

GLOBAL MINING GUIDELINES GROUP

**GMG**



# INDUSTRY PRIORITIES, CHALLENGES, AND COLLABORATIVE APPROACHES

Report on the 2022 GMG Mine Operator Roundtables

## About GMG

The Global Mining Guidelines Group (GMG) is a network of representatives from mining companies, original equipment manufacturers (OEMs), original technology manufacturers (OTMs), research organizations and academics, consultants, regulators, and industry associations around the world who collaborate to tackle challenges facing our industry. GMG aims to accelerate the improvement of mining performance, safety, and sustainability by enabling the mining industry to collaborate and share expertise and lessons learned that result in the creation of publications, such as this one, that cover common industry challenges.

Interested in participating or have feedback to share? GMG is an open platform, and everyone with interest and expertise in the subject matter covered can participate. Participants from GMG member companies have the opportunity to assume leadership roles. Please contact GMG at [info@gmggroup.org](mailto:info@gmggroup.org) for more information about participating or to provide feedback on this publication.

GMG was formed out of the Surface Mining Association for Research and Technology (SMART) group as part of the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) and with the support of other Global Mineral Professionals Alliance (GMPA) members.

GMG is an independent, industry-led organization.

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Recommended citation: Industry Priorities, Challenges, and Collaborative Approaches: Report on the 2022 GMG Mine Operator Roundtables (Report). Global Mining Guidelines Group (2022).

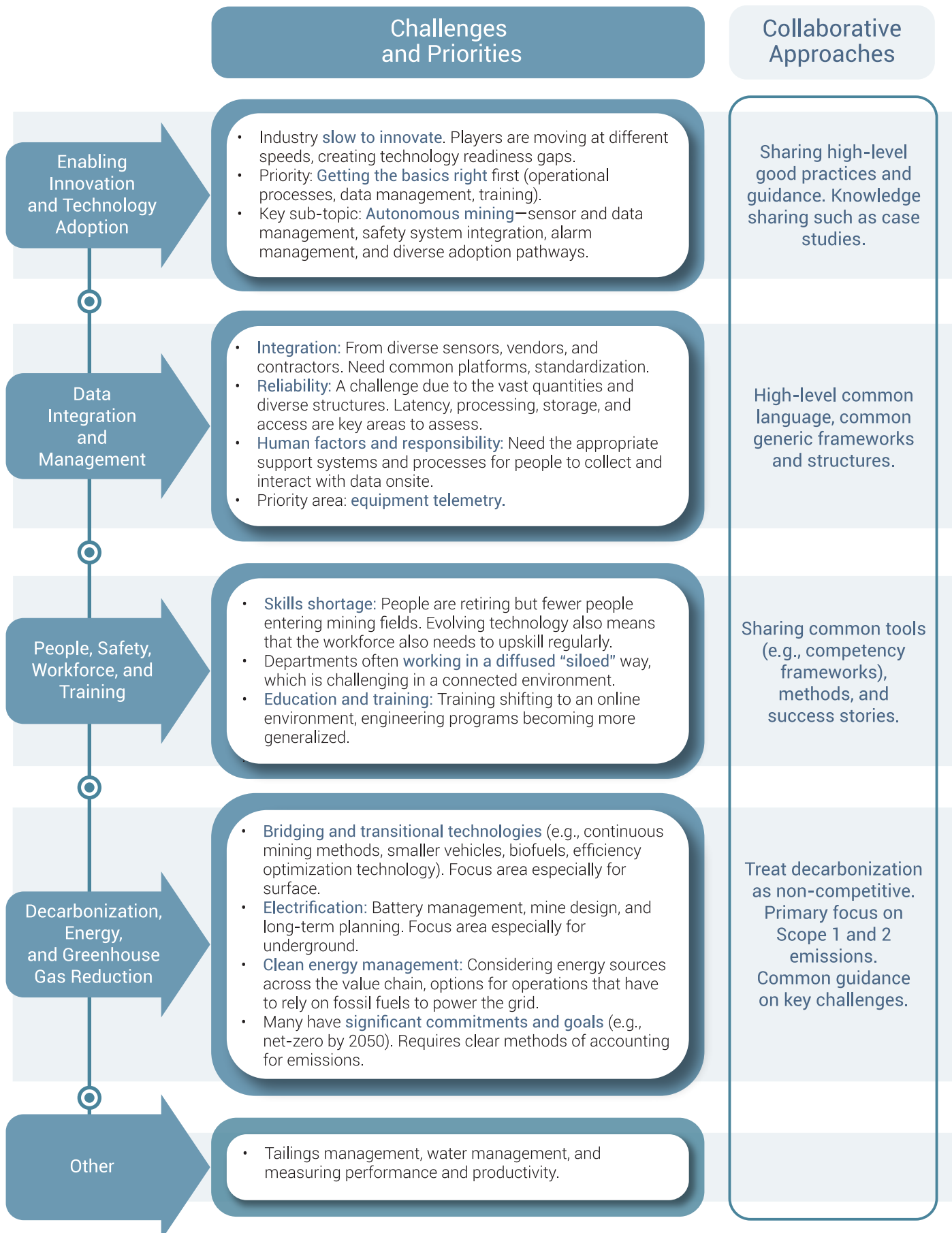
### Publication information

Publication Date: 2022-04-14

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## GMG Mine Operator Roundtables 2022: Summary of Industry Priorities, Challenges, and Collaborative Approaches



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# 1. INTRODUCTION

This report covers the output of 12 GMG mine operator roundtable workshops held in January and February 2022. It begins by outlining some key themes that emerged, followed by specifics relating to each of the following topics on which there were events—surface mining, underground mining, mineral processing, asset management, data and integration, and sustainability.

The purpose of these workshops was to facilitate critical conversations between leaders from mining companies around the globe to enable them to share experiences and identify common challenges, priorities, and potential solutions. This input will ultimately also provide guidance in the development of work plans for each GMG Working Group as well as GMG's strategic direction as a whole.

Inclusion in this report does not necessarily mean that the subject matter will all be covered by GMG projects. For example, some topics might be covered by other organizations, or the ways they need to be addressed might be outside of GMG's scope. This report will be used when considering future work in order to make sure it aligns with the needs of the industry and the GMG community. The Working Groups will investigate and critically consider GMG's role in addressing topics before launching any projects.

## 1.1 The Importance of Operator Feedback

While GMG is a multi-stakeholder organization, GMG's output is driven by the needs of the mine operators. As they are the ones doing the mining, it is in all stakeholders' benefit to understand and work to meet operator needs.

In a 2020 volunteer survey on the usage of GMG guidelines, when asked "how have you or others you know used GMG guidelines," the top answer was "to understand industry needs," followed closely by "as a reference for operational procedures."

In more recent surveys conducted as part of general strategic events in December 2021, participants identified "Industry relevance (output is useful and relevant to the industry's current needs)" as one of the biggest areas where GMG can grow and provide greater support and value to the global mining industry.

## 1.2 Demographics

There was a total of 38 mining companies represented in these events, ranging from small to large. Participants represented a range of functions within their companies, primarily in middle and upper management roles both onsite and in corporate offices. Table 1 identifies the number of participants and companies represented for each roundtable theme.

Participants predominantly represented North America and Australia, with some participation from South America and Europe (Table 2). While there is no representation from participants in Asia and Africa, many companies represented have global operations and participants shared insights on variation between regions.

TABLE 1. PARTICIPANTS

TOPIC	PARTICIPANTS	COMPANIES
Surface Mining	16	13
Underground Mining	15	11
Mineral Processing	13	9
Asset Management	16	14
Data and Integration	22	17
Sustainability	12	12

### 1.3 Methodology and Limitations

The open discussion format of the calls enabled participants to share their thoughts without being restricted. The different focus areas of the groups allow a window into how priorities diverge and converge for different areas of expertise and experience. While the roundtable format offered the opportunity for everyone to speak and hear each other, it also can potentially skew results because speakers might build on where they agree with the previous speakers and focus less on equally important topics. Two distinct roundtables were held on each focus to mitigate this limitation. For each workshop, the transcripts were analyzed and arranged by key themes. These themes are summarized in this combined report.

While these events provide a broad and nuanced view of the GMG community priorities and challenges, the format and strategic planning timeline necessitated analysis through categorizing narrative threads, leaving room for interpretation during analysis and reporting. This report is therefore formatted to highlight and discuss core common themes and the key angles and contexts in which they were raised, but it does not attempt to provide an empirical analysis. Each section summarizes the key four to six discussion topics in order of their prominence in the discussions.

TABLE 2. REGIONAL REPRESENTATION

REGION	PARTICIPANTS
Australia	27
Europe	6
North America	50
South America	10

## 2. OVERALL THEMES

The following themes emerged as overarching priorities across all roundtables. Each core theme was mentioned in every roundtable and explored in some depth in nearly all of them. Unsurprisingly, many of the themes and challenges identified reflect the findings of recent trend reports published by global research consultancies. For example, [Deloitte's Tracking the Trends 2021](#) report and [EY's Top 10 Business Risk and Opportunities for Metals and Mining in 2022](#) identify key mining industry trends around decarbonization, the future of work, integrated operations, and digitalization and innovation.

Other themes and recommended approaches support GMG's position in the industry as a global platform for the industry to collaborate, share knowledge, enable good practices, and support standardization at the operational level. The core themes are all also interconnected and interdependent in many ways. For example, good data management, the establishment of common practices, and appropriate training and preparation for the workforce are all key enablers for technology advancement.

### 2.1 Enabling Innovation and Technology Advancement

OVERARCHING CHALLENGES	TOPICS
<p><b>SPEED OF INNOVATION</b></p> <p>Mining is not typically an agile industry, and different players are advancing at different speeds, resulting in a self-perpetuating technology gap.</p>	<p><b>KEY SUBTOPIC: AUTOMATION</b></p> <p><i>Context:</i> Adoption of autonomous systems is increasing and was identified as a priority across many groups, driven by the safety benefits automation can offer, an increase in remote work, and a decrease in people entering the field.</p> <p><i>Challenges:</i> Integration of data from multiple sensors, design adjustments, integration of collision avoidance and decision support systems, workforce changes.</p> <p><i>Opportunities:</i> Improvements in safety systems and human-systems integration, incremental adoption pathways.</p>
<p><b>READINESS AND CHANGE MANAGEMENT</b></p> <p>Many operators identified that they need the basics first before adopting advanced solutions and technologies.</p>	
<p><b>REGULATORY REQUIREMENTS</b></p> <p>An evolving regulatory environment and regional differences add a layer of difficulty to adopting new technologies and establishing common practices.</p>	
	<p><b>OTHER SUBTOPICS</b></p> <p>Communications technologies, advanced analytics and AI to optimize processes and data, electric vehicles (see Section 2.5).</p>



## 2.2 Data Integration and Management

### OVERARCHING CHALLENGES

#### INTEGRATION

Data coming in from diverse sensors and sources was the biggest pain point identified. It is especially important regarding safety systems.

#### RELIABILITY

A challenge due to the vast quantities and diverse structures. Latency, processing, storage, and access are key areas to assess.

#### HUMAN FACTORS AND RESPONSIBILITY

The appropriate support systems and processes for people to collect and interact with data are needed onsite.

**FOCUS – Equipment telemetry data is a primary concern.**

## 2.3 People, Safety, Workforce, and Training

#### SKILLS SHORTAGE

Many mining fields have people retiring, but there are not enough new people getting into and staying in mining to replace them. There is a need to capture and leverage institutional knowledge so that it isn't lost when people retire.

#### BECOMING MORE CONNECTED

Many departments currently work in a distributed and disconnected way, and a connected environment exacerbates challenges associated with operational siloes.

#### EDUCATION AND TRAINING

- With rapid changes in technologies, there is a need to frequently retrain or recertify personnel with new skills.
- A lot of training has shifted to an online environment and there is an increased reliance on simulation and virtual solutions.
- In many cases, engineering programs are becoming more generalized, so specific practical skills will need to be learned on the job.

## 2.4 Decarbonization, Energy, and Greenhouse Gas Reduction

#### ELECTRIFICATION

Key challenges within electrification include battery management, mine design, and long-term planning. A key focus area especially in underground mining.

#### BRIDGING AND TRANSITIONAL STRATEGIES

Other options such as the adoption of smaller vehicles, conveyors, trolley-assist systems, and efficiency optimization technologies. A key focus for surface mining.

#### CLEAN ENERGY

Need to consider energy sources across the value chain, alternative options that companies who rely on fossil fuel have, and accounting for and measuring emissions.

#### MEETING COMMITMENTS AND GOALS

Many companies have committed to significant goals to reduce their carbon footprint (e.g., net zero by 2050).

## 2.5 Common Language, Standardization, and Good Operational Practices

Common language, standardization, and good operational practices were identified as key enablers for all of the above topics. Key considerations include:

- **Operational Processes and standardization:** There is a lot of variation in operational processes across (and sometimes within) sites. This challenge is exacerbated by mergers and acquisitions where entirely different operating strategies have to come together. While some variation is inevitable due to several factors affecting the operation (e.g., region, product, technological readiness), consistency at a high-level can help to enable many other improvements (e.g., technology adoption, reliable data-driven decision-making, benchmarking, meeting performance and sustainability targets and goals).
- **Common language:** There is a need for a common language at a high-level in many areas (e.g., common language for data types, IT/OT systems and how they integrate, performance metrics and KPIs).

## 2.6 Collaboration Approaches

How to collaborate to enable mutual advantages across the industry, particularly within the context of the GMG community, was discussed in most of the roundtables. Some key forms of collaboration highlighted throughout the roundtables include:

- **Discussion and knowledge sharing forums:** Non-competitive, global platform to come together to share knowledge, practices, successes, and challenges. This can connect groups who would not normally work together, even within stakeholder groups. Common user or interest groups would also be of benefit to the industry.
- **Case studies:** Sharing case studies can be a way to cover details and experiences that would be difficult to cover at a high-level and can also point to common challenges that should be addressed with further work.
- **Higher level guidance:** Developing common language and definitions, common frameworks, common roadmaps, and overall good practices.

# 3. SURFACE MINING

The core themes from Section 2 were prominent in the surface mining roundtables. Among the core topics raised, there were some surface mining specifics related to decarbonization, while most others generally represented common challenges across the industry. Participants represented a range of companies in terms of size and products and also a range of leadership, management, IT, onsite, and corporate roles.

## 3.1 Decarbonization, Energy Efficiency, and Greenhouse Gas Reduction

Decarbonization, energy management, and greenhouse gas reduction emerged as a key theme. The discussions focused on different options that were available and the design considerations associated with them. Overall, the best approach for decarbonization in surface mines will vary depending on several factors (e.g., mine size, life, and region). Participants also emphasized that decarbonization in surface mining is not just about trucks; it should also focus on bridging and transitional technologies. Combining different methods and strategies to reduce impact was seen as a path forward.

***“As an industry, we can’t afford to just sit and wait for the big trucks to be battery-electric or hydrogen fuel celled.”***

### BATTERY ELECTRIC VEHICLES

*Challenges:* Additional support infrastructure requirements and the larger surface vehicle size. Surface also has additional battery storage hazards than underground (e.g., weather conditions).

*Options:* Electric drills, ancillary equipment, and options that allow for dynamic charging can be effective.

### TROLLEY ASSIST AND MOBILE TROLLEY SYSTEMS

*Challenges:* While they can be a viable option for surface mines, these systems require permanent infrastructure.

*Options:* Mobile trolley systems can be a flexible option.

### CONTINUOUS MINING

*Benefit:* Using continuous mining systems (e.g., conveyors, rail systems) to move material can reduce the use of high-emission trucks.

*Challenges:* Required permanent infrastructure, handling harder rock.

### HYDROGEN FUEL CELLS

*Context:* These systems are being discussed and trialled as an option for powering heavy equipment.

*Challenges:* Costs, how the fuel cells are produced, and accommodating them in the mine design.

### SMALLER EQUIPMENT

*Benefit:* Adoption of smaller equipment could be a path forward to enable more flexibility with electrification and alternative fuels.

### RENEWABLE FUELS

*Context:* Renewable fuels (e.g., biofuels) are being considered as an alternative to benefit the industry.

*Challenges:* Variability in quality, supply chains, and impact on equipment.

### AUTOMATION

*Context:* Can be a factor in greenhouse gas reduction because of smaller vehicle size and potential for increased efficiency.

### EFFICIENCY SUPPORT TECHNOLOGIES

*Context:* Some companies are seeing success with cartridge technologies that reduce fuel burn and energy monitoring systems.

### 3.2 Enabling Innovation and Technology Adoption

Innovation is advancing rapidly, so enabling the adoption of new technologies in surface mines emerged as a key theme. The following topics were of particular interest to the surface mining community:

#### AUTONOMOUS MINING

- *Options:* Auxiliary or shuttle scale truck automation and drill automation.
- *Key considerations:* Safety systems, human factors and alarms, productivity and performance, and data management.

#### ADVANCED MINE PLANNING TOOLS

- *Challenge:* In surface mining, there is a lot of operational activity continuously happening.
- *Options:* Finding a platform or a modular mining optimization tool can be beneficial.

### 3.3 Data and Integration

Data and integration emerged as a central theme in both roundtables. The following topics were of particular interest to the surface mining community:

Efficiency and carbon data to optimize energy usage and reduce emissions

Autonomous equipment sensor data, especially for production drills

Collision avoidance and decision support system data

Equipment telemetry data from multiple vendors

### 3.4 Other Priorities and Challenges

Measuring asset performance, especially in hard rock mines

Managing and measuring unproductive idling and fuel usage

Standardization and development of common operating practices

Retaining, training, and attracting a skilled workforce

Slope stability, water management, and tailings management

# 4. UNDERGROUND MINING

Along with the key themes described in Section 2, the priorities and challenges identified by participants include challenges such as underground connectivity, using automation to reduce personnel required to be underground, and long-term considerations around underground electrification. Participants represented a range of functions within underground mining, including mine planning, automation, maintenance, and engineering at middle management and senior management levels. The participants also represented a range of mid-sized to large operating companies.

## 4.1 Enabling Innovation and Technology Adoption

Technology adoption was identified as a challenge, particularly in terms of disparities between larger and smaller companies. Autonomous systems and communications technologies were identified as priorities.

***"I think it's incumbent on us technology types to try and reduce the number of people who have to go underground, particularly when mines are getting deeper and deeper."***

**Autonomous Mining:** Underground mines have unique designs, infrastructures, and safety challenges when applying autonomous systems underground, especially in very deep mines. However, the benefits of introducing autonomous systems in deep mines include:

- Reduction of number of people underground, thereby decreasing safety risks.
- Reduced time spent travelling underground to equipment and during shift changes.

**Communications Technologies:** Sophisticated underground communications technologies are required to support other technological advancements being adopted underground (e.g., autonomous systems). There are many advancements (e.g., 5G, LTE), but there are some adoption challenges:

- Disparity in accessibility and readiness between larger and smaller companies.
- User adoption and change management.

Sharing case studies would be beneficial to justify the use of technologies and processes.

## 4.2 Electrification

Because electrification is more mature in underground mines than in surface mines (Section 3), many of the key challenges discussed were around large-scale adoption, optimization, and changing regulatory environments.

### OPERATING ELECTRIC VEHICLES

**Battery Safety:** Battery safety is a growing challenge as electric vehicles are more widely adopted.

**Charging:** There is a need to better understand charging infrastructure based on the demands of the machines.

### BIGGER PICTURE CONSIDERATIONS

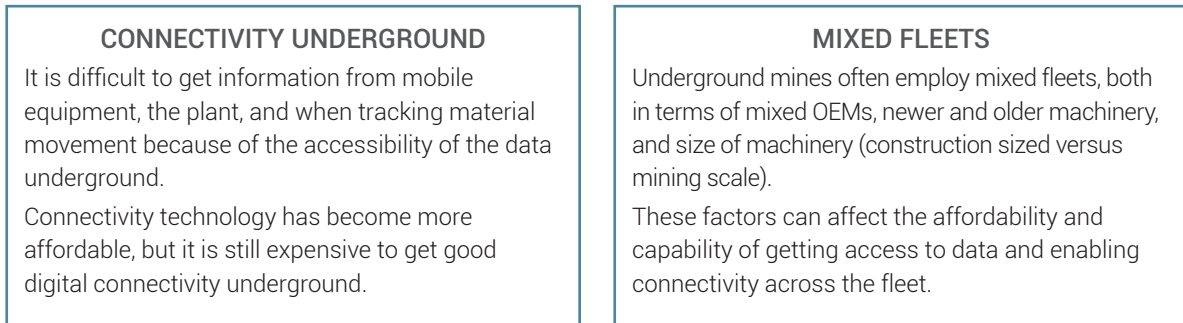
**Long-term planning:** Decision-making on electric technologies is focusing more on longer-term viability within the business and how it depends on the operation and scale of operation.

**Overall energy management:** Considerations are a key input into this decision-making.

**Regulations:** There is an increase in regulations and requirements relating to product stewardship, particularly around health hazards. It is important to understand underground emission regulations and DPM regulations when considering the adoption of electric vehicles or alternate methods of transportation in the mine.

### 4.3 Data and Connectivity

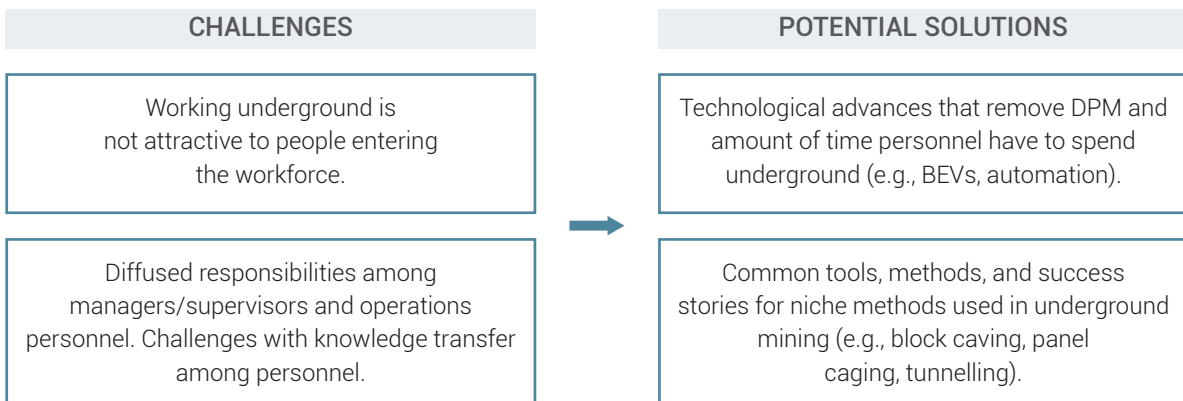
While many of the challenges participants faced around data and interoperability underground were not unique to underground mines, underground mines have added communications and connectivity challenges when it comes to data.



**UNDERGROUND FOCUS AREA**  
Materials tracking data to enable higher productivity, lower costs, and safer environment.

### 4.4 Workforce and Training

While many discussions on workforce and training within the underground groups related to mining in general, participants noted that it is particularly difficult to attract people to work underground.



# 5. MINERAL PROCESSING

Along with the key themes described in Section 2, specific mineral processing focuses included aspects related to operational siloes between departments, evaluating energy consumption, and water and tailings management. Participants represented a range of functions within mineral processing, such as processing technology and metallurgy, at middle management and senior management levels and from a range of mid-sized to large operating companies.

## 5.1 People, Workforce, and Training

Considerations related to people were discussed in depth in both roundtables. The following are key challenges that emerged for the mineral processing community:

### OPERATIONAL SILOS

The work of different departments such as hydrometallurgy, power metallurgy, and mineral processing is interconnected, but they often work in operational silos and rarely interact. Facilitating collaboration both within companies and the broader industry is needed. This could help to address challenges with energy, water, tailings, and end-of cycle processing (discussed below).

### TECHNOLOGICAL CHANGES

Technologies such as plant automation and advanced analytics can help to optimize processing and processes. For example, plant automation plays a big role in helping prevent over- or under-controlling the plant, a key challenge when using manual equipment. However, change management is a challenge, even at technologically mature sites.

### SPECIALIZED SKILLS DEVELOPMENT

Engineers are graduating from more generalized programs (e.g., chemical engineers) rather than specialized programs (e.g., metallurgical engineers), so there is a greater requirement for the employer to train staff on the practical skills associated with their jobs. Practical training for metallurgists, student site visits, and work terms were identified as possible solutions.

### COMPETENCY FRAMEWORK

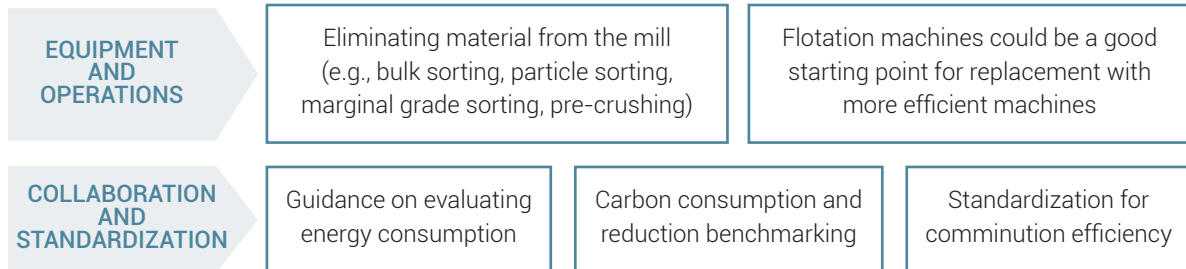
The development of a competency framework for universal mineral processing skills was identified as a potential collaboration opportunity through a platform like GMG.

The industry has taken some steps to establish definitions, but there is still work to be done to come to an agreement.

## 5.2 Decarbonization, Energy Efficiency, and Emissions

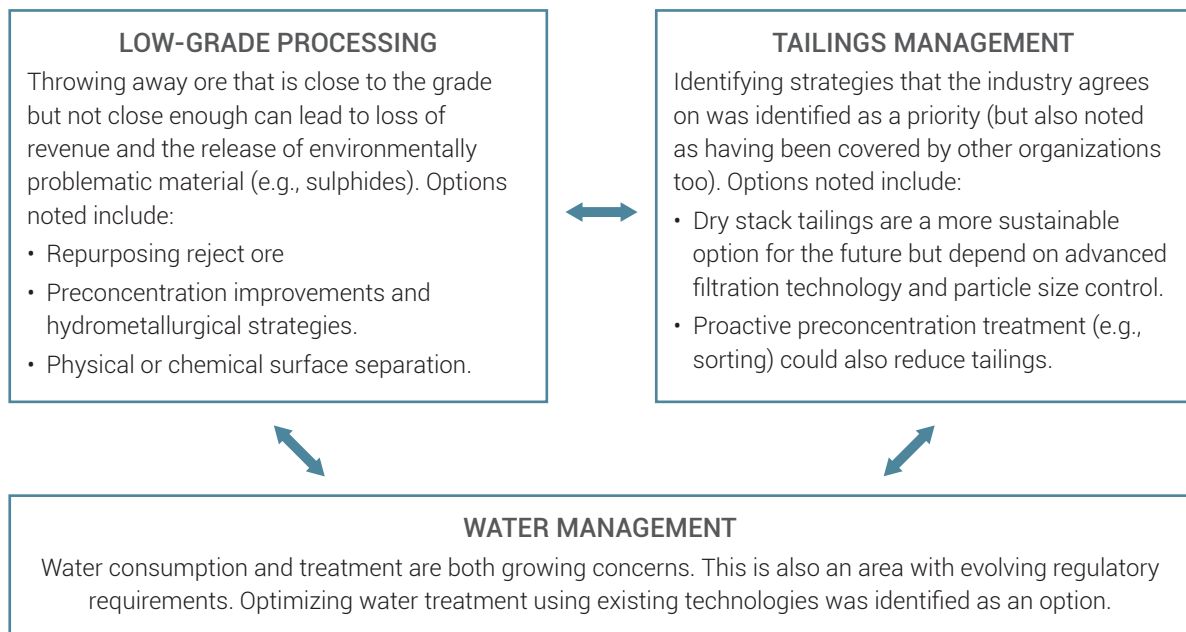
Mineral processing activities account for a large percentage of energy usage onsite. However, it can be costly and difficult to retrofit or adopt new technology since the equipment has such a long life. Creative innovations, incremental changes, and improving processes were identified as key ways of addressing this challenge.

*“The best way to save energy is to not process things you don’t need to.”*



## 5.3 Water Management, Tailings Management, and Low-Grade Processing

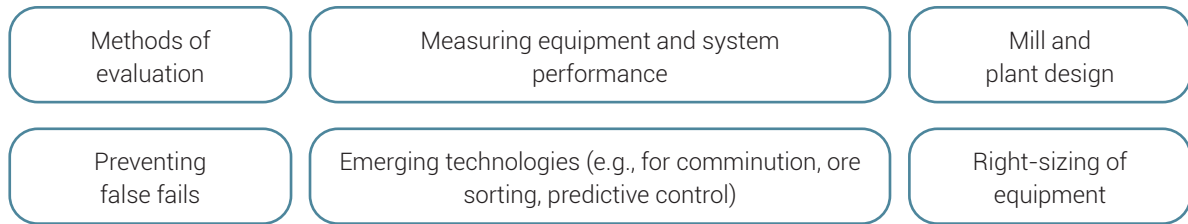
Low-grade processing, tailings management, and water management emerged as key priorities that are interconnected in many ways.





## 5.4 Common Practices

Participants noted that they faced challenges with a lack of standard processes and practices across operations. Key challenges that face the mineral processing community include the need for technological and procedural changes to be incremental and the fact that processes and challenges will vary significantly depending on the material. Key topics identified as benefiting from common practices, benchmarking, and guidance include:



## 5.5 Data Utilization

Priority data-related goals for the mineral processing community include:

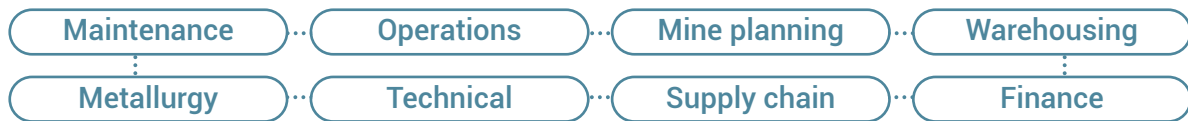
- **Enabling more sustainable operations:** Proper data utilization can help to address challenges around improving sustainability in terms of carbon consumption and tailings.
- **Better orebody knowledge:** Data is an important part of orebody knowledge. It is challenging to get the information that can be fed back into a resource model and feed forward into the processing plant and into tailings to try and predict what would happen and make informed decision-making.
- **Optimizing mill and plant functionality:** Successfully applied sensor and sampling technology (e.g., predictive control systems) can help to optimize mill and plant functionality.

# 6. ASSET MANAGEMENT

These roundtables touched on many of the core themes identified in Section 2 and focused on specifics such as the cross-functional nature of asset management. Participants represented a range of functions within asset management in supervisory, middle management and senior management levels, onsite and at corporate offices. The participants represented a range of small to large operating companies. This was the only topic where there were two very different discussions – the first focusing on strategy, and the second focusing more on onsite details. Despite these different approaches, the overarching themes had some common ground.

## 6.1 Process Standardization and Variation and the Cross-Functional Approach

Standardization and variation of processes across sites was a key challenge, often due to operational and functional siloes within organizations. Key asset decisions are diffused across many disparate teams, including:



### CENTRALIZATION

<p><b>OPERATIONAL AND FUNCTIONAL SILOES</b></p> <p>There is a need for more consideration of end-to-end process and handover points across the business, improving communication between departments, and to have a structure where there are senior asset management positions.</p>	<p><b>STANDARDIZATION, VARIATION, AND CENTRALIZATION</b></p> <p>Variation in processes across sites is a key challenge. Overall, governance (e.g., reporting and accountability) and risk management were identified as key processes to centralize, while details might have to vary between sites.</p>
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## 6.2 Data Management, Systems, and Accountability

The move towards a more integrated approach to asset management and increasing complexity in the technological landscape makes data management a high priority.

- **Integration and work management systems:** It can be challenging to get a solid framework of what is needed and how diverse systems will integrate into planning. Inconsistency and poor functionality is a particular challenge with work management systems (e.g., ERP, CMMSs). A centralized approach can resolve some issues, but sites have different capacities.
- **Responsibility and accountability:** In practice, even the very basics of data capture are not often applied onsite. There needs to be more accountability on the front lines to understand the value of data and inputting it correctly, and responsibility for supervisors to enforce and enable it to be done.
- **Data and information management:** Data management (e.g., quality, custody) and diligence around updating data is an area to improve. Good, basic data makes it easier to justify asset management strategies because you can provide examples of how a solution saved the company time and money.
- **Adopting advanced technologies:** Digital mine optimization, predictive maintenance, remote monitoring, and autonomous systems all can improve performance and productivity, but they require a high-level of technical maturity to be valuable and also bring with them a new set of maintenance challenges (e.g., maintenance of additional sensors and control systems).

### 6.3 Workforce, Skills, and Training

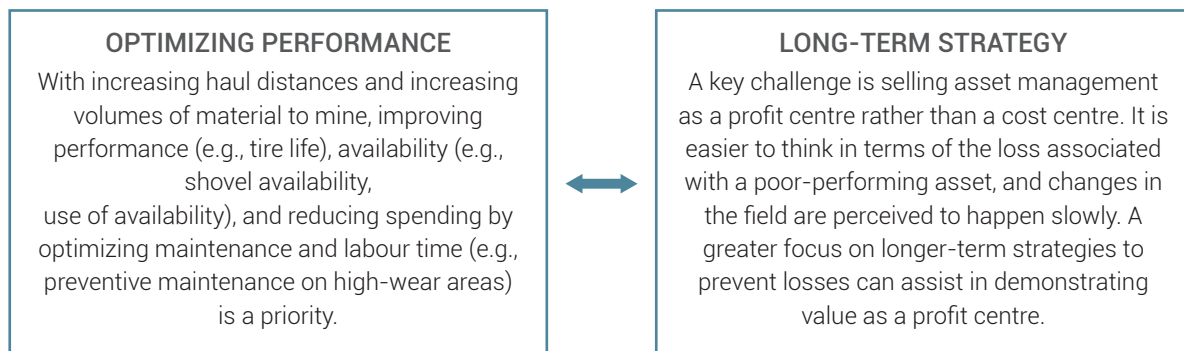
Key challenges the asset management field is facing include:

- **Skill shortage:** There is a skills shortage in the asset management field in both technical (e.g., monitoring, data quality) and management roles. People are retiring or not staying in the field in the long term, and not enough people are attracted to the field.
- **Evolving requirements:** Asset management skills learned in trade school are no longer lasting people their entire careers. This is a challenge for both the existing and new workforce. Training is becoming more of an ongoing process that requires recertification and requalification.
- **Institutional knowledge transfer:** There is a lot of knowledge among the existing asset management workforce, but capturing and transferring it is a challenge, especially as people retire.
- **Training for decision-makers:** Decision-makers at the top levels of the company should be exposed to asset management concepts as well.

*“You don’t train for life anymore. You train for a period, and then you enhance those skills periodically. And we haven’t got that.”*

### 6.4 Costs, Performance, and Productivity

Operators are also facing challenges in optimizing performance onsite, which can make it difficult to communicate the value of asset management as a profit centre to management. While the day-to-day is often the focus, longer-term strategies were identified as an opportunity to improve.

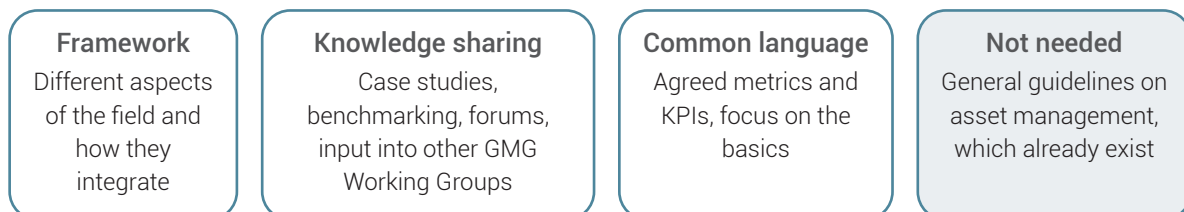


### 6.6 Decarbonization

Carbon reduction was identified as a big part of decision-making in the asset management field going forward that will affect lifecycle costing, equipment selections (e.g., BEVs, Hydrogen), and end-of-life decisions. Emissions metrics will likely become more important in measuring performance.

### 6.7 Collaboration Opportunities

Some common collaborative approaches were identified that could help to address all the challenges above.



# 7. DATA AND INTEGRATION

These roundtables typically expanded on data considerations brought up generally in others. Participants represented a range of roles, including engineering, data analysts, IT management, corporate technology leadership, and automation specialists. Small, mid-size, and large companies were represented.

## 7.1 Standardization and Common Language

Standardization and common language was identified as an overarching approach for dealing with many data-related challenges, especially around integration and data quality and reliability.

### AN ENABLER FOR:

- Improved integration and reduced need for translation.
- Adoption of advanced systems that would otherwise not be feasible (e.g., autonomous systems, predictive analytics).
- Improved internal communication.

### KEY CONSIDERATIONS:

- *Change management*: Standardization will change the way of working.
- *Existing standards*: It is valuable to look at global standards and open standards for data exchange and interoperability (e.g., ISO 81346).

### COLLABORATION FOCUS:

- Focus on common language at a high-level so that it can accommodate diverse levels of maturity and needs.
- The development of high-level maturity models can be a starting point.
- For standardization, collaborate on general requirements then work with vendors on specifics.

### IDEAS FOR COLLABORATIVE WORK:

- Common framework for integration.
- Development of a semantic-level framework.
- A standardized asset hierarchy.
- A time hierarchy for the continuous mining process.
- Common logical model.

***"It's more just about a generic framework and common language about what we call things so that we can have conversations in a targeted way."***

## 7.2 Integration and Multiple Vendors

Many operations are facing integration challenges due to having multiple vendors and contractors using different systems with many layers of reporting. Improving integration also enables improvement in data quality and analysis.

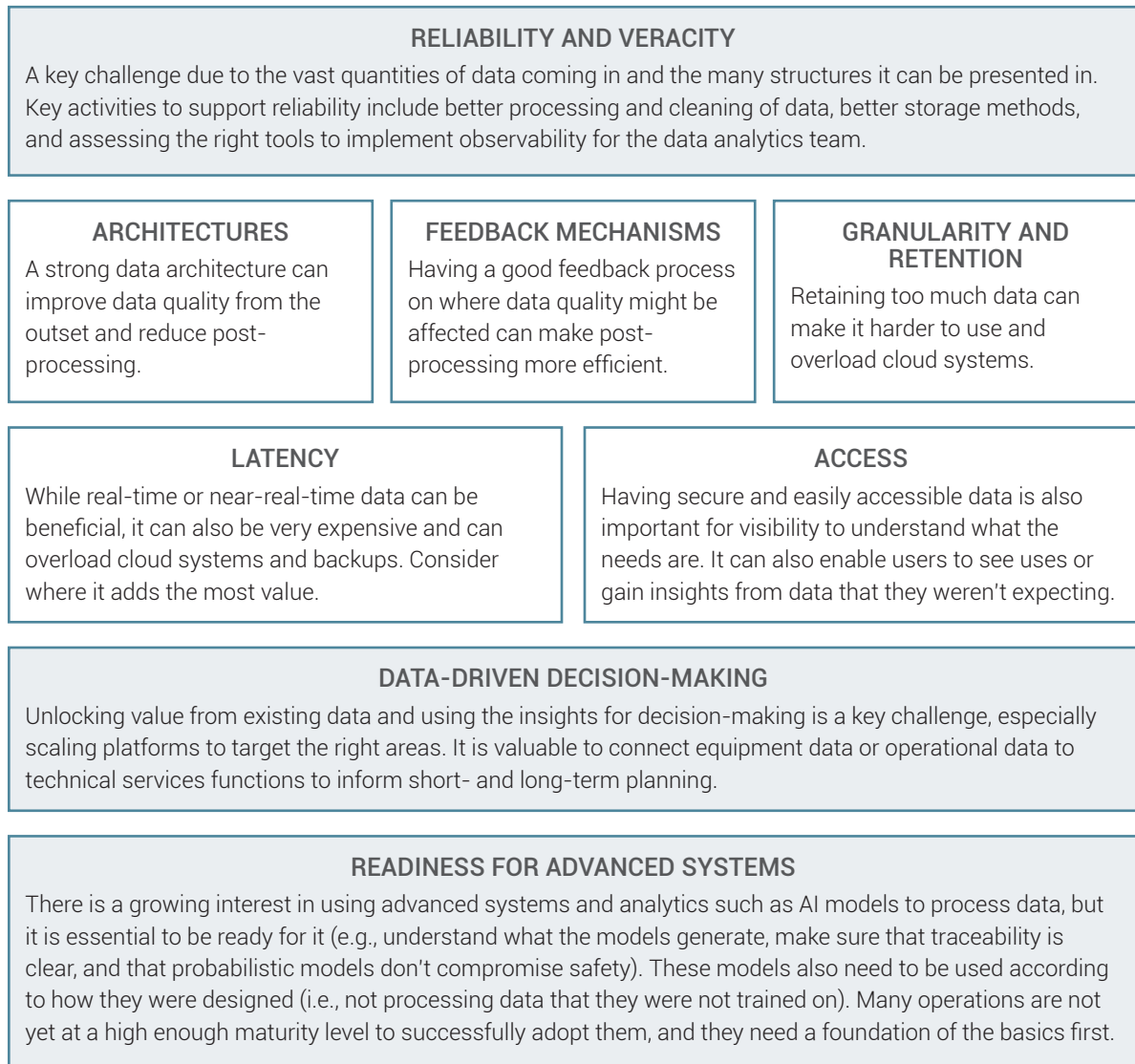
- **Distributed responsibility**: The responsibilities of the operator, the vendor, and third parties are distributed and often challenging to navigate.
- **Cross-functional IoT data**: Integration is a challenge across many functions in the operation (e.g., operations, planning, exploration, geology). IoT data is being brought together in multiple different ways (e.g., MQTT, APIs, relational databases). The time series environment is also a challenge.
- **Autonomous systems**: Their diverse safety systems and sensors mean that integration challenges have a greater impact on safety.
- **Human factors**: There are a lot of distractions in the mining environment due to integration challenges (e.g., multiple screens making it difficult to operate equipment).

### Ways operators are addressing this challenge::

Vendor-neutral logical model • Simulation and digital twin • Integrated operations centre  
Frameworks methodology • Building information modelling (BIM) • Advanced work modelling

### 7.3 Data Quality, Reliability, and Management

Getting the right data, getting quality data, and getting it in a timely manner is a key challenge as more digital technologies are introduced. Details should be covered internally or in the operator and supplier relationship because each operation has a different situation, however, common language (see above) is a collaborative focus. Key considerations and challenges include:



### 7.4 People, Education, and Skills

People, education, and skills development play an important role in connection to better data practices.

- **Fundamental training:** There is a gap in understanding the basics onsite around different formats and what is available. Fundamental training and education in data science is needed before applying new technologies for different stakeholders, even if it is just for the purpose of understanding why they are collecting certain information.
- **Regional variation:** Data fundamentals taught in higher education varies widely between regions (e.g., skills are generally more segmented in North American programs, while data basics such as SQL and time series data are taught as a core skill in many engineering fields in South America).
- **IT and OT departments:** Often IT and OT personnel struggle to communicate because of their different backgrounds (e.g., IT personnel often come in from other industries and there is a learning curve around the mining part).

# 8. SUSTAINABILITY

These roundtables had a strong focus on the interactions between operations and communities and explored some additional topics related to sustainability such as tailings and water management. Participants represented a range of functions within mining companies including sustainability senior management, carbon management, mining specialists, and environment and community management. There was also a mix of mid-tier and large mining companies.

## 8.1 Community and Social Acceptability

Community and social responsibility emerged as a key overarching theme, with discussions on the need to look beyond social licence to operate and to voluntary social acceptability.

<p><b>SOCIAL LICENSE TO OPERATE</b></p> <p>There are increasing constraints and expectations from a regulatory perspective in terms of environmental obligations to retain social license to operate. New environmental impact reduction requirements related to biodiversity and the circular economy are key factors.</p>	<p><b>SOCIAL ACCEPTABILITY</b></p> <p>It may have been acceptable to just comply with regulatory conditions or approval in the past, but the industry now needs to take more voluntary actions and be more transparent to achieve social and environmental acceptability.</p>
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*"It's an expectation that we disclose more and are more transparent as an industry."*

### KEY PRIORITIES AND CHALLENGES

<p><b>EDUCATION AND TRAINING</b></p> <p>New criteria lead to needing to have or develop new competencies in applied science that we wouldn't traditionally have had.</p>	<p><b>MISINFORMATION</b></p> <p>Misinformation can spread through social media can influence the reputation of the industry. Being able to monitor possible misinformation to be proactive about it would be helpful.</p>	<p><b>MINE CLOSURE</b></p> <p>Relinquishment is also growing increasingly difficult to achieve. This is especially a challenge for mines with shorter lifecycles.</p>
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## 8.2 Decarbonization and Greenhouse Gas Reduction

Participants identified that the industry has been doing a good job of working together to advance in this space, but there is still a long way to go, and energy demands are going up. While this was identified as a current challenge, participants noted that the industry should also avoid being narrowly focused on energy and decarbonization when it comes to sustainability since it is part of a bigger picture.

### COLLABORATIVE APPROACH

Decarbonization should be viewed as a topic like safety where you don't try to build competitive advantage in it. Scope one and two emissions are typically easier to address collaboratively than scope three emissions (emissions from assets not owned or controlled by the reporting party), which have to be addressed both upstream and downstream because there is a different legal landscape.

#### COMMITMENTS AND TARGETS

Many operations have decarbonization commitments and goals (e.g., net-zero by 2050). Many factors (e.g., energy generation method, feasibility of adopting electric vehicles) affect how challenging this is.

#### EFFICIENT EQUIPMENT

More efficient equipment (trolley assist systems, battery electric vehicles) is becoming more and more available, but each come with design and implementation challenges that need to be considered.

#### BRIDGING STRATEGIES

A priority is finding bridging strategies that can help get greenhouse gas emission reduction until we really know what the real solutions are going to be as technology evolves and develops.

***"I think some companies are further along than we are towards net zero. Collaboration is certainly going to be important. I don't think any of us can achieve net-zero on our own. Nobody has the resources to do that."***

## 8.3 Technology Enablement and Data Management

In addition to common data and technology enablement challenges, two key challenges related to sustainability were identified:

#### DIVERSITY OF TECHNOLOGY OPTIONS

One of the biggest challenges with enabling sustainable technology, whether equipment like BEVs or advanced environmental monitoring technologies, is understanding what the options are and what ones would be best for the situation before replacing existing equipment and systems.

#### DATA DISCLOSURE AND TRANSPARENCY

There are increasing demands for disclosure both in terms of transparency on operations and in terms of the data that are made publicly available. However, relating operational emissions data (such as CO<sub>2</sub> emissions) to financial data can be challenging.

## 8.4 Water Stewardship and Management

Water management and water stewardship both emerged as key themes.

### WATER STEWARDSHIP

As an industry, we need to play our role in ensuring that the surrounding communities have continued access to clean water.

### WATER MANAGEMENT

Minimizing water generated is an initial priority, then treating and reusing it onsite. Progress has been made in the past five years with water treatment technologies and methods being developed. Water management challenges vary depending on how much fresh water is available. For example, many mines near the coast are using desalination, and reverse osmosis is also an option. However, both use a lot of energy.

## 8.5 Tailings Management

Discussions on tailings management focused on technology opportunities for managing monitoring and critical controls.

### ADVANCEMENT OF REAL-TIME MONITORING

Some regulations require real-time monitoring that alert communities if tailings are moving, and real-time monitoring technologies for tailings are advancing as a result of this. For example, new battery-operated monitoring technologies can last for many years. However, with this rapid advancement in technology, there is a need for standardization.

### COLLABORATION ON CRITICAL CONTROLS

Having some guidance on critical controls and measures associated with tailings dams that can then be translated down to technology opportunities would be beneficial.



# 9. THE PATH FORWARD

While this report will be used as a reference to make sure future work in GMG Working Groups aligns with the needs of the industry and the GMG community, further input from the industry is always welcome. GMG recognizes that industry needs are evolving and intends to evolve with them. We welcome input and participation from all industry stakeholders.

Some examples of how you can contribute include:

- Sharing information such as case studies, use cases, success stories and lessons learned
- Getting involved and get others from your company involved in GMG Working Groups and Projects
- Attending or presenting at GMG events
- Spreading the word about industry initiatives being tackled within the GMG community
- Being a line of communication to ease the sharing of information between industry organizations
- If you are involved in other organizations, looking for collaboration opportunities

For information on participating, please contact us at [info@gmggroup.org](mailto:info@gmggroup.org) or through our [website](#).

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