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The era of Smart Mines: Technology Trends in Mining

The use of technology in industrial mining has been developing since its inception: dynamite helped clear tunnels and reach greater depths at a much faster rate than could be done with a pick and hammer; the industrial revolution catalyzed the mechanization of equipment; and electric conveyor belts made it easier to load and haul materials.

As we are now in the era of the fourth industrial revolution, digitalization is providing the latest significant technological advancement for the mining sector. The deployment of advanced data analytics and artificial intelligence (AI), the use of 3D modeling techniques, wearables, drones and automated equipment, and increased connectivity through the Internet of Things (IoT) are key drivers of this digital revolution. Continued scrutiny of safety, regulatory compliance and environmental concerns has meant an increasing drive to optimize equipment and systems and to be proactive, not reactive, to mitigate operational and legal risks. There is also a huge focus on driving operational efficiencies and competitiveness through the effective deployment of technology.

Digitalization may have come a little later to mining than other sectors, but it is quickly catching up. It has been reported[1,] that the global smart mining market in 2019 was valued at USD 6.8 billion and it is expected to reach USD 20.31 billion by 2025. This trend will continue despite the COVID-19 pandemic and, in many ways, it will reinforce the need for the sector to continue to automate and digitize rather than rely on manual processes.

However, in the near future, companies may be more selective in choosing digital projects and may reduce investment in experimental projects or projects with uncertain returns on investment given financial pressures.

Prospecting and exploration

At the prospecting and exploration stage, the use of 3D modeling, AI and drones is on the rise.

3D modeling techniques use software to create schematics for underground areas ahead of the construction of new mines. This can expand the area covered by exploration work by allowing the imaging of areas that would otherwise be difficult, or impossible, to access. Modeling also offers significant opportunities for worker safety by giving users a greater degree of information about a mine and its safety, and by reducing the degree to which humans are required to investigate potentially dangerous or uncharted underground areas.

AI offers key advantages by helping mining companies organize, understand and make optimal decisions on the vast amounts of data they collect. Precision is key at the prospecting and exploration stage, when digging in the wrong location can be a very costly mistake. AI can help companies accurately discover deposits. Companies can reduce initial investment costs by increasing their strike rate, which should in turn result in better returns.

Drone technology has seen rapid improvement in recent years. The use of drones can drive impressive reductions in labor costs and improvements in data collection. For example, one drone can now carry out the same aerial surveying work that was previously done by a helicopter crew. Improved AI technology built into a drone enables the drone to better understand the environment and terrain it is aerially surveying and help companies make better decisions on where exploration should be targeted.

Development and production

Digital technology is also having a significant impact on development and production.

For example, automation technology — together with improvements in AI — can vastly improve operational and cost efficiencies, particularly with the use of autonomous vehicles, drillers and haulage systems. Self-driving trucks are able to navigate through narrow tunnels without a human driver. Autonomous haulage systems (AHS) can safely move and transport far more materials than a human workforce could, resulting in increased productivity gains and safety. In 2019, a global mining company launched the world's first automated heavy-haul rail network capable of moving approximately 1 million tons of iron ore a day. In addition, certain heavy equipment manufacturers have found that organizations using AHS technology have reported productivity gains of more than 20% since implementing their AHS technology.

Automation introduces obvious advantages at an operational, production and staffing level in an industry where labor costs are high. The removal of workers from dangerous working conditions also increases the health and safety of mining operations.

AI is also being employed to improve operational efficiency, safety and production workflow, such as predicting the distributions of minerals more effectively to increase mining efficiency.

Connected and smart devices are being deployed in a range of scenarios. For example, real-time data from smart sensors attached to mining equipment and systems can help optimize equipment performance and enable preventative maintenance before equipment fails, saving time and money and reducing health and safety risks.

Just as the IoT is making our homes "smart," new mines are being constructed with the IoT in mind and the creation of one of the world's first intelligent mines is due to start production in 2021. This mine will implement systems connecting all components of the mining value chain, which is expected to enable the mining operator to analyze vast quantities of data in real time and make optimal decisions to generate efficiencies across its production and operations.

In addition to automation and AI, wearables are being used to provide real-time data on the locations of workers, help track workers' fitness for work and monitor health and safety risks.

Virtual and simulated reality and digital twins are being used by mining companies to run advanced simulations, enable enhanced monitoring of equipment and operations and increase precision in mining operations. VR/AR (virtual reality/augmented reality) can be used to provide immersive training for employees, allowing employees to prepare for difficult events in a safe environment. It also offers great potential for forensics and incident investigations.

The legal seam

With the increased deployment of 5G technology, mining's digital disruption continues, with the promise of ever-smarter mines. Nevertheless, with this new technology come some new legal and regulatory challenges. The use of AI and automated technologies creates questions regarding the responsible use of technology and sustainability.

Recently, Baker McKenzie assisted a Fortune 100 global manufacturer of mining equipment in a USD 150 million transaction to license its autonomous mining technology for use at one of the largest producing gold and copper mines in Australia. This transaction will provide the Australian mine with the first autonomous haul truck fleet used at an open pit gold mine. Baker McKenzie advised its global client on the structure and all material aspects of the transaction, including data rights, data use programs, intellectual property ownership and product liability issues.

Data maximization strategies trigger many questions, for example, "What rights do the mine operator and mining equipment manufacturer have in data that is generated by the licensed technology or collected by such technology at the mine site?" The mine operator will want to safeguard data that it believes reveals confidential information about the productivity of the mine site, while the mining equipment manufacturer will want to use data to improve and develop new products and services. In addition, with countries enacting data protection laws with ever-expanding definitions of personal data, any such data usage rights will need to be balanced against any potential personal privacy rights that mine workers may have in such data.

Moreover, the increased use of digital technology across a mining company's infrastructure and supply chain means that the parties should evaluate the appropriate contractual responsibilities in the event of a cyberattack. The use of sophisticated AI also raises unique product liability issues if the technology contributes to personal injury or property damage, even if the technology is "properly" functioning in accordance with its specifications.

Additionally, the implementation of such technology at a mine site may require that the parties share certain intellectual property. This may raise questions about what rights each party should have in new technological developments that arise out of the transaction.

Ultimately, when embracing digital technology, mining companies and mining equipment manufacturers may need to reevaluate how contracting for digital technology differs from traditional equipment services and supply contracts to build a framework for a successful relationship.

[1]https://www.globenewswire.com/news-release/2020/01/16/1971226/0/en/The-Global-Smart-Mining-Market-Growth-Trends-and-Forecasts-2020-2025.html

Contacts:

Antonio Ortuzar Jr. | Chair, Mining & Metals
Latin America | Santiago
Antonio.Ortuzar.jr@bakermckenzie.com

Kathy Honeywood | Partner
EMEA | London
Kathy.Honeywood@bakermckenzie.com

Lewis Popoff | Partner
North America | Chicago
Lewis.Popoff@bakermckenzie.com

Norman Bissett | Foreign Legal Consultant
Asia Pacific | Jakarta
Norman.Bissett@bakermckenzie.com

Johan Botes | Partner
Africa | Johannesburg
Johan.Botes@bakermckenzie.com

Derek Pocock | Partner
Asia Pacific | Brisbane
Derek.Pocock@bakermckenzie.com

Sue McLean | Partner
EMEA | London
Sue.McLean@bakermckenzie.com

Michael Stoker | Partner
North America | Chicago
Michael.Stoker@bakermckenzie.com

John Watson | Partner
North America | Chicago
John.Watson@bakermckenzie.com

www.bakermckenzie.com