

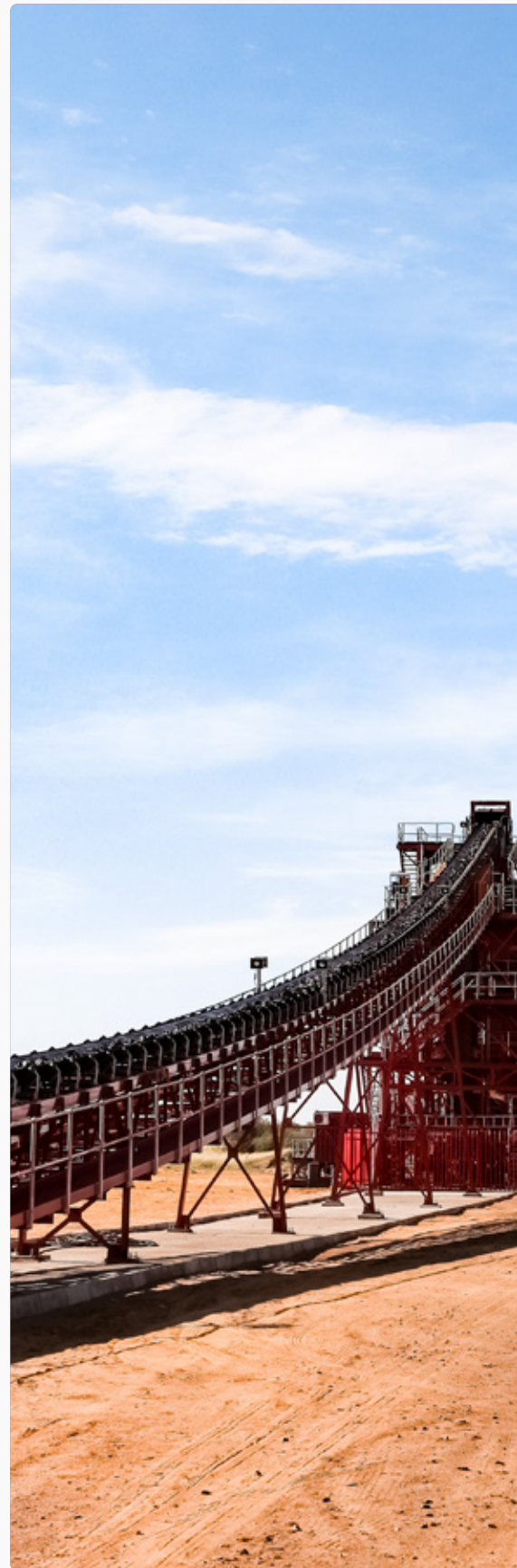


# WHITE PAPER

AI-Driven Predictive Maintenance for  
Belt Conveyors



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## Executive Summary

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Conveyors are the arteries of bulk material handling in mining & metals, cement, power, fertilizer, and port industries.

They transport ore, concentrate, raw materials, and finished goods across vast operations. A single conveyor failure can halt production, cause safety risks, and lead to significant financial losses.

In mining and metals especially, conveyors replace fleets of trucks, carrying thousands of tons per hour in harsh and abrasive environments. Unplanned breakdowns here are costly and dangerous.

This paper explains the challenges of monitoring them in real time, the importance of sensor selection, and how PlantOS, our Industrial AI platform, detects early-stage faults. We also present deployment results across 1215 conveyors in five industries, cement, Mines & metals, paper, Port and power, we achieved over 99% equipment availability, avoided 4,917 hours of downtime, reduced mean time to repair by 20%, and enhanced workforce safety.

## The Importance of Conveyors in industry

- 1. Conveyors replace fleets of trucks, reducing costs and emissions.**
- 2. They transport raw ore, concentrate, and waste efficiently across vast mine sites.**
- 3. In metals processing plants, conveyors feed crushers, mills, and smelters—any failure stalls critical production lines.**
- 4. Manual inspections in mining conveyor tunnels or transfer points expose workers to hazardous conditions.**

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

## Challenges in Monitoring

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Conveyors are subject to constant stress from load, friction, and environmental exposure.

Key operational challenges include:

High maintenance costs from wear on motors, gearboxes, pulleys, and belts.

Harsh operating environments that hinder frequent inspections.

Safety hazards from manual inspection in confined or high-risk areas

Unplanned downtime leads to major production losses.

In addition to these operational challenges, conveyor monitoring presents specific technical hurdles:

1. **Monitoring at slower belt speeds**, where vibration patterns are subtler and harder to analyze.
2. **Inconsistent operational loads** that distort vibration signatures and complicate fault detection.
3. **Network connectivity issues** caused by vast distances between monitoring points, especially in mining and port operations.
4. **Sensor durability and positioning challenges** in high-dust, high-moisture, or high-temperature environments.

These factors make conveyor monitoring one of the most demanding use cases for predictive maintenance technology, requiring rugged sensors, reliable connectivity, and advanced AI analytics to extract meaningful insights.

## Why Sensor Selection Matters

The effectiveness of predictive maintenance depends heavily on the sensors used to collect conveyor health data.

- **Powered sensors (3–5s capture):** Provide continuous, high-resolution data for mission-critical drives and pulleys in mines.
- **Wireless, battery-powered sensors:** Suitable for less critical conveyors in remote areas where wiring is impractical.
- **Piezoelectric sensors (SS body):** Resistant to dust, slurry, and vibration, which are ideal for abrasive mining environments.

### Assets Monitored:

- Motor
- Gearbox
- Head Pulley
- Snub Pulley
- Bend Pulley
- Tail Pulley

Mining operations demand **rugged, high-frequency monitoring** to prevent costly shutdowns.

## How PlantOS Identifies Early-Stage Faults

PlantOS, the Industrial AI platform, ingests high-frequency sensor data and applies advanced analytics to detect faults at their earliest stages:

- Extracts 70+ engineered features to detect weak fault signatures in low-speed belts.
- AI models identify early-stage faults such as bearings, lubrication, misalignment, and many more.
- Adaptive learning reduces false alarms, building confidence with the operators.
- Prescriptive Insights: Goes beyond detection—PlantOS recommends the most likely cause and the intervention required.

This **closed-loop AI system** reduces false alarms and builds trust with plant teams by aligning predictions with real-world outcomes.

## Deployment and Results

Across 1215 Conveyors monitored in Mining & Metals , Steel , power, fertilizer, cement and ports predictive maintenance have delivered measurable results:

- **Faults Detected:** 1257 across categories including bearings, lubrication, misalignment.
- **Downtime Avoided:** 4,917 hours across deployments.
- **Availability:** >99.9 % with almost no breakdown.
- **Maintenance Efficiency:** Mean Time to Repair (MTTR) reduced by 20%.
- **Safety:** Significant reduction in manual inspection in hazardous pump areas.

## ROI and Industry Adoption

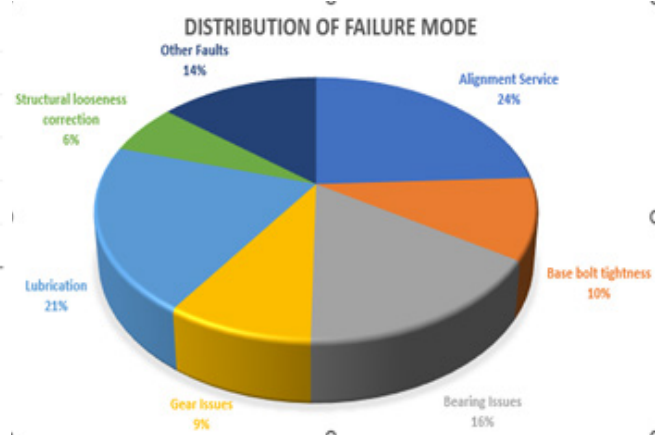
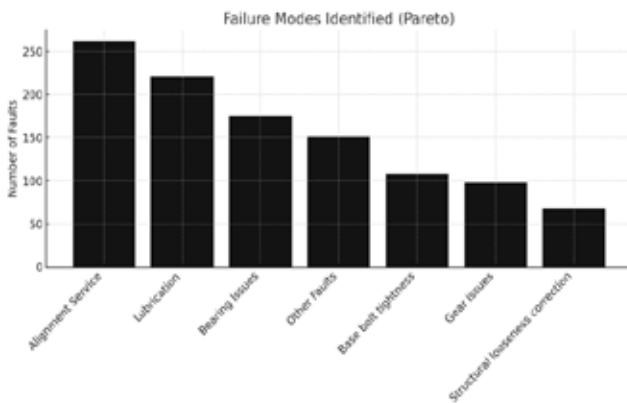
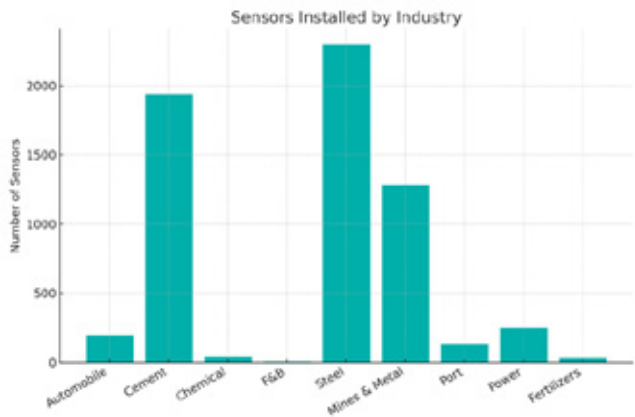
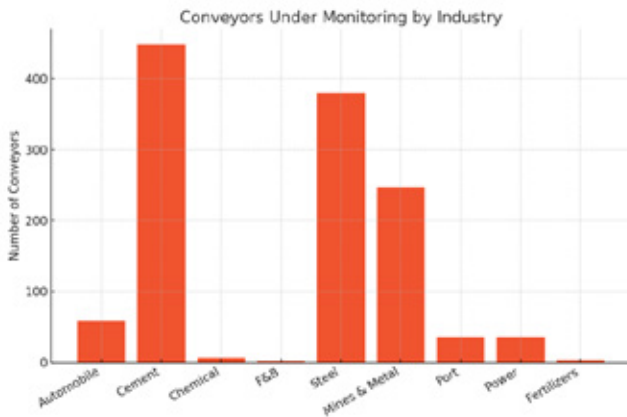
For mining and metals companies, ROI is clear:

- **Operational:** greater than 99% uptime, fewer stoppages.
- **Financial:** millions saved in avoided downtime; optimized spares inventory.
- **Safety:** reduced manual inspections in hazardous zones (transfer points, crusher feed conveyors).

Beyond mining, adoption spans cement, fertilizers, power, and ports—with cross-industry learnings enriching PlantOS models.



## Data Visualisations



## Conclusion

Conveyors are mission-critical assets across industries — from mining and metals to cement, steel, fertilizers, ports, power, and manufacturing. Unplanned failures can disrupt entire operations, create safety risks, and drive up costs. AI-driven predictive maintenance, enabled by PlantOS, offers a proven path to maximize uptime, extend equipment life, reduce maintenance costs, and protect worker safety.

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