Success with Prescriptive Maintenance Applications at Leading Canadian Metals & Mining Company

aspentech | White Paper

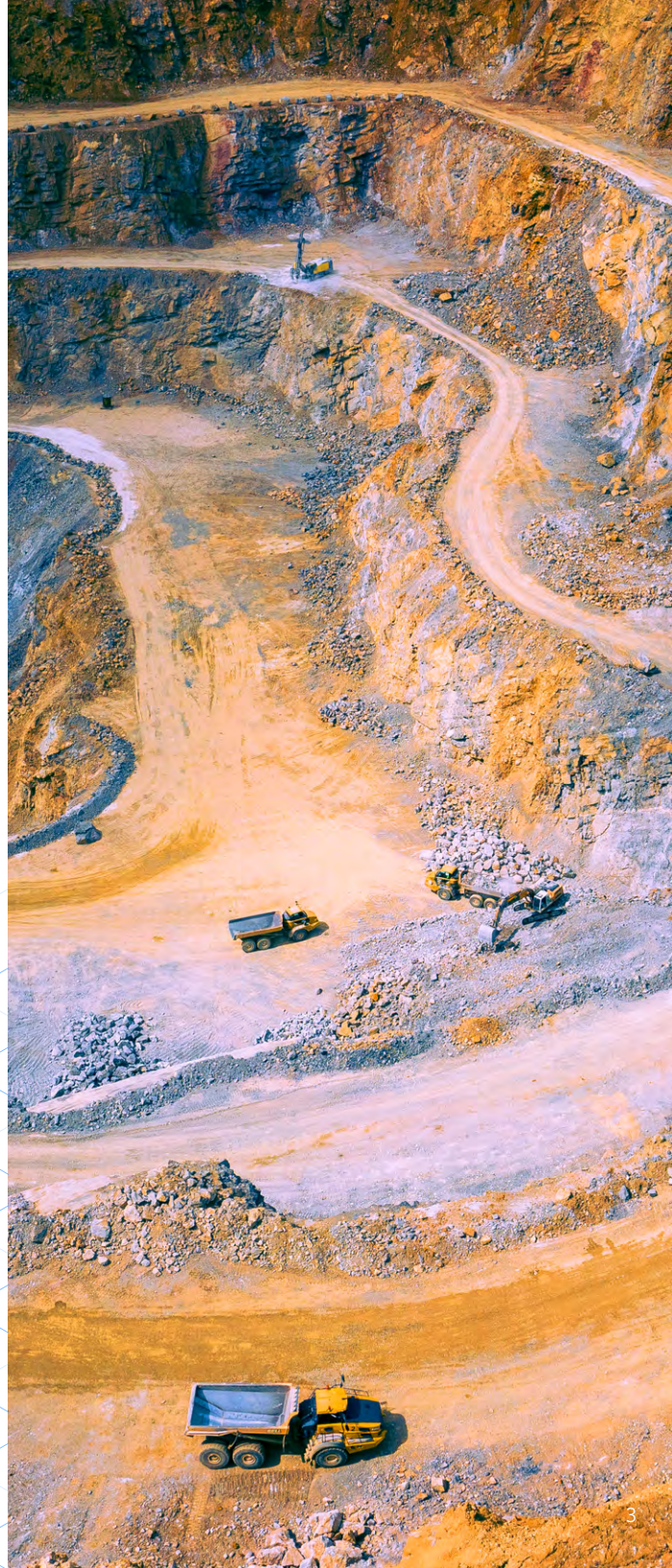
Introduction

The mining industry is undergoing a digital transformation across the entire value chain, from exploration to site reclamation. Innovative technologies are changing the way mines operate, improving operational efficiencies and lowering costs. With many mine operators still adopting a preventative maintenance approach, and with original equipment manufacturers (OEMs) designing preventative maintenance plans for the equipment they sell, mobile and fixed plant equipment maintenance costs can represent between 30-50% of OPEX expenditure across the industry.

In general, mining equipment comes from manufacturers with a detailed schedule for preventative maintenance tasks. These stipulate the frequency at which to inspect, test and service individual components, and suggest when they should be repaired or replaced throughout the equipment's useful life. These conventional methods for equipment maintenance become a recurring cost rather than a solution that adds measurable value to the operation. Time-based strategies like these do not factor in any other operating conditions that have the potential to impact the overall availability of the asset, leaving users in the dark about how varying operating conditions may affect asset reliability. OEMs that define when to service and replace parts could also be considered to have a conflict of interest since they receive additional revenue on a scheduled basis rather than "as needed."

Mining companies may want to consider taking a more data-driven approach to equipment maintenance across all assets, using technology that improves asset reliability and is optimized for specific work environments, processes and usage patterns. Leveraging asset sensor data to proactively monitor equipment for imminent and future failure adds immediate value to maintenance programs. Using artificial intelligence (AI)- and machine learning (ML)-driven predictive and prescriptive analytics, operators can manage maintenance activities strategically, planning around predicted downtime rather than working reactively.

In this paper we explore the experience of a valued AspenTech customer in North America, to see how Aspen Mtell® has been implemented successfully at one of its main operating sites in essentially every piece of equipment that can benefit from it.



Earlier Maintenance Strategy

Before the adoption of Aspen Mtell, the company's general approach to maintenance was largely a time-based preventative strategy. While some predictive techniques were implemented, they were based on measurements of vibration, thermography and oil. This required an engineer to physically travel to the plant and manually take measurements from the assets. While the maintenance team was technically able to predict equipment failures through this analysis, the information would not be regular or consistent given the intermittent manual processes involved in collecting the data.

For example, a maintenance engineer had to physically travel to inspect vibration on a given piece of equipment and repeat the process a month later—a time-consuming and inefficient process. In the interim, the equipment could and sometimes would fail. While there was a desire to implement predictive techniques, the practical application was hampered by the time-consuming manual nature of the data collection, as well as the time taken to complete its analysis.

As part of its digitalization strategy, and as an early adopter of new technologies, the company became interested in Aspen Mtell in 2011, when prescriptive and predictive maintenance in mining was a relatively new concept.

The initial drive was to leverage a range of digital signals for condition monitoring to predict equipment failure as far up the PF curve as possible. The aims were to mitigate complete failures that were being experienced, as well as to plan maintenance on equipment with minimal risk to production. A reduction in downtime maintains consistency, decreases risk of variation in production, and establishes a stable process within the mining value chain. A more stable process and reduction in downtime also benefit safety and the environment. In this case, prescriptive maintenance meaningfully impacts both.

Process vs. Maintenance Insights

A key factor that the reliability team learned early on was that while processes can put equipment into distress, the inverse is also true—equipment can put processes into distress. Circumstances may develop where a piece of equipment goes into an alert state, but the issue may be more related to process reliability than to the equipment.

An example is the case in which a thickener drive went into distress, creating a work order for maintenance. The failure of a thickener drive—a piece of critical equipment—can lead to hundreds of thousands of dollars in lost revenue.

On one side of the organization, the process engineers had a very clear understanding of why the situation had developed; they determined that alerts were being generated and issues were arising due to the compositional mix of a given batch going through the processing plant.

On the other side, the maintenance engineers, who are knowledgeable about the technical specifications and tolerances of the plant itself, understood that they would be replacing parts more frequently and introducing extra costs as well as downtime if the feedstock going into the processing plant was consistently provided at those parameters. This discovery prompted a conversation between the processing and maintenance engineers around how to solve the issue generated by mixes that were outside the tolerances of the plant.

These two groups would previously have simply dealt with the issues as they arose—one being focused on the process and the other on reliability—often with opposing objectives. The processing and maintenance engineers traditionally focused more on the mechanics without considering a change in how they should address the issue. There is now a conversation between those teams around the root cause, which has precipitated a cultural change.

The use of Aspen Mtell brought about this visibility and delivered a more holistic approach regarding how to deal with a piece of equipment that's in distress from both an equipment maintenance and a process standpoint.

Purchase and Work Order Automation

A key differentiator for the company's operations was its interconnectivity with the JD Edwards CMMS. Aspen Mtell can directly interface and integrate with the CMMS system; maintenance and purchase orders are automatically generated in JD Edwards as a result of alerts being raised in Aspen Mtell. This removes significant manual handling and monitoring typically required by members of the maintenance team.

As a technology leader, the company was the first to obtain an adapter built for the JD Edwards CMMS. "The ability to predict a piece of equipment failure and generate a work order automatically is powerful. There is also a process in which work orders are closed, and operations go back to normal, making the whole system autonomous," said a maintenance director. "Machine learning agents watch and think and generate work orders for you—there is no person sitting there watching and controlling things."

The company is driving towards maximizing work order generation automation using Aspen Mtell and is extending application of the solution across its operation.

> **"The ability to predict a piece of equipment failure and generate a work order automatically is powerful. That's what machine learning agents can do."**
>
> **—Company Maintenance Director**

Aspen Mtell's machine learning capabilities are great for some assets and failure modes, but when there is deep knowledge about the plant and the equipment being monitored, one can also predict a failure using a condition-based approach. The plant management evaluated its maintenance strategy and realized that not all assets and/or issues require the deployment of AI/ML agents.

By evaluating asset criticality and failure mode severity, maintenance engineers chose one of the several agent monitoring technologies that come embedded in Aspen Mtell. Around 10% of the agents implemented leverage the machine learning capabilities, as the company has extensive expertise and knowledge that allow them to build very good rule-based agents and focus their efforts on a condition-based approach to monitoring alerts.

Scaling Across the Operation

The implementation of Aspen Mtell began with a proof-of-concept study on three pieces of equipment, followed by buy-in from its millwrights to gain specialized knowledge and enable the maintenance team to build the best possible monitoring and alert agents. Within less than six months from the time they began monitoring the three equipment prototypes, the solution provided a number of important saves and proved its value in operational circumstances.

Those early successes opened the door to applying Aspen Mtell to additional business areas. The process was supported by a technical manager who brought in a top-down approach to get the project started and validate its value. Once that value was demonstrated, buy-in from the operational side was forthcoming. Since then, Aspen Mtell is monitoring so many pieces of equipment at the plant that they have lost count of the exact number!

An asset can be as small as a conductivity transmitter, or as large as a boiler. Currently, the company is monitoring over 350 assets, including 300 critical pieces of equipment. Each of these has a meaningful impact on the operation, whether it be production, safety or environmental. “Effectively, everything that can have Aspen Mtell on it, does!” says a company spokesman about the successful plant-wide implementation and adoption of the solution.

Failure Prevention Stabilizes the Process

An important early win was on a critical slurry pump. Before Aspen Mtell was implemented, these pumps had only a known pump curve, and measured pressure upstream and downstream as data sources. The pumps had a tendency to fail very inconveniently towards the ends of shifts. It didn't take much to convince the staff to try Aspen Mtell on these pumps, as the millwrights would typically get called in to resolve the issue at the end of their shift. On multiple occasions it would ruin their weekend plans, so they were very open to whatever could help them resolve the issue.

Seeing Aspen Mtell deliver value on the slurry pumps didn't take long. Once the team deploying it received buy-in from the millwrights and maintenance staff on the front lines and understood the clear value of the solution, they discovered a multitude of other suitable opportunities for the technology.

Another application of Aspen Mtell's machine learning capabilities is reliability investigations and root cause analysis. In addition to alerting when equipment is going to fail, these also provide an understanding of the sensors contributing to the failure and more importantly, what to do about it. "In general, Aspen Mtell saves maintenance time by taking a run-time approach, and uses those insights for reliability analysis as well as for overall retrospective plant health review," noted an Asset Performance Specialist at the company.

Another early case where Aspen Mtell prevented a failure was in the instance of a filter feed pump. The solution led to early detection of an impeller that was starting to plug up. This was causing a lack of pressure and flow to the filters, as well as an imbalance that would have subsequently led to an imminent failure. However, early intervention allowed tradesmen to go into the pump and clean the impeller in a prescribed planned shutdown, preventing thousands of dollars in lost production.

The reliability team created rule-based agents for this scenario and refined the parameters of the agent over the course of a year. Now, when the agent recognizes a developing situation, it provides at least two weeks' notice, enabling the reliability and maintenance teams to respond. The team manager explains: "We aim for at least a week or two of advance notice so that we can line up a spare pump or have a plan for getting the parts here if we need them. Shutting the plant down at a time when we won't be running anyway, so that we avoid shutting it down when it's actually needed, is great. Trying to stabilize the process and paying the time cost in stabilization after it starts back up is the value."

> **"We aim for at least a week or two of advance notice so that we can line up a spare pump or have a plan for getting the parts here if we need them."**
>
> **—Company Maintenance Director**

Similarly, runtime checks on the calciner dust pumps enable the maintenance team to schedule maintenance tasks at appropriate times, while also ensuring that the equipment demonstrates maximum availability as well as reliability. Moving the calciner dust pumps and other assets that run intermittently from a time-based preventative maintenance strategy to runtime-based maintenance has saved tradesmen from having to work on equipment that didn't need it, as well as save on parts. This means trades can spend more time on other equipment that needs attention.

A Tailored Experience

Additional new features were introduced, including cumulative alert direction. Fast-moving or intermittent processes can raise alerts that would typically not be tolerated in continuous processes, but reacting to every alert could result in significant costs or impact on the process. "Do we want to take a process down if something happens once every day, or do we want to tolerate it until gets worse?" was the company's dilemma.

"AspenTech has always been there for me. If something came apart over the weekend or in the middle of the night, someone has always been available, quickly and reliably, to resolve the issue."

—Company Maintenance Director

Cumulative alert direction accumulates a number of alerts in a given period of time before the notification is actually sent. The goal is to eliminate the "cry wolf" phenomenon where people monitoring the alerts observe and register, but ignore the alerts, given the volume of alerts coming through. With this feature, it is possible to set a given number for a particular alert—for example in a 24-hour period. Reaching that number means that it needs to be taken seriously, as opposed to a single alert, which is expected to occur at least a few times during a process. "Building and being able to do looping within our own rule-based agents has been of huge benefit to us," noted the maintenance head.

The maintenance and reliability teams are currently being trained to build agents themselves and expand the reach and scale of the solution across the operation to include critical environmental and safety monitoring equipment, thus ensuring the integrity of the key analytical measurement equipment.

About Aspen Technology

Aspen Technology, now part of Emerson, 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 asset-intensive industries can run their assets safer, greener, longer and faster to improve their operational excellence.

aspentech.com