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Cover photo: Agnico Eagle
LETTER FROM THE CHAIR

The mining industry is on the upswing.

Following the challenging drop in commodities, 2017 is expected to bring some great opportunities to our industry. As current Chair of GMSG, I am pleased to represent all of our members as we continue the important work of bringing new guidelines to the mining industry. Last year we took an opportunity to look inward, with the help of our executive, governing and leadership councils, to determine what value our ongoing projects bring to the industry. As a result, we closed the door on some projects, and began the exciting work of developing new ones. We did this through the lens of what we consider to be key building blocks for ongoing innovation in the mining industry: building the strategic vision of future mining (autonomous mining, battery electric vehicles underground), revolutionizing the mine cycle (integrated operations), realizing the true value of data (KPIs and Big Data), and total systems approach (connectivity, interoperability, the digital mine – across the full value chain).

While our expectations were ambitious, much was accomplished. The hard work of our Data Access and Usage Working Group and Industrial Comminution Efficiency Working Group led to the publication of four guidelines. The Mobile Equipment Open Data consensus guideline, the result of discussions between owner/operators and Original Equipment Manufacturers (OEMs) for access to on-board equipment data, was released in April. The trio of Comminution Efficiency guidelines on the Bond Work Index, the Morrell Method, and Surveying and Sampling were also released last year.

Last year saw immense growth in both membership and participants of GMSG. A new tiered membership structure was introduced in 2016, and we launched the Leadership Council. The Leadership Council was founded with eight member companies: AngloGold Ashanti, Atlas Copco, Barrick Gold, BHP Billiton, Caterpillar, Glencore, Hatch, and Rio Tinto. These global entities provide senior-level strategic input for GMSG. Our membership has also grown, adding 15 new companies in the past year and doubling the number of participating individuals.

A success story resulting from our tiered structure has been the introduction of the Future Mining Summit, an annual meeting between GMSG’s Governing Council and project leaders, Leadership and Collaborator members, to build GMSG’s priorities for the future of this industry.

Forty-eight people representing 20 companies attended the inaugural Summit, where the focus was on gaining invaluable insights from outside industries, from digital to automotive. It was in Amazon’s own offices that we were treated to an inspired keynote from Gavin Jewell, Director, Website Platform, on the importance of experimentation and risk-taking. I believe it speaks to the heart of what we’re trying to accomplish for the industry, and it was a fitting inclusion for such an important event for our organization.

This year we will continue to grow our events and forums to offer a space for stakeholders and industry associations to enhance their collaborative efforts. We’ll also continue to deliver valuable guidelines. We are providing professional growth workshops for employees of our member companies and we have more than 10 guidelines expected to be near publication by year’s end.

Even if you are unable to work with us face-to-face, I invite you to stay engaged with us on Twitter and LinkedIn, subscribe to our mailing list and visit us at www.globalminingstandards.org. Help us spread the word and increase participation. There is much to look forward to in the upcoming year, and we’re eager to share it with you.

Stay engaged,

Helius Guimaraes
Chair, GMSG
Performance

» 10+ guidelines targeting draft completion/publication by year-end. Thanks to growing corporate membership and project funding, more resources will be committed to enable swift, high quality progress and ensure strong stakeholder engagement.

» Develop a guideline implementation strategy to ensure published guidelines are picked up and deliver value to industry.

» Target partnerships with like-minded industry organizations to enable more inclusive and broader stakeholder engagement while avoiding redundancy of efforts.

Membership and Volunteers

» Engage resources to facilitate the projects to lessen the burden on volunteers.

» Further develop the matrix of collaboration options (online, teleconference, in-person) to help volunteers fit GMSG into their schedules.

» Planning: events and materials to be developed and circulated early enough to accommodate busy schedules.

» Develop recognition program to thank volunteers and members for their leadership and support.

Globalization

» Continue development of GMSG membership base in South America and Africa.

» Hold first GMSG events in Asia, Europe.

» Support a robust virtual collaboration matrix for volunteers, including online, tele/video conferences, workshops, regional forums and increased communications for project groups.

» Language: focus translation to Spanish for key GMSG documents.

» Expand partnerships with regional associations/government bodies to foster greater outreach to and inclusion of local industries, and to better understand the “burning platforms” of the mining industry around the world.

» Standards organizations: continue collaboration with standards bodies such as ISO, The Open Group, SLC, CSA, OPC, GS1, etc. and expand standards organizations network globally.

Communications

» Increase communications with GMSG members, focusing on timeliness, and increasing awareness of and engagement in GMSG projects and events.

» Increase communications with greater mining industry, to raise awareness of GMSG and GMSG guidelines, and attract more membership.

» Greater utilization of web-based tools, including podcasts, GMSG website, and social media.

Growth and Sustainability

» Attract new Corporate Members at all membership tiers, to enable increased resources for GMSG projects and, more importantly, broader stakeholder participation in GMSG working groups.

» Target partnerships and funding opportunities with governments and grant organizations that reflect GMSG’s commitment to a safe, sustainable and innovative industry.

» Partner with universities and other R&D leaders.

» Ensure GMSG projects reflect industry priorities and bring maximize value to GMSG members.
EVENTS

WORKSHOPS

Denver, USA
☑ INTEROPERABILITY
February 19
☑ DATA EXCHANGE FOR MINE SOFTWARE
February 21
☑ AUTONOMOUS MINING
February 23

Santiago, CH
☑ INTEROPERABILITY
March 27

Alberta, CA
☑ RELIABILITY
April 19–20

Perth, AU
☑ INTEROPERABILITY
February 7
☑ INTEGRATED OPERATIONS
February 8
☑ UNDERGROUND COMMUNICATIONS INFRASTRUCTURE
February 8

Toronto, CA
☑ BATTERY ELECTRIC VEHICLES UNDERGROUND
January 26
☑ INTEGRATED OPERATIONS EXECUTIVE ROUNDTABLE
February 2
☑ UNDERGROUND COMMUNICATIONS INFRASTRUCTURE
February 7

Montreal, CA
☐ BATTERY ELECTRIC VEHICLES UNDERGROUND
April 30
☐ INTEGRATED OPERATIONS
May 3
☐ AUTONOMOUS MINING
May 3
How to break down the barriers in the mining industry

The mining industry is at a turning point. Processes and technologies that have been mainstays for decades are increasingly becoming obsolete, and modern tools are being developed faster than they can be implemented. While this is a challenge for all industries, the mining sector must also overcome its tendency toward siloed development before it can take advantage of these new tools. A lack of communication between sectors and companies has created an impenetrable barrier to real innovation.

Fostering Open Collaboration

GMSG’s Future Mining forums are intended to break down those barriers. First held in Edmonton in 2015, they have become a central hub of collaboration for high-level industry members to collaborate and share their expertise on common industry problems. Thus far, participants have developed a shared vision of a safe, sustainable and efficient future mine, developed through the building blocks of integrated operations, reliability and interoperability.

“Collaboration is key to success in the mining industry,” says Andrew Scott, GMSG Out-going Chair and Senior Director, Digital Mine, Barrick Gold. “The Future Mining Forums were created to help facilitate that collaboration and offer a networking opportunity for forward-thinking innovators in the industry. The conversations sparked at these forums are the foundation for real solutions to common industry problems across all parts of the mining sector.”

Their open nature means any company or individual in the industry can participate. They offer an opportunity to see what occurs when the silos are broken down, get a real perspective on what is happening in the industry and evaluate how your company’s innovations can solve the riddle of achieving the vision of future mining.

Next Steps

A major focus will be on regional differences, with discussions and panels geared toward building plans that will resonate with the local mining community. At the 2016 Brisbane forum, the participation of the AusIMM, METS Ignited and Austmine helped to paint a full picture of the collaboration opportunities to benefit the Australia mining industry, including work on GMSG’s Data Exchange for Mine Software Project. The Singapore forum in February 2017 also led to key discussions with the Singapore Economic Development Board on future collaboration.
CORPORATE MEMBERS

LEADERSHIP MEMBERS
- AngloGold Ashanti
- Atlas Copco
- Barrick Gold
- BHP Billiton
- Caterpillar
- Glencore
- Hatch
- Rio Tinto

COLLABORATOR MEMBERS
- Amazon
- Anglo American
- ARANZ Geo
- Hitachi
- Orica
- Teck
- WENCO

CORPORATE MEMBERS
- 3DP
- Alight
- Agnico Eagle
- ASI
- CEMI
- Centric Mining Systems
- CheckMark Consulting
- Datamine
- Deswik
- Desert Falcon Consulting
- DetNet
- Flow Partners
- Freeport-McMoRan
- GE Mining
- Global IO
- Goldcorp
- Guardvant
- Hexagon Mining
- IBM
- Joy Global
- KGHM International
- Kal Tire
- Leica Geosystems
- Liebherr
- Lockheed Martin
- Maptek
- Metcom Technologies
- Micromine
- Minetec
- Mine Vision Systems
- MineWare
- Mining3
- MISOM
- Mosaic
- Motion Metrics
- Newmont
- Newtrax
- OSIsoft
- The PBE Group
- Peck Tech
- Prairie Machine & Parts
- RIGID ROBOTICS
- Rockwell Automation
- Runge Pinock Minarco
- Sandvik
- Schneider Electric
- Shell
- Silver Standard
- SMART Systems Group
- Suncor
- Syncrude
- Total
- Trimble
- Vale
- Vandrico
- Yamana Gold
GOVERNING COUNCIL

CHAIR
Helius Guimaraes, Rio Tinto

OUT-GOING CHAIR
Andrew Scott, Barrick Gold

VICE CHAIR
Gary Westerdale, AngloGold Ashanti

VICE CHAIR INTERNATIONAL STANDARDS
Tim Skinner, SMART Systems Group

TREASURER
Mark Bartlett, Flow Partners

SECRETARY
Peter Becu, Information Systems and Technology Consultant

SAIMM REPRESENTATIVE
Declan Vogt, University of the Witwatersrand

MANAGING DIRECTOR
Heather Ednie, GMSG

INTEGRATED OPERATIONS WORKING GROUP
Laura Mottola, Flow Partners

SITUATION AWARENESS WORKING GROUP
Mark Baker, CheckMark Consulting

TECHNOLOGY AND CONNECTIVITY WORKING GROUP
Paul Raj, Olio Technology Solutions

COMMON REFERENCE FRAMEWORK WORKING GROUP
Roy Irvine, Real IRM

UNDERGROUND WORKING GROUP
Riaan van Wyk, DetNet South Africa
Russell Kennett, Rio Tinto

INDUSTRIAL COMMINUTION EFFICIENCY WORKING GROUP
Aidan Giblett, Newmont

RELIABILITY WORKING GROUP
Zoli Lukacs, Gibraltar Mine

AUTONOMOUS MINING WORKING GROUP
Graeme Mitchell, BHP Billiton
Francois Gariepy, Peck Tech

DATA ACCESS AND USAGE WORKING GROUP
Vacant

INTEROPERABILITY WORKING GROUP
Sergio Burdiles O., CORFO

LEADERSHIP COUNCIL

VP, MAINTENANCE & OPERATIONS SUPPORT
Gary Westerdale, AngloGold Ashanti

VP, GLOBAL STRATEGIC CUSTOMERS
Don King, Atlas Copco

VP, MINING TECHNOLOGY
Olav Kvist, Atlas Copco

CHIEF INNOVATION OFFICER
Michelle Ash, Barrick Gold

MANAGER, MINE AUTOMATION
Graeme Mitchell, BHP Billiton

CHIEF ENGINEER, MINING TECHNOLOGY ENABLED SOLUTIONS
Michael Murphy, Caterpillar

GENERAL MANAGER MINING PROJECTS
Shayne Wisniewski, Sudbury Integrated Nickel Operations, Glencore

MANAGER – SUSTAINABLE DEVELOPMENT AND INNOVATION
Kevin McAuley, Glencore

ASSOCIATE
Alvaro Rozo, GD Smart Industries, Hatch

ASSOCIATE
Jeanne Els, RD Hatch Digital, Hatch

VP, INDUSTRIAL & OPERATIONAL TECHNOLOGIES
Brian Oldham, Rio Tinto
2016 HIGHLIGHTS

4 Published Guidelines

**Mobile Equipment Open Data Consensus Guideline**
*Published: April 2016*
A consensus between operators and OEM that identifies onboard datasets that should be openly available to equipment owners in a real-time, read-only format.

**INDUSTRIAL COMMINUTION EFFICIENCY TRIO**
**Determining the Bond Efficiency of Industrial Grinding Circuits**
*Published: February 2016*
Use of the Bond method and Bond Work Index allows personnel to quantify and compare relative energy efficiencies.

**Methods to Survey and Sample Grinding Circuits for Determining Energy Efficiency**
*Published: April 2016*
Details methods to survey and sample grinding circuits to generate sufficient information to support reliable efficiency analysis.

**Morrell Method for Determining Comminution Circuit Specific Energy and Assessing Energy Utilization Efficiency of Existing Circuits**
*Published: August 2016*
The Morrell method utilizes data from the SMC Test to predict an ore body’s comminution circuit in order to determine energy consumption.

Autonomous Mining Guideline
The result of GMSG’s autonomous mining definition and scope work. The group aims to develop an autonomous mining guideline for international use.

Battery Electric Vehicles Underground Project
The project is a joint effort between GMSG and the Canadian Mining Innovation Council (CMIC), launched in June 2016. As a result, a guideline on the implementation of Battery Electric Vehicles will be published in Q2.

4 New Projects

**Mapping the Interfaces for Equipment Operation**
The project has been developed by the Interoperability Working Group to describe the interfaces at all control layers required for operating machinery, with two phases looking at Control Interfaces and Machine Attributes.

**Cybersecurity**
Created based on corporate member feedback. A kick-off discussion session will be held at the CIM 2017 Convention in Montreal, CA.
### 10 EVENT SPONSORS

- **Alight Mining Solutions** Annual General Meeting (AGM) Networking event, Future Mining Summit, MINExpo Future Mining Forum, Industrial Comminution Efficiency Workshop
- **Barrick Gold** AGM Networking Event, Autonomous Mining Workshop, San Francisco Forum, MINExpo Future Mining Forum, Reliability Forum
- **DetNet** Johannesburg Future Mining Forum
- **Guardvant** AGM Networking Event
- **METS Ignited** Brisbane Future Mining Forum
- **OISsoft** Autonomous Mining Workshop, All Future Mining Forums in 2016, Future Mining Summit
- **Peck Tech** AGM Networking Event, Future Mining Summit
- **Rio Tinto** AGM Networking Event, MINExpo Future Mining Forum
- **Switch** MINExpo Future Mining Forum
- **Uptake** GM Networking event

### 16 IN-KIND SPONSORS

**Amazon** Future Mining Summit (San Francisco)
**Accenture** Singapore Forum
**AngloGold Ashanti** Denver Forum, Battery Electric Vehicles Underground workshop (Denver)
**Barrick Gold** Underground Communications Infrastructure workshop (Toronto)
**BHP Billiton** Autonomous Mining Workshop (Perth)
**Cisco** Executive Council Strategy Meeting (Toronto)
**Deloitte** Battery Electric Vehicles Underground Workshop (Toronto)
**Freeport McMoRan** Autonomous Mining Workshop (Tucson)
**Glencore** Battery Electric Vehicles Underground Workshop (Sudbury)
**Newmont** Data Exchange for Mine Software Workshop (Denver)
**Rio Tinto** Underground Mining workshop (Brisbane)
**SAIMM** Johannesburg Forum, Underground Mining Workshop (Johannesburg)
**Silver Standard** Data Exchange for Mine Software Workshop (Vancouver)
**Teck** Autonomous Mining Workshop (Vancouver)
**Vale** Battery Electric Vehicles Underground Workshop (Toronto)
**Yamana Gold** Underground Communications Infrastructure workshop (Toronto)

### 15 PARTNERS

- AMIRA International
- Australasian Institute of Mining and Metallurgy (AusIMM)
- Austmine
- Canadian Association of Mining Equipment and Services for Export (CAMESE)
- Coalition for Energy Efficient Comminution (CEEC)
- Canadian Institute of Mining, Metallurgy and Petroleum (CIM)
- Canadian Mining Innovation Council (CMIC)
- GS1
- METS Ignited
- Mining3 (formerly CRC Mining)
- Production Development Corporation (CORFO)
- Society for Mining, Metallurgy & Exploration (SME)
- South African Institute of Mining and Metallurgy (SAIMM)
- Surface Mining Association for Research and Technology (SMART)
- The Open Group

### 4 FORUMS

- Brisbane, AU
- Johannesburg, SA
- Las Vegas, USA
- San Francisco, USA

### 22 WORKSHOPS

- Brisbane, AU
- Denver, USA
- Johannesburg, SA
- Las Vegas, USA
- Perth, AU
- Phoenix, USA
- San Francisco, USA
- Sudbury, CA
- Toronto, CA
- Tucson, USA
- Vancouver, CA
Get Involved With GMSG... and Benefit in Return

1. **Attend our Events**
   GMSG’s events are an opportunity to expand your network, gain valuable knowledge and renew your passion.

2. **Contribute to a Project**
   Connect your company’s priorities with one of GMSG’s ongoing projects and be part of the process in bringing innovation to the industry. By collaborating with colleagues on one of our sub-committees or guideline reviews, your company will help discover new solutions to age-old problems.

3. **Develop the Tools to Lead**
   A new series of free professional development workshops offer a hands-on learning experience in recognizing group dynamics and leading discussions, developed by experts who have spent decades working with the mining industry.

4. **Become a Sponsor**
   Make your brand synonymous with future mining innovation by sponsoring a GMSG event.

5. **Join as a Member**
   Our tiered membership options give your company the flexibility to be involved in future mining initiatives at every level. Joining a top-level tier means you can attend the Future Mining Summit, an annual event that drives GMSG’s guideline strategies through attendee member feedback. The highest tier members have a seat on our Leadership Council, which provide strategic advice on GMSG priorities.
MEMBERSHIP

GMSG is a mine operator-driven community, enabled through results-oriented processes, that facilitates collaboration across the mining industry. GMSG brings together the start-ups and small mining companies with the established majors in a safe, level playing ground. Leading mining companies are the organization’s main voice in determining the key focus areas to enable global innovation. Corporate members have the opportunity to select what level of influence they have on current and future initiatives. With this tiered structure, increased industry input on projects will ensure GMSG brings value to member companies, the industry, and its participants.

Membership Tiers and Benefits

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<thead>
<tr>
<th>Leadership</th>
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<tr>
<td>• Seat on Leadership Council</td>
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<td>• Invitation to Future Mining Summit</td>
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<tr>
<td>• Official online member listing</td>
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<tr>
<td>• Recognition in marketing materials</td>
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<td>• Corporate Member Report</td>
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<th>Collaborator</th>
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<td>• Recognition in marketing materials</td>
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<td>• Corporate Member Report</td>
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<th>Corporate</th>
<th>US $5,000 ($2,500 for companies with less than 20 employees)</th>
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<td>• Official online member listing</td>
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<td>• Recognition in marketing materials</td>
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<td>• Corporate Member Report</td>
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Leadership Council

The GMSG Leadership Council, comprised of senior management representatives from the Leadership Member tier, acts as an advisory board to the GMSG Managing Director and Executive Council.

The Leadership Council meets at least twice annually. Responsibilities include:
• Driving GMSG’s strategies and priorities, including engagement with external organizations, participation at conferences; and global expansion.
• Reviewing progress of current projects and submissions of new Working Groups to ensure alignment with the priorities of the broader mining industry.
• Promoting a culture of innovation and collaboration throughout the leadership organizations.

Membership Growth

Member Companies are the corporate members of GMSG, supporting group operations and providing guidance and strategy.
PROJECT NEWS

Underground Working Group Guideline Documents to be Published

Communications Infrastructure Sub-committee Approves Guideline Documents
Two of the Underground Working Group (UG) projects will publish their guideline documents by Q2 2017. The Communications Infrastructure Sub-committee has approved and published Section 1 (Positioning and Needs Analysis), while Section 2 (Solutions & Architectures) of its guideline will be published by Q2. The project plan is being finalized for the development of Section 3 (General Guidelines), Section 4 (Business Development) and Section 5 (Planning, Deploying & Support Considerations), with the objective to complete all drafts this year.

The journey to creating the Communications Infrastructure guideline has been a global undertaking. The sub-committee has held more than a dozen workshops in Australia and North America to collaborate on this guideline, the final result of which will be a vital resource for underground mine operators looking to build a digital communications infrastructure. The project is led by Dave Fry, (title), Yamana Gold and the steering committee including representatives from the following companies: Agnico Eagle, Atlas Copco, Barrick Gold, Cisco, Newtrax, Rio Tinto, Sandvik, Yamana Gold, University of the Witwatersrand and Vale.

Electric Mine Project Guideline in Final Stages

This project has been one of the fastest-paced initiatives in GMSG history, thanks to the dedicated work of the project volunteers and a partnership with the Canadian Mining Innovation Council (CMIC). In roughly six months, the guideline has gone from a concept to a fully-fledged best practices document.

Following the publication of the guideline, a series of workshops will be held starting on April 30 at the 2017 CIM Convention in Montreal to introduce the guideline to industry members.
Interoperability Working Group Launches Global Workshop Series

A three-part workshop series is being held in February and March 2017 as part of a renewed focus on interoperability in the mining industry. These workshops, taking place in Australia, North America and South America, allow participants to bring their regional industry perspectives for the creation of a global interoperability strategy.

Participants will develop a consensus definition of “interoperability”; outline the working group scope and objectives; identify existing projects and organizations to include in the strategy; and reach consensus on prioritization, including key issues, industry guidelines and tools, and developing a project timeline. Following the first two workshops, work is already underway to develop stakeholder-specific use cases to define the value statement for the group and identify how this body of collaborative work will impact the industry. The Working Group has partnered with Chile’s CORFO to assist with the Interoperability work moving forward.

“Collaboration is key to success in the mining industry.”

– ANDREW SCOTT, GMSG OUT-GOING CHAIR AND SENIOR DIRECTOR, DIGITAL MINE, BARRICK GOLD
GMSG is best positioned to be the go-to organization to facilitate formal mining standards development. While GMSG is not an official standards body, the organization has become the right forum to bring forward and seed specific initiatives and developments identified and agreed to by the global mining industry. In the year 2016, GMSG supported and closely participated with two ISO technical committees (TC) on standards work related to mining.

ISO TC 82 Mining
GMSG is an official external liaison organization to ISO’s Technical Committee 82 for mining. ISO TC82 Mining held its 2016 international plenary meeting in Helsinki, Finland, in 2016. An important part of the meeting’s agenda was the presentation and discussion for the establishment of a new TC82 sub-committee for autonomous mining.

The presentation outlined the mining industry drivers for standards development, automation and autonomy, a scope statement and initial development for the sub-committee. The need, scope, and program was determined by reaching out to industry stakeholders with experience in autonomous mining, including mine operators, Original Technology Manufacturers (OTMs), OEMs, and recognized industry associations.

The scope statement is: Standardization of integrated advanced automation and autonomy of surface and underground mining processes, equipment, and people. This includes:

- Autonomous mining application and infrastructure systems and technologies
- All underground equipment, specialized surface mining equipment, all off-board systems for mobile surface mining equipment
- Non-mining support equipment and vehicles
- Mining ecosystem integration and interfaces for all operating and support functions
- Advanced sensing, telemetry, smart connected devices (IoT), geo-technical, geo-metallurgical subject matter
- Operations and support personal tracking, monitoring, and protective devices and systems

The Autonomous sub-committee scope document was distributed to TC82 nation members and ISO central for review and comment.

The final approval and official establishment of the sub-committee is to happen in Q2. It is also expected that the first projects will get underway in 2017. Increased international communication and expanded engagement is expected to increase participation by the standards and regulatory organizations of international mining nations in both ISO and GMSG.

During 2017 it is expected to identify and plan potential GMSG candidate activities for ISO standards development.
ISO TC 251 – Asset Management

The Asset Management sub-committee of GMSG’s Reliability Working Group has continued its review of the technical committee’s ISO 55000x asset management standards series under Dave Daines, Chair of the Australian mirror committee to ISO TC251. Through the sub-committee, Daines has worked with representatives from organizations across the mining sector to ensure the needs of the global mining industry will be met.

There have been four international meetings of TC 251, with the group’s activities focused on communications, feedback, improvement of the relationship to finance, and the rewrite of 55002.

ISO 55000 and 55001 have been the subject of a review and ballot in order to understand if changes were required. It was the collective view of TC 251 that there was no need for any changes to these two standards at this stage. ISO 55002 is currently being rewritten completely. The committee draft document was held open for review from December 2016 to January 30, 2017.

The next TC 251 meeting will take place in Brisbane, Australia on March 27, 2017, at which point the committee members will review the ISO 55002 draft document and discuss new work items around the guidance of asset management policies and alignments.

Other Standards Work

GMSG’s activities engage other standards organizations and efforts other than ISO, which the following highlights.

• GMSG will continue to develop a collaborative relationship with GS1, which was started in 2016. The collaboration will take the form of participation in each other’s events. GS1 develops, provides, and supports international standards for unique identification and codes for assets and products internationally.

• GMSG will be collaborating with CORFO in Chile and other international mining organizations and associations in 2017 on Interoperability. This CORFO collaboration will establish GMSG’s role within SOMIN, a national standards organization focused on mining interoperability that Chile is expected to launch in 2017.

• GMSG will be working with ISA 95 in response to member input.

• The Common Reference Framework Working Group will be drawing industry input on the updated Exploration, Mining, Metals and Minerals reference framework by The Open Group.

• Through our relationship with the Standards Leadership Council, GMSG working groups will engage a number of oil and gas standards organizations to determine whether existing standards can be adapted into mining.
The sharing of best practices for the implementation of autonomous mining will help drive innovation across the industry, facilitate the conversation with regional regulators, and contribute to a safe mining industry through the removal of personnel from the dirty, dangerous or dull jobs.

Business Objective

Publish a global guideline for implementation of autonomous mining, be it just one autonomous vehicle or a fully autonomous mining system.

Project Description

The Autonomous Mining International Guideline project was launched in October 2016, based on strong stakeholder request to share best practices and provide assistance to navigate the complex requirements to enable successful autonomy implementation. The project launch followed a year-long process of international workshops and forums to identify a global vision of autonomous mining.

The basis for this document grows from the Safe Mobile Autonomous Mining in Western Australia Code of Practice. A steering committee has been built to determine the scope of the guideline and develop and guide the project plan, with input from a recent workshop held in Denver.

Current project objectives are:
- Develop the table of contents for the full scope of this guideline project, including all the key sections and information categories to be included.
- Develop a definitions dictionary to ensure clarity.
- Phase 1 draft development: focusing on Surface Haul Trucks and Underground LHDs specifically.
- Completion of Phase 1 draft and full scope details for review by the end of 2017.

Business Case

The creation of a homogenous autonomous mining system is part of the industry’s vision of future mining, and one that has already garnered high-level interest and support over the last few years.

The development of an international guideline will benefit from the established work of outside industries, from which lessons learned can be borrowed. By using existing standards and processes, and placing them in a mining context, the industry can make leaps and bounds in innovation and progression. In doing so, companies will be able to attract more vendors to the mining sector, leading to more competition between suppliers and a surge in innovation.

The industry will benefit from an international autonomous mining guideline through:
- Increased collaborative and constructive communication with regulators.
- Helping manufacturers and tech providers adjust their innovation and development strategies.
- Consistency in output and process control, ensuring the industry is heading in one direction, thereby fostering greater collaboration.
- Allowing owners and operators to understand data requirements and standards.
- Contribute to the work of International Organization of Standardization (ISO) technical committee 82 on its upcoming sub-committee on autonomous mining, and technical committee 127 on its autonomous standards work.
## Budget Estimate

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**TOTAL COST**

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## Project Timeline

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## Participating Companies

**Group leaders:** Graeme Mitchell, BHP Billiton; Francois Gariepy, Peck Tech


## Next Steps

Steering Committee will focus on the Full Scope, and sub-groups will drive the Phase 1 draft development.
To advance awareness, knowledge and adoption of a commonly accepted framework providing a generic description of the mining business, so that new information management initiatives launch with an agreed language and basis of objectives and solutions to mining industry challenges.

**Business Objective**

Use The Open Group’s Exploration, Mining, Metals and Minerals Forum (EMMM) industry model as a reference framework to review and update with increased mining input, and to share how these documents can be useful tools for industry stakeholders.

**Budget Estimate**

Budget details will be available in Q2.

**Project Description**

The Common Reference Framework Working Group is designed to assess the EMMM industry models as an overview of the business functions and processes of a mining organization from prospecting to the corporate financial statement. The purpose is to establish it as a common industry model through the publication of a user’s guideline outlining its use and application.

Prior to the EMMM models, there has been a lack of a commonly accepted framework providing a generic description of the mining business. Without a framework for reference, every new information management initiative starts afresh with issues of explaining objectives and solutions to mining industry challenges. GMSG has selected the Open Group’s work as a reference because they have published, scrutinized, tested and approved standard models covering the full value chain of the mining industry.

Current project objectives are:

» Creation of implementation guides for Business Process Models through use cases from both supplier and customer perspectives to enable members to understand how the various frameworks can be used to drive value in their own companies.

» Review of Business Process Model to create version 2.0 to ensure that the Business Process Framework reflects all the different commodities.

» Support the EMMM Forum’s 2017 projects:
  • Creating an information architecture framework to help industry members understand what information is required to optimally manage an operation.
  • Provide new graduates and staff introductory training to the reference framework in order to assist them in understanding more about the industry and operations best practices.
Business Case

Stakeholders are as diverse as their mining company origins and the dictates of their specific discipline. Most will have a technical silo based view of the mining business, which is not necessarily wrong but potentially incomplete. Across the industry, the same words are used to mean different things and vice versa. Any framework must at least address these and other matters of a common understanding of the mining business.

Over the last two decades, several attempts have been made at producing generic descriptions of the mining business; often in isolation and from a technical silo perspective. Models from other industries have been tried and found wanting. More recently, The Open Group, a global Information Technology standards setting consortium via its EMMM Forum has published, scrutinized, tested and approved standard models covering the full value chain of the mining industry.

The EMMM model defines the operating context for the industry. It acts as a guide, providing context to the operations in the industry. The formation of this group supports the notion of collaboration as a meaningful industry tool by which to identify and disseminate practical solutions to address common stakeholder problems as they strive for operational excellence.

Project Timeline

A complete timeline will be available by Q2.

Participating Companies

Group leader: Roy Irvine, RealIRM


Next Steps

Multi-stakeholder review of the current EMMM models through GMSG, followed by the development of use cases and a user’s guideline by year-end.
DATA ACCESS AND USAGE

Data Exchange for Mine Software

This project is focused on solving the lack of interoperability between sophisticated mining geology and engineering software programs – in short, the need to export data from one software program then re-import into another – and enable major efficiency gains by eliminating the time currently required for manual and/or convoluted data transfer across the mine site.

Business Objective

Create an open source file interchange format that will allow transfer of geometric objects and other attributed data without adhering to restricted or proprietary file formats or compromising the original data content.

Project Description

The Data Exchange for Mine Software Sub-committee is made up of representatives from software vendors and mining companies. As a first step in moving toward an open standard, the committee has used the Open Mining Format (OMF) file specification to develop a software for easily transferred data.

The current data-model and file specifications offer the ability to easily share data between software packages, providing a common data-model and file format for companies to seamlessly share data internally, or with outside vendors and customers. This eliminates the need to export to specific file formats and then re-import the file into other software, allowing a more streamlined approach. OMF version 0.9 code libraries are now available on the GMSG servers.

Current project objectives are:
- Release the full OMF version 1.0.
- Demonstrate use case with version 0.9 or 1.0.
- Analyze use cases by vendors to begin work on version 2.0.
- Initiate a global outreach program, including collaboration with other industry associations, to ensure broad implementation of standard.
- Move to integrate standard with other industry associations to develop a global standard.
- Hire a project manager to oversee the work of the sub-committee and to develop an open process for managing and implementing future feature requests (i.e. new versions).

Business Case

Modern mine planning and exploration routines often require geometric and topological data to be shared between different software programs. Vendors tend to restrict direct access to proprietary Application Program Interfaces in order to protect their intellectual property. This “locking up” of data either limits users to one vendor-compatible software suite, or forces them into an inefficient workflow of exporting and importing, resulting in data loss. Generic file export formats are also becoming less able to accommodate increasingly large and complex data files.

The Data Exchange for Mine Software standard will create an open source software library to export and import simple geometric data (geometric primitives). The standard will also support properties (attributes) associated to the primitives, thereby maintaining data integrity throughout the transfer. The standard will be free and open.

The working group has identified that getting a minimum viable product into the hands of users and developers as soon as possible is the best means of growing awareness and adoption of the prototype standard. Building momentum on this project within the wider mining community will result in continual development and evolution.
Budget Estimate

Budget details will be available in Q2.

Project Timeline

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Participating Companies

**Group leaders:** Vivien Hui, Barrick; Adam Pidilsecky, ARANZGeo


Next Steps

Vendor participants are to evaluate version 0.9 to provide input for the development of version 1.0. Use cases are under development to assist the global outreach program and project sponsorship/funding program.
Business Objective
Facilitate consensus between owner/operators and OEMs to enable open access to onboard data for open pit and underground mobile equipment.

Project Description
The project began more than 12 years ago with Surface Mining Association for Research and Technology (SMART), when accessing onboard data was identified as a common industry challenge. It gained momentum in 2015, resulting in the Mobile Equipment Data Consensus Guideline, published in early 2016. Version Two of the guideline is underway to address incomplete datasets and additional types of mobile equipment.

Current project objectives are:
• Reach a consensus between OEMs and owner/operators regarding what onboard data should be provided to the owner.
• Publish Version Two by end of 2017.
• Publish a series of case studies through tracking OEM and operator use of the published guideline (Open Data Lighthouse Project).

Business Case
Most leading enterprise mine operators focus on continuous improvement and innovation. This requires a significant amount of technology, systems and information, including source data related to the real-time and historical performance of mobile mining equipment.

In addition to open access to mobile equipment data for internal operator use, many mine operators are moving to advanced services to support the ongoing health, condition and performance of the equipment. To support these services and others, OEMs also require effective real-time and historical data integration to the mobile equipment in the field. However, there are a number of challenges to address:

» Secure and cost-effective access to this data has been elusive as owner/operator, third-party solution providers, and OEM’s struggle with how to support openness while preserving their intellectual property and defining value-added service opportunities.
» Before technical equipment connectivity standards can emerge, there must be a common industry vision of what data is required and why it is needed.
» Operators have not purchased the intellectual property of the equipment itself. Some aspects of the data may unveil sensitive IP for the equipment manufacturers.

The Mobile Equipment Open Data Guideline is based on the real needs of owners to extract value from the equipment data. This guideline outlines the onboard data groups that should be made available and open to the equipment owner, in a real-time, read-only format.
Participating Companies

**Group leaders:** Matt Miller and Perry Zalevsky, OSIsoft


Budget Estimate

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Next Steps

Continue to facilitate workshops and meetings with OEMs and owner/operators, and collect guideline use data for Open Data Lighthouse project.
DATA ACCESS AND USAGE
Operational Key Performance Indicators (KPIs) and Definitions

Standard definitions will enable comparison and benchmarking of equipment and operating performance. By understanding reporting needs, users can create a better understanding of the data needed for the operation and management of the mine and provide clarity between users and suppliers of data.

Business Objective

Develop a common terminology and definitions across the industry, and standard definitions for production data and operational KPIs.

Project Description

The Operational KPIs and Definitions project was initiated by the Data Access and Usage Working Group in 2012 out of a need to develop a standard terminology for KPIs. With operators increasingly relying on data, standard KPIs and definitions are required to better determine operating performance.

Draft standard operational KPIs and a draft Time Classification Model are in review. They capture operational status, events and activities, and place them into time classifications from which the standard performance definitions are derived.

Current project objectives are:
- Standard definitions for operational KPIs and terminology.
- A Time Classification Model, which enables consistent reporting, classification of operational events and activities, and confirmation that events are appropriately classified.
- Summary of the data needed to generate KPIs.
- Identification reporting and analytical requirements of vendors/third party companies.

Business Case

A significant impediment to increasing mine operation productivity and time management is a lack of clear definitions and terminology when it comes to KPIs. They are an integral part of creating an effective benchmarking system to pinpoint opportunities to decrease lost operation time and oversee increased productivity. By providing clear definitions and common terminology for industry-wide use and a benchmarking system to provide comparisons, mine operators will have a common language to identify solutions to time management challenges.

There are a number of drivers for development of common definitions for production data and operational KPIs:
- Integration of information and technology.
- A starting point for identification of data requirements and benchmarking.
- Common terminology for use as a reference for mining systems, products and solutions.
- Using technology as enabler and as driver, with easier access to more accurate, precise information.

Budget Estimate

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Participating Companies

**Group leader: Zoli Lukacs, Gibraltar Mine**

Agnico Eagle, AMTC, AngloGold Ashanti, Barrick Gold, BHP Billiton, Canadian Natural Resources, Finning (Canada), Freeport-McMoRan, GE Mining, Gibraltar Mine, Goldcorp, Hatch, Newmont, OSIsoft, Peabody Energy, Predictive Analysis Services Group, Rio Tinto, Schneider Electric, Shell Canada, Silver Standard, SMART Systems Group, Syncrude, Teck, Total, University of Sao Paulo, Vale, Westmoreland Coal

Next Steps

Final in-depth mining company reviews on the Time Usage Model and definitions and completion of a revised draft to enter working group review and approval.
While the benefits of implementing integrated operations are clear from a cost and efficiency point of view, many challenges exist in addressing the complexity of integrating the business, from resource-to-market. The Integrated Operations Working Group (IO WG) aims to define a common approach through previous industry lessons learned to develop a standard business solution.

Business Objective

Work with industry partners to define a best practices guideline to IO through workshops and roundtables covering lessons learned and common solutions.

Project Description

IO is the coordination of people, processes and technology on every level of the mine value chain. A project plan is currently in development through a series of workshops and roundtables with stakeholders. The plan will be announced in Q2.

Current project objectives are:
- Develop a vision for IO in mining.
- Benchmarking current state in mining and other industries.
- Define links to Autonomous Mining and Interoperability WGs.
- Map the generic model of the integration loops by subgroups.
- Hold a series of regional workshops for stakeholder engagement.
- Create a roadmap and work plan for 2017.

Business Case

Traditionally, issues surrounding the integration of operations have been considered from a mechanistic point of view which favours working in silos or business functions. The IO WG suggests that the real problem is the variability of the entire production process. The high variability of material flow and quality is an unsolved problem in the mining and metals industry that sensitively affects both the levels of production and the costs. More attention must be paid to the interdependencies among the parts of the system, looking at the production process holistically.

With tight margins being stretched even further in the face of an austere operating environment, the mining industry needs to switch gears to consider new solutions to old problems, change its operating paradigm and way of thinking, using collaborative development as a way to innovate.

In order to control the variation of the entire production system, the IO Working Group will develop a best practice guideline for integrated operations which promotes:

- A balanced approach of people, process, and technology to develop a sustainable and robust business solution.
- Collaborative planning and execution throughout the value chain of the business.
- Identifying cross-functional KPIs that link upstream processes with their impact on downstream processes and the overall outcome.
- Strategic intent to operate in an integrated fashion, independently of who runs the business at a given time.
- Equip supervisors with the ability to proactively problem solve.
- Moving toward a continuous production system that optimizes asset efficiency and overall equipment effectiveness.
Participating Companies

**Group leader:** Laura Mottola, Flow Partners


Next Steps

A workshop will be held on the Wednesday morning of the CIM conference. A first focus will be on a review/white paper of existing resources on the subject and a benchmarking study of IO best practices – both within/ outside mining. The working group will continue to collaborate with high-level industry members at workshops and executive roundtables, including companies, both inside and outside of mining, which have already successfully implemented IO.

Budget Estimate

Budget details will be available in Q2.

Project Timeline

The project plan will be available Q2.
Help Mine Operators understand system information flow to the point that they can discuss and specify information delivery with OEMs and OTMS for their operations. The work product is also designed to benefit OEMs and OTMs understanding of potential product design, placement, and product opportunities.

**Business Objective**

Define the interfaces at all control layers required for operating machinery (e.g., manual to fully autonomous) beginning at the biologic interface using a generic example (haul truck).

**Project Description**

The project was launched in October 2016 to identify how information is passed between mining equipment and between mining equipment and mine systems. The work product describes basic information flow at a level that respects current logical and physical machine and system constraints while avoiding prescriptive solutions.

Information is exchanged via interfaces. Due to the shear number of interfaces, an expected influx of new interfaces, and an evolution of existing interfaces in the near term, it is neither desirable nor practical to describe individual interfaces. As such, this project seeks to describe a small number of information exchange patterns that can be applied to all information flows between mine equipment and mine systems.

At this point, 8 potential patterns have been identified, a modeling process has been constructed, and one pattern for sensor data has been mapped. It should be noted that the patterns are mapped based on existing use cases and, while the patterns may be useful in system or product design, they are not prescriptive templates.

Current project objectives are:

- Identify and map classes and of information that should be shared between machines and other operations systems, and implement constraints, such as modes of operation, mobile equipment and mine types.
- Describe the process for creating new patterns and modifying existing patterns. This includes describing the pattern modeling process.
- Create a guideline for Mine Operators, OEMs, and OTMs to better understand equipment interfaces.

**Budget Estimate**

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Business Case

The mining industry is driven by data-based analysis, and the most valuable data is derived from mining equipment. However, there remains a gap in knowledge when it comes to how information is shared between each equipment interface. Various types of equipment are failing to communicate as they are speaking a different language, rather than a unified communications model.

The Mapping the Interfaces for Equipment Operation across Control Layers project will provide an understanding of the types of conversations and information exchanged between mine systems and equipment, and between various pieces of equipment. It will identify a common pattern to be used as a model for OEMs that will deliver much-needed clarity on required equipment interfaces for mining operations. This will be the starting point for other technological developments.

Project Timeline

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Participating Companies

**Group leader:** Cliff Brandon, Automated Systems Alliance

Atlas Copco, Automated Systems Alliance, Autonomous Solutions, Freeport-McMoRan, Peck Tech, Schneider Electric, Teck

Next Steps

The project steering committee will present the project plan to project volunteers for input and approval.
Greater asset reliability in mining will result in increased production, drive down operating costs, reduce maintenance requirements and improve safety.

**Business Objective**

Collaborate with mining industry leaders and outside industries to leverage their experience and knowledge in applying existing reliability best practices to a mining environment.

**Project Description**

The Reliability Working Group is an operator-focused group whose purpose is to provide a network and forum for reliability professionals in mining to exchange knowledge and share reliability and maintenance best practices, resulting in improved asset reliability, productivity, safety, and lower operating costs.

Current project objectives include:

- Identifying the common elements of successful reliability programs, including processes, tools, technologies and organizational roles.
- Developing metrics and KPIs that enable monitoring of maintenance performance and reliability program effectiveness and facilitate comparison to industry peers.
- Publishing Reliability Best Practices Guidelines, including common maintenance and reliability terminology, definitions and KPIs.
- Enabling benchmarking of maintenance and reliability performance.
- Launching a sub-committee to develop a best practice maintenance work management model.

The working group has also developed a sub-committee to bridge the mining industry with the work of the ISO technical committee 251 on Asset Management and the ISO 55000x standards series. This sub-committee will enable collaboration with other reliability and asset management organizations beyond the mining sector.

**Business Case**

Mines are asset intensive ventures. In today’s challenging markets, investors and management want assurance that operations are realizing full value from their investment.

Best Practice Guidelines based on the collective experience and knowledge of a wide range of mining and industrial expertise maximize production capacity and minimize asset risk by applying accepted maintenance management practices. A structured reliability program informed by global best practices provides assurance to investors, insurers and the workforce that assets are reliable, efficient and safe.

**Budget Estimate**

Budget details will be available in Q2.

**Project Timeline**

A complete timeline will be available by Q2.
Participating Companies

**Group leader: Zoli Lukacs, Gibraltar Mine**


**Next Steps**

Steering committee to confirm the detailed project plan for the working group, and the Work Management Model sub-committee will be launched. Workshops will be held throughout the year.
Underground Mining
Communications Infrastructure

Improve communication and network infrastructure in underground mines by providing a framework to empower mine operations decision makers to understand the communications and IT requirements, options, limitations for better decision making, and enable system providers to communicate the requirements to implement their solutions underground.

Business Objective
Develop a guideline suite to be used as a reference for the frameworks, standards, processes and procedures supporting digital communications in an underground mine environment.

Project Description
The Communications Infrastructure Sub-committee was formed in January 2015 to examine issues related to wired and wireless communications. The group identified the need to advance guideline development and implementation in underground mines.

Current project objectives are:
- Evaluate current communications systems and methodologies used in the modern mining industry.
- Develop a reference tool for existing standards and solutions for implementation of communications in underground mining.
- Focus on planning, development and sustainability in an underground environment.
- Frame the language to appeal to mining personnel and vendors who may have little to no experience in digital communications technology.

A set of guidelines is in development around the use of existing industry standards, appropriate technologies, and vendor solutions.

Business Case
The advancement of digital technology globally continues to accelerate. These advancements include improvements in video, voice and data communications which could provide tremendous operational efficiency and safety benefits to mining.

- Digital communications services and systems are now capable of existing in underground environment.
- Solutions are becoming more complex, and advancements are very different than traditional analog systems.

Most mine personnel lack the background and experience to effectively plan, develop, deploy, and maintain new digital communications solutions. The guideline documentation is a helpful tool for key personnel to understand how to approach the strategic integration of new technology into the entire mine lifecycle in order to increase profit, operational effectiveness and safety.
Budget Estimate

### Project Timeline

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### Participating Companies

**Group leader:** Dave Fry, Yamana Gold


### Next Steps

Develop and publish sections 3-5 in the guideline suite.
The BEVs project is a joint effort between GMSG and the Canadian Mining Innovation Council (CMIC), and was launched after a formal kick-off workshop in Sudbury in June 2016. A growing need for alternatives to diesel equipment led to strong stakeholder interest in the project. As a result, a large volume of volunteers completed what would normally be a two-year project in six months.

Current project objectives are:
- To act as a blueprint for vehicle OEMs, and be included by mining companies in tender documents to equipment OEMs for mining vehicles. This will allow the OEMs to focus their R&D efforts in a direction suited to the mining industry.
- Share best practices for designing a mine to maximize advantages of BEVs underground.
- Strike an appropriate balance between standardization and innovation, while leveraging existing standards, including those from the automotive, electric, and any other industries that may apply.
- Be global in scope, but friendly to regional differences, acknowledging that regional differences in standards and regulatory frameworks exist.

Business Case

The mining industry is now extracting mineral reserves at greater depths. As underground mining progresses to deeper levels, ventilation for a diesel mobile equipment fleet is becoming a greater challenge, while diesel particulate regulations are tightening in some jurisdictions.

Battery electric mobile equipment offers a unique opportunity to significantly reduce the ventilation requirements for a mine. At the same time, it can reduce operating costs and improve the environmental footprint. However, BEVs also present a new set of challenges for mine operators in terms of infrastructure requirements, maintenance and operating constraints.

CHARGING
- Required mine infrastructure for charging of BEVs
- Charging methodology – On board, off board or battery swapping
- Charging interface standardization (connection and protocol between vehicle and charger)

EQUIPMENT STANDARDS AND LEGISLATION
- Lack of mining-specific standardization
- Existing standards and legislation are geared toward diesel equipment
- Differences between jurisdictions/regions

MINE OPERATION
- Limitations with BEV energy density versus diesel
- Mine layout considerations

OEMs and mine owner/operators are already investing in BEVs with little guidance or standardization for implementation. A guideline will address those challenges by offering a blueprint for mine design and equipment innovation up-front, providing solutions to electric mine problems before they occur.

Eliminate diesel in an underground mine through a step-by-step guide on implementing battery electric vehicles (BEVs), with the added benefits of increasing health and safety and lowering overall energy requirements.

Project Description

Business Objective

Publish a global guideline on BEVs in an underground mining environment and educate the industry on how to implement them.
Budget Estimate

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<th>Phase</th>
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Project Timeline

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<td>Guideline publication</td>
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Participating Companies

**Group leader:** Craig Harris, Glencore


Next Steps

The guideline is set for publication in Q2 2017. The first introductory workshop is scheduled at the CIM 2017 Convention.
Bridge the communication gap between onboard and off-board systems with unified language through use of an Application Program Interface (API). This can lead to less hardware on the equipment, reduce maintenance requirements, and streamline access to data to enable smarter, swifter decision making.

**Business Objective**
Identify or develop the connectivity means to enable seamless data access, sharing and movement between onboard mobile mining equipment systems.

**Project Description**
The Technology and Connectivity Working Group was formed to define a guideline or standard for applications to share data sources as an attempt to reduce the redundancy of data flow in onboard mobile equipment. A draft guideline for an API was developed in late 2014, with continued input required from the industry. The ultimate intent is to identify an API that can be used by all to consolidate, use and share the data that is being collected by and to the various onboard applications.

Current project objectives are:
- Stimulate industry engagement and feedback on definition of onboard data and systems integration.
- Identify industry API requirements and potential roadblocks.
- Survey new API technologies and standards.

**Business Case**
Modern mining technology collects a vast array of data from a variety of source applications, however siloed development by suppliers leads to duplicated data flows to each new application, an increase in onboard sensing components and increased costs and maintenance. The development of a mining API offers measurable benefits attached to the pillars of mining stakeholder profitability:

**SAFETY**
- Enables access to onboard data in real-time.
- Facilitates the innovation of smarter safety solutions, allowing the integration of proximity awareness, fatigue and operational data to easier identify high risk situations.

**PRODUCTIVITY**
- Allows greater insight into factors affecting total mine and equipment productivity.

**OPERATIONAL EFFICIENCY**
- Provides timely access to asset health and production data to identify symptoms of situations that reduce operational effectiveness.
- Gives insight into root causes – and cost to the business – to identify issues requiring immediate resolution.

**ADDITIONAL BENEFITS**
- Enables a single point of entry for the manually input of data to reduce operator interaction and enhance data quality.
- Enhances alarm and warning notification filtering to reduce nuisance alarms and increase operator situational awareness.
- Synchronizes time between devices and/or applications ensuring that data from independent systems can be correlated.
Budget Estimate

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Participating Companies

**Group leader:** Paul Raj, Olio Technology Solutions


Next Steps

A review of current mining industry API requirements and existing solutions.