

How mining companies partner with ABB to accelerate digital transformation

Best practices

The future of mining is digital

The mining industry is under great pressure to transform from an environmental, political, and cultural perspective. **This pressure will continue until major action is taken. ABB customers are setting ambitious goals for:**

- decarbonization
- increased productivity
- uptime
- better operational cost control
- optimized capacity
- workforce safety

Digital transformation is not optional for mining companies.

A complete paradigm shift and new ways of achieving these goals become possible through digitalization. Eager to attract the next generation of talent to whom issues such as climate change are a genuine concern, mining companies want to demonstrate that they are serious about sustainability and innovation.

Working alongside visionary leaders on their most critical challenges often results in new industry perspectives. Sanjit Shewale and Marcos Hillal from ABB share their insights



Sanjit Shewale
VP, Head of Digital,
Process Industries,
ABB



Marcos Hillal
Global Product Line
Manager, Mine Automation
& Digital, ABB



about mining companies successfully converting from conventional to more modern operations that are safe, smart and sustainable.

Read on to see practical examples of how to envision, create and manage digitalization initiatives and capture real value.

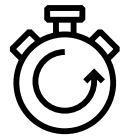
Mine 4.0 is digitally transforming modern mining operations

Mining sites globally are feats of engineering, pillars of entire communities and essential for ongoing mineral and metals security. The move from conventional mining operations to what we can call Mine 4.0 is underway.

Mine 4.0 means integrated digital operations that create better outcomes and connected experiences for miners, their customers and suppliers. It is also the foundation for autonomous mining, which has to be the future vision.

Seeing the future

So, how is the mining industry supposed to bring digital mining to life? **It all starts by envisioning the future:**



Powerful, integrated solutions speeding up decarbonization.



New business models that ensure value outcomes and competitiveness.



Autonomous operations across transparent value chains.

No single company can do it alone. We believe that this can only be achieved by collaboration with the best ecosystem partners. When embarking on a digital transformation journey, it is also important to balance both short and long-term targets, driving rapid change while keeping sight of the larger vision.

Bringing digital mining to life - starts with your vision

- Powerful integrated solutions speeding up decarbonization
- New business models that ensure value outcomes and competitiveness
- Autonomous operations across transparent value chains
- Achieved by collaboration with the best ecosystem partners

Making an impact, layer by layer

Today's business leaders require organization-wide visibility and control, so that they can quickly evaluate how production is impacted by unexpected events, adapt pricing strategies, better manage supply chains and assets. **Data integration at all levels—from equipment and processes, to engineering and business systems—becomes one of the core business imperatives.**

The mining industry is already generating a lot of data, but is struggling to make it valuable for digital applications, ready to communicate towards the cloud and the shop floor in real time—and affordably. Digital apps simply do not make sense without such trusted data.

In real-world scenarios, converging operational, IT and engineering data can be challenging, especially when enterprise information infrastructure includes heterogeneous information systems. Most mining facilities also live with incompatible legacy OT systems, which can become a massive hurdle to integration. The integration process requires expertise on both the domain and system level, and specific connectivity solutions.

ABB has the right combination of domain-specific expertise and knowledge of both OT and IT infrastructure to ensure that your data management approach is closely aligned to your business strategy. We know how to label, model and structure industry-specific data, and how to store, compute and stream high volumes of data securely and cost-effectively. Traffic between layers can be secured and controlled down to the smallest detail.

USE CASE

Maximizing Operational Efficiency with Data Integration

Monitor and analyze operational data in real-time at your mine and processing facilities to maximize operational efficiency. Integrate dozens of third-party systems from multiple business areas, such as mine operations, process control, geology and exploration, asset management, and health, safety and environment (HSE). Also integrate with back-office systems, such as enterprise resource planning platforms and platforms used for managing plant maintenance.

Engineers and operations staff will be able to monitor unified mine operations remotely, from the comfort of the office, empowered by the most modern intelligent data analytic methods available.

The old way versus the new way

When basic data requirements are fulfilled, there are plenty of potential use cases opening new possibilities. From our experience, the pain points that often come first are how to improve disparate equipment availability and ensure processes are running at the most optimal and profitable level.

To operate assets and processes optimally, don't treat them separately. The real value comes when you start uncovering previously hidden relationships and correlations.

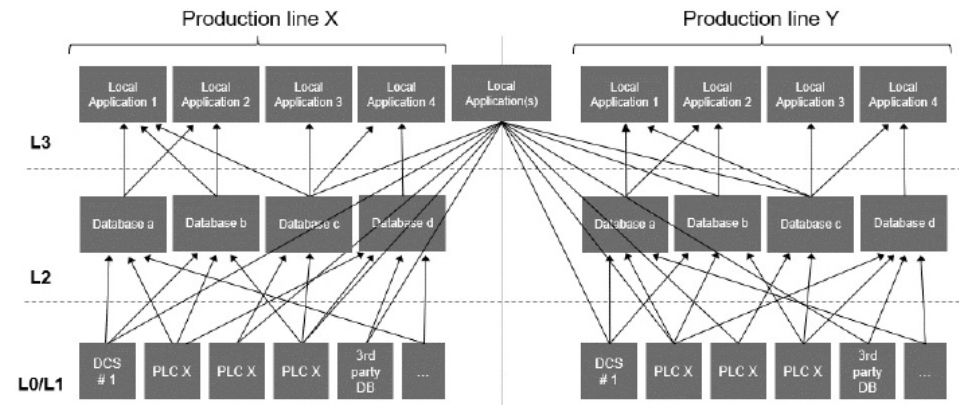
ABB is helping customers improve interactions with other parts of the value chain, and get people engaged on all levels in real time, so that everybody is working towards common goals with a sense of belonging to one family.

We help operations people manage all resources in real time and provide contracted product quantities and qualities faster.

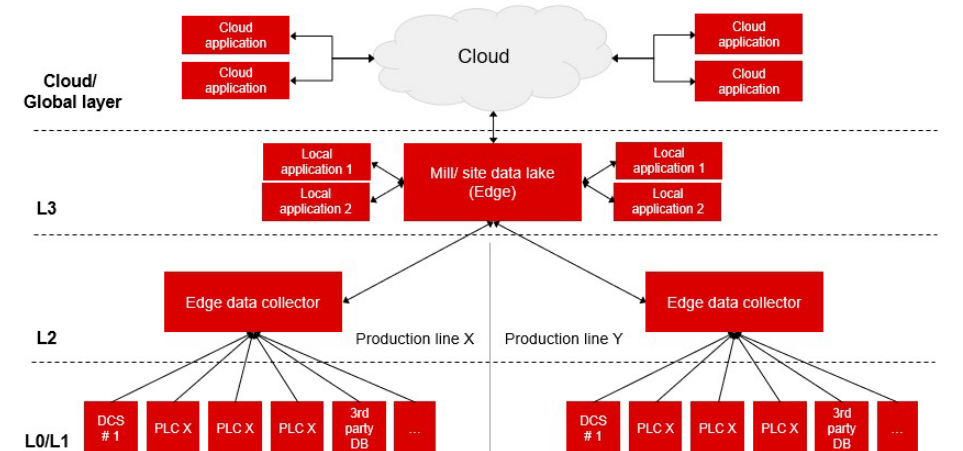
Industrial analytics and AI enable deeper insights

Companies focused on continuous improvement are eager to explore how powerful enterprise-grade industrial analytics and AI can provide them with still deeper insights about their activities, asset or process behavior and reap the benefits of higher productivity, lower energy consumption, lower emissions, and better industry reputation. Leaders with the need for deeper actionable insights are asking: How can I get real-time visibility into my business, mill, process or equipment—no matter the location or time?

Typical production data collection landscape



Real-time and accurate data across the whole enterprise for decision support



What digital solutions are out there?

When lacking in-house expertise in certain areas, **mining companies are turning to ABB** to get fast access to the best experts for cyber security services, predictive maintenance, critical equipment or process performance optimization and shared risks.

Technology leaders wish to see facilities adopt new solutions to benefit operations, but sometimes the digital landscape is intimidating, with a surplus of vendors and software solutions. Decision makers in mining companies' c-suite, along with their managers and operators, must be convinced that technology applications will deliver measurable results.

What solutions are out there and how can they be applied to create value? **We have selected real-life examples providing evidence that digital transformation strategies are working and demonstrating value in the mining industry.**

There are five digital solution areas in the ABB portfolio, representing the value pillars at right.



Sustainability solutions

Manage compliance reporting | Reduce resource costs & risks
ABB Solutions: Energy management, Energy Optimization Emission monitoring



Asset performance (AI/ML)

Increase uptime | Reduce maintenance spend
ABB Solutions: Asset Performance Management, Predictive maintenance services, Condition Monitoring



Process performance

Improve quality, throughput | Reduce variability, lead time
ABB Solutions: Advanced Process Control Simulation, Process optimization services, Alarm Management



Operational excellence

Get flexibility, value chain visibility | Execute strategy reliably, consistently
ABB Solutions: Operations Management System for Mining, Stockyard Management System



Connected workforce

Enhance safety & productivity | Protect and retain knowledge
ABB Solutions: Remote VR/AR Assistant, Remote FAT, Mixed Reality, Remote services

Sustainability solutions

Many mining companies are on the path towards the all-electric mine to move away from diesel and reach net-zero emissions goals. **We are breaking away from traditional customer-supplier relationships in some instances and working in partnerships around ABB Ability™ eMine framework of methods and solutions.** From trolley-assist systems and charging infrastructure, to digitally integrated all-electric operations with secure exchange of operational data and artificial intelligence—there are many ways to bring together each ecosystem partner's strengths.

By integrating electrical solutions with automation and digital systems, customers can be set up to plan, monitor and control processes, optimizing operations and energy usage from grid to wheel. CAPEX and OPEX can be reduced by efficiently managing power and energy for a mining site's cyclical load, controlling CO₂ emissions closely and accounting for the whole spectrum of energy sources.

CASE STUDY

Underground mine reduces 54% of ventilation cost, improving air quality

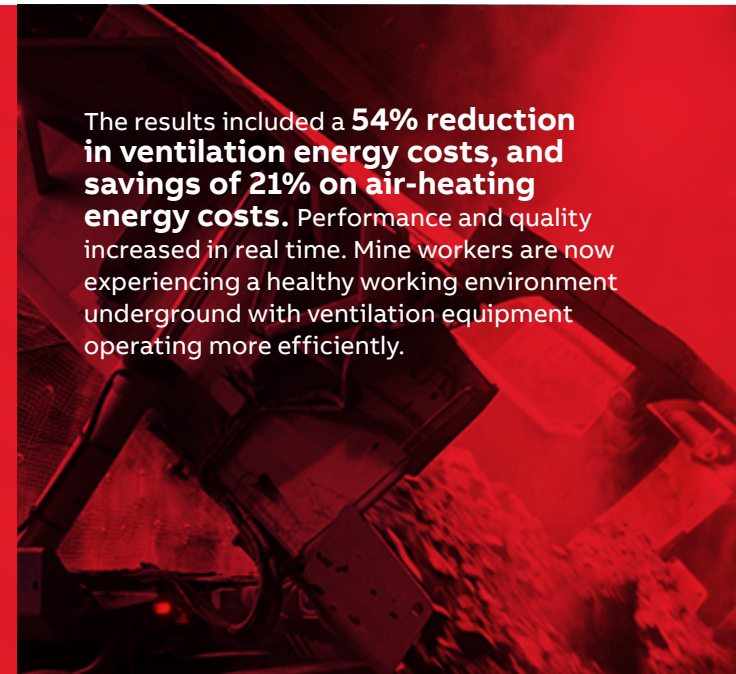


Sustainability solutions

A mine in Sweden was experiencing high energy costs for sending fresh air to a 500m deep underground mine. Ventilation accounted for almost 50% of energy consumption because of underground air being polluted by diesel vehicles and blasting.

The solution was Ventilation on Demand (VoD). ABB centralized control of ventilation equipment with sensor feedback and advanced multivariable control technology. This optimized air flow and air quality. The VoD system calculates ventilation demand dynamically from mine production schedules, events, equipment status and location.

The results included a **54% reduction in ventilation energy costs, and savings of 21% on air-heating energy costs.** Performance and quality increased in real time. Mine workers are now experiencing a healthy working environment underground with ventilation equipment operating more efficiently.



The next generation of Asset Performance Management

Digitalization allows miners to generate more value from existing assets without incurring more labor costs. Next-generation asset performance management (also referred to as APM 4.0) is a driver of mining productivity. Despite recent improvements, **mining productivity is still some 25 percent lower than 20 years ago and even more so compared to other global industries.**

Many miners have adopted a mixture of technologies, including sensors, industrial internet of things (IIoT) devices, hardware, and software - facilitating reach to difficult asset locations and stretching monitoring distances. But, because these solutions typically operate in silos, there is still too much manual effort involved.

The next-generation APM enhanced with AI and ML automates the delivery of early predictions and generates truly actionable information for reliability, maintenance and operations personnel.

The most reliable approach with an APM 4.0 transformation is to start with the existing data

from the assets that are known to cause trouble or be energy hungry. It is prudent to first select the equipment types that fall within our proven asset model library that will deliver quick wins. Then, invest in additional instrumentation and connectivity, focusing on data management and governance, gradually increasing the volume of manageable assets by a single individual and reaching a centralized view of all assets and processes.



CASE STUDY

Maximizing return on assets



Asset performance

An iron-ore-processing unit in South America turned to ABB to centrally connect more than 6,000 assets through a single asset health cockpit interface. Their ambitious predictive maintenance program now relies on our vast library of asset models and maintenance-oriented algorithms. They not only provide early warnings on potential faults, but also trigger work orders to solve the identified issues and eliminate unnecessary maintenance.

After a 60-day evaluation, **42 early warnings are estimated to have saved 846 man-hours and US\$5 million in spare parts and other material costs.** The customer has now extended the program, digitally connecting more than 12,000 assets.

Process performance

The process performance area of integrated digital operations means making the next step towards self-optimizing processes. It is all about maximizing the profitability of mining processes in a repeatable, time-efficient and systematic manner to capture additional throughput, recovery and consistent quality while reducing energy and consumables.

Operators controlling the process are being overwhelmed and overloaded with an increasing number of complex tasks. Many process models and intricate relationships between various parameters impossible to see conventionally, but can be identified from data. Dynamic model-predictive control can be used to automatically adjust to changes and learn from patterns. Again, people are essential to this process step – imagine process engineers teaching machines and improving the accuracy of AI /ML techniques. This will enable autonomous operations they can trust.

CASE STUDY

Modern automation system as an integration platform for digital



Process performance

South American mining company partnered with ABB to transition their multiple mines to digitalized and cost effective operations. This meant getting the basics right. ABB introduced a modernized common automation system that acts as an integration platform for implementing a wide range of digital use cases defined in the five-year plan. We transferred technical know-how in multiple digital formats to support the company's employees through the change in order to reach key safety and productivity targets.

CASE STUDY

Focusing on projects with the best ROI



Process performance

For an African mine that needed to maximize profitability with a fully digital beneficiation plant, **ABB digitally optimized the beneficiation processes.** Removing the need for constant manual tuning of grinding, classification and flotation control is expected to stabilize the process and significantly increase mineral throughput and recovery.



Operational excellence

Operational excellence is another value driver of digitalization. **It is about flexible execution of the entire mining value chain, improving insights from operations by integrating different areas – from production to upper-level systems – and optimizing costs across distributed sites.** This includes KPI monitoring, analytics and integrated remote operations capability.

Enterprise-focused, AI-based solutions have enormous potential for operational excellence, helping mining companies understand the reasons behind differences in performance levels between sites. Transferring knowledge and process methodology from higher performing to lower performing operations helps companies optimize production and uncover best operating points to expand margins.



CASE STUDY

Providing real-time data visibility



Operational excellence

A mining company in India prioritized their **value chain optimization** across 11 sites. Providing real-time data visibility for one concentration plant took just one month to implement.

Connected workforce

Workforce resources with mining processes and asset expertise are in high demand and in short supply around the world. When capable technicians, reliability engineers and process engineers leave or retire, the knowledge of assets and control strategies they worked on often leaves the mine with them.

Increasingly frequent job and industry changes create a heightened pressure to retain and speed up knowledge transfer through simulators and technology advances from the augmented reality (AR) and virtual reality (VR) space.

ABB is helping mining companies move towards an immersive workspace with mixed reality (XR) helping people master necessary skills more effectively and faster, establishing a more consistent foundation across the workforce.

Enhancing safety, remotely

AR and VR platforms minimize the need for personnel to go into potentially risky situations. Connected-worker apps use a combination of on-site sensors, data analytics, AR and VR to give remote workers access to information in hazardous environments without having to enter them. This reduces the number of opportunities (and their severity) for workers to get injured.

Connected-worker solutions also enhance data visibility between workers, systems, and sensors. All workers, regardless of their physical location, have the same view of a mining operation in real-time. This helps individuals, teams and supervisors spot hazards and potential dangers sooner, and take remedial action before an incident occurs.

CASE STUDY

Scanning equipment that would be challenging or impossible to reach



Connected workforce

Advanced tracking software is able to create a virtual 3D, fully immersive, digital twin of the equipment. Complemented with live data and analytics, drive faster conclusions leading to smarter, safer and more cost-effective decision making.

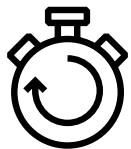
ABB is making this possible today in mining for critical systems such as gearless mill drives (GMD). Each component within the GMD has a 3D model with information such as parts identification for re-ordering, operations and maintenance documentation, precise location of instrumentation, P&ID electrical schematics all delivered in a safe and connected digital reality, with in-the-moment high-definition overlays, without the need to get hands on with the live equipment. 3D modeling and AR overlays not only provide faster information to the operators and field engineers, but promote higher levels of analysis, problem detection, and decision making, all while keeping operations and production as safe as possible.



Mining companies can't achieve the full value of digitalization on their own

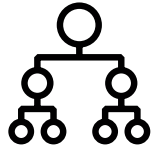
With mines moving towards autonomous processes and decarbonization, no single mining company can achieve digital transformation alone. Miners need experienced partners who know the practical steps to get them there. The industry needs ambitious customers and ecosystem partners to develop solutions that bring real value to people.

Steps to accelerating digital transformation



Step 1

Start your common digital journey



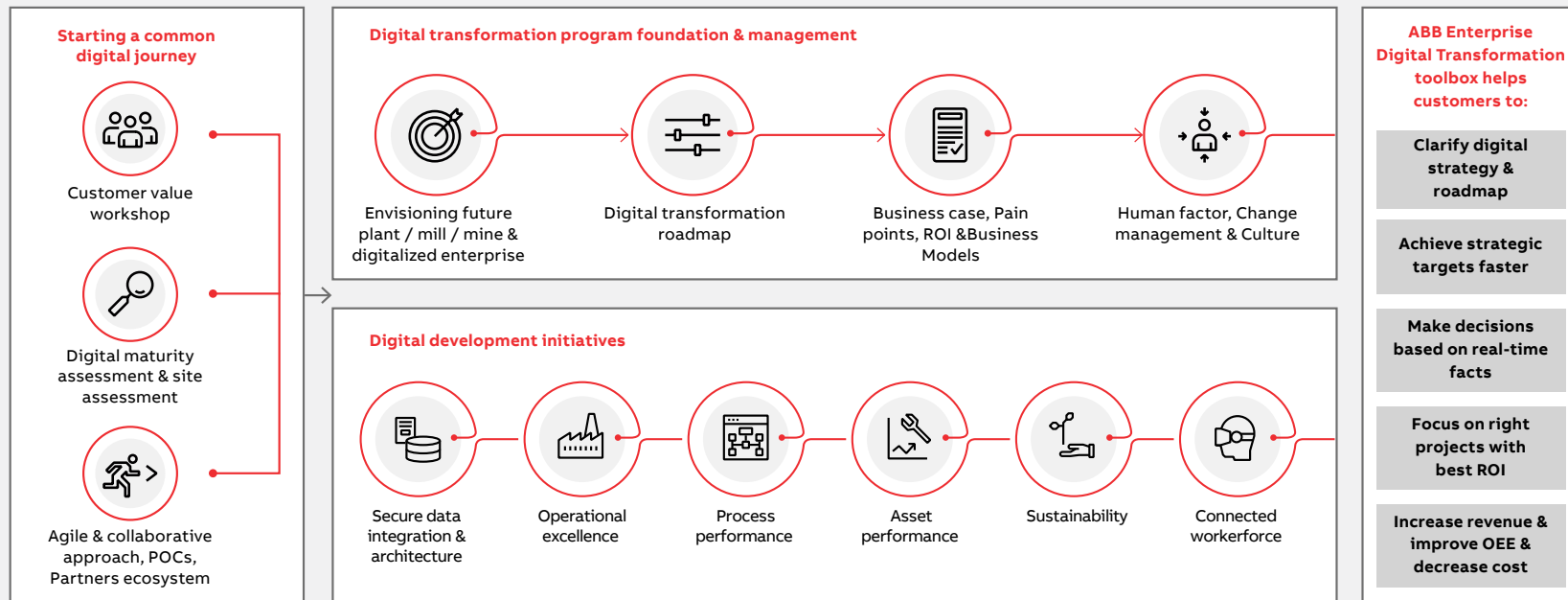
Step 2

Build your digital culture and program



Step 3

Deliver results and scaling up



Cyber security

Cyber security envelopes everything that is done in a digital space.

Trust that the business and its activities are secure is paramount.

The ever increasing inter-connectivity between operational technology (OT) and information technology (IT) systems makes mining companies more vulnerable to sophisticated cyber attacks. It is crucial to plan responses to avoid wide-ranging impact from commercial loss to use of systems to trigger catastrophic worldwide events.

By integrating specialized technologies within ABB's portfolio of deep domain expertise and cyber security solutions we are constantly enhancing operators' abilities to detect known and unknown control system threats. This means, miners get the best of both worlds - leading industrial knowledge combined with the latest technology, to better protect their operations. We often start with foundational controls to increase a system's cyber resilience and evaluate risk tolerance and financial impact of a potential cyber incident. You can simplify your security by consolidating tools, automating risk detection and remediating risks sooner by adopting ABB's cyber security workplace.



Starting a common digital journey

Your journey to digital transformation with ABB as your technology partner starts with discovery. We work with you to conduct value workshops and digital maturity assessments so that, working together, we achieve agile quick wins. Here's what this looked like during a recent engagement.

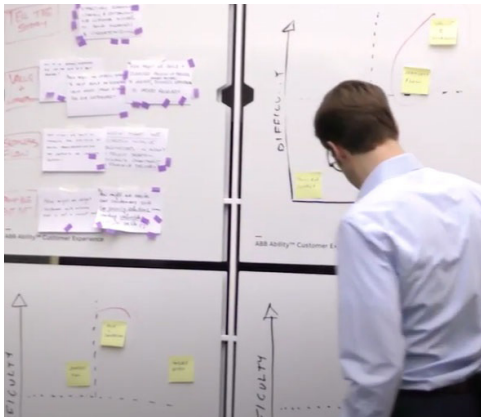
Value workshops

We inspired both our mining customer and our ABB teams with a new way of working through various in-person and virtual event formats. Engaging early allowed us to clarify and understand business priorities and challenges of our global mining customer, and enabled them to experience how our digital portfolio of ABB Ability™ solutions for the mining industry unlock value across the entire value chain. Ideas and

requirements were outlined and further specified, tested and evaluated in follow-up meetings.

For example, during a value discovery workshop, we put customer data into the Value Calculator for a Process Performance solution to estimate the potential for OPEX reduction in annual use of reagents and other grinding consumables. We also calculated possible annual value from increased throughput and better minerals recovery to determine whether the stabilization of load would lead to a lower specific energy consumption per same tone milled.

ABB worked with the customer to define follow-up plans as a deliverable of the workshop. From initial ideas to concrete digital solutions, we walked this path together as a team, hand in hand.



Digital Value Workshops tailored to the specific needs of your company



Ideate solutions for concrete pain points



Quantify potential value of digital



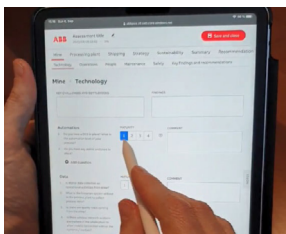
Set priorities for the path forward

Digital maturity assessments

We see a growing number of mining companies tackling their transformation from a holistic perspective and taking a vital step in getting started: looking at their digital competitiveness.

ABB's on-line digital maturity assessment tool, on-site surveys and interviews helped our mining customer evaluate their existing practices, including their digital and IT/OT capabilities.

Once we have gathered enough information through workshops and our Digital Maturity Assessment, we provided a report pinpointing where the company was on the digital transformation journey with respect to industry best practices and their strategy. And we made clear recommendations about which areas to prioritize and develop for the greatest impact.

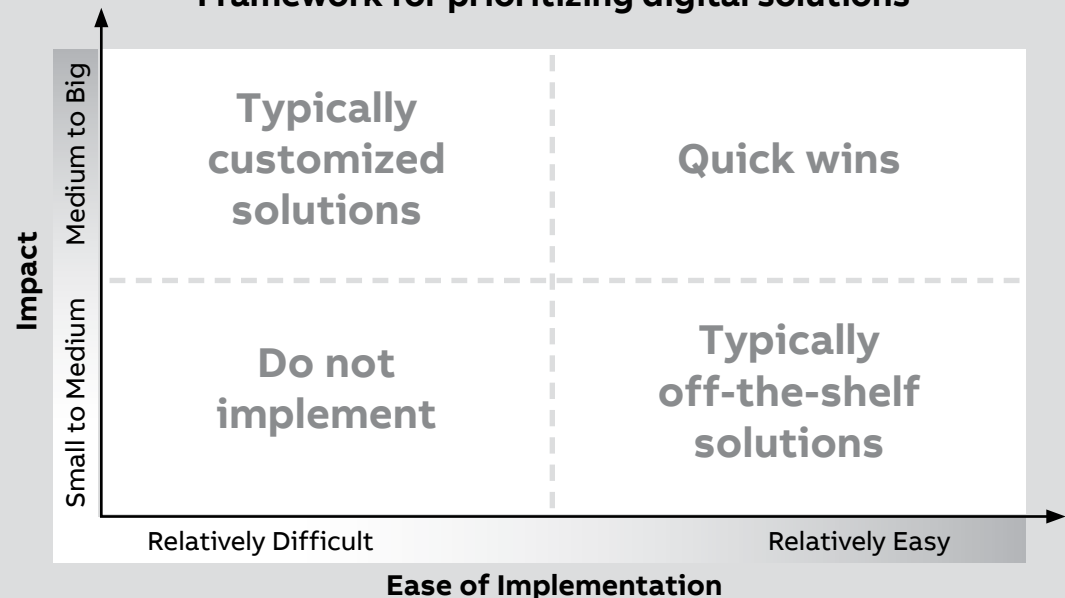


ABB's Digital Maturity Assessment app helps mining companies evaluate their existing practices, including their digital and IT/OT capabilities.

Assessment process



Framework for prioritizing digital solutions



Agile quick wins and co-creation

At ABB, our digitalization initiatives are run like lean technology start-ups, with quick execution designed to yield the maximum return on investment. Experimental projects let us dynamically analyze obstacles, barriers and hidden costs. Models that show the most potential can be rapidly scaled. Those that don't can be quickly abandoned. This helps clarify vision, investment and process.



CASE STUDY

Coordinate production planning, scheduling and execution across multiple sites



Operational excellence

A Canadian mining company prioritized the need to coordinate production planning, scheduling and execution across multiple sites via an Integrated Remote Operations Center. This required a digital solution that didn't yet exist. So, combining ABB and customer know-how, we used user-experience workshops and an agile, iterative approach to co-create a new software interface and a proof of concept dramatically different from traditional paper-based practices.

We connected the workforce, activities and equipment in real-time, which allowed split-second reactivity to disturbances. We optimized scheduling through artificial intelligence, creating a new powerful digital application tailored to the needs of the industry and with people-centric design.

The result? A lower cost per ton produced with less idle time and automated resolution of conflicts, leading to a **productivity increase of approximately 5-10%.**

We are also collaborating closely with Gold Fields, Enterprise Transformation Partners (ETP) and University of Western Australia to further enhance this solution, so that we can enhance application of latest interoperability standards; ISA-95 (IEC 62264) via B2MML V7.0.

Build your digital culture and program

ABB has always been committed to innovation and collaboration – from mining robots, trolley-assist systems, 5G and open data access, to artificial intelligence and virtual, augmented and mixed reality – there are many ways to bring together each ecosystem partner's strengths.

What does the future of your mining operations look like? When working on the vision for their enterprise, our mining customers often ask ABB experts to reflect on the future experiences together and describe practical and tangible use cases leveraging digital.

Creating future scenarios and then envisioning the key technologies involved allows us to see what is feasible with existing ABB solutions. We then evaluate what needs to be co-created. This process helps our customers better communicate their transformation goals and direction to all their people, creating buy-in within every department.

By participating in **industry committees and government initiatives**, hosting **hackathons with university students and employees**, and conducting vision workshops with customers, we commit to developing even more disruptive ways to advance mining.

Together, we bring the vision to life.



Refining transformation roadmap and business cases

When some of our customers' digital transformation programs lack clarity, pace and control over their digital developments, **ABB helps them create a more structured approach.**

We work hand in hand to put their digital initiatives on a fast-track, adaptable roadmap, with fit-for-purpose solutions and no added complexity. We organize optimal work streams and action steps for concrete value-creation goals. We prioritize low-hanging fruit to realize quick wins and milestones in targeted improvement areas.

Digital program managers particularly value our ability to match timelines and budgets, with a clear financial plan, with optimized cash flow and a commitment from key stakeholders in the plan. We make business case estimations based on an iterative approach, building up on the digital vision, site assessments, priorities and roadmap as they influence each other.



ABB pays special attention to human factor studies around the future control room as the nexus of all real-time decisions, one that empowers operators to go beyond traditional thinking.

Bringing it all together



Digital transformation discussions will continue between the many mining industry leaders and technology implementors and innovators.

Increased complexity requires the ability to master different technologies, industry-specific processes, and cyber security, and to provide the needed consultancy and assistance to the end users from the early design stages up to system commissioning and maintenance. The reward for mine owners adopting digital solutions will be better performance at a reduced capital cost, and overall standardization of operational, process, maintenance, environmental and supply chain management practices, which will help in reducing and managing inherent complexity.

At ABB, we combine first-hand experience with tailored, co-created digital solutions to solve tough problems and deliver real value. Whatever stage you're at with Mine 4.0, we'll get you where you want to be.

Let's join forces to co-develop and collaborate to set new standards for the mining industry.



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