

How leading mining companies are getting smarter with condition monitoring

Using proactive asset reliability to improve operations and profitability

Unplanned maintenance erodes profitability

- 60% to 80%** of equipment malfunctions at mining sites occur due to improper maintenance
- 2 to 5 times** of planned maintenance expenditure overruns happen due to a significantly higher unplanned downtime for mining companies
- \$1 million USD /day** Overall production losses and secondary process and equipment damage due to unplanned downtime

Proactive maintenance averts losses

- 2 to 3 times** lifespan extension for mining plant equipment, made possible with the proactive maintenance solutions
- > 4 weeks** advance alert on equipment wear and failure, thereby reducing downtime and financial risk
- 20%** average savings on annual maintenance expenditure



Triggers to adopt condition monitoring (CM) systems

Reduce unplanned downtime 60%	Need for proactive maintenance 40%
Improve productivity 47%	Cost control 27%

(% of mining companies surveyed)

Critical mining applications for condition monitoring

- Screens:** Due to high vibration and loads, there can be structural damage and spring failures. Proper vibration analysis performed, and vibrations constrained under set limits can reduce this problem.
- Conveyers:** Due to less lube oil supply and loads on the bearing there can be an occurrence of bearing failure.
- Ball/SAG Mills:** Thermal stresses result from oil lubrication failure and excessive vibration.
- Slurry Pumps:** Pumps undergo immense strain due to the transfer of viscous material throughout the pumping process. Sludge and slurry contain high solid content, which causes pitting and cracking.
- Turbines:** Turbine bearing failures can result from structural misalignments and lubrication oil defects. The malfunction can also occur due to dislocation and fatigue in joints while in operation.
- Fans:** Fans are subjected to excessive thermal and vibration stress, a major reason for fan failures.
- Crushers:** Crushers operate at high power to produce materials, putting a lot of strain on internal parts, filters, and bearings.
- Electric Motors:** Bearing failure is a major issue in electric motors. It is generally analyzed by vibration analysis.

Critical Nodes for Condition Monitoring:
Primary: Slurry pumps, Fans, Turbines, and Compressors.
Secondary: Blowers, Motors and Screeners.

Mining equipment with high frequency of failure

Our survey reveals that critical assets for miners differ based on the mineral they are extracting. The chart shows % of respondents identifying an asset as critical.

Conveyors	100%	89%	56%	Crushers	71%	67%	44%	Gearboxes	57%	67%	78%
Screens	57%	33%	22%	Blowers	43%	22%	33%	Compressors	29%	33%	33%
Motors	29%	33%	33%	% of companies surveyed: Steel & Ferrous Metals (Green), Coal (Yellow), Other (Blue)							

Note: Other metals include gold, silver, nickel, aluminum, zinc, and potash

Remaining challenges

- Escalating safety concerns
- Decreasing productivity
- Increasing skill gap due to high retirement rates
- Sustaining equipment life

Bently Nevada's portfolio and expertise helps achieve productivity goals

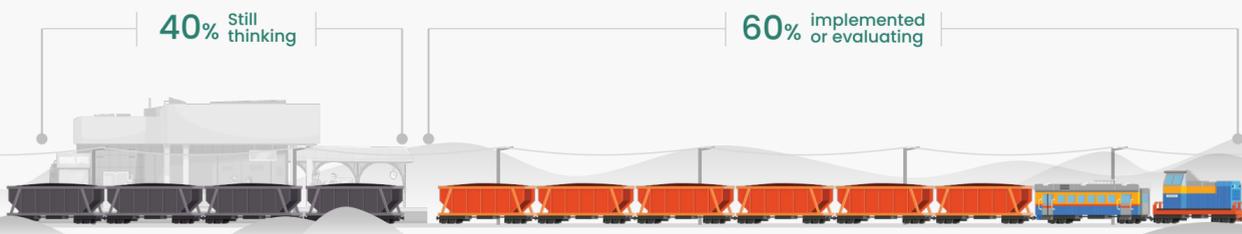
- A modular condition monitoring and evaluation system that supports up to 12 dynamic vibration and/or pressure sensors, along with up to three pulse-based machine speed sensors
- Real-time data collection across all active channels
- Portable size and shape for mounting locally on the machinery that it would be monitoring, eliminating the need for long sensor cable runs to centralized rack-based systems
- Event data recorder for smarter data collection

Site-wide condition monitoring is the future of effective maintenance

Site-wide solutions enable an eagle's-eye view of operations, facilitating higher-order operational optimization and real-time decision-making in the proactive maintenance journey of miners

More than 60% of the leading 20 miners (early adopters) have already started their journey with site-wide CM systems

Adoption (% respondents)



Incorporation of AI/ML

% of companies surveyed



Benefits of using AI/ML-embedded CM Systems

- 20%** increase in efficiency and optimized production processes
- \$30 million USD** savings coupled with a 7% expansion in mining yield
- 80%** reduction in data processing time. About 30% of miners are evaluating AI and ML functionalities and about 45% of the major miners have implemented IoT-based systems to optimize their operations.

*AI - Artificial Intelligence, ML - Machine Learning

