



## Autonomous Mining Breakout Session | GMG Austmine Perth Forum | 2022

Participants of the GMG Austmine Forum (August 17-18, 2022, in Perth, Australia) discussed priority autonomous mining topics, along with the associated challenges/requirements, and next steps to address them. The priority topics discussed included:

- Zero-entry mining (discussed by three groups)
- Small truck automation (discussed by three groups)
- Change management (discussed by two groups)
- Operational readiness (discussed by two groups)
- Community and social impacts (discussed by one group)

### Zero-Entry Mining

#### What are some key advancements in recent years?

- Wireless networks make it possible (e.g., internet speeds).
- People are adapted to operating remotely.
- There are parts of the underground mine that have mostly become zero-entry (e.g., block caving remote operated LHDs).
- Some companies are hosting site visits.



#### What are key challenges/roadblocks to overcome in this area?

- Perception and personal preferences.
- Variables on the frontline can be lost working remotely.
- Not enough machines available to replace humans.
- Identify tasks, prioritize, and engage with those that can be solved early.
- Infrastructure dependency.
- The nature and purpose of operator alarms - eliminate the unnecessary.
- Zero-entry mines need to be designed for easy human access.
- Change management and full understanding of the stability of physical environment.
- Challenges using design thinking.



#### What are key lessons learned in recent years that can be used in the future?

- How to keep front line knowledge without information overload?
- Human factors not always considered in integrated system planning early.
- Not changing equipment unless they are categorized as a failure.
- Zero-entry is unattainable but aiming at it will improve returns.

### Small Truck Automation

#### What are some key advancements in recent years?

- Ruggedization of onboard hardware.
- 4G/5G technologies.
- Good change management cultures drive effective outcomes.
- Advancement outside the mining industry (e.g., construction).
- Sensor technology become cheaper and higher quality.
- Progressing with demos in Europe.



#### What are key challenges/roadblocks to overcome in this area?

- Mine management and ineffective change management (e.g., training).
- Technology availability and lack of integration.
- Requirements gathering and economic feasibility for small truck operations.
- Security aspects, communications, and data increase with a larger fleet.
- More challenging traffic management.
- Technology not ready for more data and fleet numbers (i.e., maintenance).
- There is not a lot of focus from large mining companies.
- Current investment cost makes the technology not attractive.



#### What are key lessons learned in recent years that can be used in the future?

- Change architecture and mine planning for autonomous optimization.
- Cybersecurity lessons.
- Learnings from semi-autonomous existing mining fleets.
- Lower productivity offset with increased utilization.
- Safety systems for human systems integration for on road applications.
- Managing requirements from multiple industries to help with adaptability.

Note that this document captures some key discussions from industry participants during breakout sessions on autonomous mining during the GMG Austmine Forum held in Perth, Australia on August 17-18, 2022. It is intended to be one of many inputs into the working group and is not intended as industry guidance or a formal report.



### Change Management

#### What are some key advancements in recent years?

- Pace of technology advancement makes established practices quickly redundant.
- Consolidated holistic options are available from 3rd party vendors (well understood and structured process over time).
- More focus now than before (changes are planned and measured).



#### What are key challenges/roadblocks to overcome in this area?

- Investment in change management.
- Early engagement with end users and clearly communicating what is in it for the end users (i.e., vendor/customer alignment and transparency).
- Cultural challenges to potentially imposing technologies.
- Remote implementation of technology.
- Risk perception different depending on department and roles.
- Increasing number of stakeholders providing input that is not useful.
- Navigating frequent changes and managing all stakeholders.



#### What are key lessons learned in recent years that can be used in the future?

- It starts with the right leadership and culture
- Well-established decision-making process essential. Formalized and simplified processes.
- Communication is key for successful implementation of new system.

### Operational Readiness

#### What are some key advancements in recent years?

- Technology availability.
- Maturity learning experience.
- Culture change of the process and understanding to include stakeholders early.



#### What are key challenges/roadblocks to overcome in this area?

- Preparing to receive short lifecycle of "obsolescence" technology.
- Change Management (role/technical changes) and training.
- Value adds communication and stakeholder engagement.

#### What are key lessons learned in recent years that can be used in the future?

- Modular technology (i.e., reprogrammable, scalable).
- Minimize the change impact on operators.
- Allow all personnel the opportunity to understand and see the processes.

### Community and Social Impact

#### What are some key advancements in recent years?

- The Global Industry Standard on Tailings Management (GISTM)
- Automation and job security.
- Safe work environment (e.g., limited dust, health DPM, silicosis).



#### What are key challenges/roadblocks to overcome in this area?

- Consensus inside industry holistic stakeholder satisfaction.
- Overload and prioritization.
- Proving grounds and future skills.



#### What are some key lessons learned in recent years that can be used in the future?

- Human factor acknowledgement and consideration.
- Staged/phased implementations (acceptance, course corrections, training/support).

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