Re-thinking Surface Mining Collaboration

CMIC Annual General Meeting
June 9th, 2020 Virtual
Mal Carroll
Syncrude Canada Ltd.
Surface Mining Working Group

• Bring together cross commodity working group in surface mining operations:
  o Oils Sands, Gold, Base metals
• Build relationships, trust and networks.
• Get organized, explore opportunities, prioritize and get aligned – build a road map.
• Deliver industry identified projects – operational improvements and step change technology:
  o Alternative haulage, ore body knowledge and sorting, automation, electrification, digitalization, predictive analytics, water and tailings.
• Collaborate…
Surface Mining Working Group

Industry Participants

• Agnico Eagle
• Newmont
• Vale
• Glencore
• Teck
• Suncor
• Syncrude

Network Connections

• Canada Oil Sands Innovation Alliance (CNRL, IOL)
• CMIC Underground Mining WG
• Global Mining Guidelines
• Alberta Chamber of Resources (ACR) / University of Alberta Mining Industry Advisory Committee (MIAC)
• HATCH
• Deloitte

• Future work is planned to connect Universities

Significant Collaboration Leverage
CMIC Enables & Supports Connections to Organizations

- Mining And Supplier Associations
  - Mining Companies
  - Oil Sands Companies
  - OEM's and Suppliers
  - Consulting & Engineering Firms

- Accelerators and Incubators

- International Innovation Organizations
  - Research & Development Organizations
  - VC's, Banks

- Groups:
  - CMIC
  - Enables & Supports
  - Connections to Organizations
  - CEEC
  - Mining3
  - METS Ignited
  - Expande
  - CANMET
  - COREM
  - COSIA
  - CEMI
  - IMII
  - Mirarco
  - National Research Council
  - UAlberta
  - UToronto
  - Chrysalix
  - BDC
  - Agnico Eagle
  - Eldorado Gold
  - Glencore
  - Goldfields
  - Iamgold
  - Kinross
  - Newmont
  - Teck
  - Torex
  - Vale
  - Syncrude
  - Suncor
  - CNRL
  - Imperial Oil
  - Komatsu
  - Sandvik
  - Sepro
  - MacLean Engineering
  - MolyCop
  - Hatch
  - Deloitte
  - Optimize Group
  - XPS
CMIC Enables and Builds the Surface Mining Collaboration Ecosystem

We need to advance quickly, cost effectively and deploy technology that provide real results...

Lead (funder/doer)

Convene (facilitator)

Learn (connector)

Increase Efficiency
Reduce duplication of effort
Evaluate Technology Readiness
Reduce uncertainty

We will focus efforts, leverage resources and collaborate to accelerate the pace of innovation...
Collaboration in Surface Mining – Key Events

- February 2018 CMIC Surface Mining Collaboration Kick Off Workshop (facilitated by Deloitte).

- January 2019 ACR-MIAC Research Summit, Over 40 firms, and 77 Attendees
  (Alberta Chamber of Resources - Mining Industry Advisory Committee)


- September 2019 COSIA Innovation + Mining and Extraction Technologies

- October 2019 GMG-CIM Edmonton Forum

- May 28th, 2020, CMIC Surface Mining Strategic Session
Road Maps -> key to Alignment & Commitment

CMIC Roadmap has helped facilitate identification of common interests ...

Company Technology Strategy

CMIC SMWG Activities i.e. Tech Scan

Adjacent sector & external technical, business and sustainability

... using roadmaps to link wider mining innovation ecosystem.
Surface Mining Industry Collaboration 2018 to 2020

Focus of Collaboration

- Learning/Discovery Mode
- Broader focus of discussion.
- Looking for ideas or opportunities to progress.
- Increasing level of detail as opportunity progresses through each stage of work.
- Increasing value realized.

<table>
<thead>
<tr>
<th>Collaboration Topic</th>
<th>Ideation</th>
<th>Assessment</th>
<th>Execution</th>
<th>Sustainment Transferred, Completed</th>
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<tbody>
<tr>
<td>Potential topic</td>
<td>Topics conceived are explored more deeply</td>
<td>Sensor Based Ore Sorting Consortium Charter In Progress May 30, 2020</td>
<td>Phase 2 Alternate Haulage Non Disclosure &amp; Confidentiality Agreement in Progress</td>
<td>Phase 1 Alternate Haulage October 2019</td>
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<tr>
<td>Fully Digitized operations with performance feedback loop May 28th &amp; 29th 2019 CMIC &amp; COSIA</td>
<td>Improved Predictive Analytics May 28th &amp; 29th 2019 CMIC &amp; COSIA</td>
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<td>Selective Mining January 31st, 2019 ACR-MIAC</td>
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<td>Improve Water Treatment Management January 31st, 2019 ACR-MIAC</td>
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Alternative Haulage – Phase 1 Technology Scan

Identified existing and developing material movement solutions – worldwide.

27 Technologies compared, current technology readiness level (TRL) assessed.

Established the evaluation framework to objectively compare the different technologies.

Participants shared existing knowledge on current state to avoid duplication.

Investment to produce $250,000

Participate Leverage value of 8 : 1
Consider complex trade-offs in the context of mine operations

Members will now help develop evaluation criteria (Phase 2)

- Spatial vs capacity flexibility vs energy efficiency
- Economics vs flexibility vs operability
- Society vs environment vs economic value
- Existing vs brown field vs green field
- Mine adoption vs technology readiness
- Others

Technology Example - Magnetic Pipeline Conveyor
Value Based Technology Adoption – Phases

Phase 2
- Historic empirical data
- Existing surface mining operation
- Model and simulate historic operations
- Create a predictable model
- “Digital Twin”
- Historic financials performance
- Model and simulate historic financials
- “Digital Triplet”
- Mine Base case Value

Phase 3
- “what if” modeling
- Optimize technology performance
- Address technology risks
- Assess technology risks

Phase 4
- Dynamic simulation of material movement system
- Simulation of the technology
- Component simulation
- Optimize technology configuration

Phase 5
- PLAN ADOPTION
  - Select optimal material movement system configuration
  - Commission engineering studies for targeted mines
  - Evaluate results and develop path forward with technology innovator
  - Develop plan to implement and realize value

Applied to Alternative Haulage Project

This is a priority – phase 2 start June and phase 3 scoping July.
Each company provided their Innovation Roadmap, highlighting project collaboration interest with members.

Next Session July:
Identify new collaboration synergy and project alignment.

Discovery Process

30+ participants
In Summary ... for the CMIC Surface Mining Working Group

We have grown our **relationships** with transparency, honesty, openness & trust.

We are having extremely **valuable interactions** with great communication.

We have a **deeper understanding** of each others priorities and challenges.

Areas of technology **focus** are common and aligned.

We are supportive and **leverage** each other and CMIC.

We have made **connections** in innovation, in Mine Technology and beyond.

Effective **collaboration** has been enabled...
Accelerate the pace of innovation in surface mining!

Thank You