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Tracking the trends 2022

Redefining mining

Deloitte's Global Energy, Resources & Industrials specialists provide comprehensive, integrated solutions to all segments of the Oil, Gas & Chemicals, Power & Utilities, Mining & Metals, and Industrial Products & Construction sectors by offering clients deep industry knowledge and a global network.

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Introduction

Redefining mining

What will successful mining and metals companies look like in a low-carbon, low-waste, purpose-driven future?

The beauty of this question is that there is no definitive answer. While the core objective of the mining industry remains unchanged going forward: to extract and provide metals and minerals to downstream sectors, many of the factors that have influenced how mining companies should look, feel, and act in the past, have shifted in recent years.

The way in which companies fulfil this mission is now open to interpretation. And today, there is a rare opportunity for leaders to reorganize, generate new value, and forge partnerships to create a more responsible and attractive future for the industry.

While some early movers saw the need for change coming 10, 15, even 20 years ago and have been redefining their organizations and operations accordingly, for many firms, the necessity for fundamental change only really hit home in 2020-21. The convergence of factors including the ongoing effects of the COVID-19 pandemic on the world of work, continued drive towards digitization, the growing need to integrate ESG commitments with central business functions, and the need to pivot in response to fast-moving business and operating environments, has opened many choices for companies.

Of course, the biggest underlying driver and opportunity for transformation lies in the green energy transition. The 2021 United Nations Climate Change Conference (COP26) held in Glasgow in November, highlighted the mining industry's integral role in supplying the metals and materials critical for a low-carbon future¹. The way in which mining companies position themselves today in preparation for this change, will determine their sustainability, and could make or break their competitive advantage over the next decade.

Change on this scale is undoubtedly daunting, which is why in this, its 14th year, Tracking the trends has focused on effecting transformation. The following 10 trends provide a toolkit to help mining companies start thinking through, and moving towards, their vision of future success.

In them, our global team of experts share insights and case studies designed to get ideas flowing. We explore how to evolve traditional mining and metals businesses through new business models, capital allocation, agile work practices, and data-driven technologies to create organizations fit for the 21st century; ones that can not only survive but profit from whatever the future might throw at them and leave a positive social impact in their wake.

The next decade will be one of the most exciting and transformative in the mining industry's history. We look forward to discussing the trends with you and supporting your company on its journey. Thank you for your ongoing support.

Endnote:

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Trend 1

Aligning capital allocation to ESG

Creating an advantaged portfolio with an ESG lens

Andrew Swart, Global Mining & Metals Leader, Deloitte Touche Tohmatsu Limited
Andrew Lane, Energy, Resources & Industrials Leader, Deloitte Africa

The race to cut Scope 1, 2 and 3 emissions in mining has well and truly begun. Over the past five years, several miners have set themselves ambitious decarbonization targets. For them, the challenge now lies in determining the best way to move from intent to reality.

The approach that organizations use to prioritize and operationalize different projects and allocate capital spend across their assets could make or break their competitive advantage over the next decade. Many are, understandably, proceeding with caution.

While the global majors weigh up their next move, the mid-market is playing catch-up. Many mid-market players are only now laying out their net-zero targets and planning the steps these will require both in the short and long term. Their journeys will need to be faster than those of their predecessors in order to keep pace with fast-moving expectations around environmental, social, and governance (ESG) from stakeholders and markets.

While much of the focus today is on climate change and decarbonization, companies will increasingly need to think holistically and ensure their capital-allocation decisions reflect their ESG commitments. Building a portfolio of businesses, initiatives, and projects that are collectively strategically sound, value-creating, resilient, and sustainable will minimize risk in the face of significant future uncertainty and boost the aggregate value of a company's holdings over time.

Use an ESG lens for smart capital allocation

There are numerous frameworks designed to help executive management teams build and sustain an optimal corporate portfolio. The Sustainably Advantaged Portfolio framework¹ is simple, yet effective. Creating an advantaged sustainable portfolio involves a range of initiatives spanning four broad categories of investments detailed in figure 1:

1. Investments that help create a **strategically sound** portfolio that is competitively positioned, has the right balance of innovation, and leverages synergies within the portfolio.
2. Investments that **create value** through maximizing intrinsic value, address any gap with respect to market value, and establish whether the company is in fact the right owner for an asset in the long term.
3. Investments that make the organization more **resilient** by balancing feasibility and risk, building optionality and ensuring the organization's survival through different scenarios.
4. Investments that make the organization more **sustainable** through creating social, environmental, and economic value.

"The aim is to build a portfolio of assets which not only provide a financial return, but consider a broader set of dimensions," says Andrew Swart—Global Mining & Metals Leader, Deloitte Touche Tohmatsu Limited. "The portfolio approach is important, because not all investment opportunities are going to deliver all types of value. Each asset or project will play a different role to create a balance that informs effective capital allocation."

As companies move beyond pure reporting of metrics to making ESG an integral part of their strategies, a key differentiator will be the narrative they build for investors around their portfolio and how they are positioning their assets for the long term. With time, we could see the emergence of different portfolio themes, some of which are explored below.

Figure 1: Sustainable advantaged portfolio attributes

An ideal portfolio evaluation framework will consist of multiple tests that assess the four main qualities of a sustainably advantaged portfolio.



Source: Monitor Deloitte *Creating a Sustainably Advantaged Portfolio, 2021*

Theme 1: The economic decarbonization portfolio

Today, many energy-management related projects have clear economic returns thanks to the advancement of technology, scale effects of production, and investments made in research and development (R&D) by equipment manufacturers and the industry itself.

With energy accounting for approximately 25-30% of direct operating costs,² companies could prioritize this lever (primarily focused on Scope 1 and 2 emissions) to enhance their asset competitiveness and free up cash flow. Some firms may also invest small amounts in longer-term innovation initiatives to secure a lower long-term energy footprint.

Through the lens of mergers and acquisitions, companies may prioritize assets in geographies where renewable energy forms a significant portion of the baseload, or alternatively invest in their own renewable power capacity. These will all be key to creating a competitive advantage, as well as driving value creation.

These portfolios and investments will also need to be resilient across a range of commodity and carbon price regimes and regulatory changes. For example, today we see legislation being considered in Mexico that could potentially limit self-generation of power.³ These types of scenarios would need to be contemplated.

Finally, on the ESG side, companies might prioritize initiatives that address compliance requirements set out by local authorities and metrics that are required by traditional investors.

Theme 2: The value beyond compliance portfolio

Under this theme, some companies may push the boundaries beyond an immediate focus on energy, making investments to rethink greenfield projects and create fully electric mines with a step-change in emissions and performance. Others might look not just at projects which meet traditional return-on-investment (ROI) metrics but perhaps those with lower metrics which help the company toward its wider net-zero commitments.

This portfolio might also contemplate a different asset mix, reducing exposure to commodities that are overweight in carbon emissions on a per-ton basis. It would look at the portfolio through the lens of a potential ESG investor and consider what they might want to include in an index.

Andrew Lane—Energy, Resources & Industrials leader, Deloitte Africa, explains, “Beyond energy, it’s likely that some companies will ramp up their community and stakeholder investments. Often, these struggle for equitable assessment through traditional capital-allocation metrics, but some companies are developing methods to quantify these investments, particularly if they help de-risk assets and create deeper buy-in from communities.”

These portfolios might also look beyond cost savings and contemplate investments that build greater climate-change resilience. These could include mechanisms to address the impact of drought or flooding in different regions, or those that look at disruption of supply-chain and logistics routes as a result of climate change.

In essence, a portfolio like this would go beyond compliance requirements to create a deeper connection with stakeholders and position the organization for the future.

Theme 3: The disruptive sustainable portfolio

Under this theme, mining companies may take the opportunity to rethink how demand for green and critical minerals could generate a competitive advantage going forward. In this instance, companies could diversify parts of their portfolio to include these commodities, as Australian miner South32 recently did with copper. In October 2021, the company announced that it would spend US\$2.05 billion to purchase a 45% stake in the Sierra Gorda mine in northern Chile from Sumitomo Metal Mining Co.⁴

There is also the potential for scrutiny of Scope 3 emissions to disrupt the value chain, generating new alliances, vertical integration, and greater transparency both up and downstream. Examples include the US\$10 million investment made by Rio Tinto with China Baowu Steel in December 2020 to establish a Low Carbon Raw Materials Preparation R&D Centre which will develop low-carbon ore preparation processes.⁵

Companies could also increase their focus on the circular economy and opportunities around urban farming to retrieve minerals through recycling. For example, Swedish miner Boliden is also one of Europe's largest recyclers of used lead-acid batteries and electronic waste. The company opened a new SEK750 million (approximately US\$83 million) leaching plant at its Rönnskär facility in September 2021 to boost the recovery of lead, copper and zinc from residual material and cut the amount of waste it deposits underground by 80%.⁶ Investments such as these reflect a growing belief that traditional mining models might need to evolve in the long term.

Under this theme, companies would focus on evolution of ESG expectations, the potential for non-traditional players to enter the value chain, or the speed at which technologies such as hydrogen, carbon capture and storage (CCS) and robotics might achieve widespread adoption. All of these changes would also need to be examined from the point of view of sustainability, while also evaluating collaborative models, new ways to create social value, and rebuilding trust.

None of these portfolio themes are mutually exclusive, and we have purposefully pulled them apart to create a contrast. In reality, a final portfolio will have a mix of these elements depending on the longer-term vision of organizations and their inherent risk appetite.

The message is that companies need to factor ESG more explicitly into their capital-allocation frameworks and use that to define the contours of their portfolios today and in the future.

Create your own Sustainably Advantaged Portfolio

- **Build a company focused on purpose:** Most mining companies have visions and missions, but very few have looked beyond these to an underlying purpose that resonates with communities, employees and other stakeholders.
- **Consider investor-base evolution:** The recognition of mining as a key part of the energy transition will, in time, bring new investors into the market, particularly for those companies with strong sustainable track records. Think about how that investor base could potentially evolve.
- **Develop plausible scenarios:** When setting a decarbonization strategy, don't fall into the trap of focusing only on immediate returns. An investment that commands a small portion of an overall capital-allocation portfolio today could generate significant dividends 10 years down the line and, therefore, is strategically important today.
- **Think outside of the sustainability box:** ESG or decarbonization decisions can add value to any of the four categories from the Sustainably Advantaged Portfolio framework; they are not purely sustainability investments. Many miners are using them to create new business models, while also driving down their cost curves and mitigating energy risk. Think strategically, and don't limit thinking by only considering historically successful business models.

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Trend 2

Reshaping traditional value chains

Laying the foundations for a low-carbon future

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As the green-energy transition gets underway, calls for greater responsibility and transparency in metals supply are reshaping value chains, realigning portfolios, and spurring new business models. While the changing needs of consumers, suppliers, and investors are partly responsible for this disruption, a projected shortfall in supply for green and critical minerals is also at play.

Collectively, the industry must demonstrate that it's responsible enough to produce the vast quantity of metals required for a low-carbon future. The challenge lies in using the climate-change commitments that organizations have made, and the commodities or services they provide, to tell the story of growing, profitable, and sustainable enterprises that are contributing to societal and environmental needs in a positive manner.

For some companies, this might mean a portfolio restructure – perhaps selling off certain assets and reinvesting the returns into existing assets or critical minerals ventures – or refocusing the businesses they have to deliver better value, or even balancing them with new businesses that offer different types of value.

Going forward, mining and metals companies should also think about the impact of their operations and products across the value chain, and how that will change with the transition from linear to circular pathways. Successfully incorporating circular initiatives like metals reprocessing, recycling or urban mining into their portfolios may require mining companies to build new capabilities and skills that differ from their current business models. A key question will be how much value investors attribute to that change.

We see traditional value chains being reshaped in some interesting ways, including how portfolios are restructured, the types of new alliances being struck, new entrants coming into the value chain, and new circular business models that are being created.

Realigning portfolios

Under pressure from investors to exit high-carbon commodities, mining companies continue to review their portfolios, carving out commodities such as oil, thermal coal, and metallurgical coal assets. This will have the net effect of repositioning these corporate portfolios.

Andrew Lane—Energy, Resources & Industrials Leader, Deloitte Africa explains, “Take BHP as an example; the company is divesting its oil and gas business and realigning as a mining major focused on the energy transition.¹ I can see more mining companies heading in this direction in the future. We’re also starting to see spill-over between the mining and energy sectors. For example, some of our oil and gas clients are providing decarbonization solutions into mining.”

While public companies shed some of their assets, the underlying demand for many of these commodities will remain for some time. For example, while new hydrogen technology is being developed to displace metallurgical coal in steel production, it may be prohibitively expensive without large government incentives to convert the majority of blast furnaces to hydrogen. In the interim, private capital and family office money will continue flowing into higher-carbon assets, although this may not lead to the desired outcome of a greener economy.

Demand for critical minerals, particularly rare-earth elements, is also driving some miners to add commodities to their portfolios. For instance, Rio Tinto has recently added scandium² and tellurium³ to its portfolio. We should expect to see further moves in this direction as public mining companies realign themselves with the transition to green energy.

New alliances

Scope 3 emissions reporting will also inform a key set of choices for mining companies in terms of who their customers and suppliers are. While companies may not forward-integrate in the value chain, they are likely to create more strategic alliances to lower the value chain's overall carbon footprint.

The agreement struck between BHP and South Korea's POSCO⁴ in October 2021 to jointly develop steel-decarbonization technologies is a good example. The memorandum of understanding (MoU) follows BHP's earlier agreements with China Baowu Steel, JFE Steel and HBIS Group to explore emissions reduction from steelmaking. Combined, the output of these four steel companies equates to around 12% of reported global production.⁵

John O'Brien—Partner, Financial Advisory, Deloitte Australia, adds, "The alliances and partnerships that mining companies strike now with specialist re-processors are what will set them apart in the future. For tier one miners, the challenge will lie in redefining how they partner with customers and suppliers to achieve different outcomes to those of today."

Another parallel seen between mining and energy in recent years is a tilt toward the customer; as interest in metals provenance grows, there is an opportunity to move from a push to a pull supply mentality. Placing greater focus on the needs of the customer could help mining companies achieve a premium for responsibly-produced metals which, if reinvested correctly, will help to further decarbonize mining operations and accelerate value-chain transformation.

More likely in the short term is a drive by downstream companies, such as automakers, to lock-up supply of minerals required for the energy transition—again, either buying into the base resource itself or creating strategic alliances across the value chain. An example is the recent agreement between Tesla and Prony Resources⁶ to secure a multi-year nickel-supply agreement for electric-vehicle battery production.

New entrants into the mining value chain

The drive for green and critical minerals is also attracting companies from outside the traditional mining environment. Lithium is key in powering electric batteries, and this appeals to companies like Albemarle, a specialty chemicals producer, which has focused on Lithium production for many years and more recently acquired a 60% stake in the Wodgina lithium mine in 2019,⁷ and American Battery Technology Company that is creating an extraction and recycling business based around lithium.⁸

In other commodities, we have seen new players. For example, technology company Jetti Resources is extracting copper from low-grade primary sulfides. This has drawn the interest of miners such as BHP and Freeport McMoRan, who have invested in the company.⁹

These plays represent new entrants into the traditional 'explore– extract–process' value chain of mining, and it's likely that more companies will enter the market to support the energy transition.

Moving beyond commodities

While new entrants look to explore opportunities in the traditional value chain, some existing miners are keen to invest in new businesses and sources of growth. For example, Fortescue Metals Group has created a new business called Fortescue Future Industries which will supply renewable energy, green hydrogen, and green ammonia for Fortescue operations—all central levers to its own decarbonization journey. The company has also announced a green hydrogen investment of up to US\$8.4 billion into Argentina.¹⁰

But mining companies also have their eye on the circular economy. According to the World Business Council for Sustainable Development,¹¹ the circular economy represents a US\$4.5 trillion opportunity for global economic growth by 2030. Many mining companies already undertake a certain level of mineral and/or metal processing within their operations. Extending that interest to reprocessing will allow organizations to become less dependent upon the primary extraction of finite resources and to redefine their corporate purpose.

For example, Glencore has recycled more than one million tons of electronic scrap since the 1990s, and announced in October 2021 that it is looking to build an electronics-recycling business in the UK¹². This form of ‘urban farming’ uses significantly less energy than mining and smelting primary metal—around 80-90% less for copper¹³—and addresses a key shortfall in the supply of certain critical minerals.

In short, the focus on ESG and the opportunity around the circular economy is reshaping the traditional mining value chain and business models in new and interesting ways.

Future bites

Through partnering with adjacent industries, mining companies could accelerate value-chain decarbonization while stimulating the markets. For example, in June 2021, Rio Tinto and Schneider Electric signed a memorandum of understanding to develop a circular and sustainable market ecosystem for themselves and their customers.¹⁴ The partnership will see Schneider Electric use responsibly sourced materials produced by Rio Tinto, and Rio Tinto will use energy and industrial services from Schneider Electric, as both cooperate to develop digital platforms, technologies, and solutions to drive decarbonization.

Reimagining mining value chains

- **Position your portfolio:** The composition of a company's portfolio is one of the strongest indicators to the investment community around the positioning of the firm. Miners could use the Sustainably Advantaged Portfolio framework detailed in Trend one to explore synergies and value-creating opportunities based on their current portfolio and future investments, particularly those surrounding environmental, social governance (ESG).
- **Look for loops:** Explore opportunities to build circular loops into current production processes and design out waste. In certain instances, tailings can provide a source of residual metals and minerals ripe for secondary prospectivity. Characterization of both fresh and historical mine wastes will enable potential new streams of revenue to be identified and reprocessing options evaluated. Approaches like this could provide a powerful narrative to the market.
- **Collaborate for circular products:** According to the Global e-waste Statistics Partnership, 53.6Mt of e-waste was generated globally in 2019, but only 17.4% was properly recycled.¹⁵ Part of the issue is that recycling processes are often developed retrospective of materials, and, therefore, are either sub-optimal or large quantities of waste material have accumulated by the time they come into play. Mining companies should consider partnering with customers and others in their value chain to improve recycling processes for future materials. Collaborating to develop new products and materials that could replace metals in instances where supply might fall short could also reduce the risk of disruption. We should acknowledge that these businesses would often require new capability sets relative to what miners have today.

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Trend 3

Operating in the new super-cycle

Navigating the post-COVID regulatory and tax environment

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For the mining and metals industry, 2021 was defined by soaring commodity prices and the prospect of a new supercycle.

By June 2021, metal prices had risen 72% relative to their pre-pandemic levels,¹ with many, such as aluminum, copper, iron ore and nickel, going on to reach multi-year highs in Q3.² Sustained demand for critical metals fueled by the transition to green energy caused a number of analysts to declare the start of a new supercycle—a period where commodity prices rise above their long-term trend for between 10 and 35 years.³

This is good news for miners, although it is not without its challenges. With cyclical highs come government demands for a greater share of mineral wealth.⁴ As many countries began to recover from recession following COVID-19, the mining industry saw a raft of regulatory measures proposed and imposed for the period from 2020 to 2021, as well as various forms of resource nationalism.

The rise of resource nationalism

Resource nationalism can take many forms—some obvious, others more subtle. Traditional measures range from the expropriation and nationalization of strategic assets to states interjecting in operations by reviewing pre-agreed terms and implementing new forms of taxation.⁵

The direct expropriation of the Kumtor gold mine in Kyrgyzstan from Canada-based Centerra Gold⁶ demonstrates how these types of measures can create significant operational risk, as well as financial difficulties. In September 2021, Centerra applied for urgent interim measures in its international arbitration against the government of the Kyrgyz Republic and shareholder Kyrgyzaltyn JSC, citing deviation from the approved mine plan in ways that could cause “irreversible damage”.⁷

According to Verisk Maplecroft’s 2021 Political Risk Outlook,⁸ 34 countries, including key copper producers, such as Zambia and the Democratic Republic of Congo, witnessed a significant increase in risk during 2020 due to resource nationalism.

The firm expects this threat to grow over the next 12 months, with the mining industry bearing the brunt of new measures as governments attempt to recuperate financial losses inflicted by the pandemic.

Roman Webber—Mining & Metals Leader, Deloitte North South Europe: UK, explains, “In the past, resource nationalism has mainly taken the form of direct or indirect expropriation of assets. This time, we’re seeing more sophisticated methods, and mineral taxation is one way that host governments are looking to exert more control or gain better returns on their resources.”

He continues: “In many cases, the mining sector will be a key source of tax revenues for countries going forward. So, it’s unsurprising that we’ve seen local governments, for example, Chile and Peru are looking to increase tax on these companies specifically.”

In Chile, under a proposed bill, investors could face a tax burden of 82% in royalties and taxes on sales exceeding 12,000 tons annually of copper and 50,000 tons per year of lithium, up from 40.3%.⁹ Beyond changing tax regimes, we are also seeing other forms of state intervention, such as that currently being debated in Mexico. There, the government is considering legislation that would limit private participation in lithium production¹⁰ but could also be extended into other minerals key to the energy transition. Many of these issues are being driven by concerns around security of supply.

Decisions like these are often driven by politics rather than economics, and the danger is that, if the proposed rates of taxation are too high, or if legislation limits wider industry participation, then they could potentially be counter-productive, lower long-term competitiveness, and limit mining activity in that region or country.

Valeria Vazquez—Mining & Metals, Deloitte Mexico, adds, “Fiscal measures enforced without proper industry consultation could also impact mergers and acquisitions; one of the consequences of elevated risk ratings is that investors will lean toward safer jurisdictions which carry less risk of disruption.”

Future tax reforms

An additional challenge is that the international tax system is currently under reform. The OECD estimates that domestic tax-base erosion and profit shifting (BEPS) practices cost countries across the globe US\$100-240 billion in lost revenue each year (the equivalent to 4-10% of global corporate income-tax revenue).¹¹ Developing countries which often have a higher reliance on corporate income tax are disproportionately affected by this.

In October 2021, using the OECD/G20 Inclusive Framework on BEPS, 136 countries and jurisdictions agreed to implement a two-pillar plan to tackle tax avoidance, improve the coherence of international tax rules, ensure a more transparent tax environment, and address the tax challenges arising from the digitalization of the economy. The new minimum corporate tax rate of 15% applied to companies with revenue above EUR750 million (approximately US\$873 million) is expected to generate around US\$150 billion in additional global tax revenues annually.¹²

Countries are aiming to sign a multilateral convention during 2022, with effective implementation in 2023,¹³ and mining companies must be ready for this.

As key players in the green-energy transition, mining and metals organizations must also have one eye on carbon taxes which could increase as countries look to incentivize decarbonization. For example, the South African Carbon Tax, which was introduced in 2019,¹⁴ has proven weighty on mining companies. The first phase only applies to Scope 1 emitters, but the second phase, which is currently under review and will be implemented in 2023, will be more expansive and could include changes to rates and tax-free thresholds.¹⁵

Vazquez adds: "I think we'll see more of these types of measures introduced as the energy transition accelerates. There will be unpredictable and substantial changes in mineral taxation and/or regulation of assets over the next decade, and mining and metals companies will need to prepare for and adapt to these as best they can."

Future bites

Resource nationalism is borne out of a desire to protect a country's resources through ownership and tax revenues. New models based around circularity could potentially help to overcome this issue.

For example, if a state or nation owns metals as they move through the value chain, and mining and metals companies extract, process, and trade them as a service, then that could help to ease ownership concerns for governments and allow mining companies to be more agile.

It could also lead to greater governance surrounding metal circularity, because the state would be responsible for and incentivized (through royalties or returns) to ensure metals are recycled each time a product comes to the end of its life.

Building flexibility and resilience in the face of regulatory uncertainty

- **Seek partnerships and consultation with authorities:** Many organizations' current relationship with governments and tax authorities is dictated by past experience, whether good or bad. Some companies actively seek to create an open and engaging dialogue with authorities while, for others, a lack of trust is the defining factor in the relationship. Neither approach is right or wrong but, as in so many matters, it is best to have a seat at the table, if not a voice, wherever possible.

Being part of the consultation process for potential tax reforms brings a level of predictability that will be useful in future strategy development. Greater transparency around tax planning and through public disclosure will also help to build trust where it is lacking.

- **Demonstrate value beyond tax:** Companies should lean on their environmental, social, and governance (ESG) efforts to better explain their value to governments, not just through economic returns but also through environmental and social-impact initiatives.
- **Increase organizational agility:** Even when operating in jurisdictions that have relatively stable fiscal regimes, mining and metals companies need to factor a certain level of flexibility into their strategies so that they can adapt to and take advantage of changes in the political and economic environment.
- **Embed the use of scenarios in strategic planning:** Use long-range scenario planning tools to consider different regulatory regimes in geographies in which you operate and plan for possible responses.
- **Diversify portfolios and supply chains:** Aim to spread investments across jurisdictions with a range of risk ratings to reduce overall exposure to risk.

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Trend 4

Embedding ESG into organizations

Creating operating models to support ESG commitments

Henry Stoch, Sustainability Leader, Deloitte Canada

Harsha Desai, Associate Director, Consulting, Deloitte Africa

Pressure on mining and metals companies is growing to reach beyond environmental compliance and make high-level commitments in the public domain around environmental, social, and governance (ESG) issues that are shaping the future of the industry.

Although commitments to voluntary targets and standards around matters such as climate change or tailings management are usually set with the best of intentions, without the proper internal structures in place, companies will find it hard to make effective progress toward them. They also run the risk of failing to demonstrate, when asked by investors and ratings agencies, how they are honoring those commitments from the boardroom to the mine site.

Research shows that this issue is fairly pervasive; the Responsible Mining Foundation's RMI Report 2020¹ assessed the policies and practices of 38 large-scale mining companies around the globe. It found that, while most companies mention the United Nations Sustainable Development Goals (SDGs)² in their sustainability reporting, and a few have integrated the SDGs into their business strategies.

Create senior-level accountability in the structure

To move from pledge to action, mining and metals companies must be functionally set up to respond to and deal with ESG-related opportunities, challenges, and risks. At a practical level, this requires an operating model that facilitates visibility, accountability, and collaboration between departments, along with a clear governance structure.

A decade ago, the sustainability, or corporate social responsibility, agenda was overseen by a leader of sustainability, either at the executive level or reporting into another senior decision-maker. However, with the rise of ESG, the implications are far more cross-cutting, expanding to cover areas such as investor relations, finance, human resources, operations, supply chain, communications, and corporate development. In many

respects, ESG now represents a wider transformation of the business.

Today, many organizations have large teams of people focused on environmental and safety issues, with a chief sustainability officer role (or similar) overseeing them. This is a good start, and will help ensure compliance with environmental-permit regulations. However, to move beyond this, operational teams should be properly connected to corporate strategic initiatives; they should understand that ESG commitments are steadfast, and there should be clarity on how they translate into business or operational processes within their specific function.

We are also seeing different models emerge. Where ESG initiatives are led by the sustainability function, it's important that this function is elevated to have sufficient corporate representation at the executive level, i.e., a vice president or executive vice president of sustainability role might be required in the case of large or multinational companies.

In other cases, we have seen executive roles, such as the chief financial officer (CFO), taking responsibility for the ESG agenda, particularly as they need to face off with investors and market analysts. In many ways, it doesn't matter who leads the effort, as long as integration takes place across the organization and the individual in question has sufficient organizational authority.

Henry Stoch—Sustainability Leader, Deloitte Canada, says, "There's a more sophisticated level of expectation now from external stakeholders, particularly large institutional investors, around ESG. Many are asking very complex questions and are keen to understand how companies are integrating targets around issues such as climate change or diversity, equity and inclusion (DEI) throughout their organizations."

He goes on to explain: “If organizational structures are not yet designed for a high level of collaboration and interaction between certain departments and business units, then companies are going to struggle to demonstrate how these issues form part of their strategic planning, or budgeting and forecasting processes, for instance.”

Design processes for transparent information flow

For ESG commitments to be properly met at the operational level, information must be able to flow freely up and down the organizational structure, rather like through neural pathways. Leaders must be able to look into the business and check that the commitments they have made publicly are being understood and reflected in practices below them.

Likewise, information must also flow back up from operational teams in the form of risk registers, internal audits, operational plans, and capital commitments that show whether teams are on track with the commitment or not. Digital transformation will go some way toward this, making timely, critical information transparent and available on demand.

The danger is that, if companies don't implement and test these structures and processes, and they cannot answer stakeholders' questions or, worse still, if a failure in governance occurs, they could lose an important source of capital or be accused of greenwashing.

The latter isn't just damaging to an individual company's reputation, but to the industry as a whole. Creating accessible engagement structures through which plans and progress can be discussed with key stakeholders can foster a more cohesive and responsive approach.

This is why ESG needs to be incorporated into a broader corporate strategy as well as enterprise risk management (ERM) and performance-management systems. Using past examples of tailings dam or social failures, it's now possible to quantify both the financial and non-financial impacts of not having the appropriate operating model in place. Leading companies are starting to question traditional ERM approaches, and are developing their language and thinking to reflect this.

Embed ESG into roles and incentives

As ESG starts to be reflected in corporate strategy, it should also be reflected in the functional strategies and plans of the organization and within each function's roles. Every function across the organization has a part to play in delivering the overall ESG strategy, whether that is operations, finance, human resources, or any other key corporate role. Harsha Desai, Associate Director, Consulting, Deloitte Africa says: “This is an opportunity to make the day-to-day choices in the business very personal for people, so they are empowered to make many little or large shifts that directly affect their community. Whether this is water consumption at the operations or working with local vocational training institutions to bring more females into the workforce.” With time, these elements will become embedded in role profiles, development plans, and performance systems.

Like many organizational transformations, ESG will require people to change their individual behaviors, and how people are incentivized will be a significant driver of this. Individual and functional incentives should therefore reflect the wider ESG agenda, so that companies can create the required level of accountability.

Designing and testing ESG-driven operating models

- **Factoring ESG into organizational establishment:** For companies that are either just establishing themselves or are reorganizing following an acquisition, it's important to set up the organization in a way that creates clear accountability for external commitments from the outset. In these cases, ESG can be designed into the heart of the business and becomes part of the way the company operates from exploration to mining, to operations and decommissioning.
- **Test structures regularly:** Established organizations that have made bold ESG commitments have begun to put structures and processes in place to support them, and it is crucial that these connections or lines of reporting are tested regularly. Audits are an effective way to do this. Internal or external auditors can assess whether a company is meeting its commitments at every level. A key success factor is then ensuring that the results of the assessment go beyond the mine manager and that information is shared at senior executive levels. This enables change to be effected from the top if shortcomings are identified.
- **Quantify the risk:** Once companies quantify the level of risk associated with social or environmental failures—such as the impact of an ESG re-rating among key investors or the exclusion of a stock in an index—it becomes easier to make the case for capital allocation into ESG-driven organizational restructures, resource allocation and the creation of new roles. The latter will cost much less than the former.
- **Create a transparent and agile ESG culture:** If an audit or risk-management exercise reveals that the organizationa structure is not working as it should—perhaps a key role or communications channel is lacking—then it's important that leaders facilitate positive action based upon it. This is a learning journey for many organizations, and adjustments and changes will need to be made. Being congruent in what is said and what is do will be the most important currency to build credibility.
- **Reevaluate incentives:** Incentives are a powerful behavioral lever within organizations. Companies should re-evaluate current incentive structures and align these with the broader ESG agenda.
- **Define ESG responsibilities across the value chain:** ESG-related expectations and responsibilities need to be written into roles at every level of the organization and at every stage of the value chain. Aligning these responsibilities within functional mandates to ensure that individuals are empowered to make decisions and take action should be considered. Miners must clearly communicate their expectations around key internal and external interfaces, both verbally and in writing, so that there's strong alignment—particularly with regard to supply-chain partners.

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Trend 5

Evolving mining's world of work

Positioning organizations for an increasingly competitive labor market

Janine Nel, Partner, Consulting, Deloitte Canada

Marcello Cordova Alvestegui, Director, Consulting, Deloitte Chile

Like many industries, the mining sector has felt the lasting effects of COVID-19 on the labor market. Over past months, waves of employees have quit their jobs in 'The Great Resignation,'¹ seeking opportunities that better meet their needs and expectations. This has put extra pressure on organizations to ramp up recruitment and retention efforts, re-evaluate their employee value proposition and transform ways of working.

Digitization and remote working have fueled a fundamental shift in the way employees think about work. Facing an increasingly competitive labor market requires mining and metals companies to position themselves as an attractive sector and employer, capable of meeting evolving priorities.

Social purpose, reimagining work, and building an inclusive leadership culture provide an opportunity for miners to secure a strategic and sustainable advantage through human capital. But will companies take up the challenge? For several decades, miners have found themselves starved of talent, but COVID-19, among other issues, has intensified this challenge.

Make work matter

Mining companies will not realize their full human capital potential unless they evolve to meet two social norms: adapting to the green energy transition and maturing diversity, equity, and inclusion (DEI) within the workforce.

The push for decarbonization and renewable-energy sources provides an opportunity for organizations to reinvigorate their purpose and, in doing so, speak to untapped sources of talent. Greater DEI is crucial to breaking down prejudice and discrimination, and unleashing individual and team potential.

Aligning with a low-carbon future and mining's role in the energy transition will help miners to retain employees with valuable and transferrable skill sets needed for these initiatives, and also to attract new recruits who may not have previously considered a career in mining and metals.

The link between digital transformation in addressing the concerns of climate change and creating a more attractive

industry for younger generations is clear. In a 2020 survey from Deloitte Insights, almost 70% of executives who reported that their company had a sustainability strategy in place cited digital technologies as a key enabler.²

Realigning work and technology

In the future of work, human potential is entwined with technology. Rearchitecting work creates sustainable value for organizations by intentionally designing new outcomes focused on optimizing the interconnection of humans and work-related technologies.

Effective rearchitecture requires companies to redefine current outcomes, while looking ahead several years to understand and design for how people could interact with technology and with each other. As they do so, new skills and capabilities will emerge, both at a core technical level (e.g., data interpretation) and at a soft, human level (e.g., collaboration); the development of both skill sets is essential for a sustainable future.

As organizations introduce new technologies, roles are evolving rapidly and new jobs previously unassociated with mining are emerging. It's important to consider which skills and capabilities are needed and how companies could build these capabilities in-house, or outsource them to external partners, including the community—a unique opportunity to change the DEI profile across the value chain.

Firms are also still adapting to remote working, and some are looking to place flexible work arrangements and workforce wellbeing at the core of their strategies going forward.

Janine Nel—Partner, Consulting, Deloitte Canada, says, "We're seeing this with a number of clients. For example, in South America, a major mining company is going through an operating model review. The team is reconsidering the necessity for a physical presence at operations and, potentially, consolidating their regional head office operations."

Building a new leadership culture

As the mining industry settles into a 'new normal,' leaders are faced with mounting pressure to avoid falling back into conventional ways of working. Achieving the transition requires them to craft new business models, challenge conventional definitions of productivity, embed a culture of trust, replace hierarchic management with empowered collaboration, and manage the cultural and engagement issues associated with long-term remote working.

Marcello Cordova Alvestegui, Director, Consulting, Deloitte Chile explains: "Understandably, culture is currently a hot topic, with leadership being at the core of this shift as we move from a traditional command-and-control environment to a more inclusive and collaborative style of leadership."

Today, the goal is to hire and integrate diversity of talent and ideas, including people from underrepresented groups, races, those with disabilities, LGBTQIA+ community members, and new generations. Equity is the new key; companies should no longer focus only on hiring and achieving through KPIs. Boosting DEI within the mining sector will make it more attractive to new recruits and also improve retention.

Companies must build the confidence and environment for diverse individuals to develop to their fullest potential and create programs to instill the capabilities needed for the mining operations of tomorrow. More inclusive environments will help to drive out institutionalized harassment and discrimination, incidences of which still plague even the most progressive of firms.

Working collaboratively, and even in partnership with competitors, to promote DEI within the industry will accelerate the uptake of best practices, and consequently improve mining's appeal to diverse talent relative to other industries.

Future bites

As mines shift toward intelligent and remote operations, new roles are emerging. For example, the operations super team lead. This is the first line leader of operational mining super teams, groups of people and intelligent machines working together. The super-team lead serves as the main link between the physical and remote workplace, and can use technology to plan far in advance, conduct streamlined tasks and administration, make strategic decisions, lead, empower, and support the super teams to achieve their work outcomes.

Sourcing talent for the mining organizations of tomorrow

- **Define purpose:** Putting social purpose at the heart of corporate messaging and recruitment efforts will help miners resonate with younger generations and diverse talent, many of whom have new skill sets vital to the future of mining.
- **Reshape the social impact agenda:** Beyond talent, mining and metals organizations must reconsider their social impact agenda to improve corporate brand and stakeholder buy-in. Studies show the impact this can have on consumer choices, where 87% of respondents said they would buy a product based on the company's stand for a societal issue. This trend is even higher among millennials and zoomers who also look at corporate social purpose when choosing a workplace, with 64% considering a company's social and environmental commitments before employment.³
- **Consider introducing hybrid or permanent virtual/remote work arrangements:** Virtual/remote work has become a hiring and retention appeal and will allow miners to leverage skills in geographies where they previously lacked them. Remote-job postings on LinkedIn increased more than five times between March and December 2021, and 46% of workers are planning to move to a new location in the next year because they can now work remotely.⁴ According to LinkedIn data, since April 2020, internal-mobility hiring has also increased by almost 20% year-on-year,⁵ demonstrating the need to adapt virtual/remote work practices for employee value proposition.
- **Rethink the skills required:** Review the required skills for different roles and consider how recruits could potentially be sourced from other industries. Looking to adjacent industries for talent could provide access to a wider pool of applicants and support culture change and new performance standards within teams.
- **Consider technologies, HR and training requirements that can widen talent pool:** Including reskilling and training programs that can deliver or support workforce needs and broaden new opportunities. Deloitte's Human Capital Trends 2020 survey found that, while 74% of organizations surveyed said that reskilling the workforce is important for their success, only 9% said they are ready to address this issue.⁶
- **Reduce labor barriers for underrepresented groups:** To foster a more diverse workforce, mining companies must lower barriers for under-represented talent, including women, immigrants, and those with disabilities. Indigenous communities account for a valuable and, in many cases, untapped source of talent, not just for blue-collar positions but for management positions too. By creating partnerships with community organizations and schools, mining companies could access this valuable source of local knowledge.
- **Speculate to accumulate:** Mining and metals organizations should actively seek to improve quality of life for marginalized groups in remote communities, for example, by reinvigorating the pursuit of reconciliation with Indigenous people or providing essential services to remote communities. Financial, physical, and social resources provided for citizens will eventually trickle back to organization in the form of human capital.

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Trend 6

Establishing a new paradigm for Indigenous relations

Creating partnerships for progress

Professor Deen Sanders OAM, Lead Partner, Integrity, Deloitte Australia

Joe Hedger, Partner, Indigenous Services Group, Deloitte Australia

Jason Rasevych, Partner, National Indigenous Services Leader, Deloitte Canada

Public interest around Indigenous rights and the types of relationships that corporate organizations forge with traditional landowners continues to grow. Mining companies are now under pressure from multiple angles to rethink their strategies and set the stage for future relationships that offer economic and social prosperity for all.

Today, it's clear that Indigenous communities around the world no longer want to be positioned as stakeholders in transactional-style relationships. They are keen to establish a new type of connection and understanding with all entities that participate in their environment, including mining companies, about responsibility for the landscape.

More than an ESG issue

It is this connection with the land that has seen Indigenous engagement lumped in with mining companies' environmental, social, and governance (ESG) agendas in recent years. While increased collaboration with Indigenous communities offers many opportunities in this respect, it's important to examine how a better underlying relationship could benefit all functions within mining companies, and how ESG strategies could better serve traditional landowners, too.

Issues such as decarbonization and natural-resource management, securing diverse talent, even leadership, are all subsets of how Indigenous peoples can help mining companies better relate to and fulfill their responsibilities as actors within a landscape.

Joe Hedger—Partner, Indigenous Services Group, Deloitte Australia, says, "What we are seeing now is Indigenous people standing up for themselves and wanting to take more agency in shaping the future of their nations. What that means is that the legal, economic and social relationship between Indigenous people and the rest of the nation is going to change dramatically."

Awareness of indigenous rights, particularly in relation to social license, has grown hugely in the past decade. Social license ties into investment, project risk, and the environmental component of project permitting, as well

as regulatory and legislative functions for mining project proposals in many jurisdictions.

Governments keen to sustain industry investment are slowly developing their processes and legislation to reflect the need for greater consultation and ownership by both parties. For example, in Canada, modern treaties are now being negotiated between First Nations and Crown Governments that cover a range of rights for Indigenous people with respect to land, water, and resource development.¹ There are also various legislative acts, both at the federal and provincial level, which incorporate principles from the United Nations Declaration on the Rights of Indigenous People Act.²

Progress through partnerships

Developments like these are positive steps toward a better future and, going forward, there is enormous potential for the mining industry to work collaboratively with Indigenous peoples in different countries to advance their business strategies and goals, particularly around critical mineral deposits. However, before this can happen, a new paradigm for Indigenous involvement in mining must be established. Where injustices have occurred, proper reconciliation must take place, and a new equitable foundation laid for future collaboration; one that is built upon communication, mutual trust, and respect. This will take time and investment, as well as a shift in governance.

Jason Rasevych—Partner, National Indigenous Services Leader, Deloitte Canada, says, "It is time for resource extractive industries to shift away from standard impact benefit agreements and move towards economic and equity partnership models that are focused on developing a long term relationship with Indigenous peoples. The future state of mining depends on corporate and government recognition of First Nations ancestral rights and inherent responsibilities as stewards of the land. We can also look at the many blueprints for success where First Nation rights holders have taken an ownership position in such projects. For example, in Canada, the Keeyask hydroelectric project was developed by Manitoba Hydro in partnership with four Cree Nations communities affected by the project who own 25% of the equity partnership."³

In South Africa's Rustenberg valley, the Bafokeng community has gone one step further. During the 1800s, the group placed some of its land into trusts. This undisputable ownership has enabled it to lease the mineral rights and claim ongoing royalties from platinum miners. These have been reinvested to establish a strong administration, civil service, and infrastructure for the region.⁴

Today, the nation's investments are managed through a wholly-owned investment company, Royal Bafokeng Holdings, which is the majority shareholder and manager of platinum mining and refining company, Royal Bafokeng Platinum.⁵

Cases like these provide tangible examples to governments, industry, investors, and Indigenous people of how a partnership approach could be successfully incorporated into future mining projects.

Push for greater inclusion in standards

Today, the adoption of ESG standards has become a basic requirement for most large companies and investment funds. Globally, ESG assets are on track to exceed US\$50 trillion by 2025, representing more than a third of the projected US\$140.5 trillion in total global assets under management.⁶

While their application should ensure best practice in social endeavors, many leading ESG standards like those established by the Global Reporting Initiative (GRI),⁷ or the Sustainability Accounting Standards Board (SASB),⁸ only contain minor references to Indigenous issues. Professor Deen Sanders OAM—Lead Partner, Integrity, Deloitte Australia, adds, “Currently applied ESG principles undermine the interests and concerns of Indigenous people. Working with Indigenous people on what's best

for the land and communities will help corporates, and the wider economies they operate in, to future proof profitability.”

Miners should consider lobbying for the evolution of these standards in cooperation with traditional landowners so that they better reflect the interests of both parties in a way that promotes and fosters reconciliation.

Aligning strategies and priorities for long-term growth

Most Indigenous communities are not anti-mining, they simply want to see it done in a way that respects their rights, honors their sacred connection to the land, and helps their own projects and communities to flourish.

When planning new projects, mining companies should look for opportunities that align with local communities' own goals and priorities. Where opportunities arise for a community to benefit from mining infrastructure, such as a road, rail line, or energy facility, discussions should happen as far in advance as possible to determine whether they are consistent with the community's aspirations and ensure the development won't compete with other interests.

To make projects truly sustainable, the planning process must incorporate the entire mine life cycle to ensure the site continues to represent value rather than a liability from a local community perspective after extraction finishes.

For this reason, it's important to establish overarching strategic ambitions for both parties from the start, as well as regular communication to ensure calibration on practical issues that are of immediate relevance to both the mining sector and communities who sit on the land.

Laying the foundations for mutual economic and social prosperity

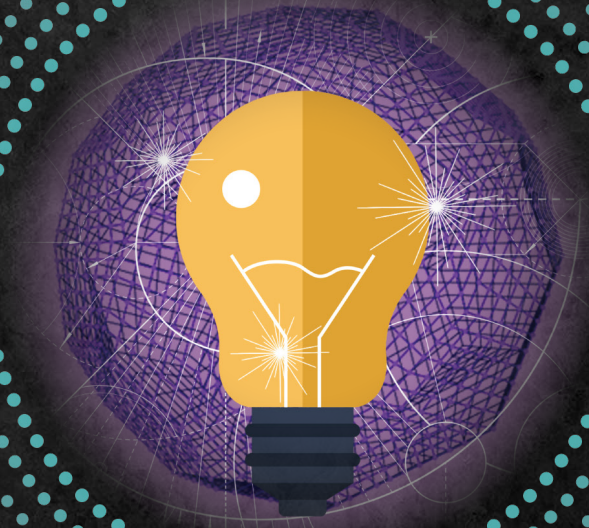
- **Re-examine current ESG frameworks:** Current ESG frameworks have been developed to be easily auditable. While this is helpful from an audit or compliance perspective, it means they often don't adequately capture the importance of meaningful consultation.

To supplement standard metrics, companies could develop their own systems to record qualitative data such as the number and diversity of their Indigenous employees, whether they have Indigenous people on boards or committees, the number of Indigenous businesses that participate in their procurement and supply chains, and financial support or donations provided to Indigenous projects.

- **Develop templates that reduce risk and improve decision-making:** There are examples in Canada where First Nations are leading the permitting or regulatory process for major development projects or are involved with the environmental assessment. There are also examples in multiple jurisdictions where Indigenous communities are raising funds to increase their participation in a project or take ownership of enabling infrastructure. Mining companies should have a vested interest in building these types of relationships and encourage participation, as Indigenous insights could significantly improve the economic and environmental performance of mining projects.
- **Early engagement in a culturally appropriate manner:** Engagement with communities should begin as early on in a project as possible and continue throughout the project lifecycle. The investment required to establish a meaningful two-way dialogue is far less than that required for legal challenges, or to rebuild a relationship after litigation. Reputational costs should also be considered. Information should be provided to communities in a way that is culturally appropriate, and in their Indigenous language so that they can make informed decisions around consent.
- **Diverse governance:** Creating seats for Indigenous representatives on boards and in other positions of power within mining companies will give communities greater confidence in the purpose and direction of mining projects. It will also give them a central role in decision-making processes, including those related to mitigating environmental and social impacts.
- **Understand the need for different relationships and roles in different geographies:** While there is a global awakening underway around Indigenous issues, it is happening in different ways in different countries and regions. While there are some common themes, there is no universal blueprint for how community-mining company relationships and roles should be structured. Mining companies should therefore build flexibility into their planning, and come to discussions willing to listen, learn and act upon their findings.

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Trend 7

Continuing the journey toward innovation-led organizations

Moving to action by embracing the change

Steven Walsh, Mining & Metals Leader, Deloitte Australia

Roland Labuhn, Partner, Consulting, Deloitte Canada

The topic of innovation is no stranger to Tracking the trends. It has long been on mining companies' agendas, but, for most, integrating the process of innovation with core business functions and operations has proven tricky. Fundamentally, this is because, rather than being structured to embrace change and benefit from it, traditional mining companies and processes are designed for stability.

So, why raise it now? A number of factors have recently converged, driving executives to embrace innovation and align their organizations behind it:

1. COVID-19 forced the world to embrace digital and remote work practices, changing the world of business for good.
2. Mining companies will need to innovate within their core processes if they are to decarbonize in line with their goals.
3. It is much easier to fund innovation while commodity prices are high and the industry is benefiting from the supercycle.

Digital transformation—or the shift from mainly separated physical systems and technologies to integrated virtual, data-driven ones—offers huge opportunities in every instance. It provides a means to leverage data for enhanced decision-making, quickly simulate changes to the value chain, and analyze the impact of new technologies and designs in advance of implementation, among many other benefits. It will also open the doors to a new generation of fresh, diverse talent with the vision and cultural expectations required of more agile mining and metals organizations.

Over the years in Tracking the trends we have spoken about putting in place innovation-capability systems, operating in ecosystems, moving toward integrated operations, and addressing different organizational barriers to innovation. We still believe the time is ripe for change, and this year we focus on some of the areas where we continue to see organizations struggle.

Challenging the status quo

It takes visionary leadership, right from the top, to

create an organization that is able to question industry-standard processes, test different ideas, and implement new ones without fear of failure.

Mining project delivery is one area that could benefit significantly from innovation, yet the status quo remains unchanged—cost overruns on construction projects in the energy and resource sector, including mining, typically exceed 30%.¹

Steven Walsh—Mining & Metals Leader, Deloitte Australia, says, “Traditionally, in project delivery, we see designs that were originally created 50 years ago, or more, that have been progressively updated, rather than starting from first principles and innovating. Part of the problem is that, in traditional mining projects, after first ideation and the vision setting phase of a project, almost every process after that is designed to eliminate risk and therefore also eliminates innovation.”

Progressive leadership combined with realistic target setting, use of different models, and better communication between teams offers the opportunity for mining projects to be more efficient and less capital intensive. To achieve this, traditional approval and delivery processes must be challenged and refreshed.

Learning from other industries

There are other asset-intensive industries, particularly those with complex logistics chains, that can offer learnings and inspiration around innovation for mining. For instance, transport and logistics operators often have lower margins than those seen in mining, and have used this as motivation to adopt new innovations that offer greater efficiencies.

There is also much that could be learned from the agile ways of working employed in the technology and financial services industries. For example, in a financial services organization, the last step in an innovation project will often be to deploy software or a new rule or policy—something that can be done at the touch of a button—whereas, in mining, a physical piece of equipment usually needs to be installed.

The innovation emphasis in mining therefore tends to be skewed toward equipment or technologies, and these projects take time. But it's worth remembering that this is only one piece of the puzzle; efficiencies and opportunities can be achieved more rapidly through innovative processes, policies or systems. Again, this emphasizes the need for a holistic approach to innovation initiatives.

Creating a culture of innovation

In an industry that measures its success through delivering to targets, trying something different that might temporarily lower production can be frowned upon. But planning in an acceptable level of risk is key to testing and deploying new solutions. Companies that are good at innovating will have a wide risk tolerance, and will allow for production fluctuations when testing an idea that could prove valuable.

Much of this relates to culture and how success is measured, not just at company level but also at industry level. Unlike in safety, where risk of any kind is unacceptable and, therefore, controls are added and very rarely removed, in mining innovation, there are two types of risk: risk of failure and risk of success—and both are equally valuable.

Because mining companies are more familiar with risk around safety and the industry's measures of success is geared towards higher production, there is a reticence to remove controls that hinder innovation in case something 'goes wrong.'

Roland Labuhn—Partner, Consulting, Deloitte Canada says: "In some ways, this culture is now holding us back, because we can design and develop new innovations, and model them with technology, but at some point they need to be tested in operations. Companies that can plan for minor interruptions and incentivize their teams to both achieve production targets and successfully innovate, will realize greater opportunities to learn and improve ahead of their peers."

Problem-solving around things that occur today should be automatic, and planned well in advance. To really move the dial in innovation and become truly agile, companies should be focusing on solving problems that are three months away or more.

Workforce evolution will also serve to accelerate innovation culture in mining. Companies are already seeing workers come through who are frustrated by the willingness of current generations to adopt new ideas. This will only accelerate as zoomers move through the ranks. Greater innovation will, in turn, increase workforce diversity and boost retention through job satisfaction.

Walsh adds: "I'm a passionate believer that differences in thinking and background are critical to innovation, and anything we can do to make mining more attractive and

inclusive to a broad range of people will result in more innovative ideas. In any conversation about innovation, we should be looking around the room and challenging ourselves on how diverse the thinking really is."

Innovation in action

OZ Minerals' Think & Act Differently, (TAD) virtual incubator is focused on unlocking opportunities to shape a vision of the mine of the future. Over the last year, they have supported innovators from around the world to propose and pursue short experiments that are providing the industry with some early knowledge, around future trends.

The focus of TAD has been on five themes; clean products, energy and emissions, data and technology, scalable and adaptable mining and waste and water. In 2021, TAD ran crowd challenges against each theme to obtain new and divergent thinking. OZ Minerals' General Manager Transformation, Katie Hulmes, explained, "What's clear is that even in areas or subjects we thought we knew a lot about—we're finding many people we were not aware of who are working on potentially breakthrough technologies. They might also have a different way of looking at a problem we have been trying to solve. The team is excited about continuing to work with innovators to complete their challenges and consolidate learnings to understand our gaps and opportunities".

Making innovation a core part of mining businesses

- **Challenge policies and controls that stand in the way of agile principles:** Mining organizations have multiple layers of controls to ensure actions that are dangerous, inefficient, or could negatively impact productivity do not occur. These are important, but, for the purposes of ideation and problem solving, staff should be encouraged to challenge controls and policies that stand in the way of agile principles and ask the question: 'why not?', rather than 'why?'
- **Accept some short-term reductions for longer-term improvements:** In truly innovative companies, there will be times when testing new ideas means sacrificing production, and that's ok. If there is a relentless focus on maximizing the numbers, it discourages the next wave of innovation. Leaders should put systems in place to encourage and reward both short-term performance and longer-term improvement.

When failures happen, teams should be supported to analyze, assess, and document them from a value perspective; a failure is only truly a failure if we do not learn from it.

- **Don't underestimate change management:** To get the full value from a new technology or business offering requires its integration with other systems, technologies, and procedures, and adoption by the workforce. Approximately 30% of the innovation effort could be dedicated to the period after deployment to make sure the change is effective. Innovation processes and budgets should reflect this, and allow for ongoing training for personnel.
- **Take low-hanging fruit:** Success inspires further innovation, and if there are quick, cheap changes that will generate fast returns (even if a technology or system will be replaced in a few years), then consider taking them. Innovation teams also need to be incentivized to hand projects over to operations before moving on to the next, rather than becoming attached or obsessing over perfectionism.
- **Structuring research and development (R&D) teams:** There have been multiple instances where mining companies have invested heavily in establishing R&D teams that are distanced from their operational counterparts, with varying degrees of success. However, this is rarely an optimal approach. Instead, consider embedding innovation functions or roles within operational teams.

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Trend 8

Unlocking value through integrated operations

Using data to drive the long view

Eamonn Treacy, Director, Consulting, Deloitte Canada

Dominic Collins, Energy, Resources & Industrials Leader, Deloitte Chile

Mining and metals companies are on a journey, to drive understanding and efficiencies holistically throughout their organizations. Digital transformation has already contributed to this by providing real-time visibility from mine to market, but many mining companies have failed to see benefits from digitization.

The reason for this is that often too much focus is put on the technology and not enough on how the organization will interface with that technology and use it to drive effective integrated decision-making that optimizes the system versus an individual function.

The next steps in achieving company-wide efficiencies and unlocking value are to use those insights to change how decisions are made at every level. Actions that benefit the organization as a whole, rather than specific departments or functions, will enable companies to become more agile in their response to changes, both in the operational and business environments, and create greater value.

The current heightened focus on environmental, social, and governance (ESG) measures has placed additional pressure on companies to make sure that they're managing not only their operational environment but also social and regulatory challenges. The need to be responsive requires organizations to empower their workforces to make these decisions.

With traditional business structures, this is tricky for two reasons. First, because many roles lack the appropriate authority. For example, even if an operator who is running a process in real time can see that its product is having a negative impact on community sentiment further down the value chain, and it knows how to improve that, in many cases the authority to make that decision still sits three or four levels above within the organization. Second, there is a lack of focus; organizations don't generally include qualitative metrics as part of their operations decision-making.

In both cases, the business structure must be updated to support a decision that would benefit the organization more holistically.

Supporting different decisions

The types of decisions that operators need to make are also changing. Traditional operator-style decisions are usually either/or type decisions. However, when considering how mining organizations relate to local communities, for example, the decisions that need to be made become more ambiguous and complex.

For instance, a company might have four mines operating that feed through a single port. It is important that dust levels at the port are kept under control to avoid negatively affecting surrounding communities.

In a traditional mine environment, operators on site wouldn't think about how the level of dust their product generates adds to aggregate levels at the port; their job only requires them to deliver a certain tonnage at quality. Now, however, organizations are asking frontline workforces to think about the potential impact of their decisions on the downstream value chain and the company's long-term viability.

The challenge lies in not only empowering but also helping operators to make good decisions based on these highly ambiguous and complicated situations, some of which, on the surface, would appear to have nothing to do with their targets.

Eamonn Treacy—Director, Consulting, Deloitte Canada, explains, "The traditional mine value chain includes a number of steps and each of those has a series of metrics that teams need to make to hit performance targets. Sometimes, in the context of the organization, hitting those targets is actually the wrong thing to do, because it creates more waste or risk for the value chain as a whole."

For example, before ore can be dug up and processed, it needs to be drilled and blasted. The drill and blast team wants to reduce costs through minimizing the use of explosives but, by making that improvement in isolation, costs might increase downstream if the material delivered isn't within the engineering specification of the processing plant. While a 5% cost saving might look like success to the drill and blast team, in reality the total cost to produce one unit of material might have increased by 8%.

In these cases, companies need to harness digital insights to shift their focus and that of their frontline operators from delivering against performance targets to delivering the best possible outcome for the organization, even if it goes against KPIs that a function has been set.

Clarifying roles and responsibilities

One way to do this is through implementing more structured rights and responsibilities. For example, traditionally, a general manager (GM) is accountable for all onsite decisions; because they are on the ground, they carry the responsibility from a regulatory perspective. What this creates is a situation where the GM is expected to handle anything and everything from short-term production targets to safety, costs, and long-term goals, rather than a focus on their role-specific targets.

However, with improved visibility and a better understanding of the system through digital technologies, other groups can look to become more of a 'business partner,' through providing trusted advice and taking the lead in developing, for example, five-year or life-of-asset plans. The GM will likely still have the final say, but, instead of being accountable for driving the result, their focus now lies in actioning the best advice, and driving shorter-term goals, like the mine's quarterly plan.

Dominic Collins—Energy, Resources & Industrials Leader, Deloitte Chile says: "With these changes, the GM role becomes much more adaptable and agile, with a narrower scope of focus but significant leeway in how the individual works. That agility is created through greater role clarity and allowing people to focus on areas where they can deliver the best value for the organization."

Relationship to the market

The way in which mining and metals organizations view and relate to the market is also maturing. While, conventionally, many organizations operated with a multi-asset strategy – where each asset group has differing strategic objectives and investment strategies – much of this decision-making remains relatively opaque to the individuals operating within each asset. Ultimately, most strategic communications occur at the corporate level, with, at best, some partial involvement from senior asset leaders. This often results in a poorly understood strategy at the operating level, where cost becomes the only focus for improvement opportunities which can start to impact value. A more nuanced and effectively integrated strategy enables a much broader consideration of all the ways to maximize asset effectiveness.

Fully communicating and integrating these different operational strategies could potentially be realized more effectively by individual assets to generate better value

for the organization as a whole. In turn, improvements in communication quality and timing also allow the organization to pivot faster when faced with changes in the market.

The power of integrated operations

Deloitte recently helped a global mining company implement an integrated operational structure at a mine site in South America. The scope of work included: program ideation, strategy development, implementation plan, and execution, including altering the organizational structure, operating philosophies, situational awareness, decision rights, rhythms and routines, and support for the design and build of an integrated remote operations center (iROC).

Substantial benefits were realized through operator behavioral changes and situational awareness, resulting in productivity improvements at key system interfaces. The program was so successful that the payback period was just six months, meaning that the integrated operation and iROC were paid back prior to their formal go-live date.

Making agile ambitions a reality

- **Lean on new and existing frameworks:** A system-based decision-making framework can help mining and metals companies transition teams from focusing on performance indicators to business indicators. This uses integrated decision-making to overcome the limitations associated with current key performance indicators (KPIs) when variability occurs in the mine environment.
- **Review and restructure rights and responsibilities across the value chain:** This is time-consuming, but the returns are worthwhile and will allow the full value of digital implementations to be realized. Rights and responsibilities should be reviewed when considering major operational changes to assess whether there are better ways that procedures can be handled.
- **Different targets need different people:** Historically, mining organizations have most valued people who can diagnose issues quickly and make immediate operational adjustments. However, the advancement of digital analytics and artificial intelligence (AI) is now de-emphasizing the need to understand what the problem is and emphasizing the need for ambiguous decision-making that can foresee problems and prevent them from becoming reality. Refocusing organizations on value-chain outcomes will require different types of personnel and will also affect how employees advance through the organization. Companies need to think now about their talent-sourcing models and how to foster these skills within their current workforce.



Trend 9

Closing the IT-OT vulnerability gap

The next frontier in cybersecurity

René Waslo, Global Risk Advisory Leader, Energy, Resources & Industrials, Deloitte US
Andrew Kwong, Partner, Risk Advisory, Deloitte Canada

Over the past five years, the acceleration of digitization, information technology (IT) and operational technology (OT) convergence and value-chain integration in the mining sector has produced new levels of efficiency, driven down miners' costs, and created exciting new business opportunities.

However, with opportunity also comes risk and, for many companies, rather than security efforts keeping pace with their digital growth, the gap between risks and controls has widened.

According to computer-security firm McAfee, the cost of cybercrime globally now tops US\$1 trillion, with monetary losses accounting for US\$954 billion.¹ Higher metal prices and the strategic importance of certain metals have brought the mining sector to the attention of criminals in recent years, and a number of firms (both metal producers and METS companies) have found themselves victims of security breaches.

For example, Norwegian aluminum and renewable energy company Norsk Hydro faced a ransomware attack in 2019 that affected more than 35,000 employees across 40 countries. The financial impact was estimated at US\$71 million.² More recently, Weir Group PLC was the victim of a ransomware incident in September 2021.³ This led to disruptions in the company's engineering, manufacturing, and shipping operations which resulted in revenue deferrals and overhead under-recoveries.

Vulnerability through IT-OT convergence

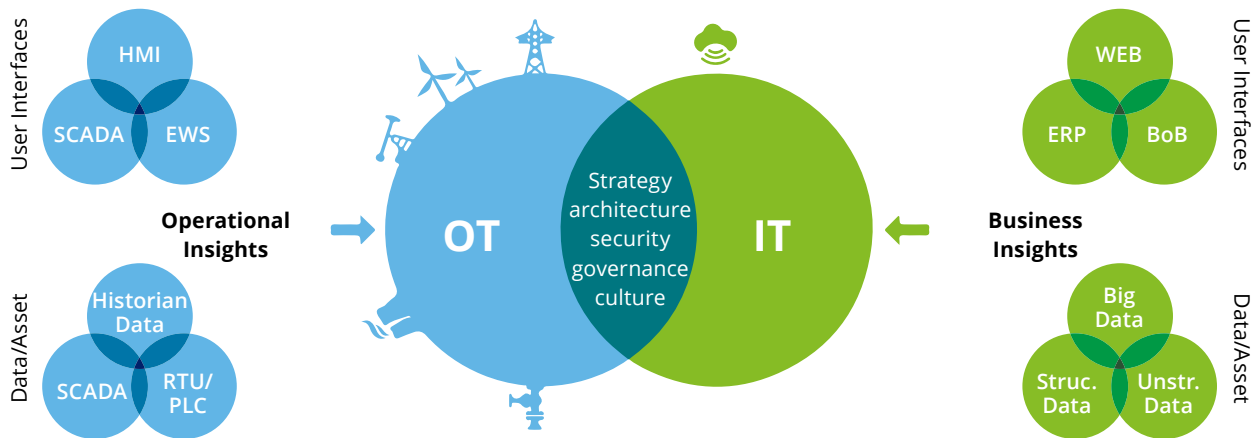
Traditionally, mining companies have placed heightened security focus on protecting data and systems in functions like finance or human resources, but not enough on the ground at mine sites. However, IT-OT convergence is increasing, and more devices are being connected than ever before, sometimes without the proper due diligence for security. The result is that, today, some of the industry's biggest cyber vulnerabilities are around OT, industrial control systems (ICS), and Industrial Internet of Things (IIOT).

René Waslo—Global Risk Advisory & Cyber Leader, Energy, Resources and Industrials, Deloitte US, explains, “While companies have begun to place more emphasis on the operations side of their businesses, we still see opportunities for improvement in the OT environment. Until there is equal focus on the front and back office, we’ll continue to see breaches.”

Future bites

Advanced digital technologies such as blockchain and artificial intelligence are already a reality. However, as future technologies, such as quantum computing for industrial applications emerge, it's important to consider the potential security issues that data management on this scale could entail in advance of implementation. Out of 600 respondents to Deloitte's 2021 Future of Cyber Survey, 64% ranked security capabilities as the top consideration in their decision to implement emerging technologies.⁴

Figure 1: IT-OT environments in mining are becoming increasingly connected



Source: Deloitte analysis

- HMI: Human Machine Interface
- SCADA: Supervisory Control and Data Acquisition
- EWS: Engineering Work Station
- RTU/PLC: Remote Terminal Unit/ Programmable Logic Controller
- ERP: Enterprise resource planning

Historically, OT systems were designed to be isolated, running less-known industrial protocols and custom software. Those systems had limited exposure to cyber-related threats whereas, today, as an enabler of business innovation and efficiency, OT environments are becoming increasingly connected to other networks and are remotely accessible to allow remote process monitoring, system maintenance, process control, and production data analysis/integration (see figure 1).

The adoption of remote and hybrid operating models as ‘the new normal’ means that now is a good time to review cybersecurity measures around interconnected or segmented networks, and ensure they are robust enough to sustain current practices and support future business growth.

Other key challenges include the high cost associated with ICS upgrades, patching, or changing configuration files on legacy systems, and a lack of redundancy in production schedules as supply chains move to more integrated or just-in-time models.

Restoring trust in the value chain

Twenty years ago, cybersecurity in mining was a technology implementation issue; as solutions were scaled up, security measures were added. While there’s still an element of

association today, the ubiquity of digital technologies and work practices means that businesses now need to factor security threats and solutions into every decision they make. As value-chain integration accelerates, there are touchpoints where miners need to ensure that third-, fourth- or fifth-party organizations with whom they are doing business have a strong cyber posture.

There is also a reputational element to consider. In the future, a mining company’s security stance could affect its ability to engage or trade with other organizations.

Andrew Kwong, Partner, Risk Advisory, Deloitte Canada explains: “When it comes to new technologies and systems, businesses are making strategic choices on how their organizations change, and those changes could have a big impact on security. Today, it’s important to put a cybersecurity lens over every business decision or technology implementation, and make sure that secure processes are in place to support these organizational changes.”

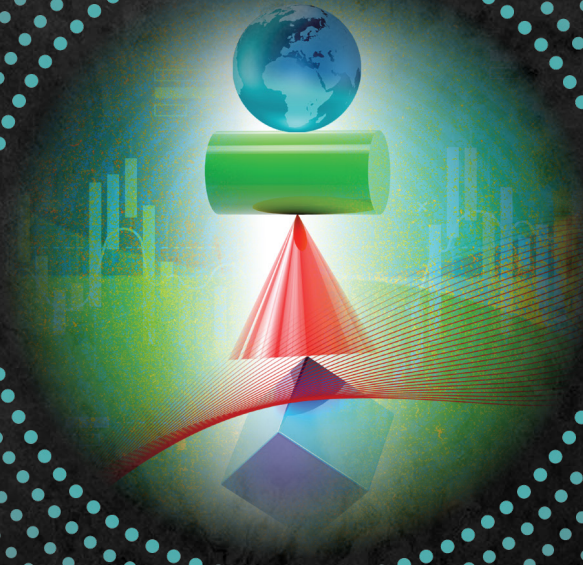
Of course, mining companies are just at the beginning of their digital journeys, so it’s worth putting the time, attention, and investment in now to ensure operations are not left exposed in the future.

Securing the mining OT environment

- **Knowledge is power:** Create and maintain a holistic inventory of all connected devices at the shop-floor level. Review this regularly to ensure OT cybersecurity measures are sufficient and properly allocated.
- **Uncover asset vulnerabilities:** Perform a passive detection of the network by collecting and analyzing traffic circulating between OT devices. This will allow vulnerabilities in the discovered assets to be uncovered.
- **Perform regular OT security assessments:** Assessments allow the identification of security gaps and missing controls, and can help leaders to gauge the maturity level of their organization's approach to OT cybersecurity. Based on this, recommendations can be made on work lots to achieve target maturity and strategic deployment roadmaps built to support this effort.
- **OT third-party risk assessment:** Conduct a workshop with critical third-party stakeholders, such as original equipment manufacturers or service providers, to discuss the controls in place to secure the interface between their systems and the mine's. Ensure these are robust and up to date.
- **Create an OT governance framework:** Establish a corporate-wide security objective for OT by defining the OT cybersecurity strategy. Also, create a functional IT/OT governance working model.
- **Consider an IT-compromise assessment:** It's also worth assessing the current IT environment, infrastructure, and selected systems to identify previously undetected backdoors, compromises, or exposures that reveal data and system integrity to significant risks.
- **Perform a thorough market review:** The traditional OT security market is niche and mature. However, OT/IT convergence is accelerating, and a growing number of cyber-physical systems are emerging in operational and mission-centric environments, creating a new security market with shifting dynamics. It's worth scanning the market on a regular basis to ensure access to the latest security systems and services.

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Trend 10

Preparing operations for climate change

Managing physical risks through digital insights

John O'Brien, Partner, Financial Advisory, Deloitte Australia

Patricia Muricy, Mining & Metals Leader, Deloitte Brazil

While decarbonization has been the primary focus of most miner's climate change-related targets and investments thus far, mitigation is only one piece of the puzzle. Alongside these efforts, organizations need to be thinking ahead and building climate resilience across their businesses and operations.

Some tier one companies have begun to do this using United Nations climate models and digital risk-management tools to quantify both physical and transitional risks at new and existing mine sites. In some cases, these efforts even extend to scoping the exposure of their suppliers. But, for most mid-tier and junior miners, particularly those in geographical areas where climate impacts to date have been limited, this is uncharted territory.

However, in time, the effects of climate change will touch all businesses, across all sectors, regardless of their size and status. The level of transparency and integration of mining supply chains today means that organizations have the chance to prepare their own operations, and also help their suppliers and customers ready themselves for whatever operational effects a changing climate might bring.

Impacts of a warming climate

Physical risks resulting from climate change can be event-driven (acute) or longer-term shifts (chronic) in climate patterns. Both can carry financial implications for organizations, such as direct damage to assets and indirect impacts from supply chain disruption.

In certain geographies, extreme weather events such as droughts and flash floods pose a growing threat to mining activities as global temperatures rise. For example, BHP reported an 11% drop in output from one of its mines in New South Wales during 2019 due to poor air quality caused by bushfires.¹ Scientists estimate that, if global temperatures rise by 2C, the hot dry conditions that encourage bushfires would occur at least four times more often.²

Record heatwaves in North America during 2021 are another example. In June, temperatures in British

Columbia reached 49.6°C, breaking the country's highest recorded temperature, and wildfires triggered evacuations in California and northern Nevada.³ This clearly has a significant effect on workers in the field.⁴

Organizations' financial performance may also be affected by changes in water availability, sourcing, and quality, as well as issues around food security, and extreme temperature changes affecting premises, operations, and transport needs.

In their 2020 metals and mining survey, 'Emerging ESG Risks in the Metals and Mining Value Chain' Fitch Ratings and CRU named water scarcity as the greatest emerging risk to the mining and metals sector.⁵ The authors state: "Pressures such as localized water shortages and competition for water are likely to increase in the coming decades, causing increasing challenges for battery and low-carbon technology production."

Most mining operations are heavily reliant on water for various purposes, including dust control, cooling of machinery, and mineral processing. Nowhere is this risk more evident than in copper. The increasingly arid conditions seen in northern Chile and southern Peru (the world's largest copper-producing regions⁶) are forcing many large miners to invest in desalination plants. The Chilean Copper Commission (Cochilco) estimates that, by 2029, seawater will account for 43% of the water used in copper mining, up 230% on its expected level in 2018.⁷

In highly water-stressed areas, closed-loop extraction processes can help to lower abstraction requirements, and innovative tailings pond linings and coverings can reduce losses through seepage and evaporation. However, in areas where prolonged arid conditions are expected in the future, then dry processes and tailings storage solutions might be more sustainable in the long run.

Supply-chain vulnerability

For mining companies, the physical risks from climate change can extend much further than their own sites. For example, meteorological events have the potential to significantly disrupt key transport corridors.

In March 2021, heavy rain in Australia's New South Wales and Queensland impacted global thermal coal supplies. Glencore was forced to cut capacity at some of its mine sites, while Yancoal suspended production at two of its open-pit mines.⁸ The Australian Rail Track Corporation temporarily ceased operations through parts of the Hunter Valley network due to localized flooding, a key transport corridor to the Port of Newcastle.⁹

Meanwhile, ship loading at the port was suspended for two weeks to repair storm damage to key equipment.¹⁰ This, plus flooding, caused Australian coal miner Whitehaven to slash its 2020-21 June–July coal production, and the number of vessels grew around port limits.¹¹

Flooding and wet weather continued through the Australian summer, and supply issues saw thermal coal prices hit a record US\$244.11 per ton on 8 October 2021.¹² Floods were still affecting prime-production regions in November.¹³

While the cumulative effects of these disruptions are yet to be published, this example demonstrates why a collective and coordinated effort toward building climate resilience is required across the value chain.

Once again, digital tools can offer insights to support. Deloitte is currently helping a tier-one mining company assess operational risks posed by climate change across its supply chain using its Illuminate solution.¹⁴ This provides transparency of complex procurement networks by leveraging augmented intelligence and machine-learning methodologies to enable rapid modeling and represent those suppliers systematically. Multi-tier networks can then be overlaid with exposures and opportunities, including those related to climate-change risks.

Assess and prepare for different scenarios

In order to mitigate physical risks at both current operations and those under development, a detailed assessment under a variety of future scenarios is necessary.

John O'Brien—Partner, Financial Advisory, Deloitte Australia, explains: "If you're building a mine today that's going to be operating for 10, 20 or 50 years, it's important to design the site, its infrastructure, and supply chain in a way that will mitigate the physical effects of climate change as far as possible."

Patricia Muricy—Mining & Metals Leader, Deloitte Brazil explains: "We know from global climate models what kind of changes will happen over the next 15 years under different scenarios ranging from 6°C to 1.5°C temperature rises. It's only after 2035 that the trajectory of these models starts to diverge. The trajectory beyond 2035 is uncertain and will be determined by the speed of global decarbonization. Miners therefore need to build a certain level of agility and optionality into their operating plans."

Why now?

Based on data from these types of solutions, mining companies should instigate conversations with their suppliers, make decisions around future capital and resource allocation, and, where necessary, diversify their own supply chains to lower operational risks.

It is reasonable to assume that consumers of critical minerals and metals, including electric-vehicle manufacturers and low-carbon energy technology providers, will soon be looking to do the same with their own supply chains. Mining companies play an important role in these both today and tomorrow. Where possible, miners should extend their climate risk-assessment exercises to the downstream portion of metal supply chains and encourage customers to ask questions about the future exposure and security of their suppliers. Security of supply is everyone's concern, and preparedness could offer miners a competitive advantage compared with their peers.

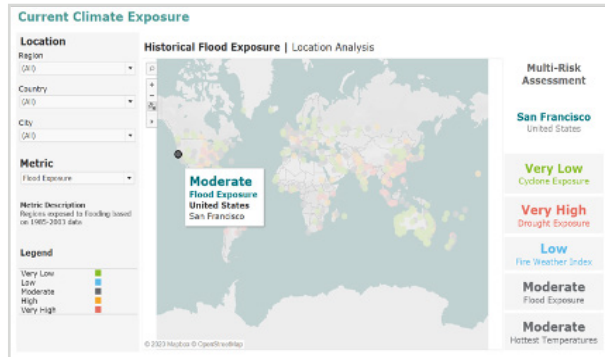
Ultimately, organizations that build climate resilience will also gain access to more attractive financing, stronger employee recruitment and retention, and cheaper energy costs to name a few benefits.

Quantify risks and opportunities

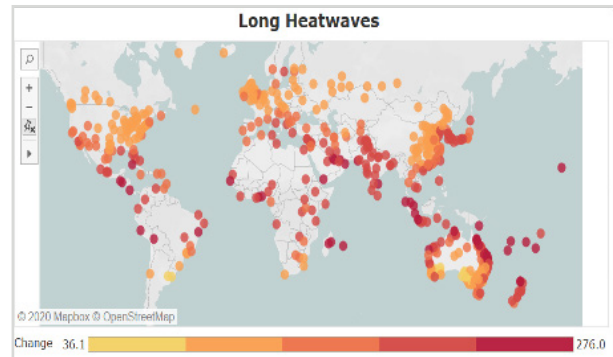
Deloitte Decarbonization Solutions™ include an Adaptation/Physical Climate Risk Module that can demonstrate mining companies' current and future exposure to various climate hazards for assets and portfolio locations. The module incorporates business and financial impacts and supports the translation of climate challenges along the value chain. It can also identify opportunities for investment and resilience and quantify climate thresholds for major disruptions. Alignment with Task Force on Climate-Related Financial Disclosures (TCFD) and other major climate risk frameworks helps to support climate risk disclosures, see figure 1.

Figure 1: Physical Climate Risk Module: Providing quantification of physical risks globally

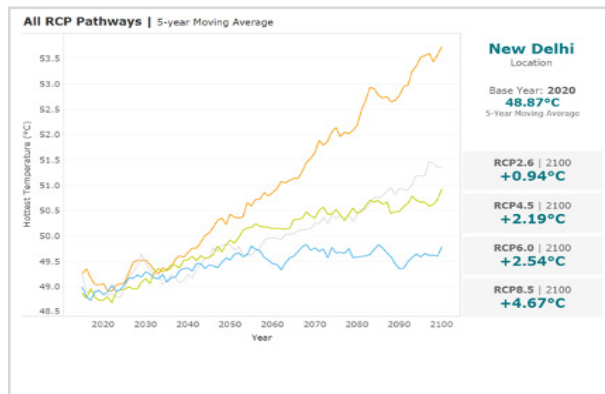
Multi-risk assessment – Assessment of current exposures to cyclones, droughts, fire, flood and heat



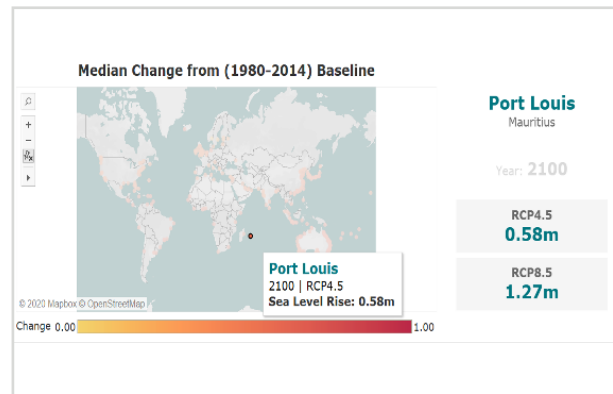
Future scenario analysis – Increase in long heatwaves under a high emission (RCP8.5) future



Local sea level rise – Increase in sea level for 2100 for RCP4.5 versus RCP8.5



Comparing future RCPs – Hottest annual temperature under four Representative Concentration Pathways (RCPs)



Source: Deloitte Decarbonization Solutions™

Building climate-resilient mining and metals businesses

- **Foster leaders for tomorrow:** Building climate resilience across a business requires solid leadership. Leaders who steer resilient organizations share common traits: they are prepared, adaptable, collaborative, trustworthy and responsible.¹⁵ Companies should actively seek out individuals who exhibit these traits and build in measures to help train and retain them.
- **Collaborate to accelerate:** For all mining organizations, but, in particular, smaller and mid-cap miners, collaboration and sharing of experiences between peers can accelerate progress. Everyone is grappling with the same climate-related challenges and will benefit from shared experiences and solutions.
- **Invest in business-wide capability:** To lower operational risk from climate change requires greater awareness throughout organizations regarding the effects of climate change, and how basic decisions today could potentially set the business up for the future. Making physical climate risks a key talking point in the organization and site briefings will help to ensure continued visibility.
- **Talk to your suppliers:** Where possible, this awareness and commitment to lowering physical-risk exposure should also be extended to suppliers. This could be through formal communication or discussions with key personnel. Suppliers may even have measures in place already that could help mining companies lower their overall risk exposure.
- **Question the value chain:** It is important that mining companies challenge the physical resilience of supply chains they are involved in, both up and downstream. Consider how exposed off-takers and end consumers are, and also how the business and operations compare to peers and competitors in terms of readiness for a changing climate. As with any change, opportunities and threats will emerge. How miners prepare for disruption and communicate this to the markets could prove critical to their competitiveness and social license going forward.

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