



Expert Insights

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Digging deep to support sustainable mining

How digital technologies
can unearth a smart mine

IBM Institute for
Business Value



Experts on this topic



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The mining industry needs to take on globalization, environmental challenges, and technology disruption simultaneously and holistically to survive and thrive.

Key takeaways

The mining industry needs disruption

With the evolution of digital technologies and increasing sustainability pressures, the mining industry must focus on both profit and its greater societal purpose for the first time in its long history.

Investors and consumers seem reticent to embrace the brand of mining

The mining industry needs to rebrand its value to offer more transparency around its impact on society and the environment, particularly for the next generation of investors and employees.

We've identified where to help the mining industry evolve

Organizations should focus their attention on openness and collaboration, integrated and intelligent workflows, and culture and skills to enable a future where they not only survive but thrive.

Disruptive forces are driving seismic shifts

New York Times columnist Thomas Friedman is known for proclaiming we're in the middle of three climate changes, but only one is environmental.¹ The other two, he says, are globalization and technology.

Digital transformation and new technologies offer mining companies golden opportunities to become more efficient, boost production, and cut costs while making the work environment safer. Especially now, as economies reopen after the initial wave of the COVID-19 pandemic, the global climate seems to be shifting from interconnected to interdependent. Decreased commodity prices, market volatility, continued regulations, geopolitical risk, shifting consumer sentiment, and public perception of the mining industry are impacting its brand and future.

At the same time, citizens in societies around the world are adapting to an operating climate filled with a dizzying number of technological innovations, many of which can influence both profit and purpose in the mining industry.

Mining faces a brand challenge with markets and millennials

The top 40 global mining companies were faring better in 2019 than the previous five years in terms of revenue and productivity, dividends, capital developments, operational excellence, reduction in impairments, and debt repayment.² But the markets—and millennials—don't appear to *like* mining. Investors and stakeholders carry concerns about vital issues such as safety, the environment, technology, and consumer engagement. And as the baby boomer generation retires, a new wave of talent—a technology fluent generation—needs enticement if its members are to fill mining industry roles.

By finding better ways of working, mining companies can close the gap between their brands and their essential value.

The mining industry should focus on being a fundamental builder of economic and societal capital and sustainable value and use that position to move away from the brand perception of mining companies as unsafe, unethical excavators that pose environmental risks. This requires both digitization and democratization (see Figure 1).

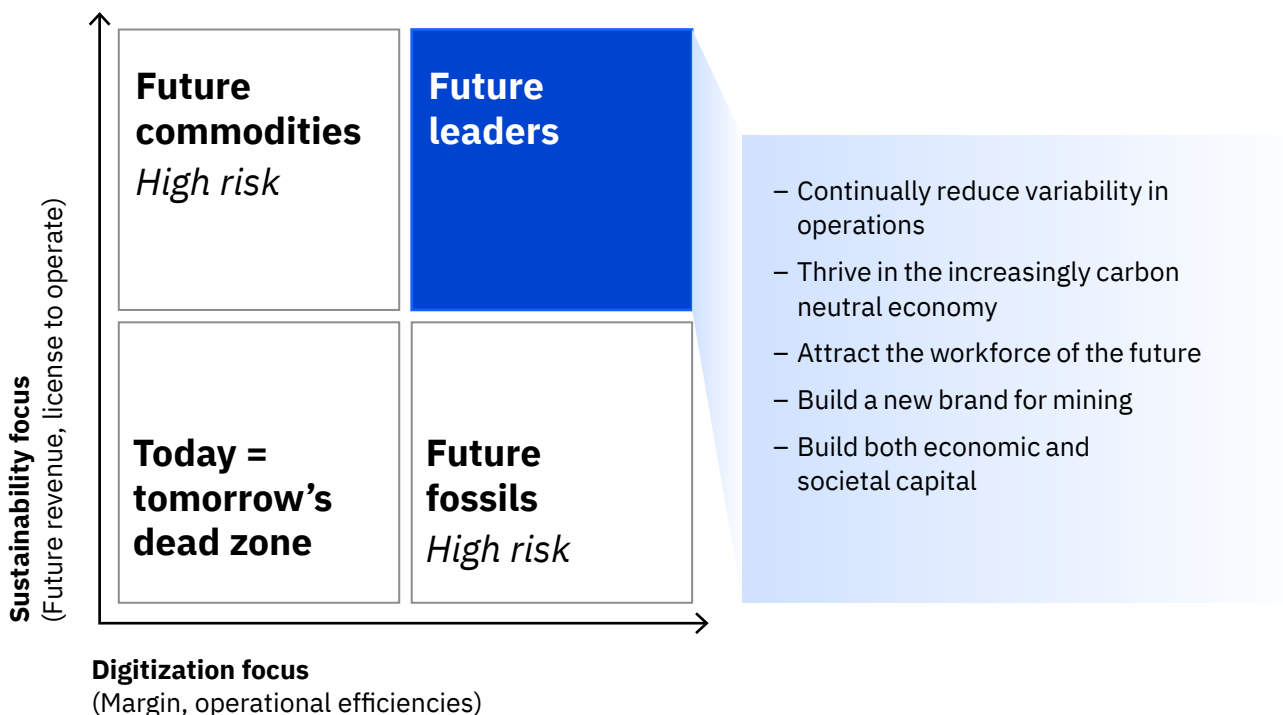
We've identified three critical areas of attention to help the mining industry evolve and thrive in the future: embracing openness and collaboration, enabling integrated and intelligent workflows, and embedding culture and skills.

Embrace openness and collaboration

In a time of continued volatility and disruption, open innovation and co-creation is the only valid response. Companies can't hire all the world's experts in the areas where they need to evolve, so instead, they need to create a culture that's able to actively innovate as part of a community (see Figure 2). Partnering across ecosystems—working with both mining industry peers and companies in other industries—accelerates the creation of business platforms. Doing so allows an organization to take advantage of its proprietary data to fundamentally transform operations and shape markets.

Figure 1

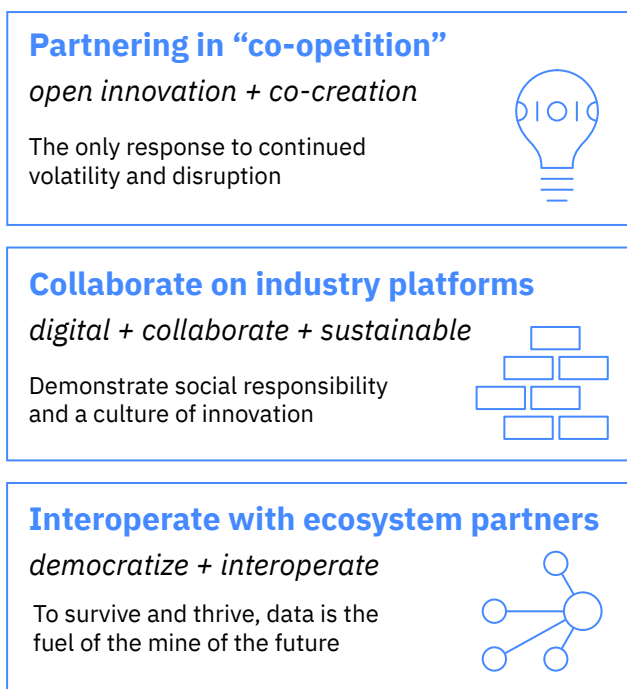
Enabling the mining industry to survive and thrive



Source: IBM Services.

Figure 2

Advancing openness and collaboration



Source: IBM Services.

Global Mining Guidelines Group (GMG), a network of representatives from mining companies, original equipment manufacturers (OEMs), research organizations, consultants, and regulators, is one example of co-opetition that is helping the mining community improve operations and/or implement new technologies. GMG focuses on industry advancement by creating guidelines and standards, expanding knowledge bases in new fields, and partnering with dozens of organizations worldwide.³

A collaboration of partners and the interoperability of data—the fuel of the mine of the future—provide for the democratization of knowledge and practices (see sidebar on page 3, “Sandvik Mining and Rock Technology: Data integration between mining systems”).

Sandvik Mining and Rock Technology: Data integration between mining systems⁴

A global supplier of mining and construction equipment, Sandvik Mining and Rock Technology taps artificial intelligence (AI), the Internet of Things (IoT), and predictive analytics to analyze and optimize underground hard rock mining and processes. Its platform, based on open system architecture, allows efficient data integration between mining systems and equipment from different providers. It eliminates bottlenecks, streamlines operations, and makes mining safer, smarter, and more productive.

Intelligent workflows transform operations to be smart from the inside out.

Market-making business platforms allow mining companies to transform business and operational processes and deliver net new business and business models (see Figure 3).

Existing investments in technology platforms such as geology, engineering, operations, maintenance, production planning, and process control and reliability underpin internal platforms. These platforms make sure that operations have the right information and metrics, the right instructions through workflows, and the right user experience for staff to do their jobs as best that they can.

Internal enabling platforms support operational competitiveness by introducing exponential technologies into typical workflows, creating new ways of working and new skills.

Internal strategic platforms embed differentiated workflows that define competitive advantage. Industry and cross-industry platforms allow miners to build economic capital and support sustainable mining by tackling difficult problems that can only be solved by competitors and other industries coming together. In a fusion of digital and social responsibility, mining companies can help build a culture of innovation via the supply chain (see sidebar on page 5, “Responsible Sourcing Blockchain Network (RSBN): Environmental protection in mineral supply chains”).

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Figure 3

Reinvent competitive positioning, create opportunities with market-making business platforms

Industry and cross-industry platforms

Mining marketplace	Smart projects	Logistics	Responsible and traceable	Smart contracts	Community and sustainability	Trading
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Internal strategic and enabling business platforms

Predictive blast	Autonomous fleet	Integrated asset	Smart plant	Collaborative supply and demand	New materials	IT/OT security operations center
Cognitive exploration	Lean production	Digital comminution	Sustainable tailings	Smart energy	Workflow resilience	Integrated operations insights

Work and technology platforms

Engineering and operations					Commercial	Enterprise	
Supply chain	Production excellence	Asset effectiveness	Operations excellence	Integrated planning	Trading	Finance and accounting	Customer relationship management
Engineering and reliability	Safety and process reliability				Treasury	Human resources	Enterprise asset management
Exploration and geology	Process control and automation				M&A and expansion	Procurement	Enterprise planning and budgeting

Source: IBM Services.

Enable integrated and intelligent workflows

Digital transformation can make a critical, enduring impact on mining operations by uncovering better ways of working and changing the way people do their jobs. Intelligent workflows transform operations to be smart from the inside out, using data to fuel competitive advantage and introducing levers of efficiency for greater productivity. These workflows are exposed as smart services shared on proprietary or collaborative industry platforms to create the mine of the future (see Figure 4).

Figure 4

Tapping intelligent workflows



Source: IBM Services.

Responsible Sourcing Blockchain Network (RSBN): Environmental protection in mineral supply chains⁵

The RSBN tracks cobalt, a chemical element similar to nickel, across the supply chain from mine to smelter, to battery manufacturers, and ultimately to automotive OEMs. Ford Motor Company, Volkswagen Group, and Volvo Cars have joined the RSBN, as have industrial-scale cobalt miners in Congo to demonstrate their responsibility to responsible sourcing standards developed by the Organization for Economic Cooperation and Development (OECD).

Goldcorp Inc.: Smart geology with AI⁶

A senior gold producer now owned by Newmont, Goldcorp used AI at its former Red Lake asset to leverage spatial analytics, machine learning, and predictive models to develop geological drill targets. Red Lake has since been acquired by Evolution Mining. Using a range of exploration data sets, the platform ingested over 8 TB of structured and unstructured data, including over 70 K drill holes, 8 M hole intervals, 6 M assay records, 150 geology projects, 80 M block model records, 230 K documents, and 6 K photos. It lets geologists spend less time finding and manipulating data and contributes to new gold discoveries.

Escape from digital experimentation to seize the opportunity to truly transform.

A smart plant uses advanced analytics and AI to predict variability across key production metrics (see sidebar on page 5, “Goldcorp Inc.: Smart geology with AI”). When metrics fall out of range, advanced algorithms prescribe operating parameters to correct processes. As a result, the plant can run at optimal performance. For example, Swiss-Swedish multinational heavy equipment and automation technology company ABB pioneered an advanced process control application that stabilizes and optimizes cement processes, helping plant managers achieve profitability and sustainability targets.⁷

Tier 1 mining companies—those with rich assets like gold and base metals that can destabilize economies or disrupt the overall demand-supply balance—employ smart assets. Using radio-frequency identification (RFID) sensors and IoT, assets can be monitored continuously to identify possible issues before they occur. AI can be engaged to help identify anomalies, assess their criticality, determine root causes, and help maintenance technicians perform repairs and advise corrective actions.

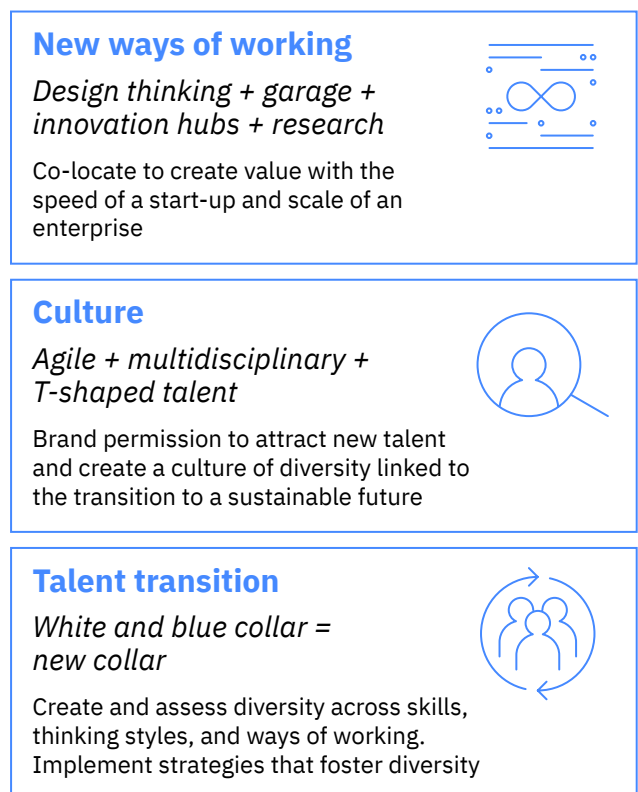
Embed culture and skills

Since most current mining jobs will likely change but not necessarily be replaced, a shift in culture, an infusion of new talent, and knowledge sharing are critical for the industry. Co-creation using design thinking and agile development with frontline employees can help talent reinvention. Mining companies will need to co-create, co-execute, and cooperate in skills transitions to help create a culture of diversity and close the talent gap within the industry (see Figure 5).

Agile, multidisciplinary teams loaded with T-shaped talent—people who have a broad range of skills and interests and are also experts in select niches—greatly accelerate this effort. Outside, expert companies can help mining companies build these teams. For example, EIC Activities—international mining and resources contractor CIMIC Group’s in-house engineering consultancy group—leads innovation programs to leverage new developments in technologies, methods, materials, and sustainability.⁸ The innovation program is highly collaborative and engages all of the CIMIC Group’s employees.⁹

Figure 5

Changing culture and skills



Source: IBM Services.

For mining, where attracting the next talent pool is inextricably linked to a sustainable future, industry transformation also means creating a culture of diversity: women continue to be vastly under-represented at all levels.¹⁰ The industry needs to become more consumer-centric and brand-savvy. And since there's no real alternative to the primary supply of essential commodities—many of which form a crucial part of the de-carbonized economy—mining companies need to clearly articulate the essential roles they play today, and will in the future, to meet both existing and emerging consumer needs.

Skills relevancy and quality are also in jeopardy. While digital skills are still important, soft skills are now even more relevant. The half-life of skills continues to shrink, while the time it takes to close a skills gap has ballooned 10 times in just four years.¹¹

Create a learning mindset

Lifelong learning should be encouraged and empowered by mining organizations and considered key requirements in hiring. Hiring strategies need to be broadened beyond seeking college degrees and former job experience. Organizations should be looking at non-traditional candidates to take advantage of two critically important talent pools that possess the behavioral skills imperative to success in the workplace: Mid-career and “new-collar” workers (see sidebar on page 7, “The P-TECH model: Preparing students for new-collar jobs”).

Insight: Smart operations through a blockchain platform¹²

From the mine to the end buyer, companies can participate in a common network using blockchain to eliminate the need for a trusted third-party and share and manage data and transactions. MineHub, a consortium of mining, technology, and banking companies, showcases what smart operations can achieve.¹³ Mining companies gain real-time visibility on the movement of their assets to intended recipients. Collective users benefit from the efficiency that's driven by better margins, increased liquidity, and a verifiable commitment to sustainability and compliance.

The P-TECH model: Preparing students for new-collar jobs

The Pathways in Technology Early College High Schools (P-TECH) model offers students real-world, practical experience through internships to gain the behavioral skills needed to succeed in the workplace. In six years, students graduate with an associate degree and much sought-after technical and soft skills. Today, there are 200 P-TECH schools with more than 100,000 students in 18 countries.¹⁴

Action guide

Digging deep to support sustainable mining

1. Emphasize collaboration and interoperation

Leverage human cognition and build intelligent workflows shared as smart services on industry platforms and become active participants in public and private partnerships.

2. Reimagine workflows infusing AI and automation

Digitize where possible into intelligent workflows, and use data—the “new natural resource”—to create the mine of the future and become builders of both economic and societal capital.

3. Foster new ways of working and focus on skills

Create and assess skills, thinking styles, and ways of working to implement strategies that both support diversity and attract the next generation of workers.

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