The Intelligent Mine: Next Generation Technologies And The Need for Interoperability

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Mining companies currently are concentrating on increasing their productivity and maximizing the value of their in-ground resources. These trends are in contrast to the "production-driven" strategies pre-GFC, when elevated metal prices prevailed. Post-GFC productivity improvements are being driven by the convergence of information and operational technologies (IT & OT Convergence) and the digitization of all processes and activities related to mining.

Historically, incremental and even step-change improvements have been made within the various departmental silos that constitute the mining value chain. However, companies are now realizing that with the availability of improved communications, automated systems, and our ability to "sensor up" nearly any process or activity, significant productivity gains could be attained by integrating information from across the value chain: from the in-situ resource model, across extraction and haulage, to processing, marketing and shipping. But this "whole of value-chain integration" is not yet possible for the majority of operations for a variety of reasons.

CSIRO's "Common Mine Model" vision is focussed on the resource block model as the mine's most important asset. The block model can be populated with a variety of attributes related to geochemical, mineralogical, petrophysical, physical, geotechnical, mining and metallurgical processing and performance parameters at various spatial resolutions, which are updated and time-stamped as mining proceeds. The block model therefore becomes the single source of truth for the resource asset. This vision also requires data and communication standards.

Numerous automated solutions for mining activities and processing operations already exist; and automation as such, is rapidly becoming a mature technology. However few, if any, of these systems provided by different vendors are interoperable; and those that are, are often expensive bespoke solutions enforced contract. The requirements for communication, data exchange and general interoperability standards are not only being driven by the need for process optimization, but also by the increasing use of on-site control rooms and remote operation centres, and the improved efficiencies and cost-savings they can provide.

The general lack of standards within the mining industry is problematic; and while there are various organizations trying to address this issue, progress is slow. Certainly with respect to infrastructure, construction, and excavation, existing standards, such as BIM, should be evaluated and adopted by the mining industry, as appropriate. In the area of data and communications, a number of partnerships or alliances have formed between METS (Mining Engineering Technology Services) companies to facilitate data exchange and to standardize on communication protocols. Some of the larger IT suppliers are providing software that acts as an "interoperability layer", which allows data from disparate 3rd party databases and software packages to be interrogated. Peer-to-peer communication standards, however, still are essential for proximity detection and safety purposes.

Advanced sensor technologies will improve our ability to characterize the in-situ resource and to measure the "ins" and "outs" of the various extraction, haulage, milling and processing activities. Substantial value can be added to the overall operation by implementing processes such as "selective mining", "grade engineering", "bulk tonnage sorting", and "precision processing". Risks will be reduced and control and safety enhanced by integrating information across all functions and activities of the mining value chain. By combining an enhanced knowledge of the resource with the improved control of mining and milling systems, our ability to optimize or tailor, all mine activities in a whole-of-business sense, will result in significant productivity gains.