

The Connected Mine

Seamless connectivity and information sharing can improve business performance, increase yield and reduce safety risks



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A Changing Industry

A volatile commodities market has impacted mining companies' profitability and sustainability in recent years. Whether this situation continues for the foreseeable future or a turnaround is just around the corner remains to be seen, but the fact is it's having a transformative effect on mining operations and business priorities.

Today, mining companies are focusing their operational investments on areas that can help them maximize yield recoveries and improve operating efficiencies while still meeting regulatory requirements and maintaining safe or "zero harm" working environments. They're also seeking opportunities to better utilize their shrinking pools of skilled workers, and to gain new flexibility to meet future supply chain demands.

Connected or "smart" operations can help in all of these areas. Greater connectivity and information sharing can help mining companies better understand their operations, improve their performance and reduce safety risks.

However, the legacy systems in place at most mining companies today lack the connectivity and embedded intelligence to realize these benefits. Instead, companies must incorporate new systems and technologies that enable seamless connectivity across people, processes and technology, and that provide scalability for future growth and expansions.

The Power of Information

Some of the largest mining companies in the world are already harnessing the power of connected operations to significantly transform their operations.

They're using connected devices and smart machines to capture real-time process information and make better business decisions. They're gaining deeper insights into their equipment to improve asset productivity. They're identifying and reducing variability across their processes. And they're using greater connectivity to establish remote-operations centers and support autonomous material transportation.

Beyond these operational benefits, companies are using better connectivity to help better track employees for enhanced safety, improved metal accounting and to achieve significant energy savings.

"If the mining and metals industry is going to streamline operations while at the same time returning cash to investors, cutting back on CAPEX and, eventually, having to cultivate deeper and more difficult resources, it is going to have to develop new and innovative ways to do so."

The Economist Intelligence Unit, "In the Pits? Mining and Metals Firms and the Slowing of the Supercycle"

"No longer is information just a historical record of what has happened or what is happening now. Information used in conjunction with analytics can be a powerful tool to help mining companies predict performance and achieve the desired results."

ARC Advisory Group, "Industrial Internet of Things Fulfilling the Vision of the Connected Mine"

This is the connected mine. It's created from the convergence of traditionally separate information technology (IT) and operations technology (OT) systems into a single, unified network infrastructure that allows for seamless connectivity and information sharing across the mining enterprise. It's enabled by emerging technologies for the mining sector, such as advanced diagnostics, cloud computing and remote access. Cloud solutions, for example, can be used for important safety and security communications such as underground ventilation information to keep workers apprised of environmental conditions.

Companies can harness the power of a connected mine to capture greater value from their operations in three key ways:

- Operational intelligence
- Reduced safety risks
- Remote and autonomous operations support

Operational Intelligence

The controllers, smart devices and software within a connected mine's operations can access and collect data that historically was trapped in a mining company's machines and processes. This data can be integrated both horizontally, such as with other machines, and vertically, with operational and enterprise systems, to help streamline data management and reduce islands of automation.

Analytics software in a connected mine can collect data from thousands of points and contextualize it into actionable information, enabling operators to have complete visibility on plant conditions and act on it. This information can be shared across the enterprise on role-based reports, dashboards and KPIs to help drive better decision making across multiple job functions:

- **Mining equipment operators** can track KPIs such as overall equipment efficiency (OEE) and mean time between failures (MTBF)
- **Maintenance technicians** can monitor asset health to support predictive maintenance and reduce unexpected downtime occurrences
- **Quality managers** can review ore grade and monitor product quality

Four Tips for Creating a Connected Mine

- 1. Modernize and standardize control equipment and software for system interoperability across the entire mining enterprise and consistent performance measurement across sites.**
- 2. Use production intelligence software to obtain a cohesive view of seemingly disparate mining data. Such software can provide context for relationships among mining equipment, raw materials, ore and people to help optimize process control and maximize production. A modern distributed control system with integrated control and information-gathering capabilities provides the means for collecting the intelligence and acting on it.**
- 3. Use model predictive control (MPC) software to help operators push equipment to its limits. MPC software has been shown to successfully increase throughput by up to 8 percent in mining applications, as well as reduce variability by 45 percent and emissions by 35 percent.**
- 4. Deploy a defense-in-depth (DiD) security approach to mitigate potential risks. While the connected mine promises tremendous benefit, it also brings security concerns to the forefront. DiD is a recommended best security practice that uses multiple layers of protection through a combination of physical, electronic and procedural safeguards.**

- **Site managers** can view cross-operations data and metrics areas such as the real-time cost of production
- **Executives** can compare operations in real-time against commodity prices and make adjustments accordingly

Unearthing Better Insights

Data can be collected from virtually any aspect of a connected mine's operations, providing numerous insights into how and where improvements can be made. Some examples include:

- **Daily targets** - Predictive visibility on delays, real-time tracking of performance against plans and visibility into emerging machine health issues to help meet daily targets.
- **Production variability** - Feed and processing rates enable managers to compare each work shift's performance against daily and hourly production targets, or for their conformance to specification. This operations visibility can help identify and reduce production variability.
- **Predictive monitoring** - Reporting and information models use real-time data to create leading indicators that can help predict production outcomes, chokepoints and equipment failures.
- **Asset performance** - Throughput sensors that measure feed and processing rates, flow, viscosity, and other variables can help maximize asset performance.
- **Condition monitoring** - Equipment sensors that monitor vibration, wear and heat can provide valuable condition-monitoring insights to help companies stay ahead of costly unplanned failures.
- **Throughput** - Intelligent systems with abnormal-situation-management capabilities can allow workers to focus on high-value non-repetitive tasks and operational process improvements to help improve productivity and throughput.

Key Business Benefits

The benefits of greater operational intelligence can add up and have significant business impacts.

For example, mining companies are required by law to conduct metal accounting to calculate the amount of saleable metal being recovered during a specific period of time. Control systems in a connected mine play a crucial role in predicting recoveries, calculating the amount of metal produced and generating data – and then delivering that information to the financial side in real-time to provide the latest and most accurate information available. The result is better recording keeping for regulatory agencies.

"The future of mining operations will approach fully untended equipment. Autonomy will benefit performance metrics, while improving safety for the labor force. By automating tasks with autonomous systems, the operation becomes a safer place for employees and also frees up their time to do tasks which are less repetitive and require greater skills levels."

Sal Spada and Scott Evans, ARC Advisory Group

"The condition monitoring system identifies at least 10 pending failures per year and at an average repair time of 10 hours per incident, the downtime saved is very significant to the business"

Scott Liddell, senior electrical engineer at Newcastle Coal Infrastructure Group

Energy management is another key area. Mining operations in Australia have experienced a 70 percent increase in energy consumption in the last 30 years, and energy costs now account for up to 15 percent of total input costs, according to the Australian government's Energy Efficiency Exchange initiative.

A connected mine can collect data from various equipment and distributed points across a mining operation to help operators and managers receive more accurate energy reporting and forecasting, identify leading causes of energy inefficiency, and optimize asset utilization and energy efficiency without impacting outputs. It also can help operators make critical adjustments on the fly, such as keeping a mine running at reduced capacity following failure of a major piece of process equipment such as a ball mill.

Greater connectivity and information sharing in a connected mine also can open the door to IT savings. For example, virtualization decouples physical computer assets from their operating systems and software. This can allow multiple virtual machines to run from one computer to optimize server and workstation assets, and reduce industrial-computing maintenance demands. It also allows the same software to remain in place even as computer assets are replaced or upgraded, which can help reduce engineering expenses and avoid downtime.

Reduced Safety Risks

A connected mine offers new opportunities to enhance safety and reduce risks for workers. RFID tags and wireless technology can help managers keep track of how many workers are underground or located on a mine site at any given time. Should something happen, they can immediately identify how many people are on-site and who's where.

Vale Cuts Energy Costs More Than 30 Percent With Connected VOD System

Mining giant Vale sought a tailored ventilation-on-demand (VOD) system for its Coleman Mine in Ontario, Canada.

BESTECH, a leading provider of system automation to the mining industry in Canada, responded with a VOD solution that uses variable frequency drives (VFD) to significantly reduce the energy used during fan operation. The VFDs precisely regulate motor speed and maintain torque levels to match the needs of the load, and reduce the mechanical stress on the motors by providing "soft-start" capability. An EtherNet/IP network connects fans, regulators and sensors to controllers to enable seamless communication on a common network infrastructure.

After implementing the system, the mine's energy savings exceeded the originally anticipated estimate of 30 percent. The VOD system is contributing to an estimated \$400,000 in energy cost savings per year, with initial connection to only 16 auxiliary fans.

"Detailed analysis of mining safety information is key to understanding the current and historical safety experience and how to advance this forward. Advanced data analytics is the cornerstone of safety analytics. It can be applied to the simple investigation of accidents or to sophisticated statistical modelling and data mining."

Deloitte, "Mine Health and Safety – Striving to Achieve Zero Harm"

Video camera, voice and display technologies connected to a network also can be used to monitor and communicate with employees should a safety incident occur. Wireless cameras can be placed nearly anywhere within a mine to help track employees in even the most rugged environments, while digital media signage systems can deliver safety warnings or emergency instructions to workers.

From an analytical standpoint, the ability to collect and analyze data surrounding safety-related events can help teams better understand the factors that led to these incidents or identify particularly incident-prone processes. From there, processes can be adjusted or safety training can be refined, as needed.

Remote and Autonomous Operations Support

Remotely connected operations have the potential to transform how companies operate their mines, enabling them to monitor and run processes for dispersed operations that are located hundreds or even thousands of miles apart from one central location.

BHP Billiton is doing just that with its Integrated Remote Operations Centre (IROC). Situated in Perth, Australia, the IROC houses the company's planning, scheduling, controlling and analysis teams to coordinate all activities across its iron-ore operations in Western Australia. A purpose-built control floor gives workers real-time visibility into the iron-ore network and hosts mine control, plant control, rail control, port control and on-the-day scheduling.

"The IROC will play an integral role in increasing the system-wide availability, utilisation and rate of our existing assets. It allows us to look at the 'bigger picture' of our operations and benefit from collaboration and coordination across the different functions in the IROC."

BHP Billiton

Remote-access technology also offers new ways for experts to support dispersed operations from a single location. This could include remote monitoring of equipment and alerting on-site workers should an issue arise – or even virtually logging in to help address the issue. It could also include remotely connecting with on-site employees through a mobile-based video feed for maintenance and troubleshooting, which can reduce travel burdens put on a company's experts and help resolve downtime issues faster.

Extending a connected mine's reach into the supply chain can help companies better coordinate the transportation of mined metals. Global mining companies already are transporting materials using autonomous trucks and trains that can be tracked and controlled from a central location, achieving true "pit to port" connectivity.

The Data's Already There

A connected mine is transformative but it does not need to be a complete overhaul of a company's existing infrastructure. Much of the data sought already exists within a company's systems – it just lacks a means of being collected, analyzed and shared. Taking the necessary steps to migrate control systems and pull together historically disparate systems will create the foundation to mine this data, reduce safety risks and achieve a new level of operational intelligence to improve productivity and global competitiveness.

Resources:

To learn more about how a connected mine can increase efficiencies and unlock value in mining operations, contact a Rockwell Automation sales representative or visit <http://www.rockwellautomation.com/global/industries/mining-minerals-cement/overview.page>.

Additional information from Rockwell Automation about designing and creating connected operations, and getting maximize value from them, is available at <http://www.rockwellautomation.com/global/innovation/connected-enterprise/overview.page>.

Cisco and Rockwell Automation combined their expertise to develop industrial automation-focused reference architectures that provide the foundation to deploy the technologies required for a connected mine: <http://www.rockwellautomation.com/global/products-technologies/network-technology/architectures.page>.

The Industrial IP Advantage online educational community shares best practices, successes and failures for using standard, unmodified Ethernet and Internet Protocol in industrial environments: <http://www.industrial-ip.org/>

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