



CENTRE OF
TRAINING
EXCELLENCE
IN MINING

SKILLS ROADMAP PROJECT

A Sector Labour Market Partnership

SKILLS ROADMAP REPORT





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A Sector Labour Market Partnerships (LMP) Skills Roadmap Project.
Provided by B.C. Centre of Training Excellence in Mining (CTEM).

The views and opinions expressed in this report are those of its author(s) and not
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The artwork on the front cover – The Frog – was gifted to CTEM by Dean Heron.
Dean is a member of the Wolf clan of the Kaska/Tlingit Nation and is a member of
the Skill Roadmap Project Team.

“The frog represents transformation and being the voice and the messenger to carry the work we are doing
forward. The frog depicted here is poised to leap into the future.” ~Dean Heron

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Introduction

BC's mining sector directly employs over 30,000 workers¹ and thousands more through indirect employment and contributes to the economy of local communities throughout BC due to the expenditures of mine suppliers and mine employees living there.

With one of the largest clusters of exploration and mining companies in Canada, BC is recognized as a centre of excellence in exploration and mining related fields. The Ministry of Energy, Mines and Low Carbon Innovation estimates the total value of mine production in 2020 was \$9.28 billion including coal, copper, gold, industrial minerals, aggregate, molybdenum, and silver². Currently, there are 18 active metal and coal mines in BC³, 30 industrial mineral mines⁴, 326 active exploration projects (providing an additional \$330 million of expenditure)⁵, and over 1,000 aggregate operations near every community in the province⁶.

The sector is dynamic – it is sensitive to global market conditions and technology and automation are changing the nature of the work – leading to new and evolving careers and the skills needed in these careers. Societal expectations and markets are driving the increase of key environmental, social and governance activities, in addition to the changes in the workforce that most industries in the province are experiencing; more workers leaving the workforce than there are new workers entering it.

2020 was a challenging year – as the COVID-19 pandemic created economic downturns and social uncertainty, impacting both the supply and demand side. But as the global economy begins to recover from the pandemic, changes in technology and increased automation continue to provide pressures for the mining sector workforce to evolve its skills to stay current with new technology and innovation that is driving changes in both corporate environments and mining operations. *“Rapid advances in technology innovation, including automation, digitization and electrification, are fundamentally changing how the mining sector operates”*⁷. Automation and robotics are identified as having the most impact in BC, followed by data analytics and the incorporation of electrical and battery-operated vehicles; however, new computer software, artificial intelligence, and the use of

1 Ministry of Energy, Mines and Low Carbon Innovation. 2022. *Ministry of Energy, Mines and Low Carbon Innovation: Featured Topics*. <https://www2.gov.bc.ca/gov/content/governments/organizational-structure/ministries-organizations/ministries/energy-mines-and-petroleum-resources>

2 Ministry of Energy, Mines and Petroleum Resources. (2021). British Columbia Geological Survey, Information Circular 2021-01. Retrieved from

http://cmscontent.nrs.gov.bc.ca/geoscience/PublicationCatalogue/InformationCircular/BCGS_IC2021-01.pdf

3 Ministry of Energy, Mines and Petroleum Resources. (2020). BC Geological Survey, Map of Regional Geologist Areas and Boundaries. Retrieved from (<https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/british-columbia-geological-survey/mineral-development-office/regional-geologists>)

4 Ministry of Energy, Mines and Petroleum Resources. (2020). British Columbia Geological Survey Information Circular 2020-01, revised February 2020, p.7. Retrieved from

(http://cmscontent.nrs.gov.bc.ca/geoscience/PublicationCatalogue/InformationCircular/BCGS_IC2020-01.pdf)

5 Ministry of Energy, Mines and Petroleum Resources, Association for Mineral Exploration, EY, The British Columbia Mineral and Coal Exploration Survey, 2019, p.4. Retrieved from

<http://cmscontent.nrs.gov.bc.ca/geoscience/PublicationCatalogue/EYSurvey/EYSurvey2019.pdf>

6 Ministry of Energy, Mines and Petroleum Resources. (2020). British Columbia Geological Survey Information Circular 2020-01, revised February 2020, p.1. Retrieved from

http://cmscontent.nrs.gov.bc.ca/geoscience/PublicationCatalogue/InformationCircular/BCGS_IC2020-01.pdf

7 Corneau, S., (2019). How Can Technology in Mining Protect the Environment? Retrieved from <https://www.iisd.org/articles/how-can-technology-mining-protect-environment>

drones, virtual and augmented reality, and sensors are all impacting the required skills of workers⁸.

Policy developments are also impacting the sector, further evolving the skillsets required by the workforce. Revisions to the *BC Environmental Assessment Act* and the implementation of the *BC Declaration on the Rights of Indigenous Peoples Act (DRIPA)* in 2019, changes to the *Professional Governance Act* in 2021, and the implementation of *BC Mining Tax Incentives 2019* are all changing the skillsets required by the workforce in the mining sector as the sector evolves to take on these key activities and requirements.

Consistent with this, mining is at the forefront of advancing reconciliation with Indigenous peoples and implementation of the *United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)*. The sector is a key employer of Indigenous people in rural and remote communities, and partner in benefit agreements and revenue sharing that provide revenue streams to advance community priorities. The mining sector has been and continues to be a leader in developing and implementing collaborative decision-making and including Indigenous communities in compliance monitoring and verification⁹.

These factors are all driving the demand for new and existing workers to increase their skills relating to technology and automation, as well as skills associated with increased environmental, social and governance (ESG) priorities.

This Skills Roadmap Report provides an overview of key skills identified through research and engagement with a wide range of subject matter expertise in the mining industry, including industry partners, mining workers, Indigenous communities, Indigenous and non-Indigenous workforce development and service providing agencies, training and education providers, and government agencies.

Opportunities for Use of the Skills Roadmap Report

The Skills Roadmap Report utilizes information gathered earlier in the project through primary and secondary research gathering tools. Specifically, a literature review and environmental scan, along with three focus groups, 21 key informant interviews and a survey with nearly 200 responses, were conducted to deepen the understanding of the mining sector workforce. It identified gaps in the research and literature, and the economic, social, labour, technological and policy factors that are shaping and impacting the BC mining sector's skilled workforce and helps to inform this report.

The Skills Roadmap Report is inclusive and representative of diverse perspectives and reflects advancements in technology, innovation, and environmental, social and governance (ESG) responsibilities. The report elaborates on key themes and findings to date in the overall scope of the Project.

The intended audiences of this report include current and future mining sector workers; communities; training providers; employers; local, regional, and Indigenous governments; and partnering organizations who support the mining sector.

The Skills Roadmap Report can be used for:

- Charting skills pathways for students and workers interested in the sector;
- Highlighting skills gaps that may exist for current workers;
- Providing guidance to training providers looking to ensure programming aligns with the evolving needs of the sector;

8 Centre for Training Excellence in Mining. June 2021. Skills Roadmap Project Key Findings Report. P.43.

9 British Columbia Mining Jobs Task Force. (2018). Mining Jobs Task Force Final Report. Victoria: BC Government. Retrieved from https://www2.gov.bc.ca/assets/gov/business/natural-resource-industries/mineral-exploration-and-mining/memp_10535_task_force_report_final-rev.pdf

- Sharing key factors for training providers and employers in order to understand, recognize and remove barriers to a diverse and inclusive workforce;
- Providing information that supports employers in filling their hiring requirements and meeting immediate operational needs;
- Informing ongoing technology requirements for training providers to meet their programming needs; and
- Clarifying and informing the discourse on environmental, social and governance requirements for industry (and individual workers) and how this evolving area of work impacts workforce development.

Current Skills Required

Technology and innovation in the mining sector is impacting the skills required for current and emerging workers. Ensuring skills training for current workers and new entrants to the workforce will be critical to their success.

That said, the mining sector workforce is a vast and varied one, including more than 120 differing jobs across the full mining life cycle; from exploration, extraction, processing, closure, and restoration. Understandably, skills vary greatly across these activities. In reviewing both international and national sector labour market information, we can begin to see how the evolving nature of the sector is shaping the skills required by current and future workers.

Skills Needed for BC Mining Careers

A mix of skillsets is needed for jobs now and in the future

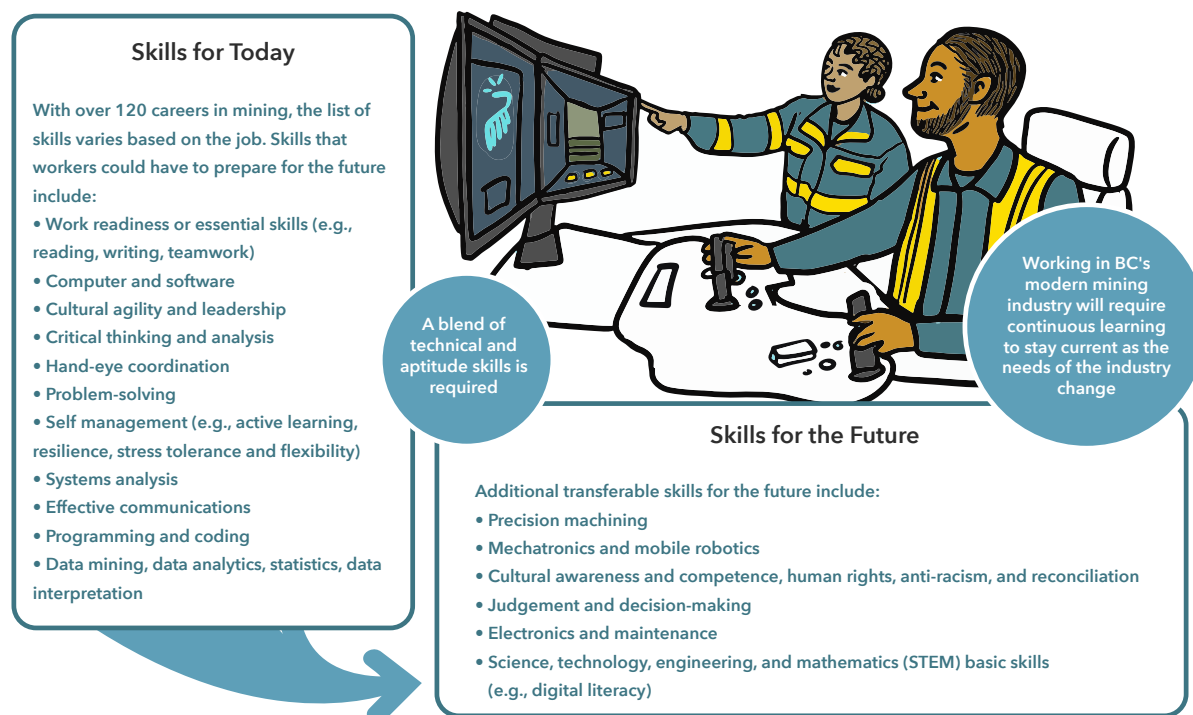


Figure 1 – Skills Needed for BC Mining Careers

Overall Skills in Demand

The World Economic Forum released *The Future of Jobs Report 2020* outlining key findings and predictions on the changing nature of work. This report estimated that by 2025, 85 million jobs globally will be displaced by a shift in the division of labour between human and machines, while 97 million new roles may also emerge¹⁰. Skills highest in demand across sectors include critical thinking and analysis, problem-solving, and skills in self-management such as active learning, resilience, stress tolerance and flexibility¹¹.

Within mining specifically, global mining organizations reported the following skills to be in high demand¹²:

- Technology use, monitoring and control
- Analytical thinking and innovation
- Complex problem-solving
- Systems analysis and evaluation
- Reasoning, problem-solving and ideation
- Troubleshooting and user experience
- Creativity, originality, and initiative
- Active learning and learning strategies
- Emotional intelligence
- Quality control and safety awareness
- Instruction, mentoring and teaching
- Technology, design, and programming

Australia, another recognized hub for mining, has identified a growing demand for the following skills¹³:

- Systems evaluation
- Systems analysis
- Mathematics
- Instructing
- Data analysis
- Data and digital literacy
- Writing
- Judgement and decision making
- Active listening and learning

Closer to home, the Mining Industry Human Resources Council (MiHR) in 2019 looked at the top technical skills required in the mining sector¹⁴. The word “technical” is defined as the way something works or describes something in specific words related to a field of work or study. Technical skills are sets of abilities or knowledge used to perform practical tasks.

The following technical skills are in demand in BC mining:

- Ability to learn, adapt to new knowledge
- Hand eye coordination, quick reaction time
- Computer and software skills
- Data-based decision making
- Communication skills
- Ability to “think outside the box”
- Programming and coding
- Mine modelling, interpretation
- Systems development
- Electronics and maintenance
- Mechanics and advanced engineering
- IT operations
- Systems integration
- Virtual reality, artificial reality
- Data mining, data analytics, statistics, data interpretation
- Problem solving/troubleshooting skills
- Ability to work in diverse groups
- Lifelong learning

10 World Economic Forum. (2020). *The Future of Jobs Report*. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf

11 Ibid.

12 Ibid.

13 EY. (2019). *The Future of Work: The Changing Skills Landscape for Miners - A Report for the Minerals Council of Australia*. Retrieved from <https://minerals.org.au/sites/default/files/190214%20The%20Future%20of%20Work%20the%20Changing%20Skills%20Landscape%20for%20Miners.pdf>

14 MiHR. (2019). *Canadian Mining Labour Market Outlook 2020*. Retrieved from https://mihr.ca/wp-content/uploads/2020/03/MIHR_National_Report_web2.pdf

- Teamwork/collaboration
- Mathematics and statistical analysis skills
- Leadership skills
- STEM basic skills
- Research and product development
- Reading, writing and creative skills

What is clear is that innovation and technology are requiring workers to be flexible, creative, collaborative, and problem-solving. The abilities to think critically, adapt and communicate effectively will be key factors in an evolving work environment; and lifelong learning to keep skills current will be essential to the successful mining sector worker, regardless of their particular technical skills.

To better understand some of the other technical skills, sub-categories have been created to help explain their significance to the sector more clearly. They include technology-related skills; trades-related; ESG skills; and additional skills. Some skills may apply in more than one category, such as electronics and maintenance which is increasingly becoming an important skillset in the trades, while also relying more and more on emerging technological innovations.

a. Technology-Related Skills

Technology is shaping the way the mining industry is working. Skills involving advanced technological development are in increasing demand due to the movement towards increasing digitization and automation within the mining sector. It is reported that 84 per cent of employers are set to rapidly digitalize working processes, including a significant expansion of remote work¹⁵.

Several key technologies are reshaping the sector, including the use of autonomous vehicles, remote operating centres, automated drilling, and tunnel boring systems¹⁶. In addition, autonomous vehicles and battery powered electric vehicles are now considered proven technology and are being adopted into the mining landscape, expanding the skillsets required by workers.

Technology-related skills in high-demand include:

- Computer and software skills; digital literacy
- Programming and coding
- Technology use, monitoring and control
- Systems development
- IT operations
- Systems integration
- Systems analysis and evaluation
- Virtual reality, artificial reality
- Mine modelling, interpretation
- Data mining, data analytics, statistics, data interpretation
- Research and product development
- Technology, design, and programming
- Instruction, mentoring and teaching (of technology-related skills)

Additional comments provided by the focus group sessions on technical skills and aptitudes included the following feedback:

- Communication of Technology – writing technical procedures, process, and implementation of innovation in the workplace
- Leadership in diverse workgroups, integration, and project management
- Ability to integrate and frame points of view for shared decisions
- Ability to communicate traditional mining knowledge to the next generation - equipment behaviour, rock behaviour and responses used to validate data

15 World Economic Forum. (2020). The Future of Jobs Report. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf

16 Corneau, S. (2019, May 23). How Can Technology in Mining Protect the Environment? Retrieved from International Institute for Sustainable Development: <https://www.iisd.org/articles/how-can-technology-mining-protect-environment>

b. Trade-Related Skills

Skilled trades are occupations that require a particular applied skill, knowledge, or ability. Most often, this is obtained at a college, technical school or through specialized training. The Industry Training Authority (ITA) manages more than 100 trades in British Columbia, including many that are in demand in the mining sector (during all phases of the mine life cycle – from exploration, extraction, processing, closure, and restoration).

Trades-related jobs found in the mining sector include¹⁷ (but are not limited to):

- Carpenter
- Construction Craft Worker
- Construction Millwright
- Electrician
- Industrial Mechanic (Millwright)
- Instrumentation and control Technician
- Heavy-Duty Equipment Technician
- Heavy Equipment Operator
- Machinist
- Steamfitter/Pipefitter
- Truck and Transport Mechanic
- Welder

According to the Canadian Apprenticeship Forum, *“Increasingly, the traditional trades are evolving into technologically advanced jobs and careers. There is a requirement in these fields to combine mental ability such as advanced math and computer programming with manual skills. CNC Machining, Mechatronics, Mobile Robotics and Precision Machining are among some [potential workers] may want to explore.”*¹⁸

MiHR reinforces this as it highlights the following trades-related skills to be in high demand in the mining sector¹⁹:

- Electronics and maintenance
- Mechanics and advanced engineering
- Mathematics and statistical analysis skills
- STEM basic skills

In addition, the Project surveys and key informant interviews revealed the specific need for Red Seal Trades, and the technical and operational skills required for equipment operation and underground mining and exploration.

From the key informant interviews, it was articulated that the adoption of electric battery vehicles (EBVs) within operating mines has shifted the skills set requirements for the tradespeople who maintain and service vehicles and machinery, noting the example of enhancing current skills to include working within high voltage environments. Additionally, the importance of individuals with dual-trades tickets was highlighted as a result of the adoption of EBV, for example, needing individuals who have both Heavy Duty Mechanics and Electrical tickets.

c. Environmental, Social and Governance Skills

Environmental, social, and governance are the three central factors in measuring the sustainability and societal impact of an organization. Environmental, social and governance (ESG) priorities and guidelines can help a mining company navigate and balance the benefits to the planet, people, and profit successfully. Criteria are a set of standards for a company’s operations that socially conscious investors use to screen potential investments and evaluate a firm’s collective conscientiousness for social and environmental factors:

- Environmental factors look at energy use, mine waste, pollution, natural resource conservation, carbon footprint, hazardous substances, and mine closure.

17 [BCJobs.ca](https://www.BCJobs.ca), (2013). Careers in the Mining Industry. Retrieved from <https://www.BCJobs.ca>

18 Canadian Apprenticeship Forum. (2022). Careers in Trades. Retrieved from <https://www.careersintrades.ca>

19 MiHR. (2019). *Canadian Mining Labour Market Outlook 2020*. Retrieved from https://mihr.ca/wp-content/uploads/2020/03/MIHR_National_Report_web2.pdf

- Social criteria examine how a company manages relationships with employees, communities, suppliers, customers, and upholds human rights; uses land, deals with resettlement, and addresses the needs of vulnerable people.
- Governance relates to a company's leadership, executive pay, audits, legal compliance, internal controls, and shareholder rights²⁰.

The landscape around ESG values and requirements is evolving. Integrating ESG within the workforce and training landscape is still within the formative stage; the absence of literature on the subject, combined with the infancy of the discussion on ESG's impact on workforce demands was demonstrated by participants in this project (through surveys, key informant interviews and committee discussions) placing emphasis on the need to develop a coordinated approach to environmental stewardship, community outreach, diversity initiatives, and reclamation; and linking these to strategies and outcomes.

Within that context, key environmental, social, governance skills are:

- Effective communications
- Community collaboration skills
- Ability to work with diverse perspectives and peoples
- Understanding and adhering to government regulations
- Sound environmental stewardship to eliminate negative impacts on other land users
- Environmental understanding, policy development, technical skills (science and computer)

Emerging Skills

When looking towards the future of mining, it is perhaps most important to recognize that the skills required currently will continue to play a role in the future of the sector. Digitization, automation and evolving ESG requirements will continue to unfold and evolve, requiring continuous refinement of associated skills to carry out these important tasks across the workforce.

Existing workers will need to learn these skills (either through formal and/or on-the-job training) to keep up with evolving technology and legislative requirements, while students and new workers will need to access training that is aligned with the pace of change in these occupational demands. Specifically, nearly 200 survey respondents (on this Project) were asked to rank skills in order of priority. Their responses indicate these skills to be critical into the future (in order of ranking):

- | | |
|---|---|
| 1. Cultural awareness, human rights and anti-racism, reconciliation | 5. Resilience, stress tolerance and flexibility |
| 2. Judgement and decision making | 6. Digital literacy |
| 3. Critical thinking | 7. Active listening and conflict resolution |
| 4. Complex problem solving | 8. Data analysis |
| | 9. Leadership and social influence |

Technology

On a global scale, technology will continue to drive the demand for skills. According to the World Economic Forum, the skills highest in demand are those that align with the following emerging global mining job roles²¹:

²⁰ Investopedia. (March 2021). Environmental, Social and Governance (ESG) Criteria. Retrieved from <https://www.investopedia.com/terms/e/environmental-social-and-governance-esg-criteria.asp>

²¹ World Economic Forum. (2020). The Future of Jobs Report. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf. P.142.

- AI and Machine Learning Specialists
- Data Analysts and Scientists
- Process Automation Specialists
- Robotics Engineers
- Software and Applications Developers
- Digital Transformation Specialists
- Remote Sensing Scientists and Technologists
- Management Analysts
- Internet of Things Specialists
- Big Data Specialists



Consistent with the World Economic Forum research, surveys and key informant interviews and technical focus group sessions for this Project indicated the following aspects of technology and innovation will have the most impact on the future of mining (ranked in order of importance)²²:

1. Automation and Robotics
2. Data and Analytics
3. Electric and Battery Operated Vehicles
4. Social Innovation
5. Computer and Software
6. Artificial Intelligence
7. Drones
8. Virtual and Augmented Reality
9. Use of Sensors
10. Internet/Wi-Fi

Important to note is that uptake in technology is highly dependent on the individual mine. There is no one list of technologies that companies should implement. Some improvements can be implemented now while others will be dictated as individual company's capabilities and technology develop. As technology evolves, those companies who embrace the management and cultural changes central to technology advancements will be well prepared with the skillsets, mindsets required, and processes needed to evolve with it²³.

Environmental, Social and Governance

Increasing regulations on the environmental and social impacts of resource projects places new skills and occupational requirements on the mining industry; individuals that possess the skills, knowledge, and the aptitude to navigate complex regulatory environments and effectively engage with the public and Indigenous communities within consultation and assessment processes will be workers that are in demand in the sector²⁴.

Shifts in the 2020 *Mines Amendment Act* alter how mining workers engage with mine regulators, acquire permits, and ensure compliance. The professional requirements of geoscientists and engineers are requiring greater understanding of governance structures and managing ethical responsibilities²⁵. There will also be an increased demand for those with permitting, auditing and inspection skills as ESG evolves and becomes fully integrated into the sector. For more information on these careers, refer to the Careers Roadmap Report.

The United Nations *Declaration on the Rights of Indigenous Peoples (UNDRIP)* and the commitment to *Free, Prior and Informed Consent (FPIC)* - a specific recommendation outlined within UNDRIP, also impact the work happening within the evolving ESG landscape. These commitments will help build joint decision-making pathways and teach how to listen to each other and come to conclusions together.

Input from Project Committees also indicates that for ESG strategies to be successful, the sector may need to attract workers from other sectors. Environmental scientists can help to integrate environmental practices and increase environmental, social, governance implementation within mining, while workers

22 Centre for Training Excellence in Mining. June 2021. Skills Roadmap Project Key Findings Report. P.43.

23 McKinsey & Company. Sept 2018). Behind the Mining Productivity Upswing; Technology-enabled transformation. Retrieved from <https://www.mckinsey.com/industries/metals-and-mining/our-insights/behind-the-mining-productivity-upswing-technology-enabled-transformation>

24 Centre for Training Excellence in Mining. (Jan 2021). Skills Roadmap Project Environmental Scan and Literature Review, P.37.

25 Ibid.

with traditional Indigenous skills (understanding the land, subsistence hunting and gathering) can be of great value to further environmental and social stewardship within the sector. These skills provide both a high level of essential skills required within mining - working safely with equipment, troubleshooting, and adapting to the environment, while also emphasizing the significance and importance of the environment and community.

Building on this, skills that require the ability to “think outside the box” and problem solve/troubleshoot will become increasingly important. This will require leadership, teamwork, collaboration, and the ability to communicate effectively and work with diverse peoples and perspectives. Workers with additional reading, writing and creative skills will add additional value as reporting and communicating between partners will become increasingly important.

Within this landscape: cultural competence; awareness of human rights; cultural awareness, holistic remediation practices; judgement and decision making, social capital; having knowledge of First Nations impact benefit agreements with mines in BC and emotional intelligence, become essential skills.

Unrecognized and Transferable Skills

As the sector broadens the skillsets it requires to meet these evolving requirements it will become increasingly important to attract workers from other sectors into the workforce. The ability to recognize skills acquired through other experience (whether work, culture, or other life experience), becomes a critical factor. Workers in anthropology, social science, resource management, technology-related fields can all apply their experience to add greater value to mining as it adapts new technologies and implements new ESG priorities.

Similarly, recognizing ‘soft’ or ‘core’ skills such as leadership, mentorship, and critical thinking will become an asset to the sector as it works to attract and retain a more varied and diverse workforce, along with judgement and decision-making.

The following is a list of commonly unrecognized, but highly transferable and relevant skills to mining:

- Traditional knowledge
- Lived experience (without credentials)
- Emotional intelligence
- Quick learner
- Commitment to work safety
- Adaptable
- Work independently and in a team
- Community and Indigenous relations experience
- Digital literacy
- Written and verbal communication

Of these, traditional knowledge; lived experience without credentials; and work independently and in a team, were prioritized by the Project Committee Members during discussions relating to often unrecognized, yet transferable skills that can be applied to mining.

Prior learning assessments and other skills assessment tools will continue to become increasingly important to attract and successfully retain workers from other sectors.

Transferable Skills are Valuable for BC Mining Careers

Workers can use their transferable skills to support technological innovation, exposing them to new opportunities



Figure 2 – Transferable Skills are Valuable for BC Mining Careers

Evolution of Training and Skills Recognition

The BC mining landscape and changing workforce requirements are evolving faster than technology or training curriculum can keep pace with. Mining is dynamic, evolving and breaking new ground as technology and innovation provide improvements to the safety and productivity of the sector and as new environmental, social and governance priorities are implemented.

It is critical that current and future workers understand they will need to be lifelong learners. Skills will need to evolve to keep pace with the impacts of technology and innovation.

Employers will benefit from identifying new skills requirements early and supporting training provider/ employer partnerships to encourage effective job placement, as well as on-the-job training, mentorship, micro-credentialling and other upskilling opportunities while workers stay employed.

New technologies such as simulations, augmented reality and virtual reality can help individuals to develop confidence and competencies in cost-effective ways for employers. Industry will need the active engagement of organizations that understand their business needs and that foster connections with education and

training providers with innovative answers that apply new learning technologies efficiently. Greater collaboration between employers and education and training providers to integrate learning into work, and work into learning will increase the sector's ability to support its learners²⁶.

With the shifts from traditional training and education, new credential recognition and certification will need to compliment these changing landscapes.

Current Workers

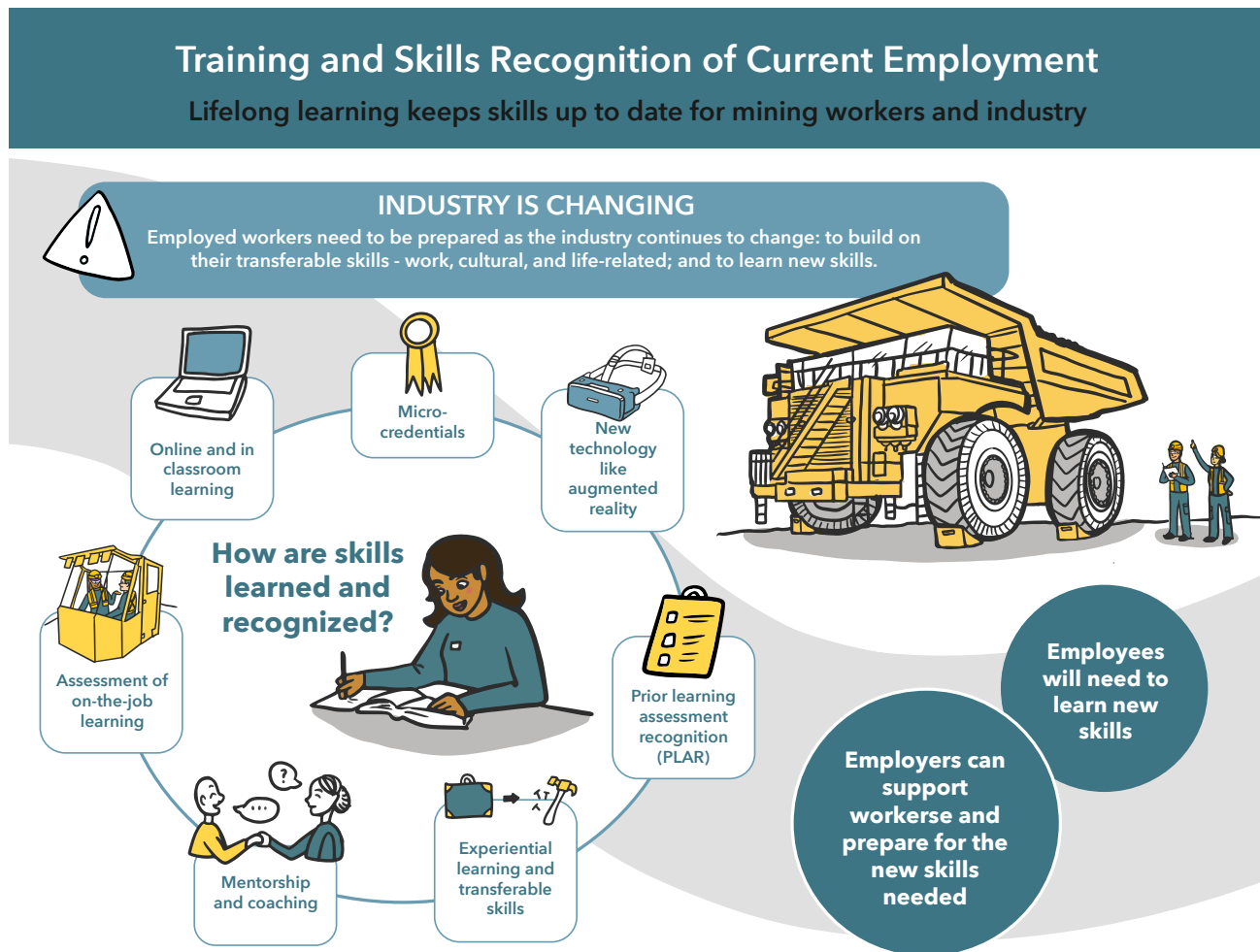


Figure 3 – Training and Skills Recognition of Current Employment

Providing a variety of training options will help current workers integrate these new learnings into their work-life and provide valuable integration of these new skills. Useful training options include:

- Combining or offering training both virtually and/or in-person
- Use new technology like virtual and augmented reality, simulations
- Work-integrated learning
- Prior learning assessment recognition (PLAR)
- Assessment of on-the-job learning
- Micro-credentials
- Certification supported by industry

26 Future Skills Council. (2020). Canada - A Learning Nation, p.35: Retrieved from <https://www.canada.ca/en/employment-social-development/programs/future-skills/report-learning-nation.html>

Students and Potential New Workers

Similarly, those looking to enter the mining workforce will benefit from training that incorporates the new technologies and growing environmental, social and governance priorities in the sector.

The use of new technology and innovation that mining is so rapidly integrating - such as virtual and augmented reality, equipment simulations - will provide great value to learners, through a mixture of online and in-person training.

Industry and training provider collaborations continue to be a critical component to increasing the success of transitioning new workers from the learning environment over to the workplace. Added mentorship and on-the-job training opportunities will further strengthen this transition and support new workers in further developing their skills.

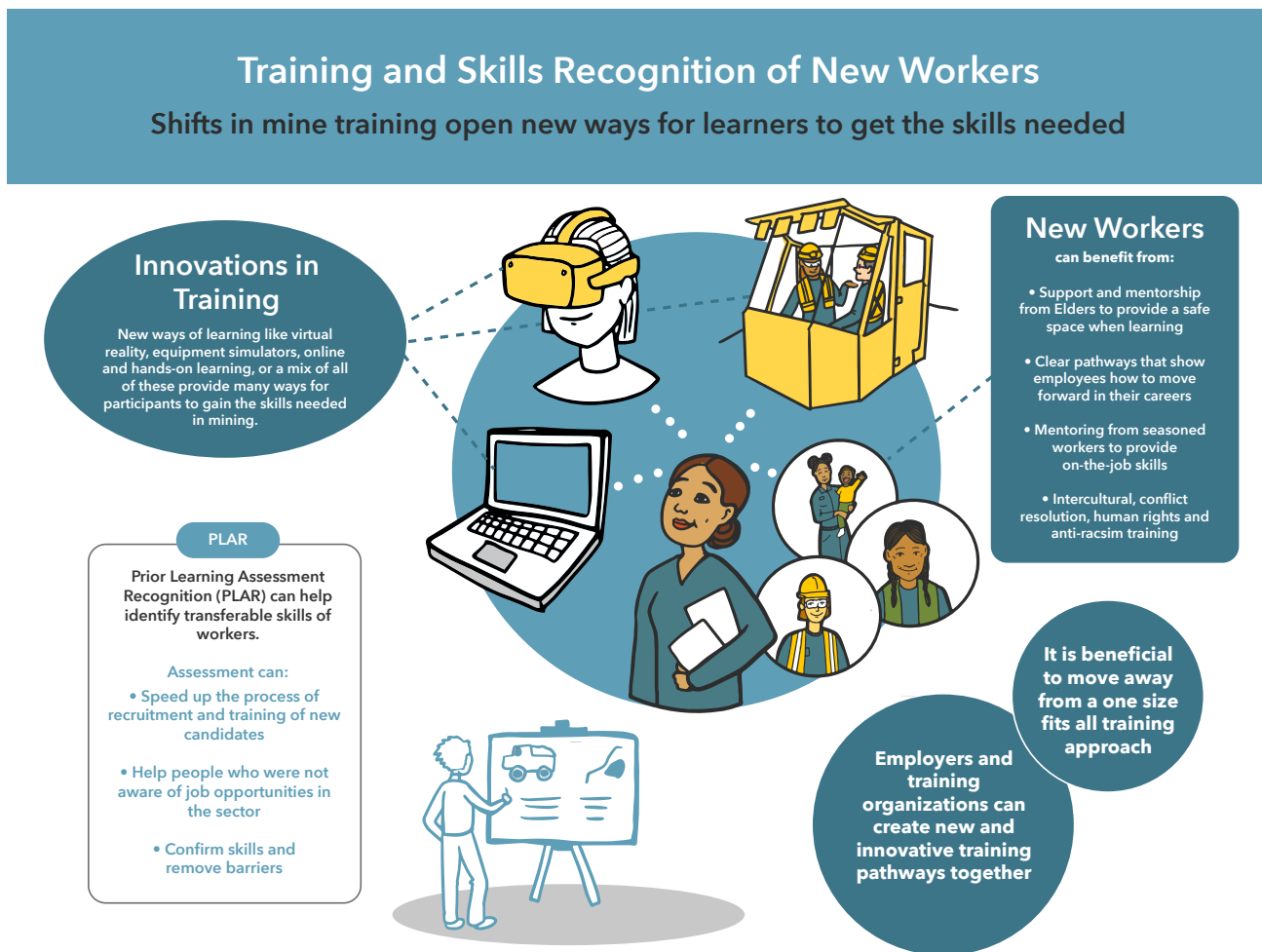


Figure 4 – Training and Skills Recognition of New Workers

This is an exciting time to enter the mining workforce; advancements in mine training and education are opening up new ways for learners to get the skills needed for workforce participation. Employers and training providers will do well by creating flexible approaches to training to help new entrants to join the workforce. Mentoring from seasoned workers to provide on-the-job skills and work ethic is a good retention strategy to keep both current and future workers engaged. A stronger shift towards teaching the value of diversity, inclusion, and equity, and ESG at all levels will be important as the sector broadens to incorporate

new environmental, social and governance priorities.

Engaging cultural mentorship from Elders who provide a safe space for life skills; cultural and spiritual support; and wise stewardship are great ways to increase knowledge, incorporate new and different understanding and perspectives, while also bridging barriers experienced by Indigenous peoples in the sector.

Utilizing assessment tools – such as Prior Learning Assessment Recognition (PLAR) to help identify transferable skills of workers and add value to the workplace. These assessments can:

- Speed up the process of recruitment and training new candidates
- Help people who have been disconnected from job opportunities in the sector
- Confirm skills and remove barriers (such as lack of Grade 12 qualification)

Recognized Barriers and Solutions That Impact Acquiring and Utilizing Skills

The Project research identifies a series of historical legacies and systemic barriers that have disproportionately affected the inclusion of women, Indigenous peoples and people living in rural and remote communities in the mining sector²⁷. Systemic barriers include, “situations, policies and/or practices, which results in some people receiving unequal access or being excluded from benefits and opportunities.”²⁸ These barriers may impact one’s ability to acquire a skill, prevent people from being hired and therefore utilizing their skills, or both.

Recognizing and removing these barriers is essential to increasing diversity and inclusion, providing great value to the broadening work within the sector, but also in providing a tangible and practical solution to both current and anticipated labour shortages. This will be critical for mining in BC to attract and retain the talent to meet the future needs of the sector.

Some barriers are faced particularly by one group of people, while other barriers are common to women, Indigenous peoples and those living in rural and remote communities. More needs to be understood about how these barriers intersect with one another – for instance, the barriers and solutions required for a worker who identifies as female, Indigenous, and living in a rural and remote community.

Research conducted for the Literature Review and Environmental Scan indicates the historical legacy of women being excluded from some mine sites (women were not permitted to work underground in mines until 1979²⁹) continues to impact the underrepresentation of women in mining. Despite making up 48 per cent of the BC workforce, women only account for 19 per cent of the provincial mining workforce³⁰.

In 2011, the Association for Mineral Exploration (AMEBC), Mining Association of BC (MABC) and Aggregate Producers Association of British Columbia (APABC) released a report that found the key drivers for women in operational roles to stay in the industry were compensation and benefits, and the proximity of the job to

27 Centre for Training Excellence in Mining. (Jan 2021). Skills Roadmap Project Environmental Scan and Literature Review, P.25-30.

28 Centre for Training Excellence in Mining. (Feb 2021). Skills Roadmap Project Research Methodology and Tools.

29 The Globe and Mail. (2020), Mining for women. Retrieved from <https://www.theglobeandmail.com/report-on-business/mining-for-women/article4419151/>

30 Mining Industry HR Council. (2016). Preparing for the Future: Mining Labour Market Outlook for British Columbia 2016-2026. Ottawa.

their home. Conversely, the drivers to exit the sector included the challenge of balancing work and home; concern for the environment and sustainability; and challenges around inclusive workplace cultures³¹.

Some important work is happening in this space already, as evidenced by the Mining Industry Human Resources Council (<https://mihr.ca/diversity-inclusion/>) and Women in Mining Canada (<https://wimcanada.org/>), and more can be done to support inclusion of women in the mining workforce.

For Indigenous peoples, the legacy and inter-generational impacts of the residential school system continue to have an impact on learning outcomes and subsequent workforce participation. Relative to the overall Indigenous population in Canada, representation is high with 7 per cent of the mining workforce self-identifying as Indigenous³². However, many rural and remote communities where mining occurs, Indigenous peoples make up a considerably larger percentage of the local population. This provides greater opportunity for increased Indigenous participation in these mining activities, and further enhances the opportunity for greater diversity and inclusion as well as environmental, social and governance implementation in the sector.

Through the Project key informant interviews, surveys and committee discussions, it has become evident that both women and Indigenous peoples are prone to experiencing these distinct barriers to training and career access in mining:

- Lack of career awareness
- Lack of opportunity or inequity in career advancement opportunities
- Lack of diversity within leadership, resulting in fewer role models and mentors, networks
- Problematic workplace and training culture – unconscious bias, micro-aggressions
- Location and remoteness

Lastly, survey respondents and key informants interviewed from rural, and remote communities cite the disparity between training and infrastructure accessibility in northern communities compared to urban centres as a distinct barrier to workforce participation. One example provided was students entering post-secondary with courses from high school may not have equal access to prerequisites. For example, high school physics is commonly required to enter an engineering program, but many high schools in northern British Columbia do not offer Physics 12.

According to members of the Project Skills Sub-committee, the barriers most impacting skills development (in order of ranking) are:

1. Training access and education gaps
2. Location and remoteness
3. Lack of diversity within leadership resulting in fewer role models and mentors, networks tied with lack of career awareness
4. Community infrastructure inequities
5. Social, health, and economic factors

31 APABC, AMEBC, MABC, (2011). Women – an unmined resource. A report on female participation within BCs mineral exploration and mining industry. Retrieved from https://www.bc-ctem.ca/sites/default/files/women_-_an_unmined_resource_a_report_on_female_participation_within_bcs_mineral_exploration_and_mining_industry.pdf

32 MIHR, (2020) Canadian Mining Labour Market Outlook 2020, Ottawa, p. 24. Retrieved from https://mihr.ca/wp-content/uploads/2020/03/MIHR_National_Report_web2.pdf

Solutions for Increasing Diversity in Mining

Women, Indigenous peoples, and people in rural communities in mining

What's Needed:

- More infrastructure, housing, childcare support, wellness, health and eldercare
- Flexibility for work/life responsibilities
- Increased training for driver's licenses
- Transportation to/from training or ensuring training occurs closer to the community
- Hiring trainers from rural communities and with Indigenous backgrounds
- Flexible regional, local, or community-based training
- Elders as part of training development to support learners at all stages
- Encouraging partnerships between training providers, Indigenous communities, local communities and industry
- The opportunity to advance into more senior/specialized roles
- Skills based training including cultural awareness, managing differences, human rights and anti-racism

Women, Indigenous peoples, and people in rural communities will be able to access more opportunities if training and workforce barriers are addressed.



Remove Barriers

Commit to a journey of cultural awareness

Cultural awareness training leads to

Developing a culture of safety and respect

Increased understanding of how to be culturally aware

Retention of workers and a workplace without discrimination, deserved by all

Figure 5 – Solutions for More Diversity in Mining

Potential Solutions

This Project has been instrumental in engaging subject matter experts across the mining industry, training providers, Indigenous communities, workforce development and other service providing agencies, government, and rural and remote communities to understand the potential solutions to the barriers experienced by women, Indigenous peoples and people living in rural and remote communities.

According to these experts, the following are key enablers:

- **Right-Sized Solutions** – Training organizations, communities and employer associations can work together to support changes required, and provide supports to small and medium enterprises, who may not have direct access to mining companies or relationships with provincial and Indigenous governments yet serve a critical role in preparing future workers. These could include supports around policy development, initiatives, and HR practices.
- **Recognition of Individual Needs** – By focusing on individuals – building relationships and understanding their interests and needs (rather than focusing on barriers), employers and trainers can increase their knowledge of the challenges, overcome barriers, while simultaneously open lines of communication to support work integrated learning opportunities.
- **Cross-Sector Partnerships** – These collaborations can support collective workforce development within regions across BC, building on strengths and shared understanding of the challenges faced in rural and remote communities in accessing meaningful employment and continuous learning opportunities to stay current in the workforce. Cross-sector partnerships, in addition to mining, could include forestry, utilities, oil and gas extraction/processing, manufacturing, Indigenous

organizations, training partners and others to support workforce capacity and development to meet future labour market demands.

- **Diversity and Inclusion Practices** – Hiring trainers from rural/remote and Indigenous communities can increase success for students as they see themselves reflected in the trainers, and provide safety, inclusion, and effective knowledge transfer to new entrants into the mining workforce. Cultural awareness/cultural safety training for new and current workers will further increase diversity and inclusion in the workforce and increase the safety and value of all workers.
- **Flexibility in Training Delivery and Workforce Participation** – Recognizing and accommodating family and personal commitments (childcare, care for aging parents, etc.) in training formats and work scheduling can increase accessibility for current and potential workers, and minimize the disruptions felt by families. Possible solutions include shorter work rotations, completing apprenticeships over a longer period with more time spent at home or in community, additional supports when providing on site accommodation for learners, and childcare.
- **Opportunities for Career Growth and Promotion** – Providing mentoring support, on-the-job training and career advancement opportunities for all workers will help to increase the number of women, Indigenous peoples and people from rural and remote communities participating in senior-level positions within the sector. This will further improve diversity and inclusion practices in the workplace and support new entrants in seeing themselves as a part of the future workforce.
- **Transportation, Accommodation and Childcare** – Lack of drivers' training, affordable housing/accommodation and childcare services are key barriers to workforce participation in rural and remote communities. Investing in these key supports will work to remove these barriers and ensure workers can participate in both training and employment regionally.





Appendix A - Project Background

The Ministry of Energy, Mines and Low Carbon Innovation (previously Ministry of Energy, Mines and Petroleum Resources) established the BC Mining Jobs Task Force (Task Force) in February 2018 as part of the Province's focus to create and sustain good jobs throughout BC. The Task Force worked with First Nations, the mining industry, and communities to develop recommendations on possible actions government could take to bring more certainty to the mining sector and create good jobs for people today, tomorrow, and beyond. The Task Force looked at all aspects of mineral exploration and mining in BC and its Final Report³³ provided 25 recommendations to government on measures it might implement to achieve the Task Force's vision of making British Columbians proud of its growing mining industry as the backbone of an inclusive, progressive, and low carbon economy. In January 2019, the Office of the Premier issued a News Release saying the provincial government is "moving forward with" the Task Force's recommendations³⁴.

One of the Task Force's recommendations was to collaborate with the Ministry of Advanced Education and Skills Training (AEST) on the development and implementation of a cohesive roadmap for enhanced mine sector training to meet the mining sector's future skills and labour needs through a collaborative, inclusive, innovative, and geographically focused approach.

In November 2020, the BC Centre of Training Excellence in Mining (CTEM) was successful in its proposal to oversee the Skills Roadmap Project (the Project) to help understand how best to meet the mining sector's future skills and training needs. This project is a collaboration between representatives from across the BC mining industry – and will support the development of a forward looking and responsive strategy for enhancing mining sector training.

The Project is funded by the Province of British Columbia and Government of Canada through the Sector Labour Market Partnerships (SLMP) Program through the Ministry of Advanced Education and Skills Training (AEST) and brings together diverse perspectives from across British Columbia who have an interest in the training and workforce outcomes within the BC mining industry. The mining industry is inclusive of the full life cycle (exploration, extraction, processing, closure, restoration) and includes the suppliers and contractors side of the industry.

The Skills Roadmap Project consists of primary and secondary research guided by consultation and collaboration with 141 participants from industry, organized labour, professional associations, post-secondary institutions, government, and Indigenous communities. This research provides the foundation for the development of skills, career, and training roadmaps (contained in this and two other Roadmap Reports) to support individuals, communities, post-secondary training providers, and industry to meet the mining sector's future skills and training needs.

About the BC Centre of Training Excellence in Mining

The B.C. Centre of Training Excellence in Mining (CTEM) is a province-wide virtual hub that facilitates collaborative and innovative training solutions for the mining industry and B.C. communities. Its mission is to connect industry, students, communities, and training providers to meet their respective employment needs by playing a leading role in determining industry skills requirements, facilitating related training,

33 British Columbia Mining Jobs Task Force. (2018). Mining Jobs Task Force Final Report. Victoria: BC Government. Retrieved from https://www2.gov.bc.ca/assets/gov/business/natural-resource-industries/mineral-exploration-and-mining/memp_10535_task_force_report_final-rev.pdf

34 Office of the Premier. (January 28, 2019). *Government acts on Mining Jobs Task Force recommendations*. <https://news.gov.bc.ca/releases/2019PREM0006-000099>

and supporting partners. It was announced by the Ministry of Advanced Education in November 2012 and became operational in May of 2013. It is funded primarily through grants from the government of British Columbia with additional support from partners.

Guided by the values of collaboration, inclusivity, innovation, support, responsiveness, and respect, CTEM works to bring together all parties interested in mining training to:

- foster innovation to improve outcomes;
- build partnerships to create more effective programs;
- enhance the competitiveness of British Columbia's mining sector;
- build awareness of all the training options for careers in mining;
- match students/job seekers and employers; and
- support other appropriate initiatives that will continue to build on a provincial reputation for producing highly skilled workers.

More information on CTEM can be found in Appendix B.

About the Skills Roadmap Project

The Project creates a set of deliverables that respond in full to the BC Task Force recommendation to *create a cohesive roadmap for enhanced mine sector training to meet the mining sector's future skills and labour needs* and support the recommendations to focus on women and Indigenous representation in the mining sector.

It has two primary objectives:

1. Establish and provide an analysis of labour market information from a literature review, environmental scan, and primary data collection to identify gaps between current skills and training in the BC mining sector workforce and the skills and training that will be required to meet the sector's future needs; and
2. Develop skills, career, and training roadmaps (in report and graphic form) to support individuals, communities, post-secondary training providers, and industry that will assist them in adapting to meet the mining sector's future skills and training needs.

To accomplish these objectives, the Project has relied on guidance and expertise of a wide range of subject matter experts who have provided context and feedback on the research collected. Over 120 subject matter experts participated in the meetings. Committees included:

- Project Governance Committee
- Training Providers Sub-Committee
- Regional, Golden Triangle Sub-Committee
- Indigenous Sub-Committee
- Women Sub-Committee

Input has also been gathered from 197 survey participants, three focus groups and 21 key informant interviews. Participants in these activities included workers, trainers and educators, employers, governance, partnering organizations and community members.

Appendix B - BC Centre of Training Excellence in Mining



BC CENTRE OF TRAINING EXCELLENCE IN MINING



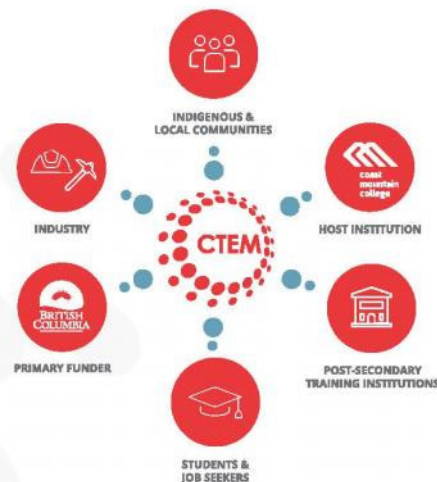
*Facilitating collaborative and innovative
training for BC's mining industry.*

**CTEM connects industry, students, job seekers, training providers,
and communities to meet their respective needs by:**

- playing a leading role in understanding industry skills requirements,
- facilitating industry driven training, and
- building alliances and supporting partners.

Quick Facts

- Provincial organization, established in 2012
- \$1.5M of grants complements \$1M of in-kind industry support
- Project successes have been used in other jurisdictions nationally and internationally



Impact

- Resources provided to 200 communities across BC
- Projects are strategic, collaborative, and specific in scope
- Organizational values are: collaborative, inclusive, innovative, supportive, responsive, and respectful

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TWITTER: @CTEM_BC
FACEBOOK: @CTEMBC



Appendix C - Additional Resources



1. Mining Industry Human Resources Council: www.mihir.ca
2. WorkBC: www.workbc.ca
3. Centre of Training Excellence in Mining: www.bc-ctem.ca
4. Association of Mineral Exploration BC: www.amebc.ca
5. Mining Association of BC: www.mining.bc.ca
6. Industry Training Authority: www.itabc.ca
7. Canadian Apprenticeship Forum: www.caf-fca.org
8. Skills Canada BC: www.skillscanada.bc.ca
9. Engineers and Geoscientists BC: www.egbc.ca
10. The Canadian Mining Certification Program: www.mihir.ca



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IN MINING