



The Digital Future of Mining Operations

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Marc is a technology advocate within the mining industry and has spent the last ten years designing and managing the development of software solutions for Geological Modelling, Mine Design, Scheduling, Operations, Optimisation, and Material Movement across more than 30 products with a focus on Integration, Automation and application of advanced technology to the unique challenges faced by the mining industry.

Marc studied in Brisbane, Australia at the University of Queensland School of Earth Sciences majoring in Geosciences. He later attended the University of Queensland Business School, obtaining post-graduate qualifications in marketing, management and executive leadership.

A fully digital mine integrates information technology and operational technology systems—allowing for digitalization, automation and continual optimization, integrating all connected processes in a mining operation.

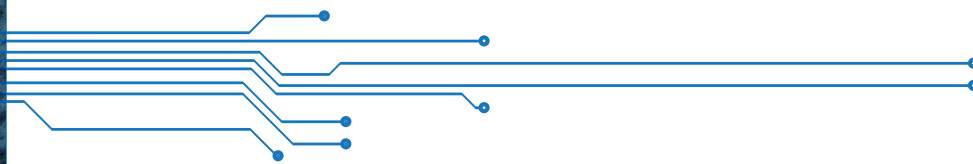
With mining companies developing digital strategies to control increasing costs and maintain their competitive edge, many are looking to the future by implementing artificial intelligence (AI) technologies. So what AI technology is best to increase productivity, safety, sustainability and profitability throughout the mining process? And when and how should mining companies deploy these solutions to proactively enhance their operations?

How do automation solutions improve mining productivity and safety?

As in many other industries, there's a strong correlation between productivity and automation in mining. An automated trucking fleet delivers value on several different fronts, including predictability, consistency, productivity and safety. It can deliver more effectively to planned schedules since no accounting is needed for events like illness, holidays or general staffing shortages.

Although there will be reduced need for drivers, the trucks will need to be maintained, as will the automation systems themselves, the positioning systems and the integration systems that move data around the operation. But because an automated fleet reduces the number of drivers, it also reduces the number of safety incidents. Removing staff from dangerous environments allows mining companies to train and grow their workforce of expert machinery operators and place them in other, safer, more secure roles supporting the new technology.

Technology drives growth while reducing costs and increasing productivity but implementation of automated solutions needs to be carefully managed so staff see value in the journey from the analog to the digital mine of the future in their daily operations.



How is enterprise historian technology used in the metals and mining industry?

Historian technology enables the automation that delivers safety, productivity and profitability.

With the vast swaths of information that is now being generated by scanning equipment, monitoring hardware and automation technologies, ensuring integrity of that data is essential. Managing data is a challenge due to sheer volume, diversity of formats and needs of various solutions or personnel.

Within metals and mining, historian technology can integrate every moving part of a mining operation to link the planning systems, fleet management systems, material movement and tracking systems, crushing and screening and processing as well as other parts of the downstream value chain.

How do mining operations apply Asset Performance Management (APM) solutions?

Prescriptive maintenance solutions provided by AspenTech use machine learning agents to not only predict equipment failure based on a series of indicators drawn from real time equipment monitoring sensors, but also prescribe changes to behavior and equipment usage that will eliminate those identified failures from occurring in the first place.

Resolving equipment downtime issues increase safety by minimizing or eliminating equipment failures in the field, removing unplanned field maintenance activities and the risk they pose to maintenance and operational staff addressing those issues in an operational open pit or underground environment. If there's no broken truck to begin with, then there's no need for an operator to leave that truck, no need for a mechanic to travel to it, and there's no obstacle to negotiate or exclusion zone for safety staff to set up on busy haul roads. The effects of prescriptive maintenance compound.

Productivity for both the operational side and the professional services side naturally increases as well, because mine planning engineers no longer need to redo their schedules to adjust for unmet



production and scheduling targets, both of which can be extremely time consuming.

How are mining operations using advanced process control (APC) technology currently?

Ensuring maximum recovery of ore mined can have a substantial impact on a mine's revenue. Process control solutions continually optimize processing operations in the presence of disturbances and frequently changing conditions. AspenTech solutions can optimize comminution circuits, assist with reagent usage such as controlling cyanide concentration or lime dosing to regulate pH levels, manage entire froth flotation plants to deliver percentage point increases in recoveries and more.

For process engineers, the expectation should be that the technology reduces the time and effort that goes into the ongoing maintenance and manual management of processing parameters, allowing decisions from information generated by an intelligent system that can continually optimize for the control variables deemed most vital - time, recovery, energy consumption or reagent dosing.

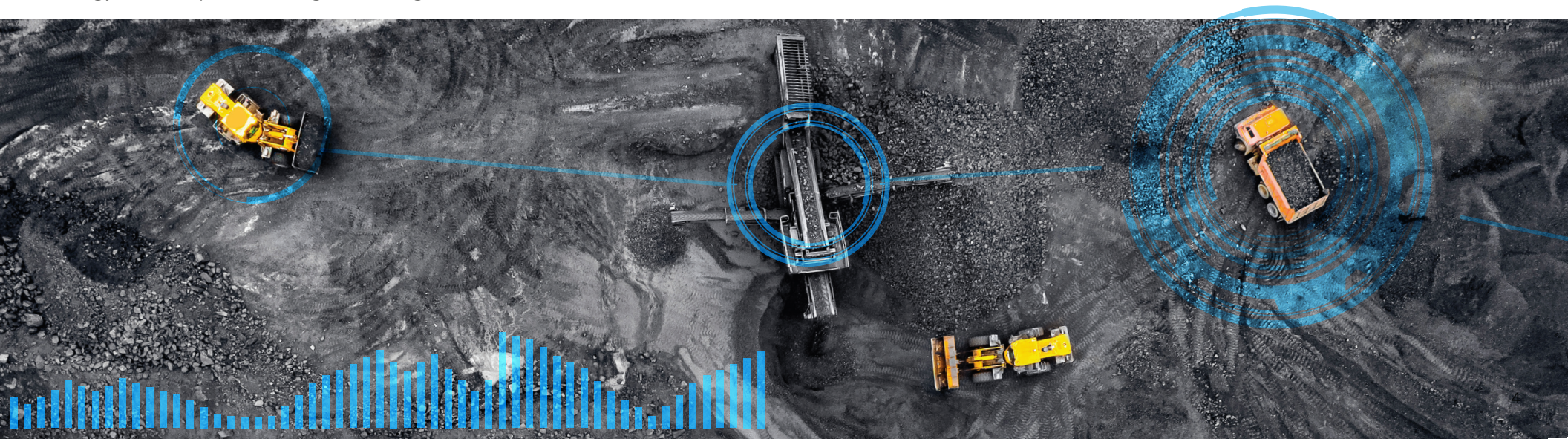
For a strategic and effective digital mining solution, where should mines typically begin?

It's crucial to focus not only on the biggest challenges, but also address the root causes of those challenges. Prescriptive maintenance diminishes or removes the most substantial burdens that operational mines carry on their balance sheets in their day-to-day operations.

We've seen our users apply our technologies to all manner of fixed and mobile plant and equipment. Because our solution is based on machine learning technology, it is preferable to choose plant or equipment with as many sensors as possible so the AI can learn more effectively from a range of different data sources.

Where does AspenTech fit into the digital journey of a mining company?

The AspenTech mining solutions solve root causes of several key issues in metals and mining operations. Our solutions can deliver:



- Increases in reliability, predictability and equipment availability using advanced machine learning.
- Decreased workload for professional services. Planning engineers can avoid ongoing adjustments to their short- or medium-term schedules.
- Maintenance warehousing strategies that are informed by the equipment's actual needs based on behavior and usage, instead of OEM suggestions. Buy and store only parts needed, rather than maintain large stockpiles.
- Increased safety by reducing the need for the staff to deal with downtime issues in the field.
- A single, mature integration solution, ensuring minimal time to data and maximum data integrity.
- The ability to control variables to continually optimize and ensure optimal operating parameters for several types of plant.
- Digital twins, allowing mine designers, process engineers and mine leadership to replicate their mine digitally, run what-if analysis on proposed changes and gain insights from simulations.

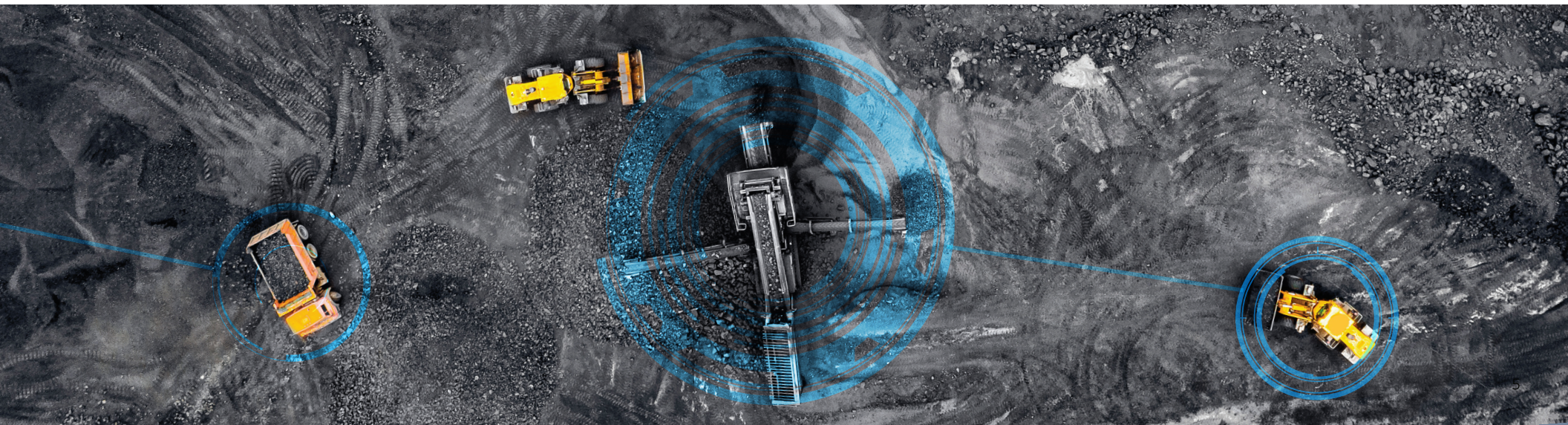
What are the data requirements for implementation?

Customers don't need vast amounts of data to get started with the prescriptive maintenance and APC solutions. Naturally the more data, the better the result that one can expect but in operational mines, it's likely that historical data already collected provides a solid foundation to gain insights from the machine learning monitoring agents.

There are implementations that are developed on just a few months of data and once they're in place, the system continues to learn from the data collected. The longer it runs, the better it gets. But our customers see value from whatever historical data they provide.

What time frame does it take to deploy these solutions and see value?

Complexity of the implementation and other variables come into play but the solutions I've mentioned can be implemented potentially as fast as within a fiscal quarter. Each solution ROI will depend on the size of the project, but typically these solutions show returns quickly, often in just months.





About AspenTech

Aspen Technology, Inc. (NASDAQ:AZPN) is a global software leader helping industries at the forefront of the world's dual challenge meet the increasing demand for resources from a rapidly growing population in a profitable and sustainable manner. AspenTech solutions address complex environments where it is critical to optimize the asset design, operation and maintenance lifecycle. Through our unique combination of deep domain expertise and innovation, customers in capital-intensive industries can run their assets safer, greener, longer and faster to improve their profitability and operational excellence.

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