



WHITE PAPER

Adaptive AI Model Training and AI-Led
Condition Monitoring



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Problem Statement

Industrial assets in mining and heavy industries face extreme operating environments such as heat, dust, vibration, and high mechanical loads.

Traditional maintenance practices often rely on scheduled inspections or reactive measures triggered after issues surface. This approach leads to high downtime, costly emergency repairs, premature spare part changes, and significant safety risks.

The challenge is clear: Industries need a predictive, adaptive, and scalable maintenance framework that ensures reliability, minimises unplanned downtime, and optimises asset performance.



Our Solution

Adaptive AI, piezoelectric sensing, and IoT-based condition monitoring transform maintenance from a reactive process into a proactive, intelligence-driven system.

By continuously collecting and analysing equipment health data, AI models not only predict failures before they occur but also prescribe interventions, diagnosing the root cause and recommending corrective action.

Core Capabilities

24x7 Data Acquisition

Using IoT sensors and piezoelectric sensing technology for harsh applications, capturing vibration, temperature, shockwave, and process parameters.

AI Algorithms and Big Data

Algorithms and analytics that detect early-stage abnormalities.

Outcome Assistant AI Model

Our model is built on 70+ engineered features for high diagnostic accuracy.

Prescriptive Intelligence

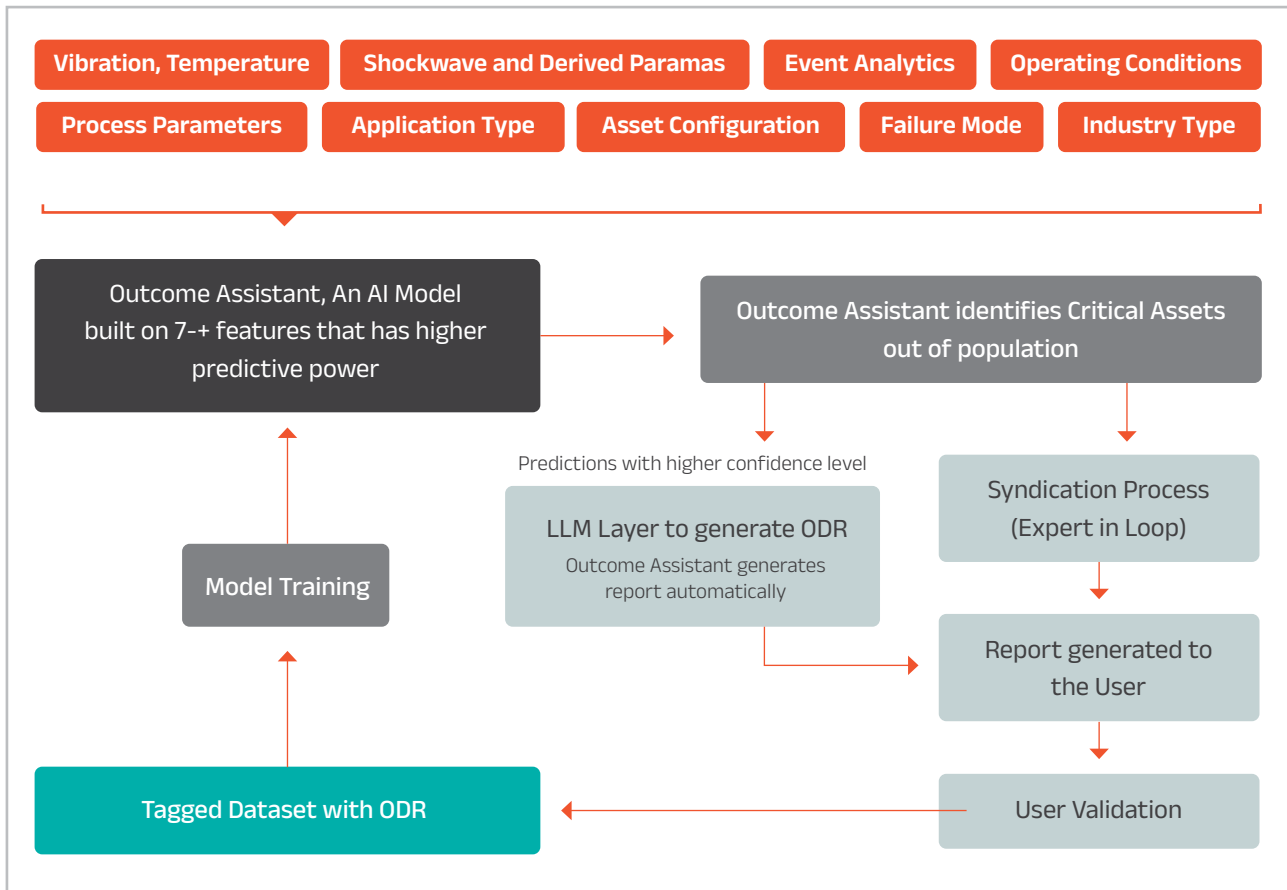
Beyond prediction, the system diagnoses the fault, explains the likely cause, and recommends intervention.

SaaS Delivery Model

Eliminating Capex and ensuring scalability across multiple sites.

Architecture: Adaptive AI Model Training and Condition Monitoring

Data, Tagging and Training Pipeline for Outcome Assistant



The system operates as a closed loop learning ecosystem, ensuring continuous improvement:

- 1. Data Foundation** – Inputs include vibration, temperature, event analytics, industry type, asset configuration, failure modes, and operating conditions.
- 2. Outcome Assistant AI Model** – Continuously trained on 70+ features with AI and LLM (Large Language Model) tuning to strengthen predictive power.
- 3. Tagged Dataset with ODR (Observation-Diagnostic-Recommendation)** – Enriched with over 100,000 tagged records across industries, improving accuracy with every cycle.
- 4. Prediction & Prescription report** – High-confidence predictions are processed into Outcome-Driven Reports through an LLM layer.
- 5. Expert Syndication** – Human experts validate AI findings to ensure reliability and trust.
- 6. Closed-Loop Feedback** – User validation feeds into the tagged dataset, further training the model and sharpening predictive capability.

This architecture ensures insights are not static but **adaptive, prescriptive, and continuously improving with real-world validation.**

AI-Enhanced Condition Monitoring

1. **Continuous, multivariate monitoring** – Of vibration spectra plus process tags (load, temperature, pressures, flows, electrical currents).
2. **Adaptive baselines** – Models learn each machine's "normal" under varying loads and seasonal conditions.
3. **Early anomaly detection** – identifies pattern drift before crossing degradation thresholds, learned from past equipment behaviours.
4. **Fault pattern library** – Maps spectral features (BPFO/BPFI/BSF, sidebands, harmonics), current signatures, and process covariates to likely failure modes.
5. **Explainable, prescriptive recommendations** – Deliver human-readable root cause hypotheses, confidence levels, and recommended interventions.

Result: Analysts spend less time sifting through raw data and more time executing targeted, verifiable interventions.

The Benefits

>99.9% Uptime

Near elimination of unexpected equipment breakdowns.

Expert Diagnostics at Scale

SaaS delivery shifts predictive maintenance from a capital expense to an operational service.

20%+ Maintenance Optimisation

Planned maintenance windows are consolidated and streamlined.

Cross-Industry Scalability

Models benefit from data across multiple verticals, strengthening predictive capabilities.

No Capex Investment

SaaS delivery shifts predictive maintenance from a capital expense to an operational service.

Improved Safety

Reduced emergency repairs lower risks for on-site teams.

Conclusion

The future of industrial reliability lies in adaptive AI model training and AI-led condition monitoring. By combining continuous IoT data collection, advanced AI analysis, expert validation, and SaaS delivery, this approach shifts maintenance from reactive to predictive. Industries adopting this architecture achieve uninterrupted production, optimised maintenance, and long-term cost efficiency, setting a new benchmark in operational excellence.

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