Towards Zero-Entry Mining Roundtable Outcomes | 2022

These outcomes are from the *Towards Zero-Entry Mining Roundtable* held on August 30, 2022. Participants discussed how to define the zero-entry mining concept, the implementation challenges and opportunities, and potential use cases. In the second half of the roundtable participants outlined the plan to increase industry education and awareness. Some of the key points that were noted includes determining if zero-entry is the appropriate name for the project, the different industries that mining can leverage off, technology integration challenges (e.g., cybersecurity), and socio-economic challenges (e.g., replacing humans).

Defining the Concept

Defining the zero-entry mining concept

Terminology

- Zero-entry is too strong a term for near future. It could be relative to an area of operation in the mine where all necessary tasks could be done without having people in that area. This could be a step towards the fully autonomous mines of the future.
- Reduced manned operations instead of zero-entry (or autonomous)

The Goal

- Reduced entry might be the path to a safe and product mine but that along is not necessarily valuable.
- Towards fully autonomous operations without people onsite (e.g., designing excavations for non-humans)
- Ability to change mining requirements (i.e., an opportunity to think about where humans are required) and allow a more diverse workforce
- Connected end-to-end value chain (i.e., incorporate processing and transport)

Specific Components

- Electric barriers
- Tele-remote or semi-autonomous equipment only
- Digital workforce, AI, remote operations, smart robots
- AOZ defined in Standards 17757 as a requirement
- Advanced decision support

What it isn't

- It is not only about the technology (e.g., autonomous trucks/drills) and not for every mine/situation
- Extra terrestrial mining
- Manned and autonomous operational area together (no people underground)
- Not immediate transition

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Challenges and Opportunities

Challenges	Opportunities
• Maintenance/servicing of the autonomous equipment • Socio-economical impacts (e.g., concerns of replacing people with machines) • Quantifying the value to convince the mine managers to implement the concept • Not even feasible for existing mines (needs to be designed for zero-entry) • Robotizing process that are currently handled by people (e.g., networking, power) • Defining the safety barriers for the limits of the AOZ • Collision avoidance • High cost of initial enablement and technology availability for all operations • Work permit and Simultaneous Operations (SIMOPS) • Cybersecurity (Security Threat) • Lack of standards (i.e., regulatory approvals), procedures, training, and skills (i.e., people with new rising competences required (automation, AI, analytics, predictive maintenance/condition-based monitoring, networks) • Capabilities are different for current operations (e.g., infrastructure, networks) • Fragmented application/data landscape (OEMs, software vendors, etc.) • Mining industry not flexible to adopt new paradigms once mining commences. • Using multiple OEMs in one zone/area	• Get rid of cost-drivers such as ventilation • Some mining methods enable this to happen now (e.g., deep sea mining) • Improved safety • Leverage latest communications (5G, etc.) • Ability to reduce costs of systems needed for people • Efficiency Improvements • Reduced road width • Operate over shift changes • Reduced ground support in underground mines • Chances to determine inefficiencies in the mine. • Shift from reactive to proactive working environment (automation combined with access to reliable /on-demand information) • Better use of data to enable operational decisions • Partnership with other industries (e.g., space)

Use Cases

Environmental	Technology
• Sea floor • Deep underground • Working in seismic areas • Dozing around the pit edge • Draw point sampling	• Underground (hard rock) production drill and blast activities • Haulage and loading using automated LHD/Boegrs and trucks • Autonomous surveying and mapping using robot-in-the-box • Remote and autonomous post-blast monitoring underground to enable the inspection of certain areas after blast from the surface without sending the re-entry crew
Safety	**Process**
• Working during blast clearance • Automation of repetitive tasks that causes workplace fatigue	• Distributed operations centres • Remote mining as a service

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Requirements

- Global best practices/use cases
- Defined Protocols
- Define work streams as part of working group (e.g., research existing papers)
- Stakeholder management

Project/Action

- **Define exactly what it is and get industry feedback.**
    - Define zero-entry mining inclusions (e.g., fully autonomous, semi-autonomous, tele-remote).
    - Think through (or clarify) the motivation behind introducing new terminology.
    - Describe future vision. Where do we want to get to and why?
    - Define a roadmap with different autonomous levels from now until the vision of having fully autonomous mines/zero-entry.
- A **survey or conference** with mining companies and OEM experts to understand their plans and interest in this space and then form a smaller working group with experts and invested people to progress (while consulting with the larger group) until we have more clarity.
    - Seek leadership in this area: blogs, posts, and articles about mines of the future and the journey to get there.
- Run pilot projects with some mines to implement autonomous operations for certain use cases and demonstrate the value.

Publication Goals

- Generate a **white paper** about the concept of zero-entry mines of the future.
- Conduct a **landscape** to understand all the concepts and frameworks that are already in place.
    - Leverage existing and adjacent research (e.g., AROSE Remote Ops Capability paper).
- **Case Studies and conceptual business case.**
- Regulatory approval guidelines (e.g., Can we drill and load immediately if no people are present?).

Purpose/Value to Industry

- Education/ sharing knowledge (e.g., publishing and sharing cases studies about successful implementation of autonomous systems).
- Achieve buy-in and alignment.
- Determining what needs to be changed (e.g., mine design, maintenance practice, equipment design).
- Shared understanding and ability to leverage work completed or WIP.

Scope

In scope:

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- Surface and underground operations from end-to-end (not just the mining face).
- Include maintenance and service personnel into autonomous areas.

Out of scope:
- Interoperability