Machinery Health Monitoring and Analysis

EMERSON
Process Management
Machinery Maintenance

Mechanical equipment is the greatest source of downtime in process & utility plants

Increases Availability and Performance at Minimized Maintenance Cost of Mechanical Equipment
“Understanding machinery condition ensures that the right maintenance is provided at the right time”
Bath Tub Curve of the Failure

- Decreasing Failure Rate
- Constant Failure Rate
- Increasing Failure Rate

- Run in
- Useful life
- Wear out

Operating Time

Failure Rate
"Of all the parameters that can be measured non-intrusively in industry today, the one containing the most information is the vibration signature."

Art Crawford
Vibration Analysis

- Imbalance (static)
- Angular misalignment
- Looseess (rotating)
- Bearings: Stage Four

BPI
2xBPI
Defect frequencies
Natural frequencies
Ultrasonic

Emerson Process Management
Diagnose Nature of Fault

- Expert System
- Program Documentation
- Multiple Analysis Options
- Report Link
- Multiple Plot Options
- Fast Indexing
- Fault frequencies to identify specific nature of fault
Automated Screening with Expert System

An alarm/screening report, and a first pass at analyzing machine condition

Multiple Diagnoses

Calculates Problem Severity

Calculates Overall Severity

Diagnosis Across Entire Machine Train
Software for Machinery Health Management

- Data from diverse technologies resides in one database structure
  - All personnel view the complete history for each asset
  - Technologies supported:
    - Vibration – portable and online
    - Alignment & balancing
    - Motor Diagnostics
    - Infrared Thermography
    - Lubrication analysis & Ultrasonics
Integration

- Seven integrated technologies
- Complete asset health condition into a single database
- All diagnosis and findings under one asset in RBMview
- Why not have all of the symptoms of the equipment failure
- Know the whole story before making a recommendation
Multi-technology Analysis Tools

- Technology and expertise… tools for decision making
  - Vibration Analysis
    - FFT, waveform, & phase analysis
    - Automated diagnostics expertise
  - Lubrication Analysis
    - Trivector wear, chemistry, & contamination analysis
  - Electric Motor Monitoring
    - Automated rotor & stator diagnostics, using current & flux
  - Infrared Thermography
    - Palette & plot annotation tools
    - Temp profile & histogram analysis
  - Alignment & Balancing
    - Tolerance plots by the job
Reporting for Machinery Health Management

- Condition tracking and documentation
- Reporting for technician and management
- Actionable information at facility and machine level
- Multi-technology asset information repository
Application Integration and Openness

- Integration with CMMS application for automated work order generation. MAXIMO and other cmms apps.
- MIMOSA open standards alliance
- ODBC open connectivity standards
- Asset Portal Consolidates information from Machinery Health Manager, Performance Monitor, Real Time Optimizer, and Intelligent Device Manager.
  - Combines asset information from multiple plant locations
  - collects summary-level information
Integration Conditional Monitoring (CM) with Computerized Maintenance Management System (CMMS)

- The role of CM is to implement a maintenance strategy (Predictive, Preventive or Breakdown)

- The role of CMMS is to manage the execution of maintenance (Providing tool as management of work, spares in inventory, purchasing, regulatory compliance and documentation)
Integration Conditional Monitoring (CM) with Computerized Maintenance Management System (CMMS)

- The opportunities for new or enhanced benefits of the integration include:
  - More effective and automated implementation of maintenance strategy
  - Improved accuracy of CM analysis
  - Identification of repetitive failure for root cause analysis
  - Effective communication of machinery health throughout the enterprise
How can these Different Systems Work Together?

- The CM has evolved in technical wrapped around the measurement technology. In practice, CM has a well developed vocabulary and data set including these parameters:

<table>
<thead>
<tr>
<th>Plant Machinery Hierarchy</th>
<th>Trend</th>
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<tbody>
<tr>
<td>Machine Priority</td>
<td>Spectrum</td>
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<tr>
<td>Measurement Locations</td>
<td>Time Waveform</td>
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<tr>
<td>Measurement Definitions</td>
<td>Thermographic Image</td>
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<tr>
<td>Measurement Interval</td>
<td>Frequency Component</td>
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<tr>
<td>Severity</td>
<td>Diagnosis</td>
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<tr>
<td>Alarm Status or Exception</td>
<td>Prognosis</td>
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How can these Different Systems Work Together?

- The CMMS is an information intensive application, historically offering its significant benefits through gathering and distributing information about the maintenance function. CMMS has a well developed vocabulary and data set includes:

<table>
<thead>
<tr>
<th>Plant Machinery Hierarchy</th>
<th>Parts Inventories / Costs</th>
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</thead>
<tbody>
<tr>
<td>Work Requests / Orders</td>
<td>Storage Locations</td>
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<tr>
<td>Work Plans</td>
<td>Preventive Maintenance Actions</td>
</tr>
<tr>
<td>Work Schedules</td>
<td>Purchase Requests / Orders</td>
</tr>
<tr>
<td>Labor Resources / Cost</td>
<td>Safety Procedures</td>
</tr>
</tbody>
</table>
How can these Different Systems Work Together?

- Creating an intelligent Connection
  - It is necessary to effectively connect the shared data between these systems as the following new types of information and relationships between the systems:
    - Connection between the Machinery Hierarchies of the CM and CMMS
    - Creation of a new CM result known as Advisory
    - Creation of Work Requests based on Advisories
    - A Gateway to Automate Communication between the Systems
    - Tracking of Work Request within the CM System
    - Display of Equipment Histories and Work Plans within the CM System