

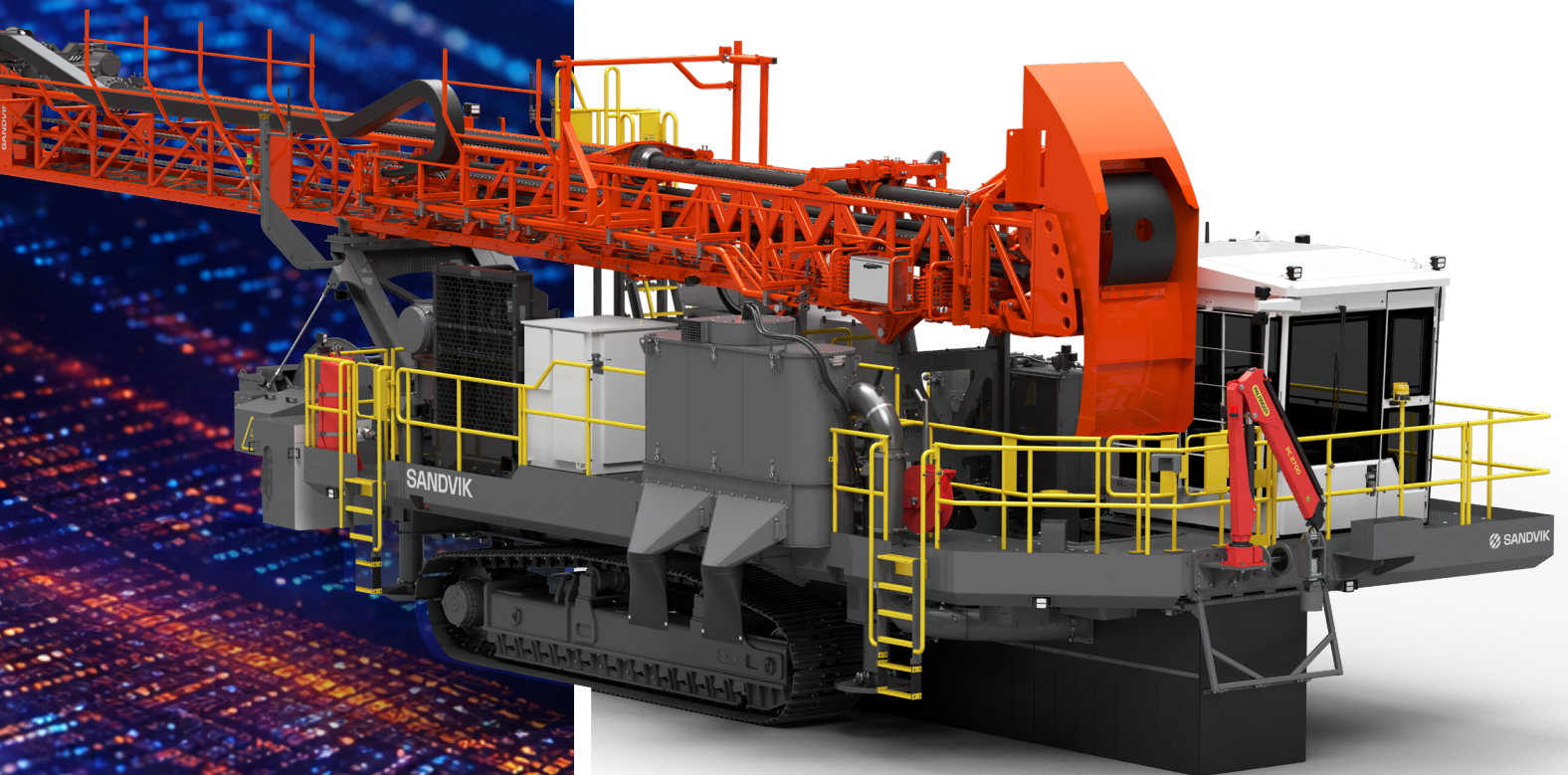


Unlock digital potential in surface mining

How automation, interoperability, and AI-ready
platforms shape surface mining operations

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Introduction to the digital mine

Data is the new ore.

Modern surface mining depends on a different kind of extraction—capturing, analyzing, and acting on information. For decades, operations have struggled with isolated systems, reactive maintenance, and inefficient workflows. Digitalization changes that. By connecting equipment, automating processes, and leveraging AI, operations can transform data into actionable insights and, in turn, boost productivity, safety, and profitability.

Digital transformation in the mining industry is at a nascent stage, with many operations just beginning their journey. Many mines are still struggling to put fully integrated systems in place. This indicates a significant opportunity for growth and development in digital solutions. The focus should be on partnering with companies that can help them merge towards digital solutions, leverage data, and onboard automation features to enhance the overall mining ecosystem.

~30-40% of the mining and metals industry is less digitally mature than comparable industries, such as automotive or chemicals.*

*Source: Boston Consulting Group, "Racing Toward a Digital Future in Metals and Mining," based on the Digital Acceleration Index (DAI), which finds the metals and mining industry is roughly 30–40% less digitally mature than comparable industries.



Unlocking the full potential of surface mining operations requires a strategic approach to digital solutions, particularly for rotary drills. These solutions should enable precise, data-driven decisions that significantly enhance productivity.

Sandvik equips operators with solutions and platforms that help optimize operations. By integrating Sandvik's suite of digital tools, operations can pinpoint areas for improvement, resulting in reduced costs, increased productivity, and enhanced profitability. The modular design of the software architecture on all Sandvik rotary drills allows for the incorporation of advanced features and scalability for future opportunities. This includes safety-related features that reduce equipment downtime and interoperability for seamless data sharing, which collectively improve drilling efficiency and sustainability.

As mining evolves, digital solutions provide operations with a competitive edge through real, operational improvements. This progression is often reflected across three levels of digital maturity—low, mid, and high—each with its own capabilities and outcomes.

Low-maturity sites

- Primarily manual processes and data collection
- Minimal cross-system integration
- Decision-making relies heavily on operator judgment and periodic reports
- Reactive vs. proactive to problems

Mid-maturity sites

- Some automation improves efficiency in specific areas
- Standalone pilot programs are often not scaled across the full value chain yet
- Ability to share information across the site
- IoT-connected equipment
- Early predictive maintenance tools
- Legacy systems are still running core processes

High-maturity sites

- Fully integrated ecosystem of digital technologies
- Real-time data analytics, AI, and machine learning
- High levels of automation and remote control
- Proactive vs. reactive to problems
- High efficiency, safety, and productivity
- Changes are evaluated based on system-wide impact
- Digital strategy directly aligns with business outcomes

Manual  → Connected  → Autonomous 



Low-maturity sites, which are just beginning to integrate digital solutions, can start with basic data analytics and monitoring. This initial step helps in understanding key performance indicators such as fuel consumption, machine penetration rates, and operator efficiency. By leveraging this data, these sites can plan maintenance schedules and improve overall productivity. As these sites progress, they can gradually incorporate more advanced features to optimize their operations further.

In the modern mining industry, the need for interoperability among various stakeholders and systems is becoming increasingly critical. With numerous parties operating on mine sites, **isolated systems fail to provide a comprehensive overview of the situation**, hindering optimization efforts. Interoperability facilitates the management of the entire process, from drilling to milling, by enabling seamless information sharing between different teams. This approach reduces silos, enhances efficiency, and supports better decision-making. By integrating various systems, mining operations can achieve a more cohesive and efficient workflow, ultimately leading to improved productivity and reduced operational costs.

Innovations in surface drilling and mining technology

Redefining performance with smarter, faster, and safer surface drilling

The evolution of surface drilling has been driven by technological innovations that transform how mining operations are conducted. Modern rotary drill rigs now feature onboard automation and high-precision 3D navigation systems, optimizing the drilling process while reducing energy consumption and enhancing sustainability. Data connectivity and interoperability allow operators to analyze performance and continuously improve operations. Artificial intelligence fine-tunes processes at scale, leading to substantial efficiency and productivity advancements, while remote machine operation exemplifies the next frontier in mining technology.

Before digital solutions, miners faced challenges like a lack of real-time visibility into fleet productivity and equipment status, unplanned downtime, maintenance issues, and safety hazards. Digital tools now provide real-time data collection and analysis, improving decision-making and safety measures. Automated features like automatic drill bit changes reduce manual intervention, enhancing operator safety.



Digitalization and automation integration have created a comprehensive value chain


Aspect	Before digital solutions	With digital and automation solutions
Visibility into operations	Limited or no real-time view of fleet productivity, equipment health, or drill status.	Real-time data collection and dashboards showing fleet performance and equipment status.
Downtime and maintenance	Frequent unplanned downtime and reactive, last-minute maintenance responses.	Data-driven maintenance planning and earlier issue detection to reduce unplanned stops.
Safety	Higher exposure to hazards due to manual interventions and limited situational awareness.	Automated functions and real-time alerts reduce manual handling and improve operator safety.
Drilling performance	Inconsistent drilling quality and energy use due to operator variation and limited feedback.	Optimized drilling parameters based on live data to improve consistency and energy efficiency.
Value chain integration	Fragmented point solutions with little connection across drilling, maintenance, and planning.	Integrated digital and automation tools that create a more connected value chain.

Creating a more connected value chain

Implementing digital solutions in mining involves integrating data with existing systems to enhance efficiency. Sandvik’s iSeries rotary drills are equipped with digital solutions that provide real-time data and analytics, optimizing the entire mining process. Functional interlocks within the digital system prevent equipment misuse and enhance safety by ensuring operations are within safe parameters.

The Sandvik Intelligent Control System Architecture (SICA) is the digital backbone of Sandvik’s rotary drills, managing every function inside the machine. Built on a modular

software platform, SICA integrates all onboard sensors to monitor performance, coordinate control systems, and automate key drilling processes. Its architecture allows features, parameters, and control logic to be reused or transferred across drill models, streamlining development and ensuring uniform functionality. Through real-time data capture and adaptive algorithms, SICA maintains precise control over drilling parameters, supports automated safeguards, and provides a consistent operator experience across equipment.

A large, tall rotary drill rig is positioned in an open-pit mine. The rig is mounted on a tracked base and has a long, vertical mast. The background shows the rugged terrain of the mine under a warm, orange sunset sky. The rig's base has a white cab and a red section with the Sandvik logo. The overall scene is industrial and captures the scale of modern mining operations.

SICA is the digital backbone of Sandvik's rotary drills, managing every function inside the machine.

When every function inside the machine is connected, optimization stops being an aspiration and becomes the standard.

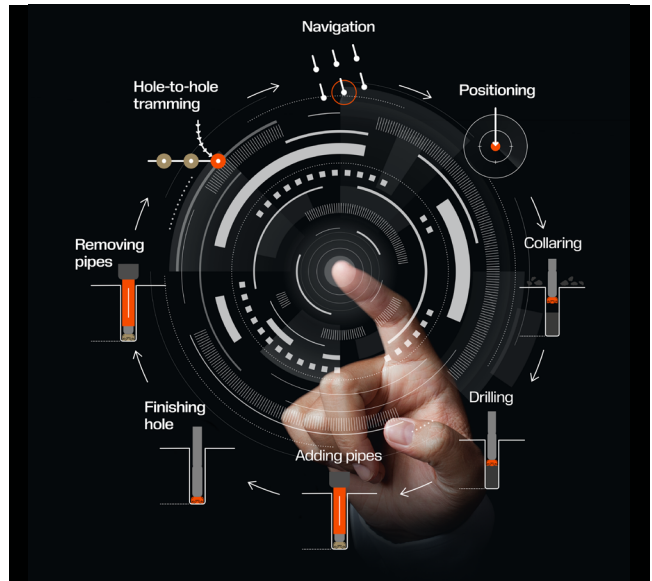
Boosting drilling efficiency with automation and digital integration

Supporting productivity at every stage of digital maturity

Automation features like auto drill, auto bit change, and auto leveling enhance drilling performance by reducing equipment wear, minimizing operator variation, and increasing availability. Auto leveling ensures proper machine positioning, auto drill automates drilling to the desired depth, and auto bit change allows automatic bit replacement, all working together to boost efficiency. These features optimize the drilling process, lower energy consumption, and improve penetration rates, ultimately increasing productivity and delivering greater value to customers.

The modular nature of Sandvik's onboard automation simplifies fleet management, operator training, and parts inventory. Automation features can be made available as required, and customers can upgrade systems with new features as needed, offering scalable solutions that grow with digital maturity. The Digital Driller™ training simulator provides a cost-effective way to train operators without disrupting production, replicating onboard automation functionalities for practice. It provides a real-world training scenario in a controlled environment where participants benefit from hands-on training without the need to take a production machine offline.

The simulator comes with custom-developed software that includes a range of specific exercises for recording and measuring operator behavior. The trainer can initiate machine faults, incidents, or hazards to train and assess operators, ensuring they are able to respond correctly to any scenario with maximum efficiency. Training sessions can be conducted for multiple participants in a safe environment, preventing risk of injury or equipment damage. The simulator also facilitates regular operator retraining and an operator assessment process without impacting site productivity.



Operational improvements of the Digital Driller™ training simulator

100% availability

Training can easily be conducted even when the rig is not available.

35% cost reduction

Less energy, rock tools usage and reduced rig damages.

5% yield increase

In annual productivity due to increased rig availability.

How integrated digital solutions enable higher maturity

Mid-maturity sites benefit from integrating digital solutions, connecting operations like drilling, blasting, and loading into a cohesive ecosystem. This integration enhances decision-making and resource allocation, leading to increased productivity and reduced operational costs.

High-maturity sites achieve full digital integration with centralized platforms, complete visibility, and advanced analytics. This allows for real-time decision-making, continuous improvement, and optimization, resulting in reduced downtime, maximized resource utilization, significant cost savings, and increased profitability.

Scalable digital solutions cater to varying maturity levels, accessible to contractors and smaller operations without advanced technology. By offering tailored products and services, digital solution providers help all mining operations improve efficiency and productivity, ensuring even low-maturity sites can gradually adopt and benefit from advanced mining technology.





AUTOMINE®

Building an interoperable and AI-supported mining system

Connecting systems to enable better safety, precision, efficiency, and cost

Interoperability in mining operations is vital for optimizing processes and improving efficiency. Seamless communication between systems and equipment is achieved through solutions like the **Sandvik iLink Data Interface**, which allows for data transfer between digital platforms, providing a comprehensive view of the mining operation. This bi-directional data flow enables real-time monitoring, ensuring all systems work in harmony. Facilitating interoperability leads to greater flexibility, adaptability, and resilience, resulting in more sustainable and profitable outcomes.

Integrating digital solutions is essential for effective data and analytics management. Customers often invest in multiple software systems from different OEMs, increasing capital equipment expense and digital solution investments. This fragmented approach requires significant resources to maintain each system, creating operational challenges. Adopting a single central mine integration system streamlines data management and reduces resource needs. This unified system lowers capital and digital solution investments, simplifying mining operations and enhancing efficiency.

Digital innovation, particularly AI integration, is transforming the mining industry. AI technology improves various aspects of mining operations, from drilling to processing, by enabling smoother and more efficient processes with reduced manual intervention. Automated drilling operations, for example, increase productivity and accuracy with minimal human input. The continuous evolution of AI technology offers exciting possibilities for further optimization and higher levels of automation and efficiency in mining operations.





One central mine integration system can replace multiple digital platforms, reducing investment and making operations more efficient.

Operationalizing digital transformation across the board

The adoption of digital solutions in surface mining operations has revolutionized the industry by providing precise, data-driven insights that enhance productivity and safety. The modular and interoperable design of these solutions allows for continuous improvement and scalability. The integration of automation and real-time data analytics optimizes the entire mining process, from drilling to material processing. As technology continues to evolve, the role of artificial intelligence and remote operation capabilities will further enhance the efficiency and safety of mining operations. By leveraging these digital tools, mining companies can achieve significant cost savings, increased productivity, and improved profitability.

This technological progression mirrors the digital maturity journey outlined earlier from low- to high-maturity sites, where incremental technology adoption compounds over time. As operations move beyond isolated tools toward integrated, interoperable systems, they shift from reactive decision-making to proactive optimization. Continuous adoption of digital solutions, automation, and analytics enables mining operations to steadily increase maturity, unlocking greater consistency, scalability, and long-term operational resilience.



Building on SICA, Sandvik's Intelligent Control System Architecture, mining companies can move beyond a focus on individual drills (i.e. isolated tools) to improve fleet-level performance (i.e. interoperable systems) and standardize performance for long-term digital maturity.



SICA's modular design harmonizes software, control logic, and automation across multiple rigs, creating a common platform for deploying and supporting new features, coordinating drilling activities across the fleet, and propagating best practices while supporting operator upskilling. Drilling parameters can be fine-tuned and shared to support consistent performance from rig to rig, while functional interlocks and integrated safety features help reduce operator variation by automating key processes.

This integration of digital solutions in mining operations is a transformative process that enhances efficiency, productivity, and profitability. By categorizing sites into different maturity levels and offering scalable solutions, digital solution providers can address the unique needs of each customer. The importance of interoperability and seamless communication between systems cannot be overstated, as it enables real-time decision-making and continuous improvement. As the mining industry continues to evolve, the adoption of digital solutions will play a critical role in driving operational excellence and achieving long-term success.

The mining industry stands to benefit significantly from the integration of digital solutions and AI technology. Interoperability among systems and stakeholders is key to achieving a comprehensive and efficient workflow. By adopting a unified data management system, companies can reduce operational costs and resource requirements. Digital innovation, particularly AI, offers exciting opportunities for automation and process optimization. For those starting their digital transformation, a strategic approach involving pilot projects and scalable solutions is essential. By embracing these advancements, the mining industry can achieve higher efficiency, productivity, and overall operational success.



Key takeaways

- Digital maturity is incremental and increasing
- Interoperability scales operations
- Automation reduces variability
- AI enables faster processes
- Modular systems future-proof investments
- Digital transformation is possible

Contact Sandvik

Sandvik is highly familiar with assisting mining operations through digital transformations. We offer a comprehensive suite of digital solutions, from planning software to autonomous and connected equipment. [Contact us](#) to discuss how we can support your specific business needs.

mining.sandvik