



7 Practical Skills Every New Engineer Must Master

THE UNDERGROUND ENGINEER'S STARTER KIT

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INTRODUCTION

Large-scale surface operations have massively redefined the global mining landscape over the past 50 years. Now a new generation of underground mines is seen as key to the industry's future. Today's mining engineers are, more than ever, central to building operating platforms that balance economic growth with environmental and social impacts.

New underground mining engineers need to master core skills in critical areas, including:

- Mine design and planning
- Management and sustainability
- Mining systems
- Mining technologies
- Geotechnical engineering
- Rock breakage
- Mine ventilation

7 PRACTICAL SKILLS FOR MINING ENGINEERS



1.

Planning, design and delivery of projects

The underground mining engineer must determine the most effective and economically viable way to safely extract minerals efficiently and sustainably. That means minimising waste and environmental impact. It means assessing the mine geology, selecting the right mining method and working with a range of stakeholders to balance the needs of the mine and those of the wider community.

One of the most pressing challenges faced by mining engineers today is the ongoing struggle with social perceptions of mining, which can create public resistance and complicate project approvals.

Mining engineers must not only address the technical challenges of resource extraction but also navigate the complex social landscape, ensuring projects meet the environmental, cultural and ethical expectations of the communities they affect.



2.

Managing people and equipment

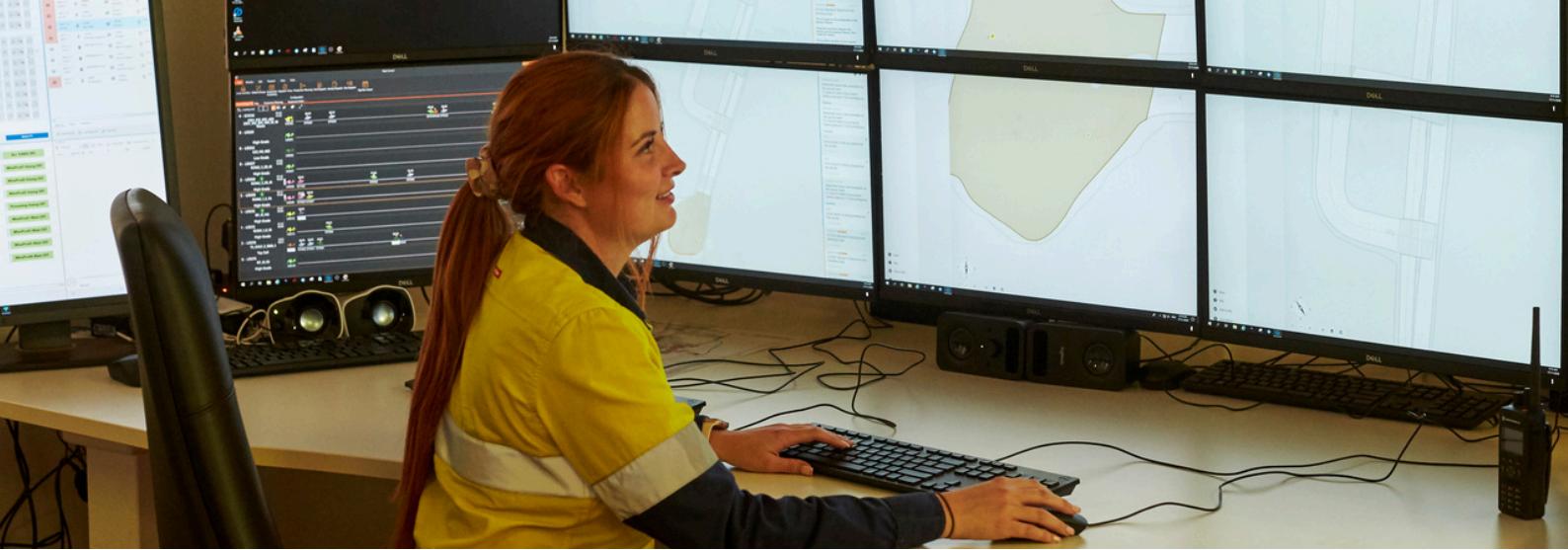
Underground mining is a complex and challenging field, requiring a combination of technical, engineering and management skills. Projects typically require large teams and significant capital investment.

Mining engineers need strong project management and leadership skills to be effective overseers.

They are typically guiding mining operations and project lifecycles, taking into account budgets and variable input costs, while staying ahead of the industry's regulatory curve.

Mining engineers must work with various stakeholders, including mining personnel, other engineering teams, local communities and often government agencies. Hence, effective communication and reporting skills are vital.

Good communication typically stems from sound planning practices and interaction with crews. This continues to be seen as a key opportunity to reduce non-productive time in today's mines.



3.

Systems thinking

New mining and processing methods are seen to offer potential to unlock mineral deposit economics, accelerate project development, lower environmental impact and improve the industry's ability to respond rapidly to volatility. More integrated, dynamic approaches to system design and modelling are being adopted to bring these methods into being and deliver next-level operational performance.

The past few years have seen rapid evolution of thinking in this area, particularly around the industry's underground and broader decarbonisation efforts. Where it has tended to focus historically on point solutions – a battery-electric truck, for example – more integrated systems design and reasoning is coming into play, supported by sophisticated, holistic modelling.

Generally, the role of underground mining engineers continues to evolve beyond traditional technical responsibilities. Connecting mineral processing and extraction techniques can ensure more raw materials are processed with minimal waste and higher recovery.



4.

Technology to the fore

Today, it's been said, mining engineers are not just problem-solvers but innovators who are designing and deploying sustainable solutions that align with modern expectations. From integrating renewable energy into operations to advancing automation and land rehabilitation techniques, engineers are shaping a future that balances productivity with environmental responsibility.

The potential for new technologies such as digitisation and automation is enormous. An area where positive impact can already be seen is teleremote loading, which boosts worker safety and improves connectivity and response.

Advances will improve mining equipment performance, allowing for higher output with reduced resource consumption and improved safety. Truly autonomous vehicles in remote operations will reduce operator risk, improve productivity and increase equipment operational uptime.

Mining engineers must be proficient in using advanced technologies to enhance efficiency and productivity. With the rise of Industry 4.0 (and 5.0) in mining, engineers who understand automation and digitalisation have a clear competitive edge in an evolving job market.



5.

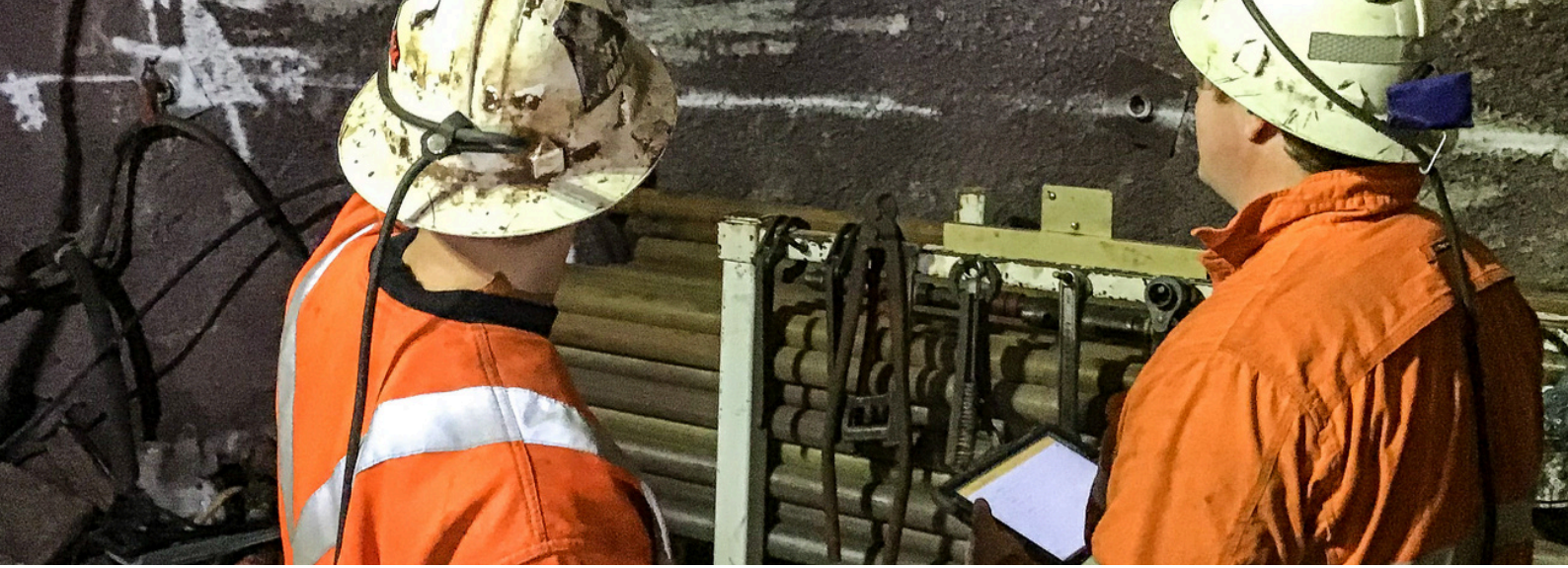
Geotechnical engineering

Mining engineers must have a solid understanding of rock mechanics and geotechnical engineering to ensure mine stability and prevent collapses or failures. Deeper mines require specialist geotechnics, logistics and hydrology knowledge.

The mechanical behaviour of rock and soil, stability analyses, implementation of rock support systems, ground movement and pressure monitoring, subsidence and seismic activity are all essential inputs into the design and maintenance of safe and sustainable mining operations.

Geotechnical engineering adds value across a mine lifecycle, from exploration and feasibility studies to operations and closure. Underground workings, shafts, waste dumps, tailings storage facilities, stockpiles and backfill placements all sit in a geotechnical engineer's purview.

To risk managers, their value extends beyond mine safety and sustainability to controlling costs and revenue margins. As mineral and metal demand increases and the industry digs deeper, seismic, mass material movement, hydrology and even geochemical risks are rising along with that value.



6.

Breaking rock

Drill and blast technologies and equipment and optimisation of rock fragmentation processes are key focus areas for underground mining engineers.

Blasting can be 15-20% of overall mining costs and is a contributor of emissions both directly and indirectly. Better fragmented rock cuts the energy needed to move it, reducing emissions from ore loaders and haul trucks, and boosts processing plant efficiency. It can also favourably impact equipment maintenance.

Again, drilling data and rock knowledge is helping engineers do smarter blasting, changing emission, cost and safety outcomes. Technology combined with engineering knowledge is presenting significant opportunities for miners to optimise operations.

Cloud-based data and rapidly evolving machine learning algorithms are the next frontier..



7. Mine ventilation

Ventilation is vital for underground mines but the systems that deliver it are high energy consumers.

Smart systems are changing ventilation and air heating by using sensors to monitor people and machines and adjust systems to provide ventilation when and where needed. These digital, automation and electrification technologies are helping to turn underground mines into safer, more efficient environments. Underground mine engineers are responsible for ensuring worker safety, reducing accidents and implementing effective risk management strategies. They must understand mine ventilation and gas monitoring, emergency response and rescue procedures, workplace safety protocols and relevant national and international mining safety regulations.

Today's mines need to balance the provision of adequate airflow to maintain worker safety while managing energy consumption. In deep mining, ventilation can account for up to half a mine's total energy consumption. At a time of increasing energy cost uncertainty, mine operators are under mounting pressure to reduce their energy footprint without compromising safety.

The industry's proactive approach to sustainability is seen as a positive indicator of the future of mining.



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