GLOBAL MINING GUIDELINES GROUP

GMG

Innovation through Collaboration

MEMBER REPORT

MAY-AUGUST 2020

OUTSTANDING COLLABORATION ACROSS THE INDUSTRY

The past few months have shown the incredible capacity of this industry to work co-operatively for rapid adaptation in a changed world. During a time in which it is more important than ever to work together, I have had the pleasure of seeing first-hand what we can achieve through collaboration. I am proud to be a part of an industry that values bringing people together to build personal connections while working to build a safer, more sustainable, and more resilient future for all.

Our Leadership Summit, held virtually this past June, is a perfect example of how we have been able to adapt to a new reality. Thanks to the combined voices of leaders throughout the industry, we have amassed lessons learned and resources, and defined industry priorities and strategies for remote work, safe reopening, and a shared vision that will drive our industry forward and shape future goals and visions. This report is available on the GMG website for all to glean insights from. A COVID-19 Response & Return to Work portal has also been created to further the learning – also available on our website.

I would like to thank everyone who has volunteered their time towards projects in these past months. All the hard work has paid off incredibly, with many new advancements and achievements to celebrate such as publishing the *Guideline for Applying Functional Safety to Autonomous Systems in Mining* and *A Standardized Time Classification Framework for Mobile Equipment in Surface Mining: Operational Definitions, Time Usage Model and Key Performance Indicators*. They have already received positive responses across the industry, and the former had garnered a Mining Magazine Safety Award in 2018 when it

was launched. Guidelines like these are essential to anyone involved in the implementation of new technologies and management of assets.

As an industry that is constantly innovating we need to keep a sharp focus on furthering efforts on interoperability. Alignment is key to understanding how and what should be prioritized. To this end, an industry landscape on interoperability will be available this fall, bringing together standards bodies and organizations leading solutions in this area. GMG's efforts in this sphere will continue with collaboration and moving forward safely for maximum impact.

The growth we've experienced as more people get involved has contributed to the development of plans for future working groups and projects. Conversations and workshops around the workforce of the future and climate action will result in the launching of a new Sustainability Working Group this fall. And our Mineral Processing Working Group, launched earlier this year, is already set to launch a healthy number of new projects. Both groups will provide valuable guidance to keep our industry moving in the right direction.

Additionally, I would like to offer a warm welcome to our new members Alcoa, Aurecon, Imerys, Mining Plus, Molycop, Mosaic, Polymathian, Rajant, Solvay and our first university member RWTH Aachen University. We're very excited for future collaboration as we build a better future for our industry.

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 (MAY-AUGUST)

NEW MEMBERS		FOLLOWERS	GMG COMMUNITY	MEMBER COMPANIES	EDUCATION
Alcoa Aurecon Imerys Mining Plus Molycop Mosaic	Polymathian Rajant RWTH Aachen University Solvay	LinkedIn page: 7,272 LinkedIn group: 818 Twitter: 1,720	4,847 total participants! (+706 in 4 months) _____ Launched a Regulators Network to provide a safe space for regulators around the globe to connect and collaborate	107 _____ We welcomed our first member university: RWTH Aachen	24 Workshops 4 Project Calls 3 Project Steerco Calls 5 Working Group Calls 7 Working Group Steerco Calls 6 Interactive Online Events 2 Webinars 1 Leadership Summit (4 events)

PUBLISHED

SURVEYS	GUIDELINES	REPORT	PORTAL	LEARNINGS
The Electric Mine Results Mineral Processing Results	Guideline for Applying Functional Safety to Autonomous Systems in Mining A Standardized Time Classification Framework for Mobile Equipment in Surface Mining: Operational Definitions, Time Usage Model and Key Performance Indicators	Mining Response to Covid-19: Achieving the Impossible through Collaboration – insights from the 2020 GMG Leadership Summit	Covid-19 Response & Return to Work Portal	Industry presentations given at GMG virtual events this year are now available on GMG's YouTube Channel. Check it out and subscribe!

PROJECTS MOVING TO CONTENT GENERATION PHASE

Implementation of AI in Mining Guideline	Open Data Sets in Mining Guideline	Battery Electric Vehicles in Mining Guideline Version 3	Location Tracking Guideline
Vendor Security Management Guideline	Implementation of Autonomous Systems in Mining Guideline Version 2	System Safety White Paper	Autonomous Mining Skills Migration Case Studies Development

GROUPS	PROJECTS	HIGHLIGHTS	NEXT STEPS
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.	• The **business foundation** will include guidance on the components of a strong business case, considerations around when to build, buy, or partner on a solution and building a multi-dimensional team, change management, and human factors • The **technical foundation** aims to serve as a common framework when building, validating, and deploying models. It will include explain ability and acceptance of AI, development approach, data and model management, shared platforms, interoperability and security • A **section on ethics** will cover the unconscious or conscious bias that can be present in data collection, and issues such as displacement of personnel, the ethical use of data • A **section on education** will cover identifying and managing skill gaps and training approaches.	Next steps: • Draft of guideline is under review by the Project Leaders • Project team call was held on August 4th to distribute sections • Section sub-committee calls throughout September to align and advance work on the sections Current needs: • Volunteers for content development • Companies to provide case studies
	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.	• The **business section** will define open data and different license types, offer guidance around perceived issues; including understanding how to share and store data, effort and cost and legal and privacy issues, and the benefits of sharing data. • The **technical section** will offer guidance around what data can be shared and are useful to share, provide a suggested process for extracting and preparing data; including guidance related to standard formats and anonymization, provide a risk assessment process that can be followed and identify a process for making the data public	Next steps: • Preliminary editing is ongoing, after which it will return to the project group for further review • Draft will be submitted to AWS and universities for feedback Current needs: • Volunteers to review following the preliminary editing to identify missing content and expanding sections • Companies involvement to share their data and begin building the repository (future)
Asset Mgnt	To be announced.	• The primary purpose of this group is to identify topics of common interest, develop guidelines for best practices, and share knowledge around asset management in mining industry.	Next steps & current needs: • Asset Management Steering Committee meeting in Sept/Oct

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GMG/MM-ISAC Cybersecurity	**Vendor Security Management Guideline** Provide vendors and operators with proper guidance for remaining resilient to cybersecurity threats and enable a resilient supply chain. It will provide clear steps for vendors and operators to identify solutions to vulnerabilities in their systems, understand how the industry is connected and best practices on asset management.	This guideline aims to provide: • Context on the risks, industry challenges, and the importance of the risk assessment and scaling to risk • General guidance on cybersecurity such as a list of key requirements and non-negotiables, roles and responsibilities, information sharing requirements, remote support and policy recommendations • A technical framework including security monitoring approaches to a variety of vendor types and sizes, practices when sharing data, and how to securely transfer data • Use cases around product development, design assumptions, procurement and assessment; systems integration; lifecycle management; and reporting • Guidance on validation and certification	Next steps • Draft of table of contents is under review by the project leaders and steering committee • The Project Team will then gather to distribute sections among volunteers Current needs: • Involvement from cybersecurity and IT departments from industry (mining, OEMs, OTMs and consultants)
Autonomous Mining	**Implementation of Autonomous Systems in Mining Guideline v2** Version 2 will include updates and new content based on new technologies. Mining companies at various stages on the implementation journey can understand their maturity level, define their path forward, identify where to seek additional guidance and build confidence in the technology.	• **Sections in V1 that continue to be high priorities:** Change management, Business case, Health and Safety, Regulations, Community and Social Impact and Operational Readiness and Deployment • **Potential new topics** around considerations for other types of equipment (bolters, drills, auxiliary equipment), guidance around zero entry mining, new section on Information Technology (IT infrastructure, cybersecurity, data), information on ownership and partnership models, and future scalability • **All sections will likely require an in-depth review**. **Potential expansion topics** are more detail on specifics relevant to implementation in underground mining (e.g. ventilation, dewatering), guidance on executing the implementation and making sure the technology is working (tools, KPIs), information about education and operator training, clearer distinction between guidance for greenfield and brownfield operation, and consideration of broader regional contexts; now that autonomous systems are being implemented globally	• Project steering committee meeting (Aug 24) to review and revise suggested content for relevancy and quality • Launching sub-groups for content generation

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Autonomous Mining (cont'd)	**Functional Safety for Autonomous Equipment Guideline** This guideline provides a common approach to applying functional safety to autonomous systems and references international standards within the context of the mining industry and its current maturity.	• Guideline published August 18, 2020. The guideline has a short revision cycle and will be updated as needed as the industry and standards landscape evolves. • Abstract: This guideline identifies important reference materials and lists standards that are relevant to applying functional safety to various aspects of autonomous systems. It outlines an example of a functional safety lifecycle for applying autonomous systems in mining and identifies some key expectations and responsibilities for providing information, documentation, and support at each stage. Finally, offers high-level guidance on software development, verification, and validation; competency management; cybersecurity; and assurance documentation	• Encourage the industry to implement guideline in their operations and document their experiences with GMG for case studies
	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.	• Identify existing resources from other industries and leverage what is specific to mining • Regulatory engagement is essential **Topics included in current draft:** • Defining system safety and its relationship to functional safety • Safety case • Risk management • Verification and evidence • Human factors and competence • Lifecycle approach and OEM/Operator relationship	• Creation and coordination of sub-committees to work on sections of the guideline • GMG is engaging with regulators
	Autonomous Mining Skills Migration Case Study Development Develop several case studies of skills migration and upskilling from organizations that have implemented autonomous systems that other can use to help make autonomous mining implementations successful.	What should be in the case study? • Identify: roles being transitioned, new target roles and skill development/training strategy • Training: employer trained or through education system or other, public skill development program, virtual or traditional training, and define best training programs • Skills shift: current roles upskilled or was there new role development, role transitioned, or new roles created and what worked and what didn't • Careers: What is the recruitment strategy? What are the new potential careers paths or opportunities?	• Looking for companies to participate • Capture learnings from involved companies

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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.	Key updates to the guideline based on workshops and steering committee input: • Clearer navigation for content on safety • Expanded maintenance information • Fire safety: fire risk, fire suppression, explosion protection and mine rescue • Mine planning • Battery storage and transformation • Risk assessment • Autonomous mining and integration (general information) • Technological evolution (general information)	• Coordinate topic sub-committees to develop and review guideline sections • Bring together a stronger representation for surface at the steering committee
	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.	• **Performance** (Cycle time BEV vs. Diesel; Point A to Point B LHD / Trucks; Face to load-out; Tramming speed based on grade; Number of cycles per shift; Tonnes moved per shift; Availability; Utilization; Ventilation reduction %) • **Battery management** (Charge time vs. swap; Energy cost vs. diesel; Heat generation, humidity, wet bulb; Number of charges per shift; Availability of batteries in a shift) • **Maintenance** (Total cost of ownership; Service capabilities and accessibility; Maintenance time to repair; Root cause of component failure; Lessons learned) • **Operator** (Ergonomics; Operator feedback during test; Vibration; Noise comparison vs. diesel; Available seat time vs. diesel) • **Business case** (Capex and Opex vs. diesel; Leadership and management information)	• Working with experts to more clearly define the KPIs • Reach out to companies to share information • Define platform to store information
Mineral Processing		The Mineral Process Steering Committee met to devise a plan based on the survey results, which gathered inputs from 100+ professionals from the mineral processing field. The action plan will define the focus of the working group and set a tone for the projects to work on for 2020. They are currently gathering project proposals on the following topics: • Process control • Geometallurgy • Metal accounting • Equipment efficiency decisions • Greenhouse gas, water, and energy efficiency • Greenfield metallurgical testing • Gold test work	• Review proposals and prioritize topics • Launch a process control sub-committee

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Mineral Processing (cont'd)	**Industrial Communication Efficiency Sub-Committee**	**Guideline review:** • Determining the Bond Efficiency of industrial grinding circuits • Morrell method for determining comminution circuit specific energy and assessing energy utilization efficiency of existing circuits **Potential new comminution topics:** • Reference material • Design testing • Fine grinding	• Gather industry experts to review the guideline and define topics that need to be added, removed or expanded • Identify and launch new projects in this field
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. Visit OMF on GitHub	A python version was developed in 2019. Need to develop C++ version. Discussions with AWS towards supporting an open data set for OMF testing	Need for funding to develop C++ version
	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.	**Key challenges identified:** • Legal Requirements: Contracts such as non-disclosure agreements (NDAs) and data privacy agreements can be restrictive and can make it difficult not only for all parties to deliver value but also have potential safety implications if they restrict access to machine data. Further, perceptions around these legal requirements can be used as a reason to withhold data rather than take a collaborative approach. • Standard Definitions: While established languages and protocols (e.g., ISA95, SAE J1939) exist, they are underused, and the lack of a standardized approach complicates integration and increases the margin for error. To address this issue, agreement on common conventions is needed for naming data in software or databases. There is also a need for guidance on a standardized way to categorize event data once it is gathered that enables it to be analyzed, especially when the data are used to prevent or mitigate safety incidents (e.g., type of failure, mode of failure).	• Validate key challenges with mining companies and OEMs, in particular • Identify the approach to addressing the key challenges

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Data Access and Usage (cont'd)	**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.	Approved for publication	• Encourage the industry to implement guideline in their operations and document their experiences with GMG for case studies
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.	• Draft mission statement: This use-case-based guideline aims to help mines build the business value proposition and the appropriate design and implementation plans for location tracking. It also provides an overview of current technologies and the opportunities they offer. • The current draft of the guideline includes guidance on developing a business case for location tracking technologies; use cases and case studies; guidance on location tracking technologies and methods. • Developed a use case template for collecting the following use case information: summary, business case/value proposition, users, area of use, output, accuracy and resolution, requirements and maturity, available technology, outcomes	• Use case template will be reviewed by the steering committee, then we will seek volunteers to contribute use cases • Preliminary content to be validated by the steering committee, then will move into content development

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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.	**Key topics:** • Background information on interoperability and its importance to the mining industry • A common definition of interoperability as it applies to the mining industry • Six guiding principles for long-term interoperability on: Industry priority and importance, Data, Control, Safety, Cybersecurity and Governance • A high-level interoperability roadmap for the mining industry **Targeted reviews were conducted between February and June 2020, review highlights include:** • Further clarification needed on interoperability vs. integration • The MM-ISAC has reviewed the cybersecurity principle and provided rewording that can help clarify some very general points • Updating the language in the control principle so it cannot be misinterpreted • Adding a general timeline to the roadmap and identifying what is already underway	• Project steering committee to review the edited report and assist with finalizing areas that require some additional input (e.g. debated areas, where additional content is needed) • Working Group 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.	Currently collecting input from organizations on their projects and initiatives on: • The role interoperability plays in the project • How interoperability is defined in the project • The type of interoperability it covers (e.g. data interoperability, hardware interoperability) • The interoperability problems it aims to solve • What aspects of mining it applies to (mine cycle stage, type of mine, business area) • Processes this project aims to improve • Type or project (e.g. research, solution, guideline, standard) • Outcomes Organizations contacted for input: AMIRA International, ISA, ACARP, COSIA, CSIRO, EMESRT, Interop, IIC, IEEE, ICMM, IEC, ISA, ISO, IREDES, ITA, MIMOSA, Mining Industry 4.0 Cooperative Research Centre, Mining3, NIOSH, OGC, The Open Group, OPC, SAE, SIP-STRIM, SMIG, SIMS, UWA I4.0 ERDi Testlab, VDMA. among others	• Compiling information into a draft landscape to share with organizations network to review

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