Seven Methods to Improve Control Performance in Pulp and Paper

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Presenter – Steve Obermann

• A Chemical Engineer with emphasis in process automation.
• Expertise in advanced process control designs for refinery and petrochemical process units, process modeling, inferential properties, real time optimization and cost/benefit estimation.
• Metso ExperTune develops and markets pre-packaged industrial software for the processing and manufacturing industries which maximizes productivity, efficiency and reduces waste.
Agenda

- What is Control Performance?
- Measure Control Performance?
- Apply Target Solutions
- Reduce Variability
- Get to the Root Cause
- Follow Up
- Document Shared Results
- Make it a Habit
- Case Study
- Summary
- Questions & Answers
Control Performance is…

The overall performance of the control system
- Instrumentation
- Controllers
- Control valves
- Advanced applications

And its effect on the business
- Cost
- Quality
- Environmental
- Production Goals
Existing Control Performance

• Control Performance – The Facts
  – 10%-35% of control loops are in **manual**
  – 1.5M to 5.3M in under utilized assets by running in manual in a 1000 loop site
  – 30% of control valves have problems
  – Are you repairing the correct valves?
  – 30% of control loops are tuned incorrectly, increasing variability in the process.
  – A tremendous amount of money can be saved by understanding the control loop interactions and implementing corrective action.
Method One: Measure Control Performance
## Finding key performance metrics for control systems

<table>
<thead>
<tr>
<th>Metric</th>
<th>How Measured</th>
<th>How it Affects the Bottom Line</th>
</tr>
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<tbody>
<tr>
<td>% of Time not in Normal Mode</td>
<td>% of time that control loops are in manual or other sub-optimal mode</td>
<td>Symptom of other underlying problems. Directly affects safety.</td>
</tr>
<tr>
<td>% of Time at Limit</td>
<td>% of time that valves are fully opened or fully closed</td>
<td>Identifies production constraints.</td>
</tr>
<tr>
<td>Oscillation Significance</td>
<td>Affect of oscillation on process performance</td>
<td>Energy costs, variability, and quality.</td>
</tr>
<tr>
<td>Valve Travel</td>
<td>Amount of valve movement per hour.</td>
<td>Maintenance Costs.</td>
</tr>
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Develop the Measures for your Site

- Report them.
- Establish goals.
- Use them to focus effort.
Method Two: Apply Targeted Solutions
Targeted solutions deliver improved business performance for the mill

<table>
<thead>
<tr>
<th>Measure</th>
<th>Targeted Solution</th>
<th>Business Value</th>
</tr>
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<tbody>
<tr>
<td>%Time Valve at Limit</td>
<td>Change valve trim, or reduce restrictions, or increase pump capacity</td>
<td>Production increases, often for very minor investment in valve trim.</td>
</tr>
<tr>
<td>Excessive Valve Travel</td>
<td>Add a filter, remove derivative action.</td>
<td>Reduced process variability, improved reliability.</td>
</tr>
<tr>
<td>Harris Index, especially for flow loops.</td>
<td>Controller Tuning</td>
<td>Stability, fast response, and quality improvement.</td>
</tr>
<tr>
<td>Oscillation Significance and Oscillation Period.</td>
<td>Sort all loops by oscillation period. Resolve root cause by tuning or valve repair.</td>
<td>Most often, energy savings and process stability. Sometimes production increase.</td>
</tr>
<tr>
<td>Opportunity Gap</td>
<td>As variability is reduced, forces operators to push key setpoints closer to optimum target values.</td>
<td>Reduce Unit Cost and improve quality.</td>
</tr>
<tr>
<td>Noise Band, especially for consistency controls.</td>
<td>Filtering and tuning</td>
<td>Reduced quality variability. Reduced operating costs.</td>
</tr>
</tbody>
</table>
Method Three: Variability Reduction
Historical record of the process variability

- Pay attention to both short-term and long-term variability
- Variability may be periodic (cyclical) or more random in nature
- Periodic variation can be tracked by performing Fourier Transform analysis on instrument signals
- The analysis shows the strength and the period of oscillations
Variability effects can be broad

- Find the bad actors
- Find the source

The bad actor may not be the root cause.
Method Four: Get to Root Cause
Automated Root-Cause Analysis

- Pay attention to both short-term and long-term variability
- Variability may be periodic (cyclical) or more random in nature
- Periodic variation can be tracked by performing Fourier Transform analysis on instrument signals
- The analysis shows the strength and the period of oscillations
Automated Root Cause is a Proven Technique

• A Plastics Plant in Alabama saved $1MM+ after identifying a Cooling Tower cycle that drove process temperature and pressure swings.

• A Chemical plant in Texas found the root cause of distillation column upsets, and immediately captured energy savings of 7,000 pounds per hour.

• A Paper Plant in Wisconsin identified the root cause of paper machine basis weight quality problems in an unlikely upstream location.
Develop your process understanding more quickly

Massive cross-correlation study

- The magnitude of the interaction is made clear.
- The groupings between variables is made clear.
- The lead/lag time factor is made clear.

Normally occurring process data
Method Five: Follow Up
Control Performance

**Detailed Unit Evaluation**
Work to establish performance KPIs, set initial benchmarks and start tracking.

**Corrective Actions**
Identify an action plan and recommendation. Follow up on action plans, to ensure the issue is resolved.

**Diagnosis**
Track performance against KPIs, with smart, targeted notifications. Identify issues with biggest economic impact and their root cause.

**Value Documentation**
Provide regular reports documenting identified issues, root cause, proposed action and resolution status.
Method Six: Document and Share Results
Control Performance

- **Documenting the Benefit**
  Ask control engineers to provide “Before and After” pictures, showing the technical impact of their work.
  Start to identify where you expect to see the economic improvements.

- **Results & Expectations**

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<tr>
<th>Benefit</th>
<th>Typical Range</th>
<th>Conservative Range</th>
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<tbody>
<tr>
<td>Energy Reduction</td>
<td>0.5% to 2%</td>
<td>0.5% to 1%</td>
</tr>
<tr>
<td>Production Increase</td>
<td>1 to 10%</td>
<td>1 to 2%</td>
</tr>
<tr>
<td>Valve Maintenance Budget</td>
<td>10% to 50% reduction</td>
<td>10% to 20%</td>
</tr>
<tr>
<td>Quality Improvement</td>
<td>5% to 50% improvement</td>
<td>5% to 10%</td>
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Method Seven: Make it a Habit
Control Performance Monitoring
The first 6 months need to become a habit

- **Continuous Improvement**
  
  Continue to resolve issues based on economic impact giving incremental performance improvement

- **Identify Additional Surges**
  
  Continuous execution of all of the components of control loop performance avoids future surges.

- **Diagnose & Correct New Issues**
  
  Identify new emerging issues – failing devices, changed process, incorrect process settings
Questions