Collaboration is a key to success.

GMMSG has experienced an excellent first half of 2017, and it’s all due to the high level of engagement and collaboration from our industry members. It has officially been a year since I took on the role of GMMSG Chair and it has been a privilege to work and speak with dedicated volunteers in our Working Groups and at our forums. We’ve discovered these member reports in particular are an invaluable resource for what GMMSG has achieved and is developing. We’ve been hard at work ensuring the guideline work GMMSG is pursuing will bring value to our industry, which has already led to some exciting progress.

The Underground Mining Working Group (UG WG), for example, has published two key sections of its Underground Communications Infrastructure guideline suite: “Positioning and Needs Analysis”, and “Scenarios and Applications”. These documents are stepping stones to bringing the full guideline to fruition in 2018.

Of course, I cannot go without mentioning the major GMMSG guideline publication in May 2017. “Recommended Practices for Battery Electric Vehicles” has been a success story for us. Launched as a joint venture by GMMSG and Canada Mining Innovation Council (CMIC), the guideline was written and published within eight months, thanks to the high level of leadership and collaboration. The feedback we’ve received from OEMs and operators has been positive, with some referring to it as “required reading.” Thanks to the nature of ever-evolving technology, the Working Group team is planning to launch a second version of the guideline. If you have not done so already, I’d like to invite you to learn more by downloading the published guideline and consider getting involved.

There is much to look forward to in the remaining months of 2017. A number of our collaborative forums are being held across the globe, with Johannesburg on September 20-21, Edmonton on October 18-19 and finishing up November 2-3 in Santiago. The annual Future Mining Summit will wrap up 2017 with our Collaborator and Leadership members in Sweden on December 4-5. This event is an opportunity for top-tier members to have real influence on GMMSG’s direction for 2018.

Those who attend these events will have the chance to learn firsthand about the new and ongoing work of GMMSG’s Working Groups, including Autonomous Mining, Integrated Operations and Interoperability, and engage in discussion on how to better support continued innovation. Our continued discussions on the concept of the “connected mine” emphasize the digital transformation of the industry, as we tackle new and pressing concerns such as cyber security and free exchange of data.

As GMMSG continues to grow its influence in the global mining community, support from our volunteers, partnerships and member companies is more important than ever. We now have 75 member organizations from mining companies, OEMs, OTMs, and consultants, as well as 11 members of our Leadership Council, first formed in 2016. I’d like to encourage you to take on the role of a GMMSG ambassador; there is no one better suited to articulate the value and purpose of GMMSG than those who are working hard to develop guidelines and create a collective vision of future mining. By doing something as small as engaging with us on LinkedIn, or as significant as bringing a colleague to a GMMSG event, you can support our GMMSG community as we continue to expand.
WHAT IS THE FUTURE MINING SUMMIT?

The Future Mining Summit is the next evolution in industry collaboration.

It is an annual global think-tank forum focused on defining the industry’s needs, opportunities and roadblocks to innovation for the vision of future mining. Participants will build a collective vision and identify the guidelines, standards, and collaboration requirements to achieve that vision.

Keynotes from the Summit go beyond everyday mining topics to deliver insights into unique and creative solutions to persistent industry concerns. In 2016, participants were treated to a keynote speech from top online enterprise Amazon on enabling innovation as a key business priority, and the value of a workplace culture that drives innovation.

Attendance is exclusive to GMSG’s Leadership and Collaborator members.

- Network with the industry’s top influencers
- Hear from disruptors such as Amazon and Google
- Collaborate on the future of the mining industry
- Share input on current GMSG projects
- Gain takeaways that can be applied in your own organization

Join us for 2017!

SUMMIT
- FUTURE MINING SUMMIT
  - December 4–5
  - Stockholm, SW

CONFERENCES & CONVENTIONS
- SME 2017 CONFERENCE
  - February 19–22
  - Denver, USA
- CIM 2017 CONVENTION
  - April 30–May 2
  - Montreal, CA
- MINES AND MONEY CONFERENCE
  - November 27–30
  - London, UK
The Integrated Operations Working Group has launched its Phase chain, resulting in increased confidence in business practices and a proposal has been submitted to the Executive Council for a new Working Group dedicated to Chain of Custody, which provides the capability to track commodities from source to end use. The Chain of Custody Working Group aims to shape and define chain of custody in the mining industry and can help improve capability to track commodities from source to end use. The WG projects. Integrated operations is the coordination of all areas of assets and transactions without the need for a trusted third party. Chain of custody allows for better visibility across the value chain, resulting in increased confidence in business practices and better data for retailers to provide to consumers.

### Recommended Practices for Battery Electric Vehicles in Underground Mining
Published: April 2017
The Electric Mine project was created through a joint effort by GMSG and the Canada Mining Innovation Council (CMIC). The guideline is meant to serve as a blueprint for original equipment manufacturers (OEMs) to move forward in research and development, and references existing standards and guidelines related to battery electric vehicles (BEVs). The new projects are:

- **Interoperability**
  A proposal has been drafted for the Interoperability Working Group to begin the work of facilitating the growth of interoperability in the mining industry, starting with the following projects:
  - Architecture Reference Framework
  - Use Cases

- **Short Interval Control and Real-Time Control**
  (Underground Mining Working Group Sub-committee)
  GMSG’s second partnership with CMIC is a collaboration dedicated to short interval control (SIC) and real-time control (RTC). SIC and RTC are the processes that allow mining supervisors to better manage tasks throughout a single shift, enabling real-time feedback on completed and outstanding work.
  The sub-committee will create a guideline with the intent of providing a roadmap outlining possible paths from an “analog” mine to SIC and RTC.

### Chain of Custody
A proposal has been submitted to the Executive Council for a new Working Group dedicated to Chain of Custody, which provides the capability to track commodities from source to end use. The WG aims to shape and define chain of custody in the mining industry through blockchain methodology, which allows for a digital record of assets and transactions without the need for a trusted third party. Chain of custody allows for better visibility across the value chain, resulting in increased confidence in business practices and better data for retailers to provide to consumers.

### Integrated Operations
The Integrated Operations Working Group has launched its Phase 1 projects. Integrated operations is the coordination of all areas of operation into one single business unit, and can help improve production efficiency when implemented effectively. The new projects are:

- Architecture Reference Framework
- Business Case Guideline
- Global Research Collaboration
The Autonomous Mining Working Group conducted a survey in June 2017, requesting that participants share their feedback on the most pressing issues regarding autonomous mining and how long it will take the industry to become fully autonomous. Of the 123 respondents that indicated having some level of autonomous experience, 35% were in the Surface environment, 33% Underground environment and 32% in both the Surface and Underground environment.

The purpose of the survey is to create a roadmap for future autonomous mining tools and guidelines to be developed by the Working Group. The results shown here provide a glimpse of the current state of autonomous mining from the perspective of the respondents.

Respondents’ Vision of Application of Autonomy on Sites Timeline

Top 5 Most Critical Challenges to Implementation of Autonomous Mining
1. Change Management
2. Proving the Value
3. Lack of Interoperability
4. Lack of Capability/Functionality/Maturity of Current Solutions & Technology
5. Unwillingness to be an Early Adopter

Top 3 Other Challenges Indicated by Respondents
1. Mine Environment
2. Workforce/Training/Skills
3. Organizational Culture

Level of Experience with Autonomous Mining*
22% Consult on autonomous mining
21% Have minimal experience
16% Operate one/a few pieces of autonomous equipment
15% Have no experience
12% Operate an autonomous fleet
11% Manufacture/supply technology related to autonomous mining

*Respondents had option to select more than one response

Top 10 Global Collaboration Areas of Interest that Would Bring the Most Value to Your Organization
1. Interoperability
2. Safety
3. Implementation/Design
4. Business Case
5. OEM Integration/Standards
6. Case Studies/Demos/Tours/Webinars
7. Regulators
8. Architecture/Framework/Data
9. Communications
10. Tech Specs & Standards

Respondents’ Organizations
46% Mine Operator
19% Consultant
17% OEM
8% OTM (Technology Provider)
2% Research/Academia
2% Contract Miner
2% Industry Association
4% Other

Respondents’ Function within Organization

Respondents’ Organizations
GMSG NEWS

Comminution Efficiency Guideline Work Recognized by CEEC
GMSG’s Industrial Comminution Efficiency Working Group (ICE) guideline paper has received a High Commendation from the 2017 Coalition for Energy Efficient Comminution’s (CEEC) Medal, Operations category. The paper, “Global Mining Standards and Guidelines for Determining Comminution Circuit Efficiency”, is a consolidation of the trio of guidelines created by ICE in 2016: the Bond Work Index, the Morell method, and Surveying and Sampling. This achievement would not have been possible without the dedicated work of every ICE volunteer, with a special thank you going to Alex Giblett, Mike Daniel, Robert E. McVey, Alex Doll and James Connelly.

The three guidelines paint a complete picture of achieving better efficiency in comminution. “Determining The Bond Efficiency Of Industrial Grinding Circuits” outlines how the Bond method and Bond Work Index allow personnel to quantify and compare relative energy efficiencies. “Morell Method For Determining Comminution Circuit Specific Energy And Assessing Energy Utilization Efficiency Of Existing Circuits” shows how the Morell method utilizes data from the SMC Test to predict an ore body’s comminution circuit in order to determine energy consumption. “Methods To Survey And Sample Grinding Circuits For Determining Energy Efficiency” details methods to survey and sample grinding circuits to generate sufficient information to support reliable efficiency analysis, and standardize how surveying and sampling is done for future benchmarking opportunities.

New Collaborative Project with CMIC in Underground Mining
GMSG and the Canada Mining Innovation Council (CMIC) have partnered to launch a new Underground Mining Working Group sub-committee on Short Interval Control (SIC) and Real-Time Control (RTC). SIC and RTC are the processes that allow mining supervisors to better manage tasks throughout a single shift, enabling real-time feedback on completed and outstanding work. A guideline similar to the recently published “Recommended Practices for Battery Electric Vehicles in Underground Mining” will be developed to outline the opportunities currently available to mining owners and operators to adopt SIC and RTC practices.

GMSG Partners with MM-ISAC in Cyber Security Collaboration
Cyber security is a growing threat for the global community, and the mining industry is no exception. As part of GMSG’s commitment to address issues surrounding cyber security, we have partnered with The Mining and Metals Information Sharing and Analysis Center (MM-ISAC). MM-ISAC was launched in May 2017 as a non-profit, industry-owned corporation established to support and improve the cyber security and resiliency of metals and mining companies. MM-ISAC will work with the International Council on Mining & Metals (ICMM), GMSG, related industry ISACs/ISAOs, as well as regulators to establish and support vendor guidelines and standards, cyber resiliency frameworks and industry best practices.


“We’ve discovered through social media that these member reports are an invaluable resource for tracking what GMSG has achieved and is developing.”
— HELIUS GUAMARÉS, CHAIR, GMSG

GMSG CENTRAL

COMMUNICATIONS STRATEGY IN THE WORKS
A communications strategy for GMSG is in development by Fresh Communications and Dovetail Communications to determine how GMSG can be more effective in sharing key messages to members and volunteers, and extending our reach on a global scale. The strategy will be deployed by year’s end. GMSG aims to better engage with the greater mining community through external communications, increase the use of social media channels and other existing tools, raise awareness of GMSG projects and events, drive increased implementation of GMSG guidelines, and enhance cross-industry collaboration.

IMPROVED BUSINESS MODEL IN DEVELOPMENT
A new business model is currently in development. This will allow GMSG to identify the areas of potential growth and value and create a more rigid structure for more consistent operating procedures moving forward. These areas include the diversification and increase in membership, obtaining new sources of revenue and strengthening existing sources, optimizing the cost structure for long-term growth, and continuing a globalization plan in key geographical areas for the mining industry. An MBA intern has been hired to draft the model for consideration by the Executive Council. The model is expected to be deployed in Q4 2017.

MEMBERSHIP UPDATE
Our list of members continues to grow; GMSG now has 75 members, including 11 in our Leadership tier, who now represent the Leadership Council, the advisory board to GMSG’s Executive Council. Part of GMSG’s ongoing communications and business development is to identify better ways to serve our members, be it through increased available resources, advance circulation of event invites, or enhanced collaboration opportunity.

GMSG’s membership program is divided into three separate tiers (General, Collaborator, Leadership), depending on the level of influence a company is interested in. To learn more about becoming a member, turn to page 14 or contact Mike Forbes at mforbes@globalminingstandards.org.

NEW GMSG LOCATION
GMSG has officially relocated! Our new offices are located at 50 Rue Lambton in Ormstown, Quebec, near Montreal. Reach us at +1-450-829-9000 or +1-450-829-9111.

NEW VIRTUAL COLLABORATION SITE: BASECAMP 3
GMSG has launched Basecamp 3, an upgrade from its current virtual collaboration site, to offer more effective project management tools. Basecamp 3 offers a cleaner look, improved communications functionalities, and easier access to important documents and files.

A brand new headquarters site (HQ) has also been added, and is a one-stop shop for GMSG operations, collaboration and info. This new information hub includes handy FAQs, with answers on GMSG governance, events, membership, and more. Access to Basecamp 3 is available through invitation only, and is now open to all GMSG participants.
INTERNATIONAL STANDARDS

ISO TC 82 Mining
The finalized scope document for the proposed sub-committee devoted to autonomous mining was sent out to all technical committee nations for a formal vote. The vote closes September 14 and the results will be available prior to the next plenary meeting in Santiago, Chile, on September 25, 2017.
Once the sub-committee is approved, the first formal meeting is expected to be held in North America in the early new year of 2018. This date is due to a minimum of four months stipulated by ISO between announcing and hosting a formal committee meeting. Communication with the industry is expected to be initiated after the 2017 plenary meeting to refine and update the current work plan for the sub-committee, and possibly start development projects. Additionally a campaign will be initiated to request participants make contact and engage with their national ISO standards committee for TC 82. This is necessary as participation in ISO is done nationally and participants need to be an identified member of a national committee.

ISO TC 251 Asset Management
The committee’s fourth meeting was held in March 2017 in Brisbane, Australia, to review and approve the ISO 55002 draft document. GMSG’s asset management sub-committee provided feedback on the document to ensure the needs of the global mining industry are met. A Draft International Standard (DIS) has been developed and will soon be released for another review and voting ballot. GMSG Members will have an opportunity for further comment. The intent is to have this review completed in time for the next planned meeting in Paris, France, from February 5-9, 2018.
Participants at the Brisbane meeting also discussed the development of new work items around the guidance of asset management policies and alignments: ISO 55010 Guidance on alignment of asset management, finance and accounting and ISO 55011 Guidance on the development of government asset management policy. Following the March meeting, all items were approved. A project plan for these documents has been outlined with the expectation of a three-year development timeline.

GS1
GMSG’s partnership with GS1 began when a representative of the standards organization attended an Interoperability workshop. Following that, GS1 held presentations on the value of logistics standards in GMSG forums throughout 2016. Rather than developing new standards for the mining industry, GS1 is interested in taking its pre-existing supply chain and asset management standards and applying them to industries in need. In Australia, GS1 standards are being widely adopted by the rail industry to support globally unique identification of parts and components as a first phase of implementation which will support the ability to effect full life-cycle tracking and thereby more effective asset management processes. The mining sector, of course, is closely related as some large mining companies operate significant rail operations and assets. Increased engagement is required by interested mining stakeholders for GS1 to continue its work and better understand the asset management needs of the industry. The collaboration with GMSG will raise awareness of GS1 and its value for the global mining sector.

The Open Group
EMMM Forum
GMSG’s collaboration with The Open Group began with the Common Reference Framework Working Group, created to provide strong mining industry feedback to raise awareness of and develop an implementation guideline for the Exploration, Mining, Metals & Minerals (EMMM) models (Business Process Reference and Business Capability Reference). The models will be used as enterprise architecture standards.
To increase engagement in the WG, group leader Roy Irvine will host Webex meetings with participants globally. Participants will be tasked to review the EMMM models and provide feedback.
Open Process Automation Forum
GMSG is involved in a new standards-based collaboration from The Open Group on the global process control automation marketplace, called The Open Process Automation Forum. The Forum is focused on developing standards-based interoperable process control architecture, addressing the technical and business issues around process automation. Currently, it has a focus on seven major industries: food and beverage, metals and mining, oil and gas, petrochemical, pharmaceutical, pulp and paper, and utilities. GMSG’s role is to provide input to the forum and raise its awareness with key mining stakeholders.
MEMBERSHIP

Membership Tiers and Benefits

**Leadership**

US $30,000

- Seat on Leadership Council
- Invitation to Future Mining Summit
- Official online member listing
- Recognition in marketing materials
- Corporate Member Report

**Collaborator**

US $15,000

- Invitation to Future Mining Summit
- Official online member listing
- Recognition in marketing materials
- Corporate Member Report

**General**

US $5,000 ($2,500 for companies with less than 20 employees)

- Official online member listing
- Recognition in marketing materials
- Corporate Member Report

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Member Companies</th>
<th>Participating Individuals</th>
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</thead>
<tbody>
<tr>
<td>2012</td>
<td>28</td>
<td>335</td>
</tr>
<tr>
<td>2013</td>
<td>335</td>
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<td>2014</td>
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<td>2015</td>
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<td>55</td>
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<tr>
<td>2016</td>
<td>1,218</td>
<td>70</td>
</tr>
<tr>
<td>2017</td>
<td>1,337</td>
<td>75</td>
</tr>
</tbody>
</table>

Member Companies:

- **20** Mining Companies
- **8** OEMs
- **33** OTMs
- **2** Research Organizations
- **11** Consultants
- **1** Industry Organization

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

IT STARTS WITH YOU

As an engaged member of the mining community, you want to see the industry grow and evolve. You’ve done the research, attended the workshops, and know the work required to get the industry where it needs to go.

GMSG aims to achieve its vision of future mining through open collaboration, and we know that any initiative begins with the individual. We’re offering some tools to show you how to get your colleagues on board with the projects and initiatives needed to help you, your company and the mining industry succeed.

By increasing your engagement with GMSG you can extend your network with like-minded members of the industry, all while promoting your work and your company’s best interests in future mining. Helping GMSG collaborate on critical industry challenges means you are part of the solution.

So what can you do to make that happen? Here are a few ideas:

**Share your work**

You’ve already put your time in; why not promote your efforts? If there is a published guideline you’ve helped create, you can easily share a link in your company newsletter or start a conversation at a corporate outing.

**Add GMSG to your LinkedIn profile**

By adding GMSG to your profile you can easily receive updates on your LinkedIn feed and publicize the volunteer work you’ve accomplished. Are you a guideline author? Have you participated in a GMSG workshop? Let your colleagues know! Don’t forget that sharing news items on LinkedIn is much more effective at raising awareness than “liking” a post.

**Invite a colleague to a GMSG event**

GMSG events are a chance to represent your company on the global industry level and a chance to network with the mining industry’s top collaborators.

**Engage with GMSG on Twitter**

It’s as easy as clicking a button, but every retweet helps to promote GMSG’s ongoing collaborative works and events. Sharing a news item about a project your company has invested in helps to boost its visibility and industry awareness.

**Encourage a peer to become a member**

There is no one better to articulate the value of GMSG’s guideline work than the volunteers who work tirelessly to make them happen. By encouraging your peers to become members, they have an opportunity to influence the future of mining. You can also encourage colleagues in your company to join a Working Group that will benefit from their expertise. Increased membership means more resources available for guideline work as all GMSG projects are funded through member support.
MEMBERS

LEADERSHIP MEMBERS
- Accenture
- AngloGold Ashanti
- Antofagasta Minerals
- Atlas Copco
- Barrick Gold
- BHP Billiton
- Caterpillar
- Glencore
- Hatch
- METS Ignited
- Rio Tinto

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

GENERAL MEMBERS
- 3DP
- Agnico Eagle
- Alight Mining Solutions
- ASI
- CEMI
- Centric Mining Systems
- CheckMark Consulting
- Dassault Systèmes
- Datamine
- Desert Falcon Consulting
- Deswik
- DetNet
- Flow Partners
- Freepoint-McMoRan
- GE Mining
- Global IQ
- Goldcorp
- Guardant
- Hexagon Mining
- IBM
- Joy Global
- Leica Geosystems
- Liebherr
- Lockheed Martin
- Maptek
- Metcom Technologies
- Micromine
- Minetec
- Mine Vision Systems
- MineWare
- Mining3
- MISOM
- The Mosaic Company
- Motion Metrics
- Newmont
- Newtrax
- OSIsoft
- The PBE Group
- Peck Tech
- Prairie Machine & Parts
- RIGID ROBOTICS
- Rockwell Automation
- RPMGlobal
- Sandvik
- Schneider Electric
- Shell
- Siemens
- Silver Standard
- SMART Systems Group
- SMS Equipment
- Suncor
- Syncrude
- Total
- Trimble
- Vale
- Vondrco
- Yamana Gold

GOVERNING COUNCIL

CHAIR
Helius Guimaraes, Rio Tinto

OUTGOING CHAIR
Andrew Scott, Barrick Gold

VICE CHAIR
Gary Westerdale, Sibanye Stillwater

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

AUTONOMOUS MINING WORKING GROUP
Graeme Mitchell, BHP Billiton

COMMON REFERENCES FRAMEWORK WORKING GROUP
Roy Irvine, Real IRM

DATA ACCESS AND USAGE WORKING GROUP
Vacant

INDUSTRIAL COMMUNICATIONS EFFICIENCY WORKING GROUP
Aidan Giblett, Newmont

INTEGRATED OPERATIONS WORKING GROUP
Laura Mottola, Flow Partners

INTEROPERABILITY WORKING GROUP
Sergio Burdiles, CORFO

RELIABILITY WORKING GROUP
Zoli Lukacs, Gibraltar Mine

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

STAFF

SOCIAl MEDIA
Andrea Green & Cayley Humphreys

MEMBERSHIP DEVELOPMENT ACCOUNT MANAGER
Mike Forbes

LEADERSHIP COUNCIL

SENIOR MANAGER
George Long, Accenture

MANAGER, OPEN PIT SUPPORT
David Londino, AngloGold Ashanti

VP, GLOBAL STRATEGIC CUSTOMERS
Don King, Atlas Copco

VP, MINING TECHNOLOGY
Olav Kust, Atlas Copco

SENIOR DIRECTOR, INNOVATION
Andrew Scott, Barrick Gold

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 Roza, GD Smart Industries, Hatch

ASSOCIATE
Jeannie Els, RD Hatch Digital, Hatch

CEO
Ric Gros, METS Ignited

GM ENTERPRISE ARCHITECTURE & EMERGING TECHNOLOGIES
Helius Guimaraes, Rio Tinto

VP, INDUSTRIAL & OPERATIONAL TECHNOLOGIES
Brian Oldham, Rio Tinto

PRESIDENT
Tim Skinner, SMART Systems Group

SIBANYE STILLWATER
Gary Westerdale

MANAGING DIRECTOR
Heather Ednie

WORKING GROUPS AND PROJECTS
Jennifer Curran

COMMUNICATIONS
Kelly Townsend
GMSG STRUCTURE

Leadership Council
The advisory body that guides GMSG direction and priorities

Executive Council
Acts as GMSG governance, providing leadership and industry outreach

Governing Council
Oversees the creation and progress of all the Working Groups and collaborative projects

Autonomous Mining Working Group
- Steering Committee
- Reliability Best Practices
- Asset Management Standards Subcommittee

Reliability Working Group
- Steering Committee
- Reliability Best Practices
- Asset Management Standards Subcommittee

Data Access and Usage Working Group
- Data Exchange for Mine Software
- Mobile Equipment for Open Data Version 2
- Operational KPIs and Definitions

Common Reference Framework Working Group
- Exploration, Mining, Metals & Minerals (EMMM) Model User’s Guideline

Integrated Operations Working Group
- Research Collaboration
- Business Case
- Architecture Reference Framework

Interoperability Working Group
- Steering Committee
- Mapping the Interfaces for Equipment Operation across Control Layers
- Architecture Reference Framework
- Use Cases
- Technology and Connectivity

Underground Mining Working Group
- Short Interval and Real-Time Control
- The Electric Mine: Battery Electric Vehicles Underground
- Batteries
- Charging
- Mine Design
- Performance Requirements
- Underground Communications Infrastructure
- Steering Committee

Events
- Regional Forum Organizing Committees
- Summit Organizing Committee

GMSSG STRUCTURE
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.

**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 existing 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 autonomous mining implementation guideline through:

- Increased collaborative and constructive communication with regulators and other stakeholders.
- 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, fostering greater collaboration.
- Allowing owners and operators to understand data requirements and standards.
- Contributing to the work of ISO TC 82 on its upcoming sub-committee on autonomous mining, and ISO TC 127 on its autonomous standards work.

**Project Timeline**

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<th>Year</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
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<td>Steak Committee develops guideline table of contents</td>
<td>Draft development</td>
<td>Working Group review of draft documents</td>
<td>Revised drafts submitted to editor for review</td>
<td>Final Working Group revisions</td>
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**Participating Companies**

*Group leaders: Glenn Johnson, Teck*


**Next Steps**

The Steering Committee will set the plan to develop the table of contents for the guideline and divide the necessary work by sections. A project manager will be contracted to ensure adherence to the schedule and delivery of a valuable tool.

**Highlights**

- Workshop held February 2018 in Denver
- Vision of Autonomous Mining Survey released June 2017, results available on pages 8-9 of Corporate Member Report
- Project roadmap developed August 2017
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.

**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 users 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.
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 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.

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.**
- **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 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.**
- **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).**

Next Steps

Sub-committee members have received feedback from users on Version 0.9. Before release of Version 1.0, a second, broader survey for users is being drafted, as well as a formal draft of the collected use cases.

Participating Companies


Highlights

- Use case evaluation of Version 0.9 launched in March 2017
- Operator use case interviews began May 2017, report to be delivered September 2017

Project Timeline

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<td>Development of stakeholder use cases</td>
<td>Project sponsorship/ funding drive, global outreach</td>
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<td>Release full OMF Version 1.0</td>
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2017 2018

Building a Strategic Vision of Future Mining
DATA ACCESS AND USAGE
Mobile Equipment Open Data Version 2

Increase operational efficiencies and analysis by providing access to onboard equipment data.

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 Open Data Consensus Guideline, published in early 2016. Version 2 (V2) of the guideline is underway to address incomplete data sets 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, related to incomplete data sets (from Version 1) and new equipment types.
• Publish V2 by 2018.
• Tracking OEM and operator use of the published guideline (Open Data Lighthouse Project) and publish a series of case studies.

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 OEMs 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.

Project Timeline

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Participating Companies
Group leaders: Matt Miller and Perry Zalevsky, OSIsoft


Next Steps
Survey results have been collected on what equipment to address in V2 and meetings with key companies are now being set up for critical input. Following this, the project leaders will begin a first draft of V2. A project manager will be contracted to guide V2 work to completion.
DATA ACCESS AND USAGE

Operational Key Performance Indicators (KPIs) and Definitions

Standard definitions will enable comparison and benchmarking of equipment and operating performance. A common terminology will provide clarity between users and suppliers of data.

Business Objective
To develop common definitions and terminology for production data and operational KPIs and guidelines for reporting and classifying operational activities for surface mining, enabling a common basis for production reporting and performance comparisons.

Project Description
The Operational KPIs and Definitions project was initiated by the Data Access and Usage Working Group out of a need to develop a standard terminology for KPIs and definitions around production data.

Operational activities and events are classified into a Time Usage Model (TUM), which forms the basis for standardized common key performance definitions and indicators. The guideline for classification and reporting of operational activity and status will provide clarity around how activity is reported and enable operators to compare their performance to industry peers.

There are three expected project deliverables:
• Identification of common surface mining operational activities, events and status.
• TUM which enables consistent reporting, classification of operational events and activities.
• Definitions for common industry performance measures.

Operational events and definitions, contributed by participating companies were combined into a consensus TUM. The draft TUM is now in use as a pilot to capture operational activities.

Current project objectives are:
• Validate application of the TUM.
• Validate the list of operating activities and statuses.
• Roll out TUM to GMSG members for further feedback.
• Confirm standard definitions for terminology and operational KPIs.
• Confirm the TUM integrates with existing automated equipment dispatch systems.

Business Case
Performance improvement requires setting clear expectations and benchmarks and understanding where to find opportunities for improving performance in an operation.

The TUM is a production model which identifies and classifies operational activities, events and statuses into standardized time categories which are the basis for operational KPIs. Standardized definitions and terminology provide clarity when activities and events are being reported.

Agreeing on a common basis for classification of operational events, identifying common events into consistent classifications and agreed on time categories and performance definitions, enables comparison of performance among industry peers and helps identify industry leaders and best practices.

Benchmarking among industry peers to identify practices which lead to superior performance and collaboration toward continuous improvement of industry practices contributes to raising the bar on collective industry performance.

Highlights
• Draft Time Usage Model (TUM) and definitions finalized and prepared for circulation to the broader membership
• Case study data collected from operator use of the TUM

Project Timeline

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Current project objectives are:
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• Validate the list of operating activities and statuses.
• Roll out TUM to GMSG members for further feedback.
• Confirm standard definitions for terminology and operational KPIs.
• Confirm the TUM integrates with existing automated equipment dispatch systems.

Participating Companies
Group leader: Zoli Lukacs, Gibraltar Mine

Next Steps
Roll out the Time Usage Model to GMSG members and obtain final feedback on model and definitions prior to developing draft guidelines.
INTEGRATED OPERATIONS

Architecture Reference Framework

A common framework will educate mining companies on the key elements of integrated operations and enable the industry’s digital transformation.

Business Objective
Describe the functionality of integrated operations in a mining system, using common language to detail and describe implementation.

Project Description
The Integrated Operations Working Group is developing an architecture reference framework. The framework will outline the following (within the scope of standards, adoption, communication and collaboration):

DATA INGESTION
• Devices
• Integration of hardware
• Software and common protocols
• Monitoring and control
• External data sources

DATA AGGREGATION
• Data stores
• Standardized storage formats
• Data resiliency and availability
• Data encryption, integration layers, abstraction and APIs

DATA PROCESSING
• Analytics (batch, real-time, predictive)
• Unified data search and retrieval
• Centralized and edge processing capabilities

DECISION PROCESS
• Data consumption and visualization
• Reporting structure

Current project objectives are:
• Understand the most popular offerings from vendors across the mining value chain from “mine to market and sensor to boardroom.”
• Align these offerings to a reference architecture framework.
• Understand the best way to enable communication between siloed systems, and platforms.

Business Case
By breaking down the silos across the mining value chain, mining companies can unlock double digit percentage improvements for mining operations. For integrated operations to operate successfully, the digital technological solutions must be made available. A reference architecture framework enables mining companies to understand their operations and communications needs, and articulate them to vendors.

Providing a narrower focus for operational mining technology will create a more competitive landscape for vendors, and enables better innovation toward integrated operations.

Participating Companies
Group leader: George Long, Accenture
ABB, Accenture, Amazon, ArcelorMittal, Barrick Gold, CORFO, Ernst & Young, Flow Partners, Hatch, Rio Tinto, Teck

Highlights
» First conceptual meeting held February 2017 in Singapore
» Workshop held in May 2017 in Montreal
» Steering Committee launched May 2017

Agnico Eagle

Next Steps
A timeline for the project will be created by the Steering Committee.
Business Case

Whilst the industry is embracing the need for adapting new technologies in digitization, automation, and decision support systems, there is recognition that the core operating processes must be integrated to realize the full potential of the technologies.

A business case can articulate the financial risks and benefits of IO. With a pre-developed business case, mining managers will avoid the added cost of labour and resources that come with creating an individual case for the company.

A business case can also guide or lead conversations with company stakeholders and identify the requirements, needs and best options.

IO can act as the catalyst to transform the mining industry to deliver maximum productivity, minimizing human exposure and impact to the environment.

Implementing IO will:

• Create a seamless business environment with transparency of information, collaborative environment, with capacity to optimize the whole system.
• Establish industry-leading technology platforms that provide solutions in automation, analytics, and decision support.
• Become more predictable and able to manage variation in operations than we are today.

Participating Companies

Group leader: Saad Hameed, ArcelorMittal

ABB, Alight Mining Solutions, ArcelorMittal, Barrick Gold, Ernst & Young, Flow Partners, Freeport-McMoRan, NextGenOpX, Teck

Next Steps

A series of workshops and teleconferences will be held in October to begin committee work.
INTEGRATED OPERATIONS

Research Collaboration

A collaborative effort to collect existing IO knowledge and research for development into an assessment of the current state of the mining industry’s operating model. The resulting document will pave the way for future integrated operations research and development.

Business Objective
Evaluate the current state of integrated operations knowledge through a collaborative effort to compile research from mining and outside industry academics on integrated operations.

Project Description
The research collaboration will address integrated operations in its application within the mining industry by building a body of knowledge of IO. The sub-committee will aggregate existing research from academics on IO and perform opportunity assessments and gap analysis.

Current project objectives are:
• Help identify and define basic operational and infrastructure requirements.
• Outline the basic roadmap steps to develop and deploy IO.
• Provide a literature summary with clearly defined references and citations.
• Provide a list of best practices.
• Identify several recent use cases that could help mining management see the benefits of IO.
• Identify new cross-functional KPIs that should be leveraged to make IO successful.
• Identify changes in the ways people are compensated as their roles change.
• Identify potential risks in IO that should be considered.

Business Case
Outside industries (oil and gas, military, utilities, airlines, logistics, and transportation) have taken the lead in developing and deploying integrated operations conceptual models. By leveraging previous work, the lessons learned and best practices developed by these other industries, GMSG can more easily align and build a pool of knowledge in mining. IO is not just about the technology used in a centralized control centre, but includes the technology, change management, and process engineering required to engage people, provide information, and restructure work processes to improve collaborative decision making for complex operations.

This research collaboration is an opportunity to get the full picture of what research has been done across the globe on the development of IO, and will be a crucial first step in providing context for all future integrated operations in the mining industry.

Project Timeline

| Phase 1: Research collection | 2017 | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
| Phase 2: Definition | 2018 | | | | | | | | |

Highlights
» Phase 1 launched May 2017
» Project proposal developed during Montreal workshop in May 2017
» Project Steering Committee held meetings throughout June and July

Next Steps
An invitation to participate will be sent to non-academics (industry organizations and research groups). A collaboration committee will be established, including Steering Committee representatives and academics, to compile existing research and oversee the project. Opportunities to publish with GMSG partners will be explored, and an online library will be developed for sharing the research results and steering future research objectives.

Participating Companies
Group leader: Fiona Campbell, CGM
Alight Mining Solutions, Anglo American, AngloGold Ashanti, Barrick Gold, BHP Billiton, CGM, Check Mark Consulting, Deloitte, Flow Partners, Global IO, Hatch, IBM, Rio Tinto, Teck, Visagio
Facilitate the development and adoption of interoperability standards between operators, OEMs, OTMs, and consultants to ensure industry automation and integration will not be constrained as new technologies and processes emerge.

**Business Objective**
Identify and describe the business and operating requirements of interoperability in mining. Capture the industry challenges and articulate the value.

**Business Case**
Mining equipment is currently unable to exchange data freely, due to proprietary limitations, which affects mine owners and operators as equipment data becomes more complex. Introducing interoperability will mean broader engagement, improved communication between equipment, better operating excellence, equipment development, and deployment.

Interoperability impacts all industry stakeholders. With proper and integrated information access to resources, processes and decision history, mine owners and operators can benefit by being able to identify, develop and deploy solutions that are more productive, safe and sustainable. This will greatly impact developing mining equipment, and communications and information technology. It will also have a direct impact on vendors and OEMs.

**Project Description**
The vision of the Interoperability Working Group is to facilitate the development and adoption of open systems and solutions, and international standards for interoperability of all mining equipment, processes, and operating personnel. As intelligent systems, digital connectivity, and data availability and exchange become a reality, it is important to consider the benefit and impact on interoperability for mining. This new Working Group will strive to ensure that the industry automation and integration will not be constrained as new technologies and processes emerge.

A series of workshops were held in early 2017 in Australia, South America, and North America to identify the interoperability priorities and requirements of the global mining industry. From these meetings, participants reached consensus on what should and should not be covered in the Working Group scope.

These areas include:
- Use cases
- Scope/function/requirements to underpin the value proposition
- Reference architecture framework
- Cyber security
- Privacy
- Commercial confidentiality

**Participating Companies**
*Group leader: Sergio Burdiles, CORFO*

**Next Steps**
Working Group leaders will work with the Steering Committee to formulate the project plan. A project manager will be contracted to ensure project delivery and liaise with related organizations.

**Project Timeline**

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**Highlights**
- Workshops held in Perth, Santiago and Denver between February – March 2017
- Steering Committee formed May 2017
- Project plan developed July 2017
Reliability Best Practices Guideline

Asset Reliability is the foundation for success of future mining practices. Improved asset reliability will result in reduced maintenance requirements, increased production, lower operating costs, and improved safety.

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

Project Description
The Reliability Working Group (RWG) 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.

The philosophy of the RWG is to share with related organizations and to leverage their experience and knowledge in applying a range of existing standards and best practices to a cost constrained mining environment. It is a collaborative model which aims to leverage practices and standards from other industry organizations through mutual participation.

Project objectives include:
- Identify standards, practices and tools that result in superior reliability and maintenance performance.
- Propose definitions for common reliability and maintenance terminology and KPIs.
- Develop and share reliability best practices that align with mining operational needs.
- Enable benchmarking of maintenance and reliability activity.
- Further the professional and personal development of reliability professionals in the mining industry.

The Working Group also supports the mining industry through the ISO 55000x standards series. This sub-committee will enable collaboration with other reliability and asset management organizations beyond the mining sector.

The deliverables of the Working Group will be a series of best practices guidelines relating to reliability in mining.

Business Case
Over the years, the application of proven reliability concepts has contributed to safer, more productive and profitable operations across a range of industries from aerospace, manufacturing, oil and gas, power generation and others.

The adoption of reliability programs in mining has been slower due in part to the perception that unique and variable operating environments present barriers to the introduction of commonly used reliability concepts.

With industry stakeholders setting higher expectations for asset performance, interest in application of reliability systems and tools is rising. Organizations are challenged in understanding which practices provide the greatest value as well as how to successfully roll out, sustain, and measure the performance and effectiveness of their programs.

By delivering best practice guidelines for reliability in mining the RWG will enable organizations to improve asset reliability and increase equipment runtime resulting in increased production and reduced operating costs.

Finally, asset and system reliability represents a key foundational element of autonomous mining systems.

Participating Companies
Group leader: Zoli Lukacs, Gibraltar Mine


Next Steps
The RWG will hold ongoing regional workshops to identify reliability best practices, select key target areas for best practices sharing, and document key maintenance and reliability metrics toward the development of an online collaboration model.
Improve communication and network infrastructure in underground mines by providing a guideline 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.

A five document guideline is currently being developed to better enable mine operators to understand modern communications requirements. The first two parts, “Positioning and Needs Analysis” and “Scenarios and Applications” were published in February and April of 2017.

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 global advancement of digital technology 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.

**Project Timeline**

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<td>Section 3-5 draft review and approval</td>
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**Highlights**

- Guideline Part 2: “Scenarios and Applications” published April 2017

**Participating Companies**

**Group leader: Dave Fry**


**Next Steps**

The Steering Committee will set the work plan to develop and publish sections 3-5 in the guideline suite in September 2017. A project manager will be contracted to ensure quality project completion.
Short Interval and Real-Time Control

Advances in autonomy in underground mining cannot be made without short interval control (SIC) and real-time control (RTC) to better coordinate miner tasks within a single shift. By enabling the efficient adoption of these processes, the Underground Mining Working Group will give the industry the required processes for efficient shifts and production times.

Business Objective

Produce a guideline outlining the current best practices for SIC and RTC, presenting all options that can be considered in the rapidly changing technological landscape.

Project Description

SIC and RTC are the processes that allow mining supervisors to better manage tasks throughout a single shift, enabling real-time feedback on completed and outstanding work. GMSG and the Canada Mining Innovation Council (CMIC) are partnering for the creation of the guideline, which will raise awareness of what is currently available to mine owners and operators.

The intent is to provide a roadmap outlining possible paths from an "analog" mine to short interval control to real-time control, providing a tool that companies can use to find where they are currently, identify where they want to get to, and see the options available to them to get there, while avoiding common pitfalls. It may also provide an introduction to newer technologies that are currently being introduced to underground mining, either through development or importation from other industries.

Current project objectives are:
- Create a table of contents to divide guideline work into sections.
- Hold regular meetings with participants via online conference calls.
- Plan in-person workshops in Australia, South America and North America for increased engagement.

Business Case

There is a strong desire for increased control and automation in underground mining. Thanks to technological advances, communication infrastructure has vastly improved in underground environments, allowing better opportunities to adopt shift management processes. Many companies have implemented some aspects of SIC and RTC, and others are looking at doing so, but there is a lack of independent guidance on how to proceed.

A best practices guideline will deliver much-needed direction on the available options for interval control, allowing for:
- Greater and faster adoption of control technologies.
- Lower cost implementation.
- Fewer companies encountering problems with the technologies, resulting in fewer companies abandoning the technologies due to poor implementation.

Participating Companies

Group leader: David Sanguinetti, Sanguinetti Engineering


Next Steps

GMSG and CMIC, with support from Business Sweden, will hold an official launch workshop in Toronto in September. A second workshop is scheduled in Stockholm in December. The guideline and table of contents will be created, with the work divided between volunteers.
The Electric Mine: Battery Electric Vehicles in the Underground

**Business Objective**
Provide an overview of the BEV options currently available for OEMs and mine owners/operators dealing with underground mines, and serve as a discussion document on the unique challenges BEVs present for the mining industry.

**Project Description**
The BEVs project is a joint effort between GMSG and the Canada 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:
- Treat published guideline as an overview of the available standards around BEV implementation in an underground mine; it can be used as a blueprint for vehicle OEMs, and be included by mining companies in tender documents to 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.
- Provide global scope, while also 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.

**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.

**Business Case**

**Project Timeline**
A complete timeline will be available by Q4.

**Participating Companies**
Group leader: Craig Harris, Glencore


- Received feedback from stakeholders on V1 of guideline
- Received Canadian federal funding

**Highlights**
- Guideline published April 2017
- Workshop held April 30, 2017 in Montreal
- Published April 2017
- Workshop held April 30, 2017 in Montreal
- Received feedback from stakeholders on V1 of guideline
- Received Canadian federal funding

Next Steps
A Steering Committee workshop is scheduled for September to set the strategy for V2 and collect feedback from V1, with the expectation that the project sub-groups will begin working on the guideline in October.