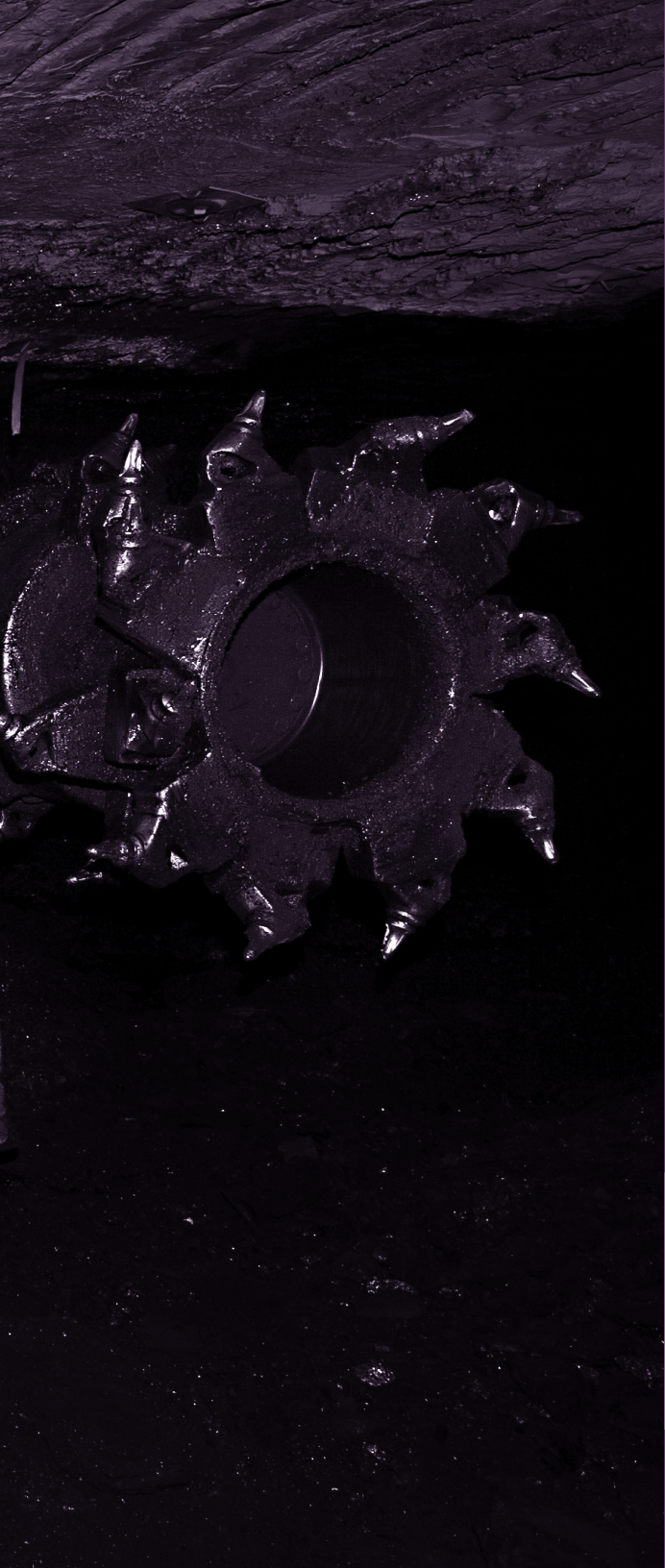




Maximize Mining Equipment Effectiveness, Minimize Margin Loss

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Introduction

Mining companies invest heavily in equipment for all stages of mining, mineral processing, refining and distribution. Yet all too often, assets sit idle—or worse, break down unexpectedly, bringing production to a halt. Either scenario costs the operation money it can ill afford. At first glance, having backup equipment on hand to use while primary assets undergo repairs seems like a wise decision. Yet with slurry pumps, conveyors, grinding mills and crushers costing hundreds of thousands of dollars, there are more cost-effective ways to avoid production delays.

So how can mines get more value out of their existing equipment? Predictive maintenance analytics give mining organizations the intelligence they need to keep critical assets running at peak efficiency, avoiding unplanned shutdowns, unnecessary maintenance costs and excess spending on redundant equipment. By monitoring asset condition and behavior and developing profiles of normal operations, anomalies and failures, predictive maintenance tools can notify staff of equipment problems prior to failure. Armed with weeks or months advance warning, staff can schedule maintenance when it has the least impact on production—saving money and improving margins.



Use Digitalization to Increase Overall Equipment Effectiveness

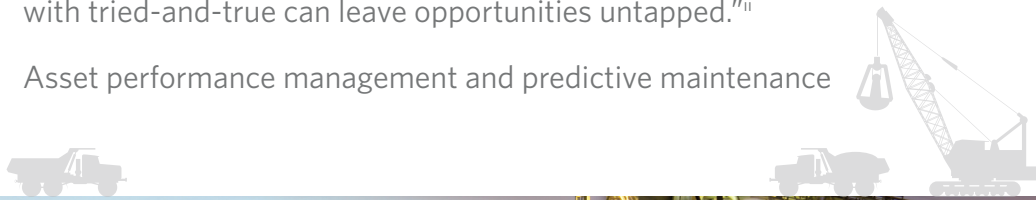
Mining, like other asset-intensive industries, is facing pressure to improve profit margins. According to PwC research, industry profits are suffering due to stricter environmental regulations, trade tariffs, volatility in raw materials prices and greater competition from producers in lower-cost economies. "The metals industry is facing economic, political and technological disruption, and the combined weight of these forces is the catalyst for a digital revolution..."ⁱ

Improving overall equipment effectiveness is low-hanging fruit for miners; digital tools offer swift return on investment in this area. Deloitte's Industry 4.0 investment survey, which included mining companies, found that productivity improvement and attaining operational goals were the top two factors driving digital transformation. While experts recommend that companies continue to invest in productivity and operations, they cautioned that "sticking mostly with tried-and-true can leave opportunities untapped."ⁱⁱ

Asset performance management and predictive maintenance

solutions offer mines the ideal opportunity to embrace digitalization for operational improvements. Many mining companies already have the foundations in place. Deloitte's research found that 90% of respondents are gathering data from the physical world, but fewer are able to analyze the data and only about half report being able to act on it in real time. In addition, 68% of respondents are using computerized maintenance management systems and another 28% plan to invest in them within the next 3 years.ⁱⁱ These systems capture data that predictive maintenance solutions can use to analyze equipment and identify looming failures.

Historically, systems monitored threshold-based indicators of equipment problems, such as temperature, pressure or vibration levels. Once these were surpassed, issues were likely already pending, giving maintenance teams little time to respond. Analyzing a variety of variables and inputs, predictive maintenance systems identify different types of asset behavior and conditions: normal, anomaly and failure. Once the parameters around each of these conditions has been set, the system monitors assets for these signatures or patterns; when something deviates from normal, the system sends an alert so staff can investigate. The new pattern can be classified as a new variation of normal, an anomaly or a failure warning. This approach delivers fewer



false positives and negatives than other solutions, allowing users to have confidence in the insight the tool delivers.

Minimize Unplanned Downtime and Maintenance Costs

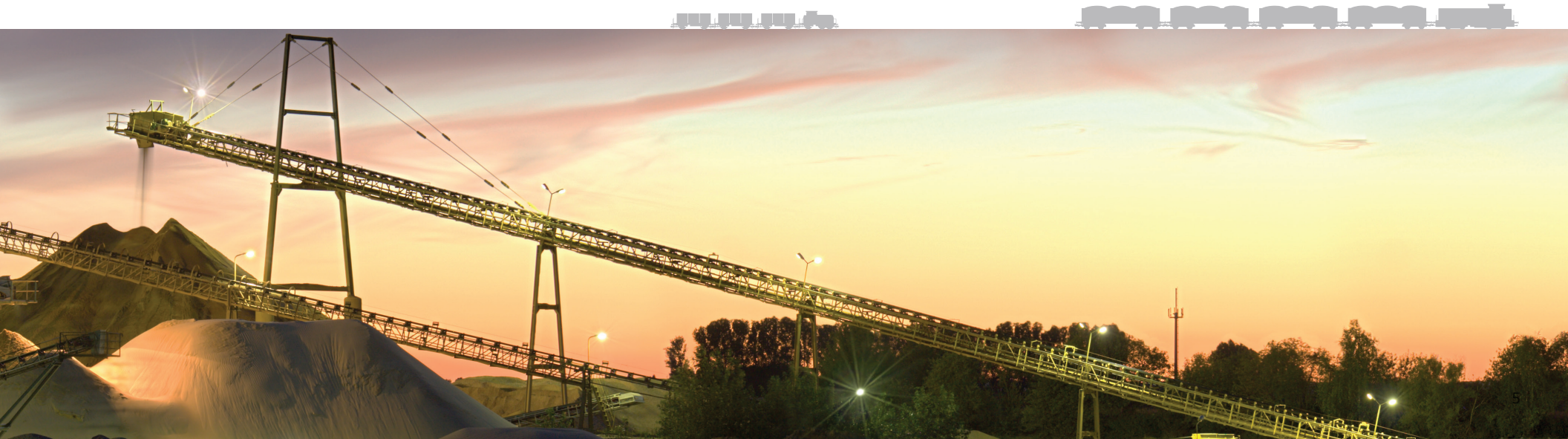
McKinsey has identified predictive maintenance solutions as one of the largest potential opportunities for mines, allowing them to improve reliability at lower costs. Multiple AspenTech mining customers have reported that unplanned downtime costs approximately three times as much as planned downtime. While no maintenance solution can completely eliminate shutdowns, the ability to plan ahead, adjust schedules and shift production to accommodate downtime helps mitigate losses.

Predictive maintenance's real value comes from the ways mines can adapt based on the intelligence these systems deliver. For example, looking at the root causes of historical failures and the failure patterns allows mines to optimize spare part inventories. Having the appropriate parts on hand when equipment fails gives mines more flexibility in scheduling repairs, without calling for huge stores of extraneous parts.

Where Predictive Maintenance Solutions Deliver Real Value

Predictive maintenance solutions can help mining companies get more out of their equipment, increasing productivity and margins. These tools can work equally well on mobile, static and fixed equipment and can quickly deliver value. Asset-intensive businesses (including mines) that have adopted predictive maintenance report lower maintenance costs as well as greater overall equipment effectiveness and availability to plan. Ultimately, this contributes to increased profit margins.

McKinsey found, "technology is helping mines conduct maintenance when it is needed rather than on a fixed schedule. One company used sensors and machine learning to implement predictive maintenance in very large (20-ton) heat exchangers. The model was able to predict when the exchangers would fail, reducing maintenance from once every 70 days to as long as once every 160 to 200 days. Given that there were dozens of heat exchangers, the cost savings have been substantial." ⁱⁱⁱ





Monitoring High-Value Mining Equipment

Mines rely on complex, costly equipment for mining, mineral processing, refining and distribution. Historically, equipment breakdowns have been part of the business—occurrences mines took for granted, along with the subsequent repairs and delays. Predictive maintenance solutions and machine learning are changing the business, reducing unexpected equipment failures and delivering significant saving to mining companies. Examine the following success stories covering different types of equipment.

Continuous casting equipment

A leading steel manufacturer in Latin America was able to implement effective prescriptive maintenance tools in days—not months, as other solution providers proposed. By applying an easy to follow, step-by-step process as well as the machine learning algorithms in Aspen Mtell®, the manufacturer detected pending failures on continuous casting equipment. Using 4 months of historian data on pinch rollers and visual mapping of production anomalies and failures, Aspen Mtell created over 30,000 predictions on equipment functions. Using pattern recognition to identify impending equipment and process failures, the system gave a 23-day time to failure notification on a pinch roller along

with a 21-day time to failure alert on a bending roller. These alerts allowed the steel manufacturer to schedule maintenance and avoid unplanned downtime and production losses.

Conveyor belts

A large open-pit diamond mine in southern Africa used Aspen Mtell on several different types of equipment. The system detected a problem with the discharge conveyor after the primary crusher. On startup, the currents for the three drive motors were out of synchronization. When staff inspected, they found an oil imbalance in the motor/gearbox system—they were able to correct the problem before the gearbox failed.

Crushers

When the diamond mine had success with conveyor belts, they rolled Aspen Mtell out to additional equipment and detected anomalies in the mine's primary crusher. Maintenance staff found a leak in the hydraulic line and replaced the line before the crusher suffered significant damage. The customer was able to stop two pending failures just weeks after they began monitoring. Based on the technology's early success, the mining company has expanded to 6 additional sites and plans to accelerate to all of their 50+ sites in the near future.





Mobile equipment

Prescriptive maintenance solutions can monitor shovels, continuous miners, haul trucks and excavating equipment as well as fixed equipment. A South African coal mine determined that using Aspen Mtell on the cutter motors of its continuous miners could deliver at least \$300,000 USD annually. With advance warning of motor problems, the mine could schedule maintenance overnight, reducing maintenance costs by 40% and increasing coal capacity efficiency by 26 minutes per equipment event.

In a presentation at Canada Mining Innovation Council's 2019 National Mining Innovation Summit, staff from Syncrude shared that over the last decade, their organization moved from dragline, bucket-wheel operation to truck and shovel. As a result of the shift, Syncrude had about 130 ultra class haul trucks, 20 large face shovels and more than 300 pieces of mobile support equipment... and a rapidly increasing maintenance budget. The mine evaluated the efficacy of moving from time-based preventative maintenance to optimized condition-based maintenance. Working with the Queen's University Centre for Advanced Computing, the mine analyzed used oil samples from six haul trucks and determined that the majority of engine components were being overserved, while powertrain components were being underserved. Initial analysis

suggested that adjusting haul truck maintenance based on the data would allow Syncrude to reduce services by 10%, avoid major component failures and increase availability by at least 1%.

Slurry pumps

A large copper producer in Latin America wanted to maximize production while reducing maintenance costs on four pumps downstream from the mill. One pump had a history of broken plates—any time a pump is out of operation, the concentrator line operates at 95% capacity. Over time, this causes significant losses – looking at the average price of copper, 20 days of reduced capacity could result in losses of \$3 million USD; 50 days at 95% capacity would bring losses to more than \$6 million USD.

Aspen Mtell was able to replicate the wear pattern of the faulty pump and apply that data to the additional pumps. Based on the manufacturer's guidelines, the mine was replacing plates and wet parts for the pumps after every 1,000 hours of operation at an average cost of \$250,000 USD per replacement. With data from Aspen Mtell, the mine was able to identify 10 maintenance jobs that could be postponed while pumps were still operating at maximum efficiency, offering an annual savings of \$2.5 million USD.



Improved Equipment Monitoring Extends Asset Life and Value

For mining, automating asset monitoring clearly has its advantages. McKinsey encourages industrial organizations to automate such data analysis: “Done right, we have seen the most successful automation transformations allow companies to capture 20 to 40 percent efficiency gains and generate a positive return on investment in 12 to 18 months.”^{iv} Asset performance management solutions can deliver returns even faster—many of the mining companies who have adopted AspenTech’s predictive maintenance tools have achieved payback in less than six months.

Choose the Right Predictive Maintenance Tools for Your Mine

Investing in predictive maintenance solutions offers mining companies a way to increase margins and extend the life and effectiveness of high-value equipment. With rapid time to value, these solutions offer a logical starting point for digitalization in mining.

Most mining companies will opt for a predictive maintenance tool that does not require data science expertise. Look for a user-friendly interface that allows equipment operators and maintenance staff to quickly understand what’s going on with critical equipment. Ideally, configuring the tool should be simple as well—ensure everything from developing pattern recognition agents to monitoring new assets can be managed in-house, without requiring costly consulting services.

While 75% of respondents in a recent ARC Advisory Group survey indicated that it was very important or extremely important for their APM solutions to issue breakdown warnings, only 59% reported receiving more than a week’s notice of pending failures.^v Look for a system that offers enough warning to avoid unplanned downtime and schedule repairs when they will have minimal impact on production.

Choosing an accurate, trustworthy predictive maintenance solution can help mines maximize equipment effectiveness for critical assets and increase profits. With quick implementation times and rapid return on investment, these solutions offer compelling proof of the value of digitalization for the mining industry.



About Aspen Technology

Aspen Technology (AspenTech) is a leading software supplier for optimizing asset performance. Our products thrive in complex, industrial environments where it is critical to optimize the asset design, operation and maintenance lifecycle. AspenTech uniquely combines decades of process modeling expertise with machine learning. Our purpose-built software platform automates knowledge work and builds sustainable competitive advantage by delivering high returns over the entire asset lifecycle. As a result, companies in capital-intensive industries can maximize uptime and push the limits of performance, running their assets safer, greener, longer and faster.

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- i "Agility in metals: digital transformation in the steel and aluminum industry." PwC, 2019.
- ii "The Industry 4.0 Paradox." Deloitte, 10 October 2018.
- iii "Behind the mining productivity upswing: technology-enabled transformation." McKinsey, September 2018.
- iv "Unlocking the full power of automation in industrials." Eelco de Jong, Bhavna Lalla-Sew goolam, and Gregory Vainberg, McKinsey, October 2019.
- v "Rethinking Asset Performance Management." Peter Reynolds, ARC Advisory Group, July 2019.

