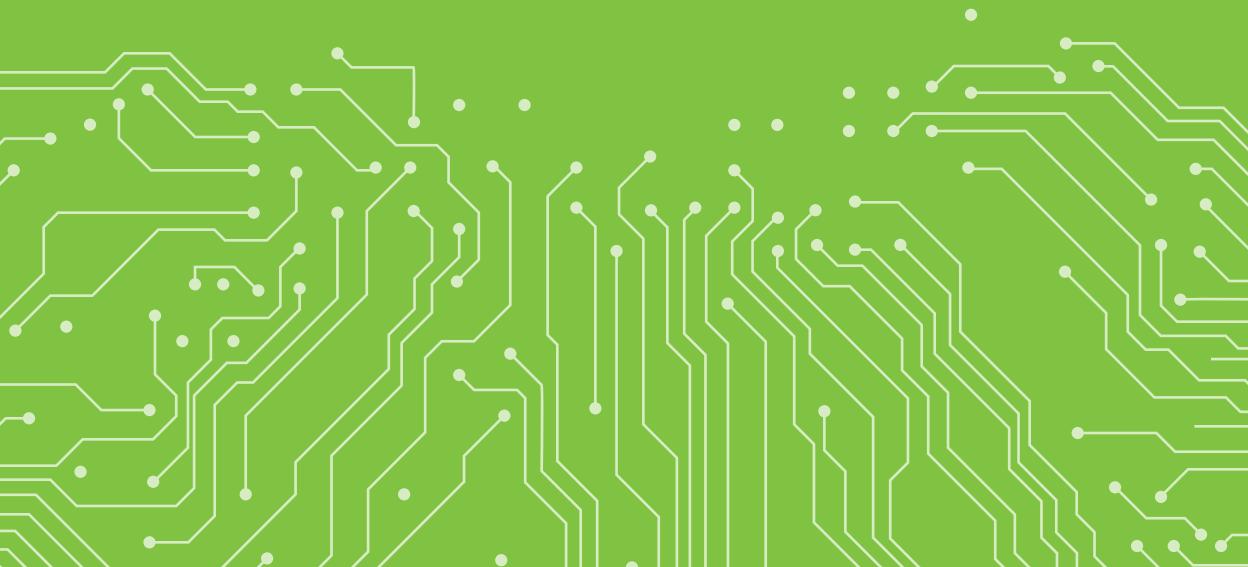


## Tracking the trends 2017

The top 10 trends mining companies  
will face in the coming year

# Contents

<b>Where to play, how to win</b>	02
1. Understanding the drivers of shareholder value	03
2. Unlocking productivity improvement	08
3. Operating in an ecosystem	13
4. The digital revolution	17
5. Mapping the threat landscape	23
6. Creating a shared vision for the sector	26
7. Re-earning the social license to operate	30
8. Supporting strategic priorities	35
9. Creating healthy and inclusive workforces	39
10. Adopting an integrated approach to reporting	44
<b>New strategic foundations</b>	47

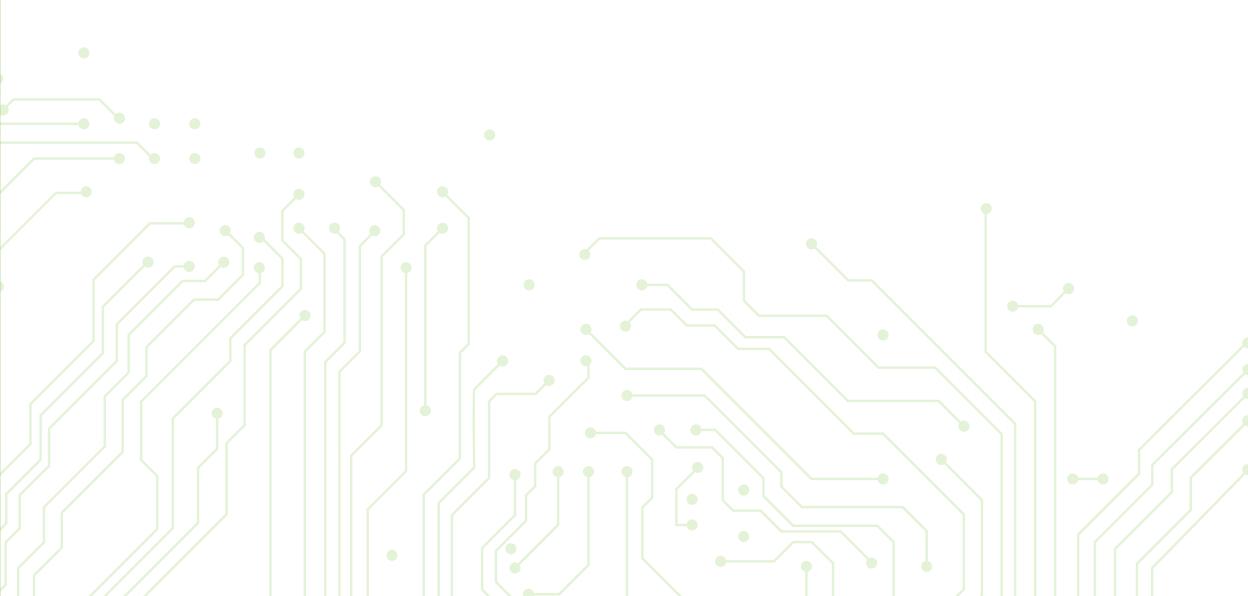


“The world looks at mining as one industry, but it’s really a collection of industries with different supply and demand dynamics. This requires companies to be very clear about how they plan to win in their chosen market. What is our commodity focus? Are we a dividend or a growth stock? Should we design mass scale or modular mines? What culture, skills, processes and technologies will support our strategic goals?”

**Philip Hopwood**

Global Leader – Mining

Deloitte Touche Tohmatsu Limited



# Where to play, how to win

**"Will the next two years be wasted time, where companies fail to learn from the mistakes of the past? Or will these be the years where miners seize the opportunity to transform themselves and create a sustainable industry?"**

**Glenn Ives**  
Americas Mining Leader  
Deloitte Canada

Philosopher Friedrich Nietzsche—admittedly not the cheeriest of men—was once quoted as saying “There are no facts, only interpretations.” The observation is surprisingly salient for today’s mining executives, whose perceptions of the market are strongly influenced by their particular operational realities.

Companies that mine iron ore or thermal coal, for instance, have an entirely different outlook than those heavily weighted in precious metals. Diversified miners face different challenges than companies with a niche commodity focus. Major producers are planning for a very different future than the one that appears on the horizon of most junior explorers.

These divergent views of the industry’s prospects emphasize a widening gulf in the sector. It seems no longer possible, if it ever was, to discuss the mining industry as a cohesive whole. This largely explains why so many companies are adopting such different strategic responses. Yet, although their approaches to the future will differ, all miners should be asking one common question: going forward, where should we play and how can we win?

The next two years will bring corporate responses to this question into sharp relief. For those willing to engage in substantive change, opportunities to rethink strategy, unlock productivity, improve sustainability and interact with key stakeholders in new ways abound. However, to successfully execute on a ‘how to win’ strategy, miners will need to make cultural shifts. This will require strong leadership, greater collaboration, and the adoption of a long-term view and leading practices from other industries, along with a commitment to fostering wellness and diversity across the enterprise.

The 2017 edition of Tracking the trends explores each of these issues. Deloitte’s global mining professionals share their experiences to help pinpoint strategies companies can take to succeed in today’s ever-changing market environment. This year, we have also included a range of case studies to showcase how some companies are bringing new solutions to life. We look forward to your input and feedback. 



# Understanding the drivers of shareholder value

## Miners seek a balance between financial discipline and growth

Every public company understands that shareholder value is more than simply a source of competitive advantage. As a measure of value creation, it also affects a company's credit rating, ability to raise capital and market reputation. Yet, despite its importance, the mining industry has traditionally underperformed in this space.

Total shareholder returns (TSR) in the mining sector have been in steady decline since 2011, with global mining stocks significantly underperforming broader equity indices. Most of the global diversified miners have registered double-digit declines in TSR growth over the past five years (see figure 1).<sup>1</sup>

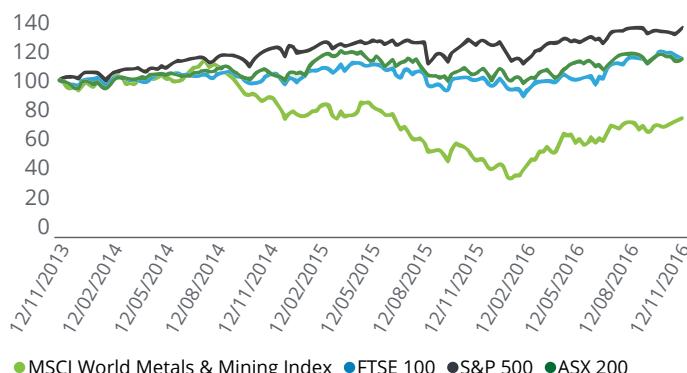
This is in stark contrast to the mining investment boom era when global mining companies delivered exceptional TSR. While the primary driver behind the TSR outperformance was the revenue uplift in a strong commodity price environment, other factors were also at play—including production increases, margin expansion and strong organic growth.

With commodity prices now recovering, mining TSR has once again begun to improve. However, as recent years have made clear, there is a danger inherent in relying on commodity prices to drive TSR. Instead, mining companies are looking for ways to control the creation of sustainable shareholder value.

### Figure 1: Mining equities under perform

Mining equities underperform

Total Shareholder Returns (TRS)



Source: Thomson Reuters Datastream

#### Taking control over TSR

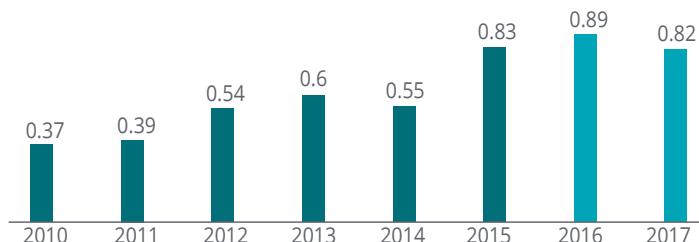
There are numerous levers and metrics management can use to influence TSR—such as costs, gearing, capex and portfolio composition. However, to generate greater value to shareholders by improving return on invested capital (ROIC) and return on equity, miners must exercise financial discipline.

For instance, to counter credit rating downgrades spurred by elevated corporate debt levels and weak earnings outlooks, companies have made efforts to reduce their debt by optimizing cash flows or pursuing asset sales. According to Morgan Stanley, industry leverage ratios are forecast to decline as a result (see figure 2).

#### Figure 2: Financial leverage in the mining sector

Financial leverage in the mining sector

Sector aggregate ND/E



Morgan Stanley, 'Australia resources lodestone', 10 July 2016 edition

#### Redefining value

In a bid to reinforce capital discipline while delivering superior returns, Rio Tinto has committed to pursuing only compelling growth opportunities—those projects that offer an internal rate of return (IRR) in excess of 15 percent. To make this a reality, the company has set out plans to allocate capital first to essential sustaining capex, second to ordinary dividends and third to an iterative cycle of compelling growth, debt management and shareholder returns.<sup>2</sup>

**"The focus on shareholder value in the mining industry is sharper than ever before, with return on invested capital a key metric. While companies are starting to focus on growth again, this is being carefully balanced with the need to maintain financial discipline. As a result, growth strategies are no longer about significant M&A deals and major new capital projects, but focused on portfolio optimization through a combination of brownfield expansions, strategic acquisitions and/or divestments and productivity improvements."**

**Nicki Ivory**

Mining Leader  
Deloitte Australia

Additional efforts to repair balance sheets, improve productivity and preserve cash flows are also helping, as is the shift to more sustainable dividend payment models. In fact, 2016 heralded the end of progressive dividend commitments, which are likely unrealistic for a cyclical industry like mining.

As a result of these moves, the mining industry has become leaner and fitter. Assets are starting to generate more attractive margins, outlook statements are becoming more positive and appetite for investment is increasing as miners weigh their organic and inorganic growth options. With costs under control and less onerous debt burdens to manage, mining companies now have more headroom to think positively about future growth.

**A new approach to value**

Yet, despite these improvements, mining companies cannot afford to take their feet off the financial discipline pedal. Rather than reverting to the days of open checkbooks and major capital projects with uncertain time horizons, companies are now acutely aware of the need to maintain strict operating and capital restraint. For most, this means pursuing low capital intensity growth options, squeezing more value out of existing assets, making operations as efficient as possible and investing where perceived returns are highest, in accordance with scrupulous investment criteria.

The creation of sustainable shareholder value now hinges on finding a balance between the need for growth and the need to maintain financial discipline. As the industry approach to value creation shifts, the connection between shareholder value and underlying operational metrics must strengthen.

This brings capital allocation decisions into the spotlight. As companies structure capital projects, engage in share buybacks and pursue mergers and acquisitions (M&A), they will need to find ways to improve production intensity while reducing labor, energy and capital intensity. In making these trade-offs, miners will likely need to eschew the higher risk investments of the past and focus instead on low capital intensity brownfield growth, and on dividend programs that more closely align to underlying earnings.

They will also need to optimize their asset portfolios. This may mean disposing of non-core assets to create a more simplified portfolio, or acquiring assets to gain entry to a new market or strengthen an existing position. It will mean using advanced analytics to gain greater visibility into operations so that companies can raise the performance bar by improving internal productivity, reducing costs and enhancing operational excellence.

By balancing financial discipline and growth, taking a more forward-looking view on capital allocation and optimizing their asset portfolios, companies gain the ability to maximize shareholder value, generate superior growth and increase returns on invested capital.

### **Redefining value**

As part of its strategic roadmap, BHP Billiton plans to free up latent capacity and pursue low capital intensity growth, with some investment to boost production, particularly in copper and petroleum. Notably, it plans to do this predominantly via organic growth channels. Rather than buying producing copper or petroleum assets, the company's focus will be on expanding exploration, squeezing more value from existing assets and driving further productivity gains across all its commodity businesses.<sup>3</sup>

# Leading strategies in focus

There are both short and long-term strategies mining companies can adopt as they continue to define a clear path towards the creation of shareholder value:

## **Optimize portfolios**

Companies should continue to optimize portfolios by analyzing their asset mix on an ongoing basis, making strategic decisions to divest lower returning assets and/or acquiring smaller new strategic assets to position their portfolios for best-of-breed ROIC and future growth.

## **Strengthen M&A processes**

Companies that choose to pursue inorganic growth through M&A must take steps to adopt more disciplined investment decision making processes and strengthen their transactional capabilities to avoid the missteps of the past.

## **Sustain the focus on costs**

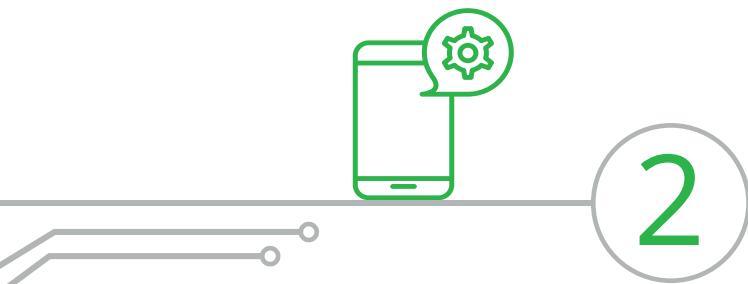
The austerity programs of recent years amply demonstrate the mining industry's commitment to cost containment and productivity enhancement. To reap sustainable advantage however, these efforts must remain ongoing. This certainly appears to be the commitment of mining companies, many of which have stated intentions to further exploit latent capacity. Strategies include improving capital project performance, strengthening third-party risk management to avoid revenue leakage, retroactively reviewing supplier invoices to recover past overpayments and petitioning governments to reclaim unpaid tax credits.

## **Play the long game**

In a survey of over 1,000 global C-level executives and board members, 87 percent said they feel considerable pressure to demonstrate strong financial performance within two years or less. Yet this relentless focus on short-term performance has been shown to distort asset prices, undermine corporate investment, deter growth and even reduce shareholder returns over time. To counter this trend, there is a growing movement to encourage the investor and analyst community to embrace the benefits of long-term investing. Companies can play their part to generate long-term value by aligning incentives to long-term financial performance, adhering to long-term strategic plans and engaging with investors to discuss the company's long-term value creation goals rather than its short-term results.<sup>4</sup>

## **Pursue innovative growth**

In addition to growing organically by investing in existing resource development, mining companies can refine their marketing approaches to gain commercial negotiating leverage and pricing power; explore commodity trading opportunities commensurate with their risk appetite; and commercialize existing assets (such as power and water treatment plants) to generate additional income. They should also look at new ways to increase production in a cost effective manner, such as collaborating with service companies and/or competitors, and using technology to unlock capacity.



## Unlocking productivity improvement

### Focus shifts to becoming serial innovators

Here's the quandary with cost cutting measures: at some point, you're bound to hit the law of diminishing returns. After years of ruthlessly driving out costs, mining companies are reaching that point. Yet, efficiency gains remain paramount. Although commodity prices have begun climbing, most miners now understand the danger inherent in ramping up spending as the cycle turns. Instead, companies are seeking ways to both sustain and extend the productivity improvements they have begun to realize.

With the low hanging fruit gone, mining companies have turned to innovation.

The challenge now is how to ingrain innovation into the fabric of the organization.

#### Working smarter

To quell confusion around the concept, we define innovation as the creation of a new, viable business offering. Specifically, innovation (as separate from invention) is the creation of a new, (to our market or the world), viable (creating value for our customers, stakeholders and ourselves) business offering (ideally going beyond products to platforms, business models and customer/stakeholder experiences).

The mining sector has been engaging in various forms of innovation for years. Driverless trucks and other forms of automation allow miners to set up remote operations, enhancing safety and efficiency. The use of sensors to monitor a wide range of factors—from tire pressure and road conditions to both equipment and labor performance—enables the collection of highly valuable data points. When parsed through advanced analytics, that data yields insight that can help companies reduce cost, streamline equipment maintenance and prevent safety incidents.

New technological capabilities also promise to drive the next wave of productivity gains. With drones, mining companies can conduct geophysical surveys in real time to aid in resource calculation, erosion detection, surface stability monitoring and beyond.

Real-time modeling of the ore body can lead to breakthroughs in how companies find and mine mineral deposits, even positioning them to detect waste before it's moved. As electrification and renewables become increasingly viable, reliance on diesel continues to decline. And geo-coding may ultimately allow companies to create 3D images of the mine—functionality already being deployed in the oil and gas sector.

#### A culture of innovation

To realize the full benefits of these evolving capabilities, however, companies must continue to drive the culture of innovation that spurred the first wave of improvements. One way to do this is by looking beyond the mining industry for ideas.

Serial innovators abound in sectors such as manufacturing, automotive and pharmaceuticals. Leveraging learnings from the

manufacturing and automotive industries, for instance, miners are exploring the benefits of full automation, artificial intelligence, 3D printing, lean operations and outsourcing.

New innovations in these sectors may also hold promise for the mining industry. For example, by digitally tagging and monitoring inventory, miners can shift away from idle inventory stockpiling to classic just-in-time (JIT) supply chain models. Using drones, they can inspect hard-to-reach or dangerous locations and equipment—something the chemical industry already employs to inspect elevated pipelines, power lines, tanks and flare stacks.

#### Innovation in action

Alcoa is expanding its 3D metal printing capability, also known as additive manufacturing. This innovation could transform the mining sector by condensing, or even eliminating, complex supply chains and the associated costs of managing them. Through 3D metal printing, parts can be produced in their entirety with minimal materials, eliminating the need for complex component assembly. In addition, 3D-printed parts, which can be made to exact specifications, can be lighter and more geometrically complex than those manufactured in traditional ways. This facilitates even greater innovation, as it allows parts to be produced in the precise shapes needed to improve the performance of other system components.<sup>5</sup>

## A structured approach

There are countless innovative ideas to improve productivity. Despite this, many mining companies are coming to realize that true innovation cannot be achieved by implementing isolated technology solutions. Research by Deloitte's innovation practice shows that organizations considered successful serial innovators tend to approach innovation as an enterprise-wide differentiator, exhibiting capabilities across four building blocks: they employ a tailored approach to innovation; they structure the organization to house the innovation competency; they acquire and nurture the appropriate resources and skills; and they develop metrics and incentives to guide their performance (see figure 3).

Shifting an organization's culture takes time. Fortunately, mining companies are no strangers to long-term planning. Those that begin to lay the groundwork today will be best positioned to use innovation to further improve productivity in the years to come.<sup>6</sup>

**Figure 3: Financial leverage in the mining sector**

			
<b>Approach</b>	<b>Organization</b>	<b>Resources and competencies</b>	<b>Metrics and incentives</b>
<p><b>1. Innovation strategy</b> Goals for innovation and thematic opportunities to pursue.</p> <p><b>2. Pipeline and portfolio management</b> How the collection of innovation initiatives are managed in a pipeline and portfolio.</p> <p><b>3. Process</b> How innovations move from abstract hypotheses and ideas to launched businesses.</p>	<p><b>4. Senior leadership</b> How senior leaders engage with innovation.</p> <p><b>5. Governance</b> How and by whom innovation decisions are made.</p> <p><b>6. External connection</b> Mechanisms for identifying and leveraging external capabilities, partnerships and solutions to deliver innovations.</p>	<p><b>7. Funding</b> The amount of financial resources devoted and the mechanisms for accessing the funding.</p> <p><b>8. Talent management</b> Attracting and deploying those with the right skills at the right time to do the work of innovation.</p> <p><b>9. Innovation tools</b> Specialized protocols, software, techniques, etc., for different aspects of innovation.</p>	<p><b>10. Financial and non-financial rewards</b> Monetary incentives, formal and informal recognition of contributions to innovation.</p> <p><b>11. Innovation metrics</b> Targets and indicators to guide innovation decisions and measure progress.</p> <p><b>12. External attraction</b> How you foster and incentivize other organizations or groups to participate in innovating on your platforms.</p>

### **Innovation in action**

Schneider Electric examined both maintenance and historical data collected over the course of one year for a 110 MW steam model turbine which had required regular, ongoing maintenance for an escalating series of breakdowns. Analysis enabled Schneider to address the root cause (thermal expansion problems) before they led to symptoms (bearing vibration) that caused equipment shutdowns. The company estimates that predictive maintenance offers millions of dollars in potential savings along with far fewer days of equipment downtime.<sup>7</sup>

GE Power is implementing digital twinning for the parts it supplies to power plants, wind farms and electrical grids. Using sensors and controls, signal aggregation and high-performance computing, it is developing real-time digital simulation models of its real-life, physical parts operating within the plant. These cloud-based “digital power plant” models will enable plant operators to know the condition of parts, optimize power, determine the right time for machinery maintenance and simulate various conditions to understand how they impact the plant.<sup>8</sup>

“Although productivity improvement remains a critical priority for mining companies, there are now fewer easy wins. To get to the next layer of efficiency gains, miners will need to foster innovation by adopting the right systems, technologies and culture.”

**Andrew Swart**

Global Consulting Mining Leader  
Deloitte Canada

# Leading strategies in focus

Organizations considered successful serial innovators tend to approach innovation as an enterprise-wide differentiator, exhibiting capabilities across four building blocks. These include:

## **Employing a tailored approach to innovation**

To generate innovations, companies need to clarify their innovation goals and articulate the thematic opportunities they wish to pursue. They need to define how they plan to manage their collection of innovation initiatives in a pipeline or portfolio, and how they intend to move innovations from abstract hypotheses and ideas to launched businesses. In essence, this is about becoming agile in managing their innovation portfolios, which requires trying new things, adjusting quickly and not being afraid to fail. At present, this type of rapid trial and error is not happening in the mining industry to a great extent.

## **Structuring the organization to house the innovation competency**

This step involves determining how senior leaders engage with innovation, defining governance structures (how and by whom should innovation decisions be made) and adopting mechanisms for identifying and leveraging external capabilities, partnerships and solutions to deliver innovations.

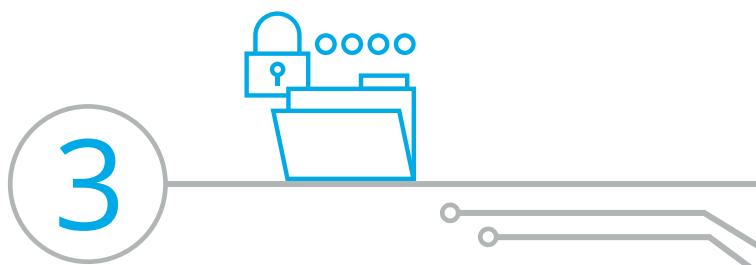
Structures can include 'greenhouses' that retain knowledge and stimulate innovation; service centers that use distinct expertise to support the innovation efforts of different business units; and highly distributed systems where most employees have some innovation responsibility. The two constants are that the preferred structure(s) must foster collaboration across functions and divisional silos, and they must interact well with existing business units.

## **Acquiring and nurturing the appropriate resources and skills**

Innovation requires the devotion of financial resources and mechanisms to access the funding, the ability to attract and deploy people with the right skills at the right time, and a range of innovation tools—such as specialized protocols, software and techniques for innovation. An insular approach that relies mainly on personnel from technology or R&D groups misses the broader opportunity of driving innovation across the enterprise.

## **Developing metrics and incentives to guide performance**

Incentives can include both financial and non-financial rewards. Either way, targets and indicators should guide innovation decisions and enable the measurement of progress. Miners may also want to consider how to incent external organizations or groups to innovate on their platforms as this type of collaboration can spark new ideas.



## Operating in an ecosystem

Collaboration and unorthodox partnerships will drive the industry forward

It's no secret that the mining industry faces a host of issues. These run the gamut—from declining grades, a lack of financing and the slowdown in exploration to mounting stakeholder demands, a shifting regulatory environment and competition for scarce resources. If there were easy ways to address these issues, they would already be resolved. The fact that solutions remain elusive may be due, in part, to the way in which these challenges have been historically approached.

Simply stated, mining companies have traditionally tried to tackle these issues on their own. This has yielded gradual improvements. Unfortunately, incremental change cannot drive exponential results. To realize major breakthroughs, the sector needs to shift from a go-it-alone mentality to one that recognizes the imperative of operating within an ecosystem.

### Working to solve collective problems

Several mining innovation ecosystems, like the Canadian Mining Innovation Council (CMIC), have also sprung up to encourage greater industry collaboration. In many cases, they engage technology start-ups, businesses and industry leaders to help find creative solutions to resource challenges in mining.

Some mining companies are even leveraging the power of technology to encourage idea sharing through crowdsourcing. Through open industry forums, mining companies can work

collaboratively with suppliers and other stakeholders to brainstorm solutions to critical issues. Similarly, hackathons allow large numbers of people to engage in intense, collaborative software development aimed at rapidly resolving a specific problem. In May 2016, BHP Billiton teamed with Unearthed to host a 54-hour hackathon. Participants were provided with actual data from BHP Billiton's Western Australia iron ore operation and given challenges designed to uncover more efficient, effective and safer ways to work.<sup>10</sup>

### Ecosystems in action

Recognizing that industry competitiveness and sustainability hinges on uncovering next-generation solutions, Austmine launched an innovative initiative to set up a series of Collaboration Laboratories. These so-called Co-Labs bring together key stakeholders across Australia's mining, equipment, technology, service and research entities to brainstorm the top challenges facing the industry. These one-day workshops gather roughly 40 senior executives committed to driving change that will benefit the entire industry.<sup>9</sup>

### Ecosystems in action

Exploration companies have long struggled to identify potentially profitable new deposits. To heighten the odds for success, Canada's Integra Gold Corp decided to crowdsource the answer by offering CAD\$1 million in prizes. Participants were provided with six terabytes of data spanning more than 75 years of exploration and development at the company's Quebec site. Over 100 submissions were received from 1,342 people hailing from 83 countries, who proposed solutions ranging from artificial intelligence and virtual reality to the use of a geographical computer system.<sup>11</sup>

### Building effective ecosystems

Although collaborative ecosystems exist in other industries, certain barriers such as a reluctance to trust each other, concerns around sharing intellectual property and technological challenges around sharing data have slowed their adoption in the mining sector. To close this gap, a more proactive approach is needed.

Potential action steps include running a workshop with key stakeholders to brainstorm collaborative strategies; meeting with competitors to discuss common problems; talking to leaders of business ecosystems in other industries to understand how to make them work; lobbying for government support; and co-investing in, or creating platforms for, sharing ideas. Although these steps will require miners to move out of their comfort zone, the potential payoffs should more than compensate for the effort.

 For more information on building effective ecosystems in mining, see the *Business Ecosystems in Exploration report*.<sup>12</sup>

"It's useful to think of ecosystems in terms of medical research. Rather than having thousands of isolated foundations researching the same issues at the same time, it makes better sense to work together at the outset so the benefits accrue to all industry players over time."

**Eduardo Tavares Raffaini**

Mining Leader

Deloitte Brazil

# Leading strategies in focus

For new ideas to gain traction, companies need a systematic approach for operating within an ecosystem. Ideas include:

## **Turning vendors into partners**

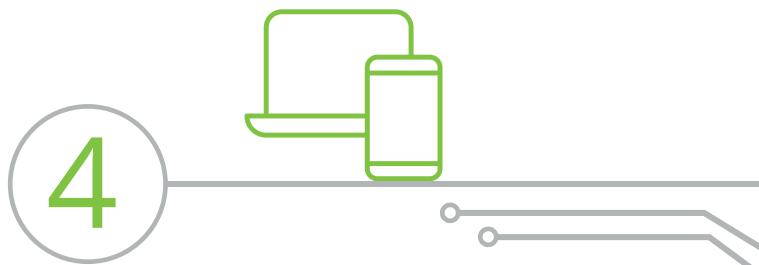
Models exist for co-innovating with service companies and suppliers. By working collaboratively to resolve common problems, these relationships encourage partners to uncover new ways to save money, improve labor productivity, enhance process efficiency and strengthen supply chains. They may even result in the development of new intellectual property that can be co-owned and monetized. To operate smoothly, however, some mining companies may need to take steps to rebuild trust with the very suppliers from whom they have demanded serious price concessions in previous years.

## **Collaborating with competitors**

Although this may go against the historical grain, a strong business case for this type of collaboration exists, especially for companies with geographically proximate mine sites. These relationships could take various forms, from co-funding infrastructure projects to coordinating deliveries with common suppliers. This level of collaboration could yield significant cost savings and productivity improvements.

## **Building extended partnerships**

Effective ecosystems are designed to encourage collaboration among all industry stakeholders—from mining companies, original equipment manufacturers (OEMs), technology vendors and engineering, procurement and construction management (EPCM) firms to educational institutions, research institutes, industry associations, local communities and governments. Although participants would need to overcome common barriers, the establishment of effective ecosystems would undoubtedly position companies to realize vastly increased opportunities for innovation.



# The digital revolution

## Mining starts to reinvent the future

Digital is a new era of business, a stepping stone in the evolution of the world enabled by the exponential use of technology. Digital disruption is changing business and operating models, reshaping competitive dynamics and, in some cases, completely altering the entire fabric of an industry. While the biggest impact has been in consumer-facing industries, there are growing examples of digital transformation in asset-intensive industries such as advanced manufacturing and natural resources.

For miners, the commodity cycle, cost and productivity pressure mean that all the low-hanging fruit have gone. As such, innovation is needed

to deliver the next wave of improvements. The potential for digital to reduce waste and create value is massive: eradicating execution waste by reducing process variability, eliminating process waste by enhancing decision making, reducing structural waste by automating processes and improving systems, and removing design waste by using digital technologies in the design of new assets.

### Using digital to drive value

The question for miners is how to turn those potential benefits into reality. Success in this space is not about adopting the latest apps and point solutions. Instead, they must embed digital thinking into the heart of their processes to

transform their strategy in a bid to completely change the way corporate decisions are made across the enterprise.

To understand how this might look, it is helpful to envisage a future-state digital mining organization and infer how this might transform core mining processes, the flow of information and supporting back-office processes.

First, as mines embrace digital, their core processes will become fully integrated, autonomous, remote and automated—capabilities made possible by a network of low cost, highly capable sensors that use internet of things (IoT) technologies.

These digital mines will fully digitize engineering and asset information and integrate it with location-aware mobile devices to support an efficient and collaborative workforce. Drones will be used for data collection, inspection, stock control, condition and safety monitoring. 3D printing of critical spare parts will reduce lead times and inventory. Wearables will be used for field maintenance and real-time machine inspection instructions, improving operator-based care and safety. As a result of this shift, digital mines will operate with fewer people who possess different skills than those required today.

### Digital in action

In 2014, South Africa's Assmang Limited introduced the SmartCap at its Beeshoek mine. The device, which looks like a regular baseball cap, has sensors to measure brain waves and detect driver alertness. Since deployment, fatigue incidents on site have dropped significantly.<sup>14</sup>

### Digital in action

In a move that likely heralds the wave of the future, Barrick Gold teamed up with Cisco to digitally reinvent its business. The aim is to digitize Barrick's entire organization—from its mines to its head office. The company plans to improve decision making through the use of real-time data, analytics and predictive tools. It is setting up an enterprise-wide analytics hub to better manage and benchmark its operational and financial performance. To enhance transparency, it will share real-time data with local communities and partners. To improve safety, productivity and its environmental performance, the company will automate its equipment, use predictive algorithms to gain greater metallurgical precision and use digital technology to streamline its permitting activities. The transformative potential is massive production costs alone are expected to drop from US\$800 to under US\$700 per ounce of gold on a sustainable basis.<sup>13</sup>

Second, to reinforce these changes in core operations, companies will need to rethink the way in which they generate and process information. In essence, the integrated digital mine will improve planning, control and decision support across the mining value chain to optimize volume, cost and capex, and improve safety. Insights will be derived by integrating data across three levels of analysis that map to three information time horizons:

- Historical analysis and reporting at all organizational levels.
- Real-time data visualization that combines operational data sources with corporate information.
- Predictive models and cognitive analytics that improve planning and reduce the need for reactive maintenance.

Central to enabling this would be a center of excellence in data management, reporting and analytics, which employs specialists, data scientists and analysts.

Finally, the effects of digitization will extend beyond core operations and the flow of information to the supporting processes and systems of functions like HR, finance and marketing, to name a few. There is a strong and growing trend towards upgrading and re-imagining these supporting systems using cloud-based solutions that have a low cost of ownership and contemporary user interfaces. A lean set of corporate processes will be assisted by robotic process automation (RPA) and artificial intelligence (AI), which will closely support knowledge workers. Shared services centers will employ a mix of onshore, offshore and robotic workers, while fully integrated ubiquitous communications provide support to the mobile workforce across all platforms. As an added benefit, technologies will enable work to be moved to locations that can support a more diverse and inclusive workforce, including workers who need to stay local to support their families and workers with physical disabilities.

### Digital in action

Automation is transforming the labor market. Deloitte estimates that by 2035 approximately 35 percent of current jobs in the UK will be automated.<sup>16</sup> Similar trends are expected in Australia and South Africa. RPA tools provide the ability to automate repetitive processes, including data gathering and data entry, by 'doing what the user would do' via a software robot, which securely logs into applications and works with the visible user interface to enter information, navigate through screens and extract and process the results.

### Digital in action

Komatsu, a global mining and construction equipment manufacturer, and General Electric announced plans to provide mining companies with big data analysis services using IoT technology to boost efficiency in mining operations. Applications include optimal truck routes and positioning, optimal speed and braking (based on site and terrain) with flow-on benefits in terms of reduced equipment downtime, better fuel efficiency and shipments between pit and port.<sup>15</sup>

All that said, reaching full digitization may not be possible for all mines given their life of mines, sunk capital and supporting infrastructure.

### **A measured approach**

Although it can seem daunting to execute on an effective digital strategy, embracing the digital future should not be a make-or-break proposition. Agility will be key and will likely be the buzzword in the industry for some time. Optimally, new approaches can be tested for minimal investment in a pilot or sandbox environment. That way, strategies that fail can be easily shelved, while strategies that deliver can be rolled out in phases—a cautious investment approach that should resonate with mining company stakeholders as the industry works to uncover the untapped opportunities that digital promises to deliver.

Globally, 69 percent of mining companies are looking at remote operation and monitoring centers, 29 percent at robotics and 27 percent at unmanned drones.<sup>16</sup>

**“To leverage the power of digital transformation, miners cannot afford to get caught up in the widgets and toys. Instead, they need to embed digital thinking, processes and structures into their entire organization in an effort to take corporate decision making to the next level.”**

**Andrew Lane**

Mining Leader  
Deloitte Africa

# Leading strategies in focus

To succeed in the digital future, mining companies should:

## **Articulate a clear digital strategy**

Rather than spawning disconnected functional initiatives, digital strategy has to be driven from the enterprise level and clearly define the value of digital to the organization as a whole. As such, digital transformation should begin with an understanding of the desired future state and the value to be created. In developing a digital strategy, companies should formulate a set of choices that define digital initiatives and capabilities, and integrate them across the organization to create value by connecting with customers, suppliers and employees.

## **Digitize the mining value chain**

Companies will need to apply digital capabilities to the core mining process, including solutions that range from digitizing engineering and asset information across the asset lifecycle, to connecting and internet-enabling remote devices and sensors. To understand what is possible and take advantage of emerging digital capabilities, they should also aim to stay abreast of the latest technology trends, such as wearables. Beyond providing benefits such as improved data quality, audit trails and access to information, digitization also creates the opportunity to automate physical processes with autonomous haulage and remote operations initiatives. In this context, collaboration will be key and companies will need to operate in an ecosystem of providers and partners, drawing on a wide range of vendors and service providers to deliver on this.

## **Deliver the integrated digital mine**

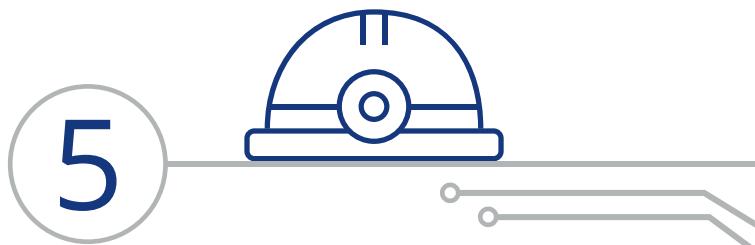
The mining value chain is characterized by waste and under-utilized capacity, resulting in process variability and sub-optimal decision-making, largely from a lack of accurate up-to-date information. Most organizations use only a fraction of the data they collect, without factoring in the real-time data they can potentially capture through IoT. To deliver on the integrated digital mine, companies must establish a capability to use data to resolve a wide range of business problems. In essence, intelligent business decisions will ultimately hinge on access to timely and relevant information. By becoming an insight driven organization, companies gain the ability to make better decisions across all time horizons and at all levels of the organization. They embed analysis, data and reasoning into their decision making processes, and reimagine their foundational data platforms, by making analytics a core capability across the organization.

### **Implement supporting platforms and enablers**

On the road to digital transformation, mining companies will need to strengthen their information technology (IT) and operational technology (OT) backbones. These supporting platforms are the core systems used to drive back-, mid- and front-office activities (such as ERP suites), as well as the technologies that manage assets and control technical processes. In some cases, driving full IT/OT integration will make sense. This level of convergence has the potential to reduce cost and risk, improve productivity and enhance safety.

### **Enable the diverse connected workforce**

Digital transformation requires top to bottom organizational transformation, which is why it is essential to have the right leadership, culture, operating model and people. To succeed at digital, companies must build a workforce of the future by attracting highly diverse people with a new set of digital skills. This is no easy task for mining companies, which will increasingly find themselves competing for scarce technical talent with more attractive pure play digital disruptors. Executives serious about reaping the benefits of the digital future must consequently ask some hard questions. Can current incumbents make this transition? How can they train for new skills and capabilities? How can they foster a supporting and inclusive culture? Interestingly, digital could help with this cultural transformation by enabling greater collaboration and agility. Staff skills can be updated using virtual training systems, which can reach them no matter where they're located. And virtual simulations could teach them to respond to a variety of potential scenarios.



# Mapping the threat landscape

## Cyber security concerns accelerate

As more data moves into the cloud, IT and OT technologies converge, digital innovation becomes the norm and sensor technologies lead to a more mature industrial IoT, mining companies will be more exposed to a broad array of online threats. As mining companies reinvent their future through digital, the threat of cyber-attack will be further amplified, particularly as companies leverage the power of IoT.

### Behind the curve

That's a challenge for the mining sector, which largely remains behind the curve when it comes to cyber security. Although companies are increasingly adopting digital solutions, cyber security often

lags in these initiatives. Many mining companies continue to rely on legacy systems and non-standard configurations to run their operating systems. IT administration at individual sites is often local and may not have the most current enterprise-level security standards. Password policies are frequently weak and firewalls not properly configured. In many cases, companies also lack the ability to detect threats before they can cause damage.

Companies with global networks are particularly vulnerable as they are only as strong as their weakest access point. If there are servers that are out of date, or security patches are not current, these could become prime vectors of exploit.

### Mining not immune

Critically, the industry is already at risk. Malicious viruses, like Stuxnet, explicitly target critical systems that control pumps, motors, valves and programmable logic controllers. Concerns that hackers could gain control over driverless cars extend to the mining sector, where autonomous vehicles continue to proliferate. Aside from the disruption this type of attack could cause, the safety implications are chilling.

Proprietary data and intellectual property are also prime targets for hackers, who include not only criminals in search of a financial payoff, but also nation-states, foreign intelligence agencies, hacktivists and organizations bent on industrial espionage. The data at risk is broad, ranging from corporate intellectual property, geological studies, exploration plans and M&A targets to personal emails, executive tax positions and employee data.

In the past several years, most major mining companies have been subject to attack.<sup>17</sup> And they are not alone. In late 2015, hackers also targeted the New South Wales government department in charge of mining approvals in an attempt to gain access to confidential commercial information.<sup>18</sup>

### Cyber maturity required

Tellingly, the increased sophistication of these threats is rendering many legacy security technologies ineffective. In 2015, Symantec discovered more than 430 million new unique pieces of malware, up 36 percent from the year before. Spear-phishing campaigns targeting employees increased 55 percent. Similarly, ransomware attacks rose 35 percent with new targets found in smart phones, Mac and Linux systems. Unreported breaches are up too, with a conservative estimate putting the number of records lost at more than half a billion.<sup>19</sup>

To counter these threats, mining companies will need to develop more mature cyber risk programs by investing in a balance of secure, vigilant and resilient capabilities tailored to their organization and aligned with their strategic goals.

“Mining companies are subject to a range of proliferating online risks. To protect against these threats, companies must enhance their security, vigilance and resilience by strengthening their security capabilities, monitoring emerging cyber risks and adopting robust response strategies.”

#### Cathy Gibson

Cyber Risk Services Director  
Deloitte Africa

### Cyber security in action

Over the past year, ransomware has become one of the most prevalent forms of cyber attack. In essence, ransomware is a type of malware that prevents users from accessing their corporate systems or data until a sum of money is paid, often demanded in the form of bitcoins. Many companies, including those in the mining sector, have been subject to these types of attack. In one recent case, when a company refused to pay the ransom, cyber attackers released the private data they had stolen into the public domain. The company responded decisively, altering its password protocols, changing its firewall configurations and ultimately finding and removing the intruders from its systems. It also demonstrated best practices by communicating honestly and openly about the breach. In the wake of the attack, the company strengthened its global cyber security posture to identify and address any vulnerabilities.

# Leading strategies in focus

As the cyber threat landscape evolves, mining companies must strengthen their cyber security programs. Responses include:

## **Strengthening traditional security controls**

Although new threats may require new forms of response, mining companies cannot afford to neglect their traditional security measures. This includes activities such as increasing firewall security, restricting administrative access to systems, deploying advanced endpoint protection and segmenting networks so hackers can access only limited segments.

## **Becoming more vigilant**

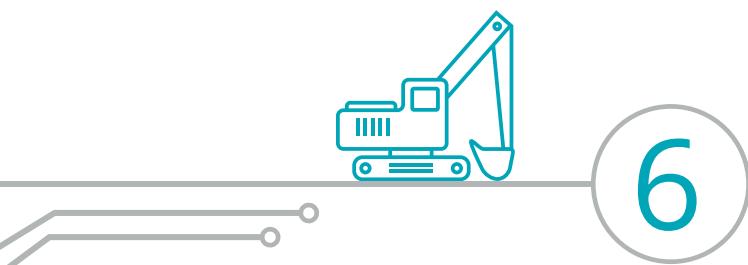
Before companies can mitigate the impact of cyber attacks, they need the ability to detect them. Security information and event management (SIEM) solutions can help in this regard by monitoring global access points for potential anomalies and malicious behavior. Similarly, 24x7 cyber response centers can help companies uncover and mitigate breaches in real time. With advance warning of potential hacker activity, companies can proactively respond to shut down threats before damage is caused.

## **Cultivating resilience**

In the event of a breach, companies need robust technical and incident response capabilities. In many ways, the response is similar to dealing with a safety incident—systems must be put in place to communicate effectively with employees, investors and other stakeholders; roles and responsibilities must be clarified to ensure a coordinated cross-functional response; and processes must be sufficiently robust to enable companies to mitigate a breach no matter where in the world it originates. The global footprint of most mining companies also heightens the imperative to develop a seamless cross-border governance framework that allows for a coordinated response.

## **Preparing diligently**

The mounting complexity of the cyber threat landscape elevates the imperative for cyber awareness and preparedness. This goes beyond conducting vulnerability assessments and ensuring they align with current risk profiles. It also includes training employees on safe computing practices, teaching them how to avoid potential attacks and instilling a cyber conscious culture. Many companies are also appointing Chief Information Security Officers to ensure adoption of appropriate governance, risk mitigation and compliance processes.



## Creating a shared vision for the sector

### Moving from compliance to a potential source of competitive advantage

The relationship between governments and mining companies has long been fraught with tension. On the one hand, some jurisdictions unquestionably target the mining sector for a disproportionate share of taxes and royalty fees, require adherence to stringent beneficiation and local content rules, and have been known to significantly delay, and even revoke, operating licenses and permits. As world politics swing towards a more populist stance, this nationalistic view may gain further ground.

On the other hand, mining companies are frequently perceived as having excessive control over a country's natural resources and causing undue damage to local environments, ecosystems and communities.

As a result of this polarization, governments at every level and mining companies continually fail to maintain open and cooperative dialogues. To address the impasse, greater levels of understanding are required between mining companies and their local stakeholders.

## Aligning interests

Some mining companies are reaching the end of their tethers.

In some jurisdictions, it may be challenging to build and maintain effective relationships with government authorities. In these situations, miners have begun asserting their legal rights and even withdrawing their investments where no other options exist.

But not all government relationships need to be adversarial. In fact, in many cases, governments are trying to balance their desire to attract mining investment with their need to raise the funds required to support local economic and social development. Given the number of competing stakeholder interests at play, this is no easy task.

This may explain why some governments are looking for new ways to bring divergent stakeholder interests into alignment. For instance, using Malaysia's Big Fast Results methodology (a process the country pioneered to tackle unemployment and crime) South Africa launched Operation Phakisa, which means "hurry up" in Sesotho.<sup>20</sup> The program is a cross-sector initiative designed to promote problem solving in a range of industries, from oil and gas to fishing, education, health and mining.

## Stakeholder cooperation in action

As a resource-rich country that sustains countless local communities, South Africa is under tremendous pressure to balance the needs of many different stakeholders. The country's mining Phakisa, which was facilitated by Deloitte South Africa, attempted to address many of these concerns. The program brought together over 150 representatives of local unions, mining companies, communities, governments and regulators to deliberate ways to make the mining industry more successful, drive investment and enable inclusive growth. In a process that was both high profile and controversial, industry stakeholders discussed strategies for improving upstream linkages between mines and the capital equipment sector; developing win-win beneficiation practices; supporting social and community development; increasing exploration activities; enhancing mining research, development and innovation; and modernizing mines.

For its part, Nigeria, whose mineral sector now constitutes only 0.3 percent of the country's GDP, is consulting with industry stakeholders in an effort to enhance the sector's operating capacity, reduce mining site waste and boost productivity and output.<sup>21</sup> This is a trend that may resonate among other oil-rich countries looking to diversify national revenues.

Many of these nations are eager to adopt more strategic mining policies that avoid the excesses of resource nationalism while still generating value for national economies. In early 2016, for instance, Ecuador took steps to attract more mining investment into the country as it seeks to reduce its reliance on oil exports.<sup>22</sup>

### Enhancing cooperation

Admittedly, for most jurisdictions, attracting mining investment will take more than reduced corporate tax rates and smoother licensing processes. Many countries lack the essential infrastructure miners need to operate—from piers and ports to roads and power generation facilities. Reinvigorating local infrastructure requires a decades-long commitment—one that can be difficult to sustain in politically volatile times.

Even more difficult will be fostering enhanced cooperation among communities, labor unions,

businesses, governments, special interest groups and investors. Despite the extensive time and resources spent on social investment projects, labor negotiations and community relations, local unrest in many jurisdictions continues to exact a serious toll. In Peru, for instance, protests at the Las Bambas mine left four people dead,<sup>23</sup> while striking miners in Bolivia kidnapped and killed the country's deputy interior minister.<sup>24</sup> More recently, a senior executive of Richards Bay Minerals in South Africa was shot outside his home in a crime that may be related to ongoing conflict over the company's job appointment processes.<sup>25</sup>

Clearly, resolving these conflicts requires much more than a financial investment in isolated community projects. Instead, it mandates all stakeholders to work together to create a shared vision for the sector. This can only be accomplished by tying business success to the prosperity of host communities and countries.

Companies that crack this code stand to benefit in the long term. Beyond de-risking their projects, they can gain the capacity to turn stakeholder management from a compliance initiative into a program that creates long-term competitive advantage.

**"Governments of resource-rich countries are grappling with the issue of how to equitably distribute the returns from their resource endowments to investors, governments and communities. There are no simple answers to this. The answer lies in effective engagement for execution and productive dialogue."**

### Karla Velasquez

Mining Leader  
Deloitte Peru

# Leading strategies in focus

Although different models of stakeholder collaboration will prevail in different jurisdictions, best practice approaches do exist for fostering a shared vision for the sector:

## **Build long-term solutions**

Real change generally happens only incrementally, which is why it is imperative to take a long-term view towards solving societal issues to benefit the business. To ensure all sides are heard, in-depth consultations with all affected constituencies should be facilitated by neutral third parties. Key decision makers must also be willing to come to the table in good faith and make the policy and process changes necessary to address the needs of different stakeholder groups.

## **Link societal outcomes to business success**

Many mining companies have a limited understanding of societal issues and lack the skills to address them. To overcome these barriers, companies should consider including social issues in project planning, developing cross-functional teams with fluency in business and societal issues, and creating incentive structures that reward strong performance against societal measures.

## **Measure social outcomes**

Companies often underestimate the business benefits that can be realized by effectively addressing community and government concerns. To strengthen the business case, it's important to measure not only the full upside of the opportunity but also the costs of not investing in these strategies. To capture these metrics, some companies have begun conducting community impact studies to measure the impact of their contributions to both host countries and citizens—not only in terms of dollars spent and employees hired, but also in terms of societal improvements delivered through higher levels of industrialization, job creation, political stability, financial and physical security, social development and professional satisfaction.

## **Align with government**

While mining companies cannot—and should not—replace government, they can strengthen their ability to create shared value by helping build local, regional and national capacity for effective governance. When building infrastructure to support mining, companies also actively work with governments to see how this can help support a wider economic development agenda. Through these efforts, both governments and companies benefit as they encourage governments to better clarify national development agendas, create policies that allow companies to align their social investments to their business imperatives and support cross-sector partnerships capable of meeting the needs of disparate stakeholders.



## Re-earning the social license to operate

### Environmental sustainability and energy management move into sharper focus

Winning a social license to operate has never been a simple proposition—and that's doubly true today as community and social groups continue to raise concerns about the industry's impact on the environment. A number of catastrophic accidents over the past two years have brought this issue into sharp relief—including the collapse of a tailings pond at the Mount Polley mine in Canada which leaked contaminants into local lake waters, and the more recent collapse of the Samarco tailings dam in Brazil which resulted in 19 deaths.

Concerns over the pollution caused by greenhouse gas (GHG) emissions are sparking

international dissent as well. In May 2016, as part of a coordinated global protest against fossil fuel companies, protesters mounted blockades, halted operations and took to the streets in Australia, Brazil, Canada, Germany, Indonesia, Nigeria, the Philippines, the UK and South Africa.<sup>26</sup>

More moderate attempts to effect change also abound. In some jurisdictions, NGOs are taking their grievances to court, while technically-savvy activists turn to social media.

Not surprisingly, this level of backlash can hamper miners' efforts to get approvals for new mines and expansions.

### Rising expectations

Notably, pressures are not just coming from local communities. Regulators also expect companies to comply with a range of mandatory and voluntary environmental disclosures, detailed in guidelines issued by the International Council of Mining and Metals (ICMM), the Global Reporting Initiative (GRI), the Extractive Industries Transparency Initiative (EITI) and a whole host of local standard setting bodies. For their part, investors have begun demanding commitments from mining companies on how they will lower their carbon footprints.

In the wake of COP21—the most recent Sustainable Innovation Forum which took place in Paris in December 2015—industry

must now also comply with new regulatory mandates to reduce GHG emissions. As part of their commitments to limit the effects of global warming to less than two degrees Celsius by 2100, 90 countries among the 195 signatories of COP21 indicated plans to use carbon pricing and other market mechanisms to achieve their emission reduction goals.<sup>27</sup> By putting a cost on carbon, governments are making it clear that industry must cut down on its emissions—or pay a literal price.

That price may rise as energy costs increase in the next few years. While many companies benefited from the 50 percent decline in global oil prices in the last two years, their actual energy efficiency on a GJ/t basis has remained flat or even risen

in some cases. Companies that missed the opportunity to transform their energy footprint while energy prices were at their lowest levels since the last financial crisis may imminently have to deal with not just rising input costs, but also mounting costs for common emissions. Energy tariffs, such as those recently imposed in Argentina, will also take a toll. Not surprisingly, these trends will bring renewables into sharper focus.

### Stakeholder cooperation in action

For years, Barrick Gold has been seeking strategies to reduce its energy intensity, lower GHG emissions, cut energy costs and understand the implications of carbon pricing on its global operations. Working with the company, Deloitte has helped Barrick assess the risks of its current energy mix, develop a global emissions profile and pinpoint areas where emerging GHG or climate policies will impact its operations from a carbon pricing perspective. As part of the initiative, the company will be pursuing opportunities for reduction, including energy contracts, fuel management, renewable energy, waste heat recovery and fuel substitution. To realize optimal results, the company also approaches energy demand management at a systemic level, rather than as a collection of separate processes.

That means energy use in some areas (such as blasting) may rise to allow systemic energy intensity to fall (i.e., by reducing energy use downstream). Energy analytics also features prominently, with the company measuring its energy use across every subsystem to set baselines, identify opportunities for improvement and validate its actual savings over time.<sup>28</sup>

### **Mitigating environmental impacts**

Given this range of pressures, mining companies must sharpen their focus on environmental sustainability and energy management. Lower GHG emissions and a lower energy footprint represent more than the right economic answer; they are also the right solutions for the communities and environments integral to the mine. Miners will, need to actively think about how reduced energy footprints can improve community sustainability, provide safer and cleaner environments for workers, and drive more lasting and meaningful relationships with governments.

In the final analysis, cutting down on emissions, reducing energy consumption and managing inputs of scarce resources like water and electricity does more than reduce costs. It also lessens miners' environmental footprint and positions them to foster the community trust needed to regain their social license to operate.

**"As the productivity and sustainability agendas converge, mining companies continue to make strides to mitigate their impact on the environment. While this alone will not win them a social license to operate, it does display a growing willingness to listen and respond to community concerns."**

**Tim Biggs**

Mining Leader  
Deloitte UK

# Leading strategies in focus

Although different models of stakeholder collaboration will prevail in different jurisdictions, best practice approaches do exist for fostering a shared vision for the sector:

## **Energy management**

With each passing year, it becomes more economically and logically feasible to reduce reliance on fossil fuels—especially as the cost of renewables falls and battery storage improves. At the same time, evolving technological innovations enable fuel substitution (i.e., replacing diesel with alternative fuels), electrification of equipment and a growing capacity for energy self-generation. Add in analytics capability that empowers mining companies to optimize their energy use, and the potential for greater efficiency is multiplied. To realize these benefits, however, mining companies must take a system-level approach to energy management. This includes looking at all their processes to reduce energy consumption across the board; building internal capabilities around energy management; setting up a governance structure; clarifying goals and targets; and fostering an energy-conscious culture.

## **Water management**

For years, mining companies adopted strategies to enhance water efficiency, while preserving water security for local communities. Massive investments have been made to develop mine water treatment technology, design processing plants that use untreated seawater, build desalination plants, recycle and reuse water, and even set up water storage and distribution networks to ensure local communities have access to potable water.<sup>29</sup> As technologies mature, opportunities to reduce water use also grow. Several companies are exploring new mine designs that enable dry processing—eliminating the use of water entirely. With sensor-based ore sorting, companies can also identify minerals and waste prior to extraction, vastly reducing the amount of water and energy used at the pre-concentration stage.

## Climate change adaptation

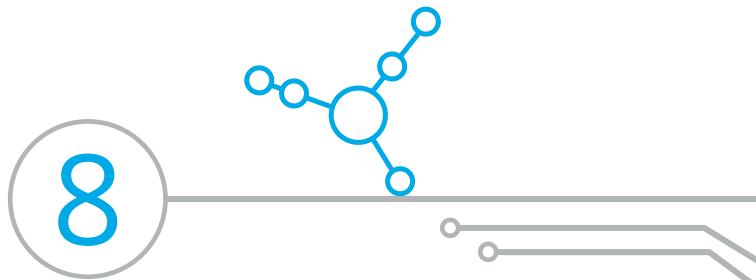
In the wake of COP21, companies are looking for ways to reduce their GHG emissions. Doing so begins by tracking and accurately measuring the current carbon footprint of their mining operations, and determining how their energy use is projected to change over the life of each mine. Next, they need a good understanding of the regional legislative and policy changes occurring with regard to carbon pricing in the areas where they operate. This will help them assess not only their potential carbon tax liabilities, but also the viability of local cap and trade regimes, and the availability of incentives to invest in renewables. Ultimately, companies should be able to assess how much money they save for every unit of energy reduced.

## Mine closure and reclamation

Following mine closure, most countries legally require companies to remediate environmental damage, support land reclamation, restore disturbed ecosystems and/or rehabilitate land by establishing alternative ecosystems. While industry performance in this space remains mixed, some companies are pursuing interesting strategies to repurpose mine sites following closure. In Canada, the Bellevue underground coal mine was turned into a museum.<sup>30</sup> The Wheal Jane tin mine in the UK is now a park that features wetlands and recreational trails.<sup>31</sup> And, more recently, several companies have transformed dormant mines into solar and wind power installations.

### Sustainability in action

When Teck's Sullivan mine was closed after 100 years of operation, the company decided on a unique reclamation plan: the construction of a solar farm. The CAD\$5.3 million SunMine solar project features a 1.05 MW solar power plant and more than 4,000 solar cell modules mounted on 96 solar trackers. In addition to providing the land and site infrastructure for the project, Teck contributed CAD\$2 million towards its construction. Today, SunMine produces enough capacity to power 275 homes and represents the largest solar farm in Western Canada.<sup>32</sup>



## Supporting strategic priorities

### Mining companies move to transform their operating models

When commodity prices first began to fall in 2011, mining company response was initially subdued. After years of record profit, few companies could perceive the depth to which prices would ultimately fall or the length of time it would take for them to rebound. As a result, the impetus to overhaul cost structures, invest in innovation, entrench productivity improvements and make substantive organizational shifts was limited.

That has changed in recent years. Although some commodity prices have begun to recover, industry leaders

have come to recognize the imperative of adopting operating models that can help them sustain growth amidst volatility. Companies that shifted their geographic focus, consolidated to realize economies of scale, diversified their assets or took other steps to strengthen their balance sheets in the latest round of cost take-outs are now considering how to align their operating models against these choices so that they can position themselves to meet their strategic objectives and sustain their new, lower cost positions.

### Operating model options

Currently, the operating model choices miners are making run the gamut, from functional outsourcing and process redesign to revised approaches towards centralization and decentralization. For instance, Goldcorp unveiled a business renewal strategy to ensure disciplined capital allocation through a decentralized management approach.<sup>33</sup>

Conversely, some majors are taking an opposing approach—moving towards centralized shared services and processing centers, and offshoring those shared service centers to lower cost jurisdictions. Some companies are outsourcing these centralized services to a small number of approved vendors to ensure process standardization and control

costs. Others are running those shared services centers with in-house talent to enhance oversight and quality control. Still others are exploring co-sourcing, allowing the business to retain control over the operational process while a trusted third party delivers the final product or service to the end customer.

### Beyond restructuring

For these efforts to produce sustainable value, however, companies must go beyond realigning the structure of their organization. They must also reconfigure core supporting processes and ensure the right skills and capabilities are in place, supported by the right culture and enabled by the appropriate technology platforms.

These operating model components—structure, process, skills, culture and technology—are critical to achieving strategic outcomes. They are also the elements that can position miners to truly differentiate themselves in the market. This differentiation could hinge on a wide variety of organizational strengths—from the supply chain through to technological superiority, unexploited process efficiencies or improved asset utilization. Regardless of the approach adopted, the key for miners is to configure an operating model that supports their strategic priorities and helps them create long-term value.

### Transforming operating models

Under Goldcorp's new decentralized management approach, mine managers are empowered to act as business owners and be held accountable for maximizing the return on capital invested in their businesses. By fostering greater accountability at the mine site and enhancing operational efficiency, this strategy is geared towards helping Goldcorp improve its returns while lowering risk.<sup>34</sup>

### Transforming operating models

Given the potential benefits of centralization—including the opportunity to eliminate duplication; streamline, automate and standardize processes; and potentially improve service levels and response times—one mining company decided to set up an offshore shared services center. Its aim is to centralize policy and governance around four key functions: technology, finance, supply and human resources. Rather than relying on external service providers, the company hopes to retain control over these functions in a bid to enhance oversight, quality control and service levels.

“The ability of a mining company to respond to industry challenges will depend on their ability to properly configure their operating models. Unlocking the next level of innovation and productivity hinges on the strength of the organization’s leadership, culture and skills, then structures, processes and technologies.”

**David Quinlin**

Mining Leader  
Deloitte Switzerland

# Leading strategies in focus

Companies with leading operating models typically see faster revenue growth and higher operating margins than those with weak models.<sup>35</sup> To join the ranks of the high performers, mining companies should look at strengthening five key aspects of their operating models:

## **Organizational structures**

In addition to setting boundaries for the company's lines of business, effective organizational structures define corporate accountabilities, management systems, and spans and layers. For miners, this has most recently translated into a clearer articulation of their commodity focus in a bid to align their portfolio choices with their strategic direction.

## **Processes**

Process optimization involves defining core activity clusters, setting decision rights and clarifying cross-organization linkages. This is a critical focal point for organizations whose core processes—such as maintenance, procurement and budgeting—have failed to keep pace with shifting cost containment mandates.

## **Technology**

Technology decisions support the company's operating model choices to deliver the information and functionality users require. Many companies are shifting from customized ERP solutions to more standardized solutions. To further streamline processes, some mining companies are also turning to technology-enabled solutions such as robotic process automation (RPA). By automating repetitive tasks, data entry and other rules-based activities, RPA can help reduce costs, virtually eliminate manual errors, enhance quality and free up staff to focus on more value-added work. Similarly, to improve training, some companies are turning to virtual reality or simulation technologies that test employee skills against real-world scenarios.

## **Culture**

Cultural decisions link back to a company's key values and distinctive competencies by defining how people collaborate—both within functional teams and across functional lines. It is also an element that has received considerable playtime among mining executives lately. There is almost a universal recognition that miners must be more agile and flexible, better able to cope with cyclical headwinds and prepared to capture market opportunities as they arise. Underpinning all of this is the importance of having the right internal culture in place.

## **Skills and people**

The functions that fall under talent management—from recruitment and training to performance measurement and compensation—remain critical areas of focus for mining companies. That's particularly true as miners try to attract the resources they need to help propel them into the digital future. This will require additional investment into human capital—not simply at the operational level, but at the leadership level as well.

9



## Creating healthy and inclusive workforces

### Wellness and diversity are rising on miners' agendas

Following the commodity price weakness of recent years, productivity improvement has been elevated to a mining industry mantra. Much of these efforts have been focused on taking out costs and streamlining processes. Behind the scenes, however, some mining companies are coming to realize that these steps don't go far enough. To ensure sustainable productivity improvements, companies must also foster healthy workforces and inclusive workplaces.

Here's why: productivity has been demonstrated to flag at both companies that struggle with a high incidence of mental health disorders, as well as

those that fail to embrace diversity of talent and diversity of thinking.

#### **Mental health issues on the rise**

Consider the statistics. According to the World Health Organization, employees around the globe will be absent for 12 billion working days each year due to depression and anxiety alone—a trend that is estimated to cost the global economy more than US\$900 billion.<sup>36</sup>

Unfortunately, mining industry performance in this area has not been stellar. Just last year, the Legislative Assembly of Western Australia issued a



report examining mental health issues among fly-in/fly-out (FIFO) workers. It found that the incidence rate for mental illness is 30 percent among FIFO workers, compared to a 20 percent national average.<sup>37</sup> Crucially, this issue is no longer confined to mine site operations. Given the sector's performance challenges and the unrelenting focus on shoring up operating models, many managers are under greater pressure than ever before. Jobs are no longer secure, there is an imbalance between effort expended and reward received, and job control is declining. As a result, the industry is seeing a

rising tide of depression, along with a growing incidence of suicide and attempted suicide at the leadership levels.

### Diversity supports growth

From a diversity perspective, numerous studies show that companies with diverse workforces outperform their less diverse counterparts. Companies with female CEOs realize an average return of 103 percent during their leadership tenure, compared to the overall S&P average of 69 percent over the same time periods. Additionally, companies in the top quartile for racial and ethnic diversity are 35

percent more likely to enjoy financial returns above national industry medians.<sup>39</sup>

The mining industry, however, lags when it comes to inclusiveness. As of 2015, women comprised only 16 percent of the global mining sector workforce.<sup>40</sup> Additionally, despite operating in countries around the world, management at mining companies often hails from headquarters rather than being drawn from local talent. As a result, there is a gulf between local employees and leadership groups that lack racial diversity.

### Wellness in action

R U OK is an Australian foundation committed to helping people connect meaningfully in an attempt to reduce the incidence of suicide. As part of its work in the mining industry, the foundation encourages FIFO workers to proactively help identify co-workers in emotional danger. It supports staff and management with a range of materials including videos, posters, conversation starters and talking points, noting that men in particular need to be encouraged to speak up when they're struggling.<sup>38</sup>

## Closing the gaps

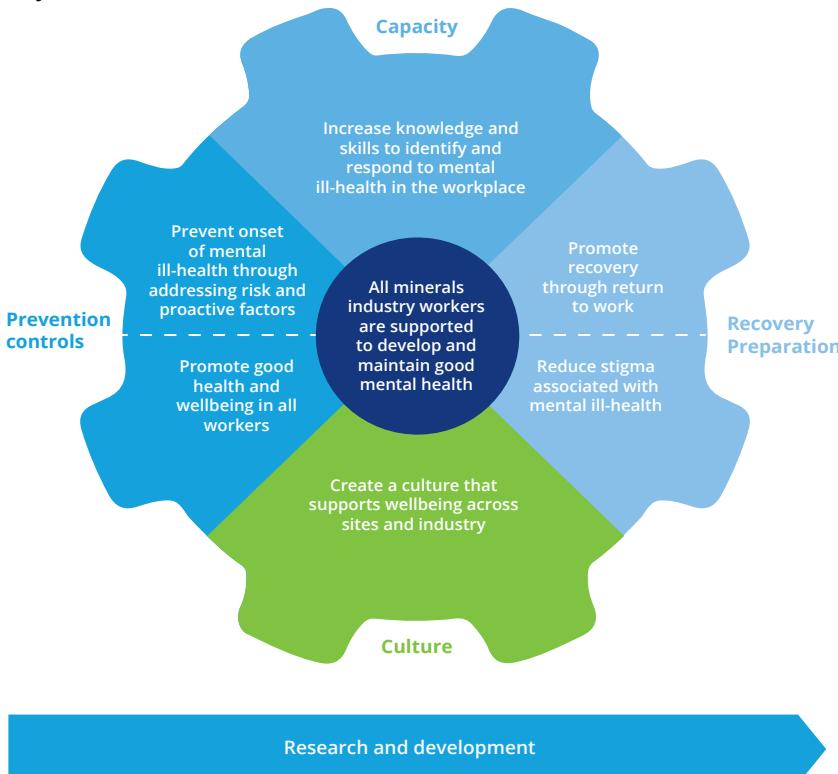
To close these gaps, the mining industry has begun elevating both wellness and diversity on corporate agendas. To address mental health issues, some companies are following the framework set out by the Minerals Council of Australia. Elements include both prevention controls and preparation for recovery—including fostering a culture that supports wellbeing (see Figure 4).

**Figure 4: Overview of the minerals industry approach to mental health and wellbeing**

### Key actions ▶



### Key directions ▶



Source: Source: Minerals Council of Australia<sup>41</sup>

### Diversity in action

While roughly 50 percent of Canada's labor force is composed of women, only 17 percent of mining sector workers are female. Worryingly, that number drops to five percent when clerical and corporate service jobs are excluded. To help shift this balance, Goldcorp Inc. pledged to improve representation of women on its board and to introduce a career development and mentorship program designed to bring more women into trade and production roles. Other companies are making similar strides. By splitting 12-hour work days into two six-hour shifts, for instance, Teck Resources has been able to employ more women in its Chilean copper mine than any other in the country.<sup>43</sup>

### Wellness in action

In 2015, BHP Billiton and Rio Tinto, among others, asked beyondblue—an Australian advocacy and support group—to visit their Pilbara operations and speak to mine workers about mental health. Part of this program was geared to help offset the risks faced by FIFO workers by aiming to break down the stigma associated with mental health issues among these largely male workforces.<sup>42</sup>

At the same time, some companies are working to adopt a broader mindset around inclusiveness. Changes in population age profiles, education and migration flows, along with expectations of equality of opportunity and work/life balance, are all deeply impacting employee populations—encouraging companies to find new ways to build diverse talent pools. Similarly, as mining companies continue their campaigns towards higher levels of productivity, diversity of thinking is coming into the spotlight. By attracting people with diverse perspectives, miners hope not only to fuel greater levels of innovation, but to develop the skillsets necessary to help catapult them into the digital future.

As an added benefit, taking a strategic approach to wellness and inclusion does more than improve worker productivity. It also enhances safety outcomes, encourages people to reach their highest potential and provides tangible evidence that the company truly cares about its people.

*"As mining companies find themselves competing with other sectors for in-demand skillsets—such as digital talent—they will need to rely on people from different walks of life, from anywhere in the world and from a wide variety of backgrounds and disciplines. Pay alone will not attract this diverse talent. Miners will also need to create an inclusive environment where people know they have the chance to work on complex problems and with leading-edge teams, and that they will be given every opportunity to grow and advance. It's about creating smarter teams to drive collective intelligence and solve more complex problems."*

### **Juliet Bourke**

Diversity and Inclusion Leader  
Deloitte Australia

# Leading strategies in focus

There are numerous steps mining companies can take to improve workforce wellness and inclusiveness. These include:

## **Amending FIFO policies**

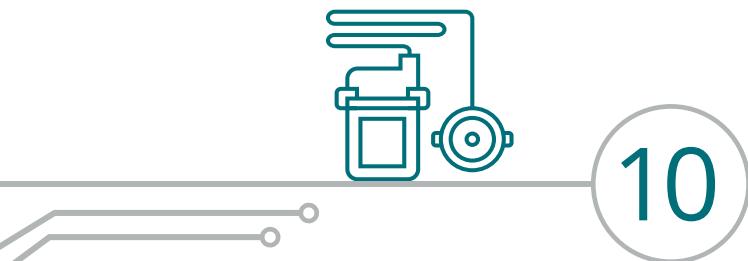
Mining companies can help address the mental health issues associated with FIFO work arrangements by adopting the code of practice proposed by Australia's Education and Health Standing Committee. Among other measures, it proposes more balanced time rosters to reduce fatigue and accommodate life events (e.g., weddings, graduations), more explicit programs to address mental health literacy and stigma, facilities to improve worker links with family support structures, improved community integration and accommodation, and training to equip managers, supervisors and workers to better handle mental health issues.<sup>44</sup>

## **Extending wellness programs to the entire employee population**

With mental health issues affecting both blue and white collar workers, companies must bring these topics to the fore. In doing so, they should consider looking at wellbeing through a variety of lenses—from physical and mental to emotional and spiritual health and safety. The aim is to tackle the holistic side of wellness instead of approaching it through a one-dimensional lens. This requires an elevation of wellness to a strategic priority given its impact on engagement, performance, talent retention and productivity. It also requires a recognition that a mentally healthy workplace creates a positive working environment that builds individual skills and resilience, reduces workplace risks to mental health problems and supports staff with mental health conditions.

## **Cultivating inclusiveness**

To transform diversity programs from a compliance obligation to a business strategy, leading companies are now considering ways to build both diverse workforces and inclusive workplaces. To succeed, however, companies must understand what makes people feel included. For instance, when employees feel known, are valued as individuals, are well-connected to other people in the organization and have a voice in decision making, their performance tends to improve across the board—in areas from customer service and innovation to safety and productivity.



## Adopting an integrated approach to reporting

### Demands for greater disclosure and transparency increase

In a trend that has emerged from the shadow of resource nationalism, governments in a growing number of jurisdictions are demanding greater levels of transparency from their domestic extractive industries. Beyond tying up resources, this has put companies under greater scrutiny as governments seek to establish that each company is paying the right amount of tax.

#### **Publish what you pay**

When the Dodd-Frank Wall Street Reform and Consumer Protection Act was first enacted in the US, it included a range of disclosure provisions affecting mining companies listed on the Securities and Exchange

Commission (SEC)—including the mandate to disclose the use of conflict minerals sourced from the Democratic Republic of the Congo, certain payments made to both US and foreign government entities, and safety warnings and violations for mines operated in the US.<sup>45</sup>

More recently, Canada adopted the Extractive Sectors Transparency Measures Act (ESTMA), which requires mining companies to track and report payments made to governments in excess of CAD\$100,000, including taxes, royalties, fees, production entitlements, bonuses, dividends and payments for infrastructure improvements.

Companies with a year end of December 31, 2016 will be expected to submit their first reports by mid-2017—and penalties for non-compliance can reach CAD\$250,000 per day.<sup>46</sup>

Under the Extractive Industries Transparency Initiative (EITI), which has 51 implementing countries, governments and companies must disclose information along the industry value chain from the point of extraction, to how the revenue makes its way through the government, to how it benefits the public.<sup>47</sup>

In the European Union, Accounting Directives require extractive companies to report payments they make to governments on both a country-by-country and project basis, for payments that have been attributed to specific projects.<sup>48</sup>

### The facts on tax

At the same time that companies are being asked to disclose their payments to governments, sweeping international tax reforms have put tax transparency into the

spotlight. Paramount among these is the OECD and G20 initiative to tackle base erosion and profit sharing (BEPS)—tax avoidance strategies that exploit mismatches in tax rules to artificially shift profits to low or no-tax jurisdictions. To date, over 100 countries are collaborating to implement a wide series of BEPS action items<sup>49</sup>—many of which will affect companies in the extractive sector.

Already, there have been trickle-down effects on mining companies. In Chile, for instance, tax authorities sent out a questionnaire to all mining companies asking for formal responses regarding their tax planning practices.

### Beyond the basics

These regulations mirror the shifting mood of the investor community, which now expects companies to go beyond mere compliance by over-reporting on material issues. This means mining companies are expected not only to make a growing number of mandatory financial disclosures, but also report on a broad range of non-financial

information. These disclosures include sustainability reporting under the Global Reporting Initiative (GRI); environmental impact reports under the Carbon Disclosure Project; corporate social responsibility reports; reporting on human rights, labor and working conditions, community health and safety and biodiversity management under guidelines such as the International Finance Corporation (IFC) performance standards; incident and safety reporting; and disclosure of material issues, such as cyber security risks or community disputes, that may impact project timelines or budgets.

In light of these growing mandates, it is becoming clear that an integrated approach to reporting and disclosure is required. Although getting there from here will be no easy task, companies prepared to bolster their reporting systems and controls are bound to reap benefits far beyond compliance—from improved transparency to the analytical capability to make more informed business decisions.

**“Mining companies are coming to terms with a step change in the reporting environment, which is no longer confined to financial disclosures. True transparency enhancements are turning out to be more complex than some companies expected, raising strategic aspects that warrant executive level attention.”**

### James Ferguson

Global Mining Tax Leader

Deloitte Touche Tohmatsu Limited

# Leading strategies in focus

To strengthen their compliance and disclosure practices, mining companies are taking steps to enhance their reporting and transparency. Here are some strategies to consider.

## **Standardize information**

To ensure companies are paying their fair share of tax, governments will increasingly be reviewing not only their financial disclosures, but their non-financial disclosures as well to check for consistency. This means companies must ensure that their financial reports remain consistent on a global basis, and that their non-financial disclosures align with their regulatory disclosures

## **Consider the benefits of over-reporting**

From a policy perspective, some companies may choose to release voluntary disclosures to supplement mandatory ones in an effort to provide greater context for their actions. Furthermore, given the plethora of different reporting requirements, over-reporting may help companies to bridge the gap between different disclosures. The key, of course, is gaining a full understanding of these differences in advance.

## **Review IT systems**

Given the expanding array of reporting standards, companies are looking for ways to consolidate their reporting efforts. Operationally, this requires them to assess if their systems are sufficiently robust. Companies must be able to easily access accurate data that provides one version of the truth—across systems and across jurisdictions. They need the capacity to generate accurate country-by-country disclosures for various purposes. In essence, their internal processes and technology solutions must ensure consistent data measurement and reporting, and their controls must empower them to treat non-financial disclosures with the same rigor as financial ones.

# New strategic foundations

## Future outcomes hinge on current actions

Now in its 9th edition, this year's mining report notes a mood of cautious optimism brewing in the mining industry for the first time in several years. With many commodity prices on the rise, shallow growth returning to different end markets and most mining companies in better cost positions than in the recent past, companies now face some key choices as to where to invest and how to position themselves in the coming years. These decisions require a careful consideration of where to play and how to win. They also require a more structured approach than ever before so that mistakes of the past are not repeated.

Opportunities for transformation exist. Innovation, collaboration and the articulation of clear digital strategies can open up new avenues for productivity enhancement. Improving balance sheet discipline, strengthening operating

models and encouraging diversity of thinking can uncover new wellsprings of growth. Similarly, by mitigating their environmental impact, engaging with communities and working with key stakeholders to create an aligned industry vision, miners can regain their social license to operate.

As companies recommit to a new set of strategic priorities, however, they will similarly need to adopt new operational approaches. Disconnected investments are no longer sufficient to drive the level of change required to gain a sustainable competitive advantage. Instead, a systemic approach is needed—one that runs from the top down, takes a critical look at enterprise-level practices and processes, aims to build integrated and coordinated responses, and fosters a culture that supports this directional shift.

**"To realize exponential change, mining companies can no longer afford to work around the fringes of their organizations. The time has come to consider new strategic approaches capable of transforming the way they operate across the board."**

### Rajeev Chopra

Global Leader, Energy & Resources  
Deloitte Touche Tohmatsu Limited

For more information, please contact a Deloitte mining professional:

## Global contacts

### Global Leader, Mining

#### Phil Hopwood

+1 416 601 6063

[pjhopwood@deloitte.ca](mailto:pjhopwood@deloitte.ca)

### Global Leader, Energy & Resources

#### Rajeev Chopra

+44 20 7007 2933

[rchopra@deloitte.co.uk](mailto:rchopra@deloitte.co.uk)

## Region/Country contacts

### Africa

#### Andrew Lane

+27 11 517 4221

[alane@deloitte.co.za](mailto:alane@deloitte.co.za)

### Australia

#### Nicki Ivory

+61 8 9365 7132

[nivory@deloitte.com.au](mailto:nivory@deloitte.com.au)

### Africa

#### Tony Zoghby

+27 11 806 5130

[tzoghby@deloitte.co.za](mailto:tzoghby@deloitte.co.za)

### Australia

#### Juliet Bourke

+61 2 9322 7379

[julietbourke@deloitte.com.au](mailto:julietbourke@deloitte.com.au)

### Africa

#### Cathy Gibson

+27 11 806 5386

[cgibson@deloitte.co.za](mailto:cgibson@deloitte.co.za)

### Brazil

#### Eduardo Tavares Raffaini

+55 21 3981 0538

[eraffaini@deloitte.com](mailto:eraffaini@deloitte.com)

### Americas

#### Glenn Ives

+1 416 874 3506

[gives@deloitte.ca](mailto:gives@deloitte.ca)

### Canada

#### Phil Hopwood

+1 416 601 6063

[pjhopwood@deloitte.ca](mailto:pjhopwood@deloitte.ca)

### Argentina

#### Edith Alvarez

+11 4320 2791

[edalvarez@deloitte.com](mailto:edalvarez@deloitte.com)

### Canada

#### Andrew Swart

+1 416 813 2335

[aswart@deloitte.ca](mailto:aswart@deloitte.ca)

### Argentina

#### Alejandro Jaceniuk

+54 11 4320 2700 ext. 4923

[ajacienuk@deloitte.com](mailto:ajacienuk@deloitte.com)

### Canada

#### Ben-Schoeman Geldenhuys

+1 416 775 7373

[bgeldenhuys@deloitte.ca](mailto:bgeldenhuys@deloitte.ca)

**China**

**Michael Liu**  
 +86 10 85207813  
 jlliu@deloitte.com.cn

**Switzerland**

**David Quinlin**  
 +41 58 279 6158  
 dquinlin@deloitte.ch

**Chile**

**Christian Duran**  
 +56 22 729 8286  
 chrduran@deloitte.com

**Turkey**

**Uygar Yörük**  
 +90 312 295 4700  
 uyoruk@deloitte.com

**Colombia**

**Julio Berrocal**  
 +57 5 360 8306  
 jberrocal@deloitte.com

**United Arab Emirates**

**Salam Awawdeh**  
 +971 4 376 8888  
 SAwawdeh@deloitte.com

**France**

**Damien Jacquart**  
 +33 1 55 61 64 89  
 djacquart@deloitte.fr

**United Kingdom**

**Tim Biggs**  
 +44 20 7303 2366  
 tibiggs@deloitte.co.uk

**India**

**Kalpana Jain**  
 +91 11 4602 1406  
 kajain@deloitte.com

**United Kingdom**

**James Ferguson**  
 +44 20 7007 0642  
 jaferguson@deloitte.co.uk

**Mexico**

**Cesar Garza**  
 +52 871 7474401 x4401  
 cgarza@deloittemx.com

**United Kingdom**

**John Woods**  
 +44 20 7007 5992  
 jwoods@deloitte.co.uk

**Peru**

**Karla Velasquez**  
 +51 1 211 8559  
 kvelasquez@deloitte.com

**United States**

**Sandeep Verma**  
 +1 214 840 7182  
 sxverma@deloitte.com

**Poland**

**Tomasz Konik**  
 +48 32 603 03 35  
 tkonik@deloitteCE.com

**United States**

**Amy Winsor**  
 +1 303 312 4156  
 awinsor@deloitte.com

**Russia**

**Igor Tokarev**  
 +74 95 787 0600 x 8241  
 itokarev@deloitte.ru

**United States**

**Kara Bresnahan**  
 +1 212 436 7448  
 kbresnahan@deloitte.com

**Southeast Asia**

**Rick Carr**  
 +65 623 27138  
 RickCarr@deloitte.com

# Endnotes

1. Thomson Reuters. TSR Chart Datastream report
2. Rio Tinto, August 3, 2016. "2016 half year results." Accessed at [http://www.riotinto.com/documents/160803\\_Presentation\\_Rio\\_Tinto\\_2016\\_half\\_year\\_results.pdf](http://www.riotinto.com/documents/160803_Presentation_Rio_Tinto_2016_half_year_results.pdf) on September 15, 2016.
3. BHP Billiton, May 10, 2016. "BHP Billiton outlines strategy to grow value." Accessed at <http://www.bhpbilliton.com/investors/reports/bhp-billiton-outlines-strategy-to-grow-value> on September 15, 2016.
4. FCLT Global, 2016. "Rising to the challenge of short-termism," by Dominic Barton, Jonathan Bailey and Joshua Zoffer. Accessed at <http://www.fcltglobal.org/docs/default-source/default-document-library/fclt-global-rising-to-the-challenge.pdf?sfvrsn=0> on November 2, 2106.
5. Australian Innovation in Mining Report <https://www2.deloitte.com/content/dam/Deloitte/au/Documents/energy-resources/deloitte-au-mining-innovation-australia-280716.pdf>
6. Wall Street Journal Video, June 7, 2016. "3-D Metal Printing and the Future of Manufacturing." Accessed at <http://www.wsj.com/video/3-d-metal-printing-and-the-future-of-manufacturing/774F8B33-BD61-4864-B31E-4E41CF054F6D.html> on September 6, 2016.
7. Schneider Electric Software, December 2015. "Predictive Asset Analytics at Power Utilities." Accessed at <http://software.schneider-electric.com/pdf/industry-solution/predictive-asset-analytics-at-power-utilities/> on September 7, 2016.
8. PC World, September 29, 2015. "Cloud-based 'digital twins' could make power plants more efficient," by Stephen Lawson. Accessed at <http://www.pcworld.com/article/2987525/cloud-based-digital-twins-could-make-power-plants-more-efficient.html> on September 7, 2016.
9. Unearthed, 2016. "MineHack Perth." Accessed at <http://unearthed.solutions/events/unearthed-minehack-perth-2016/> on September 8, 2016.
10. Waterloo Region Record, March 2, 2016. "Mining firm uses crowdsourcing to identify potential gold deposits," by Alexandra Posadzki. Accessed at <http://www.therecord.com/news-story/6373045-mining-firm-uses-crowdsourcing-to-identify-potential-gold-deposits/> on September 8, 2016.
11. Found at <https://www2.deloitte.com/ca/en/pages/energy-and-resources/articles/business-ecosystem-in-exploration.html>
12. The Globe and Mail, September 19, 2016. "For mining companies, digitization is the next gold rush," by John Chambers and John Thornton. Accessed at <http://www.theglobeandmail.com/report-on-business/rob-commentary/for-mining-companies-digitization-is-the-next-gold-rush/article31947408/> on September 20, 2016.
13. SmartCap. "Assmang Beeshoek case study." Accessed at <http://www.smartcaptech.com/industries/mining/> on September 20, 2016.
14. Australian Mining, April 14, 2015. "Komatsu and GE team up with 'big data' technology," by Vicki Validakis. Accessed at <https://www.australianmining.com.au/news/komatsu-and-ge-team-up-with-big-data-technology/> on September 20, 2016.
15. The Telegraph, July 12, 2016. "Robots will replace a quarter of business services workers by 2035, says Deloitte." Accessed at <http://www.telegraph.co.uk/business/2016/07/11/robots-will-replace-a-quarter-of-business-services-workers-by-20/> on December 13, 2016.
16. IDC, September 1, 2015. "Robotics, Transparency, and Virtual Reality: The Critical Role of Digital Transformation in Mining." Accessed at <http://www.idc.com/getdoc.jsp?containerId=prAE25879615> on October 25, 2016.
17. Trend Micro, July 13, 2016. "The mining industry is getting rocked by cyber threats." by Christopher Budd. Accessed at <http://blog.trendmicro.com/the-mining-industry-is-getting-rocked-by-cyber-threats/> on September 28, 2016.
18. The Daily Telegraph, February 2, 2016. "Computer hackers target NSW Department of Industry, Resources and Energy mining secrets," by Nick Tabakoff. Accessed at <http://www.dailymail.com.au/news/nsw/computer-hackers-target-nsw-department-of-industry-resources-and-energy-mining-secrets/news-story/8a567dfccab45543abc70596427097a4> on September 28, 2016.
19. Symantec. "2016 Internet Security Threat Report." Accessed at <https://www.symantec.com/security-center/threat-report> on September 28, 2016.
20. South Africa Department of Planning, Monitoring and Evaluation. "Operation Phakisa." Accessed at <http://www.operationphakisa.gov.za/Pages/Home.aspx> on September 27, 2016.
21. Sweet Crude Reports, February 28, 2016. "Nigeria sees emerging vision to resuscitate mining sector," by Oscarline Onwuemenyi. Accessed at <http://sweetcrudereports.com/2016/02/28/nigeria-sees-emerging-vision-to-resuscitate-mining-sector/> on September 27, 2016.
22. Mining.com, October 27, 2015. "Ecuador aims to attract \$750M in mining investment next year," by Cecilia Jamasmie. Accessed at <http://www.mining.com/ecuador-aims-to-attract-750m-in-mining-investment-next-year/> on September 27, 2016.
23. Mining.com, September 30, 2015. "Mining protests turn deadly in Peru," by Michael Allan McRae. Accessed at <http://www.mining.com/mining-protests-turn-deadly-in-peru/> on September 22, 2016.
24. BBC News, August 26, 2016. "Bolivia minister killed by protesting miners." Accessed at <http://www.bbc.com/news/world-latin-america-37192790> on September 22, 2016.
25. Sunday Times, September 5, 2016. "Mining boss murder sparks call for probe into possible link to job appointments." Accessed at <http://www.timeslive.co.za/sundaytimes/business/2016/09/05/Mining-boss-murder-sparks-call-for-probe-into-possible-link-to-job-appointments> on November 1, 2016.
26. The Guardian, May 16, 2016. "Break Free' fossil fuel protests deemed 'largest ever' global disobedience," by Oliver Milman. Accessed at <https://www.theguardian.com/environment/2016/may/16/break-free-protest-fossil-fuel> on September 22, 2016.
27. Carbon Disclosure Project, April 2016. "Carbon pricing pathways." Accessed at <http://www.greenvisionpolicy.org/wp-content/uploads/2016/07/carbon-pricing-pathways-narrative-april-2016-update.pdf> on October 26, 2016.

28. Canadian Institute of Mining, Metallurgy and Petroleum, Aug/ Sep 2015. "Are trucks the right tool for the job?" by Chris Balcom. Accessed at <https://www.cim.org/en/Publications-and-Technical-Resources/Publications/CIM-Magazine/2015/August/upfront/Are-trucks-the-right-tool-for-the-job.aspx> on September 22, 2016.
29. International Council on Mining & Metals, May 2012. "Water management in mining." Accessed at <http://www.icmm.com/publications/pdfs/3660.pdf> on September 22, 2016.
30. [www.belleuemine.com](http://www.belleuemine.com)
31. YouTube, January 19, 2012. "Wheal Jane restoration." Accessed at <https://www.youtube.com/watch?v=BUwl5nMPt4g> on September 22, 2016.
32. Teck, June 23, 2015. "SunMine Solar Farm Project at Sullivan Site." Accessed at <http://www.teck.com/news/stories/2015/sunmine-solar-farm-project-at-the-sullivan-site> on September 22, 2016.
33. Goldcorp, March 9, 2016. "Goldcorp Announces Senior Management Changes." Accessed at <http://www.goldcorp.com/English/Investor-Resources/News/News-Details/2016/Goldcorp-Announces-Senior-Management-Changes/default.aspx> on September 13, 2016.
34. Goldcorp, March 9, 2016. "Goldcorp Announces Senior Management Changes." Accessed at <http://www.goldcorp.com/English/Investor-Resources/News/News-Details/2016/Goldcorp-Announces-Senior-Management-Changes/default.aspx> on September 13, 2016.
35. Bain & Company, December 10, 2014. "Winning Operating Models That Convert Strategy to Results," by Marcia Blenko, Eric Garton and Ludovica Mottura. Accessed at <http://www.bain.com/publications/articles/winning-operating-models-that-convert-strategy-to-results.aspx> on November 3, 2016.
36. World Economic Forum, August 3, 2016. "Why workplace anxiety costs us more than you think," by Emma Luxton. Accessed at <https://www.weforum.org/agenda/2016/08/workplace-anxiety-costs-more-than-you-think/> on October 31, 2016.
37. Western Australia Legislative Assembly, June 2015. "The impact of FIFO work practices on mental health." Accessed at [http://www.parliament.wa.gov.au/Parliament/commit.nsf/2E970A7A4934026448257E67002BF9D1/\\$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf](http://www.parliament.wa.gov.au/Parliament/commit.nsf/2E970A7A4934026448257E67002BF9D1/$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf) on September 26, 2016.
38. Australian Mining, July 29, 2016. "R U OK? campaign tackles FIFO worker mental health support" by Sharon Masige. Accessed at <https://www.australianmining.com.au/news/r-u-ok-campaign-tackles-fifo-worker-mental-health-support/> on September 26, 2016.
39. Korn Ferry Institute, February 24, 2016. "Inequality In The Workplace: The Conversation That Won't End." Accessed at <http://www.kornferry.com/institute/inequality-in-the-workplace-the-conversation-that-wont-end?all-topics> on October 31, 2016.
40. Mining.com, May 22, 2015. "Can the mining industry diversify itself?" by Carol Turcotte, Dentons LLP. Accessed at <http://www.mining.com/web/can-the-mining-industry-diversify-itself/> on October 31, 2016.
41. Minerals Council of Australia, 2015. "Blueprint for mental health and wellbeing." Accessed at [http://www.minerals.org.au/file\\_upload/files/publications/MCA\\_Mental\\_Health\\_Blueprint\\_FINAL.PDF](http://www.minerals.org.au/file_upload/files/publications/MCA_Mental_Health_Blueprint_FINAL.PDF) on September 26, 2016.
42. Beyond blue, May 13, 2015. "beyond blue visits the Pilbara to support mine workers and communities." Accessed at <https://www.beyondblue.org.au/media/media-releases/media-releases/beyondblue-visits-the-pilbara-to-support-mine-workers-and-communities> on September 26, 2016.
43. The Globe and Mail, March 9, 2015. "Mining's untapped resource," by Jacqueline Nelson. Accessed at <http://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/minings-untapped-resource-goldcorp-wants-more-women-in-its-work-force/article23352076/> on September 26, 2016.
44. Western Australia Legislative Assembly, June 2015. "The impact of FIFO work practices on mental health." Accessed at [http://www.parliament.wa.gov.au/Parliament/commit.nsf/2E970A7A4934026448257E67002BF9D1/\\$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf](http://www.parliament.wa.gov.au/Parliament/commit.nsf/2E970A7A4934026448257E67002BF9D1/$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf) on September 26, 2016.
45. Norton Rose Fulbright, February 2011. "The Dodd-Frank Act: Key considerations for natural resource and mining companies." Accessed at <http://www.nortonrosefulbright.com/knowledge/publications/34971/the-dodd-frank-act-key-considerations-for-natural-resource-and-mining-companies> on September 29, 2016.
46. McCarthy Tetra, March 28, 2016. "Publish What You Pay Alert," by John Boscariol, Robert Glasgow and Roya Baryole. Accessed at [http://www.mccarthy.ca/article\\_detail.aspx?id=7239](http://www.mccarthy.ca/article_detail.aspx?id=7239) on September 29, 2016.
47. The Extractive Industries Transparency Initiative, 2016. [www.eiti.org](http://www.eiti.org)
48. European Commission, June 12, 2013. "New disclosure requirements for the extractive industry and loggers of primary forests in the Accounting (and Transparency) Directives." Accessed at [http://ec.europa.eu/rapid/press-release\\_MEMO-13-541\\_en.htm](http://ec.europa.eu/rapid/press-release_MEMO-13-541_en.htm) on September 29, 2016.
49. OECD. "Base erosion and profit sharing." Accessed at <http://www.oecd.org/tax/beps/> on September 29, 2016.

## Notes





[www.deloitte.com/mining](http://www.deloitte.com/mining)

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. Please see [www.deloitte.com/about](http://www.deloitte.com/about) for a more detailed description of DTTL and its member firms.

Deloitte provides audit, consulting, financial advisory, risk management, tax and related services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries and territories, Deloitte brings world-class capabilities and high-quality service to clients, delivering the insights they need to address their most complex business challenges. Deloitte's more than 220,000 professionals are committed to making an impact that matters.

This communication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or their related entities (collectively, the "Deloitte network") is, by means of this communication, rendering professional advice or services. No entity in the Deloitte network shall be responsible for any loss whatsoever sustained by any person who relies on this communication.