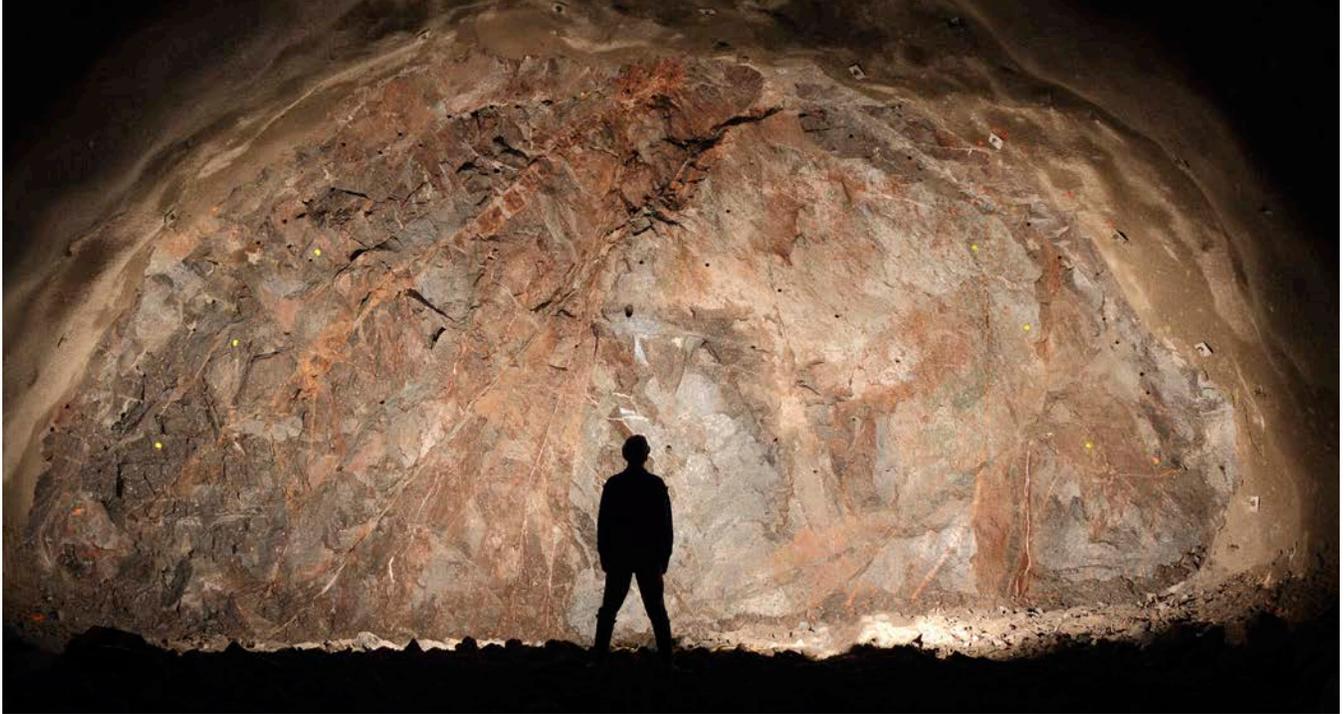




Reduce variability.
Eliminate uncertainty.
Increase predictability
across the mining value
chain through digital.

Hatch Digital Mine

HATCH



The digital transformation journey in mining

At their core, mining organizations like yours want to run safe operations. They need to execute their plans consistently, and make reliable decisions that will prepare them for the future. They want to improve productivity and efficiency, and increase their speed to market.

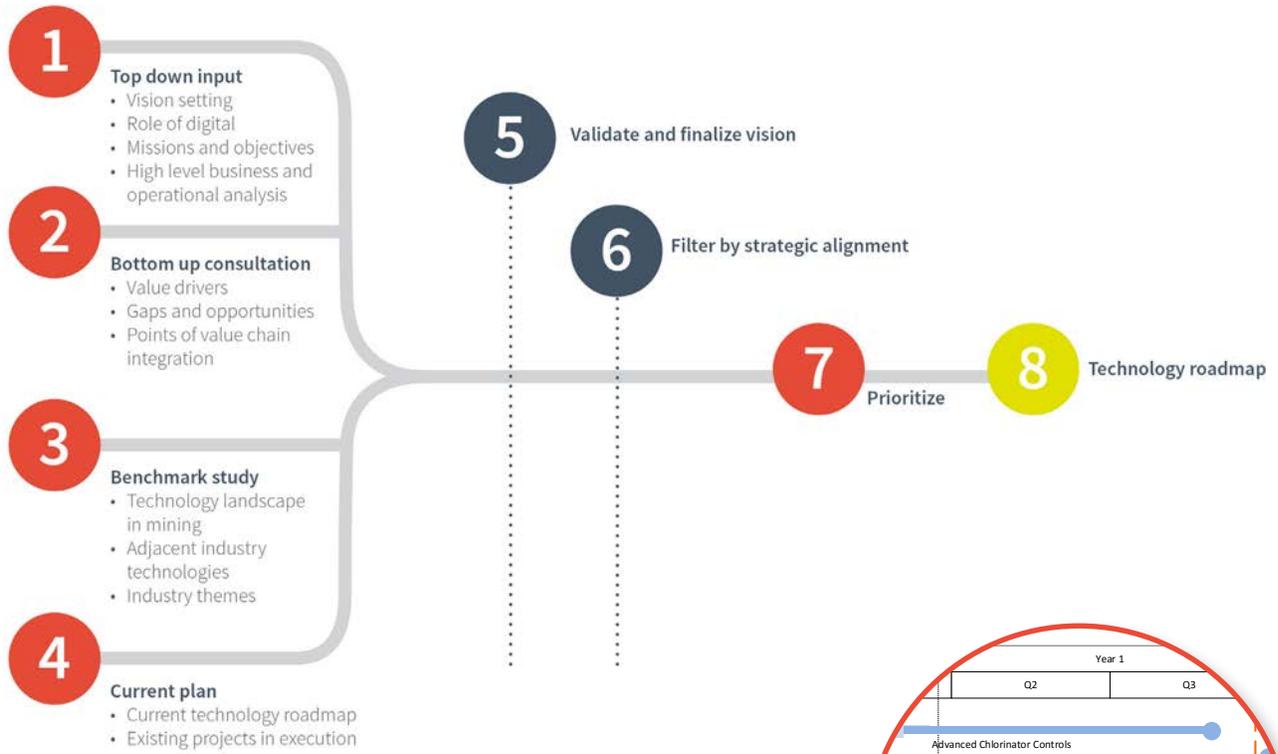
Capital projects are becoming ever more complex in marketplaces that are becoming increasingly competitive. With challenging budget and schedule constraints, success lies in creating more value—delivering projects with better engineering efficiency and more productive construction.

Ore grades are declining, often deeper underground and in remote locations. This is increasing pressure on costs, both capital and operational. The industry has gone through a strained period of cost reduction, sweating the assets to maximize output. Now, if we're going to achieve the next level of performance, we'll need a new approach.

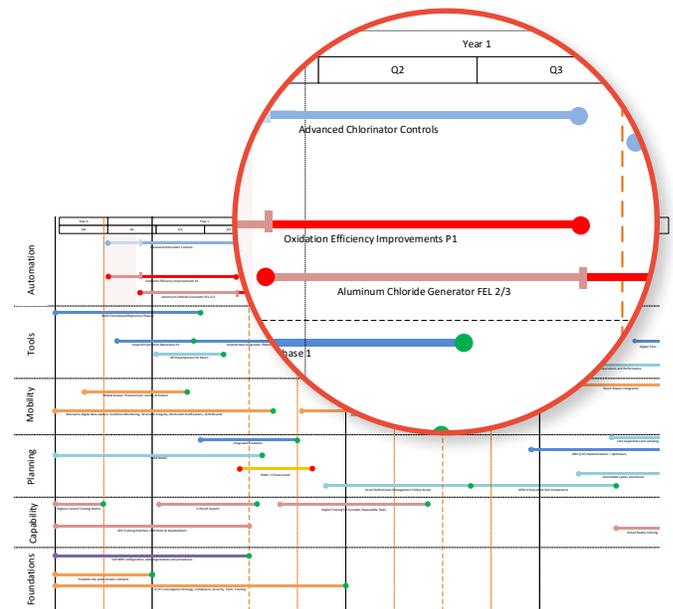
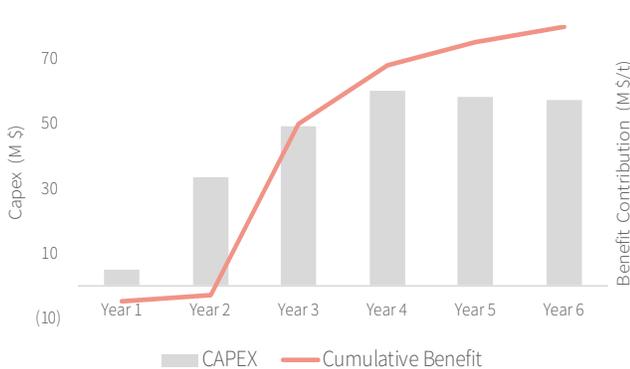
Digital technology is key to unlocking hidden potential. With advances in sensor technology, the pervasive reach of networking technology, easy access to massive computing power and richer portable graphical interfaces, we've created a whole new kind of environment to implement those valuable ideas that we have aspired to do.

Data has the potential to go far beyond monitoring, reaching into real-time predictive and prescriptive applications. Autonomous equipment is now a realistic option in the flow sheet. Digital has matured to the point where reduced variability, higher efficiency, lower maintenance costs, and better safety outcomes are the new reality in mining. Taken together, these improvements can unlock a step change in performance.

By embracing the power of digital technologies, you can transform and optimize your business. Capitalize on the full transformative power of technology with a digitalization journey that provides a robust and practical direction. On the digital transformation journey, data is the currency. Let us show you how it can create new sources of value for your business and industry.



Strategy CAPEX vs Cumulative Benefit



Ultimately, your organization and stakeholders across the entire value chain will benefit from:

- Increased safety and productivity
- Reduced project costs and schedule
- Increased engineering and construction productivity
- Higher quality and less rework
- Seamless project handover
- Better decision making
- Reduced process variation and uncertainty
- Better efficiency
- Better predictability and sustainability
- Lower operational costs
- Higher recovery and yield

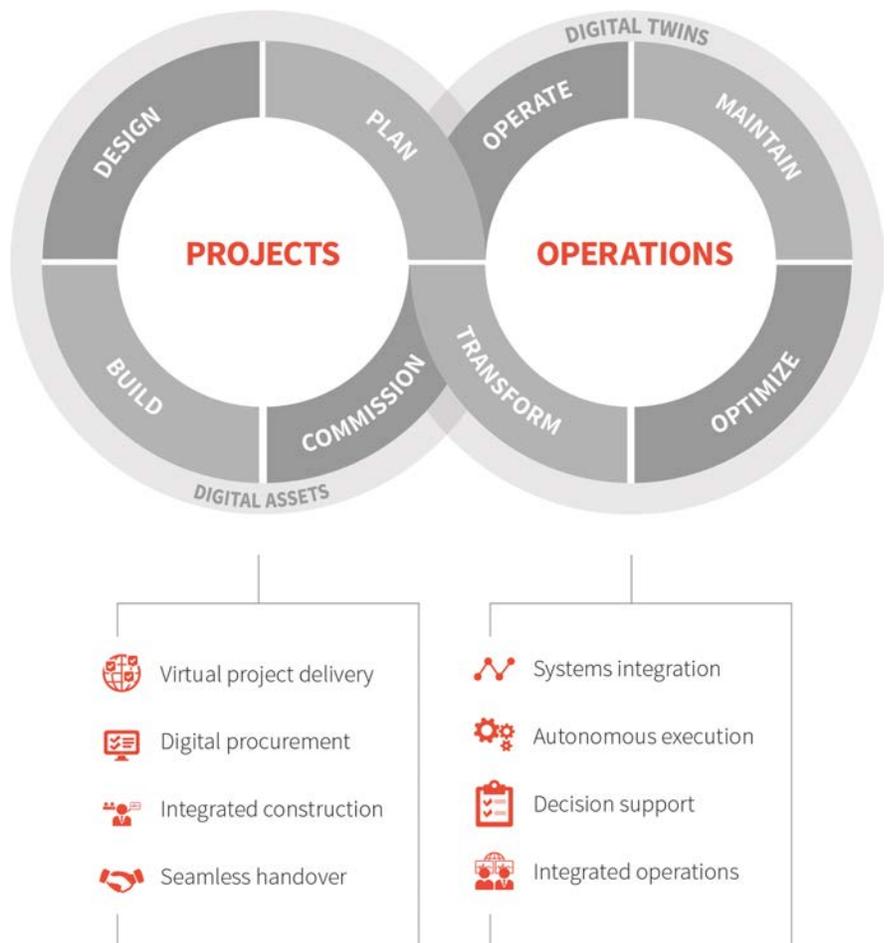


Helping to realize your ambitions

To assist you on this transformational journey, Hatch has augmented its advisory, engineering, technology development and integration, and project-execution-services leadership in the mining sector with an expanded digital service offering.

Our goal is to create a step change in mining that delivers next-level performance enhancements throughout the entire mining value chain, from the ore body through to the finished product, and across the entire mine life cycle, from project conception to end-of-life operations.

As a global industry, mining has come to recognize the need to do something different, to change and innovate to overcome the new challenges of today and develop a new mindset for the future. Because digital has the potential to unlock such significant benefits, it has become a key component of the strategic direction and vision of many mining companies.



They are looking to Hatch to support their journey in three main areas of their vision:



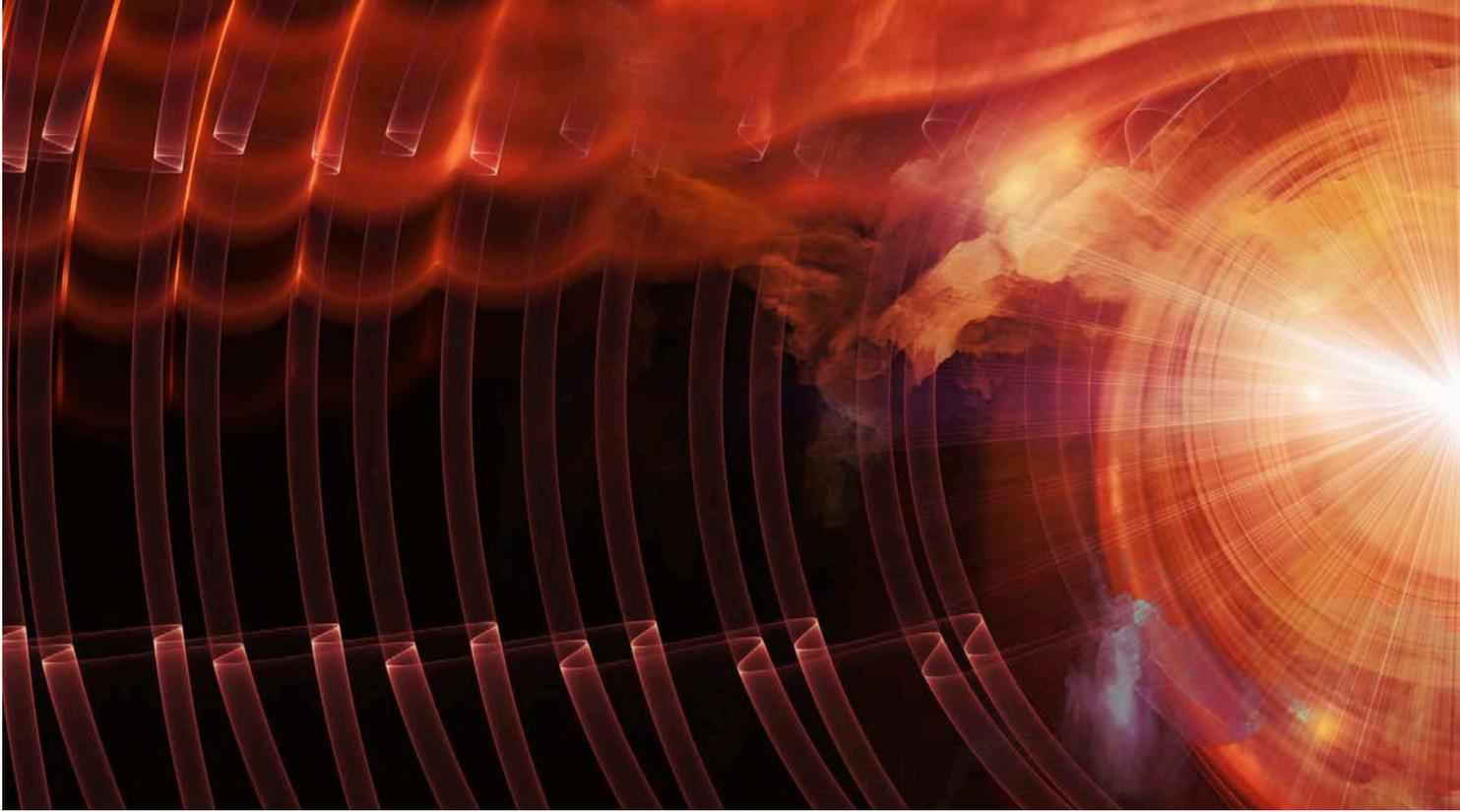
Projects – As part of a greenfield project, a major global mining company, Hatch, and other third parties are collaborating to unlock USD\$500 million NPV through digitalization. We are challenging how projects are planned, executed, and procured from engineering to construction; how the operations will be commissioned and their information handed over; and how their operations are designed, both for change and durability while meeting operating objectives and regulatory requirements.

Technology and innovation – As part of the need to create a step change in mining, we have been working with Vale, Glencore, BHP Billiton and the Canadian Mining Innovation Council to accelerate the digital transformation of various mining initiatives. We have formed technology development partnerships to accelerate the development of a wide range of key technological advances and realize benefits from potential innovations, including the digital mine.

Operations – To help drive the long-term technology direction of a major mining company, Hatch developed the vision and details of the roadmap and business case of an integrated operations strategy involving two mines, three plants, one rail, and one port. This required realigning many of the client's current initiatives to maximize the value of the strategy, which is expected to unlock more than USD\$150 million NPV of additional value. As part of the realignment, Hatch is validating and refreshing our overall ten-year technology roadmap to include new game-changing technologies, including digital.

Our professionals come from many different disciplines with a world of experience serving the mining industry over its entire value chain. We can help you understand the value, minimize the risk, and address change management issues related to implementing groundbreaking and emerging technologies in your business.

We'll show you how to break down silos with better use of your current data investment, reduce variability by addressing root causes, eliminate uncertainty with analytics and innovation, and improve predictability by optimizing your resources and assets. Depending on your ambitions, Hatch can help you realize your journey, whether it's part of your greenfield or brownfield expansion project, a mid- to long-term technology and innovation roadmap, or part of your continuous business improvement program.



A flexible approach to defining and delivering value

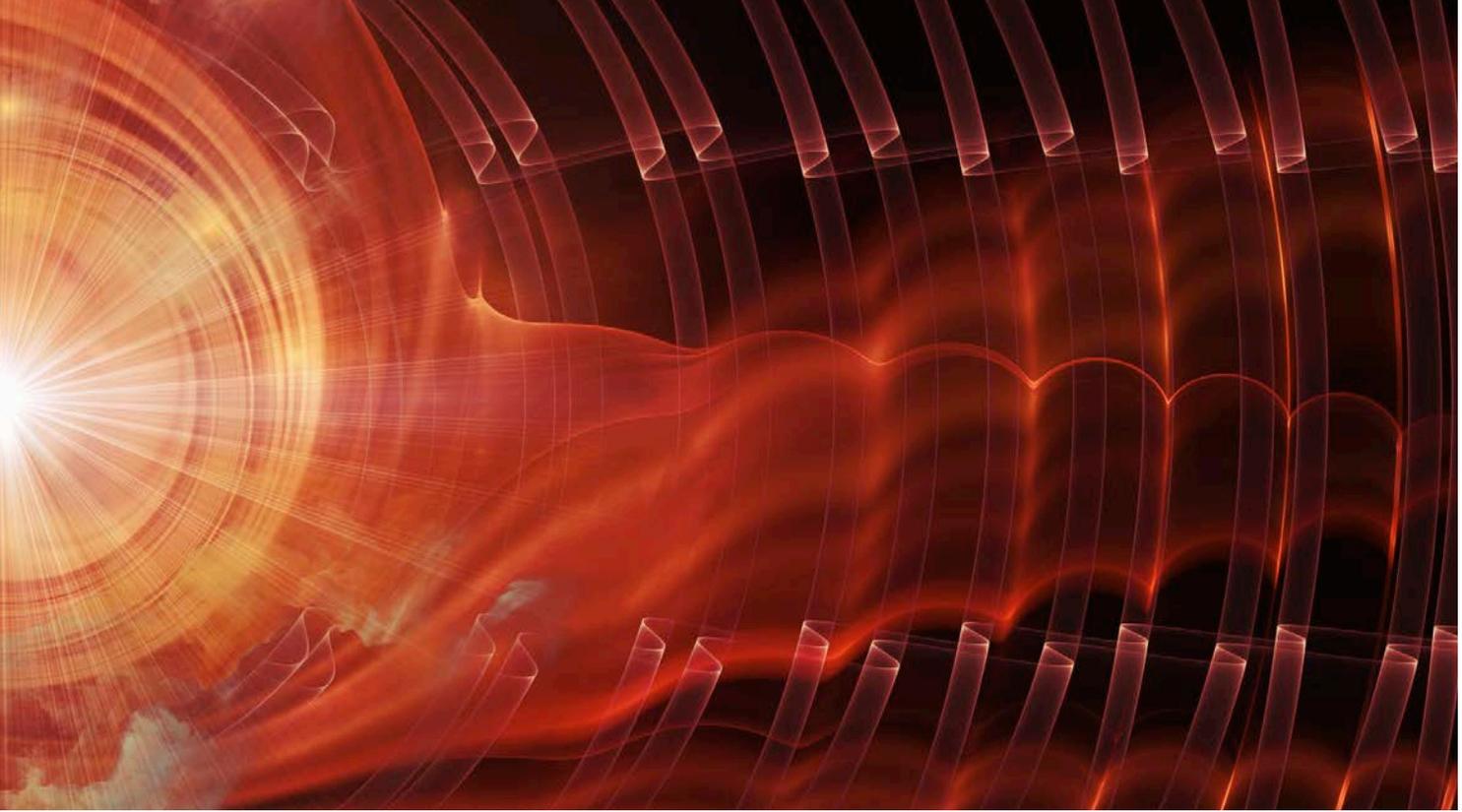
Mining is a very conservative industry. Given the volatility of market conditions, expenditures are very carefully managed for most mining companies. Many have not experienced success with emerging digital technologies or not fully realized the value of other digital technologies implemented in the past. For others, being the first offers a competitive advantage and they are setting the pace by challenging the norm. Change management becomes a critical component of the digital transformation journey.

In collaboration with our advisory services and mining experts, we can architect a fit-for-purpose project execution approach and roadmap with you that considers:

- Your business context and objectives
- Your investment habits and profile
- Your perception and understanding of the value
- The maturity of your current digital technologies, business processes, and technical skills
- The level of complexity required to address the opportunities
- The level of maturity of digital technologies and their applications in mining

We will build an understanding of your specific situation, your value levers, how you'd like to operate, your constraints and bottlenecks, what critical decisions you will need to make, what the organization will look like, and what people competencies and skills will be required.

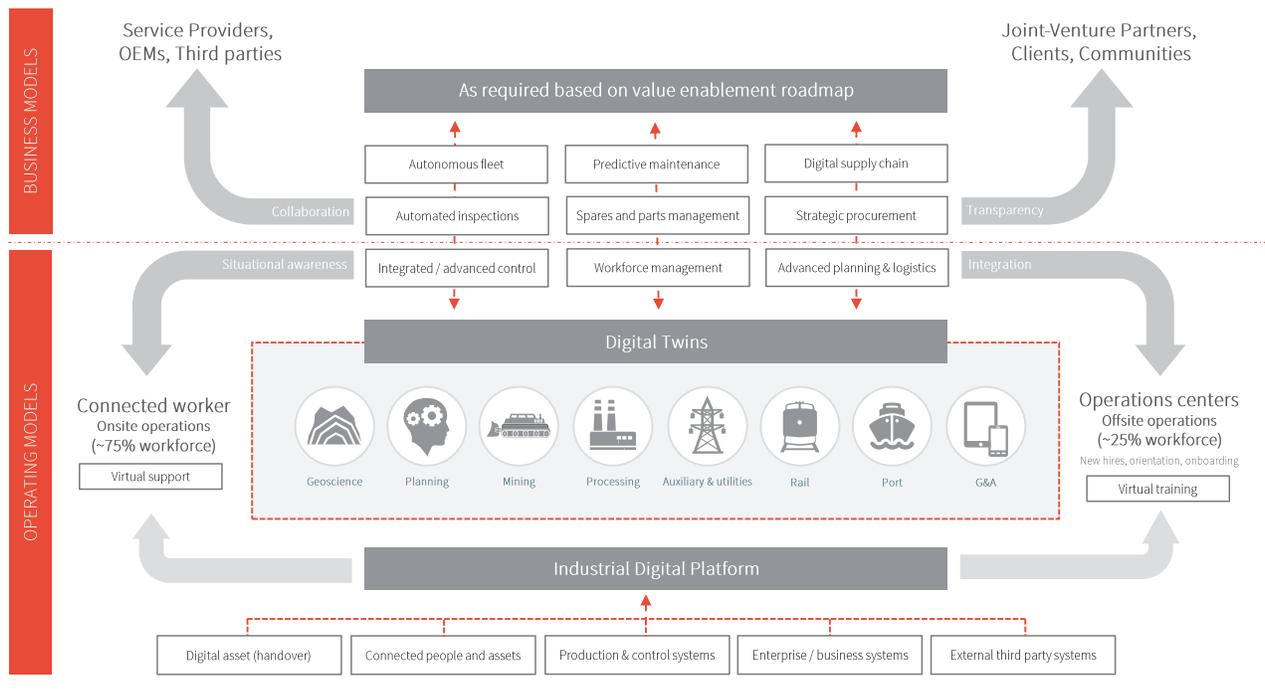
Then, we can develop a roadmap that applies a minimum viable product (MVP), a traditional waterfall development, or a hybrid approach. The MVP offers nimble flexibility in understanding the earned value and managing changes and the cost of uncertainty in your project. It can deliver additive slices of value throughout the lifetime of the project, depending on your priorities or even changes in your business environment. The waterfall development approach—"the big bang"—offers more predictability and stability, things that are often required in large integration projects.



When applying new digital technologies in mining, clients are looking for enough feasibility evidence of the value to support their business case. They need to understand the cost, minimize the risk of failing at the lowest cost possible, and balance the participation of their stakeholders due to time constraints and competing priorities.

We do this by using an MVP approach in collaboration with the technology suppliers and stakeholders involved. Technologically agnostic, we can act on your behalf. We manage the interfaces and help the technology suppliers understand the requirements, supporting their delivery to achieve the best outcome possible. We provide digital expertise, mining expertise, technology and system-integration support, from the technology selection process in demos, through to the implementation of proof-of-concept (POC), proof-of-value (POV), or pilot projects.

Cost	Pilot	Pilot implementation	<ul style="list-style-type: none">• Provides the implementation of a final solution on a small scale that can be rapidly moved to production implementation and scaled up to cover a much larger scope• Helps validate user adoption (change management) prior to full production implementation and promotes understanding of the impact of change
	POV	Proof-of-value	<ul style="list-style-type: none">• Provides evidence of the value of a particular technology or business process using relevant client data• Helps mitigate investment and project execution risks
	POC	Proof-of-concept	<ul style="list-style-type: none">• Provides feasibility evidence (prototype) of conceptual technologies or business processes• Helps mitigate technology risks
	Risks	Demo	Capability demonstration



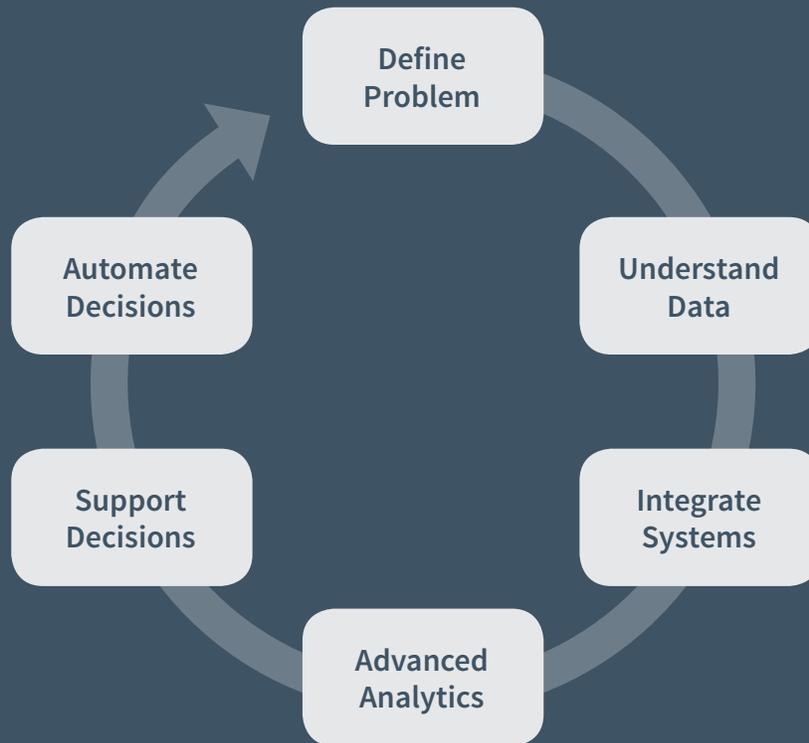
Conceptualizing your vision—Hatch’s digital mine operations vision

A digital mine strategy means many things to many organizations. For us, beyond the technology, it is a new mindset, a new way of operating, and a new way to do business. The diagram below depicts our concept for a digital mine operation. It provides an overview of the potential that digitalization offers as a transformational enabler of mine operations and mining businesses. At a glance, digitalization adds flexibility to mining operating models and creates new value with augmented business models to leapfrog the competition. Our specific areas of focus:

- Running a complex integrated value chain efficiently is difficult. Many producers have or are implementing integrated operations centers or performance center(s) strategies.
- To maximize the opportunity, workers in the field need to be better connected. This drives better coordination of scheduled activities and more timely communication of deviations that can jeopardize the plan.
- A key enabler of this is the “digital twin.” The digital twin becomes the single source of truth, providing trustworthy information about key assets (ore body, equipment, process, inventories, facilities and people) in the right format, in the right time, and to the right people, when needed.
- The lifecycle of the digital twin starts with engineering and construction where detailed information about the asset is developed. In fact, in many situations, the handover process is challenging. So, there is a great opportunity to carry forward and maximize the value of the information generated during engineering and construction during operations.
- During operations, the digital twin continues to be enhanced as more information is created from control and productions systems, enterprise and business systems, or other external third-party sources. Additional sensors may need to be added to augment the digital twin over time.
- The key is to identify the highest value areas first and start there. For example, what are the main drivers of variability in the business and how can digital solve them?
- To achieve this, some key digital technology foundations are required. There are many out there and some are represented here, such as big data storage, cloud/edge computing, machine learning, blockchain, etc.
- There are some significant benefits that digital operations can deliver. Eliminating uncertainty is a key to achieving efficiency, reducing variability and reducing operating costs. We can support with deploying data driven predictive and optimization solutions.

The foundation: Developing a sophisticated data environment

In this new, fully-connected ecosystem, you can maximize the flow of material and services across your assets over time. The prerequisite is a common heartbeat across your operations—one that's enabled by our digital platform. We can contextualize the data from your various systems and link it with subject matter expertise that our professionals provide. Your teams get facilitated analysis and decision support for continuous improvement and capital project planning.

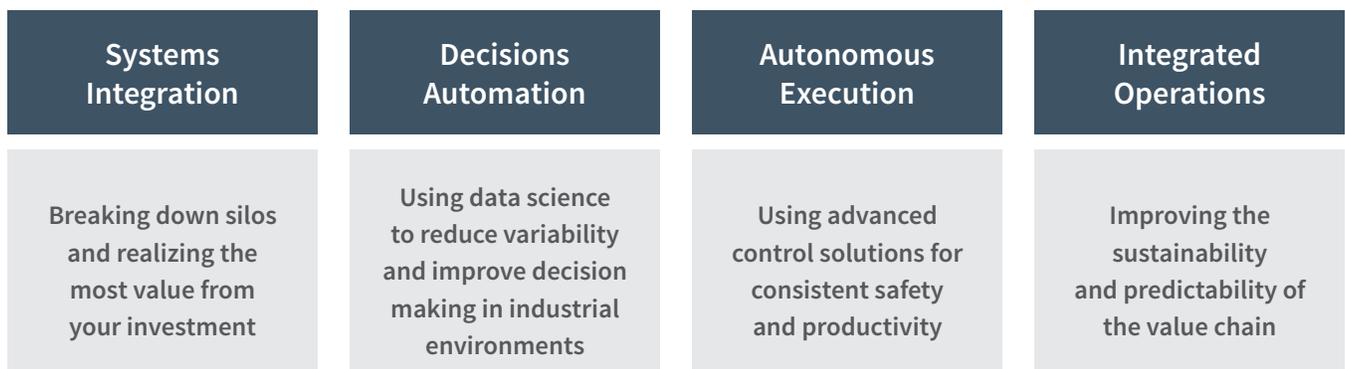


- 1** Identify the problem to solve. Where are the best opportunities for improvement in the value chain?
- 2** Identify and understand the data related to the problem.
- 3** Integrate the existing systems from where this data comes and contextualize it with respect to relevant assets.
- 4** Develop and operationalize it, using advanced data analytics and machine learning techniques to model the algorithms needed to detect and anticipate root causes.
- 5** Link the live algorithm to your decision-support systems for scenario and predictive analyses, and convey any other information required to support the decision.
- 6** Where certain, automate the resulting actions taken. As a result of the decisions made in #5 above, streamline your business processes to drive more effective decision making.



Solutions to help improve your processes and integrate your operations

One size does not fit all. We understand that companies are at different points of maturity in their digital journeys. Hatch has established the service framework below to help you plot the best course.



Pillars of incremental value in the digital transformation

Systems integration and interoperability—realizing the most value from your data investment

One of the biggest challenges with systems implementations is usually not the technology, but the people and processes.

Often, companies invest heavily in mining information management systems and control systems. Significant investment is made to implement enterprise resource planning and business intelligence systems, but without proper integration, the benefits of these systems are not fully realized. The extraction, transformation, and modeling of data to produce meaningful information is cumbersome and time-consuming. And it requires excellent understanding of the mining operations and processes.

We assist clients with a holistic and integrated approach to implementing game-changing technologies.

Hatch uniquely integrates the strengths of multiple disciplines to address the three dimensions of systems—people, processes, and technologies. We use these to deliver successful digital projects that consider operational risk profiles, regulations, recognized best practices, standards where applicable, and other important requirements. An integration partner with engineering, mining, and digital expertise, we can facilitate the communication between the various stakeholders, such as the business, operations, project, process team, technology group and other third parties.

We can help to improve current digital investments that support day-to-day operations, such as:

- Digital asset management with predictive maintenance and automated inspections
- Integrated planning and scheduling
- Operational risk management
- Integrated/advanced control applications
- Operations and production management
- Energy and water management
- Industrial network and telecommunication infrastructure, including wireless
- Digital assets and twins—augmented/virtual reality
- People and asset tracking—wearables



Agnostic integration with innovation partners of digital technologies

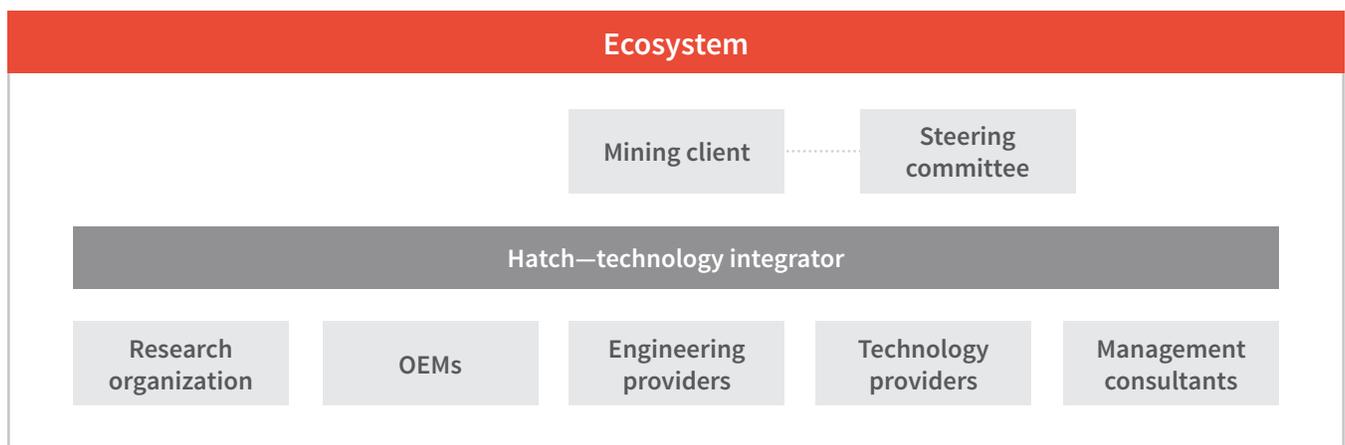
No single technology provider can deliver an entire digital solution or address the need for multiple digital solutions in mining. Hatch applies a rigorous and proven innovation partnership model to support and drive your vision.

We have experience working with major global mining clients to manage and implement technology road map as a technology integrator. Through this, we've developed best practices in governance structure for the ecosystem and partner deployment.

Our goal is always to guide you towards using technologies already available, in mining and other industries. If these technologies are not fully suitable to your requirements, then we fill the gaps with bespoke solutions or through collaborative technology innovation agreements.

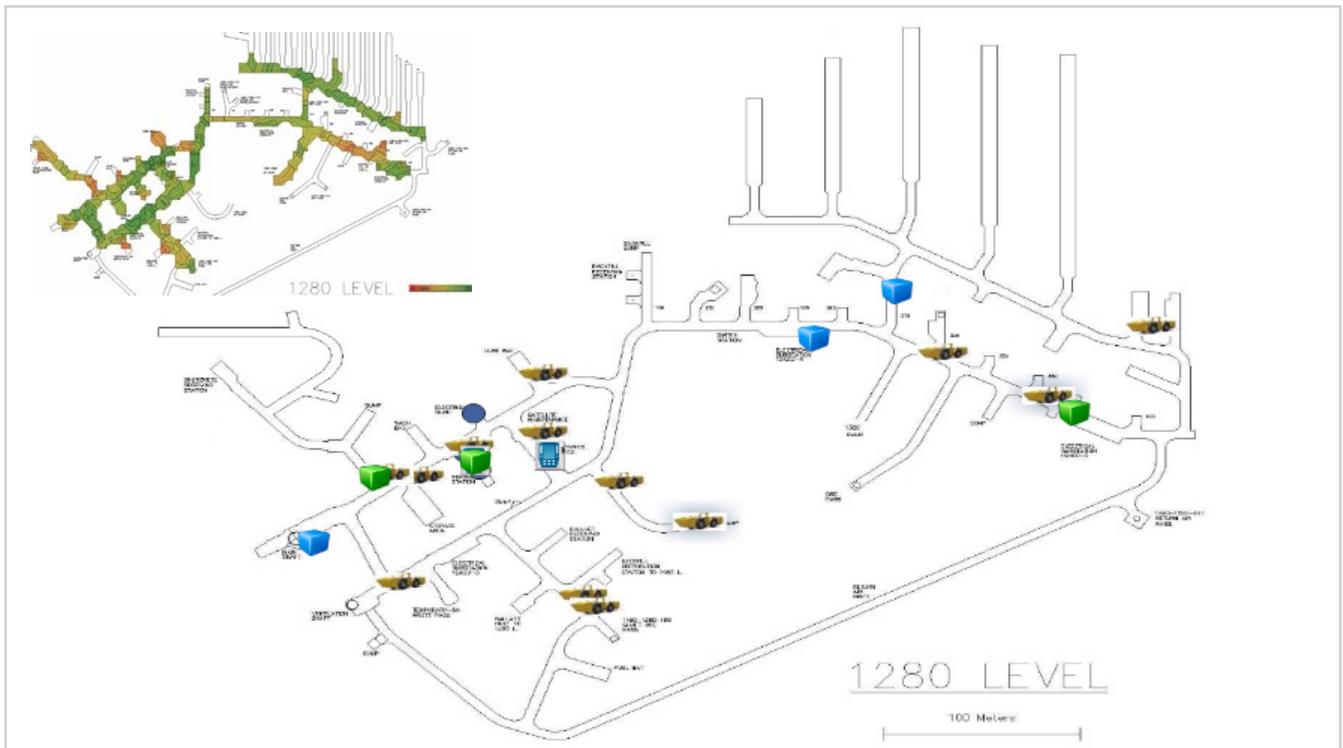
Digital projects are often delayed because of the lack of definition of scope, battery limits of work packages, project standards, procurement of software licences, or gaps requiring custom development work that does not fit in vendor technology roadmaps. Addressing these challenges requires an integration and technology partner who knows how to manage these digital projects, as well as stakeholders, vendors and other parties – one who advocates in the best interests of your project and the parties involved.

We have a track record of working effectively and transparently with multiple vendors and technology providers on our projects, both internally in our own business and externally with our clients. Thanks to our agnostic approach, we can demonstrate the value of digital to our clients without necessarily investing in additional technologies.



As a trusted partner, Hatch can play a key role in managing the ecosystem





Case study

Glencore Xstrata's digital underground mining operations

Relevant topics: industrial/underground network and telecommunication infrastructure, wireless, people & asset tracking, wearables, ventilation on demand (VoD).

- 

Comprehensive in-shift operations to plan
Manage workplace resources, task status, delays and changes in a short interval control environment to meet weekly plans
- 

Connected worker
Get instructions, schedule, task updates and reassignment in real time
- 

Real time problem solving
Conduct channel-rich conversations—underground and surface—to address issues as they occur
- 

Shift monitoring and decision making
Detailed work location and task progress monitoring and management
- 

Resource location management
Easily locate equipment and personnel to efficiently assign resources to upcoming tasks
- 

Continuous improvement
Use historical production data and centralized metrics to make better informed operational decisions
- 

Seamless shift handover
Provide accurate and timely information to next shift and quickly understand workplace status

Glencore Xstrata's underground mining operations in Sudbury, Canada, has been applying leading-edge technology for more than ten years. At its Nickel Rim South Mine in 2006, Glencore implemented a state-of-the-art mine system. It included mine wireless infrastructure, passive tags for equipment and personnel tracking, automated mine hoisting, remote mobile equipment controls, ventilation on demand, and an onsite OSISoft PI historian and product management portal, all accessible from a central control room environment. This digital infrastructure supported the underground nickel mine, a 1,700-metre multilevel shaft, backfill plant, dewatering, ore/waste handling, and process utilities.

Glencore is expanding its mining operations at Nickel Rim and Onaping, reaching new, deeper levels underground. Hatch has integrated EPCM in these multimillion-dollar greenfield and brownfield projects. Our relationship with Glencore has been augmented to include a technology venture that will increase the adoption of digitalization in underground mining operations, and extend its range to the mine face.



Case study

Energy management information system (EMIS) for ArcelorMittal

Relevant topics: *energy models, energy management information systems, integration with MES, historian and third-party systems through REST APIs.*

About 30 percent of overall costs in the mining and metals sector relate to energy use, including electricity, natural gas, and other fuels as well as water and steam. By understanding energy usage, particularly its drivers like production, and regularly monitoring and assessing the energy plan, ArcelorMittal realized reductions in base load, in variability associated with the energy drivers, and found increases in operational efficiencies.

Hatch helped ArcelorMittal identify and implement a cost-effective solution utilizing their current technology investment. An EMIS was used to automate data capture, as well as the calculations and reporting required to monitor these energy improvements. This is providing ArcelorMittal information on-demand for analysis and assessment purposes. It is targeting savings of 2 percent to 8 percent of its overall energy cost.



Case study

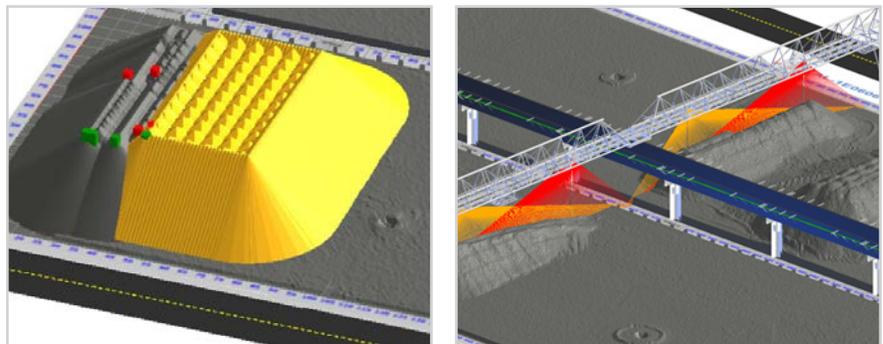
Coal stockpile planning and execution support system for the world's largest 3D printer and scanner

Relevant topics: *stockpile planning, 3D visualization, LIDAR and MES integration, bespoke solution.*

A multiuser coal terminal that receives coal by train for shipping needs to precisely manage multiple stockpiles for multiple clients, each within defined boundaries in the stockyard. Stacking is performed by a unique 250-metre-wide gantry stacker over a one-kilometre-long stockyard, for which no stockpile management solution existed in the market.

Hatch developed a bespoke planning tool that utilized data from historian and MES to maintain a 3D representation of the stockpile plan. It performs the complex calculations to generate new stacking-plan recipes for the process control system.

The plans ensure the stacker is correctly positioned to maximize stockyard capacity. New stacks can be aligned beside previously stacked coal at the same height, or over previous benches. The solution was enhanced with the addition of LIDAR scanners to accommodate stacking over remnant coal. The stacker scans and updates the stockyard heights in the planning tool database every time it moves. This way, the 3D-stockyard plan can be interrogated during plan development to eliminate delays due to poor stacking planning.



Decision support—reducing variability and improving decision making in industrial mining environments

The revolution around the IoT is creating an environment in which data is transforming industries to become algorithmic rather than people-intensive. Advances made in data science can now be used to better understand and control mining processes. We're moving from a paradigm of detection and control to one of prediction and optimization.

Our solutions cover the full data-analytics continuum, from descriptive (supporting workflow optimization and visualization) to diagnostic (allowing root cause analysis and continuous improvement) to predictive (providing insight into what might happen), and finally optimizing (using advanced algorithms to recommend or set the best adjustments to process and/or maintenance parameters).

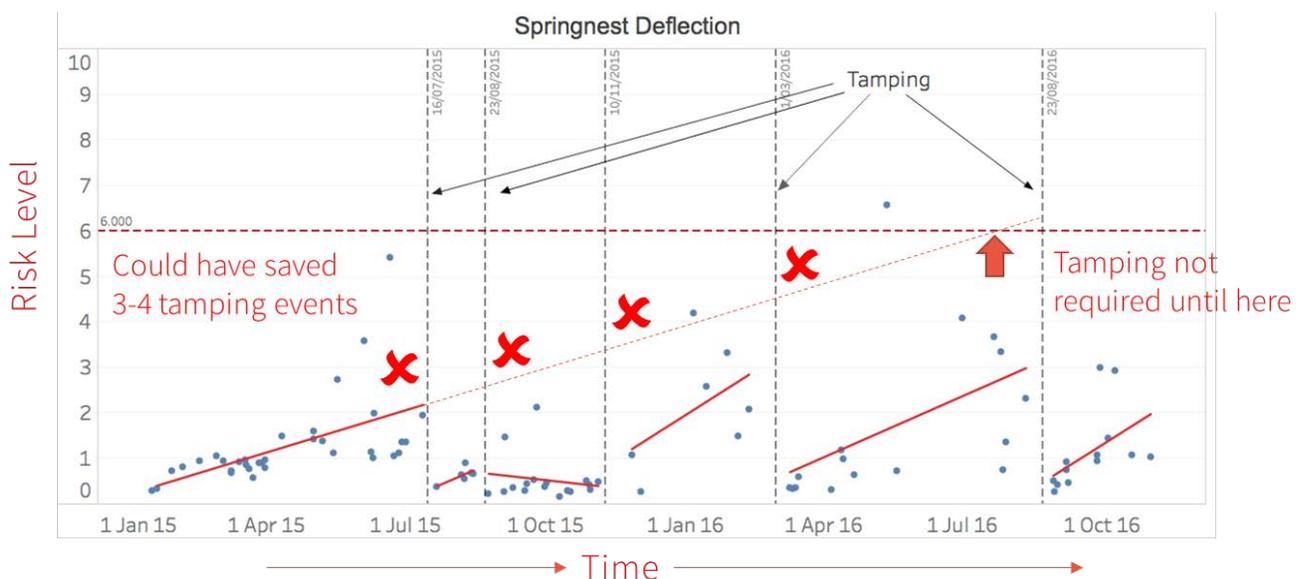
Our team of experts can analyze live and historic data. We work closely with operations teams to identify and implement solutions that significantly improve and

permanently sustain productivity outcomes. We enable remote support. Perform remote diagnostics. Anticipate problems. Promote optimum decision making for improvement. And ramp up support, knowledge, and experience transfer.

Predictive maintenance management

We can process large volumes of complex, structured, and unstructured data and apply cutting-edge algorithms for model building to extract valuable insights. We can assist in creating interactive dashboards that combine data from multiple sources into a single, comprehensible, data exploration environment. It will identify problem areas and forecast conditions to recommend timely intervention.

Hatch has a deep technical understanding of how furnaces and chemical processing facilities operate and



Analytics chart for maintenance planning purpose



has been diagnosing operational problems for years. We now augment this technical experience with our data scientists. Partnering with engineers, they churn through historic data and use sophisticated statistical

and machine learning methods to elegantly combine large and complex data sets from different sources. Then they narrow down hundreds of variables to the few that influence failure and use creative visualization to illustrate the failure analysis scenarios.

In spite of recent advances in data-based analyses, optimizing value chains is still a challenge: while there is value in building models from historical data, fundamental model equations allow decision-support systems to uncover previously untapped operating strategies with added benefits. Hatch has extensive experience developing and deploying first-principles value chain models that can be seamlessly integrated and optimized using state-of-the-art methods such as linear programming, nonlinear programming and mixed-integer linear programming.

Case study

Predictive rail maintenance management

Relevant topics: *asset health, predictive maintenance, opportunistic maintenance, advanced analytics, interactive dashboarding, systems integration.*

Recently, as part of our client’s best-practice maintenance program, Hatch used expertise in rail, asset management, and data science to guide work over a period of three months. Our data scientists built a predictive model of track failure to inform the maintenance team of its priority areas in a timely manner.

Previously, important data was not always available to decision makers. It resided in many different locations and was managed by different people, making it impossible to have a complete, consistent picture of the track condition and degradation trends without relying on visual inspections. This led to an inefficient and ineffective maintenance strategy. Our client can now access a single source of the truth and use it to plan and optimize inspection and maintenance activities. The rail and asset management experts at Hatch can then use this important information to help build a cost-effective, predictive maintenance strategy, reducing maintenance costs and improving track availability and safety.



The dashboard is used to prioritize track works. It shows different risk factors, structures, and operation considerations, such as speed restrictions and actual speeds along the track to support decision making



Case study

Hatch-Glencore Technology Venture for Glencore-Onaping Depth Digital Underground Mine Operation Management Solution

Relevant topics: *digital underground, mining intensity, connected worker, underground network and telecommunication infrastructure, seamless shift handover, real time problem solving, reduced variation, maximum sustainable rate (MSR).*

Hatch teamed with Glencore to trial operational management system (OMS) philosophies aimed at the reduction of in-shift variability. We created a digital underground operational management solution to more closely plan and manage in-shift performance; from start of shift stand-up meetings, to monitoring in-shift performance, and handover at end of shift. The project centered on creating a connected worker that has full knowledge of the schedule, the workplace status and in-shift performance disturbances. As a result, this initiative is anticipated to deliver a 25% increase in productivity.

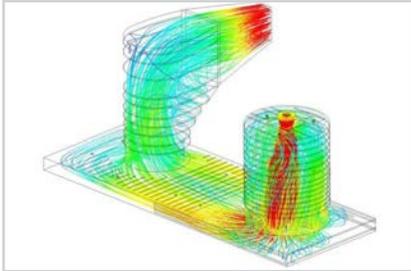


Managing variation can lead to a step change in operational performance and achievement of maximum sustainable rate (MSR).

Case study

Advanced fault diagnosis for flash smelting furnace confidential client

Relevant topics: *statistical regularization, process analytics and optimization, multivariate statistical analysis, latent variable, creative visualization.*



A copper flash smelting furnace was experiencing failures in an ancillary piece of equipment during new equipment trials. Hatch conducted an in-depth analysis to determine whether the equipment trials and equipment failures were connected. We collected data over a hundred sensors, along with manual measurements of concentrate feed and smelted slag. Our data science and furnace teams worked closely to ensure the data was interpreted correctly, and the analysis and findings were consistent with the complex flash smelting process.

We were able to:

- Develop insights about the reaction shaft operation from visualization and statistical metrics;
- Narrow the study to the five most significant variables; and
- Confirm that the failures were not related to the trials of the new equipment.

As a result, our client could focus their operation review to address the root cause of the equipment failures.

Case study

Hatch Rail Optimizer software

Relevant topics: *track maintenance scheduling, system capacity, capital expenditures optimization, linear programming, nonlinear programming and mixed-integer linear programming, first-principles value chain models.*

Developed to resolve complex rail-scheduling tasks that could not be accommodated within existing commercial tools, the Hatch Rail Optimizer tool uses the rail system infrastructure information to unlock the value of rail assets.

The Hatch Rail Optimizer can be used for different purposes:

- Quickly determining feasible train schedules
- Fast recoveries from unforeseen events in the rail system
- Scheduling track maintenance
- Determining maximum rail system capacity
- Determining optimal capital expenditures for increased system capacity.



Chris Floudas Award
Hatch Rail Optimizer

The Hatch Rail Optimizer was the proud recipient of the Chris Floudas Award at the 2017 Foundations of Computer Aided Process Operations (FOCAPO) conference in Tucson, Arizona, USA. It was selected as the most innovative contribution to the conference compared to academic papers from universities such as Harvard, MIT, Carnegie Mellon University, Imperial College London, University of Wisconsin-Madison, amongst others.

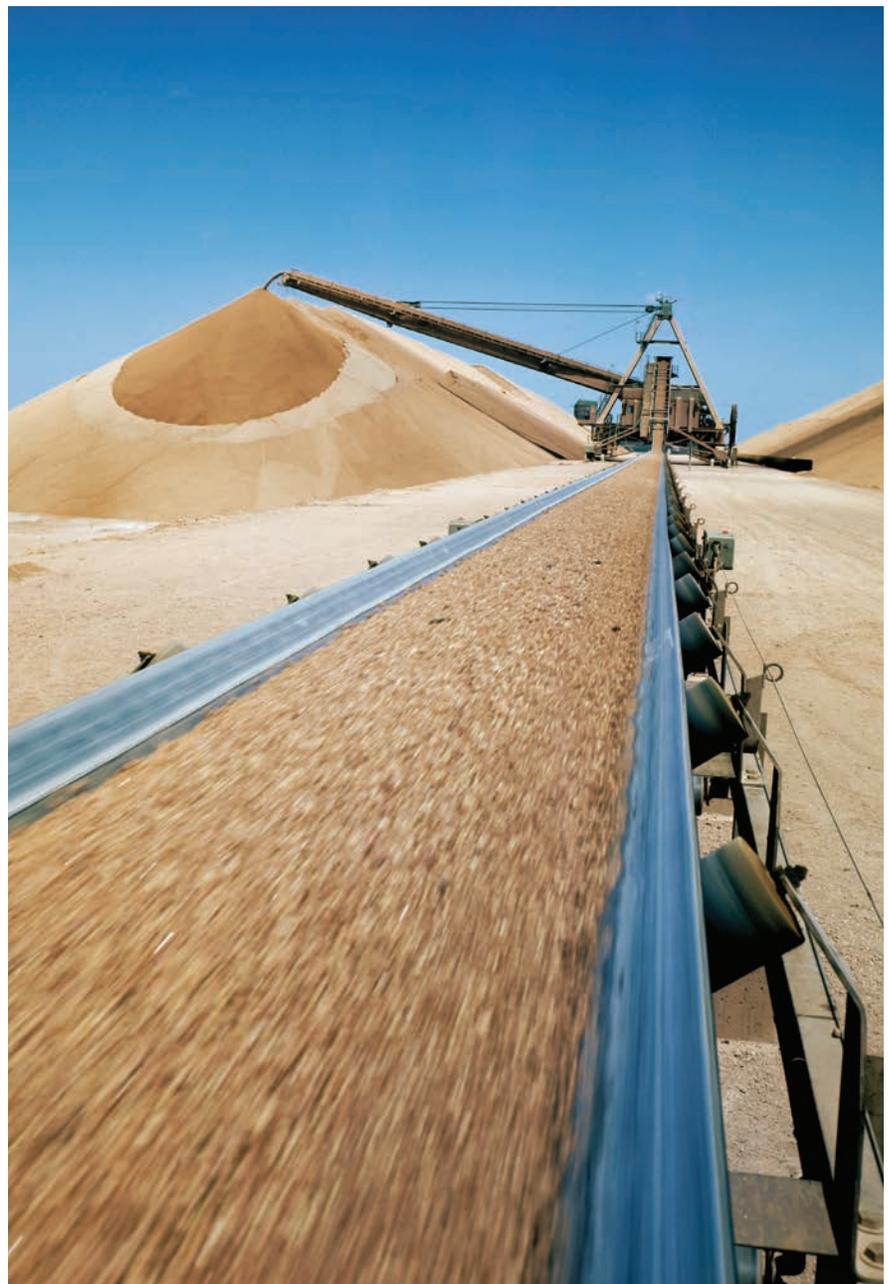
“Transnet has embarked on a major infrastructure investment programme supporting its Market Demand Strategy (MDS)... The project presented with quite a few challenges. The rail scope of the corridor was particularly complicated due to varying train lengths, varying passing loop lengths, single and double line sections... I regard the innovation and quality of output presented by the Hatch team as invaluable.”

- Transnet Group (South Africa)

Autonomous execution —using advanced control solutions for consistent safety and productivity

Today's mining operations are not standardized. They vary in complexity and scope. Because of these challenges, there remain many opportunities for further automation. But they have not always been prioritized or deemed doable.

However, with good engineering practices to design for safety and performance, industry insights to make them operational, and deep expertise in automation, it's possible to innovate further and push the frontier of automation. Hatch has developed award-winning automation solutions for the mining industry, such as autonomous fleet management, virtual spud systems, product transport and route-control systems, and stockyard automation systems, just to name a few.

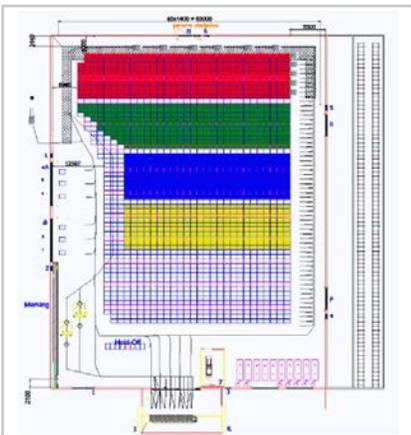




Case study

Automated guided vehicles for Aluminerie Alouette, Sept-Iles, Canada

Relevant topics: *dynamic simulation, peripheral systems, AGV system integration.*



Dynamic simulation
—layout testing

Hatch completed a project to automate aluminum sow handling equipment for ship loading at this aluminum producer. The business case for the project was justified on the elimination of demurrage charges related to ship loading while reducing labor costs associated with sow delivery management. Eliminating operator-forklift co-activity led to cost savings and improved safety in this area. The metal management process was reviewed and optimized. Optimization included metal cooling rails, metal yard operations, and sow haulage from the metal yard to the Aluminium Logistics Centre (ALC) and ALC configuration. A custom trailer was designed for metal haulage. ALC operation included reception, strapping, storage, marking, and shipping operations with 14 AGVs to enable the transportation of sow bundles between the various warehouse stations. Replacing traditional transporters with AGVs:

- Reduces operating costs
- Improves safety
- Increases productivity
- Improves product integrity through ease of repeatability, increase in predictability, and manageability of movement
- Enables product traceability through warehouse management systems
- Reduces greenhouse gases' footprint

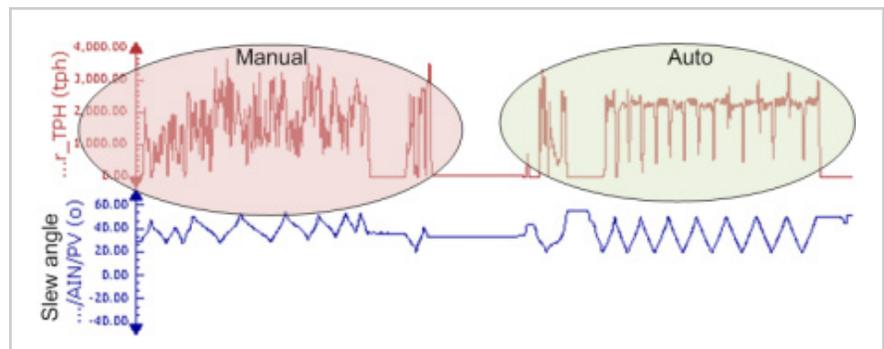
Case Study

Stockyard automation

Relevant topics: *autonomous equipment, collision detection, integrated control.*

Hatch Stockyard Automation (HSA) technology, an innovative approach to collision protection system that enables safe and efficient unmanned mobile machines operations within a stockyard.

The HSA technology suite was purpose-built to modernize yard operation by introducing a stockpile custody and seamless coordination system and collision detection system. It provides unmanned automation that can improve throughput by using advanced control techniques. Variability of human factors is also minimized and can boost productivity. HAS also addresses safety concerns by eliminating the presence of on-board operators in reclaimers and stackers, and by providing the enhanced ability to detect potential machine collision. As a result, stockpile management is simplified and there is greater stockyard safety, flexibility and efficiency. Overall, a productivity improvement of 10% has been observed.



Case study

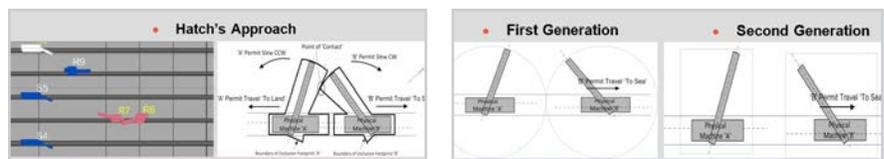
Hatch product transport (HPT) at Port Hedland, Australia

Relevant topics: *collision protection system, bulk handling, route control, human machine interface.*

Hatch Product Transport-Route Control System (HPT-RC) addresses the challenges associated with bulk material handling facilities. The system performs the critical function of controlling and coordinating all material handling equipment along a route.

HPT-RC can make intelligent decisions in real time, for optimal outcome every time. Updating the control system can achieve significant throughput gains without costly mechanical upgrades and lost production shutdowns. As new items of equipment are added, the equipment will continue to interact with its neighboring equipment smoothly and efficiently. Using HPT's patented algorithms makes coordinating multiple routes and shared equipment more efficient and flexible and results in significant productivity improvement with project timelines and project risks significantly reduced.

Hatch Product Transport-Route Control System provide safe operation of machines through centralized monitoring of mobile machine positions and motions and improve stockyard utilization by allowing closer machine operation. It has achieved a higher than 99.95% system availability, including any downtime required for system maintained, upgrades, and over 25 facility expansions.



Case study

Virtual spud at TiZir's Grande Cote Mineral Sands project, Senegal

Relevant topics: *automation, continuous mining, dredging process, complex machine to human automation, spudless dredge.*

The traditional spud dredge is the most common type of dredge use in mining but has several limitations associated with spud walk and crab movement. Using the virtual spud technology from Hatch not only promotes a safer dredging process but also eliminates the need for using a spud and enables a much wider continuous mining width to simplify operations, allow automatic operation and provide cutter trajectories for mining, cleanup and swiping modes. Thus, projects can expect a productivity improvement of 10-20% over classical spud dredges.

Hatch's Virtual Spud technology is patent pending and is the winner at the Western Australia Engineering Excellence Awards.



“Hatch’s Maneuvering Control system is a ground-breaking achievement for the industry and I see it as the future for dredge mining operations”

- October 2013 - Peter Harrison, TiZir Chief Dredge Operator

Case Study

Unmanned aerial water sampling systems (UAWSS) for Goldcorp Canada Ltd., Kinross, National Oilwell Varco and Nevada Division of Environmental Protection, Canada and USA

Relevant topics: *autonomous sampling systems, unmanned aerial vehicles (UAV), unmanned aerial water sampling systems (UAWSS), drones, mobile water testing lab, in-situ profiles, mobile water testing lab, pit lake monitoring programs, custom payload applications.*

Hatch conducted water samples and in-situ profiles of temperatures and electrical conductivity throughout the water column using unmanned aerial vehicles. With an innovative patent-pending attachment for the release mechanism on the drone that allows the collection of water samples, we were able to quickly analyze the samples for pH, iron species, and total arsenic using Hatch's mobile water testing lab and provide the client with immediate analysis and interpretations of the results. As a result, we were able to reduce the costs of monitoring while eliminating an enormous amount of risk by avoiding the need for mine personnel to access the water surface all-together.





Integrated operations— improving the predictability and sustainability of the value chain

Integrated operations is the term that describes the mix of people, organizations, work processes and information technology needed to make smarter operations-and-maintenance decisions.

Knowing the real state and location of every piece of equipment in a mining operation in real time and being able to track plan vs. actual results enables a whole new level of performance management. Once the connection is real-time and centralized, it is possible to move to an operating space where you can optimize across the entire supply chain rather than within local silos. You can address more complex problems that impact variability to achieve longer-term sustained results.

We do more than help our clients create business plans and concepts to develop their own integrated planning and operations centers. We work with them, drawing on our project execution capability to make their ideas a reality.

With Hatch's deep subject-matter expertise in mining and asset management, we provide specialized remote monitoring and diagnostic services. We implement appropriate solutions to deliver sustained step-change performance improvements for our clients.

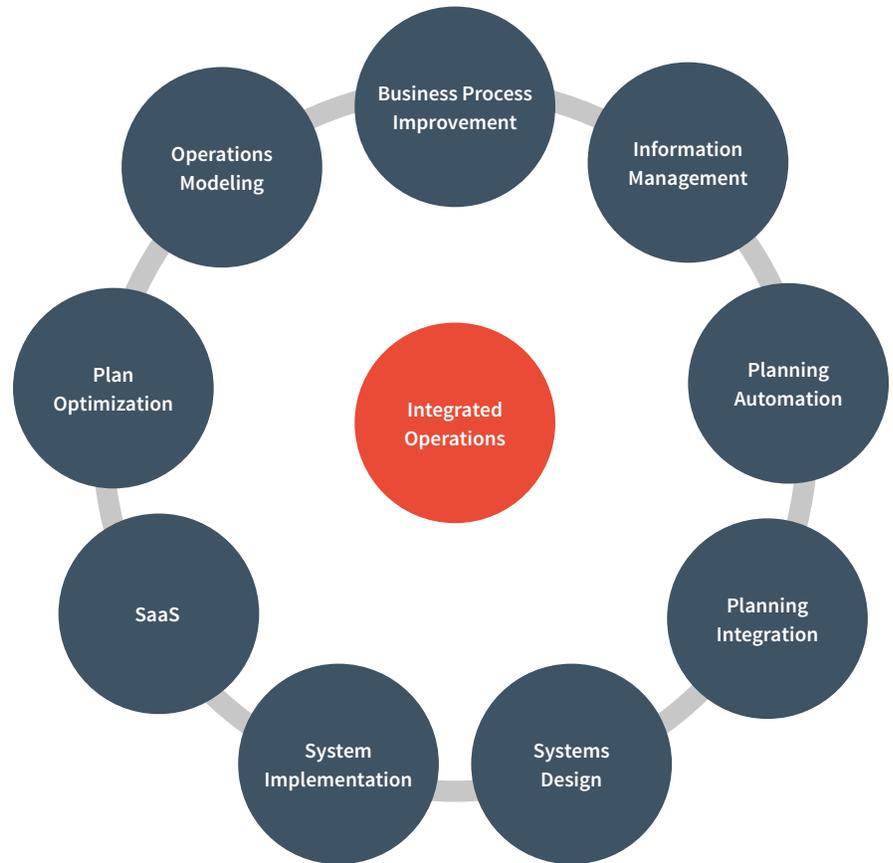
Traditional approaches to business improvement aim to address shortcomings in the activities, tools, and information that underpin the planning process. They don't always consider the operation's ability to translate planning outputs into execution. Conversely, an asset's operating philosophy is often considered in isolation, not necessarily reflecting the planning process required to make it work.

We use an integrated planning-and-operations modeling approach, embedding operations models within the planning process to better align the relationships and dependencies. The result is better business improvement.



With the aid of sophisticated operations models, we can not only characterize the performance of an operation, but measure how it is impacted by the planning process itself. By identifying improvement opportunities and pain points within existing processes at the planning stage, we can define a path to a streamlined future state. This allows planners to focus on making the decisions that truly drive value for their business.

By embedding operations models within the planning process, we provide an ideal environment to test the validity and robustness of planning inputs. At the same time, we consider the impact of equipment interactions (e.g. queuing) and stochastic phenomena (equipment breakdowns and weather) on performance and throughput. Our clients move forward with confidence that their plans are both practical and aligned with business objectives.



Combining our expertise in operations modeling, business process analysis, information management, application development to optimize planning and operations

Case study

Integrated demand and operations for Anglo American Metallurgical Coal

Relevant topics: *strategic planning, marketing and sales integration, value chain integration.*

After developing an operational model of an existing coal mining complex to support a greenfield expansion project, Hatch was retained by Anglo American’s marketing team to undertake a strategic business planning exercise using the model.

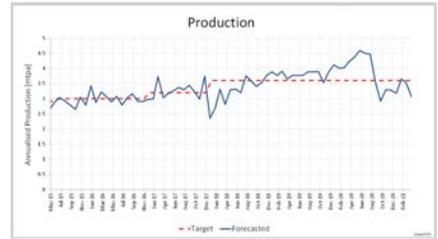
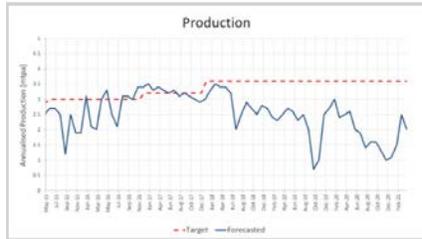
Through this engagement, Hatch identified opportunities to improve the planning tools that underpin Anglo’s established sales and operations planning process, one that spans multiple planning horizons and organizational boundaries. Concepts captured in the operations model were incorporated into an improved planning suite that provided tighter integration between surface operations, logistics, and sales planning.

Case study

Underground gold-mine-knowledge base planning for confidential client

Relevant topics: *mine planning, integrated planning and operations model, capital planning.*

Hatch was engaged by a major global gold producer to develop a mine plan. The goal was to target the aggressive production increases set out in its strategic growth plan. By using an integrated planning and operations model (knowledge base), Hatch collaborated with the client's mine planning, geology and underground operations teams to determine the optimum exploration and mining sequence to support the plan. Furthermore, the model provided a common platform from which to identify and address capital requirements (for infrastructure development and fleet sizing), operating rules (to allocate equipment to competing tasks), and planning requirements (tighter integration of exploration plan and mine design). Accordingly, the integrated planning and operations model has been adopted as a key device in our client's ongoing business planning process.



Case study

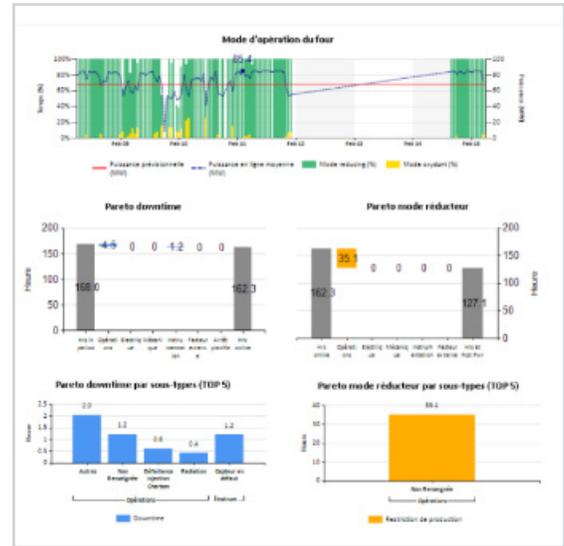
Remote site surveys of a 3D digitally-enabled copper mill plant using a virtual reality environment

Relevant topics: *digital asset, virtual reality, remote site surveys, integrated remote centers, zero harm, community engagement.*

3D models of plants and mining operations are generated during greenfield and expansion projects. Many of these models are not used again. A leading copper producer is using virtual reality to utilize these 3D models for site surveys as part of the project bidding process. This reduces the risk of incidents and accidents by removing the need to have third-party service providers at site unnecessarily.

The virtual reality environment is accessible from a remote operations center many kilometres from actual operations. Hatch was responsible for the development and delivery of the virtual reality application to the client.





Case study

Single point of responsibility for the integration of digital technologies from field to boardroom

Relevant topics: *managed network and telecommunications infrastructure, simulations, security systems, control systems, operations management systems and ERP integration, remote commissioning and operations support, 24-7 follow the sun support approach.*

This project in the North Province of New Caledonia being undertaken by Koniambo Nickel SAS. This greenfield, pyrometallurgical facility comprises a 60,000-tonne-per-annum ferronickel smelter for the extraction of nickel from saprolitic ore mined from the Koniambo ore body. Koniambo is one of the world's largest and highest-grade undeveloped nickel laterite deposits. Facilities at this world-class nickel operation include the laterite mine; ore treatment plant and ore-transport and stockpiling facilities (including a 12 km, 700 tph overland conveyor system); a pyrometallurgical ore-processing plant; coal pulverization plant; nitrogen/oxygen plant; cooling water systems and other utilities; a two-line 340-MW circulating fluid bed boiler coal-fired power plant; and other infrastructure including a port and coal stockpiling.

Hatch assisted with the design, delivery and integration of instrumentation, control systems, supervisory systems and operations management systems. As part of the scope, we also took care of the information and communications technologies (ICT) solutions that will support the contractors' mobility and the entire infrastructure for the site. Because of the remoteness of the site, we utilised the simulated software to support the commissioning and the start-up of the facilities with fewer people on site and in a shorter timeframe. We continue to support the site operations remotely from three Hatch offices with our subject matter experts on a 24/7 follow the sun approach: Mississauga, Canada, Perth and Brisbane, Australia.

Hatch received a commendation from Koniambo Commissioning Team and Owner's Team. Highlights include:

- The quality of the design, programming and testing produced before deployment on site level
- The flexibility to adjust to project priorities
- The level of accountability for delivering all systems in an integrated approach
- The capability to respect schedule constraints
- Our ability to work efficiently with vendors and operations and process teams

Hatch at the center of your ecosystem, helping you realize your ambitions

By partnering with Hatch, you extend your team. Hatch is a technology integrator, always seeking the best solutions and outcomes for you. We are independent, and agnostic to particular vendors and technologies.

We are flexible, able to work in collaboration with your functional teams, preferred vendors, and other third parties as an integrated unit.

We offer advanced digital solutions to solve previously intractable challenges in the mining, metals, and minerals industries. These are supported by our integrated performance centers, providing access to engineering specialists with deep domain knowledge.

Hatch has more than twenty years of experience assisting clients with value creation using digital visions and strategies in their projects and operations. These visions

and strategies consider the convergence of operational technologies and information technologies, and aligning them with our clients' business value creators, operating models, and game-changing technology.

There is a very real opportunity to transform the mining industry from a people-intensive to an algorithm-intensive industry, fueled by data and automation to improve the predictability of operations and drive new levels of productivity, efficiency and safety. Hatch would like to partner with you to help achieve this.

20+ Years delivering Digital Solutions	250+ Staff dedicated to Digital Solutions, Machine Learning & Data Analytics
40+ Years delivering Control, Automation & Electrical Solutions	350+ Staff dedicated to Control, Automation & Electrical
20+ Years delivering Advisory Services and Business Improvements	40+ Disciplines related to Business Improvements
60+ Years of Technologies & Innovation	







About Hatch

Whatever our clients envision, our engineers can design and build. With over six decades of business and technical experience in the mining, energy, and infrastructure sectors, we know your business and understand that your challenges are changing rapidly.

We respond quickly with solutions that are smarter, more efficient, and innovative. We draw upon our 9,000 staff with experience in over 150 countries to challenge the status quo and create positive change for our clients, our employees, and the communities we serve.

hatch.com

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