GLOBAL MINING GUIDELINES GROUP

GMG

Innovation through Collaboration

MEMBER REPORT

JANUARY-APRIL 2020

MESSAGE FROM OUR CHAIR

A STRONG AND RESILIENT INDUSTRY

I feel great pride being a part of an industry that every day is demonstrating tremendous resilience, innovative thinking and drive for collaboration towards a better future.

At GMG, we are reflecting on what is most important to our community and digging deep into our core purpose of innovation through collaboration by focussing on our industry-led projects and working groups.

At our 2019 Leadership Summit, I made a commitment on behalf of GMG to start embracing digital collaboration to make our events and workshops more inclusive. We have now been thrust into making this a reality to ensure the health and safety of our global community. So far, our virtual collaboration has been a resounding success: we have fifteen active projects driven by experts from around the globe, covering topics in underground innovation, interoperability, autonomous mining, AI, the electric mine and cybersecurity. These topics will play major roles in what will become mining's "new normal".

By working together now to improve in these areas we can help position the industry to hit the ground running after the pandemic lifts.

We also have three guidelines in review to publish in the upcoming months on operational definitions and KPIs, functional safety for autonomous equipment and interoperability. Thank you to our volunteers who have dedicated countless hours to getting these here, and we look forward to hearing case studies as they are implemented.

I would like to extend a warm welcome to our newest members Dingo, FMG, General Kinematics, GHD Group, Polymathian and Stäubli. We look forward to collaborating with you!

Additionally, given the COVID-19 pandemic, I will be continuing on as GMG Chair until we meet again in person at our 2021 AGM. Stay safe.

Michelle Ash

INDUSTRY FOCUS = GMG FOCUS

GMG is an industry-led open platform – global priorities are industry's priorities which are our priorities. Our members identify areas of focus and together we set out to develop knowledge, educate and provide guidance to the global mining industry.

In response to the COVID-19 pandemic, we are focusing on enabling our members to collaborate on projects and share best practices of how they are currently working towards ensuring their sustainability while not compromising the health and safety of their workers.

The opportunities for cross-learning are endless.

GMG SNAPSHOT

NEW MEMBERS	FOLLOWERS	GMG COMMUNITY	MEMBER COMPANIES	EDUCATION
Dingo FMG General Kinematics GHD Group Polymathian Stäubli	LinkedIn: 6736 Twitter: 1682	4,141 strong! (+1,000 in 12 mos)	99	1 webinar 5 Working Group calls 4 virtual interactive events 6 workshops 1 short course = 970 participants

PROJECTS LAUNCHED					
Implementation of Autonomous Systems in Mining Guideline v2	Autonomous Mining Skills Migration Case Study Development	Vendor Security Management Guideline	Battery Electric Vehicles in Mining Guideline v3	Electric Mine Operational Knowledge Sharing Platform	Location Tracking

GUIDELINES UP FOR REVIEW	
Morrell method for determining comminution circuit specific energy and assessing energy utilization efficiency of existing circuits	Determining the Bond Efficiency of industrial grinding circuits

SURVEY	PARTNERSHIP	GMG @ INDUSTRY EVENTS
The Electric Mine Operational Knowledge Sharing Platform	Canmet has offered to co-lead the Applications of AI in Mining guideline project	SME PDAC

GMG WORKING GROUPS

GROUPS	FOCUS	PROJECTS
Artificial Intelligence	Identify the current challenges within the industry, define long-term collaborative solutions, drive innovation, educate on AI-related concepts and technologies, keep up with the rapid advancement of technologies, and share best practices and knowledge.	• Implementation of AI in Mining Guideline • Open Data Sets for AI in Mining Guideline
Asset Management	Identify and share best practices in maintenance, reliability and asset lifecycle management to improve asset safety and reliability, increase equipment runtime, improve production and lower operating costs.	To be announced in 2020
Autonomous Mining	Identify, support, and develop tools and knowledge to enable autonomous mining as a safe, innovative, and productive approach to mining operations.	• Functional Safety for Autonomous Equipment Guideline • System Safety White Paper • Autonomous Mining Skills Migration Case Study Development • Implementation of Autonomous Systems in Mining Guideline v2
GMG/MM-ISAC Cybersecurity	Drive OT/IT convergence for centralized, cost efficient, monitored and safe management in mines. Provide guidance to enable secure and resilient systems and networks, and foster awareness at all-levels of the industry.	Vendor Security Management Guideline
Data Access and Usage	Identify best practices for data management, collaborating on defining data access requirements and priorities.	• Data Exchange for Mine Software (Open Mining Format) • Mobile Equipment Open Data Consensus Guideline v2 • Operational Definitions and KPIs Guideline
The Electric Mine	Eliminate diesel from mines by accelerating the adoption of all-electric technologies and addressing the challenges associated towards improving safety, efficiency and productivity.	• Battery Electric Vehicles in Mining Guideline v3 • Electric Mine Operational Knowledge Sharing Platform
Interoperability	Drive collaboration on a range of interoperability initiatives, including identifying and describing the industry-wide requirements for interoperability in mining, addressing industry challenges and developing tools for moving forward.	• Interoperability Definitions and Roadmap Guideline • Interoperability Landscape
Mineral Processing	Develop tools to meet common industry needs in mineral processing; share lessons learned, best practices and drive valuable conversations; enable a global platform for knowledge sharing on mineral processing. Relaunched with a new name in March 2020 to broaden its focus.	Survey to identify collaboration priorities
Underground Mining	Identify and address common underground mining problems and opportunities while considering the adaptability of the mine infrastructure and new and legacy technologies.	Location Tracking

Launching soon! Climate Change Working Group & Workforce of the Future Working Group

PROJECT ACTIVITY

JANUARY-APRIL

GMG

GROUPS	PROJECTS	STATUS
Artificial Intelligence	**Implementation of AI in Mining Guideline** Leverage lessons learned and case study examples from experience applying AI in mining to develop an implementation guideline and develop a roadmap for the industry so that AI applications can be scalable.	Key topics were defined. From a foundational perspective: • Business: Build a library of examples for business cases, define composition of business case, leverage existing frameworks and guidelines, change management and buy-in from all levels of the organization. • Technical: Define the scope of AI for the guideline, steps for development approach, guidance around data and model, and other data management critical topics.
	Open Data Sets for AI in Mining Guideline Phase one: develop a guideline for the collection, cleaning, labelling, and curating of open data sets to help the industry test and train their models for a variety of AI applications.	• Presentation by project leader Rob Johnston at the SME Conference • April workshop held to define the content to be included in the guideline. Participants identified the need for anonymous data and which data sets could be easily gathered vs which required legal procedure, and worked on defining the structure of the guideline.
Asset Management	To be announced in 2020. Steering committee will meet in Q2.	GMG is currently reaching out to industry experts to re-launch the asset management working group.
Autonomous Mining	**Implementation of Autonomous Systems in Mining Guideline v2** Guideline first published in 2019: Communicate and educate based on current industry practices and common terms of reference and provide guidance on justifying, planning, developing, testing, implementing, and executing autonomous systems. Version 2 is under development to update the content to reflect the rapidly changing landscape around autonomous technologies.	During a virtual workshop participants identified some key topics to include or expand on in the guideline, such as: new and emerging technologies, communication infrastructure, building collaborative and problem-solving cultures, upskilling, guidance on workforce and competency, expand on operational readiness and deployment section, and dedicate a section for cybersecurity and IT.
	Functional Safety for Autonomous Equipment Guideline Guideline currently in final review. Provide a common approach to applying functional safety to autonomous systems within the context of the mining industry's current maturity and offering guidance on the communication requirements to support change management and effective operation.	ICMM and EMESRT collaborated on finalizing the guideline. It is now in final working group review until May 25.
	System Safety White Paper Developing a white paper that aims to provide valuable context and education about system safety to enable safety and operational effectiveness throughout all phases of the autonomous system lifecycle.	At a virtual workshop in April project participants worked on revising the current draft, eliminating out of scope sections and prioritizing items such as success factors. They also worked on defining what system safety is, key considerations and existing tools.

GROUPS	PROJECTS	STATUS
Autonomous Mining (cont'd)	**Autonomous Mining Skills Migration Case Study Development** Develop several case studies of skills migration and upskilling from organizations that have implemented autonomous systems that mining companies can use to help make their existing and new autonomous mining implementations successful.	The project proposal has been approved by the Steering Committee and has identified key stakeholders to engage for case studies.
Climate Change	No projects as Working Group not yet launched. Workshops are planned to define the scope and objectives and identify common challenges to address through collaboration.	The ad hoc steering committee has identified the initial topics of interest for the working group. During upcoming virtual workshops participants will work to further define the areas of priority for the industry.
GMG/MM-ISAC Cybersecurity	**Vendor Security Management Guideline** In order for the entire industry to remain resilient to these threats, a clear and coherent guideline is needed to provide vendors and operators with best practices and proper guidance. The practical approaches included will be used for the mining industry to provide to vendors (as well as vendors themselves) in order to increase their resilience to a growing array of local, national, and international cybersecurity threats.	The project will officially launch in May through virtual workshops.
Data Access and Usage	**Data Exchange for Mine Software (Open Mining Format)** Version 1, released in 2017, supports basic structures including points, lines, surfaces, meshes and volumes. Version 2 (under development) has extended that support to block models, computer-generated representations of orebodies that contain valuable data about them. Currently the C++ version is under development. Visit OMF on GitHub	• Discussions with a number of organizations about open source programming • Participants are working to finalize the requirements and resources needed to develop the C++ version of OMF 2.0
	Mobile Equipment Open Data Consensus Guideline v2 Original guideline represents a consensus between operators and OEMs that identifies onboard datasets that should be openly available to equipment owners in a real-time, read-only format. Version 2 being worked on due to increased digitalization and adoption of technologies in mining.	The next steps in this project: clearly define the problem statement; establish industry alignment; reach a consensus on how to best address key challenges.
	Operational Definitions and KPIs Guideline Provide a classification framework for operational activity in surface mining that will enable meaningful performance analysis and industry-wide comparison. Covers most common surface mining activities, associated status and event descriptions, and the time categories. Guideline under final review.	A Time Classification Framework for Surface Mining has completed its final working group review and will be circulating for voting shortly.

GROUPS	PROJECTS	STATUS
The Electric Mine	**Battery Electric Vehicles in Mining Guideline v3** Battery Electric Vehicles in Mining v3 project aims to update the previous version of the guideline leveraging lessons learned, particularly related to safety and maintenance, and accommodating technology advancements. It will also add information to provide valuable guidance to the surface mining community.	• Engaged a project manager • In April virtual workshops (with an underground mining focus) were held to review the previous guideline and identify content to be added in the upcoming version. Key topics included: fire suppression and fire risk; expanding on mine rescue and safety, maintenance, battery chemistry and trolley-assist systems; guidance on charging systems for underground mining. • In May, virtual workshops will focus on the surface mining community's needs and key priorities.
	Electric Mine Operational Knowledge Sharing Platform Create a neutral platform to share operational data for electric surface and underground equipment. The industry can use this information to accelerate innovation and adoption.	• Engaged a project manager • Project officially launches in May • Survey to identify industry needs in order to prioritize what information to collect
Interoperability	**Interoperability Definitions and Roadmap Guideline** A guideline, now in review, that defines interoperability, describes guiding principles for it and presents a high-level roadmap to enable greater coordinated efforts and industry-wide alignment.	The Interoperability Definitions and Roadmap Guideline is undergoing an in-depth review. We are currently incorporating the feedback received and aim to close this review period by the end of May before returning it to the working group for final review.
	Interoperability Landscape Produce a clear landscape of interoperability initiatives, how they fit together and where there are gaps in order to increase the industry's understanding of them and confidence in them.	The project proposal is being reviewed by the Steering Committee. Once it's approved, the project will be launched. A draft of the landscape is being worked on and will soon reviewed.
Mineral Processing	**Guideline review:** *Determining the Bond Efficiency of industrial grinding circuits* and *Morrell method for determining comminution circuit specific energy and assessing energy utilization efficiency of existing circuits*	GMG guidelines are published with a revision date. Two guidelines are now needing peer review to assess their continued relevancy.

GROUPS	PROJECTS	STATUS
Underground Mining	**Location Tracking** Develop a guideline for mining companies looking to implement location tracking within their mines that covers key use cases and explains the technical aspects of location tracking technologies in a GPS-denied environment.	Project participants: • Worked to define the structure of the guideline • Identified key items needed to be covered in use cases and prepared draft use cases on topics such as inventory tracking, personnel tracking, machine tracking, evacuation tracking and autonomous proximity. • Identified key stakeholders
Workforce of the Future	No projects as Working Group not yet launched. Workshops are planned to define the group's scope and objectives and identify common challenges to address through collaboration.	The ad hoc steering committee has identified the initial topics of interest for the working group. During upcoming virtual workshops participants will work to further define the areas of priority for the industry.

JUNE EVENTS

M	T	W	T	F
1	2 **Implementation of Autonomous Systems in Mining Workshop** **Location Tracking Workshop**	3 **Autonomous Mining Skills Migration Case Study Development Workshop**	4	5
8	9 **CIM-GMG Event (presentations and workshop)** **Webinar: Value and Opportunities of IoT and Location Interoperability**	10 **Open Data Sets for AI in Mining Workshop** **GMG Leadership Summit – Part 1: Achieving the Impossible**	11 **Mobile Equipment Open Data Consensus Workshop**	12
15	16 **Implementation of AI in Mining Workshop** **System Safety Workshop**	17 **Location Tracking Workshop** **Climate Change Workshop**	18 **Vendor Security Management Workshop** **GMG Leadership Summit – Part 2: Rocking the Re-Opening**	19
22	23 **GMG Leadership Summit – Part 3: Defining the New Normal**	24 **Implementation of Autonomous Systems in Mining Workshop**	25 **Workforce of the Future Workshop** **Autonomous Mining Skills Migration Case Study Development Workshop**	26
29 **GMG Leadership Summit – Part 4: Strategizing for Success**	30			

CORPORATE MEMBERS

LERDERSHIP	Accenture ○ Anglo American ○ BHP ○ Caterpillar ○ Dassault Systèmes ○ Epiroc ○ Freeport-McMoRan ○ Glencore ○ Hatch ○ Inmarsat ○ Komatsu ○ METS Ignited ○ Motorola ○ Orica ○ Rio Tinto ○ Teck ○ Vale ○ Vedanta Resources
COLLABORATOR	Amazon ○ Antofagasta Minerals ○ Boliden ○ CSIRO ○ Digital Mine from GE Transportation, a Wabtec Company ○ Enaex ○ Fluidmesh ○ IBM ○ Ma'aden ○ MacLean Engineering ○ Newmont ○ Norilsk ○ Seequent ○ Sibanye-Stillwater ○ South32 ○ Suncor
GENERAL	3D-P ○ ABB ○ Agnico Eagle ○ Alamos Gold ○ ASI ○ CheckMark Consulting ○ CITIC Pacific Mining ○ Desert Falcon ○ Deswik ○ DetNet South Africa ○ Dingo ○ EELO SOLUTIONS ○ Endress + Hauser Group ○ Finger Food Studios ○ Flow Partners ○ FMG ○ General Kinematics ○ GHD Group ○ Global IO ○ Global PAM ○ Gold Fields ○ Hexagon Mining ○ Hitachi ○ Honeywell ○ Hudbay Minerals ○ Iamgold ○ Imdex ○ Imperial Oil ○ Kal Tire ○ Liebherr ○ Maptek ○ Marubeni ○ Metcom Technologies ○ Micromine ○ Miller Technology ○ MineWare ○ Mine Vision Systems ○ Mining3 ○ Motion Metrics ○ MST Global ○ New Gold ○ OSIsoft ○ Peck Tech ○ PETRA Data Science ○ Polymathian ○ RIGID ROBOTICS ○ Rockwell Automation ○ Roy Hill ○ RPM Global ○ SafeAI ○ Sandvik ○ Schneider Electric ○ Siemens ○ SMART Systems Group ○ SMS Equipment ○ SRK Consulting ○ SSR Mining ○ Stäubli ○ Symbiotic Innovations ○ Syncrude ○ Tellus ○ Thiess ○ TIMining ○ Total ○ Trimble

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