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WHITE PAPER

AI-Driven Predictive Maintenance for Crushers in Industrial Applications

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Published by MOVUS Australia Pty Ltd, 107 Milton Road, Milton, QLD 4064, Australia

Executive Summary

Crushers are mission-critical machines across mining, cement, metals, power, and other heavy industries.

They reduce large rocks, ores, and raw materials into smaller sizes essential for downstream processing.

However, crushers are exposed to high vibration, heavy shock loads, dust, and abrasive material, making them some of the toughest assets to maintain.

Unplanned breakdowns in crushers cause production stoppages, costly repairs, and safety risks.

By implementing AI-driven predictive maintenance across 142 crushers in five industries, results achieved include:

- >99.9% equipment availability
- Zero unplanned breakdowns over 12 months
- 20% reduction in Mean Time to Repair (MTTR)
- 537 early-stage faults detected
- 1,539 downtime hours avoided

The Importance of Crushers in industry

Crushers are essential machines in mining, cement, power, and other heavy industries, tasked with reducing large ore and rock to manageable sizes. However, they come with inherent operational challenges:

1. **High maintenance costs due to wear and tear on drive trains and critical components.**
2. **Exposure to harsh environments, making frequent inspections difficult.**
3. **Risk of catastrophic failure due to undetected faults.**
4. **Safety hazards from manual inspections in high-risk areas.**

These challenges make predictive maintenance, powered by AI and IoT, a transformative solution for the industry.

For the mining and metals sector, reliable conveyor operations are directly linked to productivity, cost efficiency, and workforce safety.

Challenges in Monitoring

Monitoring crushers is uniquely challenging because of:

Harsh environments: high vibration, dust, slurry, and moisture that damage conventional sensors.

Remote locations: difficult to conduct frequent inspections or transfer data.

Unstable loads: oversize rocks, uneven feed, and blockages create unpredictable stress.

Sensor durability: only SS-body ICP sensors with armored cables can withstand conditions.

AI-Driven Predictive Maintenance Approach

IoT Sensor Network

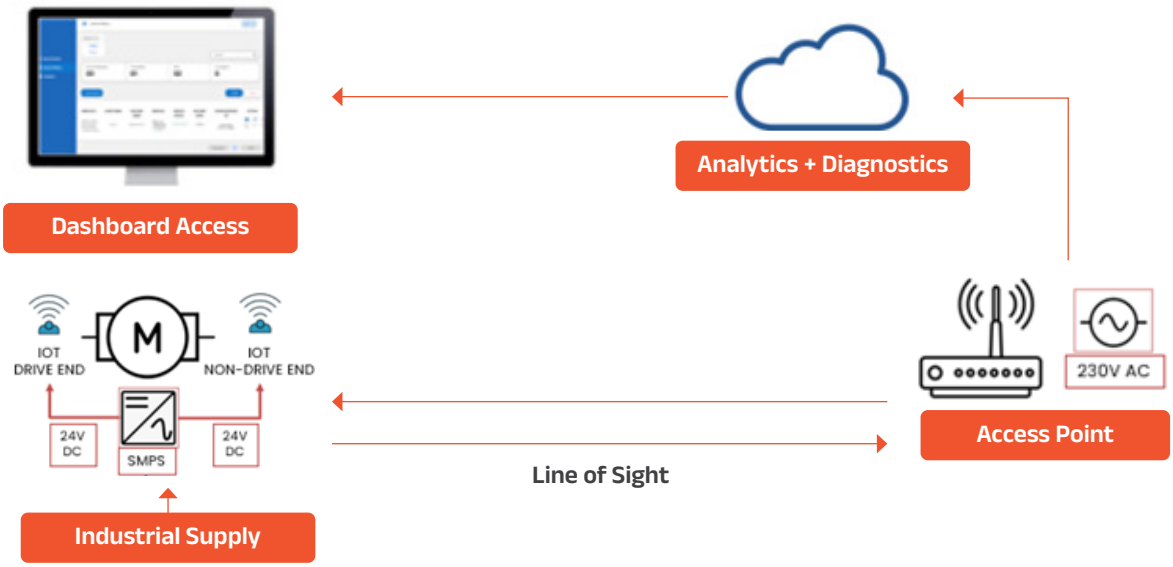
We deployed vibration, temperature, and operational sensors on critical crusher components. These sensors stream real-time data to an AI-powered analytics platform.

Machine Learning Fault Detection

PlantOS, the Industrial AI platform, transforms crusher monitoring through:

- Data ingestion: continuous capture of vibration, acoustic, and temperature signals.
- AI-driven analysis: 70+ engineered features identify early deviations.
- Fault classification: bearing clearance, lubrication failures, misalignment, gear issues, and blockages.
- Prescriptive recommendations: actionable guidance for maintenance teams.
- Continuous learning: adaptive models reduce false positives and align predictions with real-world outcomes.

Communication Architecture



Maintenance Optimisation

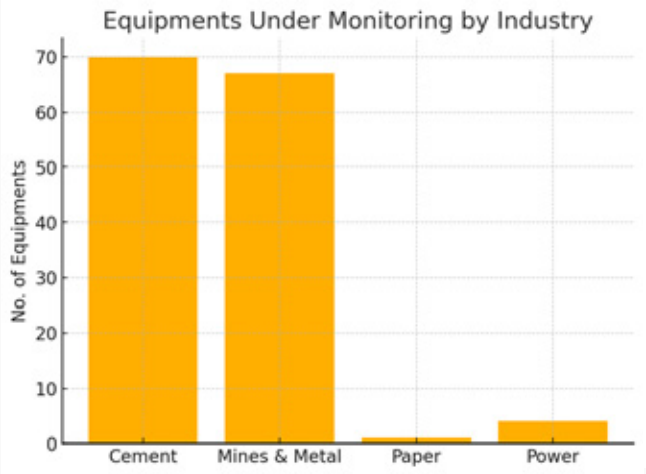
The system not only flags faults but also provides fault-type classification, from bearing clearance issues to lubrication faults, allowing targeted repairs.
This reduces:

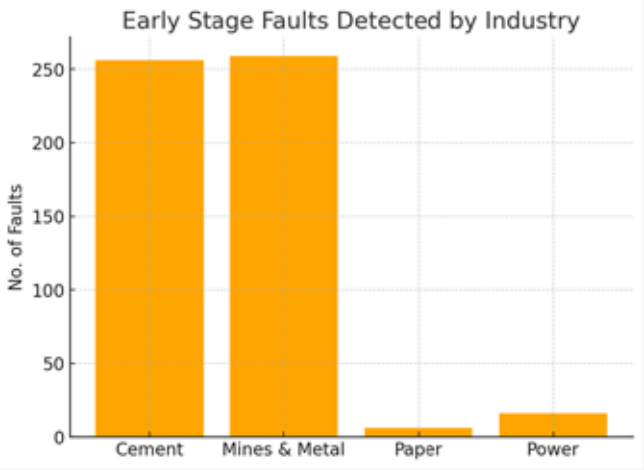
- Mean Time to Repair (MTTR)
- Unnecessary part replacements
- Maintenance crew exposure to hazardous zones

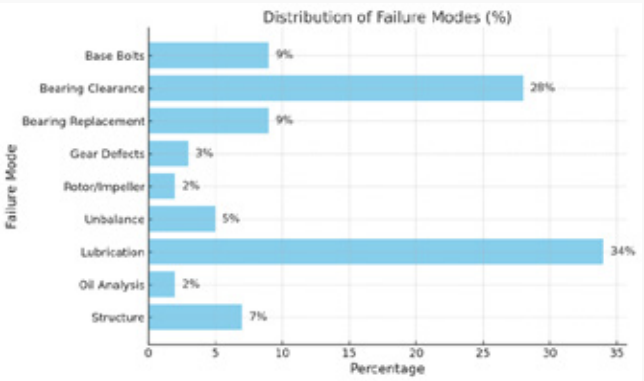
Deployment & Results

- Industries Covered: Cement, Metal, Mining, Paper, Power
- Total Crushers Monitored: 142
- Total Fault Reports Generated: 537
- Total Downtime Avoided: 1,539 hours

Data Visualisations







Conclusion

Crushers are among the most demanding industrial assets, but also among the most critical. Failures lead to disproportionate impacts on productivity, costs, and safety.

AI-driven predictive maintenance, powered by PlantOS, has proven to deliver higher availability, reduced maintenance costs, safer operations, and measurable ROI.

The success of predictive maintenance in crushers demonstrates how rugged IoT sensors and AI analytics can be applied across industries, not just for crushers, but for all mission-critical assets where uptime and reliability matter most.