GMG

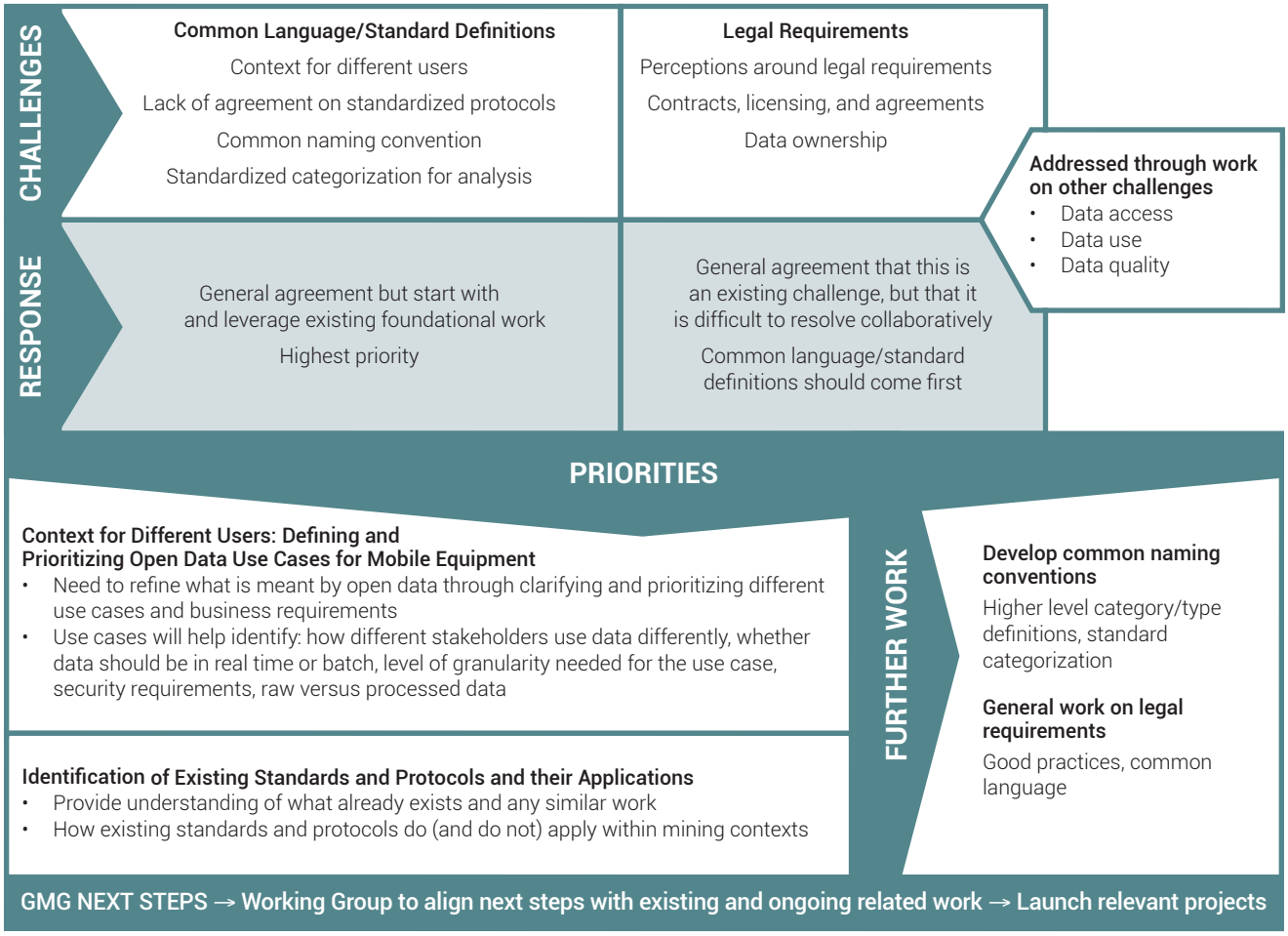
MOBILE EQUIPMENT OPEN DATA:

REPORT ON INDUSTRY CHALLENGES AND NEXT STEPS

EXECUTIVE SUMMARY

Open data from mobile equipment can enable mine operators to make data-driven decisions that maximize equipment safety, utilization, and performance and foster innovation and continuous improvement. Understanding the industry priorities and challenges around this topic has been an important topic of discussion within the GMG community. These discussions covered a range of questions and concerns around what data should (and should not) be open, enabling mine operators to better understand their needs, enabling OEMs to meet their needs associated with equipment data, improving communications between key stakeholders, and adapting to a changing technological landscape.

This report covers key challenges that were identified in workshops in Q2 2020, and key priorities for addressing these challenges that were identified by subject matter experts from GMG mining company and OEM members during outreach in Q4 2020.



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1. INTRODUCTION AND METHODOLOGY

Open data from mobile equipment can enable mine operators to make data-driven decisions that maximize equipment safety, utilization, and performance and foster innovation and continuous improvement, while original equipment manufacturers (OEMs) also have a need for machine data to improve safety, equipment availability and productivity. Understanding the industry priorities and challenges around this topic has been an important topic of discussion within the GMG community. Previous work and continuing discussions covered a range of questions and concerns around what data should (and should not) be open and how mine operators can better describe and communicate their needs around open data.

The shift towards digital technologies has made the issues surrounding mobile equipment open data even more demanding and complicated, while also making their resolution more pressing. This growing complexity mean that, for example, some operators face new challenges in making data-driven decisions, and education and awareness around the data that are available and how to access them is currently a key challenge onsite.

The feedback GMG has received in the past few years suggests that there is a need to better define the challenges around mobile equipment open data in the current landscape and to identify ways to refocus and invigorate those efforts. OEMs do make data available, but concerns remain around clarity, communication, education, and making what is available accessible and usable.

This report neither commits GMG to launching any specific projects nor offers industry guidance. It captures input and suggestions from GMG participants and provides some potential paths forward on this topic while recognizing its complexity and the need for further agreement in some areas.

Existing work on this topic

The *GMG Mobile Equipment Open Data Consensus Guideline* (2016) identified foundational principles and onboard datasets that should be available to equipment owner/operators in real or near real-time, read-only format. This guideline covered a range of underground and surface equipment types, but autonomous systems and some equipment types were out of scope. It is still in use and is up for revision in 2021.

METHODOLOGY

GMG held workshops in May and June 2020 with the aim of defining the problems and industry challenges associated with mobile equipment open data. Though the actual number of participants at the workshops was limited, mining companies and OEMs were well represented. (A report detailing workshop outcomes is available here.) Standard definitions and legal requirements emerged as key topics for consideration. Participants also saw education as a key enabler for addressing other challenges identified around data usage, access, and quality.

To confirm the priorities identified in the workshops and to identify potential next steps, GMG circulated the workshop report among Mining Company and OEM member companies, asking them to nominate subject matter experts. These participants were asked the following questions:

- Do you agree with the key challenges listed?
- How would you suggest GMG prioritizes action on these topics?
- What type of projects or activities would have the greatest impact on the industry?

Nine mining companies and five OEMs responded via oral or written interviews. The responses underwent a qualitative analysis, using a combination of content analysis to identify levels of agreement and recurring themes, and narrative analysis to provide context. The results are presented in this report. While these results represent areas of broad agreement, they do not necessarily represent the views of all GMG members and participants individually. One mining company and one OEM also provided responses outside of the questionnaire; their feedback is considered in providing context to the report but does not contribute to numbers noted.

2. INDUSTRY CHALLENGES

The outreach participants generally agreed with the challenges identified in the workshops, but also provided some nuance. The subsections below offer an updated listing of the challenges based on these responses.

2.1 LACK OF COMMON LANGUAGE/STANDARD DEFINITIONS

If data from different sources are defined and handled differently, it is difficult for the user to derive insights from them. The key areas of this challenge identified were (in order of priority as identified by participants in the outreach):

- **Context for different users:** There may need to be different data definitions for different stakeholder uses. For example, OEMs and operators need to use data for different purposes. Even different roles within a mining company may require different information.
- **Lack of agreement on standardized protocols:** While established languages and protocols (e.g., ISA95, SAE J1939) exist, there is a lack of agreement on them and their use which can complicate integration and increase the margin for error. Part of the challenge is that there is not a good understanding of what standardizations do exist and how they apply (or do not apply) to mining.
- **Common naming conventions:** There is currently little agreement on common conventions for naming data in software or databases.
- **Clear and consistent categorization for analysis:** It is important to be able to understand event data once it is gathered to enable analysis, especially when the data are used to prevent or mitigate safety incidents (e.g., type of failure, mode of failure).

Ten participants agreed that common language/standard definitions was a key challenge (see Table 1). Note that this challenge was referred to as "Standard Definitions" in the workshop report, but the responses received suggested a broader discussion around common language. For instance, issues around defining context for different users and identifying priority areas should be addressed before developing common naming conventions or categories. In the responses with partial agreement and disagreement, there were also some concerns that any attempt at standardizing naming conventions or database categories may not be technically feasible, and that if a project goes forward on common language, it is important to focus on the higher-level categories in high priority areas.

Table 1 Overall Agreement with Standard Definitions Challenge

Response	Mining Company	OEM	Total
Agree – participant agreed that this was a key industry challenge.	5	5	10
Partial agreement – participant indicated that they recognized the challenge overall but did not necessarily agree with how it was presented, or they suggested alternatives.	3	0	3
Disagree – participant did not agree that this was a key challenge for the industry.	1	0	1

"Standard definitions challenges need to be addressed first to provide a framework for legal requirements"

—OEM Participant

2.2 LEGAL REQUIREMENTS

Legal requirements from both the mining company and OEM, particularly around contracts and agreements and the perceptions around them, were identified in the workshops as one of the biggest challenges that hinder data access, specifically around the following areas (in order of priority as identified by participants in the outreach):

- **Perceptions around legal requirements:** Rigid perceptions around these legal requirements can be used as a reason to withhold data instead of addressing issues with a collaborative approach.
- **Contracts, licensing, and agreements:** Contracts, licensing, and other agreements can be restrictive and can make it difficult not only for all parties to deliver value but can also have potential safety implications if they restrict access to machine data.
- **Data ownership:** There is a need for further alignment around data ownership, how much can be shared, and how data are used outside the customer/supplier relationship.

While over half of the participants agreed that these were industry challenges (Table 2), six participants noted that foundational work on common language and standard definitions is a higher priority. Further, three participants did not provide feedback on this challenge at all. Some also suggested that, while they recognize the issue, it is not something easily solved in a collaborative space. For example, variation in data privacy laws and regulations across jurisdictions means that it would be very difficult to address any specifics at a global level. There were some suggestions for addressing these concerns at a high level, which are noted in Section 4.

Table 2 Overall Agreement with Legal Requirements Challenge

Response	Mining Company	OEM	Total
Agree – participant agreed that this was a key industry challenge.	3	5	8
Partial agreement – participant indicated that they recognized the challenge overall but did not necessarily agree with how it was presented, or they suggested alternatives.	3	0	3
Disagree – participant did not agree that this was a key challenge for the industry.	0	0	0
N/A – no response specific to this topic	3	0	3

2.3 OTHER KEY CHALLENGES

Other key challenges identified in the workshops include:

- **Data access:** limited knowledge and understanding around how to access and communicate data, no common gateway for accessing data from multiple sources, difficulty accessing basic data locally, and inconsistent access to machine parameter data
- **Data use:** storage and integration often require post-processing before use, automation is changing operator needs, need for secure and reliable access for data used in safety-critical solutions
- **Data quality:** lack of data integrity from operating sites, data are often transformed so that raw value is not accessible, unreliable acquisition model

The consensus at both the workshops and the following outreach was that addressing the challenges around standardization/common language and legal requirements can help address some of these key issues as well. Many of these challenges can also be addressed through education that targets the limited understanding around data access, usage, and quality. Some of these challenges also fall into the broader topic of data management and may be covered under the scope of other related projects.

3. PRIORITIES FOR ADDRESSING INDUSTRY CHALLENGES

While there were a variety of opinions expressed, participants broadly agreed on the following two priorities. Both are foundational work that would help to enable and prioritize future work on mobile equipment open data and help to address some of the areas where there was disagreement among participants.

3.1 CONTEXT FOR DIFFERENT USERS: DEFINING AND PRIORITIZING OPEN DATA USE CASES FOR MOBILE EQUIPMENT

One of the big challenges around establishing a common language—and in prioritizing GMG work on the topic—is a lack of definition of what is meant by open data in different contexts for different users, and where to prioritize it. Focus on this area could enable further work on developing a common language (see Table 3). Also, enabling better communication between OEMs and mining companies could help resolve some of the broader challenges mining companies face with data access, usage, and quality.

Eight participants highlighted the need to clarify and prioritize different use cases and business requirements as a way to define what is meant by open data. Other participants who did not explicitly state defining and prioritizing different use cases as a priority expressed concerns around the need for a better definition of what open data means, the difficulty with establishing common language without clear context to refine efforts, and the need to consider categories rather than specific definitions (see Section 4).

Table 3 Further Defining the Context for Different Users Challenge

What makes context for different users a challenge?	Suggested areas for defining needs	Suggested categories and uses of data
• OEMs and operators need to use equipment data for different purposes. • Different roles within a mining company need to use and access data differently. • Some types of data are more important to have in real-time or to be provided with higher granularity. • There are greater security concerns around some types of data.	Where is the data produced and consumed? For example, if it is produced on the machine, should it be consumed by other nearby equipment (e.g., safety data)? Should the data be raw versus processed? What are the implications for OEM IP? Is there agreement on what constitutes "raw" data? Who will consume the data and for what purposes? For example, will third parties have access?	One mining company participant recommended considering the following three categories, which aligned with how others referred to different types of data: • Asset/component health data • Production/productivity data • Safety/interaction data Alternatively, data categories could be adopted or adjusted based on the first version of the guideline (see Table 2) Other suggestions were to focus on maintenance, operational, and analytics uses.

SAMPLE RESPONSES

"Define the business requirements. What do we need to do and why? Use simple statements. The OEM may also suggest ways of doing it. What business processes are related to this data manipulation? We need to standardize so we can ask for standard input to our processes."

—Mining company participant

"In a specific application, if you can clarify what kind of data sharing will bring what kind of benefits for both the OEM and users, then the OEM will be motivated to actively promote data sharing. By doing so, we think that other issues will be solved naturally."

—OEM participant

"As an OEM, we sometimes are requested to get 'all data.' Use cases such as 'all data' are difficult for all parties to handle. One party has to define 'all data' and make that available and another party has to understand the definition of 'all data' and make it usable. It is critical to work with use cases and show the need for different types of information: sometimes raw data, sometimes information extracted from raw data."

—OEM participant

Examples of existing languages and protocols:

- ISA 95
- SAE J1939
- SAE J1708
- SAE J1587
- ISO TS 15843-2
- EMESRT Vehicle Interaction Protocol

3.2 IDENTIFICATION OF EXISTING STANDARDS AND PROTOCOLS AND THEIR APPLICATIONS

The challenge mentioned in the workshops stated that while established languages and protocols exist, they are not well understood, and the lack of agreement on them can complicate integration and increase the margin for error.

However, responses from the outreach suggested that trying to agree on a specific approach may not be the best way forward. Further, what does exist may not apply specifically to mining or to all areas of mining. For example, ISA 95 was developed for a manufacturing context, so while many parts of it may apply to mining, it cannot be applied directly across the industry without significant challenges or changes.

Six participants suggested that clarifying existing standards and protocols and whether they do (and do not) apply within different contexts would be a useful first step rather than trying to agree on a specific approach. In addition, identifying why some languages and protocols are not being adopted may also help to clarify how to approach this topic.

While some participants did recommend focusing on specific protocols such as ISA 95, an approach that assists — rather than dictates — OEMs and their customers to communicate openly would help to address some of the concerns that other participants had.

SAMPLE

RESPONSES

"Asset and component health data are largely defined. There are some legacy protocols still in operation (J1708/J1587), and a number of OEM-specific/proprietary protocols. The latter are generally more of an IP concern.The method of access to onboard data is not standardized for mining equipment OEMs. Standards do exist in other related sectors (e.g., the OBD2 protocol is widely used in the automotive industry and allows end user equipment from a number of vendors to access data from a majority of OEM vehicles). Standards define the message format, physical layer connectivity, etc., and are extensible, allowing for OEM or component-specific data to be made available. There are some nascent standards for 'operational' data (e.g., ISO/TS 15143-2:2020), but these are not exhaustive.Safety/interaction data protocols are being developed for autonomous road vehicles and to some extent within systems such as collision awareness systems that are currently in operation."

—Mining company participant

"In this context, how and when to use existing standards is also a key point...Is ISA-95 really the standard to use for streaming sensor data? If so, exemplify how to comply with the standard and how to follow that standard. A very important point to be made is to look at other industries; sharing data is not mining specific. Modern technologies share data everywhere: What other standards are there for mining to use?"

—OEM Participant

"Data design is a function of the engineering of the equipment, which is based on the expected function. Data design and communications become part of the OEM sold product and part of their value proposition. Transparency and standards may be difficult to reach."

—Mining company participant

"The overhead associated with dealing with different languages/protocols is now pretty low and a fixation on picking one does not add value."

—Mining company participant

4. FURTHER WORK

The priorities around context for different users and the identification of existing standards and protocols and their applications identified in Section 3 would help to provide a foundation for further, more detailed work on the topic. Some suggestions around further work are included below.

4.1 COMMON NAMING CONVENTIONS AND STANDARD CATEGORIZATION

Eight participants recommended that developing common naming conventions was an area to pursue collaboratively, five participants specified that this work is best addressed after either the work on context for different users or identification of existing standards is done, as those projects would help provide a foundation for this one. Some also strongly recommended keeping the definitions and categories at a high level, agreeing more to category/type definitions, and leaving more granular data definitions to the OEMs.

SAMPLE RESPONSES

"Agreement on naming conventions is important, however challenges exist today in conventional naming in several domains, even within an organization."
—Mining Company Participant

"Common naming conventions would make the world of supplying data easier for us as an OEM. It is much easier to translate information into a given definition and naming convention, perhaps connected to a use case definition?"
—OEM Participant

"Definitions around what types of data exists should be pursued so that vendors can protect data that is inherent to their systems and make it function as opposed to a public data."
—Mining Company Participant

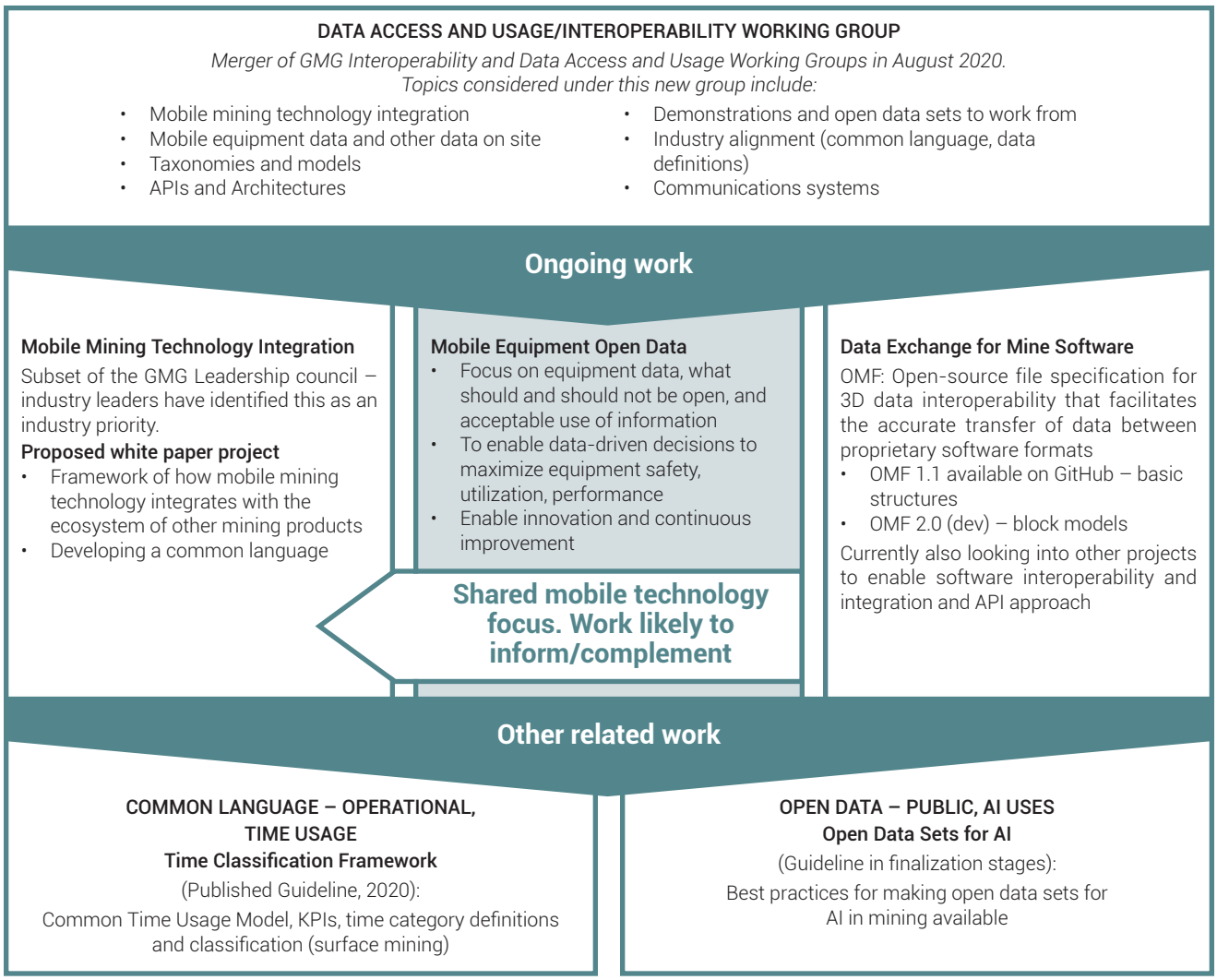
4.2 GENERAL WORK ON LEGAL REQUIREMENTS

While going into detail on legal requirements might not be possible to accomplish in a collaborative space, four participants suggested that it may be useful to provide some high-level guidance on considerations, good practices, and common language for contracts and agreements that may assist users in navigating legal requirements and distinguishing between perceptions and where issues need to be resolved.

SAMPLE RESPONSES

"Providing best practices and guidelines toward language that could be considered for integration into contracts would be useful for preparation of individual contracts."
—Mining Company Participant

"Consistency across contracts and agreements is also very important. The agreements from one organization to another can look very different and cover key aspects in a way that prolongs the review process and creates ambiguity."
—OEM Participant

5. RELATION TO OTHER GMG ACTIVITIES

Some of the priorities identified in this report intersect with and may complement other work happening in the recently-merged GMG Data Access and Usage/Interoperability Working Group. Other suggestions from the outreach that did not emerge as priorities (e.g., to focus on mobile mining technology integration, to take an API approach) may be covered in other related projects. Some of these connections are identified below. The working group will decide on launching the projects identified in this report and how they will work with related projects.