Profibus & Machinery Asset Management

Agenda

- Introduction to Reliability / Asset Management
- Asset Optimisation Tools
- Asset Optimisation Tools for Profibus MS/VSD
- Asset Management Architecture
- Summary
What is Asset Management?

- Asset Management services and technologies help Industry make the most of key production assets so that they can increase availability and performance for improved business results. This includes not only valves, transmitters, analyzers, and other field devices, but also mechanical equipment, electrical systems and process equipment.

- An Asset Management program includes three elements - technology, expertise and work processes deployed uniquely to meet the specific needs of each customer.

- These three elements are required, whether considering a single instrument, or all production assets in a facility.
Industries Face Tough Challenges

- Retiring Workforce
- Inexperienced Workers
- More Technology
- Larger, More Complex Processes
- Fewer Specialists
- Fewer Incoming Workers
Leading Challenges For Manufacturers

- Support me since I have limited Resources
- We want to be Best in Class
- Help me improve my ROCE
- Help me reach my Safety, Health, Environment, Production Targets
- Improve my Plant Availability
- Reduce my Maintenance Cost
- Help me make Easy Decisions

We want to be Best in Class
Reliability is Paramount to Achieve Business Goals

Reliability
- Unplanned Shutdowns
- Capacity Utilization
- Maintenance Index

Financial
- Return on Capital Employed (ROCE)
- Income & Margin
- Capital

Efficiency & Throughput
- Throughput
- Energy Intensity
- OpEx
- Plant Availability

Safety & Environment
- Incidents
- Spills / Emissions / Discharges
- Fines / Penalties

Personnel
- Human Productivity
- Training
- Critical Skills

Reliability is Paramount to Achieve Business Goals
Sustained Reliability requires a Continuous Improvement approach to Maintenance

- Strategy Management
- Strategy Development
- Strategy Execution
- Strategy Evaluation
Best Maintenance Strategy is Mostly Planned…
…But Industry Is Reactive

<table>
<thead>
<tr>
<th></th>
<th>1988</th>
<th>2008</th>
<th>Best Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reactive</strong></td>
<td>55%</td>
<td>55%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Preventive</strong></td>
<td>30%</td>
<td>31%</td>
<td>25-35%</td>
</tr>
<tr>
<td><strong>Predictive</strong></td>
<td>10%</td>
<td>12%</td>
<td>45-55%</td>
</tr>
<tr>
<td><strong>Proactive</strong></td>
<td>5%</td>
<td>2%</td>
<td>5-15%</td>
</tr>
</tbody>
</table>

Source: Maintenance Technology

**Why?**

- Limited manpower: 45\% 8\%
- Budgetary restraints: 38\% 9\%
- Too busy reacting to machine problems to be proactive / strategic: 27\% 7\%
- Lack of management understanding of maintenance strategies: 22\% 7\%
- Level of maintenance employee training: 21\% 3\%
- Not sure how to justify improved best maintenance practices: 20\% 3\%

BARRIER: Major
BARRIER: Insurmountable
Business Performance Indicators

World Benchmarks (Solomon)

- OEE (Overall Equipment Efficiency) > 95%
- Plant Availability > 98%
- Maintenance Cost / ERV (Equipment Replacement Value) < 1.2%
- Average Return on Assets Managed > 15%
- Lost Time Incident Rate < 0.3
- Planned work > 90%
- Reactive Work < 10%
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Asset Management Tools

- Scope extends to all major production assets
  - Instruments & valves
  - Mechanical equipment
  - Process equipment
  - Other plant assets

- Integrated family of applications and supporting Services
  - Predictive diagnostics
  - Condition monitoring
  - Performance monitoring

- Delivers improved availability, performance and more effective maintenance
Structured Services approach supports multiple Maintenance Strategies

- Realize plant performance and ongoing improvements
- Get technology working and resources trained
- Realize changes into work culture and capture results
- Formulate strategies to achieve objectives
- Refine configuration and associated procedures
- Execute planned work
- Optimize performance
- Asses objectives
- Solid setup
- Credible feedback
- Written procedures
- Quantify results
- Ongoing support
- Basic training
- Execute planned work
- Optimize performance

NEW FACILITY

EXISTING FACILITY

PRE FEED/FEED

CONSTRUCTION

CONSTRUCTION/COMMISSIONING/STARTUP

OPERATIONS

OPERATIONS

NEW FACILITY

EXISTING FACILITY

PRE FEED/FEED

CONSTRUCTION

CONSTRUCTION/COMMISSIONING/STARTUP

OPERATIONS

OPERATIONS
Machinery Health Management

- Predictive diagnosis of mechanical equipment
  - Online and portable vibration
  - Oil analysis, infrared thermography, ultrasonics
  - Motor diagnostics
  - Laser alignment and balancing
- Automated analysis indicating the nature and severity of conditions
- Root-cause analysis with comprehensive reporting and graphical presentation of results
Portable and Online Predictive Machinery Health Management Solutions

- AMS Suite
  - Machinery Health Diagnostics
  - Performance Monitoring
  - Asset Health Dashboard

- Wireless Vibration Transmitter

- Machinery Health Transmitter

- Infrared Thermography

- Ultrasonic Testing

- Lubrication Analysis

- Online Machinery Monitoring

- Electric Motor Diagnostics

- Vibration Analysis and Balancing

- Alignment
Intelligent Device Management

- Enables Configuration and Predictive Diagnostics Of Instruments And Valves

- Enables access to Device’s Built-in Intelligence
  - Configuration Management
  - Diagnostics And Monitoring

- Provides Management Of Information
  - Calibration Management
  - Documentation

- Connectivity
  - HART, Foundation Fieldbus (and Profibus DP Devices)
  - Emerson and non-Emerson Hosts & Devices
  - Business Systems (Maximo, SAP etc.) via Asset Portal
Intelligent Device Management - Overview

- **Functionality**
  - Configuration, Diagnostics & Monitoring, Documentation and Calibration Management of HART, FF, **Profibus** and non-smart devices
  - Independent of Control System
  - Emerson and 3rd Party devices

- **Typical Device Manager Users**
  - Instrument Technician
  - Project/Service/Commissioning Engineer
  - Maintenance/Calibration Supervisor

- **Job Responsibilities**
  - Installation and commissioning of instruments and Valves
  - Preventative maintenance and Predictive Diagnosis of instruments and Valves
  - Calibration of Instruments and Valves
## Different Roles require Different Tools

<table>
<thead>
<tr>
<th>Role</th>
<th>Analytical Tools and Reports</th>
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</thead>
<tbody>
<tr>
<td><strong>Plant Manager</strong></td>
<td><em>Dashboards and Reports</em></td>
</tr>
<tr>
<td></td>
<td>Assess and mitigate risk to safety, environmental, and production</td>
</tr>
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<td></td>
<td>targets</td>
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<tr>
<td></td>
<td>Optimize cost in the plant</td>
</tr>
<tr>
<td></td>
<td>Maximize asset ROI</td>
</tr>
<tr>
<td><strong>Maintenance Manager</strong></td>
<td><em>Dashboards and Reports</em></td>
</tr>
<tr>
<td></td>
<td>Mitigate risk of assets causing downtime</td>
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<tr>
<td></td>
<td>Optimize maintenance strategies and procedures</td>
</tr>
<tr>
<td></td>
<td>Maximize physical asset performance</td>
</tr>
<tr>
<td></td>
<td>Manage maintenance work through the CMMS</td>
</tr>
<tr>
<td><strong>Electrical and Instrument Engineer</strong></td>
<td><em>Analytical Tools and Reports</em></td>
</tr>
<tr>
<td></td>
<td>Identify bad actors</td>
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<tr>
<td></td>
<td>Mitigate risk of instruments, valves &amp; motors causing downtime</td>
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<tr>
<td></td>
<td>Optimize maintenance with confidence</td>
</tr>
<tr>
<td></td>
<td>- Extend Calibration intervals</td>
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<tr>
<td></td>
<td>- Reduce Valve PMs</td>
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<tr>
<td><strong>Reliability Engineer</strong></td>
<td><em>Analytical Tools and Reports</em></td>
</tr>
<tr>
<td></td>
<td>Identify bad actors</td>
</tr>
<tr>
<td></td>
<td>Mitigate risk of rotating equipment causing downtime</td>
</tr>
<tr>
<td></td>
<td>Optimize maintenance with confidence</td>
</tr>
<tr>
<td></td>
<td>- Extend PM intervals</td>
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<tr>
<td></td>
<td>- Reduce inspections</td>
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</table>
Multiple tools or an integrated Asset Management Solution?

TYPICAL FACILITY: REACTIVE 45% - 55%*

Most Work Bypasses Planning & Scheduling

Work Identification & Approval

Work Order Planning & Scheduling

Work Order Execution

Work Order Closeout

BEST COST PRODUCERS: REACTIVE 10%*

Work Identification

Work Order Approval & Prioritization

Work Order Planning

Work Order Scheduling

Work Order Execution

Work Order Closeout

Feedback Audit/KPI

* Maintenance Technology Magazine 2002
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**What is a Variable Speed Drive (VSD)?**

- A Piece of Electrical Equipment Which Can Control the Speed, Torque or Position of:
  - AC Motors
  - DC Motors
  - Servo Motors

- By Using Advanced Switching Techniques:
  - PWM (pulse width modulation)
  - Vector control
  - Thus enabling current, voltage and hence power control

- Can be Controlled by:
  - Manual interaction (switches and joysticks)
  - Automated PLC / code control (complex automation systems)
  - Hybrid manual and automated (user assisted systems)
  - Fieldbus (including PROFIBUS and PROFINET)
Why Use a Drive?

- **Lower costs through:**
  - Energy savings
  - Tighter control
  - Increased productivity

- **Better Performance:**
  - Higher throughput

**Example:**

At 80% of rated speed only 50% of the maximum power is used.

At 50% of rated speed only 12.5% of the maximum power is used.
Drive Application Diversity

- Fans/Pumps
- Paper machines
- Steel mills
- Chemical plants
- Marine
- Fairground rides
- Ski Lifts
- Printing
- Cable laying
- Lifts/Escalators
- Cranes/Hoists
- Electric cars
- Textile machines
Control Techniques’ Drives and PlantWeb

ASSET OPTIMIZATION
- Device Manager
- Machinery Manager
- Performance Monitor
- Asset Portal

DIGITAL CONTROL

MEASUREMENT

VALVES & REGULATORS

AC DRIVES

Control Techniques is a key member of the Emerson brand and has unique insight and access to the PlantWeb solution.
To get the best out of our business we need to monitor both the process and the plant, this is achieved with AMS Device Manager.

AMS Device Manager allows management of field instruments, valves, general plant and now Control Techniques Drives, through the use of PROFIBUS!

Allows for predictive diagnostics, device configuration, calibration, management, and documentation integration.
What Additional Value Does PlantWeb with PROFIBUS Bring to Drives?

- Easy communication using PROFIBUS to get plant health data
- Offers unprecedented levels of monitoring without cyclic data congestion (does not affect manufacturing activities)
- Simplifies setup
- Enables faster diagnostics
- Familiar interface within the PlantWeb environment
- Preventative maintenance (be Proactive!)
- Scheduled downtime that fits your plans
- Reduces unnecessary plant maintenance (why shutdown plant to check for possible problems?)
- Provides an indication of changing operating conditions (investigate changes in drive operation, BEFORE it’s an issue)
Guided Setup – Facilitates Rapid Setup and Deployment

The Guided Setup feature in the software facilitates rapid setup and deployment of devices. The interface shown includes sections for different types of setup, such as:

- **Initial Drive Commissioning**
  - Link to Restore Default method will be here
  - Select and apply the desired drive default values (based on geographical region of use).

- **General Drive Setup**
  - Link to Guided Setup method will be here
  - Run this drive setup wizard to configure the basic drive operation.

- **Application Specific Setup**
  - Link to Fan/Flow Setup Method here
  - Run this wizard to configure parameters specific to Fan/Flow applications.

- **Other Setup Routinel**
  - Link to Drive Reset Method here
  - Perform drive reset action.
Device Configuration Made Easy Providing a Familiar Interface for All Plant

<table>
<thead>
<tr>
<th>Configuration/Setup</th>
<th>Identification</th>
<th>Alarm/Status Levels</th>
<th>Variable Modeling</th>
<th>LCD</th>
<th>Comm Setup</th>
<th>Materials of Construction</th>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
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<td></td>
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<tr>
<td>Model</td>
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<td>Transmitter S/N</td>
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<tr>
<td>Sensor S/N</td>
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<tr>
<td>Write Protect</td>
<td></td>
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<tr>
<td>Config/Write Protect</td>
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</table>

<table>
<thead>
<tr>
<th>Revision Numbers</th>
<th>HAAT Universal Rev</th>
<th>Field Device Rev</th>
<th>Software Rev</th>
<th>Hardware Rev</th>
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<tr>
<td></td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Device last synchronized: 11/30/2009 7:31:22 AM
Monitor Drive Performance in Real Time – From Within a Standard Interface
Instant Access to the Status of Your Drive
Get Alerts and Warnings Immediately
Showing Where Problems Are
When a Drive Problem Occurs Guided Fault Finding is Only a Click Away

![Image of a computer screen showing a fault alert with details on User Trip 84 and a possible fix involving turning off Terminal 87 (Digital Input 4) to clear the trip.]

Control terminals

EMERSON
Process Management
Clear Overview of Your Plant and It’s Health with Associated History

- Clearly shows all unhealthy devices (including drives) and status
- Historic view allows engineers to see previous events (audit trails)
Making Your Manufacturing Plant Work for you with PROFIBUS

- Take control of your investment in Drives
- Use a standard interface for all key tasks
- Rapid deployment of assets allowing fast ROI
- Fast fault diagnosis
- UNIQUE pre-emptive plant failure strategies allowing you to take control of your plant and schedule down time
- Remove the need for “just in case” inspections
Key Messages

• Your plant’s health is as critical to your business as your personal health is to you

• Careful monitoring and diagnosis using PROFIBUS helps prevent serious or unexpected problems in the future

• Emerson Process Management, PROFIBUS and Control Techniques provide this reassurance for your business
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AMS Device Manager
Comprehensive Connectivity Options

Solution used with Emerson systems
AMS Asset Portal

Solution used with third party systems

AMS Suite

AMS ValvELink® Software

Motor Starters & drivers
Multiplexers
Other Hosts
Calibrators
HART over DP

1420
3420
475
ROC
### Example Diagnostics:

- **Travel Deviation**
  - Cycle Counter
  - Valve Signature
  - Step Response
  - Dynamic Error Band
  - Drive Signal
  - Output Signal

- **Process Condition**
  - Configuration Warning
  - Plugged Impulse Lines
  - Electronics Failure
  - Sensor Failure

- **pH Electrode Aging**
  - Glass Electrode Failure
  - Reference Electrode Failure
  - Reference Electrode Coating
  - Reference Electrode Poisoning

- **Process Condition**
  - Configuration Warning
  - RTD Drift
  - RTD Life Estimation
  - Electronics Failure
  - Sensor Failure

- **Reverse Flow**
  - Empty Pipe
  - Calibration Error
  - Process Condition
  - Configuration Warning
  - Electronics Failure
  - Sensor Failure

- **Bearing Faults**
  - Gear Faults
  - Belt Wear
  - Mounting

- **Chemistry Analysis**
  - Contamination Alerts
  - Particulates

- **Broken rotor bars**
  - High resistance joints
  - Voids in aluminum cast rotors
  - Cracked rotor end rings

- **Steam Traps**
  - Compressed Air
  - Grease Points

- **Alignment**
  - Balance
  - Shaft / Coupling Wear

- **Boiler Sooting**
  - Turbine Blade Wear
  - Capacity Reductions

- **Increased Energy Use**
  - Hourly Cost Increase

- **Pump Efficiency Dropping**
  - Equipment Efficiency Drop

- **Heat Exchanger Fouling**
  - Cumulative Cost Increase
  - Maintenance Effectiveness
Integrated Asset Management Solution provides better Decision-support, Reporting and Analysis

- A consolidated view of Asset health and Asset performance using all the different diagnostic technologies enable Industry to face tough challenges
PROFIBUS & Machinery Asset Management

PROFIBUS User Conference
June 2010, Stratford-Upon-Avon
Nick Garrett & Martin Dudley