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UNLOCKING OPERATIONAL EFFICIENCY

through Predictive Maintenance using BI Tools

POV

Predictive Maintenance!

SUMMARY

Predictive Maintenance – **PdM** is a valuable approach that enables Maintenance, Repair, and Operations (MROs) to identify and address potential issues before they escalate into major problems. It is a proactive and data-driven approach that helps MROs optimize their operations, reduce costs, and ensure the reliability and longevity of their equipment and assets.

Let us explore the essential components and benefits of implementing predictive maintenance, leveraging key sources of data.

This document is a deep-dive about the implementation of Predictive Maintenance through using Business Intelligence tools like Power BI, Tableau and/or inhouse development that can enable organizations visualize, analyze, and gain actionable insights from their data.

KEY COMPONENTS

By harnessing the wealth of information available in various data repositories, organizations can revolutionize their maintenance strategies. Below are the key components of Predictive Maintenance.

> **Data Collection & Integration** - This involves exploring various data sources, including IoT sensors, equipment logs, & historical maintenance data and integrating this data into BI tools using connectors and data transformation tools.

> **Data Cleaning & Preprocessing** - The key is to handle missing or inconsistent data and have a series of preprocessing steps to ensure data quality and reliability.

> **Feature Engineering** - Feature engineering includes identifying relevant features that contribute to predictive maintenance models and creating calculated columns and measures to enhance the dataset.

> **Machine Learning Models** - The game changing moment is when organizations are able to build predictive models for failure prediction based on the historical data and AI modelling. The BI tools' integration with machine learning services in an amazing method to accomplish this.

By harnessing advanced analytics and predictive modelling, organizations can shift from reactive to proactive maintenance, ensuring equipment reliability and longevity

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Predictive Maintenance to MROs

KEY BENEFITS

Predictive maintenance to MROs is a data-driven approach offering a plethora of benefits across the entire value chain including costs, equipment lifespan, safety, compliance, security, real-time monitoring and many more.

Cost Savings – PdM helps in reducing unexpected downtime and costly repairs by identifying and addressing issues proactively. This approach is much more cost-effective than the traditional reactive maintenance.

Increased Equipment Lifespan – By addressing potential issues early, PdM can extend the lifespan of equipment and assets, as it prevents the progression of minor problems into major failures.

Improved Safety - Regular monitoring and early detection through PdM can contribute to a safer working environment. It helps prevent accidents and failures that could lead to safety hazards.

Efficient Resource Allocation – PdM allows MROs to allocate resources more efficiently. Instead of regularly scheduled maintenance, resources can be directed where they are needed based on the actual condition of equipment.

Data-Driven Decision-Making – PdM relies on data collected from sensors and other monitoring devices. Analyzing this data enables MROs to make informed decisions, optimize maintenance schedules, and prioritize tasks based on the actual health of the equipment.

Reduced Unscheduled Down-time - Since potential issues are identified before they result in a breakdown, unscheduled downtime is minimized. This is crucial for industries where continuous operation is essential.

Condition-Based Monitoring - PdM often involves the use of condition-based monitoring technologies like vibration analysis, thermal imaging, oil analysis, and more. These techniques help in detecting early signs of wear, misalignments, or other anomalies.

Integration with IoT and AI – Predictive Maintenance can be enhanced by integrating Internet of Things (IoT) devices and Artificial Intelligence (AI) algorithms. These technologies enable real-time monitoring, advanced analytics, and more accurate predictions.

Compliance with Regulations - In certain industries, compliance with regulatory standards is mandatory. PdM can help organizations meet these standards by ensuring that equipment is well-maintained and meets safety requirements.

Customer Satisfaction – For businesses providing services, PdM can lead to increased customer satisfaction. It reduces the likelihood of service interruptions, providing a more reliable and consistent experience.

Organizations can unlock the full potential of Predictive Maintenance, resulting in improved operational efficiency and reduced maintenance costs

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Data is Everything!

DATA SOURCES

To be able to implement predictive maintenance effectively, organizations will need to leverage data from multiple sources. For most of our customers, we slice and dice data from the following key sources

Equipment Data
names, models, specifications, locations, maintenance schedules, warranty information, and service history

Maintenance Records
dates, descriptions of work, personnel involved, and time taken for all maintenance activities

Work Orders
creation, assignment, tracking, and closure of scheduled maintenance and unscheduled repairs

Inventory Management
spare parts and materials data, including quantities, locations, reorder levels, and usage logs

Labor Data
personnel details, qualifications, certifications, work schedules, labor hours logged against tasks, and performance history

Vendor Data
information on suppliers, service contractors, maintenance agreements, and warranties

Costing Data
financial details related to maintenance, including labor costs, parts/materials costs, and overheads

Schedule Data
planning and scheduling data for maintenance work

CHALLENGES & SOLUTIONS

While organizations embrace predictive maintenance, more often than not, they are likely to encounter some very critical challenges. From our experience, we provide some very salient solutions that can help address these challenges.

The data is either insufficient or inaccurate – Like we said, Data is everything. Organizations need to implement robust data governance practices and invest in data cleansing and preprocessing tools. IoT devices are a great solution to gather data in real-time.

Integration of diverse data sources is complex – While gathering data from multiple sources such as equipment data, maintenance records and external factors is important for predictive maintenance, integrating this can be a huge challenge. The best way to turn this around is to employ data integration platforms or middleware. In addition to this, standardizing data formats and leveraging APIs to connect disparate systems can make the whole process seamless.

PdM solutions can be expensive – PdM implementation costs include implementation, sensors, software, and skilled personnel. The champions must conduct a cost - benefit analysis to justify their investments. In addition exploring cloud-based solutions and most importantly running a pilots before going full scale can avoid several cost leakages.

Resistance to change from maintenance teams – In order to beat the resistance in the organization, it is extremely important to conduct comprehensive training and awareness programs. By involving the key stakeholders in the decision making process, adoption becomes easier than imagined.

Existing legacy systems may not be compatible with PdM solutions – It is important to invest in interoperable technologies and gradually phase out legacy systems, if possible. Middleware could be a great solution for integration with legacy systems.

Security and Regulatory Compliance – One of the key aspects of the entire PdM solution implementation process is having a robust cyber security framework and educate everyone about the security best practices. It is also important to stay updated about industry-specific regulations and conduct regular audits to ensure adherence.

PdM Features

KEY INSIGHTS

From our extensive research and experience working with several organizations, we have summarized some of the key features of Predictive Maintenance. These insights will enable organizations in deploying PDM for their MRO.

| What	Insights	Relevant for
Bad Assets	• Evaluate assets for potential end-of-life or regulatory compliance issues • Implement alternative plans to address concerns and enhance reliability • Utilize a rules-based engine for identifying problematic assets	• Equipment Manufacturing • Equipment Repair Shops
Forecasting	• Predict asset failure from past records, considering costs and timelines • Forecast employee utilization and predict the next failure using patterns and time series • Estimate repair material based on costs and frequency, using on-the-fly predictions with the exponential smoothing algorithm	• Equipment Manufacturing • Equipment Repair Shops • Production Units • Transportation • Medical • Education
Retired Assets	• Identify assets for retirement, decide to revive or replace based on age, utilization, and costs • Predict usability, rank assets by age, maintenance costs, and regulatory compliance, and recommend scrapping top-ranked assets	• Equipment Manufacturing • Equipment Repair Shops • Production Units • Transportation
Survival Analysis	• Optimize asset maintenance schedules through cost-benefit analysis, failure prediction, reliability enhancement, and warranty analysis	• Equipment Manufacturing • Equipment Repair Shops • Production Units • Transportation • Medical • Education
Remaining Useful Life	• Evaluate asset remaining life, consider lifespan versus regulated expiry, and address under/overutilization • Make ROI-driven decisions on replacement or usage adjustments • Calculate life percentage from manufacture to expiry • Determine Remaining Useful Life (RUL) at individual and group levels	• Equipment Repair Shops • Production Units • Transportation
Anomaly Detection	• Spike in maintenance expense, suggests fund seepage, or a potential fraud indicator • Unusual material consumption, indicates security breach or subpar material use • Employee underutilization, linked to work scheduling issues or resource shortages	• Equipment Manufacturing • Equipment Repair Shops • Production Units • Transportation • Medical • Education
Root Cause Analysis	• Understand and address underlying issues by utilizing a decompose or sunburst chart • Predefine factors and subfactors (3-5 levels) that are drilled down in real-time to reveal the cause of issues or anomalies	• Equipment Repair Shops • Production Units • Medical • Education
Prescriptive Maintenance	• Take proactive measures by predicting and preventing failures through prescribed maintenance actions • Aim to minimize downtime, boost maintenance reliability, optimize inventory, and enhance operational efficiencies • Utilize smart narratives to prescribe solutions based on identified causes	• Equipment Manufacturing • Equipment Repair Shops • Production Units • Transportation • Medical • Education

Zura's Expertise with PdM

EXHIBTS
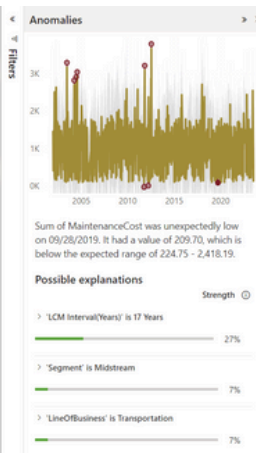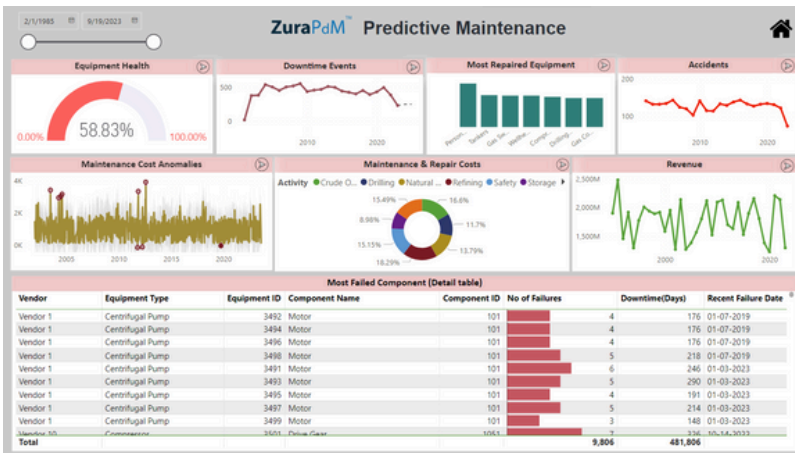
Predictive maintenance dashboard showing real-time asset health, maintenance anomalies, downtime forecasting and similar metrics for management

Survival curve provides a clear visual representation of time-to-event data, allowing researchers and analysts to understand and communicate the dynamics of event occurrence within a given population or under different conditions
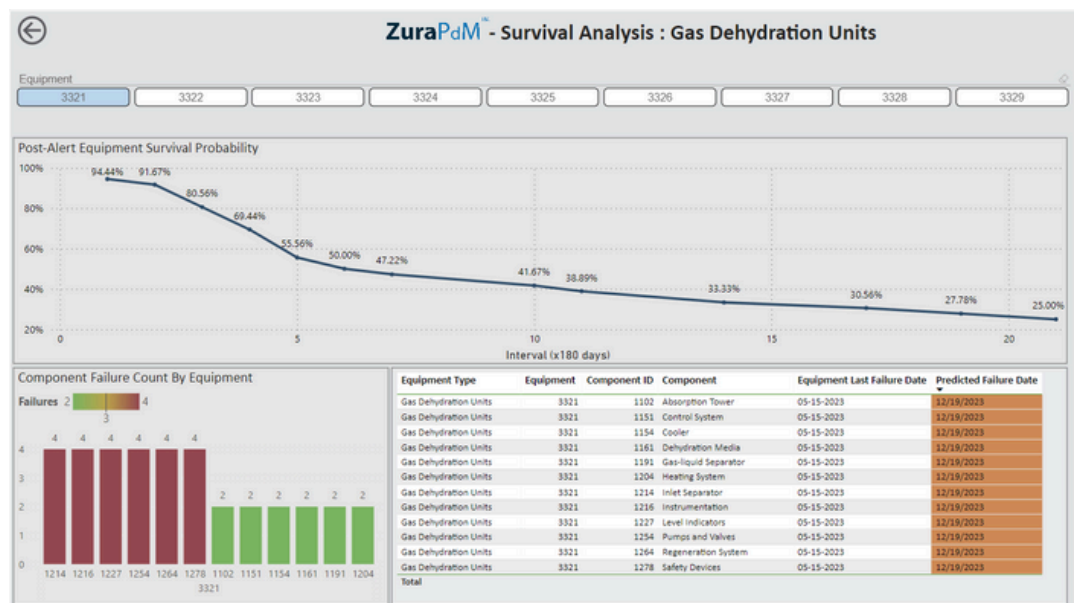
Root cause analysis (RCA) when an Anomaly occurs to find the factors and subfactors which have contributed the Anomaly. This provides insights to the management
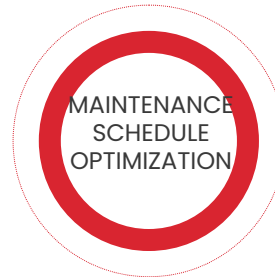
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Zura's Expertise with PdM

DASHBOARDS & METHODOLOGY

OVERVIEW DASHBOARD

- Visualizing overall equipment health
- Real-time monitoring of predictive maintenance alerts

ASSET SPECIFIC DASHOBARD

- Drill-down into individual asset performance
- Historical trends and patterns for specific equipment

MAINTENANCE SCHEDULE OPTIMIZATION

- Using BI tools' visuals to optimize maintenance schedules based on predictive insights
- Balancing predictive alerts with scheduled maintenance tasks

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PREVENT ▶▶

- Reliability
- Maintainability
- Lifecycle Cost Management

FIND ▶▶

- Early Detection
- Bad Actor Identification

ANALYZE

- Root-Cause Analysis
- Safety Incidents Minimization
- Operational Cost Reduction

Uses AI & ML on the recorded activities to identify patterns, predict, analyze and prevent any untoward events, Provides insights, forecasts and real time alerts

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