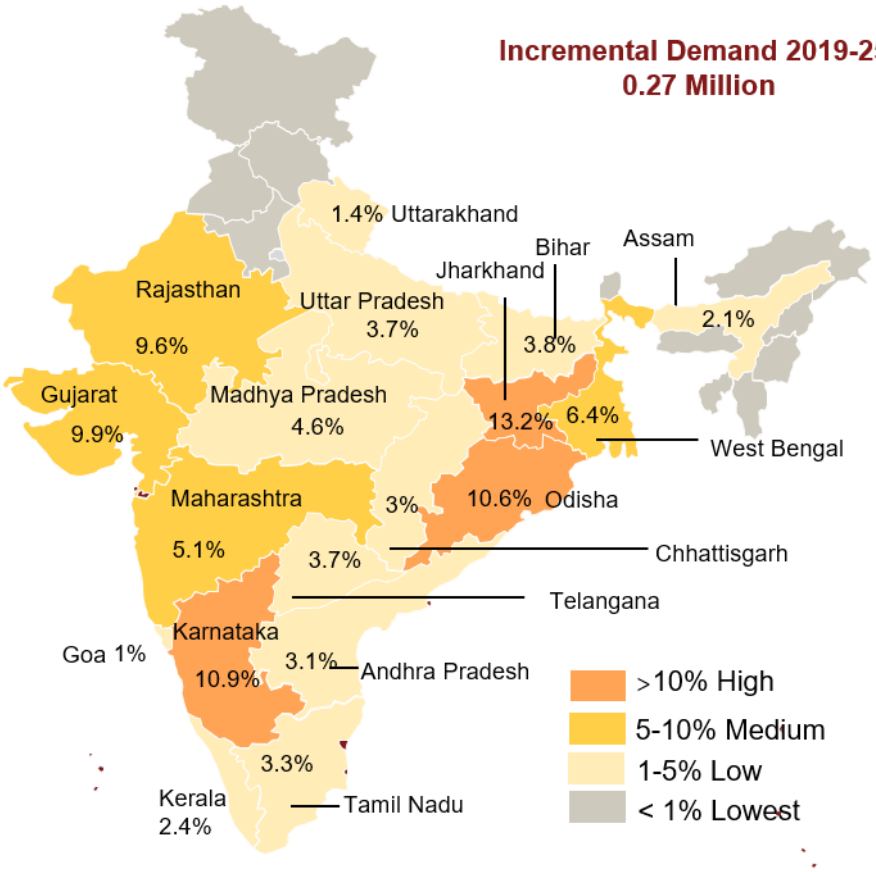
The key highlights of the incremental manpower demand across the States in the **core mining sector** are as follows:

- **High share of incremental demand**: The States of Jharkhand (13.2%), Karnataka (10.9%) and Odisha (10.6%) fall under this category together accounting for 34.7% of total incremental manpower requirement.
- **Medium share of incremental demand**: The States of Gujarat (9.9%), Rajasthan (9.6%), West Bengal (6.4%), Maharashtra (5.1%), fall under this category together constituting 31% of the total incremental manpower requirement.
- **Low share of incremental demand**: The States of Madhya Pradesh (4.6%), Bihar (3.8%), Telangana (3.7%),Uttar Pradesh (3.7%), Tamil Nadu (3.3%), Andhra Pradesh (3.1%), Chhattisgarh (3%), Kerala (2.4%), Assam (2.1%), Uttarakhand (1.4%) and Goa (1%) fall under this category together constituting 32% of the total incremental manpower requirement.
- **Lowest share of incremental demand**: Rest of the states together account for 2.3% of the total incremental manpower requirement.

Incremental demand across States has been attached in annexure A.17.

The figure below presents the incremental human resource demand by geography for the 2019-25 period:

Figure 49: State-wise distribution of incremental demand-Core Mining (2019-25)



Source: PwC Analysis

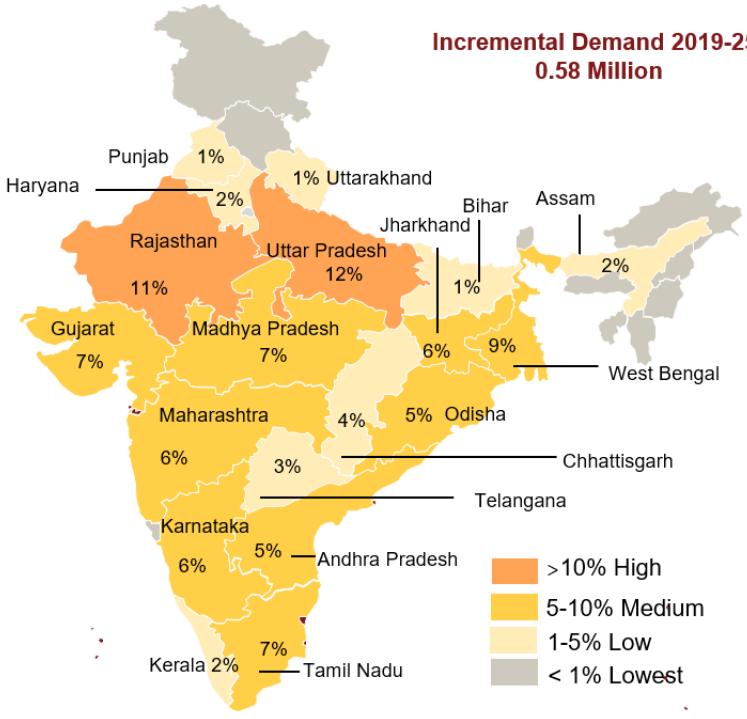
The key highlights of the incremental manpower demand across the States in the **ancillary activities** are as follows:

- **High share of incremental demand**: The States of Uttar Pradesh (12%) and Rajasthan (11%) and fall under this category together accounting for 23% of total incremental manpower requirement.
- **Medium share of incremental demand**: The States of West Bengal (9%), Gujarat (7%), Madhya Pradesh (7%), Tamil Nadu (7%), Jharkhand (6%), Karnataka (6%), Maharashtra (6%), Odisha (5%), and Andhra Pradesh (5%) and fall under this category together constituting 58% of the total incremental manpower requirement.
- **Low share of incremental demand**: The States of Chhattisgarh (4%), Telangana (3%), Haryana (2%), Kerala (2%), Assam (2%), Uttarakhand (1%), Bihar (1%) and Punjab (1%) fall under this category together constituting 16% of the total incremental manpower requirement.
- **Lowest share of incremental demand**: Rest of the states together account for 2% of the total incremental manpower requirement.

Incremental demand across States has been attached in annexure A.18.

The figure below presents the incremental human resource demand by geography for the 2019-25 period:

Figure 50: State-wise distribution of incremental demand-Ancillary Activities (2019-25)



Source: PwC Analysis

6.1.4. Incremental demand by occupation

The incremental human resource requirement by occupation has been derived using SCMS's occupational map. The break-up comprises of 17 occupations spread across the four sub-sectors with Mazdoor/Helper also considered as an occupation which exists across all mining sub-sectors and has cross-sectoral presence as well. The key highlights of incremental demand disaggregated by occupations is shown in the table below:

Table 32: Incremental human resource demand by occupation (in '000), 2019-25

S.No.	Occupation	Total Employment (2018-19)	Incremental human resource demand			%share of incremental demand (2019-25)
			2019-21	2022-25	2019-25	
Prospecting, Exploration & Mine Planning						
1.	Geological Mapping	21.7	0.7	1.8	2.5	0.9%
2.	Exploration	14.6	0.5	1.2	1.7	0.6%
3.	Mineral Estimation	4.5	0.2	0.4	0.5	0.2%
Mining Operation						
4.	Mine Surveying	17.2	0.6	1.4	2.0	0.7%
5.	Drilling/Cutting	345.4	11.9	28.0	39.9	14.7%
6.	Shot firing/ Blasting	115.1	4.0	9.3	13.3	4.9%
7.	Loading & Hauling - Opencast	473.0	16.3	38.3	54.6	20.2%
8.	Loading & Hauling - Underground	149.6	5.1	12.1	17.3	6.4%
9.	Specialized Operations	119.4	4.1	9.7	13.8	5.1%
10.	HSE Functions	23.0	0.8	1.9	2.7	1.0%
11.	Others in mining operations	176.3	6.1	14.3	20.4	7.5%
Engineering Services						

S.No.	Occupation	Total Employment (2018-19)	Incremental human resource demand			%share of incremental demand (2019-25)
			2019-21	2022-25	2019-25	
12.	Electrical Services	59.6	2.1	4.8	6.9	2.5%
13.	Mechanical Services	89.9	3.1	7.3	10.4	3.8%
14.	Instrumentation & Control Systems	11.5	0.4	0.9	1.3	0.5%
Mineral Beneficiation						
15.	Ore Processing	11.7	0.4	0.9	1.3	0.5%
Others-All sub-sectors						
16.	Mazdoors/Helpers	712.5	24.5	57.7	82.3	30.4%
	Total (Core Mining)	2,344.8	80.7	190.0	270.8	

**Mining Engineer, Material Engineer, Geotechnical Engineer, Mining Supervisor, Mining Mate/Mining Sirdar, Overman, Mine-Foreman*
Source: PwC Analysis

The highest share of incremental human resource demand is expected for occupations falling under the Mining Operations sub-sector (60.5%) followed by occupations under Engineering Services (6.8%), Prospecting, Exploration & Mine Planning (1.7%) and Mineral Beneficiation (0.5%). About 30% of incremental human resource demand is expected at mazdoor/helper level that will be available for all sector within mining. The maximum incremental demand for occupations under Mining Operations can be attributed to this sub-sector's significant (88.6%) contribution to the overall employment.

- **About 61% of incremental demand is expected for occupations under Mining operations sub-sector**: The occupational break-up is as follows: Loading & Hauling – Opencast miners (20.2%), Drilling & Cutting (14.7%), Others in mining operations (7.5%), Loading & Hauling - Underground miners (6.4%), Specialized Operations (5.1%), Shot firing/Blasting (4.9%), HSE functions (1%) and Mine Surveying (0.7%). The share of incremental demand for occupations under this sub-sector was 52% of total incremental demand of 0.26 million people over the 2014-22 year period in SCMS's skill gap study conducted in the year 2015.
- **About 6.8% of incremental demand is expected for occupations under Engineering Services sub-sector**: The occupational break-up is as follows: Mechanical Services (3.8%), Electrical Services (2.5%), and Instrumentation & Control system (0.5%). The job roles that exist in this sub-sector have demand from other competing sectors and thus constitutes smaller share to the total employment across these occupations. The share of incremental demand for occupations under Associated/Engineering Services was 15% of total incremental demand of 0.26 million people over the 2014-22 year period in SCMS's skill gap study conducted in the year 2015-16.
- **Occupations under Mineral Beneficiation and Prospecting, Exploration & Mine Planning sub-sectors account for a small proportion (2.2%) of total incremental demand**: The occupational break-up is as follows: Ore Processing (0.5%), Geological Mapping (0.9%), Exploration (0.6%), Mineral estimation (0.2%). In the SCMS skill gap report 2015-16, about 2% of the total incremental demand was estimated to be for occupations under Exploration and mineral processing.

The incremental human resource demand by job roles is attached in Annexure A.19.

6.2. Incremental human resource supply

India occupies a prominent place in the education industry globally with over 1.5 million[191] secondary and higher secondary schools, 903 universities and 39,050 colleges and 10,011 stand-alone institutions[192]. By 2030, India is expected to produce one in every four graduates as a product of its higher education system in the world. Thus, making it the largest supplier of talent in the world[193]. Moreover, given the minimum and maximum educational qualification (ranging from literates to Postgraduates and above) required for various job roles in the mining sector, talent supply is not just limited to technically certified/qualified candidates. Therefore, students from every stream (both technical and non-technical) constitute the potential talent pool.
The human resource supply has been projected across NSQF levels basis three main supply sources which includes, school dropouts/passouts, those having diploma/ITI passouts or have trade specific certificate and

[191] DISE 2016-17
[192] AISHE Report 2017-18
[193] https://www.ibef.org/industry/education-sector-india.aspx

university degree holders. The incremental human resource supply of workers from both direct and indirect courses is estimated to be 77.74 million over the 2019-25 period which is less than ~89 million estimated for 2014-22 period in the SCMS's skill gap study conducted in the year 2015-16. This fall in incremental supply can be attributed to a fall in enrolment and rise in drop-out rates at school level[194] which constitute a significant proportion of the total supply. Further, this supply pool is available for other competing sectors such as construction, manufacturing, etc., thus leading to a low trickle of skilled workforce in the mining sector.

6.2.1. Incremental primary and auxillary supply

Of the total incremental supply for 17 occupations across all four mining sub-sectors, about 64,000 comes from primary/direct sources and nearly 77.67 million is contributed by auxiliary sources. Disaggregating the incremental supply across NSQF levels/education levels show that highest share is expected at NSQF levels 1 and 2. Thus, a significant proportion of supply comes from schools which could be attributed to Gross enrolment ratio at school level being much higher as compared to higher education. Analyzing supply across other NSQF levels show that nearly 84.5% of the incremental human resource is anticipated at NSQF level 1 and 2 followed by 9.5% at NSQF level 5 and 3.4%% at NSQF level 6 and above. With respect to NSQF level 3 and 4, a relatively lower proportion (1% and 1.6% respectively) is expected to contribute to the overall incremental human resource supply. The table below shows the distribution of talent supply by NSQF levels for the 7 year period:

Table 33: Incremental human resource supply by NSQF levels (in million), 2019–25

Particulars	2019-21	2022-25	2019-25	%Share of Incremental Supply
Total entrants for 17 occupations including mazdoor / Skilled helper, all relevant sectors*	33.3	44.4	77.7	
NSQF level 06 & above (*Doctorate/ Postgraduate or equivalent degree holder)*	1.1	1.5	2.6	3.4%
NSQF level 05 *(Bachelor's/ Advanced diploma (Polytechnic) equivalent degree holder)*	3.2	4.2	7.4	9.5%
NSQF Level 4*(Diploma/ ITI equivalent certificate holder)*	0.5	0.7	1.2	1.6%
NSQF Level 3 *(Skill certification of medium-term duration – 6 months to 1 year and short term – less than 6 months)*	0.3	0.4	0.8	1%
NSQF level 1 & 2 *(School dropouts and pass outs who are not enrolled in higher/technical education)*	28.2	37.5	65.7	84.5%
**Human resource supply available to all the sectors (including mining) which are similar/ relevant for mining i.e. Primary and Auxiliary Supply*				
Source: PwC Analysis				

The key highlights of the incremental manpower supply across the NSQF levels are as follows:

- **People at NSQF levels 1 and 2 constitute the highest share (84.5%) of incremental human resource supply, i.e. school dropouts and passouts who are not enrolled in higher/technical education:** The mining sector will face competition for this pool of talent as they are eligible to be employed across other sectors of the economy such as construction, manufacturing, etc. These candidates are typically employed for carrying out tasks of laborious nature and fall under semi-skilled and unskilled category. The share of incremental supply at NSQF levels 1 and 2 has fallen to 84.5% as compared to 86.8% of total incremental supply of 89 million people over the 2014-22 year period as estimated in SCMS's skill gap study conducted in the year 2015-16.
- **About 9.5% of the total incremental human resource supply is expected at NSQF level 5, i.e. Bachelor's/ Advanced Diploma (Polytechnic) equivalent degree holders:** This pool of talent will not be exclusive to the mining sector and will be absorbed by other sectors requiring similar knowledge, experience, skills and competence. The job roles for which the candidates will be hired for the mining sector from this pool would be Geologist, Surveyor, Jr. Mining Engineer, Mine Supervisor, Mining Mate, etc. The share of incremental supply at this NSQF level was 6.3% of total incremental supply of 89 million people over the 2014-22 year period in SCMS's skill gap study conducted in the year 2015-16.

[194] U DISE data

- **About 3.4% of the total incremental human resource supply is expected at NSQF level 6 and above, i.e. Doctorate/ Postgraduate or equivalent degree holders:** There is very small proportion of candidates who pursue Doctorate, Postgraduate or equivalent degrees and hence there is fierce competition among industries for this talent pool. These degree holders are regarded as specialists/sector experts and perform managerial and advisory level functions. The job roles for which the candidates will be for the mining sector from this pool would Resource Geologist, Sr. Geologist, Mechanical/Electrical Engineer, Mineral Processing Engineer, etc. In the SCMS skill gap report 2015-16, out of the total incremental supply, 1.7% was estimated to be in NSQF level 6 category.
- **About 1.6% of the total incremental human resource supply is expected at NSQF level 4, i.e. Diploma/ITI equivalent certificate holders:** This pool of talent will not be exclusive to the mining sector and will be absorbed by other sectors requiring similar knowledge, skills and competence. The job roles for which the candidates will be hired for the mining sector from this pool would be Blaster, Safety Operator, Geophysics Survey Operator, Ore Processing Operator. In the SCMS skill gap report 2015-16, out of the total incremental supply, 4.5% was estimated to be in NSQF level 4 category.
- **Only 1% of the overall incremental human resource supply is expected at NSQF level 3, i.e. candidates with medium and short-term skill certifications:** The alternate manpower supply comprises of students from Vocational Education and Training (VET) institutes such as ITI trained candidates on courses having duration of 1-2 years, QP based trainings through NSDC empanelled training partners and trained manpower from other VET institutes. The job roles for which the candidates will be hired from this pool for the mining sector would be Sampler, Explosives Handler, Drilling Assistant, Mechanic/Fitter, etc. In the SCMS skill gap report 2015-16, out of the total incremental supply, 0.8% was estimated to be in NSQF level 4 category.

6.2.2. Incremental primary supply

Of the total incremental human resource supply over the 2019-25 period, about ~0.1% will form the primary supply for the sector. The key highlights of the incremental manpower supply exclusive to the mining sector are as follows:

- **The highest share (51.6%) of incremental human resource supply is expected at NSQF level 5, i.e. Bachelor's/ Advanced Diploma (Polytechnic) equivalent degree holders:** About 32,500-33,000 people are anticipated to constitute supply for the mining sector from primary sources over the 2019-25 period. The share of incremental primary supply at NSQF level 5 has fallen to 51.6% as compared to 64.5% of total incremental primary supply over the 2014-22 year period as estimated in SCMS's skill gap study conducted in the year 2015-16.
- **About 36.2% of the overall primary incremental human resource supply is expected at NSQF level 4, i.e. Diploma/ ITI equivalent certificate holders:** About 22,500-23,000 Diploma or trade certificate holders are anticipated to constitute supply for the mining sector from primary sources over the 2019-25 period. This pool of supply will include certificate holders for job roles such as Blaster, Mining Sirdar, Mine Foreman, etc. The share of incremental primary supply at NSQF level 4 has risen to 36.2% as compared to 27.1% of total incremental primary supply over the 2014-22 year period as estimated in SCMS's skill gap study conducted in the year 2015-16.
- **About 12.2% of the overall primary incremental human resource supply is expected at NSQF level 6 and above, i.e. Doctorate/ Postgraduate or equivalent degree holders:** About 7,500-8,000 people are anticipated to constitute supply for the sector from primary sources over the 2019-25 period. The share of incremental primary supply at NSQF level 6 & above has risen to 12.2% as compared to 8.4% of total incremental primary supply over the 2014-22 year period as estimated in SCMS's skill gap study conducted in the year 2015-16.

The table below shows the incremental distribution of talent supply by NSQF levels for the 7year period:

Table 34: Incremental human resource supply by NSQF levels (in '000), 2019–25

Particulars	2019-21	2022-25	2019-25	%Share of Incremental Supply
Total entrants for 17 occupations including mazdoor / Skilled helper, all relevant sectors * (Primary + Auxiliary Supply)	33,317.2	44,422.9	77,740.1	

Particulars	2019-21	2022-25	2019-25	%Share of Incremental Supply
Mining's share of entrants for 16 occupations excluding mazdoor/skilled Helper(Only Primary Supply)**	27.4	36.6	64.0	100%
% Share of Mining Industry Oriented Entrants for 17 occupations	0.08%	0.08%	0.08%	-
NSQF Level 6 and above (*Doctorate/ Postgraduate or equivalent degree holder)*	3.3	4.5	7.8	12.2%
NSQF Level 5 *(Bachelor's/ Advanced Diploma (Polytechnic) equivalent certificate holders)*	14.2	18.9	33.0	51.6%
NSQF level 4 *(Diploma/ ITI equivalent certificate holders)*	9.9	13.2	23.2	36.2%
**Human resource supply available to all the sectors (including mining) which are similar/ relevant for mining i.e. Primary and Auxiliary Supply* ***Assuming the historical rate of employment in respective courses and participation rate in mining sector for each occupation per year i.e. Primary Supply*				
Source: PwC Analysis				

6.3. Incremental human resource demand-supply gap

The skill gap in the mining sector has been mapped as difference between the total core requirement of skilled manpower and the total primary supply of workforce in the country. This analysis is in line with SCMS's occupation map and study objective to facilitate informed decisions and develop a holistic skilling plan and implementation roadmap.

6.3.1. Human resource demand and primary supply gap

Considering the primary supply at NSQF level 4 and above, the incremental demand-supply of the mining sector is estimated to be a deficit of ~0.11 million during the 2019-25 period which is higher than the deficit of 0.06 million over the 2014-22 period as estimated during the SCMS's skill gap study conducted in 2015-16 . This suggests that the mining sector faces a shortage of talent supply directly relevant for the sector. This necessitates the need to attract manpower from auxiliary sources through appropriate skilling (fresh skilling, upskilling, reskilling) measures to close the demand-supply gap. The key highlights of the incremental human resource demand-supply gap across NSQF levels are as follows:

- **Human resource deficit at NSQF level 6 and above i.e. Doctorate/ Postgraduate or equivalent degree holders:** Over the 2019-25 period, a deficit of about 2250 people is anticipated for job roles that require specialists/sector experts such as Geological Mapping, Exploration, Mineral Estimation, Ore Pressing, Instrumentation and Control Systems and performing managerial level functions. With advanced technologies being used in exploration activities, building a skilled manpower in line with recent technologies will be critical.
- **Human resource deficit at NSQF level 5**, **i.e. Bachelor's/ Advanced Diploma (Polytechnic) equivalent degree holders:** Over the 2019-25 period, a deficit of ~9,000 people is anticipated for job roles related to engineering, supervisory, geology and plant operations. With advanced technologies being used in exploration activities, building a skilled manpower in line with recent technologies will be critical. Based on stakeholder consultations it was found that manpower engaged at this NSQF level are not adequately skilled, especially in light of technological advancements necessitating the need for upskilling and reskilling.
- **Human resource deficit at NSQF level 4 i.e. Diploma/ITI equivalent certificate holders:** Over the 2019-25 period, a deficit of ~95,000 people is anticipated for job roles such as Mine Driller, Dumper/Tipper Operator, Blaster, SDL & LHD Operator, HEMM Mechanic, Mine-Machinist, Roof Bolter, Loader, etc. The deficit may be addressed through upskilling and RPL Certifications of the existing workforce engaged at NSQF levels 3 and below. In addition, attracting workers from other competing sectors and reskilling them as per DGMS's statutory compliances will also help address the expected shortage.

- **For NSQF levels 3 and below the talent pool may be sourced from auxiliary supply:** The key job roles that exist at these NSQF levels include, Mazdoor/Helper, Technical Helper: Mechanical and Electrical, Mechanic/Fitter, Assistant Support Persons, etc. These job roles do not require any trade specific skills owing to their repetitive/routine-based and labour-intensive nature and thus this pool of workforce can be extracted from other competing sectors of the economy.

The table below shows the incremental human resource demand-supply gap by NSQF levels for the 7year period:

Table 35: Human resource demand supply gap by NSQF levels 4 and above (in '000) 2019-25

Particulars	2019-21	2022-25	2019-25
Total Incremental Human Resource Demand (for all levels)	80.7	190.0	270.8
Incremental Human Resource Demand (level 4 and above)	50.8	119.6	170.3
NSQF level 6 and above (*Doctorate/Postgraduate or equivalent degree holders*)	3.0	7.0	10.0
NSQF level 5 (*Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders*)	12.6	29.6	42.1
NSQF level 4 (*Diploma/ ITI equivalent certificate holders*)	35.2	83.0	118.2
NSQF level 3 (*Skill certification of medium term duration – 6 months to 1 year and short term – less than 6 months*)	5.4	12.7	18.2
NSQF level 1 & 2 (*School dropouts and pass outs who are not enrolled in higher/ technical education*)	24.5	57.7	82.3
Incremental Human Resource Supply (level 4 and above)	27.4	36.6	64.0
NSQF level 6 & above (*Doctorate/ Postgraduate or equivalent degree holders*)	3.3	4.5	7.8
NSQF level 5 (*Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders*)	14.2	18.9	33.0
NSQF level 4 (*Diploma/ ITI equivalent certificate holders*)	9.9	13.2	23.2
NSQF level 3 (*Skill certification of medium term duration – 6 months to 1 year and short term – less than 6 months*)	*About 66 million people will join the labour force at NSQF level 3 & below during the period 2019-25. They will be available for employment in all sectors of the economy*.*		
NSQF level 1 & 2 (*School dropouts and pass outs who are not enrolled in higher/ technical education*)			
Incremental Human Resource Demand Supply Gap (level 4 and above)	23.4	83.0	106.4
NSQF level 6 & above (*Doctorate/ Postgraduate or equivalent degree holders)*	-0.3	2.6	2.2
NSQF level 5 (*Bachelor's/Advanced Diploma (Polytechnic) equivalent degree holders*)	-1.6	10.7	9.1
NSQF level 4 (*Diploma/ ITI equivalent certificate holders*)	25.3	69.7	95.0
NSQF level 3 & below	*To be sourced from 66 million incremental labour supply in the economy.*		

**Total Incremental supply in the economy in 2019-25 period is estimated to be 77.7 Million, of which 66 million supply will be at NSQF level 1,2&3.*
**36,574 people are provided RPL and Short-term training in mining related trades between year 2016-20.*
Source: PwC Analysis

The above analysis presents incremental human resource demand and supply over the 2019-25 period with forecasted demand-supply gap in quantitative terms. However, based on stakeholder consultations undertaken as a part of the study, occupation-wise skill gaps in qualitative terms were also analysed.

The next section provides a summary of the qualitative skill gaps across various mining sector occupations.

6.4. Qualitative skill gaps

The qualitative gaps with regard to skill development were assessed through a combination of primary and secondary research. These skill gaps are categorized across sub-sectors and occupations (including ancillary activities) that exist in the mining sector and are summarized in the table below.

Table 36: Qualitative skill gaps across occupations

SNo.	Sub-sector	Occupation	Qualitative Skill Gaps
1.	Prospecting, Exploration & Mine Planning	Geological Mapping	• Development of new ore-deposit models to improve the chances of finding environmentally friendly ore bodies • Systematic Geological Mapping (SGM), Specialized Thematic Mapping (STM) • Multi-channel seismic surveys and High-resolution seismic surveys using 3D technology • Disseminating geoscientific data through memoirs, reports, catalogue series • Preparing detailed geological maps of more mineralized areas • Real time data analysis of geological data
2.		Exploration	• Use of advanced drilling technologies such as in-hole drilling motors, jet drilling systems, turbodrills for exploration • Directional drilling and better initial targeting to minimize the number of drill holes • Use of advanced airborne gravity gradiometer technology • Better understanding of element mobility in soils and cross-bore-hole characterization • Multisensor Airborne Geophysical surveys • Acquiring and analysing, magnetic, gamma-ray spectrometric and frequency domain electromagnetic data
3.		Mineral Estimation	• Geospatial mapping and visualization applications, like Geosoft's Target software • Feasibility studies such as environmental assessment using advanced 3D modelling and geostatistical software (an open source package) • Analysis and processing of Aeromagnetic data • Use of geographic information system software products such as MapInfo, ArcGIS, SAGA, Capaware, etc.
4.		Mine Planning	• Use of 3D mine planning and scheduling software such as Vulcan, Reactore, Earthworks On-screen, etc.
5.	Mining Operations	Mine Surveying	• Prepare plan for the extraction of a blended mixture of low and high grade ores • Accurately calculate ore production, in volume or mass units, volume of the dumps of waste accumulated on the mines surface, etc. • Different methods of surveying such as hydrological survey, cadastral survey, geological survey, etc. • Knowledge about legal aspects such as land boundaries and State law, geology, rock and deposit properties • Geoscience technologies such as GPS and GIS for planning and maps, on-the-ground measurements, and image design programs such as CAD, AutoCAD • Manage data reports, mine diagrams and field observations
6.		Drilling/ Cutting	• Usage of advanced drilling and cutting machines such as magnetic drill machine, hydraulic diamond core drill machine, swivel tangential cutter, etc. • Maintenance of logbook/checklist to record all activities performed before performing cutting and drilling operations • Adherence to safety guidelines specified by DGMS • Carry out basic routine checks of machinery/tools/equipment
7.		Short firing/ Blasting	• Cautiously receive and handle all explosive materials to avoid any loss or damage • Carefully planned 'Controlled blasting techniques' • Better control of fragment sizes and more precise rock movement

			• Conform with safety procedures and guidelines as prescribed by DGMS while carrying out blasting (as per specifications) • Evaluate the geological and mineral strata where blasting is to be carried out • Use of galvanometer, digital multi-meters, oscilloscope, ring gauges etc. to identify defects in explosive material
8.		Loading and Hauling-Opencast	• Knowledge about engine, transmission, different types of hydraulic mechanisms • Carefully load ROM, product etc. into another type of machinery • Adherence to safety guidelines specified by DGMS • Carry out basic routine checks of machinery/tools/equipment
9.		Loading and Hauling-Underground	• Knowledge of advanced longwall mining method, Autonomous Haulage System (AHS) • Sublevel long hole and block caving • Use of CCTV cameras, TCT ducts • Adherence to safety guidelines specified by DGMS • Carry out basic routine checks of machinery/tools/equipment
10.		Specialized Operations	• Atmospheric Monitoring System (AMS) for gas detection and Cavity Monitoring System (CMS) for identifying underground cavities • Proper functioning of ventilation system • Logbook with detailed observations about speed, ampere reading, water gauze reading, etc. and making interpretations • Underground communications such as signalling mechanism for carrying persons and material, defects on the gate and fences at the shaft • Ensuring a healthy and safe working environment
11.		Others (Mining Engineer, Material Engineer, Geotechnical Engineer, Mining Supervisor, Mining Mate / Mining Sirdar, Overman, Mine-foreman)	• Overall project management • Improving energy use and capital productivity • Assessing the feasibility and the potential for commercial benefit of new mine sites • Ensure adherence to Occupational health and safety standards • Meeting project goals/milestones adhering to approved budget
12.		HSE Functions	• Research and Development (R&D) for better and innovative ways of reclamation activities • Understand mine workings using 3D model and plan development schedules in line with Environment Management Plan (EMP) requirements • Environmental monitoring for mines rescue plan • Knowledge of carbon footprint and emissions and promote sustainable mining practices (such as treatment of mine water, waste management, rainwater harvesting)
13.	Engineering Services	Electrical Services	• Repair and maintenance of electrical equipment and systems • Reading sketches/blueprints of machinery and equipment to install electrical substations/ electrical equipment/ electrical wiring or fixtures • Test and evaluate if the installed equipment perform as per pre-defined specifications
14.		Mechanical Services	• Reading drawings and blueprints given in the installation manual • Testing and calibration of machines and equipment • Repair and maintenance of mechanical systems of HEMM, light vehicles and other machines
15.		Instrumentation and Control Systems	• Read and understand the mechatronics equipment readings and gather statistical data • Apply advanced, computer-driven control mechanism

16.	Mineral Beneficiation	Ore Processing	• State-of-the art technology in the R&D activities • Improving the recovery rate of minerals • Monitor ore grinding process ensuring that lubrication and cooling systems are at required levels • RFID tagging of ores
17.	Others-All sub-sectors	Mazdoors/Helpers	• Basic mining operations • Soft skills (such as teamwork, problem solving skills, adaptability, etc.) • Occupational health and safety standards
18.	Ancillary activities (in the periphery of mines)	Logistics and Transportation	• Basic maintenance of vehicles (such as fluid leaks, air pressure of tyres, etc.) to ensure that safety systems are functional • Traffic rules to be followed in mining areas • Positioning the vehicle at agreed optimum loading point
19.		Stone Cutting and polishing	• Feeding of the ore to the crusher keeping in view parameters such as feed/material rate, tilt, jams, etc. • Effective equipment handling guidelines • Operational checks on issues like blockages, unusual noise and smell, etc. • Occupational health and safety standards
20.		Reclamation and housekeeping activities	• Knowledge of Environment and Safety related acts • Flora and fauna research • Effluent treatment of mine water and wastage
21.		Drilling and Blasting by explosive contractors	• Following OEM prescribed limit for angles and inclination • Drill depth plans to ensure quality of holes • Positioning of explosives and detonators • Occupational health and safety standards
22.		Equipment repair services	• Reading engineering drawings and blueprints of machines and equipment for diagnosing faults • Storage and handling of lubricants • Usage of measuring equipment such as Vernier callipers, micrometre, feeler, temp gauge, etc.

Source: PwC analysis

- In addition to the abovementioned skill gaps, employers across the value chain have stressed the importance of soft-skills (communication and inter-personal skills), digital literacy and health and safety trainings. These skills are considered important at entry and supervisory levels.
- Due to technological advancements, companies would require more skilled workers and workers certified in health and safety practices. Industry associations reported that knowledge of laws and regulations related to mining was also an important knowledge base for workers, especially those in supervisory and management roles. However, workers have limited understanding of regulations governing the sector.

The incremental human resource requirement during the 7 year period (2019-25) is expected to be positively impacted by various factors such as emphasis on increasing overall production, boost to minor minerals, vision of producing 300 million tonnes of steel by 2030-31 with technological advancements playing the most critical role amongst these factors. Owing to technological advancements, demand for new job roles will be created and thus, the workforce needs to be upskilled in line with these advancements.

The next chapter provides an overview of future occupations that may emerge in light of technological advancements.

7. Technologies- drivers for change in future occupation in mining Sector

7.1. Introduction

Technology enhancement has changed the way we do any business, and mining is not an exception. India has gone through business transformation, with disruptive technological innovations in every aspect of the mining business and it is expected to continue and effect mining exponentially in future.

The mining value chain, starting from prospecting, exploration to operations, supply chain (procurement and logistics) and sale of final product in market is led by optimization currently, and eventful management of resources is embodied through all the processes. Data from exploration, mine planning and operations – geoscience and geological data, and data from drill and blast, load and haul, ore movement, and/or resource consumption – is getting amalgamated into the new system with more effective visibility, which, in turn, is helping in decision making. Companies are slowly exploring technology infusion to maximize efficiency, resources, and investment. This trend is not is relevant for operational activities as well as other aspects of the mining value chain such as Prospecting, Exploration and Mine Planning, Mining Operations, Engineering Services (SHE, CSR etc.), Ancillary activities and Mineral Beneficiation.

The overall expected trend in technology is slow but steady and is expected to increase in the coming decade. Skills enhancement programs and knowledge management will be critical to manage the expected skill gap. The overall dependency of technology on each part of value chain/sub-sector is different, and importance of driving enhancement programs might be different for different parts.

7.2. Expected trends in mining and sub sector

Some of the technologies that might be adopted across various sub sectors of prospecting, exploration and mine planning, mining operations, engineering services and mineral beneficiation are highlighted in table below.

Table 37: Technologies being adopted globally across the key sub sectors in mining

SNo.	Technologies	Description	Job Roles related to technologies
Prospecting, Exploration and Mine Planning			
1	Advanced Airborne Gravity Gradiometer Technology for Mineral Exploration	Exploration for mineral bodies is time-consuming and expensive; making an unsuccessful attempt is extremely costly. Therefore, an advanced gradiometer known as VK 1 gravity gradiometer has been developed in an attempt to find a solution to exploration changes.	Mining Geologist, Mining Engineer, Geophysicist
2	3D Imaging Technology	A new technology that has emerged in three dimensional imaging is 3D laser scanning, which helps to capture spatial data using laser light and enables geologists to build 3D geological maps combining the surface mapping data. 3d imaging technologies have transformed the exploration of large mines and continue to hold promise with a number of emerging technologies.	Imaging Technologist, R&D Engineer, Surveyor
3	Automated Drilling	Automated and tele-operated drilling solutions can ensure mining personnel safety and improve efficiency during surface drilling operations. A tele-operated drilling solution comprises of an easily installable operator station on a range of mobile platforms connected to the drilling rig wireless network. In the old methods the drilling was manual and also was an extensive method to follow.	Drilling Supervisor, Drilling Technician, Drilling Equipment Mechanic, Installation Manager, Installation Technician

SNo.	Technologies	Description	Job Roles related to technologies
4	Efficient Shaft and Tunnel Boring System	A tunnel boring machine (TBM), also known as a "mole", is a machine used to excavate tunnels with a circular cross section through a variety of soil and rock strata. TBMs have the advantages of limiting the disturbance to the surrounding ground and producing a smooth tunnel wall. The modern breakthrough that made tunnel boring machines efficient and reliable was the invention of the rotating head.	Tunnel Superintendent, Tunnel Boring Machine Operator, Operations Manager
5	Plasma Technologies	Plasma technologies are used in a process by which complex ores such as zinc, nickel, copper and lead are heated applying ultra-high temperatures of between 8,000-12,000 degrees Celsius to break down the ore structure and free up the latent precious materials.	Machinery Operator, Operations Manager, Equipment Mechanic
6	Remote Operating and Monitoring Sector Inversion Algorithm	Remote Operating and Monitoring Sector Inversion Algorithm helps in monitoring and controlling the mining or processing the activities from a remote location which increases the efficiency, improved safety, decreased viability and better identification of the performance issues.	Facility Manager, Satellite Imaging Technician, Data Analyst, Database Management Supervisor, Automation Specialist, Field Service Technician, Facility Equipment Maintenance Technician
7	Inversion Algorithm	The new inversion algorithm allows geophysics data to be used in a different way. By first establishing the geophysical property of rocks and then measuring their geophysical signatures in the field, it is possible to generate three dimensional models of their potential mineralization.	Modelling Technician, Geophysicist, Field Surveyor
8	Portable Analyser	A portable analyser identifies the chemical elements comprising on a rocks surface using X-rays. It provides on spot results, which helps avoid unnecessary sampling and analytical testing at a laboratory.	Field Surveyor
9	Aviris	The AVIRIS airborne sensor uses hyperspectral measurements that is it measures hundreds of spectral bands, whereas ordinary satellites measure only few at a time. This helps in identifying the vegetation but also the nature of the minerals present.	Data Analyst
10	Mass Balance	Mass balance helps in dissolving minerals for e.g. copper, zinc and gold and transforming.	Mining Supervisors, Data Entry Operators, Data Analysts
11	Geographic Information System	GIS has transformed the exploration practices by organizing and presenting spatially referenced numerical data on a computer. The offices of exploration companies were once covered in maps at different scales; today they are filled with computer screens on which geologist compile their information.	GIS Application Developer, GIS Engineer, Data Analyst
12	Geo-positioning	Geo-positioning uses satellite and accurate information and dramatically facilitate field work and mapping projects. It has changed the process of exploration by allowing user to pinpoint an observation site quickly and accurately.	Application Developer, Data Analyst
Mining Operations			
1	Blasting Box	It is now possible to use an air pressured ignition mechanism rather than one that is spring loaded in order to avoid unexpected explosions.	Machine Operator, Operation Supervisor
2	Hybrid Bolt	Hybrid bolt is a combination of friction bolt and then resin bolt. Mainly the bolts end up breaking and can fail to hold the screens in place. The hybrid bolt solves them.	Machine Operator
3	Boulder Buster	In this, a small hole is drilled into the rock and then filled with water. A breach body is then inserted in the hole, a protective mat placed over the rock and cartridge placed in the breech body.	Operations Supervisor, Machine Maintenance Technician, Field Surveyor
4	Inspection camera	A wheeled inspection camera is fixed into a rigged wheel mounted housing and equipped with forward facing lighting system to carry out inspections of mine shafts and tunnel.	Machine Maintenance Technician, Field Surveyor

SNo.	Technologies	Description	Job Roles related to technologies
5	Mobile drilling	Mobile drilling is used for production holes and ground support in underground mining, being employed as much for diamond drilling as it is for regular boreholes. The small conveyor makes it easier to access narrow excavations.	Machinery Operator
6	Robomap	The inventions of mining robots provided an opportunity to design autonomous tools for mapping underground tunnels in mines, particularly for mapping the textures of their walls. The robots are able to gain access to areas that would be difficult for humans. Robomaps is an autonomous or remote-controlled machine equipped with a motion sensor for positioning.	Machine Learning Engineer, Application Developer, Maintenance Technician
7	Rockmesh	Rockmesh machine installs protective meshes on mine walls. The machine improves safety by mechanizing the application of the mesh, thereby avoiding manual handling by workers. An operator can send all commands from inside the vehicle.	Machinery Operator, Machine Maintenance Technician, Operations Supervisor
8	Mining Simulator	Immersive and virtual training systems for all types of mining operations provide training for personnel with the help of simulator. Its main objective is to teach the workers to react appropriately without exposing them to the real danger.	Machine Learning Engineer, Application Developer, Maintenance Technician, Instructor
9	Smart rock	It is often difficult to track the movement of the rocks in underground mine when the broken ore is stored in vast underground spaces during mining process known as block caving. To help solving this issue is Smart Rock an electronic gadget that resembles rock.	Data Analyst, Maintenance Technician
Mineral Beneficiation			
1	Sonar Flowmeter	These tools measure the amount of material passing along the conveyor belts using sonar capable of measuring solids just as well as liquids.	Data Analyst, Maintenance Technician
2	Underground Pre-concentration	The first step in separating ore minerals from gangue typical involves crushing and grinding which creates huge noise and pollution and lots of dust. This step is completely carried underground and this process would also reduce transport costs since less material would have to be moved out of the mine.	Machinery Operator, Machine Maintenance Technician, Operations Supervisor
3	Split online system	Milling is the first step in ore processing. The ore must be broken down to increasingly smaller pieces in order to separate minerals of the interest. It is now possible to instantaneously measure the size of fragments using continuous image analysis. It is an automated digital imaging system that monitors ore during milling. The images are captured by photographic devices installed in the crusher and on the conveyors and processed by specialized software that measure the size of the fragments.	Imaging Technician, Field Surveyor, Data Analyst, Application Developer
4	Magnetic Separator	Gravity separation, Forth Floatation, Magnetic Separation, Electrostatic separation and air tabling are the main methods for mineral beneficiation. These are focused on all major players of coal washeries in order to reduce the cost associated with transportation of unprocessed coal.	Machinery Operator, Machine Maintenance Technician, Operations Supervisor
Engineering Services			
1	Jack Adapter	Heavy machinery requires regular maintenance and occasional repairs. To do either the equipment must be lifted up and held there, safely and securely. To prevent the jack from slipping, jack adapter is designed which is placed between the jack and the raised machine.	Maintenance Technician
2	Personnel Tracking	RFID tags are invented so the workers can be easily tracked underground. It is one of the efficient methods to retain safety of the employees.	Tracking Supervisor, Data Analyst
3	Gas detection device	Underground mining produces gas from the machinery running on diesel. This gas is often toxic; hence sensors are provided that measure gas concentrations.	Maintenance Technician
4	Survival Chamber	In case of an accident survival chambers offer protection for trapped workers. They can be easily moved from one place to another, these chambers provide 36 hours of protection with supply of electricity and oxygen.	Maintenance Technician, Supervisor

SNo.	Technologies	Description	Job Roles related to technologies
5	Fatigue measuring watch	The fatigue risk management system is an electronic strap that measures the fatigue level of a worker, particularly heavy equipment operators to determine whether they are fit to work.	Application Developer, Data Analyst
6	Soundproof Tent	It serves the dual purpose of improving communication between the operators and the miners in the cage and reducing the risk of hearing problems.	Maintenance Technician, Installation Technician

7.3. Prospecting, exploration and mine planning

Mineral prospecting and exploration activities being the preliminary activity in development and extraction of a mineral resources, always goes hand-in -hand with advancement in technology. Current techniques involving basic scientific approach like geological and geo-physical studies using aerial photography, topography maps, collection & analysis of appropriate samples, geo chemical anomalies, geophysical surveying using gravity survey, electromagnetic survey, magnetic survey, remote sensing, and exploratory core drilling respectively.

These technologies have in the past decade have shown some limitations in their role for mineral discovery and are expected to be upgraded as per the initiative mentioned below.

Expected trend:

- The National Mineral Exploration Policy (2016) allow the Government to make available the pre-competitive geoscience data which can be provided to potential exploration agencies[195].
- The overall expected impact of this policy on the mining sector would be increased participation of the private sector in the exploration activities as the laws would become more flexible and business friendly leading to better availability of geological data and faster expected pace of exploration. *For the purpose of improving exploration and extraction process, research and development in basic geological sciences, geophysical and geochemical methods, and drilling technologies are being encouraged.*
- While hundreds of drill holes may be required to map and evaluate the quality of an orebody, efforts are underway to either reduce the number of drill holes, increasing the rate of drilling, or reduce energy requirements, and any of these would significantly reduce costs. Some of the novel drilling technologies under consideration for successfully increasing the drilling rate include **down-hole hammers, turbo drills, in-hole drilling motors, and jet drilling systems[196].**
- *The equipment, techniques and analytical technology used for modern geochemical and geophysical prospecting have become increasingly sophisticated*. The effective technologies are being tested and utilized by several leading mining companies in India already.
    - **The drone based geophysical surveys** are getting implemented at exploration sites of big mining companies, and these advanced technologies are going to stay in Indian market, as it makes the real time data analysis essential.
    - **Remote sensing technologies** are currently being used at a very advanced stage in exploration, and adaptation to different exploratory fields are easily accessible.
    - **New technologies such as portable X-ray fluorescence, laser fluorescence scanning, cross-borehole seismic tomography, geophysical surveying by drone, and hyper-spectral technologies** have significantly benefited mineral exploration in many countries. These and other technologies are significantly increasing productivity and reducing the invasiveness of mineral exploration efforts are expected to be implemented in India as well.

[195] National Mineral Exploration policy, 2016
[196] https://africanminingbrief.com/how-technology-continues-to-revolutionize-mineral-exploration/

Future occupations:

The expected trend as discussed above will lead to growing demand of geologists and technical personnel with understanding of geology, geophysics, surveillance, remote operations and earth science. Also, personnel with skills in data analytics, data visualizations and understanding of information technology are expected to rise in demand to gauge better inference from pre-competitive geoscience data and implementation of newer technologies.

Nevertheless, traditional occupation of unskilled personnel is expected to continue with their current role along with expected rise in demand of skilled workforce who can understand implementation of newer technologies.

7.4. Mine development and extraction

Technological innovation has taken a big step forward in the mine development and extraction stage of mining. Technologies like manual marking of drill, manual charging, using electronic detonator, surface mines, and bucket wheel excavator, simple shovel-dumper, and in-pit, out-pit crushers, with dumper movement are currently being used in different mines in India and is expected to be upgraded to more efficient and automated techniques, as described below. This is common for both open-cast and underground mining methods.

Expected trend:

Opencast Mining Methods: technologies have exponentially affected each part of the extraction process, from drilling and blasting to ore transportation and processing.

- Drilling & blasting is moving from manual marking, loading to use of *blast design and pre-blast analysis software packages, post-blast analysis of fragment distribution* to study the effect of explosives and plan for future more efficiently. Individual blast holes are now being georeferenced using GPS and to control blast and increase efficiency laser range finder and face profiler is getting common.
- With increased demand, and expected growth in demand, the production capacity of mines per year is increasingly conceptualized, and modern mines are getting bigger with larger ramp, and broader berm – giving space for giant equipment, which eventually will require more trained skills to operate and maintain.
- *"SAFETY FIRST"* – This is getting to be mantra of modern day industry, as the companies are becoming more community friendly and targets to sustainable business. Every technology is incorporated in a mining operation after aligning the safety goals and virtue linked with the equipment.

Khanan Mitra App

The app has been introduced as a part of digital initiative in the mining sector under DGMS – Western Zone and Raigarh Region with the objective spreading awareness about mines safety. A key distinguishing feature of the application is that it connects everyone in the mines hierarchy from top to the lower management. Ranging from supervisors to workers and officials in coal and non-coal mines. Each official can participate and learn about the various features of mine and can easily give their essential feedback on it.

- Technologies like semi to fully-autonomous vehicle are getting common in global scenario, and is very attractive for Indian industry as well, though it is very challenging to adopt same due to community interference in employability factor of each mine. Drones and laser scanners are the most common adaptation in surveying techniques in India.
- Companies like Tata Steel Limited, used truck dispatch system, to better manage their mine back in 2008-2009. This is slowly being accepted by the industry, and the decision making ability it gives to the management is being appreciated.
- In order to safeguard surrounding of truck/shovel movements, radio-sensors, RFIDs have been generating quite interesting results, diminishing 90% of the accidents in Americas, which used to happen around moving machineries. This will be a future technology for India and will play an active role in administrating safety in mines.

- Conveyors have been a big success in the mining industry since last two decades and are gaining acceptability in the industry as they are an efficient and effective means of transporting ore.
- Technological focus in the international mining industry is at a different level all together as compared to the Indian mining industry and are adopting/implementing the modern-day technologies like Artificial Intelligence, Blockchain technology, Internet of things, virtual reality, 3-D printing, Drones etc. These technologies have found their use in entire value chain from procurement and logistics to operations and sale of final product.

Some of the International projects using such technology or under development for use of such technology include use of Blockchain for supply chain and logistics planning and maintenance in mining-processing-end use supply chain, equipment and goods tracking using IoT enabled transportation vehicles, operations cost optimization by automation of process and pre-assessment of possible outcomes using Artificial Intelligence and Machine Learning, cyber security for mining, connected and integrated mining operations with real time data monitoring, use of 3-D printing in manufacturing of spare parts to cut dependence on costly OEM manufacturers and improve cost-benefit scenario of procurement activities, training to mining personnel's using virtual reality for activities like, driving of HEMM, mining equipment and handling, drilling and blasting techniques, virtual tour of Mines.

- The trends towards greater application of continuous mining systems, larger sized equipment and greater energy efficient systems are sure to continue but automation is an ambitious target in mining operations and is less likely to become a spectacular change in India. There are efforts required to further bring the cost of production down by improving productivity and use of technology. This may create a set of new age job roles that may require new competencies.
- Further, with challenges of lower grades, increasing depths of the deposits and rising concerns of forest depletion and issues of land, slowly mining will have to be planned underground. Technologies for efficient production are available globally but they need investments in adaptation for Indian geological conditions
- Opencast mining seems much more common in India though, employing majority of the workforce across all mineral types. It can be noted that of the total workforce employed in non-fuel minerals, a significantly large proportion is engaged in opencast mines while in case of fuel minerals, workers are almost equally spread across both types of mining[197].
- This requirement may see a shift towards deep seated mining and deep drilling techniques. Thus, would require innovative use of technology and the reskilling or upskilling of the work force currently engaged in the sector.

Underground mining methods: The manual and semi mechanized underground mining activities are expected to push towards mechanization and mechanized mining are to push towards efficiency improvement and automation.

- In general, emphasis on development and production from underground mining is rising with time. This will need training and preparation of personnel for underground work which is quite different from open cast mining[198].
- For coal in particular, post-nationalization, CIL has concentrated on technology upgradation mainly for opencast mining and there are a number of opencast mines in India of international standards. However, there had been minimal introduction of advanced technologies in underground mining and most of the underground mines continue to practice age-old technologies. As per the study carried out by a consortium of *PwC, SCCL and ISM Dhanbad, titled: "Study report on underground coal mining in CIL - Problems, potential, technology, modernization, production and safety"*, in which a study on 90 underground mines were carried out. Some of the recommendation of the study were:
    - There is *scope for introduction of mass production technologies (CM/ longwall)* in as many as 48 number of mines out of the 90 mines studied.
    - Introduction of mass production technology, particularly longwall mining, would require detailed geological information. It is therefore, recommended that thrust need to be put on application of modern

[197] Source: Statistics of mines in India: Vol I and II, DGMS (2015)
[198] Study carried out by a consortium of PwC, SCCL and ISM Dhanbad, titled: "Study report on underground coal mining in CIL - Problems, potential, technology, modernization, production and safety

exploration techniques including high resolution seismic survey for bridging the geological data gap within next couple of years.

- The study recommends widening/deepening of existing shafts, sinking of new shafts and drivage of new inclines to cater to the increased demand of vertical coal transport. For in-seam coal transportation, conventional rope haulage system has been proposed to be replaced by conveyors in the mines where mass production technologies have been suggested. As many as 62 numbers of shafts have been proposed to be sunk/widened/deepened and 79 number of new inclines proposed to be driven in the studied mines.
- To reduce the time spent in travelling and to reduce the fatigue of workers, the study recommends introduction of man riding system in almost all the mines studied.
- There is an increased emphasis on safety, which will require efforts to upskill the existing workforce. Further, certification may become an important criterion of securing employment in international markets.

Future occupation trends:

As discussed, major occupational engagements in mining operations are excavation, loading, hauling and mechanical services both for open cast and underground mines. Increasing scale of mining operations, mechanization and shift to underground mining will necessitate the existing workforce to be up skilled. Some of the expected requirement are:

- Requirement of Equipment operators and helpers for large-scale open cast machineries/ equipment.
- Requirement of large-scale open cast equipment operators and maintenance personnel.
- Personnel with understanding of IT infrastructure along with understanding of mining and mineral sector so as to strategize, implement, operate and maintain the IT infrastructure for better operationalization of Mining Sector.
- Requirement of data engineers and data scientist is expected to increase who can driver understanding from the data being generated from monitoring devices and can convert such data into useful form.
- Focus on Research and Development to adopt the recent developments in mining technologies around the world and customize to Indian standards.

In the next 5-6 years, as the government intends to increase mineral production and cut import dependence, the driving factor will be mechanization and use of new technology to improve efficiency of work, increase production of minerals and to curb accidents/ fatal and non-compliance.

Due to the current dominance of opencast mining, underground working skills are becoming rare to find. This include, Underground mine planning, underground mine working, Equipment operators and handling, establishment and maintenance of underground infrastructure, supply chain of mineral from underground face to processing plant etc. so, revamping skill development in underground mining operations is very much necessary to shift focus to underground mining.

7.5. Other sub-sectors

With the advent of technology advancements and mechanization, equipment manufacturing and maintenance sub-sector is also expected to boost along with expansion in manufacturing of underground mining and related equipment. Similarly, with the decreasing grade of mined ore with time, importance of mineral processing sub-sector is on high demand with improvement in technologies and cost-efficient grade enhancement of ore.

Some of the trends in mineral processing industries include[199]:

- In-pit crushing and conveying

[199] https://www.flsmidth.com/en-gb/solutions?sort=popularity&industries=mining

- tailing management
- real time condition monitoring of processing plant
- extraction from low grade ores
- improving flotation efficiency

One of the emerging fields in the Mining sector involves role of analytics for interpretation of the real time data/ already available data/ periodically available data. The predictive and prescriptive analytics, artificial intelligence and data driven insights are enhancing the ability to make intelligence decision that drives the growth, improve productivity and efficiency, disrupts market and capitalize on emerging opportunities.

Sub-sectors of Mining including prospecting & exploration, mine development & extraction, supply chain, marketing and end use are expected to increase the use of analytics and data driven decision making in near future. Such trend will require personnel with good understanding of mathematical analysis, tools and software for analysis and understanding of mining sector as well.
For any of the technological improvements sited above, the skill upgrades for the skill will be immense. The ability of personnel to understand and work on software, with perpetual mode of communication will be the key to success for all the technologies.

A holistic understanding of the mining sector in terms of its economic and labour market outlook and the existing education and skilling infrastructure was developed based on secondary research and consultations with nearly 1300 participants relevant for the study. In addition, a comprehensive skill gap assessment identified the most in demand occupations and major talent supply sources keeping in view the factors that may have positive implications on the sector. Taking cognizance of the demand-supply gap and interactions with stakeholders, it is important to explore the issues that the sector is currently facing with suggestions vis-à-vis each issue.

The next chapter delves into the key issues/challenges and corresponding recommendations for SCMS and other stakeholders.

8. Key challenges and recommendations

The challenges articulated in this section are based on primary and secondary research as well as the estimations for demand and supply over the period of 2019-2025. The recommendations are based on consultations with SCMS and other key stakeholders such as employers, government authorities, training service providers, industry associations, workers and students. The recommendations are also based on an assessment of the impacts of COVID-19 pandemic on commodity markets, mining sector and the general labour market in India.

The table below provides a detailed summary of the challenges and corresponding recommendations across six broad categories:

Table 38: Key issues and recommendations for the Indian mining sector

Training/ skilling needs	
Challenges	**Recommendations**
In view of Industry 4.0 technologies are slowly making their way in the Indian mining sector, little impetus is laid on equipping the workforce with skills as per expected technological advancements	• New emerging technologies across which trainings can be undertaken such as real time data analysis, data visualizations, blockchain, software packages, IoT enabled transportation vehicles, etc. have been delved in detail in section 7 of the report. SCMS can develop QPs for the priority job roles. • Premier institutions can be leveraged to do a 6-month upskilling course around newly introduced tech and innovation in mining, and can set up skilling centres with relevant technology, including simulation technology to train new workers. • Collaborations can also be sought with major mining companies which have taken initiatives towards training manpower on latest technologies such as Hindustan Zinc Limited, TATA Steel and Gujarat Mineral Development Corporation[200] in India, Rio Tinto in Australia, Anglo American's Kumba Kolomela mine in South Africa, Freeport-McMoRan in United States, etc.
Education and vocational institutions do not have soft-skills modules which match up to the needs of the sector	• Through partnerships with employers and relevant Sector Skill Councils, SCMS can design a soft-skills modules (such as inter-personal skills, teamwork, problem solving skills, etc.) and assessment methods. These modules can be introduced into various certification programs as well. Certain soft-skills courses have been mapped with QP-NOS, such as: ○ Use Basic English for Employability Variants I, II and III - MEP/N9991, MEP/N9992, and MEP/N9993 ○ Use Generic Skills for Employability Variants I and II - MEP/N9994 and MEP/N9995 • Inclusion of a soft-skill module as part of the refresher trainings (as mandated in the MVTR) is recommended. Additionally, to tackle the problem of sexual harassment of women at workplace, sessions on Prevention of Sexual Harassment (POSH)[201] can be organised as a part of soft skills training.

[200] An 'International Center of Excellence in Mining Safety and Automation' (iCEM) in has been established by the Government of Gujarat in close collaboration with GMDC with the objective of accelerating mining activities. The center gives emphasis on skill development across following sectors: Mine Automation, Mine Safety, Advanced Technological Mining Systems, Bulk Material Handling, Advanced Mapping Systems, Mine Planning, Robotics & Information System in Mining, Artificial Intelligence and Virtual Reality.

[201] Ministry of Women and Child Development by a Notification dated December 9, 2013 passed the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) POSH Act, 2013 (the "Act").

	• In order to provide language training which addresses immediate requirements for communication, immersive language workshops can be conducted.
Facilities for practical sessions in engineering colleges, polytechnic colleges and Industrial Training Institutes are of low quality	• It will be critical to identify the infrastructure and human resource needs for practical sessions and implement solutions in collaboration with employers (provision of new labs, equipment, trainers, etc.). SCMS can undertake the same for its empaneled TSPs. • Education institutions can also make use of online knowledge repositories such as National Programme on Technology Enhanced Learning (NPTEL), IIT-BombayX and Swayam. These can be utilized to facilitate online and at-home learning as well. • Simulation-based training sessions on operating various machines on mines can be conducted in engineering and polytechnic colleges and ITIs to give essential hands-on experience to trainees. This will help increase operator safety and improve productivity by giving 3-D representation of actual mining operations and providing augmented and virtual reality experiences to students and workers. However, taking cognizance of the fact that funding would be a challenge, known mining industries can be approached to adopt surrounding ITIs/Polytechnics/colleges to extend grant as a part of their CSR initiative or donate old equipment duly refurbished. • E-learns will be critical to help overcome illiteracy and language barriers and develop a trained and skilled manpower which can perform roles that blend traditional mining disciplines with new digital applications. Large companies can set up such training facilities on their premises for re-skilling and up-skilling of their workers or set up professional development programs for their staff (like professional development programs in PSUs, Vedanta, TATA Steel, Sandvik Mining, Caterpillar, etc.). • An 'International Center of Excellence in Mining Safety and Automation' (iCEM) in has been established by the Government of Gujarat in close collaboration with GMDC with the objective of accelerating mining activities. Further, Bharat Earth Movers Limited has also set-up 4 CoEs (for Hydraulics, Structural Welding, Electrical & Electronics, etc.) at its KGF, Bengaluru and Mysore complex. Thus, SCMS can collaborate with employers/higher education institutions to adapt models of such mining companies and also skill development bodies in Australia and South Africa to establish Centres of Excellence to promote up-to-date facilities. • In light of technology initiatives in the classroom, colleges, ITIs and polytechnics can avail funding under various schemes: Ministry of Human Resource Development's Rashtriya Ucchatar Shiksha Abhiyan (RUSA), Department of Science and Technology, Govt. of India's Fund for Improvement of S&T Infrastructure (FIST), Directorate General of Training's Skills Strengthening for Industrial Value Enhancement (STRIVE) and upgradation of existing ITIs into model ITIs.
Apart from PSUs and a few large employers such as Vedanta, TATA Steel, Sandvik Mining, other employers lack institutions/ programs for continuous professional development which allow technical personnel to	• SCMS can provide corporate trainings to employers (largely medium and small ones). Further, employers can incentivize technical workers to take up management roles through offering upskilling/ re-skilling programs on management-oriented activities. This would ensure that succession planning and knowledge-transfer can happen. Models for this include PSUs, Vedanta, TATA Steel, Sandvik Mining which run training programs for continuous professional development. • SCMS can work with the abovementioned to offer online Continuous Professional Development programs for other employers.

move into management roles	• SCMS and higher education institutions can collaborate to offer executive management education courses.
Due to political, regulatory and environmental concerns, mining units must ensure social and environmental considerations are incorporated into their activities	• Design trainings in environmental management and community development for those in supervisory and management roles, especially in small and micro sized industries. Employees in jobs mapped to NSQF Level 5 can undergo courses in the above topics in order to navigate the various political and environmental concerns. In addition, the NOS can be introduced in engineering and management courses to allow those in management/ executive roles to understand and plan according to the policy landscape. • Since mining is a risky activity, frequency and quality of trainings on occupational health and safety should be increased targeting right from those in supervisory/managerial roles uptil mazdoor/helpers. • The following areas can be addressed in training programs, or developed as separate Occupation Standards (NOS): o Restoration of land and water resources o Treatment and disposal of waste o Treatment of air pollution o Health outreach for communicable diseases and nutrition o Promotion of local livelihoods (mining-dependent or independent skill development and entrepreneurship promotion)
Beneficiation processes for coal washeries, iron ore, zinc, manganese and chromite ores are currently undertaken by a workforce which does not have formal, standardized training	• Training providers should be encouraged to undertake courses relevant to beneficiation. • SCMS can empanel TSPs to offer training in the following job roles associated with refining/ beneficiation of ore: o Ore Processing Operator o Assistant Operator – Ore processing / Beneficiation • SCMS can collaborate with Indian Bureau of Mines as it is currently imparting training in Mineral Processing and Beneficiation job roles. • Training providers should be linked with key employers in beneficiation such as Ap Coal Washeries, Gujarat Mineral Development Corporation Limited, etc. to enable them to capture demand right from source and ensure that their trainings are aligned to the requirements of employers
Un-standardized training programs for job roles in minor minerals (unorganized sector) and ancillary activities	• SCMS can review job roles in minor minerals and ancillary units in mining clusters and accordingly develop training programs for both the local youth and existing workforce. Some of the job roles appropriate for skilling include: o Plumber (plumbing) o Welder o Loader/Unloader (Logistics) o Gardner, Sprinkler o Machinist/Fitter o Driver (Logistics) o Stone cutter

	○ Polisher ○ Machine operators ○ Dumper/Tipper Operator ○ Gangsaw Operator ○ Driller ○ Sales Executives • To meet skilling needs, SCMS can provide affiliation to Vocational Training Centres (VTCs) set up in unorganized clusters. SCMS can facilitate collaborations with large employers or industry associations, DMF or CSR funds in districts to enable pooling of funds and efforts to drive the establishment of DGMS prescribed VTCs, which support the workforce of smaller and unorganized mining clusters as well.
Majority of the existing workforce, especially in unorganized sector and ancillary activities have not undergone any form of skills training in their field of operation; it is either hereditary learning or training under the supervision of the seniors. Such workers are unable to get certified for their on-the-job experience, and this hinders their career progression	• SCMS should undertake Recognition of Prior Learning (RPL) programs (formally recognizing and certifying the current competencies as per NSQF levels) based on the job profiles of such workers. • Such workers can also be offered monetary incentives for gaining certifications by employers. Job Roles identified for RPL are presented in the Action Plan. • RPL for level 2 job roles will be crucial in empowering workers with certificates that all them upward career mobility opportunities. • Online assessments can be explored as a way to partially make the assessment and certification process more efficient.
Limited courses and seats offered by ITIs for the mining industry	• Currently only 2 courses directly relevant to the mining industry are being taught by ITIs. Therefore, in collaboration with NCVT, courses for prevalent trades should be introduced in ITIs. • As an initial step, considering indications of interest by employers as well as workers, ITIs in mining dominant regions such as Rajasthan, Gujarat, Madhya Pradesh, Odisha, etc. should be encouraged to take up these courses.
Currently, there aren't any mining relevant trades that are being taught as part of vocational education in schools	• While mines do not allow workers below 18 years of age to work, students living in mining dominant areas can be trained in allied trades such as for industrial grade electrician, amongst others. • Mining companies can also conduct exposure visits for school students to encourage them to take up employment in the sector.
As compared to other Sector Skill Councils (SSCs) such as Automotive, Iron and Steel and Capital Goods which have over 260, 35 and 70 TPs[202] respectively, the number of TPs engaged with SCMS are relatively low (22+)	• Despite the challenges cited by non-mining TPs, they have expressed their willingness to work in the sector (given that there is huge potential of employment and skilling) provided SCMS extends support to them through a sustainable model of training such as: ○ Liaison with State governments, especially Departments of Mines and Geology (DMG) to make mining as a priority sector. ○ Forge linkages with local industries and enable active industry participation for employment and inputs on curriculum.

[202] Website of respective SSCs

	○ Capture demand from employers in both organized and unorganized sector and disseminate aggregated demand numbers for job roles to training partners. This will eliminate chances of talent oversupply and assist in bridging the talent demand-supply gap. ○ Training more Master trainers for building technical capability. ○ SCMS can help facilitating capital expenditure support to the TPs in the form of subsidized loan/ grant. • The State District Mineral Foundation (DMF) rules and Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) launched in 2015 stipulate that 60% of the funds have to be sent on high priority areas such as drinking water, sanitation, health including skill development. Thus, State governments can support TPs in leveraging funds through DMF and undertaking skill development under PMKKKY. • Develop a framework for evaluating and ranking its training providers, trainers and assessment agencies to improve quality assurance mechanism. The rating framework will help SCMS achieve the following objectives: ○ Help prospective trainees and employers in making the right decision while selecting training providers for training and employment ○ Instill a system of competition amongst training providers, trainers and assessment agencies by setting a quality standard. ○ Enable SSDMs and other Government agencies in selecting the right training provider and assessment agency. Also, training providers shall be able to select quality trainers for their institutes. ○ Ensure continuous improvement in quality of operations of training providers and assessment agencies, leading to establishment of a quality assurance mechanism. ○ Identify the training providers who are lacking, and thus, can take corrective measures such as reducing training target, among others, to improve the overall quality of the training and thereby, the training outcome.
Transnational standards required for better employability of manpower overseas	• SCMS to collaborate with major mining countries and their Sector Skill Councils such as Australia, Canada, Ghana, etc. to develop transnational standards for key job roles. • To create transnational standards, SCMS will have to benchmark its standards against Qualifications/NOSs of international skill councils and identify gaps, if any in their standards/QPs. The draft transnational standards are open for public comments for 3 months post which they are promulgated as 'Transnational Standards'[203]. • NSDC in collaboration with Department of Industry, Australia is developing transnational standards by making NOS transnational in 4 sectors (Auto, Healthcare, Telecom & IT) across 8 job roles[204]. Similarly, SSCs such as Construction, Automotive, Life Sciences, NASSCOM are developing NOSs and transnational standards to enhance the mobility of labour. • Set country specific MoUs to ease transition of workers as well as ensure their wellbeing.

[203] https://www.nsdcindia.org/nos-listing/34
[204] https://www.msde.gov.in/global.html

Mining is primarily carried out in regions having poor socio-economic condition where intensive support is required from the State governments for skilling and improved well-being of the locals	• Currently, there are 117 districts across 28 states in the country which have been identified as 'Aspirational Districts'. Of these 117 aspirational districts, there are 9 mineral rich districts (West Bokaro in Jharkhand, Raichur in Karnataka, Singrauli in Madhya Pradesh, Balangir and Koraput in Odisha, Udaipur and Barmer in Rajasthan, Khammam and Adilabad in Tamil Nadu) which fall under the purview of 'Transformation of Aspirational Districts' programme[205] • Skill development is one of the five themes of the programme having 5% weightage. Thus, SCMS can collaborate with State governments of these mineral bearing districts to run training programmes leveraging on the funds allocated for the abovementioned districts
The COVID-19 pandemic has changed the landscape of commodity markets and disrupted supply chains. This has had implications for demand for minerals as well as their production **Major possible consequences include:** • **Decrease in demand, supply and prices** • **Layoffs, freezes on hiring at all levels** • **Automation of various processes to reduce the demand for workers** • **Developments in regulations related to health and safety for workers including contractual and daily-wage workers who depend on the sector for work** • **Increasing regulatory requirements for corporate social responsibility initiatives to include healthcare-related interventions** • **Medium- to long-term reverse migration and reduction in available workforce**	• Mining companies can undertake review of health and safety measures such as availability of Personal Protective Equipment (PPE) for workers, medical supplies for treating workplace accidents, availability of manpower and resources in clinics near the mines and overall adherence to health and safety standards, including trainings on health and safety. Specific measures include: ○ Inclusion of face masks and face shields for all workers in all working spaces ○ Provision of hand sanitizer dispensers (including contact-less dispensers) ○ Temperature scanners at the entry points of offices, mines, storage and treatment areas ○ Development of standardized regulations for limits on number of workers in each process as done by mining companies such as Lundin Mining Corporation in Canada, Wescoal and Endeavor Mining in Africa, Adani, etc. ○ Adherence to regulations for disinfecting office spaces and other working spaces as published by the Ministry of Health and Family Welfare, as well as state governments. ○ Revision of health and safety trainings to include information on detecting and managing COVID-19 infections, home quarantine measures and containment plan in the event of COVID-19 spreading in mines. ○ Upgradation of healthcare support to workers (including non-permanent) in the form of fever clinics, ambulance support, and distribution of PPE kits to communities. • In order to manage migrant labourers and provide them with employment/livelihood opportunities, demand-supply mapping of available workforce in covid-19 impacted areas will be critical. ○ On the demand side, details of mining activities (ongoing projects, required manpower, skill sets in demand, current workforce, etc.) in the districts can be captured from industry associations and employers. ○ On the supply front, labour skill wise / location wise details can be collated and analysed. Additionally, labour supply in the areas near mines can be identified with support from district/block authorities. Once the details have been collated, existing skill sets should be matched with job roles required for the mining sector and those

[205] Insights from Champions of Change: The aspirational districts dashboard, NITI Aayog June 2018

	engaged in allied trades can be made suitable for the sector through basic upskilling. • Re-skilling of laid-off workforce in digital technology and other sectors, including promotion of self-employment: o SCMS through partnership with SSDMs and employers can identify and approach laid-off workers and skill them in IT/ ITeS, retail and door delivery job roles in collaboration with the relevant SSCs. o Language training in English can also be given to improve their employment potential in other areas. • Upskilling of workers at supervisory levels and above in new-age technologies to enable them to meet the demand for more technology-oriented processes. • Review of Corporate Social Responsibility (CSR) initiatives and funds to divert into health and livelihood initiatives in communities living near mines: o Mining companies can undertake the distribution of PPE kits and fund the establishment of fever clinics through partnerships with local hospitals o CSR funds can also be used to provide essentials through door-to-door supply o Unused buildings can be used as quarantine centres
Industry-Institute linkages	
Challenges	**Recommendations**
While premier engineering institutions have strong industry linkages, there is no standard for ensuring adequate industry-institute linkages. Further, colleges with smaller batches are especially affected and don't get relevant internships and placements for their students.	• Mining Industry Institute Partnership Cells can be set up in each institution, with successful institutions used as models for adoption. A capacity building module can be designed for training HODs and key staff of institutions in strategies to effectively engage employers. • Industry can support institutions by providing space for training and internship programs similar to the Corporate Skilling Centres program of the Ministry of Skill Development and Entrepreneurship, and Institute of Natural Resources (INR) by the Indian Institute of Skill Development (IISD) for providing simulation training. Encouraging large private players in such schemes will allow students to learn the latest production processes and technologies. For instance, new underground mining technologies such as longwall, board and pillar and block caving can be imparted. So can open cast technologies such as highwall. • Local and national industry associations should be brought on board to identify and shortlist private employers who are willing to contribute to funding and infrastructure, and develop pilot training centres, following which larger VTCs can be established. Employers who already have VTCs can be supported in expansion of their facilities/ intake to accommodate more trainees. This can be done with a view to aiding smaller employers in getting quality skilled resources. o MSDE, GoI and Ministry of Justice, Ministry of Foreign Affairs and Ministry of Health, Labour and Welfare of Japan signed a Memorandum of Cooperation initiating the 'Technical Intern Training Program' in the year 2017. NSDC through an RFP empanels sending organisations and conducts pre-departure trainings of the selected candidates in India on Japanese language and lifestyle skills and then sends the youth to Japan for training in key sectors such as

	electronics, healthcare, automobiles and equipment manufacturing[206]. SCMS can consider designing a concept model of similar program by collaborating with NSDC to include mining. The program should be run on a pilot basis with one of the international industry partners (in mining dominant countries such as Australia, Canada, South Africa, etc.) and post its success the program can be expanded to include other partners and territories. ○ SCMS can also engage with industry players for quality trainers, who can be deployed to TSPs. ○ Automobile manufacturers set up workshops in select Industrial Training Institutes to select, train and certify students who pass aptitude tests which are designed by the manufacturers (ex: Maruti Skill Enhancement Centres in six government ITI in Tamil Nadu). SCMS can facilitate similar workshops in mining as well. ○ Similar to the Minerals Council of Australia[207], SCMS can facilitate linkages between FIMI and Polytechnics and colleges for designing training of trainer and faculty development programs. • Collaborations with industry associations and large employers to facilitate placement opportunities in mining companies (core and ancillary) and bring graduates from smaller colleges to larger placement drives: ○ An overall assessment of the final year students/ graduates from mining courses in colleges can be undertaken to determine the mode of placement – college-level or regional (State/ region). ○ Employers can be notified of the core and soft-skills and demonstrated abilities of college graduates/ final year students . ○ Placement drives can be conducted in the form of institutional or regional sessions, where in stakeholders can work with institutional authorities to manage logistics (interviews, accommodation and travel). ○ Directorates of Technical Education undertake similar placement drives in government ITI, serving candidates from various ITI and educational institutions, with basic criteria for registration (10th pass, ITI pass, etc.). • Several Sector Skill Councils (including Agriculture Skill Council and Automobile Skill Council) have set up online placement portals where both employers and candidates can register. In international context, Austria's AMS Skills Barometer, Australia's SEEK portal, and Canada's Job Bank are portals which can be used to design sector-level job portals. • PSUs can be encouraged to offer more apprenticeships to engineers as well as diploma and ITI graduates to reduce the need for on the job training after placement. Apprenticeships can also be used to impart health and safety training and soft skills to trainees. • The council can seek support from industries towards skilling where basic training (which is theory oriented) can take place at training centres followed by On-the-Job Training (OJT) at employer's premise.
Awareness generation programmes	
Challenges	**Recommendations**

[206] https://nsdcindia.org/about-titp
[207] [https://minerals.org.au/workforce-innovation-and-skills]

Limited aspiration amongst students to join the mining sector	• A key observation through FGDs with students was the limited aspiration for joining the mining sector due to better placement prospects in other core engineering courses such as civil, mechanical, electrical, etc. Health and safety hazards associated with the core mining operations was also found to be an area of concern. In addition, students were concerned with recent policy reforms in the sector and their subsequent impact on employment. • In order to encourage youth to join the sector, targeted awareness generation programmes should be initiated across mining dominant regions. • Pan India digital campaign by key PSUs and employers (such as Vedanta, TATA Steel, Wolkem India, Rungta Mines, etc.) as well as by the ministry can be developed to attract interest of the young population. The campaign should highlight benefits of working in the sector.
Low level of awareness about Qualification Packs leading to their limited adoption	• Go-To Market strategy and institutional framework to build awareness about QPs amongst Mining industry employers and industry associations and other key stakeholders such as individuals, training partners, horizontal sector groups, recruitment agencies and assessment agencies on a regular basis. • Strengthen collaboration with universities and colleges on various aspects of customized content creation for tradition as well as futuristic skills, training of trainers and setting up of a Centre for Excellence for futuristic technologies. • Commercialization of training content along with recognized partners to enhance the value of QP based training for both individuals and employers. • Explore the establishing of SCMS cells in Academia to popularize and evangelize the adoption of QPs. • Independently obtain feedback from industry on overall experience with QP trained candidate and training partners through surprise audits and mystery shopping. • Constitution of Special Knowledge Group (SKG) comprising of large, medium, small and micro industries across 4 sub sectors with adequate representation from academia and other stakeholders to provide timely inputs from industry while developing QPs. • Develop a framework for evaluating and ranking its training providers, trainers and assessment agencies to improve quality assurance mechanism.
Low level of awareness about skilling programmes and environmental hazards in the unorganized sector	• SCMS can conduct regional awareness workshops among unorganized and minor mineral units to promote skill development. • Additionally, awareness generations programmes for the local communities on precaution measures for environment hazards should be organized. As per PMKKKY guidelines, atleast 60% of the DMF funds are set aside for drinking water, **environment preservation and pollution control measures**, healthcare, education, welfare of women and children, and sanitation. Thus, District Mineral Funds may be leveraged for organising such programmes as well as for designing and implementing interventions in case of socio-environmental fallout in collaboration with State governments and mining lease holders.
Robust demand aggregation exercise	

Challenges	Recommendations
The employment in the unorganized sector is not directly quantifiable, hence identifying job roles and skilling needs in unorganized organizations becomes difficult	• Regular tracking surveys can be undertaken in mining clusters to quantify the number of workers, job profiles and skilling needs. The tracking surveys can have a tentative design comprising of: ○ Frequency of once a year ○ Duration of 4 weeks for conducting site visits to understand dominant processes and associated job profiles ○ Employer interviews to understand challenges in recruitment/ training/ retention ○ SCMS can empanel multiple agencies for conducting surveys at regular intervals. These surveys can be made effective by ensuring that a holistic sampling plan is developed, structured questionnaires are designed and frequent backchecks on the data collated are made. *The draft template of tracking survey is attached in annexure A.20.* • As an alternative to surveys, Ministry of Mines can consider giving a mandate to all mine lease holders to update manpower related details (such as job role headcount, educational qualification, skilling needs, etc.) on a portal/dashboard using their login credentials or a system-generated link as is done in Canada, Australia, etc. This process of assimilating demand will be more useful and time effective.
While skill gap studies allow authorities to observe the mining sector every few years, the rate of technological change mandates more frequent observation of the sector and its labour requirements	• Demand-supply analysis can be undertaken more frequently, with a view to changing Qualification Packs (designing new ones, retiring or merging updating existing ones). The process can tentatively have the following components: ○ Demand assessment to understand skills which are required by employers ○ Supply assessment to understand the output of skilled graduates from technical institutions/ TSPs ○ Employability assessment of graduates ○ Gap assessment to understand where supply falls short of demand ○ Mapping of QP-NOS/ trainings with industry job profiles, and assessment of scope for modification/ retirement • The above analysis can be done with small samples of employers and TSPs to enable SCMS to finish the analysis in a short period. • SCMS in order to facilitate the above process would have to collaborate with employers to develop employability assessment frameworks. SCMS can aid in the capacity-building of TSPs to administer employability assessments. • Provision for developing interim standards that fast-track the typical QP development process to meet urgent industry requirement similar to how it is done in Singapore .
Gender diversity	
Challenges	**Recommendations**
Women are employed in a lower share in the sector	• The National Policy on Skill Development and Entrepreneurship, 2015 States that “skilling women in non-traditional roles and increasing gender

(around 4%) as compared to their employment in other sectors such as agriculture and allied (57%), manufacturing (12.5%), education (6%) and construction (5%)[208]	sensitivity in the workplace" will increase productivity and allow more women to join the workforce. The policy recommends measures such as exclusive batches for women, flexible classes, certification of women trainers, and establishment of quotas for both trainee enrolment and trainer certification programs which would ensure that adequate number of women join either program. • Women can be incentivized to join the sector in popular job roles such as Machine Operators, Geologists, Specialist Operations, Data Entry Operators, Skilled Helper, etc. through targeted skill development, gender-friendly infrastructure and benefits such as: o Transportation facilities to and from mining clusters o Women's restrooms and changing rooms in mining clusters o Paid maternity leave o Creches • These provisions can be government-funded and SCMS can help facilitate the abovementioned benefits and infrastructure support. • A study on workers in mining and related sectors can be undertaken with a gender focus to understand the challenges faced by women and devise appropriate policy solutions. • Awareness programs can be conducted on the employment potential for women in mining. However, possibilities for inclusive career progression must be highlighted to ensure continuous participation of women. • Further, Mining majors like NMDC, CIL, Vedanta etc. should be encouraged to lead and drive the change through mentorship programmes, digital series on their experience to encourage younger women to join the sector.
Other challenge and recommendations	
Challenges	**Recommendations**
Following trends in other sectors, contractual employment is increasing in the sector, pointing to reduced levels of job security. This is seen in PSUs and some large private mining companies as well.	• Social protection support for contractual workers especially for accident and health insurance and provident fund should be introduced. • This support should be provided by employers with rigorous monitoring and audit by FIMI with support from Local Industry Associations.
All QP undergo NSQC approval which is time consuming, however job roles that have limited and immediate demand in the country should be considered for a quicker approval channel to meet demand.	• Job roles such as for longwall, draglines machines have limited demand in the country primarily due to its specialized and limited usage, therefore undergoing the detailed process for developing an NSQC approved QP may not be required. An expedited process for developing such QPs is required.

Source: PwC Analysis

[208] Periodic Labour Force Survey (PLFS), 2017-18

Annexures

A.1. List of stakeholders covered

A.1.1. List of education institutes

SNo.	State	Name of Institute	Type of Institute	Key contact person	Designation
1	Rajasthan	College of Technology and Engineering	College	S.C Jain	HOD, Mining
2	Rajasthan	MBM Engineering College	College	R.P Choudhury	Assistant Professor, Mining Dept.
3	Andhra Pradesh	Godawari Institute of Engineering	College	Dr. KVV Satyanarayana Raju	Founder Chairman
4	Andhra Pradesh	Aditya Engineering College	College	Satyajeet Parida	HOD
5	Madhya Pradesh	AKS University	College	Dr. GK Pradhan	Dean Faculty of Engineering & Tech and Prof of Mining
6	Madhya Pradesh	VITS Polytechnic	Polytechnic	Narendra Jaiswal	HOD Mining Department
7	Madhya Pradesh	Government Polytechnic	Polytechnic	P.K. Jadia	Principal
8	West Bengal	IIT Kharagpur	College	Debasis Deb	HOD Mining Department
9	West Bengal	IIEST Shivpur	College	Dr. I.N. Sinha	Professor, Department of Mining
10	Chhattisgarh	NIT Raipur	College	Ravi Jade	HOD, Department of Mining
11	Chhattisgarh	Government Engineering College, Bilaspur	College	Dr. B.S. Chawla	Principal
12	Chhattisgarh	ITI, Mana Camp	ITI	T. R. Dewangan	Principal
13	Jharkhand	Indian Institute of Coal Management (IICM)	College	Vijay Kishor	Mining dept. faculty
14	Jharkhand	Govt polytechnic	Polytechnic	Ganesh prasad	Principal
15	Jharkhand	ISM Dhanbad	College	R.M Bhattercherjee	HOD, Department of Mining
16	Karnataka	National Institute of Technology, Surathkal	College	Dr. K Chandra	HOD, Department of Mining
17	Karnataka	Government school of mines	College	L. Rajan	Selection Grade Lecturer
18	Karnataka	Acharya Polytechnic Institute	Polytechnic	Kiran A	Professor
19	Maharashtra	VNIT Nagpur	College	Dr. Ishwardas L. Muthreja	HOD, Department of Mining
20	Tamil Nadu	Anna University	College	Dr. S Venugopal	Associate Professor
21	Odisha	Orissa school of Mining Engineering	College	Dr. P Balamadeswaran	Associate Professor, Dept. of Mining Engineering
22	Odisha	Bhubaneshwar Polytechnic	Polytechnic	Nilima Sahoo	Principal
23	Odisha	Government ITI, Bhubaneswar	ITI	J M Satapathy	Principal
24	Gujarat	Government Engineering College	College	Jemsih Kumar Modi	Assistant Professor and acting HOD
25	Telangana	J.B Institute of Engineering and Technology	College	V.P Kumar	Professor

SNo.	State	Name of Institute	Type of Institute	Key contact person	Designation
26	Goa	Goa College of Engineering	College	Dr. Ulhas G Sawaiker	Head of Department, Mining Engineering

A.1.2. List of training partners and assessment agencies

S. No.	Name of Training Partner	Contact Person
Mining		
1	Gram Tarang Employability Training Services Pvt. Ltd.	Amod Kumar Yadav
2	Indian Institute of Skill Development Pvt. Ltd (IISD)	Anshul Talwar
3	International Center of Excellence in Mining Safety & Automation (iCEM)	Sanjay Sakariya
4	Jan Kalyan Samiti Bikramganj	Col (Dr) VP Bhagat
5	Mosaic Network (India) Pvt. Ltd.	Siddharth Gopawat
6	Nettur Technical Training Foundation (NTTF)	Anil Kumar
7	SBA Education Society	Saurabh Baradia
8	Skill Development Institute Visakhapatnam (SDI)	Kattamuru Nagesh
9	Exceluslearning Solutions (PMKK Bellary)	Ajay Gupta
Non-Mining		
10	IL&FS Skills Development Corporation Ltd.	Vandana Bahri
11	Centum Workskills	Mehwash Siddiqui
12	Labournet Services India	Biju Kumar
13	Pratham	Upender Singh
14	Mahendra Skills Training & Development Pvt. Ltd.	Ashish Srivastava
15	Rooman Technologies Private Limited	Jayanth
16	Datapro Computers Private Limited	Kishore Varma
17	Empower Pragati Vocational & Staffing Pvt Ltd	K B Rajendran
18	Edujobs Academy Pvt Ltd	Santanu Mukherjee
S. No.	**Name of Assessment Agency**	**Contact Person**
1	Asset Author Pvt. Ltd.	Vishal Agarwal
2	Navriti Technologies Pvt Ltd	Mrinal Kumar
3	Trendsetters Skill Assessors Pvt. Ltd	Col Rajkumar Mann
4	Skill Mantra Edutech Consulting India Pvt. Ltd	Ketan Bindra
5	SP Institute of Workforce Development (SPIWD)	Arvind Srivastava

A.1.3. List of Central/Apex Organizations/Mining Associations

SNo.	State	Name of Entity/Organization	Key Contact Person	Designation
1	Delhi NCR	Ministry of Coal	Animesh Bharti	Economic Advisor
2	Delhi NCR	Ministry of Mines	Satendra Singh	Joint Secretary
3	Delhi NCR	National Skill Development Corporation (NSDC)	Soma Sharma	Deputy Head
4	Jharkhand	Directorate General of Mines Safety (DGMS)	R Subramanian	DG, DGMS
5	West Bengal	Indian Chamber of Commerce	Nilanjan Choudhary	Joint Director
6	West Bengal	Geological Survey of India	Nirod Nayak	Supt. Geologist
7	Rajasthan	Federation of Mines Associations of Rajasthan	Akshaydeep Mathur	Secretary General

SNo.	State	Name of Entity/Organization	Key Contact Person	Designation
8	Rajasthan	Mining Engineers Association of India (MEAI)	P.R Dave	President
9	Rajasthan	Udaipur Chamber of Commerce and Industry	Kaustabh	COO
10	Jharkhand	Central Mine Planning & Design Institute Limited (CMPDI)	Alok Kumar	GM HRD
11	Jharkhand	Central Institute of Mining and Fuel Research (CIMFR)	Dilip Kumbhakar	Head of skill development
12	Goa	Goa Mining Association	Glenn Kalavampara	Secretary
13	Goa	Goa Mineral Ore Exporter Association	Glenn Kalavampara	Secretary
14	Gujarat	Gujarat Mineral Association/ GUJMIN	P N Rao	President
15	Gujarat	Porbandar Industrial Association	P Raichura	Ex-President
16	Karnataka	Department of Industries and Commerce	G. VijayKumar	DG, DGMS

A.1.4. List of State Government Officials

SNo.	State	Name of Department	Key Contact Person	Designation
1	Andhra Pradesh	Department of Mines and Geology	Koteshwar Raju	Joint Director
2	Karnataka	Department of Mines and Geology	Kumar, Shankar Kulkarni	Deputy Director
3	Tamil Nadu	Department of Mines and Geology	E.SARAVANAVELRAJ, Somsekar	Director/ Deputy Director
4	Rajasthan	Department of Mines and Geology	AK Goyal	Director, DMG
5	Maharashtra	Department of Mines and Geology	Anushree	Officer
6	Madhya Pradesh	Department of Mines and Geology	Jitendra Solanki	Associate Director
7	Telangana	Department of Mines and Geology	Rafi Ahmed	Joint Director
8	Gujarat	Controller of Mines and Geology	D M Solanki	Add Director Development
9	Odisha	Department of geology	Arunbala Mishra	Director
10	Odisha	Department of mines	Deepak Mohanty	Director
10	West Bengal	Department of Mines and Minerals	Manabendra Das	Director
11	Jharkhand	Department of Mines and Geology	Aboobacker Siddique	Secretary cum Commissioner
12	Chhattisgarh	Department of Mines and Geology	Anbalagan P. (IAS)	Special Secretary
13	Goa	Directorate of Technical Education and Training	Neeta Naik	AD, Centralized Admission
14	Madhya Pradesh	Directorate of Technical Education and Training	Ashish Vashisht	Director and IAS officer
15	Karnataka	Directorate of Technical Education and Training	Shrikanth	Joint Secretary
16	Tamil Nadu	Directorate of Technical Education and Training	Shyamala, J, Abdul Wahab	Administrative Officers in Engineering College and Polytechnic College
17	Odisha	Directorate of Technical Education and Training	Ajay Panda	Deputy Director (Manpower planning)
18	West Bengal	Directorate of Technical Education and Training	Bidyut Bhattacharya (IAS)	Add. Secy DTE

A.1.5. List of employers by ancillary units

SNo.	State	Name of the Organization	Key contact person	Designation
1	Madhya Pradesh	Vikky Satwani	Vikky	Owner
2	Madhya Pradesh	Abde Ali Saify	Ali	Worker
3	Madhya Pradesh	Kalpana Steel and Hardware	Faizal	Worker
4	Madhya Pradesh	Bajrangi Earthmovers	Rajesh Kumar	Proprietor
5	Madhya Pradesh	Chandrabahn Automobile	Pratap	Proprietor
6	Madhya Pradesh	Harita Computer	Ravi HB Sawlani	Proprietor
7	Madhya Pradesh	Shree Computer	Nishatn	Worker
8	Madhya Pradesh	Anand JCB	Anand Shah	Proprietor
9	Madhya Pradesh	Balaghat Road Lines	Divyansh	Proprietor
10	Madhya Pradesh	Panday Road Line	Pandey	Proprietor
11	Madhya Pradesh	Sri Gurunanak Transport	Shiva Kumar	Proprietor
12	Madhya Pradesh	Bhajan Jcb	Sandesh	Proprietor
13	Madhya Pradesh	Sri Kripa Road Lines	Rohith Kumar	Worker
14	Madhya Pradesh	Rahul Transport	Shom	Proprietor
15	Madhya Pradesh	Guru Nanak Transport Company	Shree	Worker
16	Madhya Pradesh	Kewal Sonker	kewal sonkar	Proprietor
17	Madhya Pradesh	Taj Nursery	Chintu	Worker
18	Orissa	Sai International	Utkarsh	Owner
19	Orissa	Manish Enterprises	Manish	Owner
20	Karnataka	Navneeth Enterprises	Das	Proprietor
21	Karnataka	M C Contractor	Krishnappa	Proprietor
22	Karnataka	Indian Earthmovers	Ravi Kumar	Proprietor
23	Karnataka	Sri Varalalkshmi Earth Mover	Kumar	Proprietor
24	Gujarat	J K Engineering	Khatri	Proprietor
25	Gujarat	Versatile	Shailesh	Proprietor
26	Gujarat	Kishan	Raju	Proprietor
27	Gujarat	M S Infotech	Irfan	Proprietor
28	Gujarat	Bharuch Express	Zeeshan Kadri	Proprietor
29	Gujarat	Gujrat Freight	Amir	Proprietor
30	Gujarat	Nh Transport	Deeak bhai	Proprietor
31	Gujarat	Shah Electrical Contractor	Vivek Shah	Proprietor
32	Gujarat	Security Force	Suresh bhai	Proprietor
33	Gujarat	Omdevsingh	Om Dev Singh	Owner
34	Gujarat	Tr Associates	Harish patel	Manager
35	Gujarat	Ararti Explosives	Snehal Devmurai	Manager
36	Gujarat	Sanjay	Sanjay	Owner
37	Gujarat	Shree Tirupati Roadlines	Somnath	Owner
38	Gujarat	Transport clicks	Sanji	Manager
39	Gujarat	Ali Zafar	Ali Zafar	Owner
40	Gujarat	Sardar Agro Pvt Ltd	Babu bhai	Proprietor
41	Gujarat	Rajwadi Transport	JK Gohil	Proprietor
42	Gujarat	Anand Nursery Farm	Manush Bhil	Owner
43	Gujarat	Kirti Nursery	Siddharth Mandaliya	Owner

SNo.	State	Name of the Organization	Key contact person	Designation
44	Gujarat	Khesav Ratna Nursery	Keshav Ganpat Solanki	Proprietor
45	Gujarat	Armed Security Guards Services	RAMADEVSINH VALA	Partner
46	Gujarat	Sardar Patel Security Agency	D.S Rawal	Managing Partner
47	Gujarat	Delta Security Force	Satyapal Sinh	Manager
48	Rajasthan	Mahesh Kumar	Mahesh Kumar	Proprietor
49	Rajasthan	Shree Narayan Earth Movers	Balram	Owner
50	Rajasthan	Bhumika Earth Master	Dharam Singh	Owner
51	Rajasthan	Raju Parts	Virat	Owner
52	Rajasthan	Choudhary Earth Movers	Choudary	Owner
53	Rajasthan	Jakir	Jakir	Proprietor
54	Rajasthan	Kamelesh	Kamelesh	Proprietor
55	Maharashtra	Bharat Garage	Pravin Tate	Proprietor
56	Maharashtra	Diamond Spares	Diwakar Landge	Proprietor
57	Maharashtra	Ramesh	GOHIL ENT.	Proprietor
58	Maharashtra	Bhaurau	Lakshmi	Worker
59	Maharashtra	Govinda Infra Explosives	Dadaram Bhure	Proprietor
60	Maharashtra	Kahale	HARSHAL	Proprietor
61	Maharashtra	Sm Explosive	Samir	Proprietor
62	Maharashtra	Diwakar Eng Services	Diwakar Landge	Proprietor
63	Karnataka	Karam Shoes And Helmet	Karamchand	Proprietor
64	Maharashtra	Star Sales Agencies	Raj Singh	Worker
65	Maharashtra	Dcg Gurubaxi	DCNG Thakare	Proprietor
66	Maharashtra	Ph Jain Transport	PH Jain	Proprietor
67	Maharashtra	Laxminand Logistics	Yogesh	Proprietor
68	Maharashtra	En Patil Transport	Eknath Patil	Proprietor
69	Maharashtra	Gmr Warda	Patel	Worker
70	Maharashtra	Krishna Nursery	RANJIT	Proprietor
71	Maharashtra	Pramod Sakore	Pramod Sakore	Owner
72	Maharashtra	Bharat Security Services	Rajes	Worker
73	Rajasthan	Kallu Khan	Kallu khan	Proprietor
74	Rajasthan	Jagdish	Jagdish	Proprietor
75	Rajasthan	Balaji Golden Transport Company	Bhimaram	Proprietor
76	Rajasthan	Surajmal	surajmal	Proprietor
77	Orissa	Utkal Divine Mines And Minerals	Devesh	Owner
78	Andhra Pradesh	Janardan	Janardan	Owner
79	Andhra Pradesh	C. Narasimhulu	C Narasimhalu	Owner
80	Andhra Pradesh	Koteswara Suppliers	Koteswara reddy	Proprietor
81	Andhra Pradesh	Jeelani Water Supplies	Jeelan	Proprietor
82	Andhra Pradesh	Hyundai Leibherr	Jagat Reddy	Worker
83	Andhra Pradesh	Koteswara Reddy	Koteswara reddy	Owner
84	Andhra Pradesh	Forest Nursery	Naik	Plantation person
85	Andhra Pradesh	Sri Sai Enterprises	Venkateshwara Reddy	Proprietor
86	Andhra Pradesh	Vishnu Transport	M.Vishnu Reddy	Proprietor
87	Andhra Pradesh	Madhu Transport	Madhu	Vehicle owner

SNo.	State	Name of the Organization	Key contact person	Designation
88	Andhra Pradesh	M. Vishnu Reddy	Vishnu Reddy	Owner
89	Andhra Pradesh	Dhone Nursery	Forest Department	Proprietor
90	Andhra Pradesh	Sujanan Security Services	Venkateshwara rao	Proprietor
91	Andhra Pradesh	Lakshmi Stone Cutters	Lakshmi Reddy	Proprietor
92	Andhra Pradesh	Lakshmi Reddy	Lakshmi Reddy	Owner
93	Karnataka	Jaibeem Civil Constructions	Balavanthappa	Contractor
94	Karnataka	Mariyappa Kattimani Contractor	MARIYAPPA KATTIMANI	Contractor
95	Karnataka	Peer & Co	Peer sab	Contractor
96	Chhattisgarh	Rakesh Yadav	Rakesh	Proprietor
97	Chhattisgarh	Shruti Enterprises	Vikas Patel	Proprietor
98	Chhattisgarh	Chhattisgarh Earth Movers	Sonal	Proprietor
99	Chhattisgarh	Sharma Earthmovers	Pawan sharma	Proprietor
100	Rajasthan	Corporate Security Services	Dalchand	Proprietor
101	Rajasthan	Hari Singh	Hari Singh	Proprietor
102	Rajasthan	Sambhu Singh	Sambhu Singh	Proprietor
103	Rajasthan	Shankar	Shankar	Proprietor
104	Rajasthan	Kailash	Kailash	Proprietor
105	Rajasthan	Mohan Lal	Mohan Lal	Proprietor
106	Rajasthan	Dinesh	Dinesh	Proprietor
107	Rajasthan	Chaman Singh	Chaman Singh	Proprietor
108	Rajasthan	Gopal	Gopal	Proprietor
109	Rajasthan	Parmanand	Parmanand	Proprietor
110	Rajasthan	Kaliya Bhai	Kaliya Bhai	Proprietor
111	Rajasthan	Lakman	Lakman	Proprietor
112	Rajasthan	Jain Marble	A.K Jain	Proprietor
113	Rajasthan	Ram Lakhan	Ram Lakhan	Proprietor
114	Rajasthan	Ramla Khan	Ramla Khan	Proprietor
115	Rajasthan	Raipur Roadways	Devinder	Worker
116	Tamil Nadu	Sri Palaniyantavar Enterprises	Pazhaniappan	Proprietor
117	Tamil Nadu	Ysk Trading	Murugan	Proprietor
118	Tamil Nadu	Sivasakthi Industrial Explosives	Guru	Proprietor
119	Tamil Nadu	Irk Mining Equipments	Chandrasekaran	Proprietor
120	Tamil Nadu	J K Mining & Chemicals	Gopi	Proprietor
121	Tamil Nadu	Sivasakthi Chemicals	Arun Kumar	Proprietor
122	Tamil Nadu	Thanisha Enterprises	Venkatesh	Proprietor
123	Tamil Nadu	Ars Mining Equipments	Rajendran	Proprietor
124	Tamil Nadu	Kk Agencies	Karthikeyan	Proprietor
125	Tamil Nadu	Sri Kumaresa Enterprises	Chandru	Proprietor
126	Tamil Nadu	Amman Water Service & Lorry Service	Santhakrishnan	Proprietor
127	Tamil Nadu	Rasi Agriculture And Construction Equipments	Thomas	Proprietor
128	Tamil Nadu	Jeeva Transport Services	Christu Das	Proprietor
129	Tamil Nadu	Cag Equipment	Perumal	Proprietor
130	Tamil Nadu	Jai Market Tools	Sampath	Proprietor
131	Tamil Nadu	Madhusri Mining Works	Vijayakumar	Proprietor

SNo.	State	Name of the Organization	Key contact person	Designation
132	Tamil Nadu	Tvk Earth Movers	Kesavan	Proprietor
133	Tamil Nadu	Kavitha Lorry Service	Sankaran	Proprietor
134	Tamil Nadu	Isha Nursery	Kumar	Proprietor
135	Tamil Nadu	K M G Packers & Movers	Ramesh	Proprietor
136	Tamil Nadu	Murugan Stone Polishing	Saravanan	Proprietor
137	Madhya Pradesh	Surendra Pathak	Surendra Pathak	Owner
138	Madhya Pradesh	Maa Gayatry Aqua Minerls	Nitesh Baderiya	Proprietor
139	Madhya Pradesh	Expert Computer	Shashank	Worker
140	Madhya Pradesh	Kashyap Computer	Sonu Kashyap	Proprietor
141	Madhya Pradesh	Sai Transport	Prateek	Worker
142	Madhya Pradesh	Ahuja Transport	Soni Ahuja	Proprietor
143	Madhya Pradesh	Subhash Goods	Subash	Owner
144	Madhya Pradesh	Kushwaha Nursery	Dayanand Kushwaha	Proprietor
145	Madhya Pradesh	Jai Gurudev Nursery	Santhosh	Proprietor
146	Madhya Pradesh	Ehawak Man Force & Security	Deepak Saket	Proprietor
147	Madhya Pradesh	Tiwari Nursery	Suresh Narayen	Proprietor
148	Madhya Pradesh	Mahakal Explosive	Roop Singh	Proprietor
149	Madhya Pradesh	Pateriya Explosive	OP Pateriya	Proprietor
150	Madhya Pradesh	Huma Ro Water	Mobin	Proprietor
151	Madhya Pradesh	Sai Computer	Suchit Gupta	Proprietor
152	Madhya Pradesh	Maa Vindhyawashini Enterprises	Dev	Owner
153	Madhya Pradesh	Jaswant Transport	Lakhwinder Jaswant	Proprietor
154	Madhya Pradesh	Sarveshwar Mines	self	Proprietor
155	Rajasthan	Swastic Campaser	Akshat	Worker
156	Rajasthan	Nalwaya Mineral Industries Pvt. Ltd.	Jytosih	Worker
157	Rajasthan	Gulab Bohra Power Tools & Machineries	Prahlad	Proprietor
158	Rajasthan	Vardhman Machinery Equipments Pvt Ltd	Vardhman	Proprietor
159	Rajasthan	Baroda Nursery	Jytoibasu	Proprietor
160	Rajasthan	Patel Tractor Compressor Breakers	Chand Patel	Proprietor
161	Rajasthan	Sashikant & Company	Sashikant	Proprietor
162	Rajasthan	Mahesh	Mahesh	Proprietor
163	Rajasthan	Puransingh	Puransingh	Proprietor
164	Rajasthan	Sagar Group	Sagar	Proprietor
165	Rajasthan	Rajesh Motors	Rajesh	Worker
166	Rajasthan	Shree J P Roadlines	Sunny	Worker

A.1.6. List of employers/contractors/MDOs

SNo.	State	Name of Entity/Organisation	Key Contact Person	Designation
1	Gujarat	New India Mineral Industries	I A Saiyed	Partner
2	Gujarat	All India Minerals	Imtiyaz Ali	Partner
3	Maharashtra	Pavri Kynite Mine	Kannan	Partner
4	Maharashtra	Dighori Kynite Mine	Jayshyam Fulchand Katre	Mine Supervisor

SNo.	State	Name of Entity/Organisation	Key Contact Person	Designation
5	Maharashtra	Jain Metal Industries	Satish Shankar Varate	Mine Supervisor
6	Maharashtra	Venkatesh Crushing & Construction Pvt Ltd	Francis Polimetla	General Manager
7	Maharashtra	Bajrang Stone Crusher	Shree Sudhakar T Rohankar	Owner
8	Maharashtra	Laxminand Logistic Pvt Ltd	Simon Swami Das	Plant In charge
9	Maharashtra	Shree Ganesh Metal	Kaustubh Sudhir Khandre	Owner
10	Gujarat	Bhawani Minerals	Shree Uditkumar Vinod Chandra Patel	Partner
11	Gujarat	Mandovi Minerals Pvt Ltd	Milan Shah	General Manager
12	Telangana	B.V.R Minerals	P.Venugopal Reddy	Chairman
13	Telangana	Abhishek minerals	K.sanjay kumar	Chairman
14	Telangana	Tanmay minerals	P.Tanmayreddy	Chairman
15	Madhya Pradesh	Tirupati stone	Shyam Sunder Mishra	Owner
16	Madhya Pradesh	Sarveshwar Mines	Gyanendra singh	Owner
17	Madhya Pradesh	Barkha Agarwal Stone Suppliers	Anand Agarwal	Owner
18	Telangana	Sapthagiri minerals	M. Ramamurty	Owner
19	Madhya Pradesh	Indu Mines	Sharad Kumar Bansal	Owner
20	Madhya Pradesh	Harsh Minerals	Sharda Prasad Bansal	owner
21	Madhya Pradesh	Kunti Lal Shawari Mines	Ram chandra Agrawal	Owner
22	Madhya Pradesh	Mukesh Tiwari Stone mines	Mukesh Tiwari	owner
23	Madhya Pradesh	Rajesh Shah associates	Rajesh Shah	Owner
24	Gujarat	Jaldeep Minerals Co.	Laxmikant D Mehta	Partner
25	Gujarat	Saurasthra Minerals & Chemicals Industries	Mohammed Ali Vartheji	Partner
26	Gujarat	Aerochem Industries	Bhimdevshi B Gohil	Mine Supervisor
27	Gujarat	Shivshankar Mineral Product Co.	Laxmikant Mehta	Partner
28	Tamil Nadu	SRC Project Private Limited	P Vimalan	Manager
29	Tamil Nadu	Sri Amman Blue Metal	R Selvam	Owner
30	Tamil Nadu	K G S Blue Metal	G Sajikumar	Mine Supervisor
31	Tamil Nadu	R K Blue Metal	K Rajam	Owner
32	Tamil Nadu	A R K Blue Metal	O K Kumar	Owner
33	Tamil Nadu	M K Blue Metal	Mohammed Basha	Mine Supervisor
34	Tamil Nadu	MPM Blue Metals	A Natarajan	Mine Supervisor
35	Jharkhand	Kiran Enterprises	SS Pani	Manager
36	Jharkhand	Classic Ingicon Private Limited	Chandan KG Mandal	Site In-charge
37	Jharkhand	Subhas Agarwal Mines	Akash Sharma	Manager
38	Rajasthan	Rajendra Kumar Agarwal	Rajendra Kumar Agarwal	Owner
39	Rajasthan	Shree Mateshwari Marble Mine	Mangi lal	Owner
40	Rajasthan	Silver Marble and Minerals Mine	Firoz Khan	Owner
41	Rajasthan	SSR Minerals Mine	Mukesh Kothari	Owner
42	Rajasthan	Shree Mama Minikem Mine	Mahesh Kumawat	Owner
43	Rajasthan	Vishakarma Stone Crusher and Mine	Mali Ram Kumawat	Owner
44	Rajasthan	Bhagwati Industries	Dinesh Agarwal	Owner

SNo.	State	Name of Entity/Organisation	Key Contact Person	Designation
45	Rajasthan	Jai Sawariya Marble Mine	Hitesh Patel	Owner
46	Rajasthan	Aruna Minerals Mine	Sanjeev Tyagi	Owner
47	Rajasthan	Virani Marble mine	Basant Kumar Virani	Owner
48	Rajasthan	Ranawat Marble Mine	Anil Kumar	Owner
49	Rajasthan	MMM Enterprises	Rajendra Singh	Owner
50	Rajasthan	Vijay Export Mine	Vijay Singh	Owner
51	Rajasthan	Sadhbhav Marble Mine	Vijay Singh Rathore	Owner
52	Rajasthan	Shine Marble mine	Bashudin	Owner
53	Rajasthan	Sahi Green Marble Mine	Virendra Kumar Dubay	Owner
54	Rajasthan	Shah pancholi marble mine	kaniya lal choudhary	Owner
55	Rajasthan	Arihant Minerals Mine	Parveen Modi	Owner
56	Rajasthan	Shree Laxmi Kuber Marble Mine	Jaisingh Nathawat	Owner
57	Rajasthan	Bherunath Marble Mine	Devisingh Rajput	Owner
58	Karnataka	Mineral Enterprises Limited	Manjunath J	Senior manager - mines
59	Andhra Pradesh	Gayatri Minerals & co.	M. Nagi Reddy	Managing Partner
60	Andhra Pradesh	South West Mining Ltd	O. Kesava Reddy	Senior Manager
61	Andhra Pradesh	Thirumala Balaji Mining & Co.	Raghu Ramulu Gowd	Mine Owner
62	Rajasthan	Parshwanath Marble Mine	Prateek Jain	Owner
63	Rajasthan	Sajjan Marble Private Limited	Ravindra Singh	Owner
64	Rajasthan	Mewar Marble Mine	Naresh	Owner
65	Chhattisgarh	Chandrahasini Mines	Rakesh Yadav	Owner
66	Madhya Pradesh	Pathak Enterprises	Atul Pathak	Owner
67	Madhya Pradesh	Mukul	Amit Mukul Chandrakar	Owner
68	West Bengal	Steel Authority of India Limited	R Muniraju	GM (P & A)
69	Rajasthan	Hindustan Zinc Limited	Ruchir and Sanjay Sharma	Tech head and HR
70	Rajasthan	Rajasthan State Mines & Minerals Ltd	Satyendra Meena	Dy. Manager (Pers. And Admin)
71	Telangana	National Mineral Development Corportaion	B Durga Vijay Chand	HRD NMDC
72	Tamil Nadu	Neyveli Lignite Corporation	Franklin	GM
73	Jharkhand	TATA Steel	Devraj	Sr. Manager Chief Regulatory Affairs
74	Karnataka	Hutti Gold Mines Company Limited	Salma K. Fahim	Managing Director
75	Gujarat	Gujarat industries power company ltd	N K Purohit	CGM (Mines)
76	Odisha	Odisha Mining Corporation Ltd.	R Vineel Krishna, IAS	Managing Director
77	Maharashtra	Mineral Exploration and Corporation Limited	Dr. Ranjit Rath	CMD
78	Madhya Pradesh	Northern Coalfields	Shahid Khan	Deputy Manager
79	Odisha	Gandhamardhan Graphite Udyog	Umesh Chandra Debta	HR
80	Odisha	Rungta Mines	Tapan Kumar Dash	HR
81	Odisha	Idcol ferro	P.K Mishra	HR

SNo.	State	Name of Entity/Organisation	Key Contact Person	Designation
82	Odisha	M.G Mohanty	Debasish Dash	HR
83	Rajasthan	Wolkem India	Devindra Singh	GM-HR

A.2. Study tools used

A.2.1. Assessment agencies

1. Under which all schemes you conduct assessments and identify the ones running smoothly with respect to timeliness and course effectiveness and why?
2. Which all trades /job roles in the mining sector have most number of assessment intakes (active) and which all trades have the least number of assessment requests by the TPs [209](inactive)?
3. Do you suggest any addition of module/QP which you find will be helpful for mining sector?
4. What is the eligibility criteria for hiring assessors? Do you also have Mining Skill Experts with an industry exposure or similar?
5. Are you or your assessors registered in Takshashila portal (National portal by NSDC for assessors and Trainers?)
    - Has your agency tried this portal in finding right trainers/ assessors in mining sector?
    - Is the quality of assessors registered here satisfactory?
6. Do you have any internal training program for your assessors?
7. How many training institutes do you undertake assessment for? Any challenge faced in conducting assessments at Training partner site?
8. Kindly share the job role wise assessment data of mining sector for last 3 years (Scheme, Job roles assessed, TPs, Number of intakes, pass %age)? What is the passing rate of students across each sub sector in which your agency conduct assessments?
9. What are the key skills (core or soft) in which students fails the assessment? Why do they fail?
10. What is the time and cost of each assessment borne by the agency? (Is there any other payment by SSC or relevant source other than the candidate assessment fee submitted by TPs?)
11. How are these assessments in mining sector conducted? What kind of infrastructure/ equipment is provided for assessments for mining sector?
12. How are the responses evaluated? What are the touch points in the process? Do you also share the checked papers or the evaluated Q&A to the training partners or to the SSC?
13. What are the challenges experienced by you with respect to assessments conducted based on QPs
    - Quality of assessment
    - Is the QP prescribed assessment criteria relevant for the job role? In your view, is the QP framework adequate to evaluate competency of trained candidate? Does QP training increase candidate's awareness of the actual work to be performed?
    - Relevance of actual job role performed in the industry or their trainings with that of assessments conducted in skill development courses
14. Does the agency undertake other (non-QP based) assessments in the Mining sector (are these for up-skilling purposes of regular course training)? If yes, which are these and how are they different from the QP based assessments? What kind of clients ask for such assessments?
15. Do you also conduct assessments for Apprenticeship programs in mining sector?
16. Is the agency currently (or have in the past) undertaking RPL assessments? If employers require customized assessments how can the assessments be customized for each employer?

[209] TPs – abbreviated for Training Partners

17. What are some of the challenges pertaining to assessment in RPL in Mining sector?
18. Suggestions to the training partners to increase the effectiveness of their training for better performances in mining sector?
19. Suggestion to the **Mining Skill Sector Council** for increasing effectiveness of overall Skill development programs, if any?

A.2.2. FGD Questionnaire for Students

QUESTIONNAIRE FOR STUDENTS OF VOCATIONAL PROGRAMS

Section A – General Information

A1. Location	:	_____	A2.			
A3. Name of Institute/College	:	_____				
A4. Type of Academic/Vocational Program	:	(1) ITI (2) ITC (3) Polytechnic College (4) Engineering College (5) Degree College (6) Others, pls specify _____				
A5. Interviewer's Name	:	_____	A6.	Date of Interview	:	___/___/2019

Profile of Respondents

Sl. No.	Name of respondent	Age	Gender 1- Female 2- Male	Annual Family Income (INR) 1- <50,000 2- 50,000-1 lakh 3- 1- 2 lakhs 4- 2-3 lakhs 5- 3-4 lakhs 6- 4-5 lakhs 7- >5 lakhs	Social Group 1- OBC 2- SC 3- ST 4- Oher minority group 5- Others (pls specify_ _____)	Course/ Trade

Section B – Probe areas

B1.	Were you able to choose a vocational course of your choice? Is yes, what was the reason for your preference? If not, how were you enrolled in your present course? If the course was allocated to you through a specified selection process – on what principles was the course allocated to you [entrance exam, aptitude/aspiration tests, etc]? How do you rate the effectiveness of the course allocation? If you were given the choice to select a course – which course would you have taken and why?

	According to you, which vocational courses/degree programmes are in demand in the mining industry? Which courses would be relevant? Please provide reasons for your answer.	
B2.	Please comment on the following attributes of the course/trade which you have enrolled in?- i. Course Content [ease, rigour] ii. Capabilities of the Instructor [Lesson Planning, communication skills, approachability] iii. Assessment Systems [ease, rigour, fairness] iv. Elements of OJT/internship	
B3.	What are the reasons for which you have joined the vocational programe/course – work or further studies or an add-on value to an already obtained degree? What do you intend to do after completion of the course? (Probe: Government job)	
B3.	Are you satisfied with the competence and capabilities of your Trainers/Teachers? If not, why?	
B4.	Is the proportion of theory and practical sessions adequate? Do you have access to relevant, updated equipment for training? If not, why and how should it be revised?	
B5.	Which are the infrastructure related challenges in your course?	Response: (1) Insufficient number of labs and workshops for practical sessions (2) Shortage in number of equipment/ machines/ tools (3) Outdated equipment/ machines/ tools (4) Availability of facilities is dependent on off-peak hours of utilization by host institution (5) Other challenges, if any _____
B6.	Do you get opportunities for OJT, internship, apprentice training, etc. If yes, please elaborate on the existing arrangements. Please elaborate on the employer for the internship/ OJT, location, type of work, etc. How would you rate your learning experience? Are you satisfied with the duration and quality of OJT, internship, apprentice training provided? If not, give reasons. What are the challenges faced? Please provide your suggestions for improving the effectiveness of such hands-on training experiences.	
B7.	Do you think your course fees are reasonable? If not, why?	
B8.	Please list the areas of collaboration between your Institute and industry organizations	Response: (1) Curriculum upgradation (2) Sourcing of Trainers (3) Inputs on training methodology (4) Placements (5) Internship (6) OJT (7) Apprenticeship (8) Funding (9) Exposure visits (10) Others, if any _____ _____
B9.	Please list areas within mining and ancillary sectors in which you aspire to work in.	Response: (1) Metal processing (2) Non-metallic mineral processing (3) Fuel mining and processing (4) Other mining products (5) Environment-related jobs like effluent treatment, (6) Other jobs

B10.	Please comment on your expectations with respect to wages.	(1) 5,000 – 10,000 (2) 10,001 – 15,000 (3) 15,001 – 20,000 (4) 20,001 – 25,000 (5) 25,001 – 30,000 (6) 30,001 or higher
B11.	Do you have any preference for the location of work?	(1) Within district (2) Within state (3) Within neighbouring state (specify which) (4) Within India (region) (5) Abroad (specify which)
B12.	How can the effectiveness of the industry engagement be enhanced?	
B13.	What kind of entrepreneurship programs are offered in your Institute? Please elaborate on the usefulness and relevance of these entrepreneurship programs. How would you rate the curriculum, course content, course duration, availability and competence of Trainers, teaching methodologies, opportunities for hands-on training, etc? What are the measures (across policy, programme, processes, etc) which could be adopted to enhance the effectiveness of the entrepreneurship programs?	
B14.	What are the challenges associated with the assessment and certification systems and procedures? How can these challenges be addressed?	
B15.	What are the future opportunities after finishing this course? Do you intend to get Directorate General of Mines Safety (DGMS) certifications? What are your employment/ self-employment aspirations in the short-term?	

A.2.3. Training Partners/Education Institutes

This document details the tool for conducting interview with various training service providers in the survey catchment. The respondents should be senior level officials from these training service providers. The different types of TSPs to be covered include:

- ITIs
- Polytechnics
- Private Vocational Training Providers
- Vocational Higher Secondary Education Schools (If Any)
- Colleges providing vocational courses
- Colleges providing bachelors/ post-graduate programmes in mining sector

This questionnaire is designed to gather information about the training infrastructure available, the trades offered, profile of trainees etc. in the survey catchment
Time: 60 minutes per interview (depending on the time availability of the respondent)
Key Respondent: Officials from TSP
Team: 1 interviewer
Interviewer Details

Name of Interviewer	
Date and Place	
Cluster	
District	
Block	
Investigator Contact details	

Start Time		
End Time		
Status of Interview	Completed	1
	Incomplete	2
	Refused	3

Profile of Training Service Provider

Q. No	Question	Response	Code	Skip
1.	Name of the respondent			
2.	Designation of the respondent			
3.	Name of the training service provider			
4.	Address and Contact details of the institution			
5.	Please provide the ownership details of the institution (Whether Government or Private)	Government	1	
		Private	2	Skip to Q. 7
6.	Please mention the type of institution.	Government ITI	1	Skip to Q8
		Government Polytechnic	2	
		Vocational training providers	3	
		Government College	4	
		Any other (specify)_____	98	
7.	Please mention the type of institution.	Private ITI	1	
		Private Polytechnic	2	
		Private TSP affiliated to National Skill Development Corporation (NSDC)	3	
		Private TSP affiliated to NCVT	4	
		Vocational Training Provider	5	
		Private college	6	
		Any other (Specify)_____	98	
8.	Is the institute empaneled with any of the central / state run government schemes?	Yes	1	
		No	2	Skip to Q. 10
9.	If yes, please specify scheme details? (Multiple Response Possible)	Rural Self Employment Training Institutes (RSETI)	1	
		National Urban Livelihoods Mission(NULM)	2	
		Deen Dayal Upadhyaya Grameen Kaushalya Yojana(DDU GKY)	3	
		Pradhan Mantri Kaushal Vikas Yojana (PMKVY)	4	
		Buildng and Other Construction Worker (BOCW)	5	
		Others (Specify)	98	
10.	What is the source of funding for the institute	*Funding Source* / *Contribution (in %)*		
		Central Government	1	
		State Government	2	

		Others: _____(Specify source)		98	

11.	**Is this a residential training facility or non-residential facility?**	Residential	1	
		Non-residential	2	
		Both	3	
12.	What is the current seat capacity of this institute?	Current Seat Capacity:_____		
13.	How many trainees are currently enrolled in the institute?	Current Trainees enrolled:_____		
14.	How many males and female students are currently enrolled with the institute	Male:_____	1	
		Female:_____	**2**	

15.	16. **Please provide trade-wise details of high demand courses; start with the course having highest enrolment. (Please collect information for all 3 years)**

S. No	Sector	Trade	Whether SSC certified course (Yes or No)	Training duration (in Hours)	Training fee per student (in INR.)	Certification Agency	Annual Seat Capacity		Actual enrollment		No of trainee certified		No of trainees placed (within the State)		No of trainees placed (Outside the State)		No. of trainee placed (Total)		Average monthly salary		No. of trainees who opted for self-employment	
							M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
2016-17																						
1.																						
2.																						
3.																						
4.																						
5.																						
6.																						
2017-18																						
1.																						
2.																						
3.																						
4.																						
5.																						
6.																						
2018-19																						
7.																						
8.																						
9.																						
10.																						
11.																						
12.																						

17.	Among those students who opted for self-employment, what type of self-employment are they engaged in?			
18.	List the job roles which are related to core mining activities			
19.	List the job roles, which are related to ancillary services. (Ancillary activities include logistics, equipment manufacturing and servicing, mining explosives contractor)			
20.	What has been the basis of selection of these job roles. List 3 reasons	Reason 1:_____		
		Reason 2:_____		
		Reason 3:_____		
21.	Are all the job roles listed above have been QP mapped?	Yes	1	Skip to Q 26
		No	2	
22.	Which courses are not mapped to the QP			Q23 to Q25 are follow up questions to Q.22
23.	What is the reason for not running QP mapped courses for the job roles mentioned in Q.22			
24.	What are the key components of the curriculum for these courses. (Probe for domain, soft skills, digital literacy etc.)			
25.	How often is the curriculum revised for these courses. (Mention duration of review in years)			
26.	In your opinion, how relevant are the above mentioned courses from the point of view of industry demand	Highly relevant	1	
		Relevant	2	
		Somewhat relevant	3	
		Irrelevant	4	
27.	Which of the above mentioned courses are most relevant from	Rank 1:_____	1	
		Rank 2:_____	2	

	the point of view of industry demand. (Mention top 3)	Rank 3:_____	3	
28.	What are the reasons for these courses to be most relevant from the point of view of industry demand?			
29.	How many industries are currently present in the proximity of the training service provider			
30.	Does the TSP have any working relationships with any of the industries/employers	Yes	1	
		No	2	Skip to Q33.
31.	With how many industries/employers does the TSP have a working relationship			
32.	For what aspects does the TSP engage with the industries (Probe for- curriculum validation, apprenticeship training, Training of trainers (ToT), internships, placements, health and safety trainings etc.)			
33.	How often does the TSP interact or engage with the Industries	Monthly	1	
		Quarterly	2	
		Yearly	3	
		As and when required	4	

Training Delivery

34.	Is the existing curriculum adequate to prepare the trainees for jobs?	Yes	1	Skip to Q.37
		No	2	
35.	If not, has the institute introduced sessions (theory or practical) beyond the standard curriculum?	Yes	1	
		No	2	Skip to Q. 37
36.	Please provide details Of the additional sessions (Probe: which trade, details of additional			

	aspects/sessions added and reasons for the same.)?			
37.	Is availability of qualified trainers an issue for the institute.	Yes	1	
		No	2	Skip to Q. 39
38.	If yes, please provide the names of trades/courses for which well qualified trainers are hard to find.			
39.	Do you face any difficulties with regard to assessment and certification processes	Yes	1	
		No	2	Skip to Q 41
40.	If yes, what challenges does the institute face in ensuring smooth functioning of the assessment and certification process.			
41.	Are the students provided any type of counselling?	Yes	1	
		No	2	
42.	What are the key areas of counselling **Multiple response possible**	Need for financial independence	1	
		Grooming sessions to perform well in the placement process	2	
		Key considerations for migration	3	
		Counselling to parents/guardians of the trainees on emplyment prospects	4	
		Others (specify)_____	98	
43.	Do you face any of the following key challenges		**Yes**	**No**
		i. Inadequate gender sensitive infrastructure	1	2
		ii. Difficulty in mobilising students from remote locations	1	2
		iii. Unwillingness of trainers as the training institute is located in a remote/distant location	1	2
		iv. Lack of industry/employer support for placements	1	2
		v. General perception of the community that skill training is mostly for the male students	1	2
		vi. Presence of traditional industries	1	2
		Any other (specify)	98	

A.2.4. Mining Industry Associations

This document details the tool for conducting an interview with various mining training associations in the survey catchment. The respondents should be senior-level officials from these associations.
This questionnaire is designed to gather information on the mining sector, its value chain, and associated activities.
Time: 30 minutes per interview (depending on the time availability of the respondent)
Key Respondent: Officials from Mining Association
Team: 1 interviewer
Interviewer Details

Name of Interviewer		
Date and Place		
Cluster		
District		
Block		
Investigator Contact details		
Start Time		
End Time		
Status of Interview	Completed	1
	Incomplete	2
	Refused	3

Profile of Mining Association

Q. No	Question	Response	Code	Skip
44.	Name of the respondent			
45.	Designation of the respondent			
46.	Name of the association			
47.	Address and Contact details of the association			
48.	Please mention the type of organizations that are part of the association	Mine owners	1	
		Mining engineers	2	
		Mine workers	3	
		Stone cutting/ processing companies	4	
		Any other (specify)_____	98	
49.	No. of members in the association			
50.	Which minerals are linked to this association			
51.	What are the key activities undertaken by the association			
52.	Is the association financially supported by the government	Yes	1	
		No	2	

53.	If Yes, then mention the department/ source within the government			
54.	Under which scheme/ provision is the funding taken			

Mining related information

55.	Which are the major minerals in this cluster				
56.	Total no. of employers in the cluster. (Categorization as per turnover) **Type of firm** / **Annual turnover (in INR)** Small: 0-75 crores Medium: 75-250 crores Large: More than 250 Crores	Small		1	
		Medium		2	
		Large		3	
		Total		4	
57.	List 3 key small employers in the cluster	**Name of employer**	**Turnover**		
		Employer 1_____			
		Employer 2_____			
		Employer 3_____			
58.	List 3 key medium employers in the cluster	**Name of employer**	**Turnover**		
		Employer 1_____			
		Employer 2_____			
		Employer 3_____			
59.	List 3 key large employers in the cluster	**Name of employer**	**Turnover**		
		Employer 1_____			
		Employer 2_____			
		Employer 3_____			
60.	List the key activities associated with core mining. (activities related to exploration, mining and processing to be captured)				
61.	List the services that are associated with mining in the cluster (services related to core mining activities only)				
62.	List 5 major ancillary activities that support mining in the cluster and the key stakeholders associated with them.	Activity 1_____	Mention key Stakeholders		
		Activity 2_____			
		Activity 3_____			
		Activity 4_____			
		Activity 5_____			

63. **Please provide information on key job roles across the mining value chain (the job roles should cover all the activities mentioned in Q. 17,18,10)**

S. No	Job role	Total requirement (approximate no. required for mining area of 1 hectare)	Educational qualification required for this job role	Any other certification that is required for this job-role (mention the certification agency)	Total work experience required for the profile (in no. of years)	Are the people employed locally or from other states. (mention the states from where these people migrate)	Women participation in job role (Yes/ No)
Core mining activities							
7.							
8.							
9.							
10.							
11.							
12.							
Associates services							
13.							
14.							
15.							
16.							
17.							
18.							
Ancillary activities							
19.							
20							
21.							
22.							
23.							
24.							

Code for educational qualification – 5th to 8th (1), 9th to 10th (2), 10th to 12th (3), 12th pass (4), graduate (5), post graduate (6), ITI/ Diploma (7), No Qualification requirement (8)

64.	Do the employers face challenge in recruiting people for any of the job roles	Yes	1	
		No	2	Skip to 24
65.	List the job roles where hiring is a challenge			
66.	What are the 5 key challenges faced during hiring in these job roles	Challenge 1_____ Challenge 2_____ Challenge 3_____ Challenge 4_____ Challenge 5_____		
67.	How many vocational training centres (VTCs) are present in the cluster			
68.	Are all the VTCs operational	Yes	1	Skip to Q 27
		No	2	
69.	What are the key reasons for VTCs not being operational			
70.	Is health, safety and environment training conducted for employees	Yes	1	
		No	2	Skip to Q 29
71.	What is the frequency of these trainings			
72.	What are the 3 key reasons for not conducting such trainings	Reason 1_____ Reason 2_____ Reason 3_____		
73.	In your opinion, what are the areas which require additional training			
74.	Will you be willing to hire skilled and certified workforce	Yes	1	
		No	2	Skip to Q 34
75.	If yes, then will you be willing to pay a premium for such manpower	Yes	1	Skip to Q 34
		No	2	
76.	What are the key reasons for not paying a premium for skilled and certified work force			
77.	Which areas will see maximum investment in the next 5 years			
78.	Which job roles will be positively impacted due to these investments	1. 2. 3. 4.		
79.	Which job roles will be negatively impacted due to these investments	1. 2. 3. 4.		
80.	Key technological changes expected in the industry in the next 3 to 5 years			

81.	List the job roles that will be created due to the technological changes (list 5)	1. 2. 3. 4. 5.		
82.	List the job roles that will become redundant due to the technological changes (list 5)	1. 2. 3. 4. 5.		
83.	Which are the skills for which upskilling or reskilling will be required in order to adapt to the technological changes			
84.	Are you aware of any skill development initiatives for the mining sector	Yes	1	
		No	2	
85.	List key government initiatives that have enabled growth in the sector *(Probe on initiatives like rawana, vocational training, auctioning among others)*			
86.	What measures can be taken to increase women participation in this sector *(Probe areas where women participation can be increased and the steps that can be taken to do so)*			
87.	What are the key recommendations to ensure skilling in this sector (List 5)	1. 2. 3. 4. 5.		

A.2.5. Commerce and Industry departments

Introduction

This document details the tool for conducting an in-depth interview with state/district level investment departments. These are:

- Chamber of commerce and industries
- Department of industrial policy and promotion
- Investment promotion boards

Purpose of the interview:

- To understand the current and future investments in the mining sector
  To understand the investment utilization in the sector
- To collect relevant data/documents aggregated at the district level

Time: 30 minutes per interview (depending on the time availability of the respondent)

Team: 1 interviewer

Interviewer Details

Name of Interviewer		
Date and Place		
District		
Investigator Contact details		
Start Time		
End Time		
Status of Interview	Completed	1
	Incomplete	2
	Refused	3

Name of the respondent.....
Department .....
Designation .....
Contact Details .....
Email id .....
District .....
Date of Interview.....

1. What are the **current investments being made** to enable growth of mining of sector in the state? *(Details to be collected regarding the applicable schemes/ programs, also for different areas under mining such as infrastructure, skill development, technological advancements, etc.))*

	Current Scheme/ Program Details	**Budget**	**Target Beneficiaries**	**Challenges/ Hindrances (if any)**
Central Government *(if applicable)*				
State Government *(if applicable)*				
Others, Specify (private/ local institutions)				

2. Are there any **future large scale investments** to be made that would have an impact on mining sector in the state?

	Future Scheme Details	**Targeted Geography**	**Project Investments (in INR)**	**Nature of Employment Opportunities**
Central Government *(if applicable)*				
State Government *(if applicable)*				
Others, Specify (private/ local institutions)				

3. Please share district/state level data related to investment **<we need to understand from here, the percentage of investment vis-à-vis investment in other sectors>**
4. Please share any annual reports and any other related report/ data compilations done by the department.

S.N	Question	Probe area	Response
1.	What are the top 10 sectors that contribute to the economy of the state	Probe on the contribution of major sectors to economic development Probe on the contribution of major sectors to employment generation	
2.	In order to ensure rapid economic development and prosperity of the community in the region, what are the key initiatives/activities undertaken by the dept.	The dept. is responsible for promotion of trade, industry and services. We need to understand how is it doing it.	
3.	In order to strengthen linkages for technological advancement (especially in case of mining where industry 1.0 exists), are there any investments planned/already made?	Probe on what kind of technological advancements are investments directed towards.	
4.	What are the key investments planned in different sectors for the district?	*Probe on the planned investments (infrastructural as well as skilling related) for the district in context of mining and other sectors and emerging job roles that are expected to grow in the next 5 years* *Probe on the investments that will have better job prospects suitable for youth*	
5.	Has the department made any investments towards skill development in the state/district?	*To be probed in context of mining. Probe on the amount of investments, if they have established any COEs, VTCs, etc. Also probe on nature of trainings, its frequency.*	
6.	What are the upcoming plan of the district/state and how will it affect the nature	*Probe on key investments plans in terms of setting up new training institutions or up-grading the existing one, new skill*	

S.N	Question	Probe area	Response
	of jobs required by the industries.	*development schemes etc. (in context of mining)*	
7.	In your view, are the investments directed towards mining sufficient to make it attractive for youth and propel the sector's growth vis-à-vis other sectors?	*Probe on whether investments* can be scaled up to improve the employment generation scenario?	

A.2.6. Workers

This document details the tool for conducting interview with workers in mining sector.
The purpose of the interview:

- To understand the socio-economic and education status of the workers
- To understand the job roles in which workers are currently employed
- To understand their views on the skilling ecosystem in the sector

Time: 30 minutes per interview (depending on the time availability of the respondent)
Key Respondents: Mining Employees/workers
Team: 1 interviewer

Interviewer Details

Name of Interviewer		
Unique ID		
Unique ID of the employer tool		
Date		
State <dropdown to be created>		
Name of mining district <dropdown to be created>		
Investigator phone number		
Name of the company employee is currently working for		
Sub-sector in which the employee is engaged **<single response only>**	Prospecting & Exploration	1
	Mineral Processing & Beneficiation	2
	Mineral Extraction	3
	Associated Services	4
If Mineral extraction sub-sector then, Mineral type they are engaged with <single response only>	Metallic	1
	Non Metallic	2
	Minor	3
	Fuel	4
If Mineral extraction sub-sector then, Name of mineral <dropdown to be created>		

If Mineral extraction sub-sector then, Type of mine		Captive	1
		Non Captive	2
Sector of the organization		Organized	1
		Unorganized	2
Size of the employer (revenue)		Large	1
		Medium	2
		Small	3
		Micro	4
Start Time			
End Time			
Status of Interview		Completed	1
		Incomplete	2
		Refused	3

Type of firm	**Annual turnover (in INR)**
Micro	0-5 crores
Small	5-75 crores
Medium	75-250 crores
Large	More than 250 Crores

Respondent Details

Q No.	Question	Response	Code	Skip
1.	Name of respondent			
2.	Age (years) (Single Response)			
3.	Gender (Single Response)	Male	1	
		Female	2	
4.	Social group of the respondent (Single Response)	General/Unreserved	1	
		Scheduled Caste (SC)	2	
		Scheduled Tribe (ST)	3	
		Other Backward Caste (OBC)	4	
5.	Home State <dropdown to be created> (Single Response)	<List of all states in India should appear> 1. Andhra Pradesh 2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa 6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa 19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		
6.	Total work experience (in months)			
7.	Total work experience in the mining sector (in months)			
8.	Duration of engagement in the current company (in months)			
9.	Are you engaged in mining operations throughout the year?	Yes	1	Go to Q12
		No	2	
10.	How many months in a year are you engaged in this work?	0-3 months	1	
		3-6 months	2	
		6-9 months	3	
		9-12 months	4	
11.	When you are not doing mining, what do you do?	Casual wage worker	1	
		Agriculture worker (Other's farm)	2	
		Agriculture worker (Own farm)	3	

		Own account worker	4	
		Others, pls specify	99	
12.	Current Job role <dropdown to be created>			
13.	Functional Classification <to be autopopulated basis response to Q12>			
14.	Occupational Classification <to be autopopulated basis response to Q12>			
15.	What is the official company designation for your role?			
16.	Nature of Employment	Permanent/Full time	1	
		Contractual	2	
		Casual	3	
		Part-time	4	
17.	Highest level of education achieved (Only one code)	Doctorate / PhD	1	
		Master's / Post graduate Degree	2	
		Post Graduate Diploma	3	
		Bachelor's / Graduate Degree	4	
		Advanced Diploma – Polytechnic or equivalent	5	
		Diploma - ITI or equivalent	6	
		Higher Secondary (11th / 12th)	7	
		Secondary (9th / 10th Std)	8	
		Upper Primary (6th to 8th Std)	9	
		Primary (1st to 5th Std)	10	
		Never gone to school	11	
18.	Skill Certifications received	Medium term skill certification (6 months – 1 year)	1	
		Short term skill certification (< 6 months)	2	
		Statutory Certification	3	
19.	Specify the name of course/trade in which certification is attained			
20.	Specify the duration of course/trade (in months)			
21.	Are you the only bread winner in the family?	Yes	1	
		No	2	Go to next section
22.	How many dependents?			

Employment Details

Q No.	Question	Response	Code		Skip
23.	How did you get this job? (Only one code)	Campus (PG/ UG)	1		
		Long Term Skill Programs (ITI/Polytechnic)	2		
		Short Term Skill Programs (up to 6 months)	3		
		Short Term Skill Programs (more than 6 months)	4		
		Employee Reference	5		
		Recruitment / Manpower Agencies/Contractors	6		
		Local Community	7		
		Advertisements in newspapers	8		
		Social Networks (Friends/Family already working/have worked in mines)	9		
		Web Portals	10		
		Job Melas	11		
		Others (Specify)	99		
24.	Salary range per month (in INR)	Less than 5000	1		
		5000-10,000	2		
		10000-15000	3		
		15000-20000	4		
		20000-25000	5		
		25000-30000	6		
		30000-40000	7		
		40000-50000	8		
		50000-60000	9		
		60000-80000	10		
		More than 80000	11		
Q 25 to 29 to be asked only to people engaged in Mineral Extraction sub-sector					
25.	Where do you work?	Opencast mining	1		
		Underground mining	2		
		Surface operations	3		
		Both	4		
26.	Are you provided with the following safety equipment?	27.1 Ear plugs	Yes	1	
			No	2	
		27.2 Helmet	Yes	1	
			No	2	
		27.3 Hard toe shoes	Yes	1	
			No	2	
		27.4 Reflective jackets	Yes	1	
			No	2	
		27.5 Breathing masks	Yes	1	
			No	2	
		27.6 Gloves	Yes	1	
			No	2	
27.	Did you undergo training on health and safety before beginning mining operations?	Yes	1		
		No	2		Go to Q30
28.	If yes, when?	<drop down of month (Jan-Dec/year starting from 1991 to 2019>			
29.	How often this training is provided by the employer?	Once every month	1		
		Once every 6 month	2		
		Once a year	3		
		Was provided only at the time of joining	4		

Training Details

Q No.	Question	Response	Code	Skip
30.	Have you received any training pertaining to your current job role?	Yes	1	
		No	2	Go to Q 35
31.	Please specify the trade in which training was given			
32.	Please mention the duration of training (in months)			
33.	Please mention where you received the training <dropdown list of all states>			
34.	Please mention the nature of training	Classroom based training	1	
		Classroom based training with on the job training	2	
		Apprenticeship	3	
		Others, pls. specify	99	
35.	Did you receive any skill certification through RPL?	Yes	1	
		No	2	
36.	Are you aware of the following training programmes?	37.1 Pradhan Mantri Kaushal Vikas Yojana (PMKVY)	Yes 1 / No 2	
		37.2 Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU GKY)	Yes 1 / No 2	
		37.3 Apprenticeship Training Scheme (ATS)	Yes 1 / No 2	
37.	If yes what type of skill training you require?	Core Technical skills	1	
		Interpersonal skills	2	
		English language skills	3	
		Basic Computer/IT skills	4	
		Problem solving/Analytical	5	
		Team work	6	
		Time management	7	
		Upskilling to meet technical needs	8	
		Refresher training	9	
		Training on Health and Safety	10	
		Others, pls specify	99	

A.2.7. Employers (local ancillary units)

SN	Description	Option	Code	Skip
1.1.	Name of Respondent			
1.2.	Designation of Respondent			
1.3.	Contact details of the respondent	A. Phone no: _____		
		B. Email: _____		
1.4.	Name of Organization			
1.5.	Please specify the type of ancillary activity you are engaged in	Logistics & transportation (wagon loading, transport outside of mine, personnel carrier)	**1**	

	Only one code	Local Suppliers (equipment – computer, Personal protective equipment and material- bricks, water supply, fuel, stemming material for blasting, etc)	**2**	
		Explosive Contractors	3	
		Security guards	4	
		Equipment Repair services	**5**	
		Stone cutting	6	
		Nurseries and horticulture	7	
		Others, pls. specify	99	
1.6.	How many such units exist in your district? <only number permitted>		1	
1.7.	How many mines do you work with?			
1.8.	How many people are employed in your unit? <Total strength>			
1.9	Please provide the skill level split (skilled, semi-skilled and unskilled)			
1.10	List the job roles that exist in your unit			
1.11	Provide the gender wise split of your total headcount	Male		
		Female		
1.12	What is the average duration for which workers work with you?	0-3months	1	
		3-6 months	2	
		6-9 months	3	
		9-12 months	4	
		>12 months	5	

A.2.8. Employers (medium and small)

Profile of the respondent and organization

SN	Description	Option	Code	Skip
1.1	Name of Respondent			
1.2	Designation of Respondent			
1.3	Contact details of the respondent	A. Phone no: _____		
		B. Email: _____		
1.4	Name of Organization			
1.5	Complete address of the organization			
1.6	Year of establishment			
1.7	Which category do you operate in?	Mining Company	1	Continue
		Contractor (outsourced company)	2	Skip to Q1.21
		MDO	3	Skip to Q1.25
		Ancillary activity	4	Skip to Q1.30
Q1.8 to Q1.20 to be administered only with employers in Mining Company category				
1.8	Based on turnover/revenue, under which category does the firm fall? **Type of firm** / **Annual turnover (in INR)** Small / 5-75 crores Medium / 75-250 crores	Medium	1	
		Small	2	
1.9	Type of mine	Captive	1	

		Non-Captive	2	
1.10	How many mining leases do you have?			
1.11	Please specify the size (in hectare) for each lease?			
1.12	How many of these leases are operational?			
1.13	What is the production capacity of each operating lease <in tonnes>			
1.14	On an average, what is the typical production/output on an annual basis of each operational lease? <in tonnes>			
1.15	When does each one of your mining lease expire? <specify the years>			
1.16	Please specify the type of mining you are engaged in	Opencast mining	1	
		Underground mining	2	
		Surface mining	3	
		Both	4	
1.17	Total number of employees on each operational lease. Also specify the size of lease.	Lease 1: Size…..		
		Own rolls –Permanent……..		
		Own rolls –Contractual……..		
		Own rolls –Casual……..		
		Own rolls-Part time……...		
		Lease 2: Size…..		
		Own rolls –Permanent……..		
		Own rolls –Contractual……..		
		Own rolls –Casual……..		
		Own rolls-Part time……...		
1.18	Total number of employees on each operational mining lease. Also specify the size of lease.	Lease 1: Size…..		
		Through MDO……..		
		Through Contractor/Outsourced company……..		
		Lease 2: Size…..		
		Through MDO……..		
		Through Contractor/Outsourced company……..		
1.19	Please specify mineral category you are engaged in Multiple response possible	Fuel Minerals	1	
		Metallic Minerals	2	
		Non-metallic minerals	3	
		Minor Minerals/Dimensional Stones	4	
1.20	Please specify the minerals (coal, lignite, iron ore, zinc, mica, limestone, etc.) <refer to options> *Multiple Response possible* **Go to Q.1.33 after asking this question**			
Q1.21 to Q1.24 to be administered only with employers in Contractor category				
1.21	For how many mine companies/employers you supply labour? <specify number>			
1.22	Currently, how many workers have you contracted out to mines? <specify number>			
1.23	Do you supply labour outside the state/district?	Yes	1	Go to Q 1.24
		No	2	
1.24	Please specify the state/district <refer to options>			

	Go to Q.1.33 after asking this question			
Q1.25 to Q1.29 be administered only with employers in MDO category				
1.25	Based on turnover/revenue, under which category does the firm fall? **Type of firm** / **Annual turnover (in INR)** Small: 5-75 crores Medium: 75-250 crores	Medium	1	
		Small	2	
1.26	Currently, how many projects do you have? <specify number>			
1.27	Please specify the location (state/district) of the projects			
1.28	Please specify mineral category you are engaged in Multiple response possible	Fuel Minerals	1	
		Metallic Minerals	2	
		Non-metallic minerals	3	
		Minor Minerals/Dimensional Stones	4	
1.29	Total number of employees for each project <specify project wise number> **Go to Q.1.33 after asking this question**			
Q1.30 to Q1.32 be administered only with employers in Ancillary activity category				
1.30	Based on turnover/revenue, under which category does the firm fall? **Type of firm** / **Annual turnover (in INR)** Small: 5-75 crores Medium: 75-250 crores	Medium	1	
		Small	2	
1.31	Please specify the sub-sector	Manufacturing of Equipment	1	
		Explosive Contractors (including manufacturing)	2	
		Logistics and transportation	3	
1.32	Total number of employees pan India **Go to Q.1.33 after asking this question**	Own rolls –Permanent……..		
		Own rolls –Contractual……		
Q1.33 to Q1.40 be administered with all employers				
1.33	What is the average duration for which workers work with you?	0-3months	1	
		3-6 months	2	
		6-9 months	3	
		9-12 months	4	
		More than 12 months	5	
1.34	Please provide the gender wise split of employees <in %>	Male……		
		Female……...		
1.35	% of employees across age brackets	18-24……		
		25-34……..		
		35-44……..		
		45-54…….		
		55-64…….		
		65 and above….		
1.36	Key states of operation in India <MR possible>	<List of all states in India should appear> 1. Andhra Pradesh 2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa		

		6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa 19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		
1.37	Are you aware of National Skill Development Corporation (NSDC)	Yes	1	
		No	2	
1.38	Are you aware of Skill Council for Mining Sector (SCMS)	Yes	1	
		No	2	
1.39	Are you aware of Qualification Packs (QPs)?	Yes	1	
		No	2	
1.40	Are you aware of National Skills Qualification Framework (NSQF)	Yes	1	
		No	2	

Job role wise details

2A. Job roaster to be captured for the following:

- **Mineral Processing and Beneficiation**
- **Mineral extraction**
- **Associated Services**
- **Ancillary activities**

S. No	A1 Name of job role	A2 Designation referred to by the company	A3 Key tasks that the person is required to perform	A4 Current staff strength			A5 Minimum qualification/s required (See Code below)	A6 Nature of Employment (See Code below)	A7 Current shortage of manpower (See Code below)	A8 Average Salary range per month (See Code below)	A9 Skills/ vocational training received (See Code below)	A10 When was the latest training provided (See Code below)
				A4.1 M	A4.2 F	A4.3 All						
1	A1.1…… ……	A2.1…….	A3.1…….									
2	A1.2…… …..	A2.2…….	A3.2…….									

Gender and Recruitment related details

SN	Description	Option	Code	Skip
Distribution of Employees				
3.1.	What are the common modes of recruitment of employees? **(Multiple Response Possible)**	Campus (PG/ UG)	1	
		Long Term Skill Programs (ITI/Polytechnic)	2	
		Short Term Skill Programs (up to 6 months)	3	
		Short Term Skill Programs (more than 6 months)	4	
		Employee Reference	5	
		Recruitment / Manpower Agencies/Contractors	6	
		Local Community	7	
		Advertisements in newspapers	8	
		Social Networks	9	
		Web Portals	10	
		Job Melas	11	
		Others (Specify)	99	
3.2.	What kind challenges do you face while recruiting manpower **(Multiple Response Possible)**	No Challenges Faced	1	Go to Q 3.4
		Non-availability of youth group for employment due to disinterest	2	
		Lack of requisite skills training	3	
		Lack of adequate educational requirements	4	
		Not adequately matured to carry out the assigned task	5	

		Regulatory restrictions from Labour / other offices	6	
		Others Specify(___)	99	
3.3	At which level do you experience a challenge in recruiting	Entry level	1	
		Middle level	2	
		Supervisor level	3	
		Management level	4	
3.4.	Is there a preference for certified manpower (for non-statutory roles)?	Level / Yes / No		
		3.4.1. Entry / 1 / 2		
		3.4.2.Middle / 1 / 2		
		3.4.3.Supervisor / 1 / 2		
		3.4.4.Management / 1 / 2		
If the respondent says 'Yes' for any category, then ask question 3.5 and for categories for which the respondent says 'No', then ask question 3.6				
3.5.	If yes, please give reasons	Less expense on training/induction	1	
		Less attrition	2	
		Better productivity	3	
		Readily available	4	
		Others (specify)	99	
3.6.	If no, please give reasons	Attrition is high	1	
		Not much difference in the productivity of certified or un-certified manpower	2	
		Demand higher wages	3	
		Are not readily available	4	
		Others (specify)	99	
3.7.	What % of your people fall in each of these certifications?	No certifications……..		
		Statutory certifications…….		
		Academic/ Professional certifications…….		
		NSQF certifications…….		
3.8	Do you hire apprentices ?	Yes	1	
		No	2	Go to next section
3.9	What is the percentage of apprentices?			
3.10	If the % is less than 10% then do you plan to take it up to 10%?	Yes	1	
		No	2	Go to next section
3.11	If yes, by when? <specify year>			

4. Women and PAP related questions

4.1	Do you provide support features at your organization that encourage recruitment and retention of female?	Yes	1		
		No	**2**		Go to Q4.3
4.2.	Are the following specific support features (infrastructure, services, etc.) provided? (Multiple Response Possible)	4.2.1 Separate Toilets	Yes	1	
			No	2	
		4.2.2 Transport facilities	Yes	1	
			No	2	
		4.2.3 Maternity leave	Yes	1	
			No	2	
		4.2.4 Crèche facilities	Yes	1	
			No	2	
		4.2.5 Medical leave	Yes	1	
			No	2	
		4.2.6 Flexible timings	Yes	1	

			No	2	
		4.2.7 Feeding Room	Yes	1	
			No	2	
4.3.	Is there a preference for hiring female workers in the future?	Yes	1		
		No	2		Go to Q 4.5
4.4.	If yes, for what kind of work?	Machine operating	1		
		Associated services (accounts, data entry, administration)	2		
		Testing	3		
		Supervisory work	4		
		Others, specify	99		
4.5	If no, what are the key reasons? (Multiple Response Possible)	Remote location of mines	1		
		Lack of Requisite core/technical/domain Skills	2		
		Lack of Requisite Soft Skills	3		
		Lack of minimum education requirement	4		
		Lack of Prior Experience	5		
		Lack of social acceptance of girls to work in the Community	6		
		Nature of work requires strenuous physical labour	7		
		Long/Odd Working Hours	8		
		Resistance by family to allow them to work	9		
		Attrition/Uncertainty due to marriage and children/due to involvement in Household chores	10		
		Others (specify)_____	99		
4.6	What is the number of Project Affected People (PAPs) hired by you?				
4.7	What is the education level of the PAPs?	Illiterate	1		
		Literate <operational literacy>	2		
		Primary Education (up to Class V)	3		
		Upper Primary (Upto Class VIII)	4		
		Secondary Education (up to Class X)	5		
		Higher Secondary Education (up to Class XII)	6		
		Short Term Skill Development	7		
		ITI/ Vocational Training	8		
		Diplomas (Polytechnic)	9		
		Graduation	10		
		Post-Graduation / Highly Specialized Training	11		
		Statutory certification	12		
4.8	What kind of training do you provide to PAPs?	Technical	1		
		Non- Technical	2		

5. Migration related details

5.1	Do you employ people who have migrated from outside the district and state for the purpose of work?	Yes	1	
		No	2	Go to next section
5.2	Reasons for hiring from outside the district/state? **(Multiple Response possible)**	Lack of skilled resources in the district	1	
		High attrition among locals	2	
		Frequent absenteeism of locals	3	
		Locals are unwilling to work	4	
		Others, specify	99	
5.3	To which states do the in-migrants belong? **(Multiple Response possible)**	<List of all states in India should appear> 1. Andhra Pradesh		

		2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa 6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa 19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		
5.4	What % of your in-migrants are male and female	Male…….. Female……		

6. Training and Skilling Details

6.1	Where do they undertake training?	Company own Vocational Training Centre	1	Go to Q 6.2 and 6.3
		Group Vocational Training Centre	2	
		In-house specialised training centres (other than VTC)	3	Go to Q 6.4
		External Training Centre	4	Go to Q 6.5
6.2	Number of VTCs owned by the company			
6.3	Specify the location of your VTCs <Options to be referred>			
6.4	What are the In-house specialised training programmes and with whom? <define: tie-ups/partnerships>			
6.5	What are the External training programmes and with whom? <define: sending participants out to academic/VET institutions>			

7. General Perceptions

SN	Description	Option	Code	Skip
. 7.1	What are the key focus areas and growth/expansion plans for the upcoming years (2018-22) *Probe on new areas of investments, plans for expansion, expected growth etc.*			
. 7.2	Are there any technological advancements that are likely to impact the manpower requirement?			
. 7.3	Please specify job roles that will become redundant due to technological advancements?			
. 7.4	Please specify job roles that will emerge due to technological advancements and will require fresh skilling?			

7.5. Are there any comments/suggestions/recommendation that you may like to share to improve the skill development system for following key stakeholders of your industry in your state?

SNo.	Key Stakeholders	Comments
1	State/Centre Government	
2	Industry/Industry Association	
3	Skill Council for Mining Sector/NSDC	
4	Technical Training Institutes	
5	Any others, specify	

A.2.9. Employers (Large)

Profile of the respondent and organization

SN	Description	Option	Code	Skip
1.1	Name of Respondent			
1.2	Designation of Respondent			
1.3	Contact details of the respondent	A. Phone no: _____		
		B. Email: _____		
1.4	Name of Organization			
1.5	Complete address of the organization			
1.6	Year of establishment			
1.7	Which category do you operate in?	Mining Company	1	Continue
		Contractor (outsourced company)	2	Skip to Q1.21
		MDO	3	Skip to Q1.25
		Prospecting and Exploration Company	4	Skip to Q1.20.
		Ancillary activity	5	Skip to Q1.29.
Q1.8 to Q1.19 to be administered only with employers in Mining Company category				
1.8	Type of mine	Captive	1	
		Non-Captive	2	
1.9	How many mining leases do you have?			
1.10	Please specify the average size (in hectare) of all leases?			

1.11	How many of these leases are operational?			
1.12	What is the average production capacity of all operating leases <in tonnes>			
1.13	On an average, what is the typical production/output on an annual basis of all operational lease? <in tonnes>			
1.14	When does each one of your mining lease expire? <specify the years>			
1.15	Please specify the type of mining you are engaged in	Opencast mining	1	
		Underground mining	2	
		Surface mining	3	
		Both	4	
1.16	Total number of employees on each operational lease. Also specify the size of lease.	Lease 1: Size……		
		Own rolls –Permanent……..		
		Own rolls –Contractual……..		
		Own rolls –Casual……..		
		Own rolls-Part time……...		
		Lease 2: Size……		
		Own rolls –Permanent……..		
		Own rolls –Contractual……..		
		Own rolls –Casual……..		
		Own rolls-Part time……...		
1.17	Total number of employees on each operational mining lease. Also specify the size of lease.	Lease 1: Size…..		
		Through MDO……..		
		Through Contractor/Outsourced company……..		
		Lease 2: Size…..		
		Through MDO……..		
		Through Contractor/Outsourced company……..		
1.18	Please specify mineral category you are engaged in Multiple response possible	Fuel Minerals	1	
		Metallic Minerals	2	
		Non-metallic minerals	3	
		Minor Minerals/Dimensional Stones	4	
1.19	Please specify the minerals (coal, lignite, iron ore, zinc, mica, limestone, etc.) <refer to options> *Multiple Response possible* **Go to Q.1.31 after asking this question**			
Q1.20 to be administered only with employers in Prospecting and Exploration category				
1.20	Total number of employees pan India **Go to Q.1.31 after asking this question**	Own rolls –Permanent……..		
		Own rolls –Contractual……..		
		Outsourced manpower……..		
Q1.21 to Q1.24 to be administered only with employers in Contractor category				
1.21	For how many mine companies/employers you supply labour? <specify number>			
1.22	Currently, how many workers have you contracted out to mines? <specify number>			
1.23	Do you supply labour outside the state/district?	Yes	1	Go to Q 1.24
		No	2	Skip to Q1.31

1.24	Please specify the state/district <refer to options> **Go to Q.1.31 after asking this question**			
Q1.25 to Q1.28 to be administered only with employers in MDO category				
1.25	Currently, how many projects do you have? <specify number>			
1.26	Please specify the location (state/district) of the projects			
1.27	Please specify mineral category you are engaged in Multiple response possible	Fuel Minerals	1	
		Metallic Minerals	2	
		Non-metallic minerals	3	
		Minor Minerals/Dimensional Stones	4	
1.28	Total number of employees for each project <specify project wise number> **Go to Q.1.31 after asking this question**			
Q1.29 to Q1.30 to be administered only with employers in Ancillary activity category				
1.29	Please specify the sub-sector	Manufacturing of Equipment	1	
		Explosive Contractors (including manufacturing)	2	
		Logistics and transportation	3	
1.30	Total number of employees pan India **Go to Q.1.31 after asking this question**	Own rolls –Permanent……..		
		Own rolls –Contractual……		
		Outsourced manpower……		
Q1.31 to Q1.38 to be administered with all employers				
1.31	What is the average duration for which workers work with you?	0-3months	1	
		3-6 months	2	
		6-9 months	3	
		9-12months	4	
		>12 months	5	
1.32	Please provide the gender wise split of employees <in %>	Male……		
		Female……...		
1.33	% of employees across age brackets	18-24……		
		25-34……..		
		35-44……..		
		45-54…….		
		55-64…….		
		65 and above….		
1.34	Key states of operation in India <MR possible>	<List of all states in India should appear> 1. Andhra Pradesh 2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa 6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa		

		19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		
1.35	Are you aware of National Skill Development Corporation (NSDC)	Yes	1	
		No	2	
1.36	Are you aware of Skill Council for Mining Sector (SCMS)	Yes	1	
		No	2	
1.37	Are you aware of Qualification Packs (QPs)?	Yes	1	
		No	2	
1.38	Are you aware of National Skills Qualification Framework (NSQF)	Yes	1	
		No	2	

Job role wise details

2A. Job roaster to be captured for the following:

- **Mineral Processing and Beneficiation**
- **Mineral extraction**
- **Associated Services**
- **Prospecting and Exploration**
- **Ancillary activities**

S. No	A1 Name of job role <refer to options below>	A2 Key tasks that the person is required to perform	A2 Current staff strength			A3 Minimum qualification/s required (See Code below)	A4 Nature of Employment (See Code below)	A5 Current shortage of manpower (See Code below)	A6 Average Salary range per month (See Code below)	A7 Skills/ vocational training received (See Code below)	A8 When was the latest training provided (See Code below)
			A2.1 M	A2.2 F	A2.3 All						
1	A1.1…… ……	A2.1…….									
2	A1.2…… …..	A2.2…….									

Gender and Recruitment related details

SN	Description	Option	Code	Skip
Distribution of Employees				
3.1	What are the common modes of recruitment of employees? **(Multiple Response Possible)**	Campus (PG/ UG)	1	
		Long Term Skill Programs (ITI/Polytechnic)	2	
		Short Term Skill Programs (up to 6 months)	3	
		Short Term Skill Programs (more than 6 months)	4	
		Employee Reference	5	
		Recruitment / Manpower Agencies/Contractors	6	
		Local Community	7	
		Advertisements in newspapers	8	
		Social Networks	9	
		Web Portals	10	
		Job Melas	11	
		Others (Specify)	99	
3.2	What kind challenges do you face while recruiting manpower **(Multiple Response Possible)**	No Challenges Faced	1	Go to Q 3.4
		Non-availability of youth group for employment due to disinterest	2	
		Lack of requisite skills training	3	
		Lack of adequate educational requirements	4	

		Not adequately matured to carry out the assigned task	5	
		Regulatory restrictions from Labour / other offices	6	
		Others Specify(___)	99	
3.3	At which level do you experience a challenge in recruiting	Entry level	1	
		Middle level	2	
		Supervisor level	3	
		Management level	4	
3.4.	Is there a preference for certified manpower (for non-statutory roles)?	Level / Yes / No		
		3.4.1. Entry / 1 / 2		
		3.4.2.Middle / 1 / 2		
		3.4.3.Supervisor / 1 / 2		
		3.4.4.Management / 1 / 2		
If the respondent says 'Yes' for any category, then ask question 3.5 and for categories for which the respondent says 'No', then ask question 3.6				
3.5.	If yes, please give reasons	Less expense on training/induction	1	
		Less attrition	2	
		Better productivity	3	
		Readily available	4	
		Others (specify)	99	
3.6.	If no, please give reasons	Attrition is high	1	
		Not much difference in the productivity of certified or un-certified manpower	2	
		Demand higher wages	3	
		Are not readily available	4	
		Others (specify)	99	
3.7.	What % of your people fall in each of these certifications?	No certifications……..		
		Statutory certifications…….		
		Academic/ Professional certifications…….		
		NSQF certifications…….		
3.8	Do you hire apprentices ?	Yes	1	
		No	2	Go to next section
3.9	What is the percentage of apprentices?			
3.10	If the % is less than 10% then do you plan to take it up to 10%?	Yes	1	
		No	2	Go to next section
3.11	If yes, by when? <specify year>			

4. Women and PAP related questions

4.1	Do you provide support features at your organization that encourage recruitment and retention of female?	Yes	1		
		No	**2**		Go to Q4.3
4.2.	Are the following specific support features (infrastructure, services, etc.) provided? (Multiple Response Possible)	4.2.1 Separate Toilets	Yes	1	
			No	2	
		4.2.2 Transport facilities	Yes	1	
			No	2	
		4.2.3 Maternity leave	Yes	1	
			No	2	
		4.2.4 Crèche facilities	Yes	1	
			No	2	
		4.2.5 Medical leave	Yes	1	

			No	2	
		4.2.6 Flexible timings	Yes	1	
			No	2	
		4.2.7 Feeding Room	Yes	1	
			No	2	
4.3.	Is there a preference for hiring female workers in the future?	Yes	1		
		No	2		Go to Q 4.5
4.4.	If yes, for what kind of work?	Machine operating	1		
		Associated services (accounts, data entry, administration)	2		
		Testing	3		
		Supervisory work	4		
		Others, specify	99		
4.5	If no, what are the key reasons? (Multiple Response Possible)	Remote location of mines	1		
		Lack of Requisite core/technical/domain Skills	2		
		Lack of Requisite Soft Skills	3		
		Lack of minimum education requirement	4		
		Lack of Prior Experience	5		
		Lack of social acceptance of girls to work in the Community	6		
		Nature of work requires strenuous physical labour	7		
		Long/Odd Working Hours	8		
		Resistance by family to allow them to work	9		
		Attrition/Uncertainty due to marriage and children/due to involvement in Household chores	10		
		Others (specify)_____	99		
4.6	What is the number of Project Affected People (PAPs) hired by you?				
4.7	What is the education level of the PAPs?	Illiterate	1		
		Literate <operational literacy>	2		
		Primary Education (up to Class V)	3		
		Upper Primary (Upto Class VIII)	4		
		Secondary Education (up to Class X)	5		
		Higher Secondary Education (up to Class XII)	6		
		Short Term Skill Development	7		
		ITI/ Vocational Training	8		
		Diplomas (Polytechnic)	9		
		Graduation	10		
		Post-Graduation / Highly Specialized Training	11		
		Statutory certification	12		
4.8	What kind of training do you provide to PAPs?	Technical	1		
		Non- Technical	2		

5. Migration related details

5.1	Do you employ people who have migrated from outside the district and state for the purpose of work?	Yes	1	
		No	2	Go to next section
5.2	Reasons for hiring from outside the district/state? **(Multiple Response possible)**	Lack of skilled resources in the district	1	
		High attrition among locals	2	
		Frequent absenteeism of locals	3	
		Locals are unwilling to work	4	
		Others, specify	99	
5.3	To which states do the in-migrants belong?			

	(Multiple Response possible)	<List of all states in India should appear> 1. Andhra Pradesh 2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa 6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa 19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		
5.4	What % of your in-migrants are male and female	Male…….. Female……		

6. Training and Skilling Details

6.1	Where do they undertake training?	Company own Vocational Training Centre	1	Go to Q 6.2 and 6.3
		Group Vocational Training Centre	2	
		In-house specialised training centres (other than VTC)	3	Go to Q 6.4
		External Training Centre	4	Go to Q 6.5
6.2	Number of VTCs owned by the company	VTC……		
6.3	Specify the location of your VTCs <Options to be created>			
6.4	What are the In-house specialised training programmes and with whom? <define: tie-ups/partnerships>			
6.5	What are the External training programmes and with whom? <define: sending participants out to academic/VET institutions>			

Options for Q6.3

District
Kurnool
Srikakulam
Raigarh
Surguja
Bharuch
Bhavnagar
West Bokaro
Jamshedpur
Raichur
Bellary
Balaghat
Singrauli
Satna
Bhandara
Chandrapur
Balangir
Jajpur
Keonjhar
Koraput
Sundargarh
Bundi
Dungarpur
Rajsamand
Udaipur
Neyveli
Salem
Khammam
Adilabad
Paschim Bardhman

6.6 Please list the occupation wise skill sets that can be improved. <refer to the codes below>

Occupation	Entry level	Middle level	Supervisory level	Management level
Exploration & Resource Management and surveying				
Drilling & Cutting				
Blasting				
Loading & Hauling - Opencast				
Specialist Operations - Underground				
HSE Functions				
Engineering Services				
Mineral Beneficiation				

Other services

Code for Q 6.6	
Technical Skills for the Job Role	1
Inter-personal/communication skills	2
Team work	3
Organizational awareness	4
Adaptability	5
Time management	6
Analytical skills	7
Health and safety awareness	8
Environmental/sustainability awareness	9
Digital skills	10
Others	99

7. General Perceptions

SN	Description	Option	Code	Skip
. 7.1	What are the key focus areas and growth/expansion plans for the upcoming years (2018-22) *Probe on new areas of investments, plans for expansion, expected growth etc.*			
. 7.2	Are there any technological advancements that are likely to impact the manpower requirement?			
. 7.3	Please specify job roles that will become redundant due to technological advancements?			
. 7.4	Please specify job roles that will emerge due to technological advancements and will require fresh skilling?			

7.5 What are your recruitment plans for the next 5 years <specify numbers>?

Occupation	Entry level	Middle level	Supervisory level	Management level
Exploration & Resource Management and surveying				
Drilling & Cutting				
Blasting				
Loading & Hauling - Opencast				
Specialist Operations - Underground				
HSE Functions				
Engineering Services				
Mineral Beneficiation				
Other services				

7.6. Are there any comments/suggestions/recommendation that you may like to share to improve the skill development system for following key stakeholders of your industry in your state?

SNo.	Key Stakeholders	Comments
1	State/Centre Government	
2	Industry/Industry Association	
3	Skill Council for Mining Sector/NSDC	
4	Technical Training Institutes	
5	Any others specify	

A.2.10. Employers (Micro-Unorganized)

Profile of the respondent and organization

SN	Description	Option	Code	Skip
1.1	Name of Respondent			
1.2	Designation of Respondent			
1.3	Contact details of the respondent	A. Phone no: _____		
		B. Email: _____		
1.4	Name of Organization			
1.5	Complete address of the organization			
1.6	Year of establishment			
1.7	Type of mine	Captive	1	
		Non-Captive	2	
1.8	How many mining leases do you have?			
1.9	Please specify the size (in hectare) for each lease?			
1.10	How many of these leases are operational?			
1.11	What is the production capacity of your each operating lease <in tonnes>			
1.12	On an average, what is the typical production/output on an annual basis of each operational lease? <in tonnes>			
1.13	When does each one of your mining lease expire? <specify the years>			
1.14	Total number of employees on each operational mining lease. Also specify the size of lease.	Lease 1: Size……		
		Own rolls –Permanent……..		
		Own rolls –Contractual……		
		Own rolls –Casual……		
		Own rolls-Part time……...		
		Lease 2: Size……		
		Own rolls –Permanent……..		
		Own rolls –Contractual……		
		Own rolls –Casual……		
		Own rolls-Part time……...		
1.15	What is the average duration for which workers work with you?	0-3 months	1	
		3-6 months	2	
		6-9 months	3	
		9-12 months	4	
		>12 months	5	
1.16	Please provide the gender wise split of employees <in %>	Male……		
		Female……..		

1.17	% of employees across age brackets	18-24……		
		25-34……..		
		35-44……..		
		45-54…….		
		55-64…….		
		65 and above….		
1.18	Please specify type of minor mineral you are engaged in <refer to options>			
1.19	Please specify the type of mining you are engaged in	Opencast mining	1	
		Underground mining	2	
		Surface mining	3	
		Both	4	
1.20	Key states of operation in India	<List of all states in India should appear> 1. Andhra Pradesh 2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa 6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa 19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		

Job role wise details

S.No	A1 Name of job role	A2 Key tasks that the person is required to perform	A3 Current staff strength			A4 Minimum qualification/s required (See Code below)	A5 Nature of Employment (See Code below)
			A3.1 M	A3.2 F	A3.3 All		
1	A1.1……	A2.1…….					

2	A1.2……..	A2.2…….					

3. Migration related details

3.1	Do you employ people who have migrated from outside the district and state for the purpose of work?	Yes	1	
		No	2	Go to next section
3.2	Reasons for hiring from outside the district? **(Multiple Response possible)**	Lack of skilled resources in the district	1	
		High attrition among locals	2	
		Frequent absenteeism of locals	3	
		Locals are unwilling to work	4	
		Others, specify	99	
3.3	To which states do the in-migrants belong? **(Multiple Response possible)**	<List of all states in India should appear> 1. Andhra Pradesh 2. Arunachal Pradesh 3. Assam 4. Bihar 5. Goa 6. Gujarat 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Karnataka 11. Kerala 12. Madhya Pradesh 13. Maharashtra 14. Manipur 15. Meghalaya 16. Mizoram 17. Nagaland 18. Orissa 19. Punjab 20. Rajasthan 21. Sikkim 22. Tamil Nadu 23. Tripura 24. Uttar Pradesh 25. West Bengal 26. Chhattisgarh 27. Uttarakhand 28. Jharkhand 29. Telangana 30. Delhi (NCT) 31. Chandigarh 32. Puducherry		

4. Training and Skilling Details

4.1	Do you have a Vocational Training Centre (VTC)?	Yes	1	
		No	2	
4.2	Have your workers received any kind of skills/vocational training?	Yes	1	
		No	2	Go to next section
4.2	Specify skill sets on which training was given Multiple responses possible	Induction	1	
		Domain Skills on recruitment	2	
		Career Advancement	3	
		Up-Skilling to meet technical needs	4	
		First Aid training	5	
		Fire Safety training	6	

		Rescue training	7	
		Specialised training (if any) <needs to be specified>	99	

5. General Perceptions

5.1. Are there any comments/suggestions/recommendation that you may like to share to improve the skill development system for following key stakeholders of your industry in your state?

SNo.	Key Stakeholders	Comments
1	State/Centre Government	
2	Industry/Industry Association	
3	Skill Council for Mining Sector/NSDC	
4	Technical Training Institutes	
5	Any others, specify	

A.2.11. Departments of Mines and Geology

Respondent Details

Name of the respondent.....
Designation .....
Contact Details .....
Email id .....
District and State .....

Checklist of documents required

1. Latest mining profile of the state and clusters (if available)
2. What are the minerals found in your state? Also, specify key districts/clusters against each mineral, and manpower employed. <information to be captured in following format for all the minerals>

Mineral 1:									
SNo.	District	Leases (Number)			Area (hectares)			Production (tons)	Employment
		Active	Inactive	Total	Active	Inactive	Total		
1.									
2.									
3.									

Mineral 2:									
SNo.	District	Leases (Number)			Area (hectares)			Production (tons)	Employment
		Active	Inactive	Total	Active	Inactive	Total		
1.									
2.									
3.									

Mineral 3:

SNo.	District	Leases (Number)			Area (hectares)			Production (tons)	Employment
		Active	Inactive	Total	Active	Inactive	Total		
1.									
2.									
3.									

3. Any recent annual reports or data compilations done by the department.
4. List of relevant projects (On-going and proposed for the coming years) with details.

<support in connecting with district offices for our shortlisted districts>

1. What are the current policy initiatives taken by the state government/department to enable growth of mining sector in the state?

2. Are there any future schemes/policies/large scale investments to be implemented that would have an impact on mining sector in the state?

3. What are the top 3 key drivers for competitive growth of mining sector in the state and why?

    a) ……..

    b) …….

    c) ……

4. Which are the high demand job-roles in mining sector in the state? Pls. specify the sub-sectors across each job role, employee profile and nature of skills required against each listed job role.

S.N	Question	Probe area	Response
5.	List down the job roles preferred by women in the sector and reasons for the same	Since women participation in the field is minimal, probe on key job roles in which majority of women are employed and reasons for it.	
6.	What is the status of mineral discoveries in the state? *(try getting data on this)*	Probe on the minerals discovered, status of explorations and surveys.	
7.	What impact do you foresee of inclusion of several major minerals into minor minerals?	Probe on the impact on production value, production quantity, etc.	
8.	What kind of modern/latest technologies are being used for mineral discoveries and exploration and to ensure mineral conservation?	Probe on technologies, equipments used, it's adoption rate among miners, is it confined to only large players.	
9.	Are you undertaking any steps to ensure mineral based Industrialization in the state?	Probe on the role of public and private sectors to enhance mineral availability in the state.	
10.	Could you please elaborate on how the royalty is collected?	Probe on the mechanism of collection, e-rawana, it's benefits.	
11.	What are the major challenges faced by the mining companies?	Probe on the infrastructural, manpower availability, investment related, policy level challenges faced by the industries/companies.	
12.	Pls. comment on the status of ITIs/Polytechnics in the state offering training for mining related job roles.	Probe on the no. of such institutes in the state, functional status, are there any training institutes present in mining clusters.	
13.	Pls. comment on the utilization of District Mineral Fund (DMF) in	Probe on % of fund usage towards skilling	

S.N	Question	Probe area	Response
	skilling the mining labour force.		
14.	Does the department organise any training programmes for the unemployed youth or workers	Probe on such training programmes, frequency of the programme, target beneficiaries, methodology.	
15.	What kind of initiatives have been taken in the state towards ensuring welfare of mining affected communities under Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY)?	Probe on any developmental and welfare projects/programs, programs for long-term sustainable livelihoods, etc.	
16.	What are your recommendations to make the sector as reliable source of gainful employment especially in the rural and tribal areas where alternate/additional source of income is a necessity?		
17.	What is your vision for the future of mining in the state?		

A.2.12. Central/Apex Organizations

Probe areas for Central Ministries- Ministry of Coal, Ministry of Mines, and Ministry of Steel

1. Which are the minerals that contribute most to the sector? <*Probe on the contribution of identified minerals to total mineral production and employment generation*>
2. What are the current policy initiatives taken by the government to enable growth of mining sector in the country? Who are the target beneficiaries of these schemes/policies?
3. What are the major investments in the sector currently and expected in the next 5 years? How will it impact employment and growth of the sector?
4. What are the top 3 key drivers for competitive growth of mining sector in country?
5. What will be the impact of National Mineral Policy 2019 on the sector in terms of improving the productivity and competitiveness of the sector?
6. In your opinion, what kind of ancillary activities exist in the periphery of mines?
7. What are the key skill development programmes being implemented across the sector? <probe on VTCs, private training centers within the periphery of mining clusters>
8. What kind of skills are lacking among the workforce? <*technical/job-specific skills, soft skills such as team work, time management, organisational skills, communication skills*>
9. Pls comment on the utilization of DMF in skilling in the sector.
10. Are there any initiatives for RPL (providing certification) or up-skilling. If yes provide details
11. Do you think there is adequate infrastructure available for expanding skilling initiatives? If not, what strategies could be adopted to enhance the skilling activities?
12. Basis pilot in Rajasthan, it has been noted that mines in unorganized sector, especially in minor mineral mines, there is no trained and educated manpower that is employed, including Mines Manager. How do you plan to tackle this issue?
13. What kind of technological advancements are happening in the sector? What is the current extent of technology adoption? Do you foresee technology impacting employment in the next 3 to 5 years?
14. In the light of technology, is reskilling and upskilling a priority. If yes, what kind of skills?
15. Pls comment on women participation in the sector. Typically, what kind of job roles are performed by them.
16. Reasons for low women participation in the sector. What strategies can be proposed to increase their participation in the sector.
17. What are the major challenges faced by the sector? <*Probe on the infrastructural, manpower availability, skilling, investment related, policy level challenges*>
18. What are the upcoming plans of the ministry and how will it affect the employment and nature of jobs in the sector?
19. What are your recommendations for new skilling areas, upskilling and reskilling in the sector?
20. What are your recommendations on enhancing employment in the sector?

Probe areas for Indian Bureau of Mines

1. What is the process that you adopt for approval of mining plans and mining schemes?
2. How is India's mining sector placed internationally?
3. What is the country's minerals export-import potential? Pls comment on the top minerals in terms of export and import.
4. Which minerals dominate in terms of production quantity and value?
5. How many reserves have been declared as 'actual' till date? What is the future prospect of reserves in the country?
6. Pls. comment on the current status of mines in India. Which policies are enabling sector's growth; issues/challenges faced by mines?
7. Which states are doing well in the country? Pls comment on the reasons for it.
8. What steps are being undertaken towards mines closure, restoration and abandoned mines?
9. What steps are being undertaken to promote scientific and systemic methods of mining and how are you ensuring that mine owners are adopting these methods?
10. Pls explain the typical process of mines audit that is undertaken every year.
11. What impact do you foresee of National Mineral Policy 2019 on the sector?
12. What kind of technologies are being used for upgradation of low grade ores? Are there any new technologies that can ensure environment-friendly mining or reduce damage to environment? Pls. comment on it's adoption.
13. What is the future of Mineral Beneficiation in the country?
14. What are your recommendations on enhancing the sector's future outlook?
15. Can you provide us with some environmental studies that you would have undertaken for promoting conservation of mineral resources and environment? How often are these studies undertaken?

Probe areas for GSI and MECL

1. What is the current status of mineral exploration (through ground, airborne, satellite, and marine surveys) in the country?
2. Of the total identified OGP area of 5.71 lakh sq. km, only 10% has been explored in detail till date. What are the reasons for the same?
3. What is the expected time by which all the geological potential of the country will be explored?
4. Is the exploration done domestically or outsourced to international companies?
5. What kind of technologies across different types of surveys are being used for undertaking mineral exploration activity?
6. Are you in collaboration with international organisations to improve understanding of the earth, its ecosystems and its geology?
7. What kind of job roles exist in your organisation? Comment on their headcount.
8. Do they undergo some sort of training? Pls elaborate on the methodology, nature and duration of training.

9. What are the recent policy level initiatives that have been undertaken to expand and speed-up the exploration activity? Also comment on the initiatives to probe deep-seated/concealed mineral deposits.
10. Is the baseline geoscience data available freely in the public domain? How frequently is the data updated?
11. Pls comment on the extent of private sector participation in exploration. Name a few of the private players that have been granted permission to carry out exploration activities.
12. Has the establishment of the National Centre for Mineral Targeting (NCMT) increased the discovery rate in mineral exploration and the quality of discoveries? Pls comment on it's performance as a think tank for mineral exploration.
13. Do you face any challenges while carrying out mineral exploration? <*old/outdated technology, lack of trained personnel, budgetary allocations, regulations*>
14. What would be your strategies/plans to scale up exploration activities, especially probing the deep-seated/concealed mineral deposits in the coming years?
15. Pls comment on what kind of minerals will be most explored in the next 3-5 years?

Probe areas for DGMS

1. Since mining is a hazardous activity carried out using different technologies, how are you ensuring comprehensive surveillance at workplaces w.r.t health and safety norms?
2. What newer strategies can be proposed for prevention of accidents in mines, especially in light of increasing number of mine companies moving to mechanization and focusing towards bulk production?
3. What changes will the proposed risk based 'Safety and Health Management System' (SHMS) bring to the health and safety of workers in the mines?
4. Pls explain your process of annual audit of mines. How is it carried out? What are the parameters on which mines are audited on adherence to health and safety norms?
5. What kind of new equipments/machines are being used in the mines? Typically, which companies are using these equipments? <large, medium and small>
6. In your opinion, what will be the impact of technological advancements on employment in the sector? What will be the extent of impact?
7. How many VTCs currently exist in the sector? How are they performing? Pls provide us with the job role-wise training data (past 5 years if possible).
8. Based on our pilot, it has been found that VTCs don't exist in the mines operating in the unorganized sector. How do you plan to ensure that such training centres exist in the unorganized sector?
9. Do you think VTCs can be used for upskilling and reskilling the workforce in the sector?
10. What kind of job roles pertaining to mines safety can exist in the sector? Do you have any plans to introduce more such job roles?
11. As per your recent notification, allowing women to work in underground mines, do you think women employment in the sector will be boosted?
12. In your opinion, what are the top 3 key drivers for competitive growth of mining sector in country.
13. What are your recommendations for improving the skilling ecosystem in the industry?

MOLE

14. What are your current initiatives in terms of skill development, particularly of youth in the sector leading to employment? <*probe on the ongoing skill development training programmes, number of ITIs/ skill training centres (Government and private), and job roles which interest the young population*>
15. Are women also participating in the skill development trainings?
16. Do you think there is adequate infrastructure available for expanding skilling initiatives? If not, what strategies could be adopted to enhance the skilling activities? <*probe on the sufficiency (number of seats, capacity utilization etc.) of ITIs /Polytechnics/ VTPs(government and private), existing infrastructure in these institutions and related quality issues*>

Probe areas for Skill Council for Mining Sector (SCMS)

1. As per the training data, the number of trained candidates across job roles in the past few years is quite low with almost no trainees enrolled for majority of QPs, what are the reasons for the same?
2. Are women also participating in the skill development trainings?
3. Does the SSC track placement of students trained in QPs?
4. What kind of companies (small, medium, large) are recruiting? Also comment on industry buy-in in the sector?
5. Is there any feedback from the industry on what needs to change in the ongoing trainings, especially w.r.t to model curriculum for job roles in the sector?
6. Is there a need for transnational skills in your sector? How many of existing QPs are transnational? What has been the impact so far in terms of trainees benefitted? What has been the impact on employers (do they prefer to hire employees trained as per transnational standards)?
7. Given that your current occupational matrix primarily pertains to organized sector mining, do you a plan to draft an occupational matrix specifically pertaining to unorganized sector?
8. Since there are no ITIs and only few polytechnics offering mining related courses (especially in Rajasthan), what are your plans in terms of expanding outreach of the training programmes?
9. Basis pilot in Rajasthan, it has been noted that mines in unorganized sector, especially in minor mineral mines, there is no trained and educated manpower that is employed, including Mines Manager. Do you think opening training institutes in the periphery of mines can resolve the problem?
10. Pls. comment on the utilization of DMF in the mining sector.
11. Are the employers aware of RPL in the sector? Which are the sub sectors that lend themselves to RPL? Also, what is the model of RPL being followed in the industry? How is the uptake among private employers?
12. Do you think there is adequate infrastructure available for expanding skilling initiatives? If not, what strategies could be adopted to enhance the skilling activities? <*probe on the sufficiency (number of seats, capacity utilization etc.) of ITIs /Polytechnics/ VTPs(government and private), existing infrastructure in these institutions and related quality issues*>

13. In your opinion, what will be the likely new job roles that can emerge in the sector? In which sub-sector will these job roles emerge?
14. What kind of technological advancements are taking place in the sector? What is the current extent of technology adoption and what impact it will have on employment?
15. Are there any future schemes/ policies/ large scale investments to be implemented that would have an impact on mining sector?
16. What are the top 3 key drivers for competitive growth of mining sector in country

Probe areas for NSDC

1. What are your recommendations for new skilling areas, upskilling and reskilling in the sector?
2. What are your recommendations on enhancing training and employment in the sector?
3. What strategies would you propose for improving women participation in the sector?

A.3. List of 24 Minor Minerals in India

1. Building Stones (Granite & other building stone)
2. Gravel
3. Ordinary clay
4. Marble
5. Shale when used for building material
6. Sand stone when used for building purposes or for making road metals and house-hold utensils
7. Quartzite when used for building purposes or for making road metals and house-hold utensils
8. Saltpetre
9. Ordinary sand other than used for prescribed purposes as given below:
    i. Purposes of refractory and manufacture of ceramic
    ii. Metallurgical purposes
    iii. Optical purposes
    iv. Purposes of stowing in coal mines
    v. Manufacture of silvicrete cement
    vi. Manufacture of sodium silicate
    vii. Manufacture of pottery & glass
10. Boulder
11. Shingle
12. Chalcedony for impure quartz pebbles used for ball mill purposes or filling for bore wells or for decorative purposes in buildings
13. Limeshell when used in kilns for manufacture of lime used as building material
14. Lime kankar when used in kilns for manufacture of lime used as building material
15. Limestone when used in kilns for manufacture of lime used as building material
16. Brick earth
17. Fuller's earth
18. Bentonite
19. Road metal
20. Reh-matti
21. Slate when used for building material
22. Stones used for making house-hold utensils
23. Ordinary earth when used for levelling or filling purposes in constructions of embankments, roads, railways, buildings, etc.
24. Murrum

A.4. List of 31 Minor Minerals

1. Agate;
2. Ball Clay;
3. Barytes;
4. Calcareous Sand;
5. Calcite;
6. Chalk;
7. China Clay;
8. Clay (Others);
9. Corundum;
10. Diaspore;
11. Dolomite;
12. Dunite/pyroxenite;
13. Felsite;
14. Felspar;
15. Fireclay;
16. Fuschite Quartzite;
17. Gypsum;
18. Jasper;
19. Kaolin;
20. Laterite;
21. Limekankar;
22. Mica;
23. Ochre;
24. Pyrophyllite;
25. Quartz;
26. Quartzite;
27. Sand (Others);
28. Shale;
29. Silica Sand;
30. Slate;
31. Steatite/Talc/Soapstone

A.5. Major legislations in the mining sector in India

Important rules and regulations framed under MMDR, 1957 are

- Mineral Concession Rules, 2016
- Mineral Conservation and Development Rule, 1988
- Granite Conservation and Development Rule, 1999
- The Mining Leases (Modification of Terms) Rules, 1956
- Mineral Concession (Amendment) Rules, 2003
- Mineral Conservation and Development (Amendment) Rules, 2003
- Marble Development and Conservation Rules, 2002

Important rules and regulations framed under Mines Act, 1952 are

- Coal Mines Regulation, 1957 and (Coal Mines Regulations, 2017)
- Metalliferrous Mines Regulation, 1961 and (Metalliferrous Mine Regulation, 2012)
- Coal Mines Nationalisation Acts (Coking and Non Coking)
- Coal Mines Nationalisation (Amendment) Act, 1976
- Coal Bearing Areas (Acquisition and Development) Act, 1957

Important Acts, rules and regulations for Atomic Minerals

- Atomic Energy Act, 1962
- Atomic Energy (Radiation and Protection) Rules, 2004

Important Acts, rules and regulations for Offshore Minerals

- Offshore Areas Mineral (Development and Regulation) Act, 2002

Important Polices

- National Mineral Policy, 2008 and National Mineral Policy, 2019
- New Coal Distribution Policy, 2007
- National Steel Policy, 2005 and National Steel Policy, 2017

Other Acts, Rules, Regulations and Policies

- The Environmental Protection Acts like the Air Act, Water Act, Forest Conservation Act and similar other statutes are applicable to mining projects.
- Contract Labour (Regulation & Abolition)Act, 1970 is applicable for employment of contract labour in mining projects

A.6. Comparative of different minor mineral concession rules

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
Andhra Pradesh	i. Quarry Lease ii. Permit	For 100% EOUs max. 10 hectares For block granite per lease subject to max.50 hectares For colored granite, max. 100 hectares. Not exceeding 20 hectares per lease	5 to 15 years depending on mineral type. 2 years max. for sand lease by auction. Granite for 15 years	On application 90 days before expiry. Renewable for period not exceeding original lease	Not specified. Issued to meet immediate or timely petty requirement	Not specified	Not exceeding 60 days	(G) INR 750 and INR 500 per cu. meter for black and other colors respectively INR 10 per piece for cut/ dressed blocks and INR 50 per tonne for kerl stones (M) INR 50 per cu. meter (O) INR 5 per cu. meter to INR 40 per tonne	(G) INR 30,000 and INR 25,000 per hectare per annum for black variety and others respectively (M) INR 10,000 per hectare per annum (O) INR 5,000 to INR 10,000 per hectare per annum	Payable annually. Amount not specified
Goa	Quarrying Lease	Not exceeding 5 hectare per	Ordinarily not	On application	Not applicable	Not applicable	Not applicable	Traditional extractors	(G) INR 10,000 per	--

[210] Dead rent is the rent fixed for mines without considering the fact whether the mine is profitable or not. It is mostly fixed in a mineral lease. This rent must be paid whether minerals are being extracted from the mines or not.
[211] The rent that the lessee is liable to pay for the surface area used for the purpose of mining operations.

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
		lease and not exceeding 50 hectares within the State	exceeding 10 years	at least 90 days before expiry. Renewable for one or more periods not exceeding duration of original lease				liable to pay royalty at 50% of prescribed rates (G,M,O) INR 1.5 to INR 10 per cubic meter	annum for area up to 5 hectares (O) INR 3,000 to INR 5,000 for area up to 5 hectares	
Gujarat	i. Quarry Lease ii. Quarrying Parwana iii. Quarrying Permit	10 hectare max. for ordinary and specified minor minerals(marble, limestone, limeshell, bentonite, fuller's earth, chalcedony pebbles) and 20 hectare for others *Parwana*: Plot not exceeding 2000 sq. meter	3 years for ordinary sand, kankar, murrum, gravel. 10 years max. for others *Parwana*: One year ending 31st December	On application at least 90 days before expiry. Aggregate 12 years for kankar, murrum etc. and 20 years for others *Parwana*: Renewable for a period not exceeding 3 yrs, each year.	Not exceeding 4000 tonnes	As specified	As specified on permit	(G) INR 7 per tonne (M) INR 10 to INR 40 per tonne (O) INR 3 to INR 20 per tonne	Not provided for in Rules	INR 100 per hectare or part thereof for quarry lease INR 0.15 per 100 sq. meter or part for quarrying parwana
Karnataka	i. Quarry Lease (QL1)	(QL1) Under one or more leases, 50 acres for existing EOU granite units, 40	(QL1) 20 years for specified minor minerals and 5	(QL1) Renewable for 2 periods each not exceeding	Not exceeding 1000 tonnes	Not specified	Not exceeding 3 months	(G) INR 600 to INR 2,000 per cu. meter	(G) INR 15,000 per acre per annum	Not applicable

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
	ii. Quarrying License (QL2) iii. Quarrying Permit iv. Quarrying lease by tender cum auction (QL3)	acres for other granite cutting/ polishing units and 10 acres for others. Limit not applicable to Government undertakings (QL2) Discretion of competent authority (QL3) To be specified	years for non-specified minor minerals (10 years on request by captive industry holders) (QL2) 10 years (20 years for granite cutting units (QL3) To be specified in the Notification. Not exceeding 10 years	20 years for specified minor minerals. For non-specified, 2 periods not exceeding 5 years (10 years in case of captive minerals based industry) (QL2) As in case of grant for renewal cases of pattadars (QL3) Not specified				(M) INR 100 per cu. meter (O) INR 2 to INR 100 per tonne and 25% of sale value at pit head	(M) INR 15,000 per acre per annum separately (O) INR 100 to INR 15,000 per acre per annum	
Madhya Pradesh	i. Quarry Lease ii. Quarrying Permit	Max. area to a co-operative society/ association/ company is 10 hectares. To an individual it is 4 hectares	2 to 20 years	On application one year before expiry	In some cases 50 cu. meter for departments of Central/ State government with one month duration	Not specified	2 to 3 years	(G) Dimensional stone – INR 400 to INR 750 per cu. meter (M) INR 50 to INR 150	(G) Except for the 1st year, 2nd to 3rd year INR 10,000 and 4th year onwards INR 15,000 per annum	All the rates specified for the area occupied or used by the lessee

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
								per cu. meter (O) INR 10 to INR 40 per cu. meter	(M) 2nd and 3rd year INR 5000 and 4th year & onwards INR 7,500 per annum (O) 2nd and 3rd year INR 2,000 to INR 5,000 and 4th year & onwards INR 3,000 to INR 7,500 per annum	
Maharashtra (Mumbai and Vidarbha Region[212])	i. Quarry Lease ii. Quarrying Permit	Max. 50 acres for specified minor minerals and 150 acres for other minor minerals. A lessee is allowed to hold max. 3 sq. miles in respect of one or group of minor minerals	Not more than 10 years	On application atleast 60 days in advance. Renewable for one period not exceeding the period of original lease	One million cu. feet	Maximum area not specified	Specified on permit	INR 15 per tonne (INR 60 per brass) levied on all stones intended for decorative purposes (O) INR 1.25 to INR 10 per tonne (INR	(O) Min. INR. 10 to max. INR 25 per annum, per acre or part thereof in case of specified minor minerals excluding first 3 months. In	Surface rent charged for mining at the rate fixed by Collector, not exceeding land revenue and cess

[212] The Vidarbha region has no provision for permit. Instead a prospecting license is awarded, which is not for exploitation of deposit

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
								5 to INR 40 per brass)	case of others it is INR 5 to INR 10	
Maharashtra (Marathwada Region)	i. Quarry Lease ii. Short term concession	Not specified	One to five years	Renewable for a period not exceeding 5 years	Short term concessions – Not specified	Short term concessions – Not specified	Short term concessions – 3 months	INR 15 per tonne (INR 60 per brass) levied on all stones intended for decorative purposes (O) INR 1.25 to INR 10 per tonne (INR 5 to INR 40 per brass)	There is no provision for dead rent. Instead, a 'fixed quarrying fee' is prescribed. The lessee is liable to pay either royalty or min. fixed quarrying fee at the rate of INR 100 per acre per annum	There is no provision for surface rent. However, lessee is liable to pay annual land assessment on the leased area
Odisha	i. Quarry Lease ii. Quarry Permit	100 hectare max. under one lease and max. 3 sq. km in the State. 150 hectare or 50 hectare for granite according to lessee's category	3 to 10 years depending upon the category of lessee	On application 90 days before expiry. Renewable for one or more periods of not exceeding 10 years each for	1000 tonnes	Not specified	Not exceeding one year	(G) Dimensional stones INR 400 to INR 500 per cu. meter. (M) INR 32 to INR 210 per cu. meter	(G) Dimensional stones INR 500 per hectare per annum up to 15 hectares. INR 1,000 for 15 to 50 hectares and INR 2,000 for	Surface rent of INR 50 per hectare per annum for all minerals

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
				decorative, industrial and including dimension stones. Renewable for 3 to 5 years according to lessee's category for one or more periods for other minor minerals				(O) INR 15 to INR 62 per cu. meter	above 50 hectares (M)(O) INR 100 per hectare per annum up to 15 hectares, INR 200 for 15 to 50 hectares and INR 500 for above 50 hectares	
Rajasthan[213]	i. Mining Lease (ML) ii. Quarry License (QL) iii. Short term permit	(ML) One hectare to 10 sq km (QL) Dimension of one plot not exceeding 400m x 200m for marble and associated mineral and min. not less than 60m x 30m. In case of fixed annual	(ML) 10 to 20 years (QL) 5 years	(ML) On application 12 months before expiry. Renewable for 20 years so that total period does not exceed 60 years (QL) Renewable for further 5	Max 500 tonnes (exception contract works of State/ Central Governments) Quantity of brick earth calculated by formula in tonnes = 150xWxN.	50m x 50m	4 months exception Government contracts 1 to 5 years for brick earth	(G) INR 40 to INR 75 per tonne (M) INR 25 to INR 140 per tonne (O) INR 3 to INR 500 per tonne or 10% of PMV	(G) INR 10 per 10 sq. meter (M) INR 25 per 10 sq. meter (O) INR 3 to INR 25 per 10 sq. meter	At the rate equal to land revenue

[213] Rajasthan Granite Policy: As per policy, plot size is 2.25 hectare and maximum 2 plots are granted. More than 2 plots are granted on certain conditions up to a maximum of 20 plots Rajasthan Marble Policy: Plot size of 2.25 hectare with a maximum area limit of 4.5 hectares. However, the max. area also depends on deployment of machinery. When the no. of Gangsaws/ automatic tilling plants are 2 then max. area will be 6.75 hectares, 3 then max. area will be 9 hectares and 4 or more will have max. area 11.25 hectares. Mining Lease and Quarry License is also provided to applicants who undertake to deploy prescribed mine machinery within 6 months. The policy also provides for granting leases with low grade marble deposit to applicants from SC/ST/OBC categories

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
		rental fee, 10m x 10m and max. 2 licenses granted		years up to max. period of 30 years	W = 3.5 tonnes N – No. of vertical columns of brick					
Tamil Nadu	i. Quarrying Lease ii. Quarrying Permit	5 to 10 hectare depending upon type of mineral with max. 2 leases at a time	1 to 5 years (20 years in case of Granite)	Only in some cases on application to the State Government by the Government company/ corporation	2000 cu. feet under one permit	Not specified	Not specified	(G) INR 1,000 to INR 2,000 per cu. meter (O) INR 2.25 to INR 18.50 per cart load up to 10 cu. feet and 20% of the local market value of mineral at pit's mouth	(G) INR 5,000 to INR 6,000 per hectare per annum (O) Varies between INR 500 to INR 800 per hectare per annum depending upon the mineral.	Rate of area assessment per hectare per annum varies between INR 50 to INR 100 depending upon minerals
Uttar Pradesh	i. Mining Lease ii. Auction Lease iii. Mining Permit	30 acres	10 to 15 years (5 years in case of auction lease)	Not renewable	Not specified	Not specified	6 months maximum	(G) INR 200 per cu. meter (M) INR 40 per tonne or INR 72 per cu. meter (O) INR 4 to INR 75	(G) INR 6,000 per acre per annum (M) INR 3,000 per acre per annum (O) INR 1,400 to	No provision

State	Type of Concessions	Mining Lease			Permits			Taxes		
		Area	Period	Renewal	Condition on production	Area	Validity	Royalty	Dead Rent[210]	Surface-rent[211]
								per cu. meter and also 10% PMV (INR 40 per quintal for saltpeter)	INR 3,000 per acre per annum	
West Bengal	i. Mining Lease ii. Quarry Permit	3 sq. km. exception West Bengal Mineral Development & Trading Corporation Limited (WBMDTC Ltd.)	5 to 20 years	On application to State Government six months before expiry	Not specified	5 acres	3 months maximum	(G) INR 300 to INR 500 per cu. meter (O) INR 10 to INR 20 per 100 cu. feet	INR 80 per hectare or INR 32 per acre	At the rate fixed by District authority and specified in lease

A.7. List of direct and indirect courses offered at education institutes

SNo.	Courses at Industrial Training Institutes	Courses at Engineering Colleges
1	Civil Engineer Assistant	Mining Engineering
2	Data Entry Operator	Mechanical Engineering
3	Draftsman	Electrical Engineering
4	Driver Cum mechanic	Computer Science Engineering
5	Electrician	Information Technology Engineering
6	Electrician (power distribution)	Electronics and Telecom Engineering
7	Electronics mechanic	Electrical and Electronics Engineering
8	Fireman	Metallurgy Engineering
9	Fitter	Civil Engineering
10	Geo-Informatics Assistant	Geology
11	Heavy Equipment Operators	Geophysics
12	HR Executive	Chemical Engineering
13	Information Communication Technology	
14	Machinist	
15	Machinist(Grinder)	
16	Mech.Repair and maintenance of Heavy vehicles	
17	Mech.Repair and maintenance of Light vehicles	
18	Mechanic – Mechatronics	
19	Mechanic- Motor Vehicle	
20	Mechanic – Tractor	
21	Mechanic Auto Body painting	
22	Mechanic Auto Body Repair	
23	Mechanic Diesel	
24	Mechanic Machine Tool Maintenance	
25	**Mechanic mining machinery**	
26	Mechanical Auto Electrical and Electronics	
27	Operator Advanced Machine Tools	
28	Plumber	
29	Pump Operator	
30	Safety Operator - HSE Professional	
31	Sheet Metal worker	
32	**Stone Mining Machine Operator**	
33	Stone Processing Machine Operator	
34	Surveyor	
35	Technician Power Electronic system	
36	Turner	
37	Welder – DA	
38	Welder – GMAW & GTAW	
39	Welder (welding and inspection)	

A.8. Technologies being adopted globally across the key sub sectors in mining

#	Technologies	Description
Prospecting, Exploration and Mine Planning		
1	Advanced Airborne Gravity Gradiometer Technology For Mineral Exploration	Exploration for mineral bodies is time-consuming and expensive; making an unsuccessful attempt is extremely costly. So it has developed an advanced gradiometer known as VK 1 gravity gradiometer in an attempt to find a solution to exploration changes.
2	3D Imaging Technology	A new technology that has emerged in three dimensional imaging is 3D laser scanning, which helps to capture spatial data using laser light and enables geologists to build 3D geological maps combining the surface mapping data. 3d imaging technologies have transformed the exploration of large mines and continue to hold promise with a number of emerging technologies
3	Automated Drilling	Automated and tele-operated drilling solutions can ensure mining personnel safety and improve efficiency during surface drilling operations. A tele-operated drilling solution comprises of an easily installable operator station on a range of mobile platforms connected to the drilling rig wireless network. In the old methods the drilling was manual and also was an extensive method to follow.
4	Efficient Shaft and Tunnel Boring System	A tunnel boring machine (TBM), also known as a "mole", is a machine used to excavate tunnels with a circular cross section through a variety of soil and rock strata.TBMs have the advantages of limiting the disturbance to the surrounding ground and producing a smooth tunnel wall. The modern breakthrough that made tunnel boring machines efficient and reliable was the invention of the rotating head.
5	Plasma Technologies	Plasma technologies are used in a process by which complex ores such as zinc, nickel, copper and lead are heated applying ultra-high temperatures of between 8,000-12,000 degrees Celsius to break down the ore structure and free up the latent precious materials
6	Remote Operating and Monitoring Sector Inversion Algorithm	It helps to in monitoring and controlling the mining or processing the activities from a remote location which increases the efficiency, improved safety, decreased viability and better identification of the performance issues.
7	Inversion Algorithm	The new inversion algorithm allows geophysics data to be used in a different way. By first establishing the geophysical property of rocks and then measuring their geophysical signatures in the field , it is possible to generate three dimensional models of their potential mineralization
8	Portable Analyser	This tool identifies the chemical elements comprising on a rocks surface using X-rays. It provides on spot results, which helps avoid unnecessary sampling and analytical testing at a laboratory.
9	Aviris	The AVIRIS airborne sensor uses hyperspectral measurements that is it measures hundreds of spectral bands, whereas ordinary satellites measure only few at a time. So this helps to identify the vegetation but also the nature of the minerals present.
10	Mass Balance	It helps in dissolving minerals for e.g. copper, zinc and gold and transforming.
11	Geographic Information System	It has transformed the exploration practices by organizing and presenting spatially referenced numerical data on a computer. The offices of exploration companies were once covered in maps at different scales ; today they are filled with computer screens on which geologist compile the their information
12	Geo-positioning	It uses satellite and accurate information and dramatically facilitate field work and mapping projects. It has changed the process of exploration by allowing user to pinpoint an observation site quickly and accurately
Mining Operations		
1	Blasting Box	It is now possible to use an air pressured ignition mechanism rather than one that is spring loaded in order to avoid unexpected explosions
2	Hybrid Bolt	It is a combination of friction bolt and then resin bolt. Mainly the bolts ends up breaking and can fail to hold the screens in place. The hybrid bolt solves them.
3	Boulder Buster	A small hole is drilled into the rock and then filled with water. A breach body is then inserted in the hole, a protective mat placed over the rock and cartridge placed in the breech body.
4	Inspection camera	A wheeled inspection camera is fixed into a rigged wheel mounted housing and equipped with forward facing lighting system to carry out inspections of mine shafts and tunnel
5	Mobile drilling	It is used for production holes and ground support in underground mining, being employed as much for diamond drilling as it is for regular boreholes. The small conveyor makes it easier to access narrow excavations

6	Robomap	The inventions of mining robots provided an opportunity to design autonomous tools for mapping underground tunnels in mines, particularly for mapping the textures of their walls. The robots are able to gain access to areas that would be difficult for humans. Robomaps is an autonomous or remote controlled machine equipped with a motion sensor for positioning.
7	Rockmesha	It installs protective meshes on mine walls. The machine improves safety by mechanizing the application of the mesh, thereby avoiding manual handling by workers. An operator can send all commands from inside the vehicle.
8	Mining Simulator	Immersive and virtual training systems for all types of mining operations provide training for personnel with the help of simulator. Its main objective is to teach the workers to react appropriately without exposing them to the real danger
9	Smart rock	It is often difficult to track the movement of the rocks in underground mine when the broken ore is stored in vast underground spaces during mining process known as block caving. To help solving this issue is Smart Rock an electronic gadget that resembles rock.
Mineral Beneficiation		
1	Sonar Flowmeter	These tools measure the amount of material passing along the conveyor belts using sonar sonar capable of measuring solids just as well as liquids
2	Underground Pre-concentration	The first step in separating ore minerals from gangue typical involves crushing and grinding which creates huge noise and pollution and lots of dust. So this step is completely carried underground and this process would also reduce transport costs since less material would have to be moved out of the mine
3	Split online system	Milling is the first step in ore processing. The ore must be broken down to increasingly smaller pieces in order to separate minerals of the interest .It is now possible to instantaneously measure the size of fragments using continuous image analysis . It is an automated digital imaging system that monitors ore during milling. The images are captured by photographic devices installed in the crusher and on the conveyors and processed by specialized software that measure the size of the fragments.
4	Magnetic Separator	Gravity separation, Forth Floatation, Magnetic Separation, Electrostatic separation and air tabling are the main methods for mineral beneficiation. So it is focused on all major players of coal washery in order to reduce the cost associated with transportation of unprocessed coal.
EngineeringServices		
1	Jack Adapter	Heavy machinery requires regular maintenance and occasional repairs. To do either the equipment must be lifted up and held there, safely and securely. To prevent the jack from slipping , jack adapter is designed which is placed between the jack and the raised machine
2	Personnel Tracking	RFID tags are invented so the workers can be easily tracked underground. It is one of the efficient method to retain safety of the employees.
3	Gas detection device	Underground mining produces gas which are often toxic, from the machinery running on diesel. So sensors are provided that measure the gas concentrations
4	Survival Chamber	In case of an accident survival chambers offer protection for trapped workers. They can be easily moved from one place to another, these chambers provide 36 hours of protection with supply of electricity and oxygen.
5	Fatigue measuring watch	The fatigue risk management system is an electronic strap that measures the fatigue level of a worker, particularly heavy equipment operators to determine whether they are fit to work.
6	Soundproof Tent	It serves the dual purpose of improving communication between the operators and the miners in the cage and reducing the risk of hearing problems.

A.9. Best practices across assessment and certification globally

SNo	Parameters	Australia	Canada	USA	China
1	**Purpose of Vocational Training**	To ensure qualifications are designed to provide the skills that employers and industry needs. A strong VET sector will boost the employment outcomes of those completing VET courses and instill confidence in users of the sector.	Canada's mission of TVET and entire education system is to provide high-quality learning opportunities and the required skills to students to enter the labour market. In Canada, TVET programs are aligned with labour market requirements for distinct communities and age groups.	The mission of USA's TVET is to promote education about work, for work or education through work. Each state has also its own TVET mission depending on the regional labour needs. TVET in the United States is known as Career and Technical Education (CTE).	Aims to enhance the employability of its labour force by contributing to China's social as well as economic development.
2	**Frameworks to Impart Vocational Training**	***The Australian Qualification Framework (AQF)*** - formerly known as the Australian Qualification and Training Framework (AQTF). It sets out the standards of education and qualifications across Australia[214].	***Canadian Degree Qualification Framework*** – setting degree-level standards, categories, maintaining, assessing standards which are met by new institutions, providing context for identifying degree credentials and comparing it with other jurisdiction in order to provide proper education and training to workforce[215]. ***Territorial and Provincial qualification framework are developed in the different provinces.*** For example: Maritime Degree Level Qualifications	The United States doesn't have any National Qualification Framework, however, there is a "Connecting Credentials Framework" developed by Lumina Foundation to facilitate transparency, comparability and quality development of learning outcome[217,218,219]. U.S. Department of Education has developed employability skills framework. It includes – ***Applied knowledge:*** • Applied Academic Skills – reading skills, writing skills, maths strategies/procedures, scientific procedures • Critical Thinking Skills – thinks	***China is reforming its vocational education sector*** – underlining various objective, one of them is developing **National Qualification Framework**. Education and Occupational Qualification System are two components of qualification system in China[221, 222]. ***The Vocational Qualification Certificate System*** was introduced in 1993 with 5 NVQ levels[223].

214 https://www.training.com.au/aqf-the-australian-qualifications-framework/
215 https://www.cicic.ca/docs/cmec/QA-Statement-2007.en.pdf
217 https://connections.etf.europa.eu/blogs/f062de46-649f-4ccf-80a9-190ab49938fe/entry/A_Credentials_Framework_for_the_US_A_beta_version_has_been_launched_for_tests_and_further_developments?lang=en_gb
218 http://connectingcredentials.org/framework/
219 http://degreeprofile.org/
221 http://documents.worldbank.org/curated/en/216651508745207540/pdf/120583-WP-P150980-PUBLIC-China-NQF-summary.pdf
222 https://internationaleducation.gov.au/News/Latest-News/Pages/China-announces-majer-reform-to-vocational-education-sector.aspx
223 https://unevoc.unesco.org/wtdb/worldtvetdatabase_chn_en.pdf

SNo	Parameters	Australia	Canada	USA	China
			Framework and Ontario Qualifications Framework are developed in New Brunswick, Nova Scotia, Prince Edward Island[216].	creatively and critically, makes sound decisions, solves problems, negotiations skills, plans/organizes • Effective Relationships: interpersonal Skills - understands teamwork and work with others, exercises leadership, negotiates to resolve conflict, respects individual differences • Personal Qualities – taking initiatives, demonstrating professionalism etc. ***Workplace skills:*** • Resource management – managing resources, personnel. • Communication skills – listening, comprehending, writing, observing and verbal communication • Information use – organises, uses, analyses information and skill • Systems thinking - understanding and using systems, monitoring and improving systems • Technology use - understands and uses technology[220]	
3	**Agencies Involved for Vocational Training**	***Australian Skills Quality Authority (ASQA)*** is the national VET regulator responsible for the registration of Registered Training Organisations (RTOs) and	**Government bodies for each province and territory which administers the postsecondary education, training and apprenticeship**	***Office of Career, Technical and Adult Foundation (OCTAE)*** previously known as Office of Vocational and Adult Education (OVAE) facilitates the development of programs related to	***China Employment Technical Instruction Centre (CETTIC) and Occupational Skill Testing Authority***

216 https://www.cicic.ca/1287/provincial_and_territorial_qualifications_frameworks.canada
220 https://cte.ed.gov/initiatives/employability-skills-framework

SNo	Parameters	Australia	Canada	USA	China
		monitoring their compliance with national VET standards. ***The Council of Australian Governments (COAG) Industry and Skills Council (CISC)*** provides leadership and direction to the sector. ***The Australian Industry and Skills Committee (AISC)*** advises the CISC on policy directions and decision making in the national training system. ***Industry Reference Committees (IRCs)*** advise the AISC about the skill needs of their industry sector and ensures training packages meet the needs and concerns of the employers, employees, training providers and people seeking training qualifications. ***Skills Service Organisations (SSOs)*** are independent and professional service organisations that support IRCs in their work development and reviewing training packages.	**laws and regulations.** These agencies are mentioned in the "Quality Assurance" section for each province. ***At national level agencies are***: **Employment and Social Development Canada (ESDC),** or ***Human Resources and Skills Development Canada (HRSDC)*** - Department of the government of Canada is responsible for social program and development of labour market at the federal level, outlining essential skills required at workplace, supporting Canadian government in development of skilled workforce, developing program initiatives[224]. ***Canadian Council of Directors of Apprenticeship (CCDA)*** – Only voluntary body in Canada which enhances the intergovernmental partnership among the provinces and territories, is responsible for apprenticeship training and trade certification and the federal government[225].	adult education and literacy, CTE and community colleges in collaboration with Division of Adult Education and Literacy (DAEL), is responsible for developing program with significant skills required to be a productive worker[227,228]. ***Center on Education and Training for Employment (CETE)***, which is part of the College of Education and Human Ecology (EHE) at the Ohio State University, administers standards, curriculum and instruction, assessment, evaluation, professional development, and international initiatives[229]. **CTE – is national level non-profit organisation that represents each state's secondary, postsecondary and adult Career Technical Education (CTE)**, which was formally known as National Association of State Directors of Career Technical Education Consortium (NASDCTEC)[230]. The Center for Employment Training (CET) is a non-profit organization that has partnerships with the U.S. Department of Labor. CET has pioneered the practice of open-ended, competency-based training that uses the workplace as the context for simulations.	***(OSTA)*** conducts skill testing all over the country and provides technical guidance employment and vocational training work nationally. ***National Industrial Committee for Vocational Education and Teaching (NICVET)*** helps in developing the curriculum for vocational. In collaboration Department of Vocational and Adult Education is responsible for initiating, implementing & evaluating various policies related to vocational higher education. ***Central Institute for Vocational and Technical Education (CIVTE)*** is a national research institute for VET and provides policy advice to government and cooperation among various VET institutes. ***China Ministry of Education and Ministry of Finance*** developed program in collaboration with China Education

224 https://www.canada.ca/en/employment-social-development/programs/essential-skills.html
225 http://www.red-seal.ca/about/ccd.1-eng.html
227 https://www2.ed.gov/about/offices/list/ovae/index.html
228 https://www2.ed.gov/about/offices/list/ovae/pi/AdultEd/index.html
229 https://unevoc.unesco.org/go.php?q=UNEVOC+Network+-+Centre&id=883
230 https://www.careertech.org/who-we-are

SNo	Parameters	Australia	Canada	USA	China
			Skill Competency Canada (SCC) is a non-profit organisation, which comply with the essential skills developed by ESDC by conducting various competitions, developing programs and initiatives. ***Council of Ministers of Education, Canada (CMEC),*** is responsible for delivery and assessment of postsecondary education including vocational and technical education, preparation of curriculum for postsecondary education, vocation-oriented college programs. Formerly known as Association of Canadian Community Colleges (ACCC), ***College and Institutes Canada (CICan)*** is dedicated to providing quality education and skill development opportunities in Canada. ***The Office of Literacy and Essential Skills (OLES)*** seeks to assist adult Canadians enhance their literacy and essential skills so they can better prepare for, get and keep a job, adapt and succeed at work. Focus is	***Mine Safety and Health Administration (MSHA) provides training programs aimed at improving safety and health in the mining industry.***	Association for International Exchange (CEAIE) named, VELT program, focuses on improving skill sets like leadership, communications etc. and uplifting the quality of overall Chinese higher vocational education.

SNo	Parameters	Australia	Canada	USA	China
			more on supporting indigenous people, youth, Official Language Minority Communities (OLMCs) or any other individual with low skills and facing multiple barriers to employment[226].		
4	**Quality assurance (QA)**	**ASQA** registers training providers, monitors compliance with national standards and investigates quality concerns. **AQF** regulate qualifications nationally to ensure quality and consistency.	Canada witness quality assurance system at territorial level rather than national level. Quality assurance for 13 provinces are: ***Alberta - CAQC***, determines quality review and procedures, reviewing degree program, ensuring degree proposal meet the council's standards quality and recommendation to Minister of Advanced Education for approval[231]. ***British Columbia*** – consist of various QA mechanisms depending on type of program and institution, namely - Degree Quality Assessment Board (DQAB), Private Career Training Institutions Agency (PCTIA), external and internal review, provincial registration, affiliation[232]. ***Manitoba*** - legislation (statutes and regulations), credit transfer and	The quality assurance is termed as 'accreditation' which is provided by institutional accreditation and professional accreditation. The Council for Higher Education Accreditation (CHEA), which defines quality standards for assurance (accreditation). Department of Education also provide federal financial support to accrediting bodies[241]. **The seven regional institutional accrediting bodies are**: • Middle state association of colleges and schools (MSCHE) • New England Association of Schools and Colleges (NEASC) • Higher Learning Commission (HLC) • Northwest Association of Schools, Colleges, Universities (NWCCU) • Southern Association of colleges and schools (SACSCOC) • WASC Senior College and	***Ministry of education and Ministry of Human resource and Social security provides standards for NVQ framework.*** The standards help in maintaining quality, relevance and proper learning outcome.

226 https://www.canada.ca/en/employment-social-development/programs/literacy-essential-skills.html
231 https://www.cicic.ca/1131/alberta.canada
232 https://www.cicic.ca/1156/quality_assurance_practices_for_postsecondary_institutions_in_british_columbia.canada
241 https://www.nuffic.nl/en/subjects/education-and-diplomas-united-states/

SNo	Parameters	Australia	Canada	USA	China
			articulation, external and internal review, professional accreditation[233]. ***New Brunswick*** - Maritime Provinces Higher Education Commission is responsible for QA for Universities. New Brunswick Community Colleges Act (NBCC), Collège communautaire du Nouveau-Brunswick (CCNB) and New Brunswick College of Craft & Design (NBCCD) governs and conducts internal of program for community colleges. New Brunswick Association of Career Colleges (NBACC) for private institutions. Department responsible for postsecondary education and training is – Department of Post-Secondary Education, Training and Labour [234,235]. ***Nova Scotia and Prince Edward Island*** - Maritime Provinces Higher Education Commission (MPHEC) is responsible for quality assurance of postsecondary education[236, 237] ***Ontario Universities***	University Commission (WSCUS) • Accrediting Commission for Community and Junior colleges, Western Association of schools and colleges (ACCJC)	

233 https://www.cicic.ca/1201/quality_assurance_practices_for_postsecondary_institutions_in_manitoba.canada
234 https://www.cicic.ca/1197/quality_assurance_practices_for_postsecondary_institutions_in_new_brunswick.canada
235 https://www2.gnb.ca/content/gnb/en/departments/post-secondary_education_training_and_labour.html
236 https://www.cicic.ca/1186/quality_assurance_practices_for_postsecondary_institutions_in_nova_scotia.canada
237 https://www.cicic.ca/1169/quality_assurance_practices_for_postsecondary_institutions_in_prince_edward_island.canada

SNo	Parameters	Australia	Canada	USA	China
			Council on Quality Assurance (OUCQA) is responsible for the QA in Ontario. Ministry of Training, Colleges and Universities (MTCU) is responsible for apprenticeship and post-secondary education [238,239]. ***Northwest Territory*** – The Department of Education, Culture and Employment (ECE), through the Advanced Education division administers the NT Apprenticeship, Trades and Occupation Certification (AOC) Program[240]		
5	**Type of Trainings**	***Core skills:*** The Australian Core Skills Framework - learning, reading, writing, oral communication and numeracy skills. The Core Skills for **Work Developmental Framework**- problem solving, collaboration, self-management, communication and information technology skills. The **Skills for Education and Employment programme**- provides language, literacy and numeracy training to job seekers to	***Learn Canada 2020***, is being used by the ministries of Canada and respective provincial education government bodies in Canada. The main objective of Learn 2020 is to address postsecondary capacity and meet training and learning needs. ***Skills for Future*** outlines various programs/initiatives conducted by territorial and provincial government While Skills for Future does define the detailed overview	**The National Career Cluster (NCC)** knowledge and skill statement was developed in 2008 which clearly listed the skills required for various industries. It also reflected the industry wide expectation. 16 Career clusters were developed and organised by CTE which were in line with the NCC skill framework[245,246] **New Skills for Youth (NSFY)**, a five-year initiative, was developed and funded by the JP Morgan Chase and Co in 2016 in collaboration with Council of Chief State School Officers	Vocational training comprises apprenticeships, on-the-job training, re-training and short training courses that could take place before or during employment[250]. **Various types of certifications at secondary and tertiary level in China are:** ***The specialized secondary schools (SSS), under MOE*** provides 3- year certificate course for skilled and management

238 https://www.cicic.ca/1178/quality_assurance_practices_for_postsecondary_institutions_in_ontario.canada
239 https://www.collegeoftrades.ca/training-standards
240 Apprenticeship, Trades and Occupation Certification (AOC) Program
245 https://cte.careertech.org/sites/default/files/CareerClustersPathways.pdf
246 https://careertech.org/knowledge-skills-statements
250 http://siteresources.worldbank.org/EDUCATION/Resources/278200-1121703274255/1439264-1242337549970/6124382-1288297991092/ChinaNote-byWenjinWang.pdf

SNo	Parameters	Australia	Canada	USA	China
		enable them to participate more effectively in training or in the labour force. ***Foundation skills:*** The National Foundation Skills Strategy for Adults- focuses on improving the language, literacy, numeracy and employability skills of working age Australians.	of each program conducted and initiated by provincial and territory, Skills competences of Canada provides a brief overview of essential skills as listed below[242], [243, 244]: • Numeracy • Oral Communication • Working with other • Continuous Learning • Reading Skills • Writing skills • Thinking skill • Document use • Digital	(CCSSO), Advance CTE and Education Strategy Group (ESG). 24 States and Washington D.C received grants for 6 months under phase-1 of the initiative. 10 States from phase-1 had opportunity to apply for phase-2 of the initiative and received grants till next 3 years. It helped the states to develop the greater number of graduates ready as per the industry and employer demand[247, 248, 249].	personnel in the services sector, medicine and health care, education, industrial technology etc. The graduates of these schools are more likely to enter the labour market directly[251]. ***The skilled workers schools (SWSS), also known as technical schools (under MOHRSS)***, offers 3-year certificate courses to train workers (with some level of skills) with knowledge and training required for working in the manufacturing sector and state occupational license qualification. The graduates from SWSs being capable of practicing and operating machines get directly engaged in production activities. ***Secondary vocational schools (SVS), under MOE*** serves a wide variety of fields in the services sector, such as commerce, information

242 http://skillsforthefuture.ca/Presentations/Toolkit_EN.pdf
243 https://www.canada.ca/en/employment-social-development/programs/essential-skills/definitions.html
244 https://www.skillscompetencescanada.com/wp-content/uploads/2016/07/27891_89606_PAP_EssentialSkil_1-2.pdf
247 https://careertech.org/new-skills-youth
248 https://cte.careertech.org/sites/default/files/files/resources/DC_Phase_One_Snapshot_2017.pdf
249 https://cte.careertech.org/sites/default/files/files/resources/NSFY_Snapshots_Ex_Summary_2018.pdf
251 http://planningcommission.gov.in/reports/genrep/rep_devch1104.pdf

SNo	Parameters	Australia	Canada	USA	China
					technology, legal work, traffic service and management. The graduates from secondary vocational schools either enter the labour market or progress further to polytechnic colleges. ***Adult specialized Schools (AVS),*** provides full/part-time courses for those who want to pursue senior secondary school education. Most short-term courses of occupational and technical training can be grouped into this category. ***Post-secondary level, there are higher vocational/technical colleges (HVC)*** available under the MOE. One of such schools are Senior skilled worker's schools (SSWS).
6	**Training delivery**	Registered Training Organisations (RTOs) delivers trainings through Technical and Further Education (TAFE) institutes, secondary schools, universities, private training providers, enterprises, industry organisations, community-based providers and other government organisations. There are 4,600 RTOs in Australia.	Training delivery through Secondary school, public colleges and institutes, private for-profit colleges, at workplace through apprenticeship programs, technical and vocational institutes, in-class training sites, and online learning classes are also offered.	Trainings are conducted in public education system (limited to high schools), community or technical colleges serving a wide range of public needs, enterprise-based training system.	**12,559** registered training organisations deliver VET through Enterprise-sponsored training centres, secondary vocational schools, higher education vocational colleges, SWSS, employment training centres, Junior Vocational Colleges (JVCs), Advanced Skilled Workers

SNo	Parameters	Australia	Canada	USA	China
					Institutions (ASWIs) etc[252, 253].
7	**Training in mining sector**	***Metalliferous Mining IRC (MM-IRC)*** is responsible for national training package qualifications relevant to metalliferous mining industries (quarrying)[254]. ***Coal Mining IRC (CM-IRC)*** is responsible for national training package qualifications relevant to coal mining operations[255]. Both the MM-IRC and CM-IRC are supported by the SSO and PwC's Skills for Australia. Levels of the certifications in mining are: Certificate level I, II, III, IV Diploma level and Advanced Diploma (AD) are completed by department managers and mine managers. Examples of diploma certification are – • Advance diploma and diploma of underground coal mining management • Advance diploma and diploma of surface coal	***Canadian Mining Certification Program (CMCP) -*** responsible for conducting competency-based assessment of the candidate applying for certification as described in National Occupation Standards (NOS)[256]. ***Canadian Northern Economic Development Agency*** – invest in capacity and skill development through various programs and initiatives. **Centre for Northern Innovation in Mining (CNIM)** at Yukon College has been established in association with territorial government and business leaders. Some of the programs/courses offered are Core Competencies for First Line Supervisors, Driller's Helper, entry-level certification for Environmental Monitoring tasks, Heavy Equipment Technician amongst others[257]. ***Level of certification in mining:***	**Level of certification are** Certificate – after 1 year Associate degree – after 2 year Bachelor's degree – after 4 years for Coal mining, metal ore mining, non-metallic mineral mining and quarrying, support activities for mining[258]. Mine Safety and Health Administration (MSHA) provides training programs aimed at improving safety and health in the mining industry.	

252 https://unevoc.unesco.org/wtdb/worldtvetdatabase_chn_en.pdf
253 http://planningcommission.gov.in/reports/genrep/rep_devch1104.pdf
254 https://www.aisc.net.au/content/metalliferous-mining-industry-reference-committee
255 https://www.aisc.net.au/content/coal-mining-industry-reference-committee
256 https://www.mihr.ca/certification-training-standards/national-occupational-standards
257 http://www.cannor.gc.ca/eng/1370347322954/1370347369442
258 https://collegegrad.com/industries/mining

SNo	Parameters	Australia	Canada	USA	China
		mining management Certificate II, III and IV provides underground coal operations, surface extraction operations, resource processing Advance diploma and diploma can be pursued in metalliferous mining, drilling management, extractive industry management, civil construction	Two levels of certification are: **Level 1** - Affirms fundamental training required and minimum number of hours on the job, indicating the ability to apply skills and knowledge in the workplace. **Level 2:** Other than the level-1 requirements, it affirms additional hours, specialized skills and expertise to perform a specific occupation effectively without supervision. **Level of education required:** High school graduation (for example: diploma or certificate) Skilled trades, vocational or college education (for example, certificates, diplomas) University education (for example, degrees)		
8	**Framework for Assessment**	***VET Quality Framework*** – The learners are being assessed on the competency standards developed by industry for understanding their competency. Competency standard comprises information on individuals units of competency. An individual's foundation skill levels are identified and measured through an interactive tool which is ***The Foundation Skills Assessment Tool (FSAT)***	There is no PAN-Canada framework developed yet.	U.S. doesn't have any proper assessment framework, however, it witnesses number of organisations like National Collaborative on Workforce and Disability, SkillsUSA, My Next Move, Careeronestop, which are usually centrally sponsored help candidates skill assessment.	There is no defined framework for assessment, however the vocational qualification assessment system is the most important part of China's vocational qualification and certification system and refers to the objective, fair, normative evaluation. Assessment for labor's skill level or vocational qualification, based on

SNo	Parameters	Australia	Canada	USA	China
		The Australian Core Skills Framework (ACSF) is used to describe an individual's performance in the five core skills i.e. learning, reading, writing, oral communication and numeracy. ***Core Skills for Work Developmental Framework (CSWDF)*** is used to describe core non-technical skills that have been identified by Australian employers and industry as important for successful participation in the workforce.			occupational classification and standards, is conducted by the assessment institutions designated by the government[259].
9	**Key Parameters for Evaluation of Trainees**[260]	***The VET Quality Framework comprises of:*** • Standards for RTOs, 2015 • The Fit and Proper Person Requirements • The Financial Viability Risk Assessment Requirements • The Data Provision Requirements • The Australian Qualifications Framework.	**For job seekers:** 1) A guide and informal assessment that asks learners to solve questions to get an indication of their essential skills and ability across indicators such as: Numeracy indicator, Reading indicator Document use indicator 2) Self-assessment: These are informal assessments, which guide learners through a series of	***Mostly focusses on Technical and soft skills[261].*** **Examples of Technical skills includes:** Build a cabinet Read an image Operate equipment Paint a portrait Write computer code Teach a lesson Investigate a scientific question Sell products to customers **Examples of soft skills includes:** Communicate well Think critically Participate as a team member Self-motivated Flexible Determined and persistent Quick learner On time	The Vocational Qualification and certification system of China is based on occupational classification and standards system.

259 http://siteresources.worldbank.org/EDUCATION/Resources/278200-1126210664195/1636971-1126210694253/Vocation_Qualification.pdf
260 quality_in_the_vet_system_-_a_shared_responsibility.pdf
261 https://www.careeronestop.org/ExploreCareers/Assessments/skills.aspx

SNo	Parameters	Australia	Canada	USA	China
			statements to help them identify their essential skill strengths and areas for improvement. Self-assessments available for 9 essential skills are: • Oral communication self-assessment • Computer use self-assessment • Writing self-assessment • Reading self-assessment • Document use self-assessment • Numeracy self-assessment • Continuous learning self-assessment • Working with others self-assessment • Thinking self-assessment 3) Online indicators and checklists: These are online assessments and checklist		

SNo	Parameters	Australia	Canada	USA	China
			which contains a series of short quizzes that provides an indication of an individual's skill strengths and areas that may require improvement. **For apprentices and tradespersons:** Parameters for assessment are reading, document use, writing, numeracy, oral communication, working with others, thinking, computer use and continuous learning.		
10	**Agencies Involved in Assessment/Evaluation**	Regulation of training and assessment strategies and practices of RTOs is done jointly by ASQA and state-based VET regulators viz, (Victorian Registration and Qualifications Authority (VRQA) and Western Australian Training Accreditation Council (TAC))	***Alliance of Credential Evaluation Services of Canada*** that produce assessment reports for recognition bodies like postsecondary educational institutes, employers, etc. ***The Canadian Information Centre for International Credentials*** (CICIC)[262]. ***Association of Accrediting Agencies of Canada (AAAC)*** involved in advancement of standards and processes of accreditation, establish benchmark etc[263].	Due to increasing demand for skilled workforce, U.S. witness presence of various countless certifications, credentials offered by industry, educational providers etc. Proper credentials system (especially for post-secondary education and industry-based certification) is necessary. At State level, some states have developed strategy to implement proper CTE structure. ***Florida***: has developed its credentials system and independent local workforce development board CareerSource Florida, which administered the credentials submitted by the eligible candidates[264]. **Kansas** has also developed a three-tier quality credential	***CIVTE*** – Conducts national supervision, assessment and evaluation on TVET quality. Apart from issuing vocational certificates, Ministry of Labor and the Ministry of Personnel also assess the trainings.

262 https://www.cicdi.ca/en/index.aspx?sortcode=2
263 https://aaac.ca/english/index.php
264 https://cte.careertech.org/sites/default/files/files/resources/Credentials_of_Value_2016_0.pdf

SNo	Parameters	Australia	Canada	USA	China
				system involving concerned state agency and regulators, industry mandate, employer[265]. Similarly, **Tennessee, New Jersey and Delaware** have also developed quality credentials at state level[266] ***Certification Data Exchange Project*** - an initiative by Association for CTE and other state and national partners, which supported matching the candidates data with labour market outcome. ***Council for Adult and Experiential Learning - CAEL's*** standards for assessing learning help in creating, implementing and evaluating the assessment strategies	
11	**Assessment Practices Prevalent in Mining Sector**	***Assessment in Australian mining sector:*** Assessment mode for candidate: Observed, documented and/or first-hand testimonial evidence of the candidate's written and/or oral assessment Consistent achievement of required outcomes **Conditions for assessors:** The assessors must have current skills and knowledge relevant to the industry sector for which they are	Assessment and evaluation is conducted by respective territory and province a trainee wish to work in. **Candidate assessment process includes:** • Verification of the documents and certification • Skills checklist • Information by the territory and province apprenticeship, certification authorities and employer **Skill demonstration** Trade credentials like Red Seal (holding red seal	The Directorate of Educational Policy and Development (EPD) helps in planning, monitoring and evaluating, MSHA training program. EPD also assists in the development and improvement of health and safety program for mine operator and contractor in the mining community with the help of staff in 35 states. EPD is also responsible for providing certification and qualification to miners and instructors[270]	NA

265 https://www.ksde.org/Portals/0/CSAS/CSAS%20Home/CTE%20Home/Kansas%20Resource%20List%20of%20Certifications.pdf
266 https://cte.careertech.org/sites/default/files/files/resources/Raising_the_Bar_Pathways_Approval_2017_0.pdf
270 https://www.msha.gov/about/program-areas/educational-policy-and-development

SNo	Parameters	Australia	Canada	USA	China
		conducting assessment; Assessments must be conducted in the context of the relevant industry sector's workplace, unless personal safety or environmental damage are limiting factors, in which case they can be assessed in environments which adequately replicate the workplace; Assessments must include the demonstration of skills and knowledge consistently over a period of time and under a range of conditions/circumstances. ***In western Australia, mining competency is assessed through[267]:*** a structured learning environment on-the-job training and off-the-job training and other relevant workplace experience All verification methods must include a documented assessment Theoretical knowledge is assessed in a training room but may also be conducted on the job Using a practical test or simulation, skill	would help trainee to work in anywhere across Canada) Trainee can also sit for Red Seal examination if all the examination criteria are met[268] **Prior Learning Assessment and Recognition (PLAR)** – applicable in few territories is also applied by candidates lacking formal education or in case if inability to show prior training proof[269].		

267 http://www.dmp.wa.gov.au/Safety/What-is-competency-and-how-is-it-5973.aspx
268 https://www.mihr.ca/careers/information-for-newcomers-to-canada/skills-and-training
269 http://www.ellischart.ca/tradeschart/tid_103_en.html?tid=%2Ftradeschart%2Ftid_103_en.html

SNo	Parameters	Australia	Canada	USA	China
		assessments are generally performed on the job. The Resources and Infrastructure Industry Training Package (RII) was developed by industry in consultation with SkillsDMC, the National Industry Skills Council for Drilling, Mining, Quarrying and Civil Infrastructure. It outlines the units of competency that meet the minimum requirements for training and assessment.			
12	**Best Practices**	Reviewing –Assuring that the assessment tools reflect the current industry practice and the candidate is competent and employable in the industry after the assessment Reviewing the assessment process documentation and tools to match the training package and meet regulatory requirements by trainers/assessors, identifying the opportunities for improvement via external and internal review. Comparing – Comparing the assessment of judgement done by the trainer/assessor for the tools used for the competence of the trainee, understanding the difference in the judgment and		***SkillsUSA*** – develops standards and authentic assessment segmented on the basis of career clusters and CTE instructions. The assessment was created keeping Perkins IV accountability requirement, relevance to entry level skills[271,272]. ***Careeronestop:*** website that provides a range of career-exploration support such as job search, type of training, skills assessments etc. Interest Assessment helps candidates in identifying the most favourable career/occupation/apprentice options. It also helps candidates in the skill assessment. Skill Matcher, mySkill myFuture, O*NET, helps in identifying the right career choice on the basis of previous occupation/skills.	

271 https://www.skillsusa.org/programs/career-clusters/
272 https://www.careeressentials.org/assessments/assessment-areas/

SNo	Parameters	Australia	Canada	USA	China
		reaching to consensus. Evaluating – Identifying the possible improvement by surveying the current learners and employers, surveying also includes the feedback from other stakeholders.		***Mynextmove***[273]: It is an electronic tool which gives individuals three main ways to explore careers, including an online O*NET interest assessment and provides a profile of each occupation highlighting significant knowledge, skills, abilities, technologies being used, basic salary components and outlook information and sources for specific training and employment related opportunities. ***National Collaborative on Workforce and Disability*** - provides training and support to disabled youth, by supporting states and local government policies for complete access to high quality workforce development to them.	
13	**Certification Authority**	RTOs (***ASQA*** is the regulatory body for RTOs in the Australian Capital Territory, New South Wales, the Northern Territory, Queensland, South Australia and Tasmania.) ***Victorian Registration and Qualifications Authority*** in Victoria and **Training Accreditation Council** in Western Australia	***For each province and territory there is agency responsible for the issuing the apprenticeship certificate.*** Some are listed below: Ontario - Ministry of Training, Colleges and Universities which was previously The Ministry of Advanced Education and Skills Development (MAESD)[274]. New Brunswick - Apprenticeship and Occupational	Industry-recognized certifications – e.g. CAPE certification is one (industry or acceleration)	The ***Ministry of Labor and Social Security*** is responsible for the distribution and management of skill vocational qualification assessment and certification, and the ***Ministry of Personnel*** is responsible for the distribution and management of professional technologists' vocational qualification assessment and certifications[276].

273 https://youth.gov/youth-topics/youth-employment/career-exploration-and-skill-development
274 https://www.collegeoftrades.ca/sprinkler-and-fire-protection-installer-classification-change/ministry-of-advanced-education-and-skilled-development-issued-certificate-of-qualification-holders
276 http://siteresources.worldbank.org/EDUCATION/Resources/278200-1126210664195/1636971-1126210694253/Vocation_Qualification.pdf

SNo	Parameters	Australia	Canada	USA	China
			Certification (AOC) Board[275]. Northwest Territory - Apprenticeship, Trade and Occupation Certification Board (ATOCB).		
14	**Value of Certification**	Delivers nationally recognized courses and accredited AQF VET qualifications	Delivers nationally recognised courses and accredited respective territory and province ministry.	Accredited by Department of education or state government	Nationally recognized certificates.
15	**Certification in Mining Sector**	As per the qualifications contained in Training Packages approved by AISC between 1 September 2015 and 31 March 2016, there are 5 diploma programs in mining and 8 certifications[277]. For mining sector there are 4 levels in certification programs, 1 diploma level and 1 advance diploma level as qualification pathway	As per CMCP, there are two levels of certification in mining. The trainee must comply with the NOS standards for respective occupation. ***Level of certification in mining:*** Two levels of certification are: **Level 1** - Affirms fundamental training required and minimum number of hours on the job, indicating the ability to apply skills and knowledge in the workplace. **Level 2:** Other than the level-1 requirements, it affirms additional hours, specialized skills and expertise to perform a specific occupation effectively without supervision.	Level of certification are: Certificate – after 1 year Associate degree – after 2 year Bachelor's degree – after 4 years for Coal mining, metal ore mining, non-metallic mineral mining and quarrying, support activities for mining	5 levels of national occupational qualification certificate system are listed as below: Level 5 (primary) level 4 (middle) level 3 (higher) level 2 (technician) level 1 (higher technician)

275 https://www2.gnb.ca/content/gnb/en/departments/post-secondary_education_training_and_labour/Skills/content/ApprenticeshipAndTrades/GovernanceLegislation/AOC-Board.html
277 https://docs.education.gov.au/system/files/doc/other/list_of_qualifications_subject_to_18_month_transition_mar_2017.pdf

A.10. Mergers and Acquisitions in the Mining Sector 2000- 2012

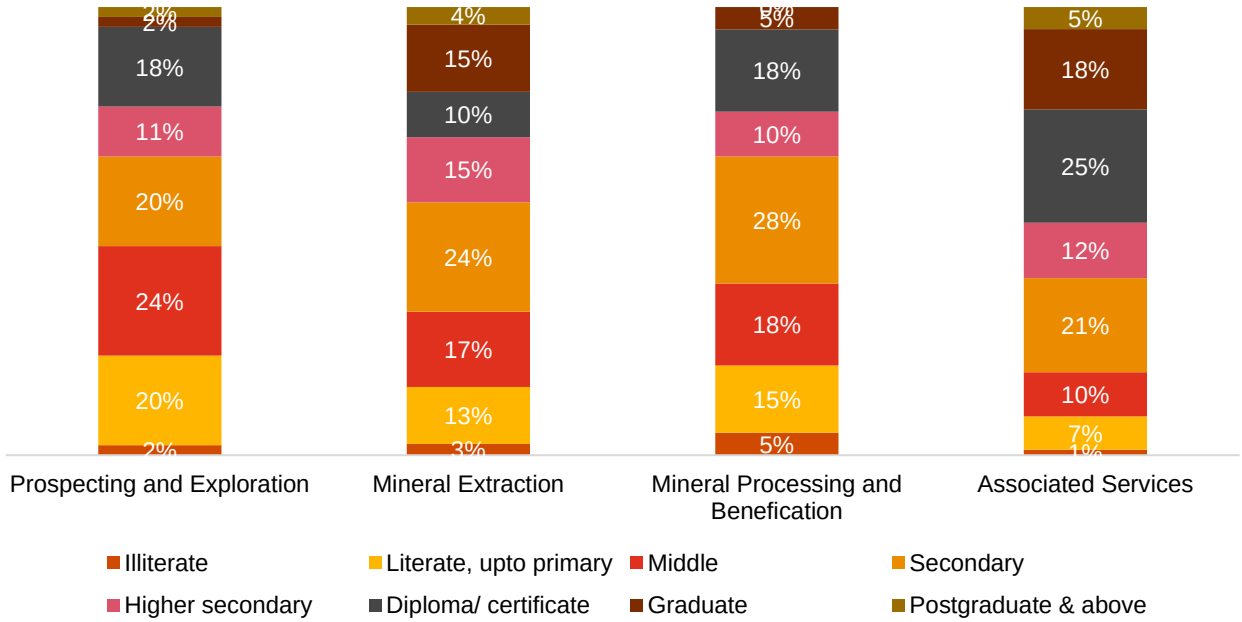
Acquirer	Target	Acquisition price (USD bn)
ArcelorMittal	Essar Steel	7.13
Tata Steel	Bhushan Steel	7.04
Balasore Alloys	Zimbabwe Alloys	0.09
Mr Anil Agarwal	Anglo American (Partial stake purchased)	2
JSW Energy Ltd	Jindal Steel and Power Ltd	0.976
SAIL	Reiterated its interest to acquire majority stake in NINL in Jajpur, Odisha	-
JV: Vedanta Resources & Sesa Goa	Merger of Sterlite Industries and Sesa Goa	3.9
GVK Power and Infrastructure Ltd	Hancock Coal-Queensland Coal	1.26
Sesa Goa Ltd	Cairn India Ltd	1.18
JFE Steel Corp	JSW Steel Ltd	1.03
Lanco Resources Australia	Griffin Coal Mining Co Pty Ltd	0.7227
Vedanta	Cairn India	1.56
ONGC	Gujarat State Petroleum – KG Basin	1.2
Tata Steel	Brahmani River Pellets Ltd	0.13235

A.11. Findings from Worker Survey

1. Educational qualification and skill certifications

Within various sub-sectors, the distribution of educational qualification indicated that more than half the workforce across all sub-sectors (except Associated Services) have educational qualification of secondary education or below as shown in the figure below. With respect to workers having graduate and above degree, it is the Associated Services sub-sector which dominates followed by Mineral Extraction with 23% and 19% share respectively in this category. The below figure presents worker survey findings on educational attainment by mining subsectors.

Figure 51: Educational attainment by mining sub-sectors



Source: PwC Survey Data Analysis[278]

Educational qualification distribution across organized and unorganized sectors shows that on an average, workers in the organized sector are more educated in terms of diploma/ college education and are more likely to have higher secondary qualification. This could be explained by organized units hiring workers who have cleared the minimum education qualification needed to work in statutory job roles, as defined by the Directorate General of Mines Safety. In the case of PSUs, most job roles require minimum education qualification (Class 8th or Class 10th pass) for candidates to be eligible for application**. With respect to skill certifications (some kind of degree given post training), around 7% of the respondents reported to have received short-term or medium-term skill certification**. However, as per SCMS, only 2% of workers have received NSQF-aligned trainings till date.

Training in mines

Field visits to employers in organized and unorganized mines suggest that organized mines have workers who are on average more trained/ formally certified. Large employers like Vedanta, NMDC, GMDC, SAIL and NLC run their own training institutions, or short training programs for their workers. Health and Safety training are provided to most of the workers. In the unorganized units, workers were not trained/ certified.

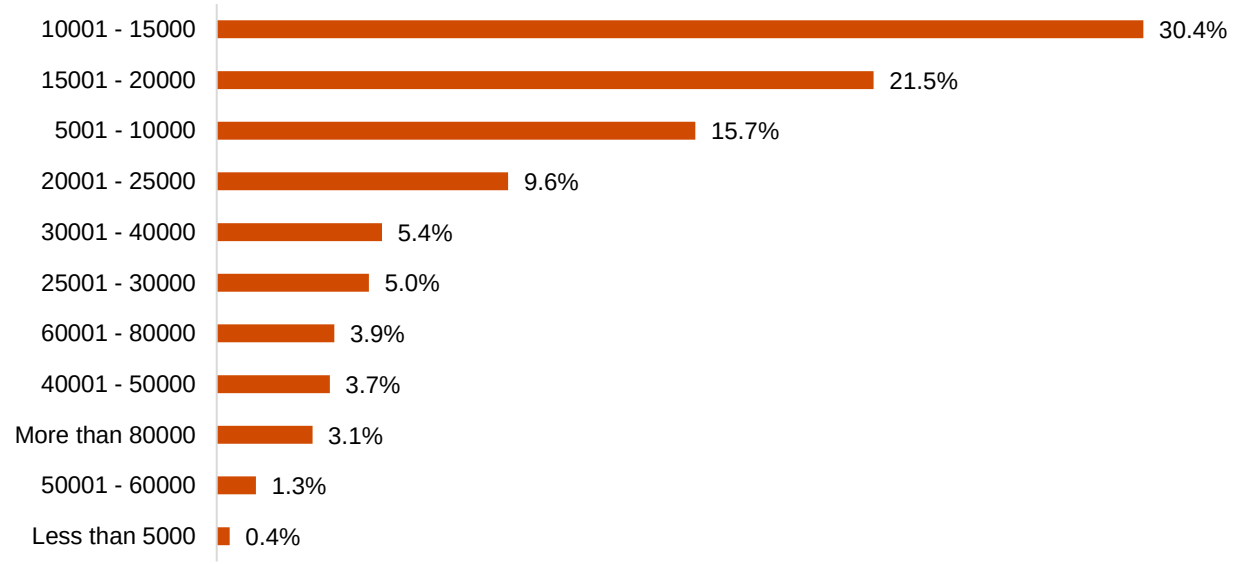
They join as helpers and train on the job to reach supervisory positions. They are unaware of health and safety precautions either. Unorganized employers feel that formally trained workers may not apply to work with them due to low wages and harsh working conditions.

[278] n=701

2. Salary

Around one-third of the respondents reported that they receive monthly salaries of INR 10,001 to 15,000 per month. Lower salaries can be attributed to workers working in semi-skilled and unskilled job roles, contractual work and in unorganized units. Around one-fifth earn salaries of INR 15,001 to 20,000 per month as shown in the figure below.

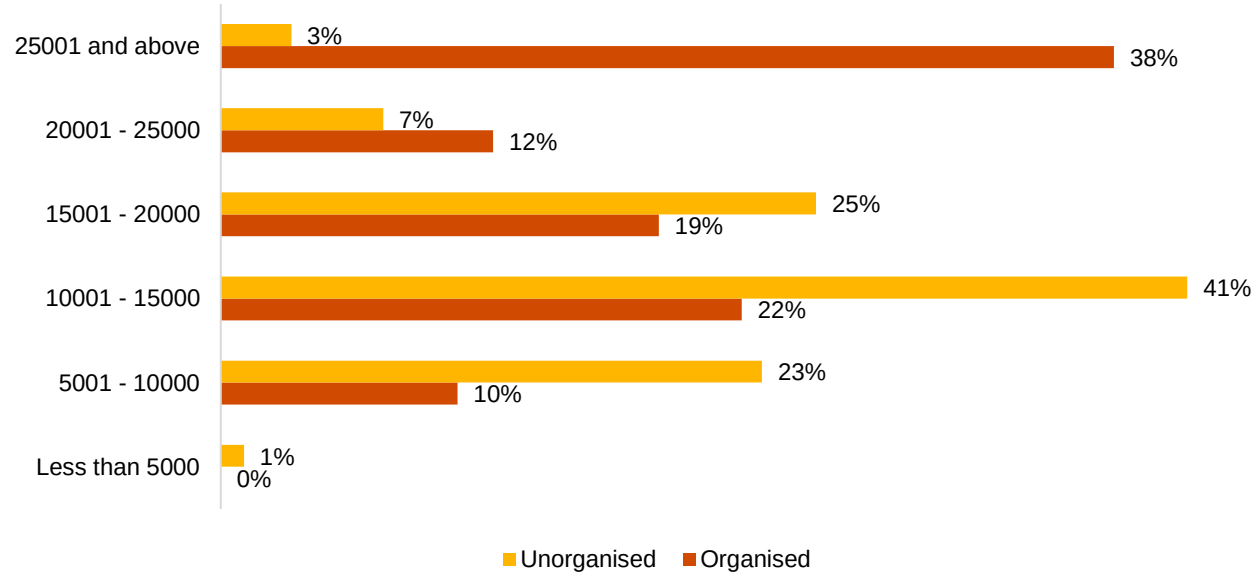
Figure 52: Distribution of workers by salary per month



Source: PwC Survey Data Analysis[279]

Disaggregating salary distribution across organized and unorganized sectors shows that around half of the workers engaged in the organized sector have salaries of INR 20,000 and higher per month, while only 10% of workers in the unorganized sector reported having received salaries in the same range. The figure below presents the salary distribution across organized and unorganized sectors.

Figure 53: Salary distribution: organized vs unorganized

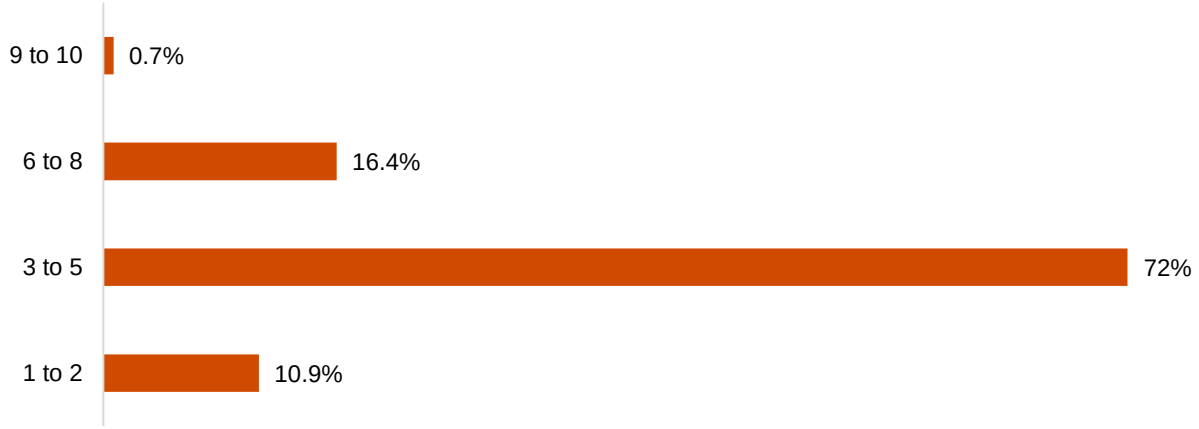


[279] n=701

Source: PwC Survey Data Analysis

The survey data also indicates that around 60.1% of respondents are the only breadwinner in their family with majority of them having 3-5 dependents.

Figure 54: Distribution of workers by number of dependents



Source: PwC Survey Data Analysis[280]

3. Job profile

Of the total workforce surveyed, a large proportion reported to be working as Mazdoor/Helper (29%) followed by Mining Supervisor (9%), Dumper/Tipper Operator (8%) and Excavator Operator (6%) performing entry and supervisory level job roles as shown in the figure below. For all other job roles, the proportion of workers engaged is less than 3%. It can be noted that the remaining mine workers are engaged in the occupations of Loading and Hauling (Opencast) and Drilling and Cutting which falls under Mineral Extraction sub-sector. Other occupations where mine workers are engaged which fall under this sub-sector includes, Blasting and Loading and Hauling (Underground). Under Associated Services, it is Mechanical and Electrical Services and HSE Functions which dominate in terms of workforce engagement.

Though women are underrepresented in the sector, it is noteworthy that the surveyed women are working across occupations such as Mazdoors, Safety Officers, Mine Foreman and Mining Engineers.

Figure 56: Distribution of mining workers by top 5 job roles

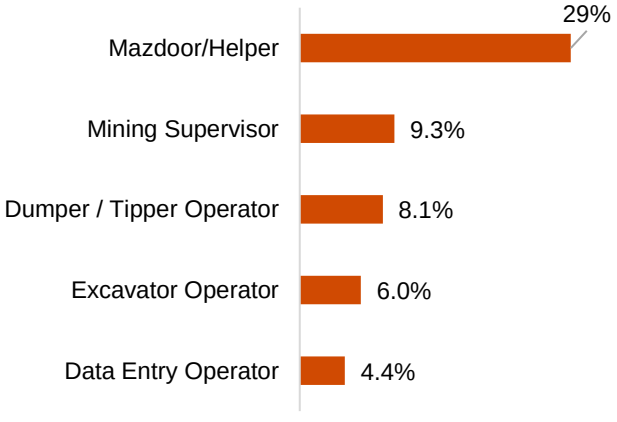
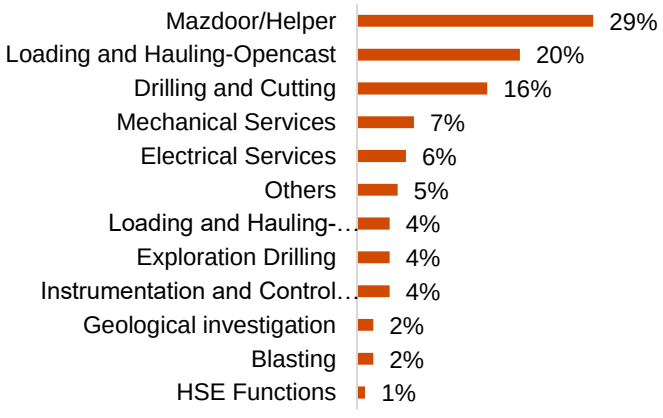


Figure 55: Distribution of mining workers by occupations

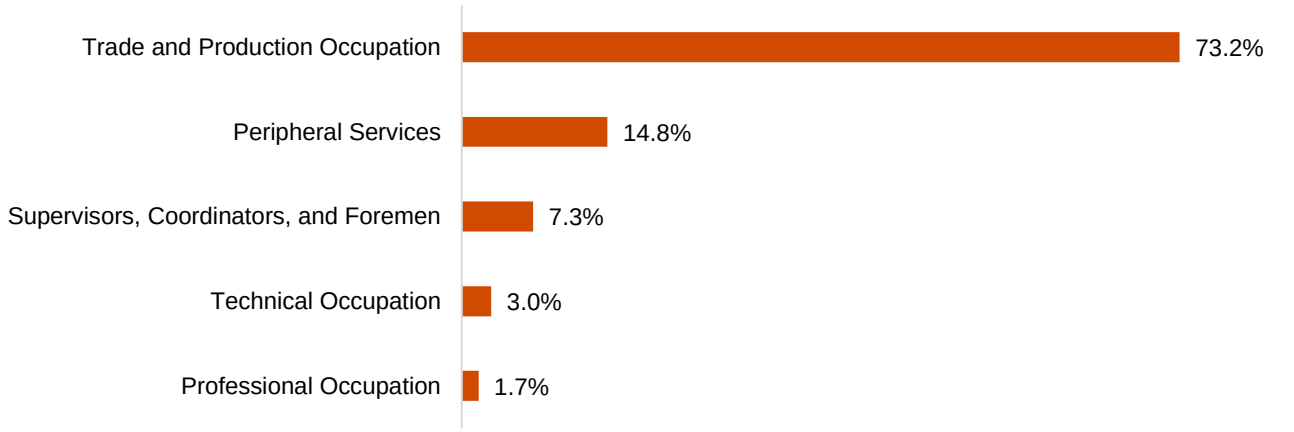


Source: PwC Survey data analysis[281]

[280] n=421
[281] n=639

With respect to functional categorization of the surveyed workforce, a significant percentage (~73%) are employed in the occupations related to trade and production followed by peripheral services (~15%). The figure below summarizes the distribution of workers by functional category defined as per SCMS's occupation map.

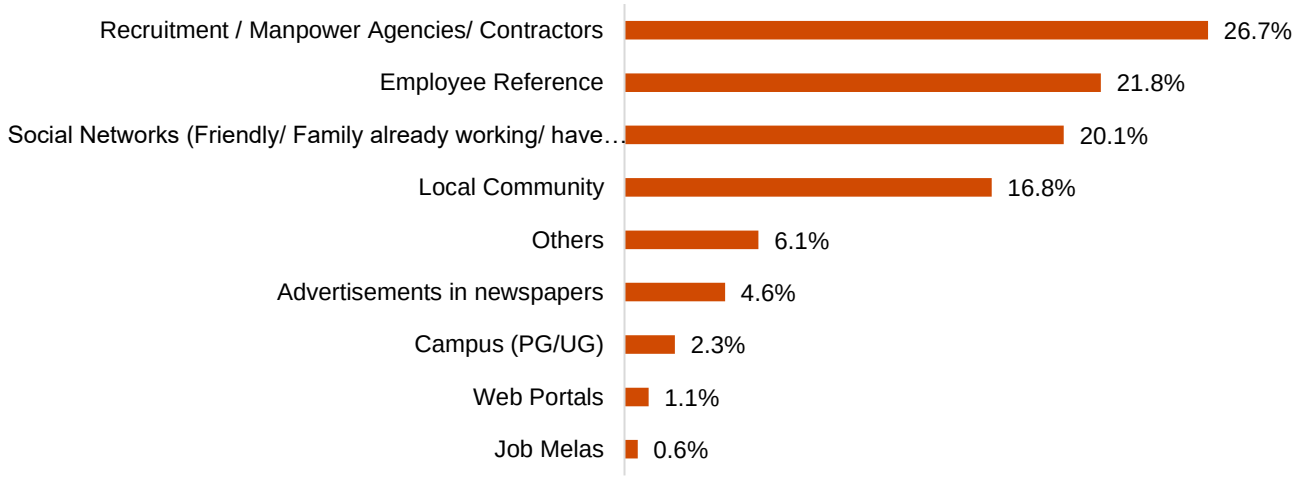
Figure 57: Distribution of workers by functional category



Source: PwC Survey data analysis[282]

The survey data indicates that majority of the workers currently engaged in the sector got their job through recruitment/manpower agencies/contractors followed by employee reference and social networks (friends/family already working/have worked in the sector) as shown in the figure below.

Figure 58: Modes of seeking job



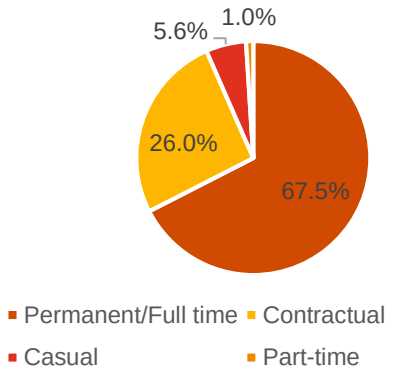
Source: PwC Survey data analysis[283]

[282] n=701
[283] n=701

4. Nature of employment

According to survey findings, the number of contract, casual and part-time workers are less than permanent/full time workers suggesting a buoyant marketplace for permanent work in the sector. Adjacent figure shows that a significantly large proportion of workers (~68%) are employed as permanent workers with only 26% employed on contractual roles, ~6% working as casual workers and 1% engaged in the sector on part-time basis.

Figure 59: Nature of employment



Source: PwC Survey Data Analysis

However, it should be noted that results are based on interactions with workers who may not be fully aware about their nature of engagement in view of their poor educational background thus skewing the analysis towards permanent hiring. The current market trend points toward contract-based work picking pace in the country across almost all sectors with permanent direct employment gradually declining. A significantly large number of contractors have emerged in the mining sector taking care of all mining activities including supply of workforce such as Adani Enterprises, Thriveni Earthmovers, etc.

Contract based hiring scenario in the mining sector is summarized below basis some case studies:

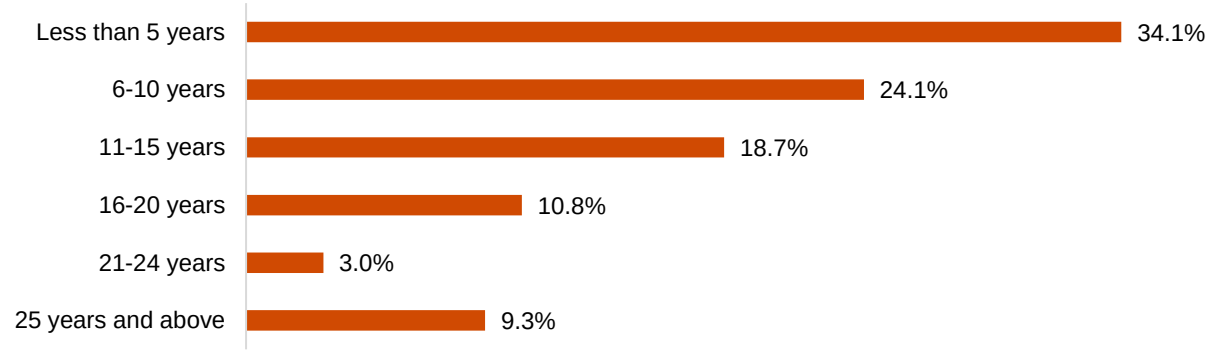
- According to Rashtriya Koyla Khadab Mazdoor Sangh (RKKMAS)-workers union in a Northern Coalfields Limited subsidiary, there has been no hiring of permanent workers since 1980s. Further, Asansole Contract workers union believe that proportion of permanent workers is rapidly declining.
- Hindustan Zinc Ltd. has prioritized contract-based recruitment employing about 4,000 permanent and 8,000 contractual workers in 2012.
- RKKMAS further reported that contract workers are mostly employed in underground and surface mining, safety and civil jobs and transport related operations.
- Indian National Mineworkers Federation (INMF) accounted for 40% of the total contract workers in the sector.

Source: Precarious work in India, Industrial Global Union, 2012

5. Work experience and stability

The survey findings suggest that majority of the workers have less than 10 years of work experience. Amongst these, around 24% fall within the 6 to 10 years of experience category, whereas the rest have less than 5 years of experience. This indicates that there is shortage of workers well-versed with the sector, i.e. limited knowledge and skills relevant for the sector. In view of the limited availability of experienced workforce, upskilling will be instrumental to equip them with industry-relevant skills.

Figure 60: Distribution of workers by years of work experience in mining



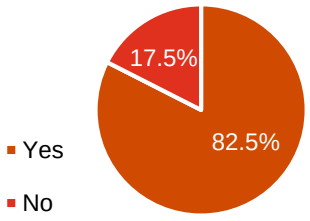
Source: PwC Survey data analysis[284]

Analyzing seasonality of the sector, it was observed that 18% of the workers are not engaged in mining operations throughout the year.

On an average, about 78% of the workers who are not associated with mining for the entire year, work for 9-11 months and the remaining time is spent working as casual workers and in the agricultural fields (either working on their own field or on other's farm) implying that workers look for alternative sources of income.

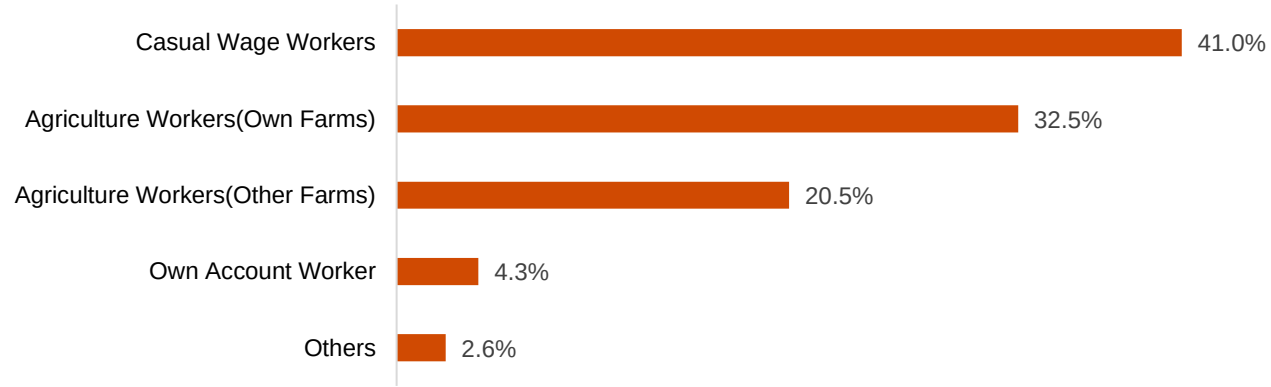
Thus, mining sector in the country is stable in terms of worker's engagement for most part of the year but lacks expertise as smaller proportion of workers have work experience of more than 10 years.

Figure 61: If workers are engaged in mining throughout the year



Source: PwC Survey data analysis[285]

Figure 62: Workers engagement across other activities when not doing mining



Source: PwC Survey data analysis[286]

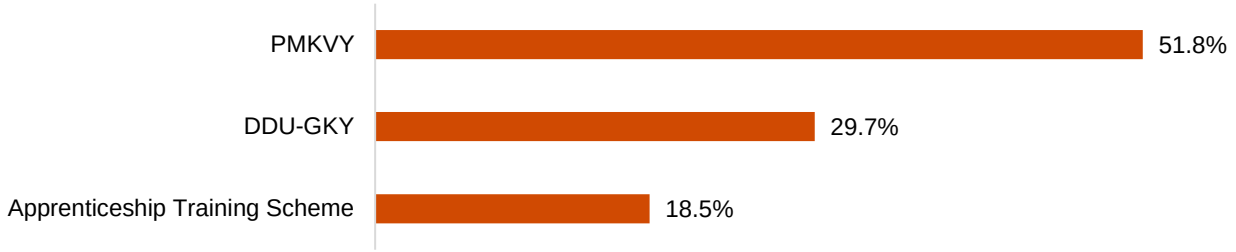
[284] n=697
[285] n=701
[286] n=118

6. Awareness about skilling programmes

The survey data indicates that about 44% of the workers employed in the sector are not aware about various skill development schemes such as PMKVY, DDU-GKY, Apprenticeship Training Scheme (ATS). Of the total workers unaware about skilling programmes, about 45% are from organized sector and 55% from unorganized sector (minor minerals). Thus, workers from unorganized sector are mostly unaware about various skilling schemes as also noted during the study team's pilot study.

Of the 56% that were aware of government skilling interventions, majority knew about the PMKVY scheme. This is primarily due to numerous awareness generation drives conducted by the local State and district governments with a view to ensure greater outreach of MOSDE's flagship scheme. The awareness generation programmes through Kaushal Melas, candidate mobilization drives, advertisement on social media (in newspapers and television), etc. are carried out in hinterlands as well.

Figure 63: Distribution of workers by awareness of skilling schemes



Source: PwC Survey data analysis[287]

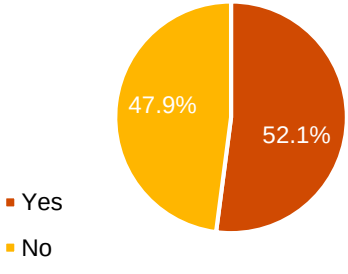
Considering the limited dissemination of schemes amongst the workforce, awareness generation interventions will be crucial for undertaking skill development. Dissemination interventions should highlight benefits of skilling, existing skilling schemes, envisaged benefits, eligibility criteria, etc. with focus on workers employed in the unorganized sector. This will increase the uptake of various short-term courses not just in the mining sector but across other sectors as well. In addition, based on primary interactions with the local industry associations, it has been found that sectoral workforce lacks knowledge about various rules and regulations governing the sector and thus knowledge dissemination about policy and legislative environment of the mining sector should also be stressed upon while conducting training programmes and generating awareness of skilling initiatives for the workers.

7. Current status of training and future skilling aspirations

Mines Vocational Training (MVT) Rules, 2018 drive vocational training in the sector. The rules mandate that all the mines which come under Mines Act 1952 Act have to provide training on Health and Safety to all the workers before they begin mineral extraction process.

About half the surveyed workers reported that they undergo training on health and safety[288], but this training is provided only once a year for a period of 7-8 days. Survey findings indicate that **workers engaged in the unorganized sector (minor minerals) receive informal training and workers already working in the sector are trained only on the first day of joining**. Thus, employers in the unorganized sector are ignorant of worker's health and safety. In addition, given that mining is a risk activity and prone to various accidents, employers have to provide the workers with all types of safety equipment. While all

Figure 64: If the workers undergo health & safety training before beginning mining operations



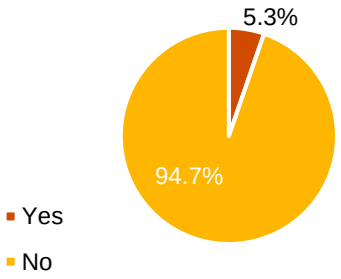
Source: PwC Survey data analysis

[287] n=392
[288] n=701

workers falling in the organized sector informed having access to ear plugs, helmet, breathing masks, gloves, etc., those working in unorganized sector are not equipped with necessary safety equipment.

Currently, majority of the surveyed workforce is engaged in job roles at NSQF levels 4 and below and typically have no formal certifications; it is either hereditary learning or training under the supervision of the seniors. **In light of absence of formal certifications/qualifications, RPL plays a critical role to formally recognize informally learnt skills. However, only around 5% of the workers have received certifications through RPL[289].**

Figure 65: If the workers received RPL Certification



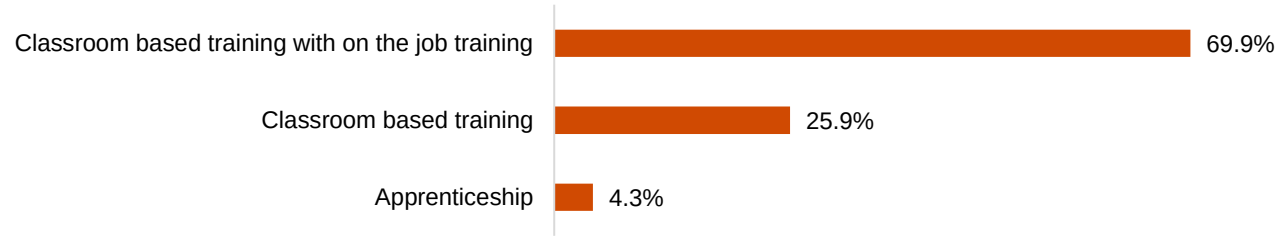
Source: PwC Survey data analysis

Regarding the worker's vocational training status, the survey data indicates **that majority of the workers (60%) employed in the sector have not undergone any form of training with respect to their current job role**. Disaggregating the training status by sectors reveal that of the total workers who did not receive any training with respect to their existing job, about 59% fall in the unorganized sector. In addition, of the total workers who reported to have received training related to their job role, 93% received training having duration of less than 6 months, i.e. short-term trainings.

The field survey findings also indicate that of the total workers who reported having undergone some sort of training, nearly 96% received classroom-based training which also aligns with findings from employers' consultations who cited In-house or Onsite trainings as a preferred mode for upskilling and reskilling their employees. This method of conducting training programmes is most preferred due to the following reasons as cited by employers during primary consultations and field survey:

- **Low training cost**: Training cost per head is low as no additional costs are incurred such as travel, accommodation, food, etc.
- **Scope for customizing training**: Training a group of employees together allows learning to be focused on the company and it facilitates discussions using company examples.
- **Team building**: People of different or same departments get to learn together encouraging greater team work and better understanding of each other's roles.

Figure 66: Nature of training



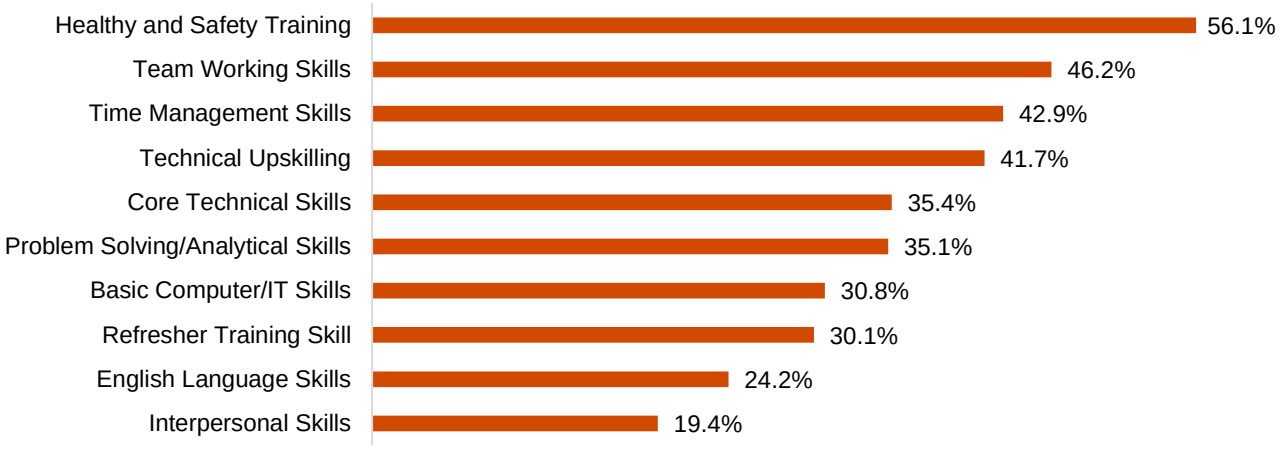
Source: PwC Survey data analysis[290]

Regarding respondent's need for receiving additional training for career growth, it can be observed that more than half the respondents feel that there is a need for undergoing training across specified skills. Of all the respondents who expressed the need for undergoing training in vocational/skills courses, majority reported that they would require training in Health and Safety (56%) aspects such as use of first aid kit, awareness about importance of wearing safety gadgets while on the field, etc.

[289] n=701
[290] n=282

It is certainly true that technical/core skills are indispensable part for most of the jobs and will continue to remain the foundation stone for strong career but to ensure career progression and it's longevity some sort of social/generic skills such as- team-work, time management and problem solving skills will be required to supplement the technical capabilities as cited by majority of workers in the figure below.

Figure 67: Skills in which workers need additional training



Since this is a multiple response question, percentages may add up to more than 100%
Source: PwC Survey data analysis[291]

[291] n=396

A.12. Initiatives undertaken by other countries to aid migration in mining

Country	Initiatives aiding migration in mining
Australia	The new regional visas in Australia: It will be beneficial to those who are planning to engage in basic service sectors such as agriculture, hospitality and tourism, construction, machinery-maintenance, and mining. With this visa the individual will be able to access permanent residence if they live and work in regional Australia for 3 yeaINR In other words permanent residence will be possible post-November 2022[292].
Philippines	Philippines, Mines and Geosciences Bureau (MGB) has selected students to offer full scholarships, considering the nation is at the edge of mining manpower shortage.
Mexico	Mexico had opened mining jobs to women to help with the manpower shortage in the industry. SETA (Sector Education and Training Authority) was advised to redouble efforts to tackle skills shortage in the mining sector.
Canada	Canadian Government is trying to attract and recruit women and men from every national and cultural background in mining industry. There has been number of programmes developed to recruit newcomers to Canada such as: • Initiatives to attract newcomers to remote locations of the province • Corporate efforts to encourage diversity in the workplace • Strategies for streamlining foreign-credential recognition • ITA's Immigrants in Trades Training program Further, the Mining Industry Human Resources Council (MiHR), Canada has created a guide specifically for newcomers to Canada. The guide provides with following advices : • Videos on mining in Canada • Life in mining – what to expect • Skills and training • How to get your international education and experience recognized • Canadian mining jargon • Tips on applying for jobs

[292] 'Indians the largest group to migrate to Australia in 2017-18' article, Times of India, 2019

A.13. Comparative analysis of the features of National Mineral Policies

Table 39: Comparative analysis of the features of National Mineral Policies

National Mineral Policy 2008	National Mineral Policy 2019
Goals: Large scale prospecting and optimal mining (zero waste mining)	**Goals:** Promote domestic industry and Make in India with sustainable mining and regulations for ease of doing business
Regulation of mineral: MMDR act, MCR and MCDR will be amended in line with the policy to make process of grant of concession transparent and seamless	**Regulation of mineral**: Emphasis on strengthening the regulatory mechanism by incorporating E-Governance, end-to-end accounting of mineral using IT system and making process of grant of concession transparent
Role of State in mineral development: Regulate exploration and mining activities, provisions of infrastructure and tax collection with transparency and fair play in the reservation of ore bodies to state agencies.	**Role of State in mineral development**: Promote ease of doing business by streamlining process of grant of statutory clearances, auctioning block with pre-embedded clearances along with annual roadmap for development of mineral sector.
Prospecting and exploration: Encourage private sector investment, introduce large area prospecting license and focus on exploration of strategic minerals, sea bed minerals, low grade iron ore, base metal, Nobel metal, diamond and high-grade ilmenite.	**Prospecting and exploration:** • Encouraging private sector to take up exploration activities, focus on exploration of energy, critical minerals, fertilizer minerals, precious metals and stone, strategic minerals, deep seated minerals and other import dependence minerals. • Right of first refusal at the time of auction or seamless transition between stages.
Mineral development: • Mineral development in terms of import substitution, value addition and export, bring legal framework for zero waste mining and probing unscientific mining, promoting manufacturing, foreign technology induction as well as import of mining machineries which improves efficiency, safety, economics of mine. • Emphasis on mechanization, computerization and automation of mining units and suitable reorientation of HRD program, facilitate financing of exploration activities and promoting infrastructure development • Social impact assessment and resettlement of project affected people.	**Mineral development:** • Upgradation of mining technology, recovery of metals through recycling, foreign technology induction as well as import of mining machineries, economics of mine and bring legal framework for zero waste mining and probing unscientific mining • Efforts to allot merchant mining and captive mining leases expiring in 2020 and 2030, encourage transfer of mining lease • Focus on improving gender balance in mining industry, dedicated mineral corridors for transportation and other innovative modes like slurry pipelines. • To facilitate financing of exploration activities. • Identify ecologically fragile areas and declare them “no-go” for mining. • Ensure welfare of project affected person, emphasis on mine closure, mine safety and mineral security
Foreign trade and investment: • To export minerals in value added form, corporation with countries having complementary resource base • A long term export policy to provide assurance on export of mineral to encourage sustainable investment	**Foreign trade and investment** • To export minerals in value added form, corporation with countries having complementary resource base • A long term export policy to provide assurance on export of mineral to encourage sustainable investment and FDI
Fiscal aspect • Royalty structures will be designed to ensure that the producer earns, and the consumer pays the true value of the minerals produced and consumed	**Fiscal aspect** • To benchmark royalty and other tax with mining jurisdictions across the world to make India an attractive destination for exploration and mining.

Research & Development • To find alternative uses for minerals whose demand is on the wane. • To improve efficiency in process, operations and also the recovery of by-products and reduction in specification and consumption norms. • Efforts will also be directed to evolve low capital and energy saving processing systems. • Focus of R&D in mining methods (mineral processing (to bring lower grade and fines to use), development of robotics and automated equipment, deep sea mining and production of material with high quality	**Research & Development** • To find alternative uses for minerals whose demand is on the wane. • To improve efficiency in process, operations and also the recovery of by-products and reduction in specification and consumption norms. • Efforts will also be directed to evolve low capital and energy saving processing systems. • Focus of R&D in mining methods (including mine design, ground control, safety, environment etc.), mineral processing (to bring lower grade and fines to use), development of robotics and automated equipment, deep sea mining and production of material with high quality • To form an inter-ministerial body under ministry of mines to ensure sustainable mining
Outcome Current state of industry (Refer to report)	**Outcome:** The outcomes expected from these policy proposals are, an increase in the production of MCDR (Mineral Conservation and Development Rules, 2017) minerals (in value terms) by 200 % in 7 years; and on the other hand reduce the trade deficit in minerals sector by 50% in 7 years.

A.14. Overview of sub-sectors in mining

Figure 68: Overview of sub-sectors in mining

Sub Sector wise Categorization		Description	Key Players
A	Prospecting and Exploration	**Prospecting:** This is the act of searching for and identification of a mining prospect. The phase starts with primary reconnaissance and finalizing of target area. The target is then investigated for discovery of prospect followed by preliminary evaluation of the prospect. **Key factors considered are:** geography, land status, mining rights, political and sociological factors, geology, mining condition, ore treatment requirement, environmental requirement and restriction and economic criteria **Various methods of prospecting**: geological method, geophysical method, geo-chemical method **Exploration:** establishing a mineral deposit through geological and geophysical methods. The deposit is then delineated establishing its shape and size, characterized in terms of physico-mechanical and physico-chemical properties and establishing grade tonnage relationship and spatial relationship.	Mineral Exploration Corporation Limited, Geological Survey of India, Central Mine Planning and Design Institute, National Mineral Development Corporation, Hindustan Zinc Limited
B	Mineral Extraction	Identified with activities of extraction of mineral from the earth in quantity. **Key activities performed under sub-sector:** construction and development of sites, mining, drilling, cutting, transportation and blasting **Factors influencing selection of mining method**: characteristics of mineral deposit, safety, environment, technology, economics and some geological conditions such as dip, shape and strength of ore and surrounding rock. • *Surface mining: mechanical excavation methods such as open pit and open cast and aqueous method* • *Underground mining: usually classified in three categories of methods: unsupported, supported and caving*	Adani Group, Coal India Limited and its associated subsidiaries, Essar Group National Mineral Development Corporation, Hindustan Coppers Limited, Manganese Ore India Limited, Rungta Steel, Tata Group, Vedanta Limited
C	Mineral Beneficiation	Process that improve the economic value of ore by removing gauge material and resulting in higher grade product. **Type of beneficiations methods:** Gravity separation, Forth Flotation, Magnetic Separation, Electrostatic separation and Air Tabling **Key areas:** Focused attention of all major players on coal washery in order to reduce the cost associated with transportation of un-washed/processed minerals	MSPL part of Baldota Group of Companies, Tata Group, Jindal Steel and Power Limited, NMDC, Hutti Gold Mines
D	Associated Services	Services primarily engaged in providing support services required for the mining and quarrying of minerals such as health, safety, environment services. These support services are provided mostly within the mining sites.	These are largely undertaken within organisations
E	Ancillary Services	The services provided to support the above sub sector in order to deliver mineral from extraction to end user but this particular study will focus on covering ancillary industry and services associated with equipment, maintenance, logistics and explosives (including blasting) in and around mining areas.	These are activities undertaken in and around the mine area

A.15. Key features of the National Mineral Policy 2019

- An institutional and legal framework will be established to promote zero-waste-mining and a commitment to prevent sub-optimal and unscientific methods of mining. This will lead to increase in mine mechanization and compliance requirement and thus may raise the demand for skilled work force.
- Focus on human resource training and education to keep the pace with the international best practices. The policy also talk about ensuring gender balance in the sector.
- Adoption of cluster approach to tackle the economic unviability for mining of small and isolated deposits. This will include granting a combined single lease, common processing and refining facilities within a geographic boundary. Such business model will attract big mining companies to enter into business.
- Extraction of replenish-able deposits of beach sand minerals will be encouraged to promote economic growth. Such small scale and less mechanized operations can boost the demand for unskilled/ semi-skilled labor.
- Research and Development for the entire value chain in mineral sector with emphasis towards development of new technologies to improve operations, efficiency and recovery, thus equipping the nation with better Human Resources.
- Proper identification of “no-mining areas” and to create Exclusive Mining Zone (EMZ) that will have prior statutory clearances. This will lead to improved production levels can ultimately raise demand for skilled/ semi-skilled workforce.
- A long-term import export policy to ensure stability in the sector, which will in turn attract more private participation and investment (specifically Foreign Direct Investments) into the sector.
- A sustainable development framework shall be devised to serve as basis for project evaluation. An inter-ministerial body under Ministry of Mines along with member ministries will keep a check on total annual excavation, its macro-environmental impact and resource availability in future.
- Focus on inter-generational equity

A.16. Gazette notification defining NSQF

TO BE PUBLISHED IN THE GAZETTE OF INDIA

EXTRAORDINARY, PART 1, SECTION 2

MINISTRY OF FINANCE

(Department of Economic Affairs)

NOTIFICATION

New Delhi, the 27th December, 2013

No. 8/6/2013-Invt.—In pursuance of the decision of the Cabinet Committee on Skill Development in its meeting held on 19th December, 2013, the National Skill Qualification Framework (NSQF) is hereby notified as per the following details:

1. DEFINITIONS APPLICABLE TO NSQF

i. "**Competence**" means the proven ability to use acquired knowledge, skills and personal and social abilities, in discharge of responsibility roles. It is the ability to do a job well.

ii. "**Credit**" is recognition that a learner has successfully completed a prior course of learning, corresponding to a qualification at a given level.

iii. "**Knowledge**" means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. Knowledge is described as theoretical and/or factual.

iv. "**Learner**" refers to an individual undergoing skill development training, whether in a formal or informal setting.

v. "**Learning Outcomes**" represent what a learner knows, understands and is able to do on completion of a learning process, and which would be expressed in terms of knowledge, skills and competence.;

vi. "**National Skills Qualifications Committee**" or "**NSQC**" refers to the Committee set up in accordance para 14. (i).

vii. "**Qualification**" means a formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards.

viii. "**Recognition of Prior Learning**" or "**RPL**" is the process of recognising previous learning, often experiential, towards gaining a qualification

ix. "**Sector**" means a grouping of professional activities on the basis of their main economic function, product, service or technology

x. "**Skills**" means the ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);

xi. "**Trainer**" means someone who trains, instructs, teaches or otherwise enables the learner(s) to acquire the appropriate knowledge and skills.

xii. "**Training Provider**", "**Institute**" and "**Institution**" refer to any organisation providing knowledge and skills to learners.

2. WHAT IS THE NATIONAL SKILLS QUALIFICATION FRAMEWORK?

i. The National Skills Qualification Framework (NSQF) organizes qualifications according to a series of levels of knowledge, skills and aptitude. These levels are defined in terms of learning outcomes which the learner must possess regardless of whether they were acquired through formal, non-formal or informal learning. In that sense, the NSQF is a quality assurance framework. It is, therefore, a nationally integrated education and competency based skill framework that will provide for multiple pathways, horizontal as well as vertical, both within vocational education and vocational training and among vocational education, vocational training, general education and technical education, thus linking one level of learning to another higher level. This will enable a person to acquire desired competency levels, transit to the job market and, at an opportune time, return for acquiring additional skills to further upgrade their competencies.

ii. The key elements of the NSQF provide:

a. national principles for recognising skill proficiency and competencies at different levels leading to international equivalency
b. multiple entry and exit between vocational education, skill training, general education, technical education and job markets
c. progression pathways defined within skill qualification framework
d. opportunities to promote lifelong learning and skill development
e. partnership with industry/employers
f. a transparent, accountable and credible mechanism for skill development across various sectors
g. increased potential for recognition of prior learning

iii. The qualification framework is beneficial to schools, vocational education and training providers, higher education institutes, accrediting authorities as well as industry and its

representative bodies, unions, professional associations and licensing authorities. The biggest beneficiaries of such a framework are the learners who can judge the relative value of a qualification at a particular level on the framework and make informed decisions about their career progression paths.

3. INTERNATIONAL EXPERIENCE WITH QUALIFICATION FRAMEWORKS

i. A paradigm shift from education based on inputs towards education based on learning outcomes is taking place. Outcomes-based learning is a widely used term. The shift to learning outcomes is important for a number of reasons:

a. It shifts focus from providers to users of education and training.
b. By explaining what a learner is expected to know, understand or be able to do at the end of a learning process, individuals are better able to see what is offered in a particular course and how this links with other courses and programs.
c. It increases transparency and strengthens accountability of qualifications – for the benefit of individual learners and employers.

The vast majority of the world's industrialized and transition countries are reforming their qualifications, while at the same time developing frameworks to relate these qualifications to each other and to generally reflect new demands in society and the labour market. The development of these systems is often linked to changes in higher education, technical and vocational education and training (TVET) and lifelong learning.

ii. Many countries worldwide are in the process of introducing qualification frameworks. Though the theoretical principles of all frameworks remain largely similar, the objectives of launching the frameworks vary. Whether the emphasis is on increasing the relevance and flexibility of education and training programs, easing recognition of prior learning, enhancing lifelong learning, improving the transparency of qualification systems, creating possibilities for credit accumulation and transfer, or developing quality assurance systems, Governments are increasingly turning to qualifications frameworks as a policy tool for reform. In some cases national developments are propelled by the emergence of regional frameworks (such as the European Qualification Framework). In many cases the implementation of qualification frameworks has been widely supported by international organizations and is often linked to aid money and even loans. There is increasing activity from international agencies in the area of qualifications frameworks: the Organisation for Economic Cooperation and Development (OECD), the International Labour Office (ILO), the World Bank (WB) and the European Union (EU) have current qualification framework projects.

4. BACKGROUND OF DEVELOPMENT OF QUALIFICATION FRAMEWORK IN INDIA

i. Through the National Policy on Skill Development, 2009, India recognized the need for the development of a national qualification framework that would transcend both general education and vocational education and training. The Policy envisioned that the framework will stimulate and support reforms in skills development and facilitate establishment of nationally standardized and acceptable, and internationally comparable qualifications. In the absence of an organization at the Central level to develop such a framework, individual Ministries started working on development of the framework, which were to subsequently be subsumed in the National framework, when available. The Ministry of Labour and

Employment developed the National Vocational Qualifications Framework (NVQF) and the Ministry of Human Resource Development developed the National Vocational Educational Qualification Framework (NVEQF). The Ministry of Human Resource Development also launched a pilot of the NVEQF in Haryana at the secondary school level.

ii. Realizing the need to have a unified framework, an Inter-Ministerial Committee was formed by the Cabinet Secretariat to use the work already done by the two Ministries as the foundation of the National Skills Qualification Framework. With the formation of the National Skill Development Agency, the mandate to anchor and operationalize the NSQF to ensure that quality and standards meet sector specific requirements was transferred to the Agency.

5. NEED FOR QUALIFICATION FRAMEWORK IN INDIA

i. In India, general education and vocational education & training have been operating as separate verticals, with very little interaction between the two. This has led to hesitation amongst the youth in opting for vocational education and training as it is presumed that this avenue would preclude the concerned individual from being able to acquire higher degrees and qualifications. In order to facilitate mobility from vocational to general education, and vice-versa, a qualification framework for India, i.e. the National Skill Qualification Framework (NSQF) will help make qualifications more understandable and transparent.

ii. The need for the NSQF arises due to the following additional reasons:

a. Till now the focus of education and training has been almost entirely on inputs. The NSQF is based on an **outcomes-based approach**, and each level in the NSQF is defined and described in terms of competency levels that would need to be achieved. Job roles corresponding to each of these competency levels would be ascertained with the involvement of industry, through the respective Sector Skill Councils (SSCs).
b. Pathways of learning and progression, especially on the vocational education and training front, are generally unclear or absent. There is no clear provision for vertical or horizontal mobility. The NSQF will **make the progression pathways transparent** so that institutes, students and employers are clear as to what they can or cannot do after pursuing a particular course and address the issues of inequity and disparity in qualifications
c. There is lack of uniformity in the outcomes associated with different qualifications across institutions, each with its own duration, curriculum, entry requirements as well as title. This often leads to problems in **establishing equivalence of certificates/diplomas/degrees** in different parts of the country, which in turn impacts the employability and mobility of students
d. The negative perception associated with vocational education and training can be significantly removed by the **development of quality qualifications that also permit acquisition of higher qualifications**, including degrees and doctorates
e. There exist a large section of people who have acquired skills in the informal sector but who do not have the necessary formal certifications to attest to their skills. As a competency-based and outcomes based qualification framework, NSQF will facilitate

Recognition of Prior Learning (RPL) that is largely lacking in the present education and training scenario

f. Majority of Indian qualifications are not recognized internationally and vice-versa. This creates a problem for the students and workers as their international mobility is adversely affected and they often have to undergo a course again to get a qualification that is recognized in the host country. The NSQF will also help **alignment of Indian qualifications to international qualifications in accordance with relevant bilateral and multilateral agreements**. Many countries are already in the process of aligning their qualifications to international qualifications through qualification frameworks

g. The **credit accumulation and transfer system** that will be integrated in the NSQF will allow people to move between education, vocational training and work at different stages in their lives according to their needs and convenience. It will be possible for a student to leave education domain, get some practical experience in industry and return to studies to gain qualifications to progress higher in his chosen career

6. OBJECTIVES OF NSQF

i. The objectives of the NSQF are to provide a framework that:

a. Accommodates the diversity of the Indian education and training systems
b. Allows the development of a set of qualifications for each level, based on outcomes which are accepted across the nation
c. Provides structure for development and maintenance of progression pathways which provide access to qualifications and assist people to move easily and readily between different education and training sectors and between those sectors and the labour market
d. Gives individuals an option to progress through education and training and gain recognition for their prior learning and experiences
e. Underpins national regulatory and quality assurance arrangements for education and training
f. Supports and enhances the national and international mobility of persons with NSQF-compliant qualifications through increased recognition of the value and comparability of Indian qualifications

ii. **The NSQF is a quality assurance framework** — it facilitates the awarding of credit and supports credit transfer and progression routes within the Indian education and training system. It seeks to help everyone involved in education and training to make comparisons between qualifications offered in the country, and to understand how these relate to each other.

7. HOW IT WORKS?

i. The National Skill Qualification Framework is composed of **ten levels**, each representing a different level of complexity, knowledge and autonomy required to demonstrate the competence commensurate for that level. Level one of the framework represents the lowest complexity while level ten represents the highest complexity. The levels are defined by criteria expressed as learning outcomes. Volume of learning denoting *notional* time taken to acquire qualification may also be indicated for some levels and some sectors, but **it is important to note that the NSQF Levels are not related directly to years of study.** They are defined by the extent of demands made of the learner in broad categories of competence, i.e. professional knowledge, professional skill, core skill and responsibility. Over a lifetime of learning, individuals will move to higher from lower levels or across levels of qualifications as they take on new learning and acquire new skills.

ii. Each NSQF level is defined by a set of descriptors expressed as learning outcomes. The level descriptors are designed to **allow broad comparisons** to be made between outcomes of learning. **However, it is not the case that every qualification will or should have all of the characteristics set out in the level descriptors**. Each qualification at an NSQF level may be further defined with reference to curriculum, notional contact hours, subjects, duration of studies, workload, trainer quality and type of training institution, to indicate what is expected of the learner in terms of ability to do or apply at the end of the learning process. The positioning of two or more qualifications at the same level only indicates that they are broadly comparable in terms of the general level of outcome. It does not indicate that they necessarily have the same purpose or content.

iii. Some **other issues associated with** the NSQF are given below:

a. **National Occupational Standards (NOS)**: NOS define the measurable performance outcomes required from an individual engaged in a particular task. They list down what an individual performing that task should know and also do. These standards can form the benchmarks for various education and training programs and recruitment range of HRM practices. Just as each job role may require the performance of a number of tasks, the combination of all the NOSs corresponding to these tasks would form the Qualification Pack (QP) for that job role. The NOSs and QP for each job role corresponding to each level of the NSQF are being formulated by the concerned Sector Skill Councils (SSCs). In the event of there being no SSC for a given sector, or inability on the part of the SSC to produce the NOSs/QPs in a timely manner, this responsibility may be assigned by the National Skills Qualifications Committee (NSQC) to a relevant regulatory body or other entity having experience and knowledge of the sector.

b. **Curriculum Packages**: The competency based curriculum packages would consist of syllabus, student manual, trainers guide, training manual, trainer qualifications, assessment and testing guidelines and multimedia packages and e-material. These will be developed for each NSQF level, and where relevant, for specific Qualification Packs (QPs) identified by the SSCs. This may be done by such agencies as the Ministries/ Departments, Sector Skills Councils and Regulatory Bodies may designate, or any other body, in accordance with the NSQF. NSQF curricula should be modular, allowing for skill accumulation and facilitating exit and entry. Curricula

design will also be aligned to a credit framework that reflects credits earned and competencies acquired. Training of trainers would also be aligned to the NSQF.

c. **Industry Engagement**: Since the NSQF is based on an outcomes-based approach, participation of the industry and employers is a critical prerequisite for the success of NSQF. Vocational education, vocational training general education and skill development courses will be designed, developed, delivered, and learners assessed and certified in accordance with the NSQF in consultation with SSCs, industry and employers. In addition to this the industry may also provide support in terms of providing training institutions.

d. **Horizontal and vertical mobility**: For horizontal and vertical mobility to take place, the following are essential:
   - Each level is linked to the ones above and below it by a series of steps. If these steps in any industry sector or academic domain are missing, the NSQF would help identify and map these missing gaps.
   - These gaps would have to be filled, and the key administrative ministry, regulatory bodies already operating in that sector, the SSCs and other stakeholders being part of the NSQC, would need to be consulted in the process
   - The degree of lateral mobility that is considered desirable would have to be identified by the NSQC, and the same would have to be facilitated through on-going credit accumulation and transfer.

   Accordingly, the NSQF would require such regulatory institutions (e.g. UGC, AICTE, NCVT, Technical and School Boards etc.) to define each of their entry and exit parameters in terms of competencies ascribable to that level of the NSQF so that vertical progression in vocational education would be strengthened. If necessary, reservations for individuals progressing though these channels can be considered and provided for. For instance, the system would permit vocational pass outs of Class X – XII, ITIs and polytechnics to gain entry into higher education programs in vocational/technical/general education courses including degree level courses such as the Bachelor of Vocational Studies (B.Voc.), notified by the University Grants Commission. Taking into account the competencies acquired and the credits accumulated, it would also be possible to change courses, if desired. Further, persons with skills shall have the option to move between vocational education, vocational training, general and higher education or vice versa at various stages, using pathways provided by the school boards, universities and colleges. If there are "competency gaps" identified in a candidate, a "bridge course" based on modular curricula to acquire those competencies may be imparted by the receiving Institution.

e. **International comparability**: The NSQF will provide a means of articulation and alignment of the Indian Skill Qualification levels with those of other countries and regions. This will help in the mobility of Indian NSQF-aligned Qualification holders to work in and/or relocate to other parts of the world. The NSQF will also be the means of interface with the various geographical regional frameworks that are developing across the world.

8. LEVEL DESCRIPTORS

i. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

ii. Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

a. Process
b. professional knowledge,
c. professional skill,
d. core skill and
e. Responsibility.

Each of these is briefly described below:

a. Process
Process is a general summary of the other four domains corresponding to the level.

b. Professional knowledge
Professional knowledge is what a learner should know and understand with reference to the subject. It is described in terms of depth, breadth, kinds of knowledge and complexity, as follows:

- Depth of knowledge can be general or specialized
- Breadth of knowledge can range from a single topic to multi-disciplinary area of knowledge
- Kinds of knowledge range from concrete to abstract, from segmented to cumulative
- Complexity of knowledge refers to the combination of kinds, depth and breadth of knowledge

c. Professional skill
Professional skills are what a learner should be able to do. These are described in terms of the kinds and complexity of skills and include:

- Cognitive and creative skills involving the use of intuitive, logical and critical thinking
- Communication skills involving written, oral, literacy and numeracy skills
- Interpersonal skills and generic skills

d. Core skill
Core skills refer to basic skills involving dexterity and the use of methods, materials, tools and instruments used for performing the job, including IT skills needed for that level.

e. Responsibility
Responsibility aspect determines the following:

- Nature of working relationships
- Level of responsibility for self and others
- Managing change
- Accountability for actions

iii. The descriptors give broad, general, but meaningful, indicators of the learning outcomes at each level. The descriptors can be used in a number of ways:

a. To allocate levels to learning programs and qualifications
b. In validation and moderation of various qualifications and programs
c. As a basis for communication with learners and other users of qualifications
d. As a guide for mapping progression routes within and across the education and training sectors
e. By program designers when making entry requirements and recommendations for programs

iv. The NSQF level descriptors are given below:

LEVEL	Process required	Professional knowledge	Professional skill	Core skill	Responsibility
Level 1	prepares person to/carry out process that are repetitive on regular basis require no previous practice	familiar with common trade terminology, instructional words meaning and understanding	routine and repetitive, takes safety and security measures.	Reading and writing, addition subtraction personal financing, familiarity with social and religious diversity, hygiene and environment	No responsibility always works under continuous instruction and close supervision
Level 2	prepares person to/carry out process that are repetitive on regular basis with little application of understanding, more of practice	Material tools and application in a limited context, understands context of work and quality	limited service skill used in limited context, select and apply tools, assist in professional	receive and transmit written and oral messages, basic arithmetic personal financing understanding of social political	No responsibility works under instruction and close supervision

			works with no variables differentiates good and bad quality	and religious diversity, hygiene and environment	
Level 3	person may carry put a job which may require limited range of activities routine and predictable	Basic facts, process and principle applied in trade of employment	recall and demonstrate practical skill, routine and repetitive in narrow range of application	Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment	Under close supervision Some Responsibility for own work within defined limit.
Level 4	work in familiar, predictable, routine, situation of clear choice	factual knowledge of field of knowledge or study	recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	language to communicate written or oral, with required clarity, skill to basic arithmetic and algebraic principles, basic understanding of social political and natural environment	Responsibility for own work and learning
Level 5	job that requires well developed skill, with clear choice of procedures in familiar context	knowledge of facts, principles, processes and general concepts, in a field of work or study.	a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools,	Desired mathematical skill, understanding of social, political and some skill of collecting and organising information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning

			materials and information		
Level 6	demands wide range of specialised technical skill, clarity of knowledge and practice in broad range of activity involving standard non standard practices	factual and theoretical knowledge in broad contexts within a field of work or study	a range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Reasonably good in mathematical calculation, understanding of social, political and, reasonably good in data collecting organising information, and logical communication	Responsibility for own work and learning and full responsibility for other's works and learning
Level 7.	requires a command of wide ranging specialised theoretical and practical skill, involving variable routine and non-routine context.	wide ranging, factual and theoretical knowledge in broad contexts within a field of work or study	wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	good logical and mathematical skill understanding of social political and natural environment good in collecting and organising information, communication and presentation skill	full responsibility for output of group and development
Level 8	Comprehensive, cognitive, theoretical knowledge and practical skills to develop creative solutions, to abstract problem. Undertakes self study, demonstrates intellectual independence, analytical rigour and good communication.			Exercise management and supervision in the context of work/study having unpredictable changes, responsible for development of self and others.	
Level 9.	Advanced Knowledge and skill Critical understanding of the subject, demonstrating mastery and innovation, completion of substantial research and dissertation.			Responsible for decision making in complex technical activities, involving unpredictable study/work situations.	
Level 10.	Highly specialised knowledge and problem solving skill to provide original contribution to knowledge through research and scholarship.			Responsible for strategic decisions in unpredictable complex situations of work/study.	

9. CREDITS

.i. "**Credit**" is recognition that a learner has successfully completed a prior course of learning, corresponding to a qualification at a given level. For each such prior qualification, the student would have put in a volume of institutional or workplace learning, and the more complex a qualification, the greater the volume of learning that would have gone into it. The credit points give learners, employers and institutions a means of describing and comparing the learning outcomes achieved. Based on this, the additional learning outcomes to acquire a qualification at a higher NSQF level can be determined. Credits quantify learning outcomes that are subject to valid, reliable methods of assessment. The number of credits may be worked out on the basis of the number of notional learning hours that an 'average' learner at a specified NSQF level might expect to take to achieve the learning outcomes, including the assessment. **However, this is merely a guide and no credits are added or taken away if more or less time is taken to achieve the outcomes**. No credits are "earned" by a learner if the learning outcomes are not achieved or, in the case of RPL, demonstrated.

ii. Credits can be used to assist learners to transfer between programs. This can happen only when awarding bodies determine how much credit can be transferred into which of their programs. This decision will depend upon the nature/content of the learning for which the credit has been given and the requirements of the program into which transfer is being sought. This will also facilitate multiple entry and exit pathways at each level (or within a level) with the bundle of credits earned clearly certified by assessment and certification bodies which have been authorized to do so.

iii. Wherever notional learning time is used, it should include all learning activities required for the achievement of the learning outcomes for a particular level, including, for example:

a. Formal learning, including classes, training sessions, coaching, seminars and tutorials
b. Practice and learning on the job - gaining, applying and refining skills in the workplace
c. Involvement in informal learning, example: community-based workshops, youth groups, playgroups
d. Doing practical work in laboratories or other locations
e. Expected private study, revision and remedial work
f. Work-based activities which lead to assessment
g. Undertaking all forms of assessment

Notional learning time may also be linked to the International Standard Classification of Occupations (ISCO 08), which includes reference to a nominal duration of learning and workplace training for each occupation.

iv. The need to undertake any or all of these will be considered when credit is being allocated to a qualification or learning program. The mix of learning activities will vary from program to program — in school, the learning might be mostly class-based; in higher education much of the learning time could be spent outside of formal lectures etc. In other situations, much of the learning will be work-based. In determining the notional learning time

involved in achieving outcomes of learning (for eg. in a module/unit, program, or any piece of assessed learning), no rigid allocation of time is implied in this system, particularly as flexible and distance learning develops.

Credit Transfer

i. Credit transfer is the process of recognizing prior learning that has been credit rated by the assessment and certification bodies authorized to do so. The transfer of credit points from one qualification or learning program into another helps to minimize duplication of learning. Learners may have already achieved NSQF credits for learning that they have previously undertaken and it may be possible for all or some of these credits to be transferred to another qualification or learning program. The key focus of credit transfer decisions should be on the benefit to the learner and on support for effective learning pathways. Transparency in decision-making for credit recognition and transfer is a critical factor in supporting and encouraging the on-going involvement of learners in education and training.

ii Credit transfer would facilitate access and promote new learning opportunities without compromising learning outcomes associated with a given NSQF level. Those responsible for designing qualifications and learning programs will be encouraged to identify opportunities for credit transfer wherever they exist.

iii. Credit transfer can be made in various ways such as allowing a learner to drop a subject already studied or take the next level course in that subject, direct admission to higher-level such as direct second-year admission, etc. This could also take the form of reservation of seats for students coming with prior learning background. The credit transfer system in each industry sector or academic domain needs to be detailed out by the NSQC, with the inputs from the respective institutions/universities/Ministries/regulators, etc. at the time of registration of qualification, so that students undertaking the qualification are clear about the possible credit transfer opportunities available to them. These could include issues such as

a. Standardisation of course content, syllabus, notional learning time, credit values etc.
b. Standardisation of credit values for prior/ informal learning.
c. Stipulation of time limit and other conditions beyond which the credit will not survive – as students may forget training inputs unless these are put to use.
d. Stipulation of related subjects for credit transfer. For example, credits in Chemistry would be relevant for polymer technology. Credits in turning / machining may be relevant for mould making, though both mould making and polymer science form part of the same 3 year Diploma currently in force.

10. QUALIFICATIONS REGISTER

i. To ensure that learners have access to all the qualifications registered and currently being provided by various training providers/institutions, a register of qualifications, that are approved and available, shall be maintained and regularly updated. The NSQF Register will be the official national public record of all qualifications aligned to NSQF levels, qualification pathways and accrediting authorities.

ii. The qualifications register will be made available on a web portal and regularly updated. Every institution offering an NSQF-aligned qualification will have to keep details of

its training programs updated on the portal.

11. SHARING OF RESOURCES

Sharing of Resources already created by different organizations would be encouraged for optimum utilization of the funds and expertise available. Industry and employers would be encouraged to partner with skill / vocational training providers/institutes so that the requirements and ethos of the work place are integral to skill training packages/programmes.

12. RECOGNITION OF PRIOR LEARNING

i. Recognition of Prior Learning (RPL) is a very important associated function of the NSQF, especially in the Indian context where majority of the workforce has not received formal training. The NSQF will help individuals who have gained learning informally, such as through life, work and voluntary activities to have this learning recognized. This will include knowledge and skills gained:

a. Outside of formal learning situations
b. Through informal learning and training in the workplace, the community and/or the voluntary sector
c. From continuing professional development activities
d. From independent learning

ii. RPL will give an option for personal or career development or to gain credit towards other qualifications or learning programs to learners who have the skills but no certificate to prove it. It will help learners make clearer connections between the learning they have already achieved and future learning and/or career opportunities. Benchmarking an individual's learning against the NSQF Level Descriptors will help them to identify the appropriate level of options for progression. This will improve career progression and skill upgradation of learners as well as facilitate the engagement of the experienced practitioners as resource persons.

iii. At present, the Modular Employable Skills (MES) scheme under the Ministry of Labour and Employment has a component of RPL, wherein direct testing and assessment of skills may be done. Ministry of Tourism also runs the Skill Testing and Certification Programme, wherein candidates can get their skills assessed and get certificate for the same. However, efforts for recognition of prior skills are limited. By introducing RPL through the NSQF, such efforts will gain momentum and allow learners to benefit on a larger scale. The NSQC will develop process for Recognition of Prior Learning/traditional learning for any given job role against the relevant level descriptors and notify the same for Skill Training Providers/Vocational Training Providers/Certificate awarding bodies for use in assessment and certification.

13. FUNCTIONS/RESPONSIBILITIES OF STAKEHOLDERS

The NSQF is the joint responsibility of many stakeholders and each has its own role to play in its development, implementation and maintenance. The roles/responsibilities of the main stakeholders are listed below:

a. National Skill Development Agency (NSDA)
The NSDA has been mandated to anchor and operationalize the NSQF to ensure that quality and standards meet sector specific requirements. The NSDA will also facilitate the setting up of professional certifying bodies in addition to the existing ones. In performing the above functions, the NSDA will be ensuring that the NSQF acts as a quality assurance framework and facilitates capacity building.

b. Sector Skills Councils (SSCs)
Sector Skill Councils are industry-led national partnership organizations that will bring together all the stakeholders from their respective sectors. Based on the needs of the industries in concerned sector, the SSCs are developing the NOSs and QPs for the various job roles in their sectors, and they will align the same to appropriate levels of the NSQF. They will work to supplement the existing vocational training and education system for the Industry Sector in meeting the entire value chain's requirements of appropriately trained manpower in quantity and quality across all levels on a sustained and evolving basis

The SSCs shall also provide inputs to the Central and State level implementing agencies in developing the curriculum packages, capacity building of institutions and training providers, and assessment and certification of the skills imparted. The Sector Skill Councils shall be licensed and regulated by the National Skills Qualification Committee.

c. Central Ministries
The Central Ministries, being at the apex of the issues in their administrative control, will have to provide the leadership to ensure that all stakeholders align the programs being offered by institutions/bodies under their aegis to the NSQF in accordance with the Implementation Schedule in para 14.iv.

d. State Governments
The institutions/bodies under the control of the respective State Governments will be encouraged to align their learning programmes to the NSQF, as this would facilitate greater mobility for individuals holding such qualifications. The State Governments will also help determine the modalities for ensuring that while regional variations are provided for, the same do not undermine the quality assurance associated with the NSQF.

e. Regulatory Institutions.
All the existing regulatory institutions (e.g. UGC, AICTE, NCVT, Technical and School Boards etc.) would define their entry and exit competencies and qualifications in terms of NSQF levels so that provision of vertical progression in both general and vocational education would be strengthened and vocational pass outs are able to gain entry into the respective portals of higher education in the vocational/technical/ general education courses including degree level courses.

Thus, Regulatory/Awarding bodies while continuing to regulate their courses, programmes, affiliation, and accreditation system shall ensure their alignment and conformity with the NSQF.

f. Training Providers/Institutes/Institutions
All training providers would have to organise their courses/programmes to ensure alignment with NSQF levels in accordance with the implementation schedule in para 14.iv.

14. IMPLEMENTATION

The NSQF would be anchored in the National Skill Development Agency (NSDA), and will be implemented through the National Skills Qualification Committee (NSQC). A permanent secretariat for the NSQC would be set up under the NSDA for this purpose.

i. National Skills Qualification Committee

Composition: The NSQC shall have a composition as under:

i.	Chairman NSDA	Chairman
ii.	Secretary, Dept of School Education & Literacy, Ministry of HRD	Member
iii.	Secretary, Dept of Higher Education, Ministry of HRD	Member
iv.	Secretary, Ministry of Labour & Employment	Member
v.	Member Secretary, Planning Commission	Member
vi.	Mission Directors, from three State Skill Development Missions (in rotation)	Members
vii.	Sectoral Representatives as below	Members
viii.	Director General NSDA	Member-Secretary

For each sector that is being discussed, the Sectoral Representatives would comprise:

ix.	Secretary, Administrative Ministry	Member
x.	Chairman/CEO of the concerned Sector Skill Council(s)	Member
xi.	Heads of all Regulatory Bodies, including where relevant, UGC, AICTE, CBSE, NCVT, State Boards etc in the Sector	Members
xii.	Heads of two training institutions (one Govt and one private)	Members
xiii.	Any other person/agency relevant for the sector*	Member

**Note: Where more than one Ministry / Department is related to a particular sector, a representative from each of these Ministries/Departments would be invited under this provision so that all concerned are represented. The representative could be a technical person from an expert agency or body under the Ministry dealing with the issue of training and skills in that particular sector. In sectors that focus on skilling for overseas job markets, representatives of the Ministry of Overseas Indian Affairs would be included.*

The NSQC would be at liberty to set up specific sub-committees for addressing sectoral issues. However, all Members of the NSQC representing specific sectors, and listed under the group of "sectoral representatives" would necessarily have to be part of the sub-committee(s) on the sector".

Functions:. Functions of the NSQC would be as under:
a. approve and notify the NOSs and the QPs prepared by the Sector Skills Councils, including job roles that exist across various sectors;
b. approve the accreditation norms developed by the concerned Sector Skills Councils for training providers in the sector;
c. develop/approve the accreditation norms for non-statutory certification agencies;
d. based on the National Standards for Occupation/National Industrial Classification or any other nationally accepted classification system, to determine the definitions of

sectors, and approve the creation of additional Sector Skills Councils including on the recommendation of the NSDC;

e. prescribe guidelines for ensuring that implementing agencies, including training providers, address the special needs of disadvantaged sections of the population, including persons with disabilities, members of Scheduled Castes and Tribes, OBCs, minorities, women etc.;
f. review and resolve any issues/disputes among Ministries/ Departments/ Regulatory Bodies regarding alignment of courses to NSQF, credit transfer, etc.;
g. all matters requiring cross-sectoral approach, such as credit accumulation and transfer, recognition of non-formal learning, apprenticeship, online and distance learning, lateral mobility and bridge courses;
h. coordinate and align Indian qualifications to international qualifications frameworks to allow international mobility;
i. addressing all transition issues, including developing suitable mechanism for recognizing and aligning to the NSQF all qualifications pre-dating the implementation of the NSQF;
j. Any other activity as may be entrusted by the Government;
k. map all existing certificate, diploma, degree and other courses available in the sector, and identify gaps if any;
l. determine whether progression from one level to another should be allowed for a specific course/discipline (eg, should a progression link be established between a nursing qualification and a medical one?);
m. map all the progression pathways so determined and agreed, and decide how the progression will take place – how much credit would be allowed for movement from one level to the next, and how such progression can be facilitated;
n. determine progression links between courses and certifications that are granted by regulatory and/or professional bodies, and those that are currently unregulated;
o. identify and specify bridge courses and processes if any, that would be needed to permit progression from one level to another;
p. establishing and maintaining high standards for skill training in each sector.

Provided that functions (a) to (j) above would have to be discharged by the NSQC itself, and would not be delegated to any sub-committee.

At the State level the State Skill Development Mission shall perform the coordination function in the realm of skill development along with local SSCs/industry/ trade association and all other stakeholders for the implementation of NSQF.

ii. Accreditation

While national accreditation norms would be approved by the NSQC, actual accreditation of training providers will be done by relevant regulators. The identification, registration and accreditation of the institutes/training providers would be done through a mechanism determined by the concerned Ministries and regulators in consultation with SSCs/industry as the case may be.

iii. Assessment and Certification

Assessment and certification will be done by the respective agencies of the Government/private sector as is done now. However, assessment and certification norms developed by the concerned regulatory bodies, SSC/industry would be approved by the NSQC to ensure that outcomes conform to the appropriate NSQF level. Certificates issued

post assessment will mention that the level of the NSQF at which it lies.

iv. Implementation Schedule

In order to ensure a smooth transition, the implementation timetable for rolling out the NSQF would be as under:

(i) Immediately upon the Notification of the NSQF,
   a. All other frameworks, including the NVEQF (National Vocational Educational Qualification Framework) released by the Ministry of HRD, would cease to exist, and would be superceded by the NSQF.
   b. NSQF compliant training/ educational programmes/courses would be entitled to receive government funding on a preferential basis.

(ii) After the third anniversary date of the notification of the NSQF,
   a. Government funding would not be available for any training/ educational programme/ course which is not NSQF-compliant.
   b. All government-funded training and educational institutions shall define eligibility criteria for admission to various courses in terms of NSQF levels.
   c. The recruitment rules of the Government of India and the public sector enterprises of the central government shall be amended to define eligibility criteria for all positions in terms of NSQF levels.
   d. State Governments shall be encouraged to amend their recruitment rules as well as those of their public sector enterprises to define eligibility criteria for all positions in terms of NSQF levels.

(iii) After the fifth anniversary date of the notification of the NSQF,

   a. It shall be mandatory for all training/educational programmes/courses to be NSQF-compliant.
   b. All training and educational institutions shall define eligibility criteria for admission to various courses in terms of NSQF levels.

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Joint Secretary to Government of India

A.17. State-wise employment by mineral type (2018-19)

Table 40: State Wise Employment (Core Mining (in '000)

State/UT	Fuel Minerals	Metallic Minerals	Non-Metal and Minor Minerals	Incremental Demand (Total)
Rajasthan	-	5.1	263.9	26.0
West Bengal	60.8	-	130.8	17.4
Bihar	-	-	110.6	10.2
Maharashtra	48.9	-	104.4	13.9
Uttar Pradesh	10.2	1.5	94.0	10.0
Karnataka	-	59.3	93.0	29.5
Andhra Pradesh	2.5	-	89.2	8.4
Odisha	63.1	43.7	83.3	28.6
Gujarat	-	55.8	76.8	26.8
Tamil Nadu	3.1	7.5	64.0	8.8
Madhya Pradesh	80.8	-	58.6	12.5
Kerala	-	5.3	49.1	6.4
Assam	13.2	-	48.7	5.6
Uttarakhand	-	-	39.9	3.7
Telangana	59.5	3.6	39.5	10.1
Jharkhand	162.2	50.9	38.5	35.8
Meghalaya	-	-	26.8	2.5
Chhattisgarh	79.8	-	12.9	8.2
Manipur	-	-	11.0	1.0
Punjab	-	-	8.8	0.8
Haryana	-	-	7.7	0.7
Mizoram	-	-	3.7	0.3
Jammu & Kashmir	-	-	3.7	0.3
Tripura	-	-	1.1	0.1
Arunachal Pradesh	-	-	0.9	0.1
Sikkim	-	-	0.0	0.0
Goa	-	7.6	-	2.7
Chandigarh	-	0.6	-	0.2
Total	**584.2**	**240.9**	**1,461.1**	**270.8**

Note: For cells left blank, a particular mineral isn't available in that State
Source: PwC Analysis

A.18. State-wise employment by ancillary activities (2018-19)

Table 41: State-wise employment in ancillary activities (in '000)

State/UT	Employment 2018-19	Incremental Demand
Uttar Pradesh	626.5	72.3
Rajasthan	540.6	62.4
West Bengal	442.6	51.1
Madhya Pradesh	373.8	43.2
Gujarat	362.3	41.8
Tamil Nadu	349.9	40.4
Maharashtra	316.3	36.5
Jharkhand	286.7	33.1
Karnataka	279.1	32.2
Andhra Pradesh	269.7	31.1
Odisha	249.8	28.8
Chhattisgarh	203.3	23.5
Telangana	170.8	19.7
Haryana	120.7	13.9
Kerala	85.2	9.8
Assam	79.2	9.1
Bihar	73.4	8.5
Punjab	65.4	7.6
Uttarakhand	46.7	5.4
Goa	17.2	2.0
Manipur	13.5	1.6
Meghalaya	12.9	1.5
Jammu & Kashmir	9.9	1.1
Delhi	8.8	1.0
Himachal Pradesh	6.2	0.7
Tripura	3.7	0.4
D & N Haveli	3.4	0.4
Mizoram	1.9	0.2
Puducherry	1.5	0.2
Chandigarh	1.2	0.1
Arunachal Pradesh	0.7	0.1
A & N Island	0.7	0.1
Lakshadweep	0.1	0.0
Sikkim	0.0	0.0
Total	**5023.7**	**580.1**

Source: PwC Analysis

A.19. Incremental human resource demand by job roles 2019-25

Job Role	Employment 2018-19	Incremental Demand 2019-25	%Share
Prospecting, Exploration & Mine Planning			
Mine Driller (Exploration)	11,371	1300-1320	19.4%
Sampler	13,305	1530-1550	22.7%
GIS Expert	872	100-120	1.5%
Geologist	3,139	360-380	5.4%
Geophysics Survey operator	349	40-60	0.6%
Drilling Engineer	1,221	140-160	2.1%
Geophysicist	349	40-60	0.6%
Drilling Assistant	10,202	1170-1190	17.4%
Mazdoor/ Helper - Prospecting & Exploration	17,812	2060-2080	30.4%
Mining Operations			
Mining Supervisor	227,950	26,330-26,350	11.2%
Mining Mate	74,530	8,600-8,620	3.7%
Mine Foreman	62,312	7,200-7,220	3.1%
Dumper / Tipper Operator	217,004	25,060-25,080	10.6%
Explosives Handler	50,230	5,800-5,820	2.5%
Mining Engineer	51,472	5,950-5,970	2.5%
SDL & LHD Operator	57,084	6,600-6,620	2.8%
Shot Firer/ Blaster	56,743	6,550-6,570	2.8%
Excavator Operator	141,154	16,300-16,320	6.9%
Loader	61,769	7,130-7,150	3.0%
Haulage operator	27,971	3,230-3,250	1.4%
Sprinkler & vehicles driver	22,035	2,550-2,570	1.1%
Mine Ventilation Supervisor	31,342	3,620-3,640	1.5%
Track Layer operator	21,403	2,470-2,490	1.1%
Timberman	32,270	3,730-3,750	1.6%
Mobile Conveyor belt operator	20,196	2,330-2,350	1.0%
Roof/ Cable bolters	16,702	1,930-1,950	0.8%
Bulldozer Operator	32,936	3,800-3,820	1.6%
Jack Hammer Operator	47,057	5,440-5,460	2.3%
Haul Truck operator	13,382	1,540-1,560	0.7%
Rig Mounted Drill Operator	15,668	1,800-1,820	0.8%
Explosive Van operator	14,109	1,630-1,650	0.7%
Jumbo Drill Operator	11,219	1,300-1,320	0.6%
Scaler Operator	13,505	1,560-1,580	0.7%
Grader	20,113	2,320-2,340	1.0%
Banksman	8,552	990-1,010	0.4%
Mine Surveyor	13,578	1,570-1,590	0.7%
Wire Saw Operator	8,150	940-960	0.4%
Surface Miner	7,395	860-880	0.4%
Strata Monitoring Operator	6,741	780-800	0.3%
Road Header Operator	6,238	720-740	0.3%

Job Role	Employment 2018-19	Incremental Demand 2019-25	%Share
Material Engineer	3,018	350-370	0.1%
Reclamation Supervisor	5,031	580-600	0.2%
Land Survey Technologist	4,930	570-590	0.2%
Gas Detector	4,628	530-550	0.2%
Winding Engine Operator	2,968	340-360	0.1%
Ventilation Adequacy Checker	2,666	310-330	0.1%
Geotechnical Engineer	2,012	230-250	0.1%
Stacker & Reclamation Operator	1,258	150-170	0.1%
Long Wall operator	855	100-120	0.0%
Bucket Wheel Excavator	704	80-100	0.0%
Mazdoor/ Helper - Mineral Extraction	619,306	71,520-71,540	30.4%
Engineering and Associated Services			
Data Entry Operator	17,206	1,990-2,010	7.4%
Dewatering pump Operators	9,435	1,090-1,110	4.1%
Mechanical Engineer	13,216	1,530-1,550	5.7%
Mine Electrician	18,198	2,100-2,120	7.9%
Mechanic/ Fitter	18,713	2,160-2,180	8.1%
Electrical Engineer	9,719	1,120-1,140	4.2%
HEMM Maintenance Operator	6,423	740-760	2.8%
Firemen	1,932	220-240	0.8%
Mine Machinist	4,179	480-500	1.8%
Safety Operator	2,728	320-340	1.2%
Mine Welder	14,594	1,680-1,700	6.3%
Compressor Operator	5,119	590-610	2.2%
Emergency Response & Rescue Specialist	2,317	270-290	1.0%
Safety Specialist	2,317	270-290	1.0%
Occupation Health Specialist	1,250	150-170	0.5%
Environmental Engineer	1,976	230-250	0.9%
Auto Electrician	1,110	130-150	0.5%
Electrical Supervisor	5,550	640-660	2.4%
Foreman (Electrical/Mechanical)	1,110	130-150	0.5%
Jr. Electrical Engineer	1,110	130-150	0.5%
Jr. Mechanical Engineer	2,775	320-340	1.2%
Mechanical Supervisor - Field Services	4,440	520-540	1.9%
Mechanical Supervisor - Workshop	2,220	260-280	1.0%
Technical Helper - Mechanical	7,215	830-850	3.1%
Technical Helper - Electrical	4,995	580-600	2.2%
Safety Officer	1,110	130-150	0.5%
Mazdoor/ Helper - Associated Services	70,255	8,110-8,130	30.4%
Mineral Processing and Beneficiation			
Ore Processing Operator	2,546	300-320	15.2%
Assistant Operator (Ore Processing)	1,608	190-210	9.6%
Instrumentation Technician	2,580	300-320	15.4%
Mineral Processing Engineer	897	100-120	5.4%

Job Role	Employment 2018-19	Incremental Demand 2019-25	%Share
Supervisor Plant Operations	2,683	310-330	16.0%
Operator Instrumentation/ Mechatronics In-charge	598	70-90	3.6%
Inspector/ Tester – Mineral Processing	523	60-80	3.1%
Electronics & Instrumentation Engineer	224	30-50	1.3%
Mazdoor/Helper - Mineral Processing & Beneficiation	5,089	590-610	30.4%
Source: PwC Analysis			

A.20. Draft template for conducting tracking survey

1. Profile of the respondent and organization

SN	Description	Option	Code	Skip
1.1	Name of Respondent			
1.2	Designation of Respondent			
1.3	Contact details of the respondent	A. Phone no: _____		
		B. Email: _____		
1.4	Name of Organization			
1.5	Type of mine	Captive	1	
		Non-Captive	2	
1.6	How many mining leases do you have?			
1.7	Please mention the average size and production capacity of each lease?			
1.7	Please specify the minor minerals you are engaged in (Multiple response possible)			

2. Job role wise details

S.No	A1 Name of job role	A2 Key tasks that the person is required to perform	A2 Current staff strength			A3 Minimum qualification/s required (See Code below)	A4 Nature of Employment (See Code below)	A5 Current shortage of manpower (See Code below)	A6 Skills/ vocational training received (See Code below)	A7 When was the latest training provided (See Code below)
			A2.1 M	A2.2 F	A2.3 All					
1	A1.1……	A2.1….								
2	A1.2…….	A2.2….								

CODE FOR THE ROASTER			
Codes for Question Q A3			
Illiterate	1	Short Term Skill Development	7
Literate <operational literacy>	2	ITI/ Vocational Training	8
Primary Education (up to Class V)	3	Diplomas (Polytechnic)	9
Upper Primary (Upto Class VIII)	4	Graduation	10
Secondary Education (up to Class X)	5	Post-Graduation / Highly Specialized Training	11
Higher Secondary Education (up to Class XII)	6	Statutory certification	12
Codes for Q A4		**Codes for Q A5**	
Permanent/Full time	1	No shortage	1

CODE FOR THE ROASTER			
Contractual (on monthly contracts)	2	Less than 10%	2
Casual (daily wage workers)	3	10%- 25%	3
Part-time	4	26%- 50%	4
Outsourced manpower	5	51%- 75%	5
Through MDO	6	More than 75%	6
Code for Q A6		**Code for Q A7**	
None	1	Never	1
Induction	2	1- 6 months ago	2
Domain Skills on recruitment	3	6- 12 months ago	3
Career Advancement	4	12-24 months ago	4
Up-Skilling to meet technical needs	5	24 to 36 months ago	5
Refresher training (VTC)	6	More than 36 months ago	6
VTC initial training	7		
First Aid training	8		
Fire Safety training	9		
Rescue training	10		
Specialised training (if any) <needs to be specified>	11		

3. What are your recruitment plans for the next 1 year?

Building Relationships, Creating Value

Full legal name	*:*	*PricewaterhouseCoopers Private Limited*
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