FUTURE MINING LEADERSHIP

INNOVATION THROUGH COLLABORATION
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Thank you for helping GMSG grow.

This has been a tremendous year for our organization. GMSG is increasing both its global reach and the level of engagement in the mining industry. With the help of our volunteers and the diligent work they do, we remain committed to helping solve issues facing the industry today. Our growing membership reflects this high level of engagement: GMSG has seen an increase of 19 corporate members for 2017, which includes Leadership-level members and Collaborators.

In December, GMSG hosted the Future Mining Summit 2017 in Stockholm, Sweden, which was well attended by senior industry influencers and stakeholders and covered topics such as digital mining, the machine learning revolution and using blockchain technology to improve traceability and security in the industry. Altogether, GMSG has hosted events on six continents during 2017, which included events held for the first time in Asia, with the Singapore Future Mining Forum in February, and Europe, with the Future Mining Summit. We plan to repeat the successes of these international events in 2018.

As well as increasing our global footprint, GMSG has been making great strides in our collaborations with industry partners. We launched a second guideline project with our partner, the Canada Mining Innovation Council (CMIC), on Short Interval and Real-Time Control, and will continue our newly formed collaboration with the Mining and Metals Information Sharing Analysis Center (MM-ISAC) in an attempt to address issues surrounding cyber security.

We also published several guidelines in 2017, including Underground Communications Infrastructure Sections 1 and 2 and Recommended Practices for Battery Electric Vehicles in Underground Mining. Since then, our Data Exchange for Mine Software Sub-committee has released V1.0 of its Open Mining Format (OMF) standard on GitHub, and published a report about the challenges associated with manipulating and transferring 3D images between mining software packages. This report continues to garner a lot of interest from industry and media.

2018 promises to be equally busy with plans to hold nine forums, the Summit, as well as a number of workshops. Nine guidelines are currently on track for publication and three new Working Groups topic areas are being considered. Our three-pronged strategy for 2018 will include greater regional engagement, revenue diversification and improved project execution.

We will continue our efforts to expand GMSG’s influence and address important issues facing the industry in 2018. This is not something we can do alone. We look forward to your ongoing engagement and your commitment to shaping the future of mining with us.
**GMSG 2018 STRATEGY**

**EXPAND OUR REGIONAL ENGAGEMENT.**
- In 2017, GMSG hosted its first events in Asia and Europe. We plan to continue working on these continents to increase our relevance and effectiveness.
- Further develop our membership in South America and Africa and translate key GMSG documents into Spanish.
- Build partnerships with regional associations/government bodies to foster greater outreach to and inclusion of local industries.
- Increase activities and participation across all regions to better understand the key issues of the global mining industry and ensure a global voice in guideline development.

**STRENGTHEN COMMUNICATION.**
- Support a robust virtual collaboration matrix for volunteers, including online, phone/video conferences, workshops, regional forums and increased communications for project groups.
- Cultivate outreach opportunities through social media and traditional platforms to increase awareness of GMSG and important issues to the mining community.

**GROW OUR MEMBERSHIP AND VOLUNTEER BASE.**
- Attract new corporate members at all membership tiers, to increase resources for GMSG projects and broader stakeholder participation in GMSG working groups.
- Form a recognition program to thank volunteers and members for their leadership and support.

**IMPLEMENT GUIDELINES AND MEASURE THEIR EFFECTIVENESS.**
- Increase resources to enable swift, high quality progress on developing guidelines and ensure strong stakeholder engagement. This includes targeting partnerships and funding opportunities with governments, universities, grant organizations, and other R&D leaders.
- Develop a guideline implementation strategy to ensure published guidelines bring value to the industry.
- Provide tools for members to share feedback on guidelines and improve effectiveness.

**STRENGTHEN OUR ABILITY TO DELIVER VALUE.**
- 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.

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**did you know...**

In 2017, GMSG’s membership grew **24%**
2018 EVENTS

WORKSHOPS
MOBILE EQUIPMENT OPEN DATA
February 28
Minneapolis

UNDERGROUND COMMUNICATIONS INFRASTRUCTURE
March – Toronto & Brisbane
May – Vancouver

RELIABILITY WORK MANAGEMENT PRACTICES
March 15
Tuscon

AGM & NETWORKING EVENT
Vancouver
May 8

SUMMIT
PERTH
November/December

CONFERENCES & CONVENTIONS
SME
February 25-28
Minneapolis

CIM
May 6-9
Vancouver

Final dates will be made available on the GMSG website.

FORUMS
DENVER
May 30-31

SUDBURY
June 12-13

BRISBANE
August 21-22

SWEDEN
September 5-6

EDMONTON
October 2-3

JOHANNESBURG
October 30-31

CHILE
November 6-7

PERU
November 9

SINGAPORE
November 22-23
2017 HIGHLIGHTS

3 Published Guidelines

Underground Mine Communications Infrastructure Guideline Part 1: Positioning and Needs Analysis
Published: February 2017
Provides a high-level overview of the services and supporting technology generally used in each phase of the mine lifecycle.

Recommended Practices for Battery Electric Vehicles in Underground Mining
Published: April 2017
Serves 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.

Underground Mine Communications Infrastructure Guideline Part 2: Scenarios and Applications
Published: April 2017
Organizes general tasks and components needed for each phase of underground mine planning and development through checklists for mine personnel and contractors.

1 Published Report

Data Exchange for Mine Software: 3D Interoperability User Interviews and Common Challenges
Published: November 2017
Details challenges associated with manipulating and transferring 3D images and provides next steps for developing an Open Mining Format (OMF) to resolve issues.

In 2017, GMSG held events on six continents: North America, South America, Europe, Africa, Australia and Asia.

North America: Montreal, Toronto, Denver, Edmonton
Europe: Stockholm
Australia: Perth
South America: Santiago
Asia: Singapore
Africa: Johannesburg
20 EVENT SPONSORS
ABB Battery Electric Vehicles Workshop, Integrated Operations (IO) Business Case Workshop
Accenture Singapore Forum
Alight AGM and Networking Event, Edmonton Forum
AMTC Santiago Forum
AngloGold Ashanti Denver Forum
Barrick Gold AGM and Networking Event, Battery Electric Vehicles Steering Committee Workshop
Business Sweden Short Interval and Real-Time Control (SIC/RTC) Workshops
CORE Interoperability, Communications Infrastructure and IO Workshops
CORFO Interoperability Workshop (Santiago Forum)
Deswik AGM and Networking Event
Epiroc Future Mining Summit 2017
Flow Partners Interoperability Workshop (Santiago Forum), IO Executive Roundtable
Miller Thomson SIC/RTC Workshop
OSIsoft Executive Council Strategy Workshop
Peck Tech AGM and Networking Event
Suncor Reliability Workshop
Teck IO and Autonomous Mining Workshops
Trimble Autonomous Mining Workshops
University of Alberta Edmonton Forum
Vale Battery Electric Vehicles Workshop
Yamana Gold Underground Communications Infrastructure Workshop

6 EVENT PARTNERS
AusIMM Perth Forum
Austmine Perth Forum
CIM Edmonton Forum
CORFO Santiago Forum
SAIMM Johannesburg Forum

18 COLLABORATIVE PARTNERS
AMIRA International
Austmine
Australasian Institute of Mining and Metallurgy (AusIMM)
Business Sweden (BuS)
Mining Suppliers Trade Association (MSTA) Canada (formerly CAMESE)
Canadian Institute of Mining, Metallurgy and Petroleum (CIM)
Canada Mining Innovation Council (CMIC)
Coalition for Energy Efficient Comminution (CEEC)
Corporación de Fomento de la Producción (CORFO)
GS1
International Organization for Standardization (ISO)
Mining3
Mining and Metals Information Sharing Analysis Center (MM-ISAC)
Society for Mining, Metallurgy & Exploration (SME)
South African Institute of Mining and Metallurgy (SAIMM)
Standards Leadership Council
Surface Mining Association for Research and Technology (SMART)
The Open Group

CONNECTIONS
Engaging members with industry news and offering opportunities to collaborate is one of our key priorities.

- **Gained 19 new corporate members for 2017**
- **Increased group members by 275%**
- **Surpassed 1,000 newsletter subscribers**
- **2 trade show booths**
- **4 news briefs**
- **7 press releases**
- **43 web articles**
- **5 partner events**
- **3 brochures**
- **7 newsletters**
- **2 magazine articles**
GMSG NEWS

Influencers Gather in Sweden for Summit
GMSG held its annual Future Mining Summit in Stockholm, Sweden, in December. The two-day event, hosted by Epiroc at its test mine, engaged senior industry influencers and stakeholders in timely topics such as digital mining, cyber security, and blockchain technology.

Greg DeMichillie, Director of Product Management at Google, delivered a presentation on the ways in which companies can begin leveraging machine learning technology to solve problems and fuel innovation.

Peter Burman, Program Manager Mine Automation at Boliden, spoke about the company's Mine Automation Program, which Burman says will make it possible to run the underground mine 24/7, aims to improve productivity and mine safety.

Kevin McAuley and Greg Sandblom of Glencore gave a presentation about the challenges the company has faced in its transition from being an “old, rich mining camp” to developing new mines, the new technology and innovations that make these new mines viable, and the shift in the relationships between information technology (IT) and operational technology (OT) toward closer collaboration.

Torbjorn Holmstrom, Senior Advisor of Research and Technology at Volvo Group, predicted there will be autonomous vehicles in use before 2030 and discussed the fact that different applications can feasibly use the same autonomy platform.

For more information on the presentations from the Future Mining Summit, visit the Library/Documents section of our website.

Report Makes Headlines
GMSG’s 3D Interoperability: User Interviews and Common Challenges report has been getting a lot of traction in the media. The report, which was published in November by the Data Access and Usage Working Group’s Data Exchange for Mine Software Subcommittee, details use cases and the challenges associated with manipulating and transferring 3D images between software packages, and recommends use of an Open Mining Format (OMF) in order to reduce costs and decrease time lost due to these issues. The report was based on interviews with personnel at Teck, Barrick and Newmont.

News of the report was quickly picked up by several media outlets and a number of our partners. The Sub-committee is currently working on V2.0 and plans to release it in 2018. V1.0 is now available on GitHub.

GMSG Members Go Underground
GSMG coordinated its first-ever mine tours in Sweden in December 2017, which provided attendees with the opportunity to learn about established Swedish mining operations at Boliden, Lundin Mining Corporation, and LKAB. The first tour featured Boliden’s Renström Mine, which opened in 1952. Renström is one of the deepest mines in Sweden at approximately 1,445 metres deep. The Renström Mine tour was followed by a demonstration at Boliden headquarters about the company’s work with SIC&RTC, as well as with connectivity and remote control in its Knakenberg mine. Also included was a tour of LKAB’s Kiruna Mine the world’s largest, most modern underground iron ore mine.
NEW PROJECT MANAGERS COMING ABOARD

GMSG has engaged project managers to head up several projects launched in 2017, including Underground (UG) Short Interval Control (SIC), UG Battery Electric Vehicles (BEV), UG Communications Infrastructure, and Data Access and Usage (DAU) Mobile Equipment Open Data. The BEV Version 1 guideline development process serves as a prototype for current process improvement. Going forward, GMSG project managers will help to streamline the guidelines development process by ensuring greater control over projects and enabling greater volunteer engagement. GMSG also plans to engage a program manager by mid-2018, who will be responsible for guideline project management.

MEET OUR NEW STAFF

Heather Turnbull
Office Assistant

Blaine Sullivan
Membership Support

Alexander McCleave
Communications Coordinator

Melissa Wallace
Communications Coordinator

GMSG’S NEW BUSINESS & FINANCIAL MODEL

GMSG is implementing a new business model in the coming year. The new model will include diversifying the organization’s revenue streams and dedicating resources within targeted regions around the world. This regional focus will aim to develop collaborative communities, identify regional priorities, attract new members, host regional events, develop regional partners, and drive value realization through guidelines implementation. The updated model will enable us to be more strategic in building a streamlined events planning model and enabling increased communications with both GMSG members and the industry at large.

“We will continue our efforts to expand GMSG’s influence and address important issues facing the industry in 2018.”

— Helius Guimaraes, Chair, GMSG
ISO TC 82 Mining
The Advanced Automated Mining Systems Subcommittee under ISO Technical Committee (TC) 82 was approved by member nations in an international vote completed September 14, 2017. The sub-committee was approved with a very strong vote: 16 nations approved, 6 abstained, with 0 disapproved. The scope, plans, industry priorities and next steps for the sub-committee were presented at the plenary meeting in Santiago, Chile in September. An organizational and planning meeting is expected for late first quarter of 2018, to be held in North America. Communication with the industry will be initiated shortly as will a campaign to request participants, especially mine operators, to participate in the sub-committee and its planned activities.

Two ISO projects that require strong mine operator presence and participation are underway. One project is on standards for Collision Avoidance and a mine operator lead is needed for the underground component. The TC 82 is organizing talks with TC 127 Earth Moving Machinery on a new project dedicated to emergency remote stop; this project requires engagement from TC 82 mine operators. GMSG is requesting mine operators come forward regarding participation. Further communication to mine operators will also be initiated.

ISO TC 251 Asset Management
A review of the ISO 55000x series document 17021:5 closed December 1, 2017. The document details the minimum requirements for an Auditor or Assessor for an asset management system. The Reliability Working Group Sub-committee sent feedback on the document in order to provide a mining context to asset management requirements.

The ISO 55002 Final Draft International Standard (FDIS) document is due for review ahead of the next planned meeting in Paris, France, from February 5-9, 2018.
MEMBERSHIP

Leadership 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.

Member Companies

- **21** Mining Companies
- **10** OEMs
- **33** OTMs
- **2** Research Organizations
- **13** Consultants
- **1** Industry Organization

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

LEADERSHIP MEMBERS
- Accenture
- AngloGold Ashanti
- Antofagasta Minerals
- Barrick Gold
- BHP Billiton
- Caterpillar
- Epiroc
- Freeport-McMoRan
- Glencore
- Hatch
- METS Ignited
- Motorola
- Rio Tinto
- Vale

COLLABORATOR MEMBERS
- Amazon
- Anglo American
- Boliden
- Dassault Systemes
- Hitachi
- Maclean Engineering
- Newtrax
- Orica
- Seequent
- Teck
- Wenco

GENERAL MEMBERS
- 3D-P
- Agnico Eagle
- Alight Mining Solutions
- ASI
- CEMI
- Centric Mining Systems
- CheckMark Consulting
- Datamine
- Desert Falcon Consulting
- Deswik
- DetNet
- Flow Partners
- GE Mining
- Global IO
- Goldcorp
- Guardvant
- Hexagon Mining
- IBM
- Komatsu
- Leica Geosystems
- Liebherr
- Lockheed Martin
- Maptek
- Metcom Technologies
- Micromine
- Miller Technology
- Minetec
- Mine Vision Systems
- MineWare
- Mining3
- MISOM
- The Mosaic Company
- Motion Metrics
- MST Global
- NDT Global
- Newmont
- OSIsoft
- Peck Tech
- Prairie Machine & Parts
- RIGID ROBOTICS
- Rockwell Automation
- RPMGlobal
- Sandvik
- Schneider Electric
- Shell
- Siemens
- SMART Systems Group
- SMS Equipment
- SSR Mining
- Suncor
- Syncrude
- Total
- Trimble
- Vandrico
- Yamana Gold
GOVERNING COUNCIL

CHAIR
Helius Guimaraes, Rio Tinto
VICE CHAIR
Michelle Ash, Barrick Gold
OUTGOING CHAIR
Andrew Scott, Symbiotic Innovations
VICE CHAIR INTERNATIONAL STANDARDS
Tim Skinner, SMART Systems Group
TREASURER
Mark Bartlett, Flow Partners
SECRETARY
Peter Becu, Information Systems and Technology Consultant
MANAGING DIRECTOR
Heather Ednie, GMSG
SAIMM REPRESENTATIVE
Jean-Jacques Verhaeghe, South Africa Chamber of Mines and the Mining Innovation Hub
AUTONOMOUS MINING WORKING GROUP
Graeme Mitchell, BHP Billiton
COMMON REFERENCE FRAMEWORK WORKING GROUP
Roy Irvine, Real IRM
DATA ACCESS AND USAGE WORKING GROUP
Marcus Thomson, CEMI
INDUSTRIAL COMMINUTION EFFICIENCY WORKING GROUP
Aidan Giblett, Newmont
INTEGRATED OPERATIONS WORKING GROUP
Laura Mottola, Flow Partners
INTEROPERABILITY WORKING GROUP
Sergio Burdiles O., CORFO
RELIABILITY WORKING GROUP
Zoli Lukacs, Independent Consultant
UNDERGROUND MINING WORKING GROUP
Riaan van Wyk, DetNet South Africa
Russell Kennett, Rio Tinto

LEADERSHIP COUNCIL

GEORGE LONG
Senior Manager, Resources, Digital Transformation, Accenture
LIV CARROLL
Senior Principal, Analytics, Digital Mining, Accenture
ALEX KENT
Vice President, Engineering And Projects, AngloGold Ashanti
VITESH MAHARAJ
Senior Vice President Engineering, AngloGold Ashanti
JUAN QUISPE ARANCIBIA
Vice President, Operations & Maintenance, Antofagasta Minerals
DENIS GRATTON
Vice President, Autonomous Mining, Barrick Gold
MICHELLE ASH
Chief Innovation Officer, Barrick Gold
GRAEML MITCHELL
Manager, Mine Automation, BHP Billiton
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Principal Risk & Business Analysis Technology, BHP Billiton
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Vice President, Mining Technology, Epiroc
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Vice President, Technology, Freeport-McMoRan
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KEVIN MCAULEY
Manager – Sustainable Development And Innovation, Sudbury Integrated Nickel Operations, Glencore
ALVARO ROZO
Global Director, Smart Industries, Hatch
JEANNE ELS
Regional Director, Hatch Digital, Hatch
RIC GROS
CEO, METS Ignited
LISA BOUTILIER
Corporate Account Manager, N.A. Mining, Motorola Solutions
SCOTT SCHOEPEL
Vice President, Commercial Markets, Motorola Solutions
HELIUS GUIMARAES
General Manager Data Strategy, Rio Tinto
BRIAN OLDHAM
Vice President, Industrial & Operational Technologies, Rio Tinto
ANDREW SCOTT
GMSG Outgoing Chair and Principle Innovator, Symbiotic Innovations
TIM SKINNER
GMSG Vice Chair International Standards and President, SMART Systems Group
SAMANTHA ESPLEY
Director, Technical Excellence, Vale
SIMON NICKSON
Principal, Underground Mining Engineer, Vale
Working Groups
Project Description
The purpose of the project is to provide a playbook that will drive innovation across the industry and facilitate the conversation between all stakeholders. Self-driving trucks and remote or autonomous drills are changing the landscape of the mining industry. Companies that embrace automated technology increase safety and productivity. Autonomous equipment will reduce downtime, decrease expenses and grow overall production.

The key areas covered by the guideline will include functional capability, functional safety, change management, communications with the workforce and the local community, business case development, and interactions with the regulators. The guideline will be considered an expanded checklist or playbook, highlighting the success factors required to make the journey from research and development to deployment.

Business Case
There are currently few regulations and standards dedicated to autonomous mining, despite the fact that innovation around autonomy is building at a rapid pace. A guideline would not only help companies adopt these processes, enabling identification of existing standards and processes from other industries and placing them in a mining context, but it would also act as a tool to assist companies in conversations with regulators new to autonomous mining.

A guideline would allow the industry to progress rapidly and attract more vendors to the mining sector, leading to more competition between suppliers and a surge in innovation in mining equipment.

Participating Companies
Group Leaders: Glenn Johnson, Teck; Chiraj Sathe, BHP Billiton

Next Steps
A table of contents for the guideline will be developed to divide the necessary work by sections. A project plan including schedule of meetings and workshops will be circulated to working group. The full draft is to be completed in 2018.

Project Timeline

![Project Timeline Graph]

1 – Project plan development
2 – Completion of a first draft
3 – Working Group review and approval
4 – Guideline publication
Common Reference Framework

Exploration, Mining, Metals & Minerals (EMMM)
Models Users Guidline

Advancing 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 solution to mining industry challenges.

Project Description
The Common Reference Framework Working Group is designed to assess The Open Group's EMMM industry models as a reference framework for business functions and processes of a mining organization, from prospecting to the corporate financial statement. The Open Group is a global information technology standards-setting consortium. Working Group members will update the models with increased mining input, and share how these documents can be useful tools for industry stakeholders with a user's guideline.

GMSG has selected The Open Group's work as a reference because it has published, scrutinized, tested and approved standard models covering the full value chain of the mining industry. The Working Group will enable members to understand how the various frameworks can be used to drive value in their own companies. The group will also support the EMMM Forum’s ongoing projects, including the creation of an information architecture framework to help industry members understand what information is required to optimally manage an operation.

Business Case
Prior to the EMMM models, there was no 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.

Over the last two decades, several attempts have been made at producing generic descriptions of the mining business; often in isolation. The Open Group’s EMMM model defines the operating context for the industry. It acts as a guide, providing context to the operations in the industry. This group supports the notion of collaboration as a meaningful industry tool by which to identify and disseminate practical solutions to common stakeholder problems as they strive for operational excellence.

Participating Companies
Group Leader: Roy Irvine, Real IRM


Next Steps
An action plan will be set by the Steering Committee based on the teleconferences’ outcomes.

Project Timeline
To come
Focusing 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.

Project Description
The Data Exchange for Mine Software Sub-committee proposes the creation of an Open Mining Format (OMF) as a better solution to transferring, managing and manipulating 3D information. By developing a common definition for 3D objects, mining organizations may improve the compatibility of mining software packages, which will allow for fewer issues with manipulating 3D information.

OMF V1.0 code libraries are now available on GitHub. The sub-committee published a report in November 2017 outlining the challenges of manipulating 3D models, and how OMF will address those issues.

2018 Objectives:
• Analyze use cases by vendors to begin work on V2.0
• 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. Generic file export formats are also becoming less able to accommodate increasingly large and complex data files.

Currently, mining companies use multiple applications to manage and manipulate their 3D models. Surveyors, geologists, mine engineers, and managers need to be able to move from one 3D data application to another with consistency and relative ease in order to manipulate 3D projects.

Having multiple applications creates common technical and process challenges that can result in significant setbacks, some of which occur more than others. These issues revolve around scripts, ASCII, flat files, name conventions, rotation of 3D images, validity, colour models, managing coordinate systems and file size, while the significant process challenges are the time loss, reverse engineering, restricted use of available technology, additional costs, and increased risk. This requires additional costs to maintain the solutions, causing significant time lost to manual maintenance of the processes.

Next Steps
1. Steering Committee will begin work on V2.0.
2. Seek one or two mining companies to provide case studies and a proving ground.
Accessing operating data from mobile equipment offers opportunities for superior analysis and increased operational efficiencies. The guideline creates a consensus between owners/operators and OEMs by defining open access data for open pit and underground mobile equipment.

Project Description

The Mobile Equipment Open Data Consensus Guideline was published in 2016 to define a set of data parameters for open pit and underground mining mobile equipment that are, in principle, accessible to equipment owners and operators. OEMs and miners reached a consensus on what onboard data would be made available and open to the equipment owner, in a real-time, read-only format. The Guideline does not consider how the data may be accessed or applied.

Version 2 of the guideline is in development with the objective of re-connecting OEMs and equipment owner/operators such that they may re-visit data types previously considered “closed” and include additional mobile equipment types in the Guideline. OEM and operator use of the published guideline is being tracked and will result in a series of case studies.

Business Case

Modern world-class mining operations require continuous technical improvement and innovation to maximize productivity and safety. Operational data is critical to this goal and includes source data related to the real-time and historical performance of mobile mining equipment.

Access to such operational data has historically been granted on an ad-hoc basis, which has burdened owner/operators with defining data requirements and negotiating access. While OEMs support open data, they also wish to preserve Intellectual Property and value-added service opportunities.

The Mobile Equipment Open Data Guideline seeks to provide a standard framework of available data, streamlining requirements of owner/operators and supporting OEMs in contributing to mine success. Once Open Data is agreed upon, best practices may be developed to increase productivity and profits.

Next Steps

The draft V2 is being developed in January/February. A workshop is scheduled for February 28, 2018 to reach a group consensus, with the objective to publish V2 by May, 2018.
Operational Key Performance Indicators (KPIs) and Definitions

Developing common definitions and terminology enables reporting consistency between operators, allowing effective comparisons of performance data.

Project Description
Industry has expressed a need to develop a standard terminology and KPI definitions around surface mining equipment performance parameters. Standard terminology will provide benefits in reporting and classifying operational activities, enabling a common basis for internal and external performance comparisons.

Project deliverables include the identification of common surface mining operational activities, events and status, and proposed standard definitions for common industry performance measures. Operational activities and events will be classified into a Time Usage Model (TUM), which forms the basis for standardized common key performance definitions and indicators. 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. The guideline for classification and reporting of operational activity and status will provide clarity around how activity is reported enabling consistent performance comparisons.

Business Case
Performance improvement requires an understanding of current performance, establishing clear expectations and benchmarks and the ability to find opportunities for improving performance. Standardized definitions and terminology provide clarity on how activities and events are being reported enabling consistent performance comparisons among fleets. Agreeing on a common industry basis for classification of operational events and performance definitions enables comparison of performance internally and among industry peers. Benchmarking among industry peers helps identify industry leaders and best practices, raising the bar on collective industry performance by continually raising performance expectations.

Participating Companies
Group Leader: Zoli Lukacs, Independent Consultant

3D-P, Accenture, Anglo American, AngloGold Ashanti, Barrick Gold, BHP Billiton, CNRL, Centric Mining Systems, Dassault Systèmes, Data Mine Software, Deswik, Freeport-McMoRan, Gibraltar Mine, Global IO, Hexagon Mining, IBM, JVA, Newmont, OSIsoft, PT Uku Tech Indonesia, Rio Tinto, Schneider Electric, Siemens, SMART Systems Group, SSR Mining, Teck, The Electrum Group, Trimble, University of Sao Paulo

Next Steps
Roll out the draft Guideline and Time Usage Model to GMSG members and obtain final feedback on proposed model and definitions prior to developing final guideline. During the review phase obtain feedback into additional industry KPIs and definitions required.

Project Timeline

1 – Circulate draft guideline
2 – Industry draft review and update
3 – Working Group review and approval
4 – Guideline publication
INTEGRATED OPERATIONS

Business Case Development

Developing an adaptable Integrated Operations (IO) business case for mining company executives to help ease the transition for companies seeking to shift their production processes.

Project Description
The objective of this Integrated Operations (IO) Working Group project is to create a guideline that companies can use to develop their own business cases.

The business case guideline will focus on six key areas:
1. Financial evaluation
2. Developing the direction and vision
3. Creating a roadmap
4. Scoping
5. Prioritization
6. Maturity assessment

Business Case
While the industry adapts to new technologies in digitization, automation, and decision support systems, core operating processes must also be integrated to realize the full potential of the technologies.

A business case guideline can detail the financial risks and benefits of IO and start conversations with company stakeholders when identifying the requirements, needs and best options for implementing IO.

With a guideline, companies can reduce the added costs of labour and resources that will inevitably come with researching their own individual cases. By creating a blueprint business case, companies can adapt their own by using a basic frame of reference to implement IO in their own organizations.

Implementing IO will:
• Create a seamless business environment with transparency of information.
• Establish industry-leading technology platforms that provide solutions in automation, analytics, and decision support.
• Become more predictable, enabling companies to better manage variations in operations.

Participating Companies
Group Leader: Saad Hameed, ArcelorMittal


Next Steps
• The Working Group will finalize a project plan, including a timeline.
• The first draft of the guideline is expected to be completed in 2018.

Highlights
» Workshop held November 2017 in Montreal, Canada
» Table of contents for guideline drafted

Project Timeline

1 – Project plan development
2 – Guideline draft development
3 – Review and approval
4 – Publication
INTEGRATED OPERATIONS
Research Collaboration

A collaborative effort between industry and academia to develop and implement a research project with a specific focus on identifying and aggregating both new and existing Integrated Operations (IO) knowledge and research for development into an assessment of the current state of the mining industry’s operating model. The end goal is a more effective and cost-efficient model.

Project Description
The Integrated Operations Working Group Research Collaboration will address IO in its application within the mining industry by building a body of knowledge of IO. The Subcommittee will work to aggregate existing research and perform opportunity assessments and gap analysis while evaluating the current state of operations knowledge, in conjunction with establishing a long-term academic research project to analyze IO and its ongoing evolution in the mining industry globally. This is a collaborative effort in partnership with academia to compile information on integrated operations both within and outside the mining industry.

Gathering this information will help identify and define basic operational and infrastructure requirements, and outline the basic roadmap steps to develop and deploy successful IO. The resulting document will provide a research summary with clearly defined references, recent use cases to describe the benefits and potential risks of IO, and a list of best practices to help monitor change management. The aggregated research will also identify new cross-functional KPIs that should help IO become more successful. The results of this study will be published and the opportunity for industry to be the drivers behind the direction and objectives of the study will be instrumental in contributing to establishing a benchmark in the mining industry in terms of IO.

Business Case
The mining industry is looking to IO to solve challenges such as inefficiencies, high turnover of skilled staff and variability of performance across the value chain. This will require financial evaluation, a prioritization of issues, and mostly, a clear and concise roadmap. Currently this information does not exist for the mining industry so in order to get there, mining must work collaboratively with other industries to build that knowledge base. This will give the Working Group the tools to articulate an IO best practices guideline, creating concrete steps that will result in effective solutions. It will also be openly available as a resource for companies to consult on their own IO projects.

Participating Companies
Group Leader: Fiona Campbell, CGM

Next Steps
Meeting at the University of Toronto with GMSG, a small group of industry members, and academic and administrative university staff, to define and identify expected outcomes of research project as well as to discuss the next steps in terms of required information to apply for both short- and long-term funding. From this, the focused research project will begin and milestones as well as expected dates for results will be determined.

Project Timeline

1 – Phase 1 Research collection
2 – Analysis and dissemination/publication
3 – Phase 2 Definition
Facilitating the development and adoption of interoperability standards to ensure industry automation and integration will not be constrained as new technologies and processes emerge.

Project Description
The Interoperability Working Group aims for a mining industry with open systems and international standards for interoperability of all mining equipment and operating personnel. To do that, the group will identify and describe the business and operating requirements of interoperability in mining, while articulating its value to the industry.

The first step is for the Working Groups to identify common terminology and definitions, and develop a roadmap for interoperability for the Working Groups and the industry as a whole.

Additionally, the Working Group will publish use cases that underpin the value proposition of interoperability, create an Architecture Reference Framework, and evaluate cyber security, privacy, and commercial confidentiality.

Business Case
Mining equipment is currently unable to exchange data freely, due to proprietary limitations. Mine operators require access to resources, processes and decision history, to identify, develop and deploy solutions that are more productive, safe and sustainable.

Introducing interoperability will mean improved communication between equipment, end-to-end process integration, enhanced equipment development and innovation, and support for remote operations.

The Interoperability Working Group will provide useful principles to help companies reach a shared interoperability vision for the industry. 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. Guidelines published through the group will enable future standards for data transfer and machine-to-machine interface, and mechanisms for governance of interoperability across the industry.

Next Steps
- Development of draft terminology and definitions.
- A project plan and a timeline for roadmap development will be circulated in early February.

Project Timeline
- 1 – Definitions and terminology draft development
- 2 – Roadmap to Interoperability development
- 3 – Review
- 4 – Phase 2 project plan development

Participating Companies
Group Leader: Sergio Burdiles, CORFO
Reliability Best Practices Guidelines

Improved asset reliability will result in reduced maintenance, increased production, lower costs and improved safety.

Project Description
The Reliability Working Group (RWG) is an operator-focused group whose purpose is to provide a network and forum for reliability professionals to share knowledge and develop best practices related to reliability in mining.

The philosophy of the RWG is to share knowledge and experience with related organizations. It is a collaborative model which aims to leverage practices and standards from other industry organizations through mutual participation.

RWG’s objectives include identifying practices and tools that will result in a superior level of reliability and maintenance performance. Delivery of the working group’s mandate is through focused, regional best practices workshops and on-line collaboration. Leading practices identified by the group will be circulated as guidelines available to GMSG membership. In addition a focus on leading practices the RWG will propose KPIs and definitions for common reliability and maintenance terminology, enabling comparisons and benchmarking of maintenance and reliability activity and performance.

RWG 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.

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

With industry stakeholders setting high expectations for asset performance, the interest in application of reliability systems and tools is rising. In asset centric organizations such as mining, increased equipment runtime directly benefits the bottom line. Not only does improved reliability enables organizations to leverage the full value of their assets, but in the autonomous mine of the not so distant future, reliability represents a key foundational element of autonomous mining systems.

Organizations are challenged in understanding which practices provide the greatest value and effectiveness. By identifying leading practices and sharing best practice guidelines for reliability in mining, the RWG will enable organizations to apply appropriate practices supporting improved asset reliability and increased equipment runtime.

Participating Companies
Group Leader: Zoli Lukacs, Independent Consultant


Next Steps
1. RWG will continue to support the mining industry through the ISO 55000x standards series.
2. Organize work management workshop in Tucson on March 15 2018, hosted by Caterpillar.
4. Establish sub-group dedicated to developing a guideline for maintenance and reliability KPIs.

Highlights
- First best practice workshop of 2018 scheduled for March 15 in Tucson to focus on Best practices in Maintenance Workflow Management
- Develop draft reference guideline for key elements of a reliability program
- Establish sub-group to identify and categorize maintenance and reliability metrics
- Review feedback from Reliability Survey and industry input to establish additional best practice workshops (Goal of two additional workshops in 2018)
Providing a guideline suite for underground communications and network infrastructure will educate operators. This guideline will enable mine owners and operators to determine their communications needs and solutions, allowing for a more efficient and cost-effective system of communication, ultimately ensuring greater productivity.

**Project Description**

The goal of Communications Infrastructure is to examine issues related to wired and wireless communications and advance implementation in underground mining. A five-document guideline is currently being developed to help mine operators better understand modern communication requirements. The first two sections, “Positioning and Needs Analysis” and “Scenarios and Applications” were published in February and April of 2017.

The guideline suite is a reference tool for a set of standards and solutions for communications in underground mining. It evaluates current communication systems and frames the language being used to appeal to all mining personnel who may have less experience with digital communications, and focuses on planning, development and sustainability in an underground environment.

**Business Case**

The global advancement of communications technology continues to accelerate. Video, voice and data networks provide tremendous operational support in industrial settings, including underground mine environments. Due to the variety and sophistication of modern communication infrastructure, mining personnel may lack the background and experience to develop and maintain efficient and cost-effective communication solutions. The Underground Mining Communications Infrastructure guideline is intended to bridge this gap. The Guideline will support key personnel in understanding different approaches to the strategic integration of communications technology into the mine lifecycle in order to increase productivity, profit, and safety.

**Participating Companies**

**Group Leader:** Dave Fry, Granite Technology Group; Russel Kennett, Rio Tinto


**Next Steps**

First draft workshops to occur in Toronto and Brisbane in late March 2018.

Second draft workshop to occur with the CIM Convention in Vancouver in May 2018.

First draft of the Guideline Section 3 expected to be published in June 2018.
Enabling the adoption of Short Interval Control (SIC) and Real-Time Control (RTC) will give the industry the required processes to optimize shift time and use of assets in underground mines. This will allow for better planning, quicker decisions, increase production and lower costs.

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 with the support of Business Sweden to produce a guideline outlining the current state of technology and its potential.

The goal is to create a roadmap outlining possible paths from an “analog” mine to a digital mine which uses short interval control and real-time control. This will include a roadmap to get there, while avoiding common pitfalls. It will pave the way for an introduction to newer, more efficient technologies.

The guideline will entail descriptive visions of what SIC/RTC may look like in a mine and will include a map of the entire mining system. It will outline the potential problems that are associated with SIC/RTC and help provide effective and accurate solutions, such as the creation of common terminology. Changes in roles for workers and how to integrate new processes into the work cycle will also be addressed.

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 increased opportunities to adopt shift management processes. Many companies have implemented some aspects of SIC/RTC, but there is a lack of independent guidance on how to proceed.

The guideline will deliver much-needed direction on the available options for short interval control, allowing for greater and faster adoption of control technologies. It will lower costs and result in fewer companies encountering problems.

Participating Companies
Project Manager: David Sanguinetti, Sanguinetti Engineering

Next Steps
Building on the Table of Contents and required subject matter generated at the first two workshops, individual groups for each of the Guideline’s sections have been formed. These groups are now meeting virtually to generate content of the guideline, which will then be sent out for review prior to final editing and publication.

1 – Project plan development
2 – Guideline draft development
3 – Review and approval
4 – Publication
Providing operators and OEMs with the tools and standards to solve the challenges associated with the transition from diesel to Battery Electric Vehicles (BEVs).

**Project Description**

The BEVs project is a joint effort between GMSG and the Canada Mining Innovation Council (CMIC) to provide guidance to OEMs and mine operators looking to take advantage of battery electric technology in the underground. An initial recommended practices guideline was published in April 2017. Since then, OEMs, mining companies, OTMs, and consulting companies are among the stakeholders who are providing feedback on what needs to be included in Version 2.

The current guideline also provides 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 include best practices for designing a mine to maximize advantages of BEVs underground around charging and operations. With the proper implementation of BEVs, diesel use can be drastically reduced with consequent reduction in harmful emissions and thus ventilation requirements. Version 2 will build on existing information and add topics such as business case elements and how to build a BEV simulation.

**Business Case**

The mining industry is now extracting mineral reserves at greater depths but as underground mining progresses to deeper levels, ventilation for diesel mobile equipment becomes a challenge. With regulators and industry both making commitments to health, safety and the environment, BEVs offer a unique opportunity to significantly reduce ventilation requirements, operating costs, and a mine’s environmental footprint, all while maintaining a rigorous focus on safety and productivity.

At the same time, BEVs are presenting a new set of challenges, with original equipment manufacturers (OEM) and mine owner/operators already making investments with little guidance or standardization for implementation.

A guideline will address these challenges in terms of infrastructure requirements, maintenance and operating constraints by offering a blueprint for mine design and equipment innovation up-front, and move the industry forward, together.

**Participating Companies**

**Group Leader:** Craig Harris, Glencore


**Next Steps**

Now that areas for improvement have been highlighted and new content identified, teams have begun to generate the new material. Once written, the revised guideline will be edited and reviewed prior to publication.

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2017 2018
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