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Enabling technology for integrated operations

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Introduction

At a time when declining ore grades and operating efficiencies continue to challenge mining concerns, it has perhaps never been more important to make the right decision at the right time. Yet, this has become more difficult to do. For many companies, the perpetuation of organizational, functional, and technological silos remains a major barrier to responding effectively and efficiently in a way that optimizes overall business value.

Leading mining organizations are addressing these challenges by adopting integrated operations (IO) philosophies, approaches and processes. At its core, IO is about designing and embedding mechanisms and processes that drive effective trade-off decisions to determine what is best for the whole business, in a timeframe that aligns with the intended value to be achieved. This typically involves rethinking operating models and making significant investments in data governance, integration, and visualization, and supporting upgrades to technological infrastructure and applications.

An integrated operations initiative aims to take a more holistic view of the business, with a level of integration that is ultimately a function of organizational maturity, readiness for integration, and the value at stake. The value of IO has proven to be substantial. Organizations have seen significant benefits, including:

Increased production   **Reduced unit cost**   **Improved safety**

Decreased downtimes   **Increased productivity**

Successfully delivering on IO is no easy undertaking as it requires focusing on four key pillars: people and culture, workplace design, organizational processes, and technology (see Figure 1). These pillars are discussed in more detail in the 2021 edition of Deloitte's global mining report, Tracking the trends, in "Trend 7: The path towards integrated operations."

This report focuses on the technology pillar, since a move to IO may require new or improved infrastructure as well as applications to enable information transfer, and decision-making that supports the value the business is looking to unlock. We also explore the main impacts technology has on the path to integration and outline some of the frequent challenges encountered when embedding technology to enable IO.

Figure1: The four pillars of integrated operations

People and culture
- Leadership and team culture
- Organizational structure
- Role and team definition
- Decision rights and RASCI*
- Escalation protocols
- Training and competency

Workplace design
- Facility location
- facility design
- Workplace fit-out
- Floor design
- Ergonomics and environment

Integrated operations

Process
- Operations strategy
- Operating modes
- Rhythms and standards
- KPIs and performance targets
- Continuous improvement

Technology
- Data collection
- technology Infrastructure
- IT/OT requirements
- Network requirements
- Advanced analytics capabilities

Source: Deloitte analysis

This marks the sixth time Deloitte Canada has collaborated with NORCAT and NORCAT-affiliated companies to dive into an industry challenge, drawing on the experience and innovation coming from the NORCAT Underground Centre and the leading IO thinking that Deloitte is continually developing. Previous reports in this series highlighted how technologies such as artificial intelligence and wearables have already advanced and improved operations. In this report, we address the major trend of integrated operations, which both Deloitte and NORCAT have observed in the market, and we aim to provide practical guidance on how best to manage technology, based on the experiences of those who have successfully navigated IO transformations.

The impact of technology on the IO journey

In this increasingly digital and connected world, few will argue that investment in enabling technology is often the difference between sustaining an organization and succumbing to operating pressures. For the mining industry, significant investment in technology is required in three key domains:

- **Intelligent operations:** Improving and optimizing operational process through automation, digitization, and robotics.

- **Nerve centres:** Bringing together data from across the value chain and integrating data from information technology (IT) and operational technology (OT) in order to make real-time decisions.

- **Intelligent enterprise:** Improving and optimizing supporting processes through integration, automation, and digitization.

At the same time, technology has never been simply a matter of "plug and play." Successful deployment of technology in IO starts with identifying which decisions need to be made, and then designing the underlying architecture to support decision makers with the right information to make optimal choices. Ultimately, the rapid evolution of technology may remove much of the need for a human-based decision to be made in the first place, with algorithm-based automation enabling next-level response capability.

Investment in technology typically involves three major areas:

1. **Creating situational awareness.** The biggest impediment to organizational performance today is the ability to constantly be aware when a deviation from plan occurs, and then knowing what can or should be done to address the deviation. Creating situational awareness – a state of knowing what is currently occurring, what needs monitoring, knowing when a decision is required, and then formulating an informed plan of action – depends on real-time reports, dashboards, alerts, radio announcements, etc., that only technology can provide.

2. **Enabling decision automation and support.** Optimum integration at the interfaces happens when human-based decision-making is either supported or eliminated. Organizations that code decision logic into their control system, fleet management system, or other expert system realize significant gains by letting it run and recoding the system when changes are required. Using decision logic and automating the decision and action processes supports the application of consistent, predictable, and timely decision-making. Alternatively, automation can be developed for decision support where personnel have the authority to accept or reject recommendations given their own experience, knowledge, and insight.

3. **Increasing speed of action and/or improving safety.** Technology can be used to increase the speed and safety of an activity, which not only ensures more stable operations but also removes personnel from harm's way and de-risks the activity. For example, take moving from manual rock-breakers in ore-bins to automatic and/or remote operation. Since rock-breaking is only required intermittently, operations typically don't use the equipment frequently; when rock-breaking is required, there's usually a delay until someone can be allocated to the machine. Using a remote rock-breaker, however, means faster responses and better utilization of operators. When coupled with pressure sensors in the bin, there's also a reduced likelihood of damaging bin liners because automatic shut-off logic can be built into the remote equipment. These technologies also enhance safety by removing people from hazardous situations.

Overcoming the challenges

Moving toward integrated operations requires changes in the way decisions are made, how resources are managed, what skills are required, and how value is created. Although it should never be technology-led, technology enablement is critical to achieving the desired level and speed of integrating data and information, which in turn enable the desired outcomes.

Drawing on interviews conducted with industry leaders associated with the NORCAT Underground Centre, we explore these challenges in detail and look at how companies are successfully overcoming them.

Challenge one
Gaining stakeholder commitment

The first challenge starts with creating and selling a competitive value proposition to senior leadership. With the mining industry continuing to come under cost pressure, expenditures to complete large transformational projects becomes increasingly difficult and, given the scope and scale of IO enablement, it's critical to build and communicate a strong and competitive value proposition. To complicate matters, it often proves difficult to clearly tie value back to the large investment often required for foundational enabling technologies like network infrastructure, meaning these investments need to be considered differently from other value-based ones.

Creating and selling a competitive value proposition requires a complete understanding of program goals and makes use of information and insight from all stakeholders and partners in the broader operating context, including:

- Aligning all stakeholders with the vision, value, and use of a solution

- Identifying if there is adequate motivation to execute the project

- Striking a balance between the push of corporate needs and the pull of site needs

- Understanding the scalability and repeatability of expanding the offering to other sites/ assets. Running pilots, hypothesis testing, and proof of concepts/values are common ways of demonstrating the value that can be extracted before making large investment decisions.

Once leadership is on board, the challenge then widens to stakeholders across the IO scope, all of whom tend to have unique perspectives on implementing technology. Success does not depend on any one part of the organization owning the project; it is ultimately the stakeholders across the organization seeing the value derived from the changes and supporting the project that brings the implementation to fruition.

It's therefore paramount to engage key stakeholders early in the project and to use their valuable organizational and site experience in laying the foundation for implementation. The front-line operators know best how their work can be done more efficiently and effectively. Supervisors need to ensure they support the front line by responding to the notifications and insights provided by their digital tools. Leadership needs to allow for, and endorse, flexible governance and streamlined processes.

Since IO programs are blueprints for restructuring how work is done, they may raise the prospect of resistance to change from both operations personnel and labour unions. IO program managers

and organizational leaders must therefore ensure any new technology is tamper-proof and that strict change-management protocols are put in place to prevent device damage and reduce the likelihood of safety incidents.

Reliable connectivity is a critical enabling component required to enable situational awareness, and at the NORCAT Underground Centre **Nokia** has been deploying and testing their industrial-grade private wireless network with ecosystem members. Nokia believes that leveraging a single wireless infrastructure throughout the mine as a foundational system to support situational awareness, automation, and increased speed to decision making will add value and reduce the resistance to change from stakeholders. A single system to know, understand and manage has a greater likelihood of being accepted by the users. "Starting with a pilot to align all stakeholders and quickly scaling up will enable mining clients to see incremental decision automation and short-interval control capabilities from their digitization blueprints."

Another key part of IO is enabling speed and safety. HARD-LINE, a leader in mine automation and remote-control technology, has seen many companies resist putting capital into wireless technologies due to their capital-intensive nature and large sustainment needs. However, connectivity is critical for such wireless technologies, which help prevent unsafe environments and identify and respond to emergency situations.

"Starting with a pilot to align all stakeholders and quickly scaling up will enable mining clients to see incremental decision automation and short-interval control capabilities from their digitization blueprints."

Nokia

When implementing technologies to enable IO, there is no one-stop-shop to solve all the challenges. Typically, it takes the integration of several technologies and assistance from specialized vendors to successfully enable it.

Here, leading companies typically take a platform-driven approach, deciding on anchor technologies and partners and then designing each operation's current and target state to ensure holistic roadmaps are developed and agreed to, ensuring effective and efficient enablement for all operations. At the same time, managing selected vendors within a well-structured and governed transformation program, from a well-understood current state to a clearly defined target state, ensures a cohesive approach and reduces the burden of managing multiple and interconnected change-management interventions when implementing technologies individually.

Challenge two
Designing, implementing, and integrating multiple technologies

The vendor community also recognizes the fragmented nature of the technology landscape and the difficulty clients experience when integrating multiple technologies to reach their IO goals. Companies like Strata Worldwide, a global provider of advanced safety and communication technologies, join forces with other vendors for some of their implementations. "Sometimes we partner with other vendors for technologies which we don't have. By doing so, it provides a quicker path to value for the client and helps with integration into existing networks. Our clients also save time and the cost of developing multiple technology capabilities."

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Strata Worldwide

To enable effective trade-off decisions across the value chain, data from various sources is needed consistently and often in real or near-time. Consider Symboticware, a provider of products and services that include advanced data management solutions. It recognizes that having multiple types of assets in fleets and multiple original equipment manufacturers (OEMs) means having to deal with multiple support centres, which may lead to challenging integrations. After its collaboration at the NORCAT Underground Centre, Symboticware recently announced its partnership with Nokia to become anchor providers of a complete digital solution in real-time connectivity for underground mining clients.
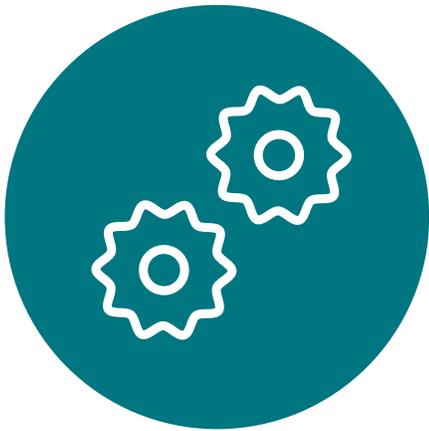
Challenge three
Addressing business process and behavioural changes

Successful implementation of IO technology in mining often requires significant process and behavioural change, especially when it comes to automation. When mining equipment is enabled to operate autonomously and requires maintenance or refuelling, the interaction of human and machine introduces a new set of safety concerns. It necessitates a detailed review of processes and work instructions to ensure new behaviours and safety in operations are embedded.

Automation also brings the risk of alienating workers, who may feel they'll be replaced by robots or autonomous activities in the future. However, there are many opportunities for operators to be upskilled to work with automated or remote machines, such as in dispatch and maintenance activities. When identifying how IO processes can impact employees, think about how to provide affected workers with opportunities to adapt and develop new skills. Building these considerations into the design, prior to implementation, will support a shift in responsibilities and skills, providing a structured and more positive uptake of the change.

Further human resources considerations include tracking workforce change caused by embedding technology and preparing to include a holistic change management approach to overall project scoping. This should include open and honest consultation with those directly affected and preparing workforce transition strategies that identify processes and behaviours that may need to change for the technology to be successful.
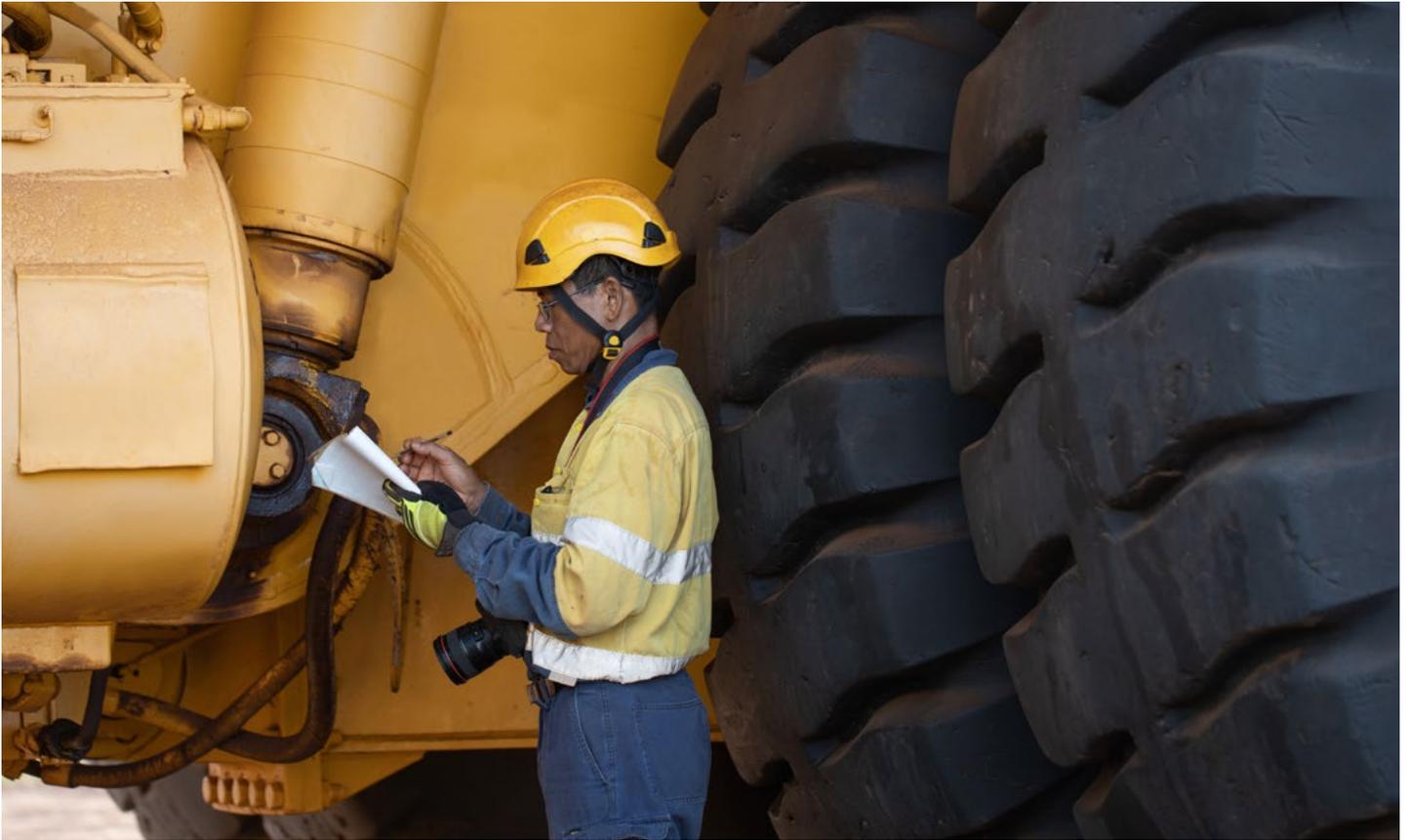
It's critical that these processes and behaviours are considered throughout the course of IO design to support the technology-based outcomes that are part of the solution, while also facilitating the successful transition of activities and tasks still required in the operation.

As organizations embarking on IO journeys move toward automation, they also need to be mindful of unintended consequences. Built Robotics, a company that specializes in upgrading heavy earth-moving equipment with AI guidance systems to enable it to operate fully autonomously, is focused on bridging the gap between human and machine interaction and on removing unpredictability. "We work with clients to ensure that humans can anticipate what the robot will do, and the robot can anticipate what the human is about to do. This requires modifications to the production process, and behaviours of operators will need to change to accommodate this new symbiotic working relationship."

Whether it be creating situational awareness, enabling decision support, or embedding automation technologies, all three challenges of the IO journey require a high-availability infrastructure that reliably supplies the required data and information to users. Cheetah Networks, a company that delivers real-time AI-driven network analytics, finds its clients often underestimate the significant process and behaviour challenges that are required to fully unlock the value of advanced analytics. "The analytics provides mission-critical insight on network assurance and availability to ensure reliable and predictable connectivity to a variety of sensors, equipment and business applications. Processes and behaviours usually require redesign to enable faster and more efficient decision-making, reflective of the insights that are provided."

To support the redesign of processes and behaviours, as new technologies and capabilities come onboard, companies may need to address their employees' training needs for new technologies, create and define new positions, develop new business processes, and identify and remediate gaps left by outgoing technologies and processes.

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Conquering complexity

Relying on accurate and timely information in order to make the right decisions at the right time has never been more important for mining companies. Safe, secure, and prosperous mining operations increasingly require holistic, integrated approaches that break down organizational, functional, and technological silos.

Regardless whether a company is looking to unlock value within a specific value chain, across multiple sites, or perhaps throughout the whole organization, IO is emerging as a critical centrepiece of essential change intended to carry mining operations well into the future.

To successfully move toward IO, the onus lies on mining leaders to focus on the work that drives value for their business and redesign the business around the work activities and outcomes that will unlock that value. Companies navigating this journey need to start from first principles and commit to the following:

- Understand your operations and those activities and outcomes where value is lost due to a lack of integration

- Understand how the workforce and technologies should be re-configured to harvest this lost value (what role does the workforce and technology play in capturing this value?)

- Rethink how work is traditionally done and enable trade-off decisions to be made as effectively and efficiently as possible, embedding automation and decision support technology to enable the transition to a new hybrid working world.

In a world of ever-increasing operational complexity—in technological, organizational, and environmental domains—the need to respond to complex change in timely, robust, and enduring ways is vital.

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To discover some of the best approaches for technology implementation or to discuss which steps you should undertake as part of your integrated operations strategy, contact us today:

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About Deloitte / NORCAT collaboration

Deloitte Canada and NORCAT have entered a strategic alliance—that will help the global mining industry better understand the latest mining technology and innovation trends. This unique collaboration will combine the on-the-ground insight from companies with emerging technologies installed at the NORCAT Underground Centre and the market knowledge of Deloitte's global mining industry team. Deloitte and NORCAT will work together to develop and distribute thought leadership briefings that highlight, discuss, and showcase examples of emerging technologies and innovations. These briefings are poised to contribute to the continuing transformation of the global mining industry.

About NORCAT

NORCAT is the only non-profit regional innovation centre in the world that has an operating mine designed to enable start-ups, small/medium enterprises, and international companies to develop, test, and showcase new and innovative technologies in an operating mine environment. This unique facility anchors one of the world's leading advanced manufacturing and mining technology clusters and represents a "one-stop shop" to see future technologies and innovations that are poised to transform the global mining industry.

Special thanks

We would like to thank Built Robotics, Cheetah Networks, HARD-LINE, Nokia, Strata Worldwide and Symboticware for agreeing to participate in this publication and sharing their insights with us as well as Emeldah Difatlhi, Erik Lantz, and Ebony Clark for their work on this piece.

Publication series

Other articles Deloitte has developed in collaboration with NORCAT focus on:

• How the mining industry is adopting a "Human-centred design" approach to mining innovation

• How the "Future of work" in mining will affect both front-line employees and leadership

• How organizations can take the first steps toward a "Future of mining with AI"

• How mining companies can harness the hype of the "Future of mining with wearables" to improve safety

• How to reshape the way mines are designed and steer energy strategies toward broader transformational shifts
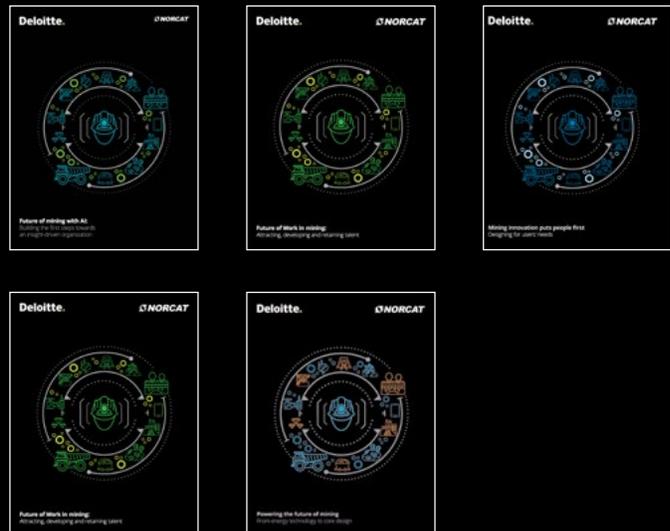
All publications can be found on the webpage "Deloitte and NORCAT—Collaborating to explore the future of mining" at www.deloitte.ca

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