Guidelines for Evaluating Control System Performance

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**Why Is Control System Performance Important?**

Most plants have a huge opportunity to improve control system performance. A typical plant may exhibit:

- 30% of Control Loops in Manual
- 30% of Loops with tuning problems.
- 10% - 40% Loops oscillating

The control system has a direct impact on the operation of the plant. The above problems combine to drive loss of efficiency, reduced production rates, higher energy costs, quality problems, and a host of other problems that directly affect the bottom line.

The opportunity for improvement depends on the specific plant, but has been seen to range from **2% to 10% of operating expense**.
Introduction

What to Measure?

There are many ways to measure the performance of a control system. In fact, ExperTune’s PlantTriage software measures over 80 different aspects of control performance for every single control loop.

These assessments of performance range from simple statistical measures, to complex analysis, to diagnostics for specific issues.

In the following pages, you will see how to combine this information with some engineering knowledge, to gain powerful insights, and to pinpoint the biggest payback improvements in your plant.
Introduction

Use Diagnostics to Gain Immediate Insight

Get insight into your process by applying engineering knowledge to the performance metrics.

For example, most instrument readings move at least slightly due to process variation or noise. If a process variable never, ever moves, you can be fairly sure the instrument has failed.

Somewhat surprisingly, it is common to find problems like this in most process plants.

There are dozens of engineering rules that can be applied broadly, once the control performance assessments are completed.
Introduction

What These Guidelines Will Tell You

This e-book focuses on only the most important parts of monitoring process control performance. In the following pages, you will see:

• How to interpret performance

• When to measure performance

• The role of diagnostics

• How to find root cause
Loops Not in Normal Mode

**What is Normal Mode?**
For most controllers, “AUTO” is the normal mode of operation.
In more advanced schemes, the control loop should be operated at the higher level mode, such as “CASCADE”.

**Symptom or Problem?**
A loop in “MANUAL” is usually a symptom of an underlying problem. The operator will put a loop in “MANUAL” when he suspects the instrument, the valve, or does not like the response.

**Why Does it Matter?**

**Efficiency**
When a controller operates in “MANUAL”, it is effectively doing no control. The loop will tend to drift away from setpoint. There is no response to process upsets unless the operator happens to be paying close attention to the loop.

**Safety**
Also, many industrial accidents have occurred because control loops have been left in the wrong mode.

**Guidelines**
1. **Track** the % of time in normal mode for every control loop.
2. World-class plants have less than 10% of loops running out-of-normal.
3. **Prioritize**: Target the economically-important loops that are always out of normal mode.
4. **Fix the root cause.** Remember, operators usually have a reason to put a loop in manual. Be sure to ask why!

<table>
<thead>
<tr>
<th>Loop</th>
<th>Description#</th>
<th>Time in normal (%)</th>
<th>Economic Sign#</th>
</tr>
</thead>
<tbody>
<tr>
<td>18FC026</td>
<td>Master Fuel Rate</td>
<td>0%</td>
<td>High</td>
</tr>
<tr>
<td>18FC027</td>
<td>A18 Air Makeup</td>
<td>0%</td>
<td>High</td>
</tr>
<tr>
<td>18FC002</td>
<td>A18 Train 2 Outlet Temp</td>
<td>0%</td>
<td>High</td>
</tr>
<tr>
<td>C05DLC633</td>
<td>A18 Feed Preheat</td>
<td>0%</td>
<td>High</td>
</tr>
<tr>
<td>10FC029</td>
<td>Flash Drum Elms to mix tee</td>
<td>0%</td>
<td>Average</td>
</tr>
<tr>
<td>10FC041</td>
<td>A10 Inlet Feed Flow</td>
<td>0%</td>
<td>Average</td>
</tr>
</tbody>
</table>
High Variability

What Causes It?
Variability can come from many different sources, including:
• Load Disturbances
• Sensor Noise
• Valve Stiction
• Setpoint Changes
Variability can be cyclical or random in nature.

Why Does it Matter?

Efficiency
Excessive variability almost always causes a loss of efficiency.

Stability & Quality
The process capability decreases, and making it easier to exceed operating limits. Operators become hesitant to adjust the process, operating in ‘safe’ areas.

Reliability
Excessive variability leads to excessive control response, wearing out control valves, and stressing other equipment.

Guidelines

1. Track Variability for every control loop.
2. World class: Stable loops have less than 3% Variance as % of span.
3. Prioritize: Target loops based on variance and economics.
4. Fix the root cause. Use tools such as pattern-recognition to identify the true source of the variability.
Eliminate Oscillations

**Where Do They Start?**
Unfortunately, oscillations can start just about anywhere. They can start from:
- Sticky Valves
- Overly-Aggressive Tuning
- Batch Operations
- Process Design

Once an oscillation starts, it spreads throughout the plant. In fact, it is common to see dozens of controllers cycling together.

**Why Does it Matter?**

**Efficiency**
Oscillating loops create inefficiencies in your plant. This is especially true for energy-consuming processes.

Eliminating oscillations can lead to instant energy savings, sometimes as much as 5% of overall energy.

**Quality**
Oscillations create swings in quality measures. This can be especially troublesome for producers of solid products, such as paper, or steel.

**Guidelines**

1. **Identify** Oscillations for every control loop. Power Spectrum finds:
   - Period of Oscillation
   - Strength of each Period
   - Significance to the Process

2. **Sort by Period** of oscillation to determine root cause.

3. Use pattern recognition, looking at the shape of the PV and CO signals, to find the **root cause**.

**4% Production Increase**

**View Case Study**
Get to the Root Cause of Interactions

Where do They Start?
Most process plants are full of interactions due to:
- Process Design
- Recycle Streams
- Heat Integration
- Control Strategies

Many plants have found that the original source of process upsets come from very far upstream, often in the utilities area.

Why Does it Matter?

Staffing
Finding the original source of an interaction can be like finding a needle in a haystack. Most plants simply do not have the enough people to fully investigate using older methods.

Quality, Efficiency, Production
Finding the original source of an interaction problem can stabilize large portions of the plant. It is quite common to save $1 Million or more, from a single improvement.

Guidelines
1. Use Process Interaction Maps on critical quality loops, to define the root cause of interaction.
2. Interaction Hot Spots can boost process understanding, showing all related measurements.

$1MM Energy Savings

View Case Study

Interaction Hot Spots
When to Measure Performance?

**In a New Plant:**
Get through the start-up curve faster, by identifying process and control problems quickly. Start monitoring during “water runs”.

**In Existing Plants:**
Process plants are dynamic environments. There are changes to:
- Raw Materials
- Operating Procedures
- Seasons and Weather
- Product Specifications
- Equipment
- Economic Factors

**24x7 is a Requirement**
Changes can happen at any time. Fortunately, most plants are already logging all the process data that you need to solve all of the performance issues described in this book.

**Immediate Improvement**
Using the tools and techniques described above, you can tap into your data history, and begin making improvements immediately.

**Guidelines**
1. **Start** Monitoring control system performance right away.
2. **Cast a broad net.** Keep in mind that the root cause may be far away in the plant.
3. **Use proven tools** and techniques to start getting value right away.
Conclusions

Control Performance Matters!

**Immediate Benefits**
As you have seen throughout this e-book, controller performance issues have a direct impact on the bottom line.

What many people find surprising is that improving these control problems results in an almost immediate improvement to the bottom line.

**A Proven Approach**
These techniques have been proven in hundreds of plants worldwide, in many different process industries, including chemicals/petrochem, metals, pulp & paper, oil & gas, utilities, pharmaceuticals, and more.

**Return on Investment**
Of all the projects you can do with a control system, control performance monitoring has one of the fastest returns on investment. Expect a complete return on your investment in less than 12 months.

Business Benefits
Interview
View Video

Improved Control
$/ton
ton/hr
What is PlantTriage?

**Control Performance Monitoring**

PlantTriage monitors your plant 24x7, automatically identifying opportunities to improve.

**Expertise Built In**

ExperTune has specialized in control performance software for over 25 years.

The expert systems in PlantTriage capture engineering knowledge, and put it to work for you.

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**What’s Included**

**Software**

PlantTriage’s server-based software connects directly to your existing control system. A web browser interface makes it easy to get answers to your plant’s problems.

**Service & Training**

With PlantTriage, you get all the training and service you need, to start getting value from PlantTriage right away.

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**For More Information**

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Case Studies

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