MOVUS

WHITE PAPER

AI-Driven Predictive Maintenance for Paper Plants

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Executive Summary

Paper manufacturing is one of the most asset-intensive industrial processes, relying heavily on rotating machinery such as dryer cylinders, calender r olls, pumps, fans, mixers, and pulp screening systems.

These machines operate under high temperature, humidity, and load conditions, making them highly susceptible to early stage degradation and unexpected failures.

Across 25+ paper plants, our Industrial AI platform PlantOS continuously monitors 900+ critical assets, detects 1,500+ early-stage faults, and has already helped plants avoid more than 2,500 hours of unplanned downtime.

This has enabled a measurable improvement in plant reliability, including:

- >99% machine availability
- 25% improvement in maintenance planning effectiveness
- 20% reduction in Mean Time to Repair (MTTR)

This white paper outlines the challenges unique to paper mills, the role of correct sensor technology, and how Industrial AI shifts maintenance from reactive firefighting to precise, predictive and prescriptive decision-making.

Challenges in Paper Plant Monitoring

Paper mills operate in some of the harshest manufacturing environments. Core challenges include:

- **High unplanned downtime**
- **Aging infrastructure**
- **High energy consumption**
- **Chronic lubrication, alignment, and contamination issues**
- **High temperature and humidity exposure**
- **Dryer sections operating at high temperatures**
- **Difficulty attracting and retaining experienced maintenance personnel**
- **High humidity accelerates corrosion and bearing failures**

Together, these factors create conditions where failures occur frequently and often without warning.

Failure-Prone and Critical Equipment

Dryer Cylinders

Dryer cylinders are the heart of the paper machine, responsible for moisture removal, stabilise sheet quality, and influence production line speed. They operate under high surface temperatures, mechanical loading and continuous moisture exposure.

Major Failure Modes:

- Bearing damage from thermal expansion and lubrication breakdown
- Misalignment between cylinders
- Unbalance at high rotational speeds
- High vibration leading to structural and shaft damage.

Calender Rolls

Calender rolls refine paper surface characteristics such as smoothness and gloss, which is essential for high-quality printing, packaging, and specialty papers.

Major Failure Modes:

- Bearing wear from high pressure and lubrication issues
- Misalignment or unbalance causing vibration
- Heat-related damage
- Contamination contributing to premature bearing failure.

Why Sensor Selection in Paper Plants Matter

Paper mills combine high-criticality assets and harsh environmental conditions, making the correct sensor selection essential.

Piezoelectric Sensors (Powered, Continuous Monitoring):

Ideal for monitoring high-criticality rotating equipment such as dryer cylinders, calender rolls, high-speed fans, blowers, and main drives. These sensors tolerate harsh conditions and deliver continuous vibration and temperature data for early-stage fault detection.

MEMS-Based Wireless Sensors (Battery Powered):

Suitable for less critical or hard-to-access equipment where wiring is impractical. These sensors perform intermittent monitoring, offering periodic condition checks where continuous data is not required.

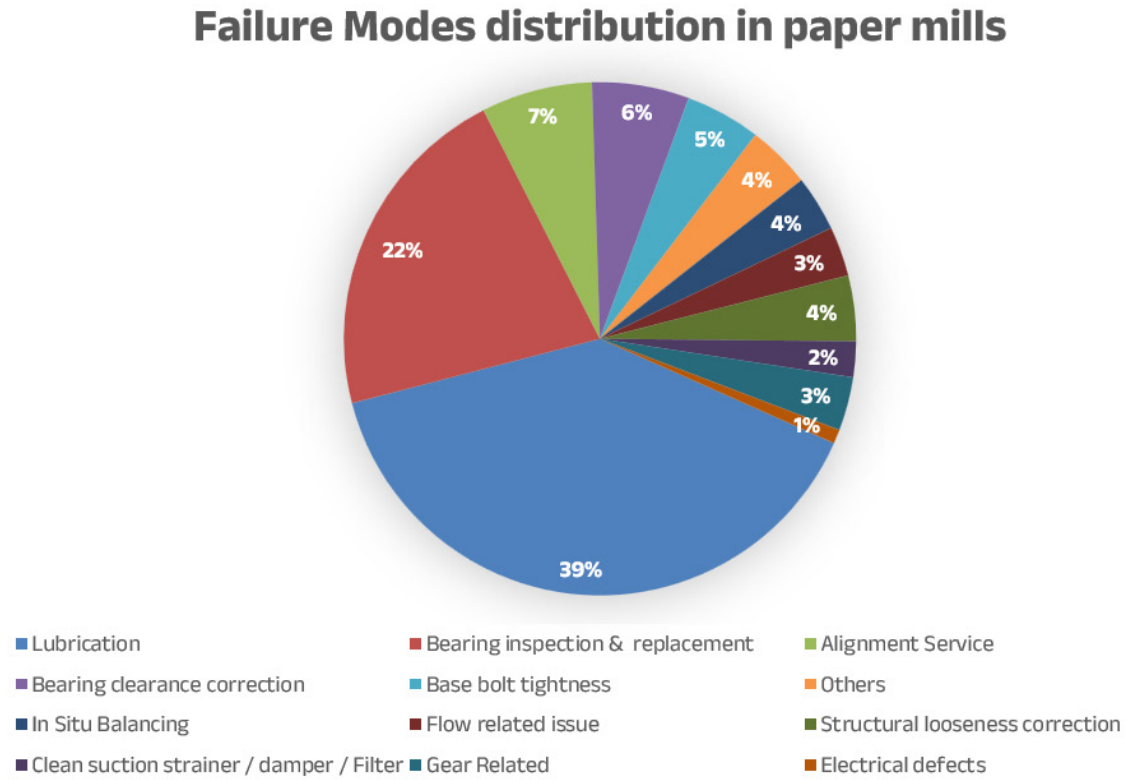
How PlantOS Identifies Early-Stage Faults

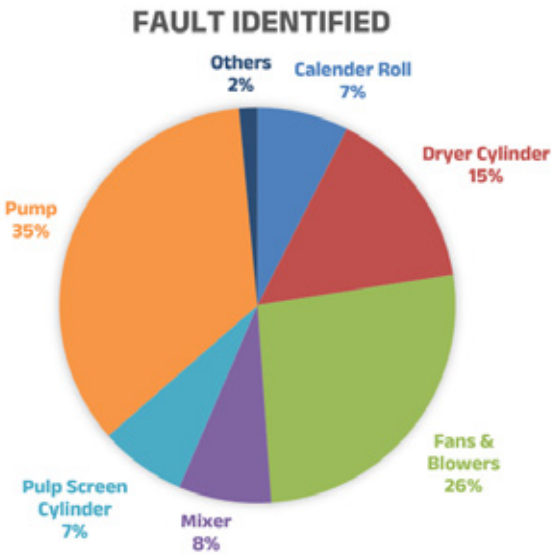
PlantOS ingests high-frequency sensor data and applies advanced analytics to detect faults at their earliest stages:

- **Data Capture:** Vibration, temperature, acoustic, and torque signals.
- **Feature Engineering:** 70+ engineered signal and statistical features.
- **Adaptive AI Models:** Learn normal vs. abnormal patterns under varying loads.
- **Fault Classification:** Detects issues such as bearing clearance changes, misalignment, lubrication faults, gear/pinion defects, and shell or liner wear.
- **Prescriptive Insights:** Provides the most likely root cause and recommended intervention.

This **closed-loop approach** reduces false alarms and builds trust by aligning predictions with real-world site feedback.

Data Visualisations





Conclusion

Paper plants operate high-temperature, high-humidity, and mechanically demanding assets such as dryer cylinders and calender rolls. Traditional inspection-based maintenance cannot reliably detect early wear or degradation under these conditions.

AI-driven predictive maintenance, enabled by continuous monitoring and prescriptive diagnostics, is now essential for achieving higher reliability and reduced downtime. PlantOS provides the insights needed to detect faults early, plan interventions, and extend asset life.