Knowledge and Information Transfer in the Mining Business

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Agenda

1. Introduction
2. ESI overview
3. Importance of knowledge and information transfer
4. ESI projects / case studies
5. Feedback
ESI Overview

• **Industry-led** working group
• 25+ members from **across the mining innovation ecosystem**
• **Mandate:** define and solve some of the myriad sustainability issues facing the mining business
## ESI Roadmap

### Themes

<table>
<thead>
<tr>
<th>1-3 Years</th>
<th>3-5 Years</th>
<th>5-10 Years</th>
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<tbody>
<tr>
<td><strong>Industry Needs Assessment</strong>&lt;br&gt;Technology roadmaps, TRL* assessment, RDI* coordination, project definition</td>
<td><strong>Technology Acceleration</strong>&lt;br&gt;Lab, bench-scale, proof-of-concept, field / site testing and validation</td>
<td><strong>Commercialization</strong>&lt;br&gt;Technology scale-up and broad uptake by industry</td>
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<tr>
<td>Linking CMIC technical groups and tailings technology clusters to develop whole-system approaches</td>
<td>Reduction in contaminant loadings; contaminant removal; ARD management; ML management; saleable waste products</td>
<td>25% reduction in tailings disposal and treatment costs; widespread reduction in environmental footprint</td>
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<tr>
<td>Mapping technology development / management approaches to optimize water consumption and treatment</td>
<td>Water re-use / recycling; closed-loop / zero-discharge operations; treatment with resource recovery; real-time monitoring</td>
<td>25% reduction in water management costs and liabilities; widespread reduction in water consumption</td>
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<tr>
<td>Iterative stakeholder consultation process to determine industry, regulatory, and government requirements</td>
<td>Passive systems; natural landform / applied geomorphology; bio- and phyto-remediation; standardized framework for relinquishment</td>
<td>25% reduction in closure liabilities, provisions and bonding requirements; frameworks for long-term stewardship reduce risk of abandoned / orphaned mines and associated liabilities</td>
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<td>Predictive modeling for rehabilitation and reclamation scenarios; integration with existing modeling software; pilot-scale databases of environmental data</td>
<td>Analytical tools for determining environmental effects / impacts; scaled-up databases in major mining jurisdictions</td>
<td>Improved accuracy of predicted and actual environmental performance, costs and liabilities; comprehensive, national data portals linked to environmental data</td>
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### Tailings (benign tailings, in situ treatment)

- Linking CMIC technical groups and tailings technology clusters to develop whole-system approaches

### Water (volumes, process management, discharge, monitoring)

- Mapping technology development / management approaches to optimize water consumption and treatment

### Closure ("walk-away" technologies / systems; relinquishment)

- Iterative stakeholder consultation process to determine industry, regulatory, and government requirements

### Environmental Data Management (access, analysis, preservation)

- Predictive modeling for rehabilitation and reclamation scenarios; integration with existing modeling software; pilot-scale databases of environmental data
Why Knowledge Hub?

- Data and knowledge are **critical for environmental management** because:
  - Helps inform environmental management strategies
  - Helps assess performance
  - Communicates results to stakeholders
Why Knowledge HUB?

Records and Information Management.

The investigation of the breach informed MEM about the need for a comprehensive records management system (....)

Such a system would assist MEM in regulatory oversight capabilities (....) communications with permittees, and responses.

It would also enhance the ability of MEM to meet the expectations (....) for transparency and disclosure of all appropriate information pertaining to mine permits within the limitations of privacy considerations. Such a system could also support long-term, integrated decision making by the permittee and consulting professionals with responsibilities on mines.
Why Knowledge Hub?

According the Mining Association of Canada (MAC): Facts and Figures 2016 of the Canadian mining Industry:

– Regulatory reform of 2012 maintained the federal government’s high level of mining project oversight, if not increased it.
– Mining projects constitute the vast majority of projects undergoing Environmental Assessments under CEAA 2012.
Why Knowledge Hub?

Why Knowledge Hub?

• Boxes of copies of an EISA submitted in 2015: 6,000+ pages of reports with massive amount of monitoring and characterization data

• Is there a way to make this information more accessible while respecting necessary confidentiality and proper QA/QC?
Knowledge Hub – Problem Statement

• Beyond being key to mining, water is one the primary interfaces between the industry, the regulators, the communities, the land owners and general public
• Water is probably the most regulated aspect in the industry and one of the easiest to associate clear and simple performance indicators
• Reporting is generally done on a systematic basis or according to predefined schedules defined in permits
• Significant resources and $$$ spent collecting and analyzing the data
• Data critical for informing management strategies and assessing performance
Knowledge Hub – Problem Statement

• Reporting approach is not adapted to current technologies and remain quite traditional
• Duplication of effort (i.e. proximal mine sites) – difficult to integrate into larger context: watershed approach
• Data is difficult to access by land owners, stakeholders and public – most of the data ends up being public anyway
• Transferability of data for future use (EAs, permits, etc.) remains challenging
• Knowledge base for making informed resource management decisions is currently not optimized
Knowledge Hub – Project Overview

• Project objectives: compile, centralize, and disseminate water quality data
• Partnership with innovative earth science organization, Geoscience BC
• Pilot project ongoing in British Columbia
• Preparing for scale-up in 2017/18
Knowledge Hub – Benefits

- Data preservation
- Data accessible for future projects (i.e. EAs, permits, etc.)
- Reduced duplication of effort
- Enhanced baseline / knowledge base = better management
- Enable better cumulative effects analyses
- Improved access enhances transparency and social license
CMIC, in partnership with Geoscience BC, is developing the first stage of the Mining Industry Knowledge Hub, which is a repository of environmental data related to mining activities in British Columbia. The primary information included in the mock-up is publicly-available water quality data. Additional environmental data may be incorporated into the Hub as the project progresses.
OMIC, in partnership with Geoscience BC, is developing the first stage of the Mining Industry Knowledge Hub, which is a repository of environmental data related to mining activities in British Columbia. The primary information included in the mock-up is publicly-available water quality data. Additional environmental data may be incorporated into the Hub as the project progresses.

Sample Locations (80)

<table>
<thead>
<tr>
<th>EMS_ID</th>
<th>MONITORING</th>
<th>NPRI Facility Locations</th>
<th>Industry Data - Sign-In Required</th>
<th>LOCATION_T</th>
<th>SAMPLE_STA</th>
<th>SAMPLE_DESC</th>
</tr>
</thead>
<tbody>
<tr>
<td>E003013</td>
<td>HAC-08</td>
<td></td>
<td></td>
<td>RIVER, STREAM OR CREEK</td>
<td>Fresh Water</td>
<td>General</td>
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Knowledge Hub – Regulatory Changes

It is important the industry remains at the forefront of potential, upcoming changes:

– MMER amendments include proposal that all data become public
– CEAA expert panel recommends that all EA data – including baseline data – be included in a national database for public access (*Building Common Ground: A New Vision for Impact Assessment in Canada*)
Remote Sensors Project – Summary

• Real-time data opportunities
• Aligned with digital transformation across mining business
• Enables stakeholders to make data-driven decisions
Remote Sensors Project – Problem Statement

- Water quality monitoring critical for environmental management
- Most monitoring conducted via “grab” sampling
- “Grab” sampling a highly-limited, outdated approach
Remote Sensors Project – Benefits (I)

- Reduces lag times for sampling results
- More data = more representative picture of water quality, rather than the “snapshot” provided by grab sampling
- Early-warning mechanism
- Mitigates sampling errors and degradation during transport
Sensors Project – Benefits (II)

- Reduces safety and health risks of sampling in remote locations
- Extra layer of stakeholder confidence
- Significant implications for process control
Sensors Project – Overview (I)

- Consortium of mining companies
  - Agnico Eagle, Barrick, and Teck
- Matching funding from funding agencies
- De-risks technology development and leverages upside
Sensor Project– Overview (II)

- Investing in multiple mid-stage technology companies
- Genomics-based technology
- Demonstration / validation work
- Sensor customization and development work
Sensors Project – Example Technology

BACTERIA SENSE THE CONTAMINANT...

...AND PRODUCE AN ELECTRIC SIGNAL...

...THAT IS MEASURED BY THE DETECTOR...

...WHICH REPORTS THE CONTAMINANT CONCENTRATION.
Next Steps

• Revise roadmaps based on stakeholder feedback
• Define and develop additional projects
• Build on current success by executing additional initiatives
Thank you!