

share digital transformation priorities – and expectations

By any measure, advances in digital technology and the Industrial Internet of Things (IIoT) have transformed the industrial landscape. But the path to transformation is challenging. This is especially true for the mining sector, which has lagged behind other industries in digital implementations.

Constrained by a volatile commodities market, vast stores of legacy equipment and siloed operations, mining companies oftentimes lack a unified vision – and struggle to prioritize limited resources for digital investments.

Recently, Rockwell Automation explored senior management perspectives about digital transformation and IIoT initiatives at their companies.

In-depth interviews and global quantitative survey findings drawn from mining executives and experts point to key outcomes companies expect from digital investments, progress made, potential roadblocks – and a path forward.

Opportunities in a volatile environment

For mining companies, the overwhelming good news is an expected strong demand for minerals and metals. The world's increasingly urban and more affluent populations¹ require resource-intensive goods of all sorts.

As infrastructure development increases worldwide, so does demand for steel, copper, aluminum and nickel. As the middle class expands, so does the appetite for automobiles, household appliances and personal electronic devices. In addition, the quest for a less carbon-intensive future has spurred growth in electric vehicles – and lithium, magnesium, cobalt and other minerals used in battery production. Likewise, bigger and better energy storage batteries are flooding the marketplace to support wind, solar and other "clean" sources of power.

There's no doubt. The world needs mining.

At the same time, mines face a volatile market intensified by an unpredictable geopolitical climate. Responding to the dictates of the commodity market is nothing new. But global uncertainty has made mine operators wary of new capital investments that may not deliver an immediate return.

In fact, many mines are still stinging from large capital programs in the past decade that did not result in the productivity gains expected.²

However, companies recognize the need for innovative solutions to complex challenges including declining ore grades, energy management, safety, and changing workforce demographics.

For risk averse mines, each investment made must have a measurable impact – and drive shareowner value.



Defining digital value: business intelligence

There is broad consensus across the industry that digital technologies are key to better performing mines. In fact, some of the largest mining companies in the world have harnessed the power of "smart" technology to transform their operations. Investments in automation at the extraction level are particularly robust.

But often, a mine's initial steps toward digitization are focused on individual technologies deployed in isolation to optimize one piece of machinery or process. According to our study, mines are beginning to take a more holistic approach to digital transformation – and prioritize investments that can improve decision-making across the organization.

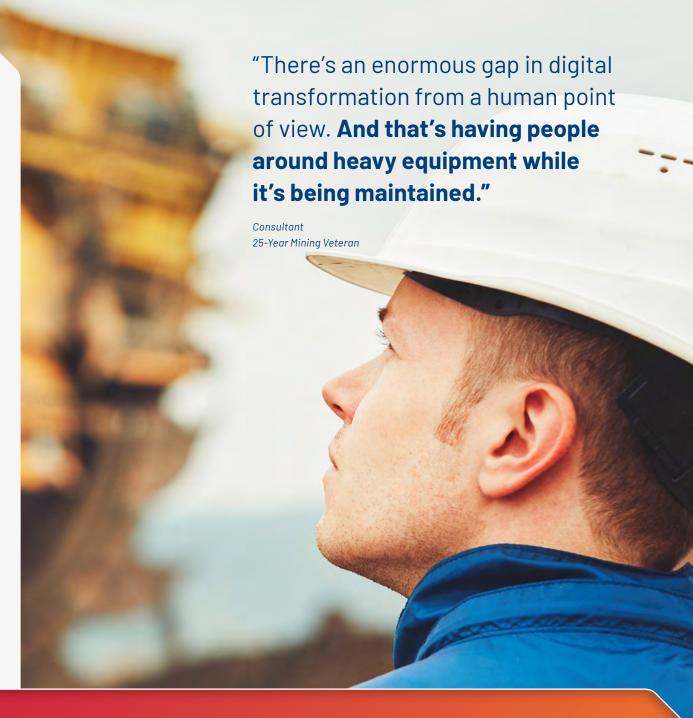
Specifically, mines seek solutions that can better connect their smart assets – and contextualize and share information across the enterprise.

"...Data has been around a long time. One of the greatest challenges for digital transformation is actually turning it into something useful."

Former General Manager
Rio Tinto Kennecott and Cornerstone Capital Resources

Company leaders know they must address operational challenges. And they expect investments in digital technologies – and especially data analytics – to provide answers to critical questions:

- How do we identify sources of inefficiency in our mining operations in real time?
- How do we analyze the risks associated with different potential environments and scenarios, including impacts to human safety?
- How can data be used for competitive intelligence in a commodity market?
- How can we improve maintenance schedules of capital equipment to be more predictive?



Top priorities for digital transformation

When it comes to prioritizing digital transformation outcomes, operational efficiency tops the list of both short-term and long-term goals. In fact, some sources indicate that while worldwide mining productivity is starting to improve, gains have been modest – and levels are still below those of more than a decade ago.³ Mines must increase output while controlling capital costs and improving the efficiency of existing assets.

Given the extraordinary number of variables involved within a mining operation, pinpointing the sources of inefficiency – and improving productivity – is challenging. A typical mine does not have a lack of data. In fact, the number of collected variables from a haul truck alone can be in the thousands.

Today's mines recognize that through digital transformation, they can achieve better analysis of those variables – and uncover insights that optimize production schedules and maximize revenue.

"Productivity doesn't necessarily mean more tons, but it may mean that you get those tons with lower inputs, less fuel, less labor, less time, fewer parts."

Former General Manager Rio Tinto Ltd.

SHORT-TERM FOCUS: EQUIPMENT OPTIMIZATION, ENERGY UTILIZATION & SAFETY

As a whole, miners' additional short-term priorities (one to three years) support their need to address inefficiency at its source. Of course, executives expect digital investments to **deliver better overall equipment effectiveness (OEE).**

Some of the world's largest mines have already made impressive progress in this area. Wireless networks and condition-monitoring systems have improved network connectivity and real-time information – even in underground operations. As a result, the biggest digital payback for mines thus far has often been improved maintenance operations – and better equipment availability.

Now, mines seek investments to enhance remote operations – and enable a more predictive approach to maintenance. As one general manager for a global mining company stated:

"If equipment starts to become self-diagnosing and tells you not only what's wrong with it, but what you need to do to fix it and when you need to fix it, that's the brass ring... we're talking hundreds of thousands of dollars in cost reduction simply by being able to monitor a machine remotely and make decisions remotely." 4



Improving energy usage is also a critical short-term priority. For a typical mining company, energy accounts for about 30 percent of operating costs.⁵ And energy for extraction and transportation increases as mines face decreasing ore grades, deeper excavations and operations in more remote locations.⁶

Miners turn increasingly to IIoT technologies, including energy intelligence software solutions, to capture and give context to energy data – and deliver information that enables better decision-making.

In the short term, mine operators also prioritize investments that **expose fewer people to risk.** And some believe that the true transformational impact of remote technologies is yet to be understood:

".. fewer people at the mine face, on the equipment, and repairing the equipment less often makes for a much safer operation. The safety side of this [digital transformation] is much larger than anyone is thinking about right now." 7



EXTENDING TRANSFORMATION ACROSS THE VALUE CHAIN

Along with operational efficiency, supply chain integration is cited as a short-term and long-term priority. In the longer term (four to six years), **improving supply chain integration** lags only behind operational efficiency as a desired outcome.

As the study demonstrates, mines first prioritize investments in IIoT infrastructure, Mine Information Systems (MIS), mobile devices, simulation, fleet management and other digital technologies that impact up-front systems.

For example, adding smart, integrated process equipment and MIS solutions enhances a mine's ability to track ore production and quality. And transitioning to autonomous fleets improves haul consistency, productivity and safety.

But many mines continue to function under a rather immature supply chain model that limits their agility in a fluctuating marketplace. This industry veteran with 10 years of management experience explained the situation well:

"Miners will work to meet demand until they oversupply. When prices fall, they fall back. When they fall back, they lay off skilled people and cut down on production." 8



Mine operators recognize the "suboptimization" enabled by digital technologies on the front end is insufficient long term. In coming years, miners plan to take a broader view with investments that deliver real-time visibility across the supply chain – from remote extraction sites to rails and ports.

In addition, mines intend to prioritize investments in software and analytics to integrate production and transportation systems with business and marketing systems. The information generated from this integrated, analytic approach promises to improve demand forecasting, lead management, pricing and aftermarket services.

In the longer term, mines also expect their digital transformation journey to **guide management thinking and decision-making – and support innovation.**

WHAT MINES EXPECT FROM DIGITAL TRANSFORMATION

PRIORITIES FOR OUTCOMES IN THE NEXT 3 YEARS

- 1. Increase operational efficiency
- 2. Overall equipment efficiency (OEE) for optimized asset utilization and machine health
- 3. Decrease energy usage for enhanced sustainability and reduced costs
- 4. Improve environmental health and safety (EH&S)
- 4. Achieve supply chain integration (tied)

PRIORITIES FOR OUTCOMES AFTER 3 YEARS

- 1. Increase operational efficiency
- 2. Achieve supply chain integration
- 3. Guide management thinking and forward decisions
- 4. Drive innovation
- 4. Reduce maintenance costs (tied)



DIGITAL TRANSFORMATION JOURNEY

Rockwell Automation Quantitative Research:

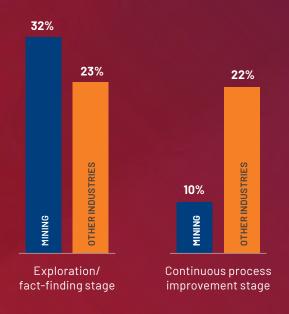
Digital Transformation Journey

Progress in the journey

While mine executives readily identify their priorities, progress made to date is less mature than other industries surveyed.

Most mines are in the pre-implementation phase of their journey. In fact, nearly one third are still in the initial exploration and fact-finding stage – and only 10 percent have completed at least one digital implementation.⁹

The slower progress in the mining sector is not unexpected. Historically, environmental conditions – remote locations, harsh surroundings and underground operations – have made technological advancement more complex for mining than other industries. ¹⁰ Age-old situational challenges remain for companies that seek to enable digital transformation. And the typically longer timelines for mines are exacerbated by a fluctuating commodities market, which results in uncertain capital budgets.



Only 10% of mining executives surveyed have implemented at least one digital transformation initiative.

Rockwell Automation Quantitative Research:
Digital Transformation in Industry

DATA INTEGRATION AND INVESTMENT CHALLENGES

Aside from environmental factors, mines indicate data integration issues are limiting their ability to realize digital transformation – and a truly Connected Mine. Of those surveyed, 63 percent struggle to integrate data across multiple systems and 39 percent are challenged to integrate legacy equipment.¹¹

Why do so many mines struggle with data integration? For some, an abundance of suppliers with proprietary systems is a significant roadblock. According to this general manager:

"There are no interoperability requirements. Everybody builds their own protocols. If I have a shovel [from one manufacturer] and a truck [from another], they can't talk to each other. You need a third party to integrate." 12

No doubt, mines would welcome an open-source approach to software development across the supply chain. In addition, mines recognize they must invest in a secure IT/OT infrastructure to support data integration. Adopting a cloud-based approach to data storage and management is another way mines can address some operational issues. But as one respondent explained, the digital infrastructure required to support the vast amounts of data available can become very expensive, very fast.

Additionally, justifying any new digital transformation investment can be difficult in an industry that has typically focused on physical assets. In other words, decision makers are more likely to endorse the building of new servers than fund less tangible data investments, like cloud-based infrastructure.

Furthermore, financial officers sometimes have difficulty relating to digital value that is not readily apparent on a balance sheet. For example, predictive maintenance that helps avoid a repair cost can be difficult to quantify:

"...it's a dynamic non-event...if the event had happened, it would have cost this much.

Accountants have a hard time, because there's nothing that happens in the balance sheet." 13



ATTRACTING SKILLED LABOR

Mines must also address workforce impediments to progress.

Typically, human resource challenges center on motivating existing managers to embrace new ways of doing things and finding new talent.

Changing behavior among established employees – some who have been on the job for 25 years or more – is never easy. Redesigning processes is particularly challenging when a clear strategy is not in place. In fact, 30 percent of survey respondents indicate that the lack of a digitalization strategy is limiting their progress toward transformation.¹⁴

In addition, mines have a hard time attracting highly educated talent with the skills required to run a fully automated mine – and the desire to do so. More than one third of survey respondents say the lack of required skills is a key digital transformation challenge. A regional chief operating officer (COO) for a global mining company put it this way:

"It's the millennials that are coming, and they're difficult to attract into the mining industry. So how do you attract them? How do you integrate them into the entire value chain? That's a real challenge." ¹⁶



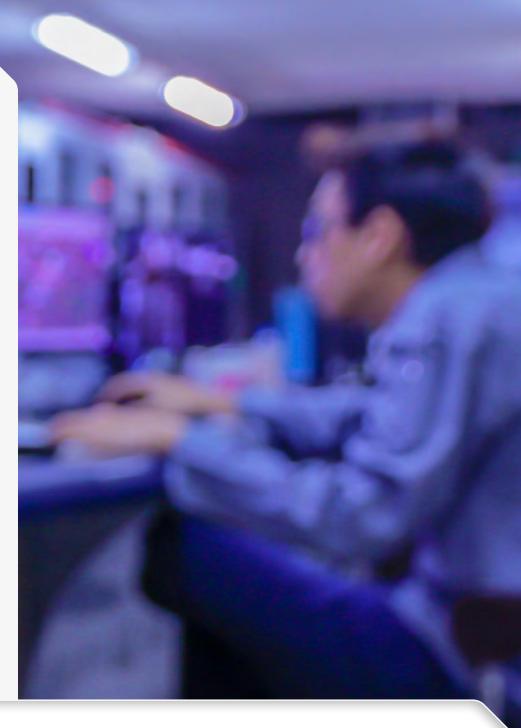
SPOTLIGHT ON REMOTE OPERATION CENTERS

While mining has lagged behind other industries in digital implementations, significant headway has been made by those who recognize that remote operations is one way to address the dearth of skilled labor in far-flung locations.

Equally important, remote operation centers enable companies to integrate and centralize resources – and achieve greater visualization across multiple mines and the "pit to port" value chain.

First deployed by large global companies, remote operation centers are extending to other segments of the industry. According to a principal advisor for a global mining company:

"...now the smaller, mid-sized miners are actually starting to put [remote operation centers] in. Instead of having one person at every one of your mine sites, you have one person in a remote center that can do the work of four or five." 17



The path forward

Ultimately, mines evaluate investments in digital transformation by the results produced – as they do any other major expenditure. But unlike some capital investments that are assessed only in the short term, digital transformation is a journey with incremental value accelerating along the way.

While mines continue to lay the foundation for digital transformation success, they describe an innovative future that will include: ¹⁸

- Adoption of edge computing to enable the use and analysis of data close to the source of information.
- Increasing use of analytics to drive optimization across operations.
- Advancement of artificial intelligence leading to more autonomous operations and maintenance.
- Further development of multispectral sensors, satellite imaging and other advanced technology to guide exploration and improve mineral recovery.
- Next generation autonomous transport guidance systems that will improve and speed a vehicle's ability to achieve precise positioning.
- Rise of robotics in material handling and transport.
- Dynamic pricing in line with market demands and enabled by enhanced integration across the value chain.

"A piece of equipment that autonomously maintains itself removes one of the biggest operational risks. It minimizes the number of people exposed to the mining environment."

Consultant 25-Year Mining Veteran Mining is at a technological crossroads. Those who make a long-term commitment to digital transformation will reap the benefits of a Connected Mine – and future innovations. An industry insider who served as chief information officer (CIO) for two global companies summarized the opportunities succinctly:

"I strongly believe that a company that doesn't seriously go into digital transformation today will not be in business 10 years from now ... companies who push digital transformation further, maintain their investments over five, six years... will end up eventually having competitive advantage." 19

ABOUT THIS STUDY

Rockwell Automation conducted primary research with more than 40 global executives directly involved with the selection, design or execution of Digital Transformation/IIoT initiatives in the mining and cement industries. The research spanned an online quantitative survey (June-August, 2018) and 14 one-hour, one-on-one, in-depth interviews (November 2018). The research was hosted by GLG without participant knowledge of Rockwell Automation sponsorship.



NOTES

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- ⁹Rockwell Automation Quantitative Research: Online Survey. Digital Transformation in Industry: Global online data collection. (June-August, 2018; hosted by GLG, without respondents' knowledge of Rockwell Automation sponsorship.)

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- ¹⁹ Rockwell Automation Qualitative Research: In-Depth Interviews. Digital Transformation in Mining: One-hour interviews with mining industry executives and experts. (Conducted November 2018; hosted by GLG, without interviewee's knowledge of Rockwell Automation sponsorship.)



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Publication MIN-WP003A-EN-P - March 2019

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