Predictive Maintenance & Quality
in a Big Data Environment

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What is Predictive Analytics?

**Predictive analytics** involves analyzing data in order to unfolds patterns and relationships. Predictive models can be applied to new data, in order to predict outcomes that will optimize decision taking at the point of impact.

- Uncover (unexpected) patterns and associations from all data within your organization
- Perform advanced analytics, data mining, text mining, social media analytics and statistical analysis
- Deliver optimized decisions to your operational systems and decision makers

Leverage the widespread use of data in order to make better decisions
Which issues can Predictive Maintenance address?

- How can I perform in-depth, root-cause failure analysis on my process and equipment?
- How can I detect warranty issues sooner?
- How can I optimize my maintenance plan?
- How can I predict an impending equipment failure and the cause?
- How do I achieve optimal equipment efficiency and availability?
- What is the life expectancy of an asset’s component or part?
- How can I create the highest quality products?
- How can I reduce process variability?
- How can I ensure supply is aligned with demand?

**Asset Performance**

**Process Integration**
Evaluating Your (Analytical) Asset Management Maturity Level

- **Value**: 
  - V: Innocence
  - IV: Awareness
  - III: Understanding
  - II: Competence
  - I: Excellence

- **Maturity**: 
  - V: Fire fighting
  - IV: Work Mgmt - Preventive - Spares parts
  - III: Reliability - Condition based monitoring - Predictive
  - II: Service Level Agreements - Service Management
  - I: All Processes - Asset & Services Management - Enterprise wide Business Alignment
What is IBM *Predictive Maintenance & Quality*?

IBM Predictive Maintenance and Quality reduces operational costs, improves asset productivity and increases process efficiency by helping monitor, maintain and optimize assets for better utilization and performance, as well by predicting asset failure and enhancing product quality and supply chain processes, via out-of-the-box data models, dashboards, reports, and enterprise asset management connectors enabling accelerated ROI for organizations.

1. Reduce warranty cost
2. Reduce Downtime
3. Predict time to failure
4. Root Cause Analysis
Predictive Maintenance & Quality: What if…

What if you could predict the failure of an asset to prevent costly unexpected downtime?

What if you could statistically determine, monitor, and control those variables that effect product quality?

What if you could recognize warranty issues sooner, identify the root cause faster and perform corrective / preventative actions?

What if you could quickly mine the thousands of maintenance logs to determine the most effective repair procedures and maintenance cycles?

You could …

- Reduce operational costs
- Improve operational efficiency
- Optimize product quality
- Extend the life of an asset
- Reduce unscheduled maintenance
- Improve diagnosis and prognosis capabilities
- Determine best repair strategies
- Exceed customer expectation
- Improve customer experience
Collect & Integrate Data  
Structured, Unstructured, Streaming

Generate Statistical & Predictive Models

Conduct Root Cause Analysis

Display Alerts and Recommended Actions

Act upon Insights

Predictive Maintenance & Quality

Asset Performance

Process Integration

Predictive Maintenance & Quality – How

1. Collect & Integrate Data  
Structured, Unstructured, Streaming

2. Generate Statistical & Predictive Models

3. Conduct Root Cause Analysis

4. Display Alerts and Recommended Actions

5. Act upon Insights
Decision Management

Decision Management is a business discipline that combines a variety of techniques to enable optimizing actions and outcomes:

- Optimize actions with resource constraints, aligning execution with strategy
- Empower real-time and adaptive decisions accommodating changing conditions
- Provide front-line employees and systems with recommended actions
Decision Management

IBM® Analytical Decision Management for Predictive Maintenance

Properties of Robotic Arm Malfunction

Choose Who This Use Case Applies To

Allocate Using Segment Rules

- Allocate using rules
- Multiple Allocation
- Allocate randomly

<table>
<thead>
<tr>
<th>Rule name</th>
<th>Allocation</th>
<th>Insert rule</th>
<th>Remove</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Fractured parts or parts predicted to fail</td>
<td>Replace Fractured Part; Perform Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2  Low rotor speed</td>
<td>Tighten Lead Screw; Check Stepping Motor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3  High voltage</td>
<td>Replace Fractured Part; Perform Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4  Predicted driver failure</td>
<td>Check Drivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5  Time since last service above threshold</td>
<td>Check Drivers; Perform Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6  Remainder</td>
<td>Perform Maintenance</td>
<td></td>
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</tr>
</tbody>
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MCTY2014 Maximo Comes To You
PMQ - Architecture

End User Reports, Dashboards, Drill Downs

Predictive Analytics

Decision Management

Business Intelligence

Analytical Datastore
(Pre-built data schema for storing configuration, quality & maintenance information, including aggregated sensor information)

Integration Bus
(Message Broker)

Telematics, Manufacturing Execution Systems, Legacy Databases, Distributed Control Systems

High volume streaming data (low level sensor data, log records)

Enterprise Asset Management Systems
The wider Solution Framework

Data Sources

- **Devices**
  - Manufacturing
  - Quality Control

Data Consolidation Structured & Unstructured

- Performance Log Data
- Condition / Sensor Data
- Environmental Data
- Incident Log Data
- Maintenance Log Data
- Asset Data
- Customer Data
- Financial Data
- Social Networks

Analytics

- Real-Time Event Processing & Analytics (condition, sensor data)
- Business Analytics
  - Event Rules
  - Models
  - Work Flows
- Statistical Analytics

Vizualisation & Messaging

- Alerts
- Dashboards
- Reports & Analysis
- Visualization & Discovery

Capture → Monitor → Predict → Prescribe → Next best action

Analytic Data Store

(High Performance MPP)

PMQ
PMQ provides several key features

- Real-time Capabilities
- Big Data, Predictive and Advanced Analytics
- Quick and Accurate Decisioning
- Maximo Integration
- Business Intelligence
- Accelerated Time to Value
- Open Architecture
Business Intelligence

Features

- Maintenance Dashboard for analytical and holistic insight discovery
- Using multiple interconnected visualizations to analyze the larger picture and reduce time to actionable insight discovery
- Conduct self-service query, reporting and analysis from virtually any data source
- Leverage the drag-and-drop studio environment to provide real-time views
- Experience insight wherever needed with mobile capabilities (any device)
- Drill-down into data for additional insight
Real-time Capabilities

Features

- Conduct real-time monitoring of assets and processes
- Collect, integrate, analyze and report streaming information
- Orchestration of events and services for efficient processing provided by Analytic Solutions Foundation
- Operationalizes analytics
- Connect to sensors, PLCs, SCADA systems, databases, maintenance logs, big data streaming sources
Maximo Integration

**Features**

- Integrate directly with Enterprise Asset Management systems, such as IBM Maximo
- PMQ leverages asset master and fault data from Maximo
- Master data is synchronized between Maximo and PMQ
- PMQ generates work orders based on analytic insight and business rules
- Directly act upon predictive insights with system of engagement
Accelerated Time to Value with Advanced Maintenance Modelling

Features

- Leverage easy-to-install, preconfigured software and content stack
- Utilize out-of-the-box data source connectors and models, dashboards and reports to reduce the need for additional services
- Quickly expand or modify included models for specific industry and business applications
- Advanced Maintenance modeling leveraging combination of Text Analytics, Wear, Fatigue, cycle data
- Leverage IBM Research assets:
  - advanced process control
  - quality early warnings
  - advanced SPC charting
  - customizable Exponential Weighting Coefficient
Open Architecture

Features

- Analytics Solutions Foundation provides APIs for integration and customization
- Partner-included content for specific industry and business applications
- Integrate directly with Enterprise Asset Management systems, Business Process Management or other services
- Easy connection to external shop floor data via ILS deviceWISE
Customer stories
BMW leads in differentiating with analytics
Quality Management in early production stage

Casting engine blocks

- Analyze large volumes of production and quality data, as well as parameters.
- Using statistical models, BMW was quickly able to identify flaws in the production process and implement the appropriate corrective actions.
- This process of revealing hidden information helps to identify improvements, and thus increase product quality while reducing time to do quality checks.

80% Scrap rate reduction
Real time repair plan

Service Advisor
Service advisor picks up the car.

Data Readout
Engineer reads out failure messages.

Repair
Repair is done as proposed and guided by diagnostic software.

Data Transfer
Data transfer of both technical and business data to the headquarter.

Analysis & Reporting
Interpretation and analysis of the data.
Railway company: Predict equipment flaws

- **Wayside detectors**
  - Wheel impact load detectors
  - Hotbox detector
  - Acoustic bearing detector

- **Transmits to Network Operations Center**

- **Next best action:**
  - Non-emergency (suspect list)
  - Stop or Slow the train
  - Pull this car at next station

- **Results**
  - Prediction of severe alarms within 7 days with 98% accuracy (6% false positives)
  - Newly developed predictive rule set was more accurate than SME rules developed over 10 years
  - Now focusing on many more objectives
The need

Facing an aging infrastructure and numerous customer complaints, the District of Columbia Water and Sewer Authority (DC Water) needed to improve asset reliability and lifespan, and streamline its business processes.

The solution

- Modernize infrastructure management
- Gain greater visibility into critical operations
- Proactively detect and signal risks of failures
- Optimize spare part supply chain
- Improve resource planning & efficiency

What makes it smarter

Advanced spatial analytics will deliver near real-time information to assist DC Water in predicting potential problems and occurrences based on location, time, weather and historical events.

Solution components

- IBM Cognos Business Intelligence
- IBM Maximo Asset Management
- IBM Maximo Spatial Asset Management
- IBM SPSS Predictive Analytics
- IBM WebSphere ILOG BRMS

Business benefits

- 36 percent reduction in customer calls through increased preventive maintenance and implementation of automated meter readings
- Increased percentage of emergency investigations dispatched within 10 minutes from 49 percent to 93 percent
- Ability to generate reports for regulatory compliance and management review in seconds versus days
- Significant reduction in asset downtime

https://www.youtube.com/watch?v=xFEIO1SczNk
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Best Practices – Lessons learned

- Analytics should become an enterprise-wide capability
- Think Big, but start small
- Data Quality - Analysis will tell you what you need
- Domain knowledge versus Analytical skills
- Predictive analytics adds to SME; it doesn’t replace it
- Model Management: models don’t last forever
- Be creative: adding new data will create new hypotheses
Thank You