Prioritizing and Optimizing Problem Loops Using a Loop Monitoring System

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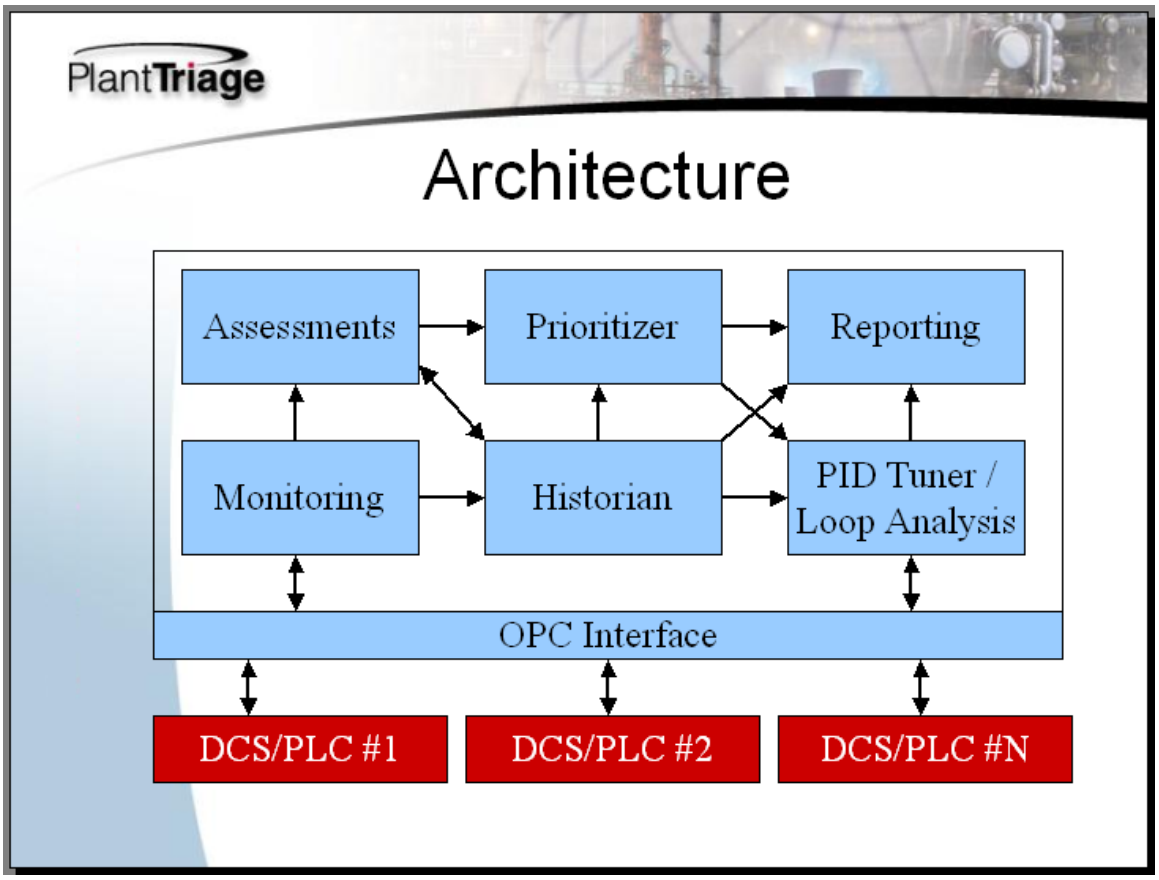
The demands on technical plant personnel are continually increasing. Being able to identify the most economically important loops that need attention will make them much more effective, with the ability to improve the plant the most. This presentation covers the workings of a tool that helps plant personnel identify those loops and optimize them.



LOOP MONITORING REQUIRES DATA GATHERING AND STORAGE

The first mechanical step required is to get the data and save it for assessments. The primary method of connecting to the process control computer is via OPC. OPC servers are available for most process control computers.

In general, the faster the data collection the better. Sample times of about 1 second are ideal. However, although PC's and networks are extremely fast today, often times the process control computer is relatively slow and is the bottleneck for getting process data quickly. Because of this limitation, each loop can be sampled at a different sample interval. This interval is from 1 second to 1 minute. This way the load on the process control computer can be balanced.

ASSESSING THE DATA

Each loop is assigned a unit operation, the same way they are assigned in the plant. Each unit operation is assigned an assessment interval. The assessment interval defines how often that unit operation's performance is assessed. Assessment times can vary between 2 hours and 1 week. If the unit is fast (a blender for example) than fast assessment times may be appropriate.

It may be advantageous to set assessment times to 8 or 12 hours to compare how different shifts or different times in the day effect performance or perhaps 1 assessment every 24 hours is appropriate.

At the assessment interval, the monitoring package's assessment service assesses each loop in the unit operation. There are over 30 assessments including:

* Process model and quality
* Oscillation Detection and Analysis
* Loop Robustness
* Harris index
* Setpoint Crossings
* Normalized IAE
* Average Error
* Noise Band
* Variability and variance
* Time in normal mode of operation

BASELINING, THRESHOLDS, TEMPLATES AND TRIAGE

To make use of the assessments, the software incorporates the concepts of baselines, thresholds, templates and triage or the priority of this loop.

BASELINES

Ideally the plant baseline would correspond to assessments performed during a time when the plant was perfectly tuned and optimized. In reality the baseline will correspond to a starting point where the plant was running smoothly. The service engineer selects a baseline by working with the plant personnel to select a time period when the plant was running smoothly. They select this time period by looking at the software's trend graphs of assessments and windowing in on the appropriate time.

THRESHOLDS

The threshold concept is somewhat similar to alarms. Thresholds could be set based on 3 or 4 sigma values from data collected over the baseline period. All thresholds can be bi-directional.

The combination of assessments, baselines, thresholds, and economic significance for a loop determine how well that loop is doing. They answer the question, "What is the health of this loop?"

TEMPLATES

Every type of processing plant will have different importance levels on the assessments. For a particular plant, some assessments may not be used at all, while thresholds for others are set at particular limits or even sigma values from the baseline.

The setup for baselines and thresholds is made much simpler for the user with templates. Using templates, the service engineer working with the customer can quickly set up the baselines and thresholds in a way that is meaningful for that particular manufacturing operation, plant, unit operation, loop type or just that single loop. For example, all flow loops could be quickly set based on a flow loop template.

The template allows the user to specify either:
* adjust the sigma value that will set the threshold
* use the maximum or minimum to set a threshold
* use a fixed value for a threshold or baseline
* make no change to a threshold or baseline
* make the threshold or baseline null

THRESHOLD USES

Thresholds let each plant customize their evaluation of performance. Thresholds also provide a mechanism for prioritizing loops. For example, you can examine the % towards threshold for the plant:

% Towards Threshold = 100 x (Assessment - Baseline) / (Threshold - Baseline)

The smaller the value of "% Towards Threshold", the better the loop is performing. If an assessment parameter has a null parameter for a loop, it is considered not important to this

plant. The software reports on "% Towards Threshold" over time and on a unit operation basis. You can compare units and see how they are doing over time.

ECONOMIC SIGNIFICANCE

The "Economic Significance" sets the importance of each loop economically to the plant. 1 is most significant and 10 the least. This value is used as a divisor to determine the priority of the loop and used in reporting to answer, "How are we doing?"

TRIAGE

The broad definition of triage from Webster's dictionary is "the assigning of priority order to projects on the basis of where funds and resources can be best used or are most needed." This is accomplished by combining the idea of "% Towards Threshold" with the "Economic Significance" or divisor:

Economic Priority = % Towards Threshold / Economic Significance

"Average % Towards Threshold" is the average of the entire "% Towards Threshold" for all assessments used in the loop. If a threshold or baseline is null it is not counted. The "Average % Towards Threshold" applies to individual loops, groups of loops, unit operations and the entire plant.

"Average Economic Assessment" is the Average % Towards Threshold weighted by the Economic Significance (or Economic Loop Priority Divisor).

Sorting your loops based on the "Average Economic Assessment" yields a list of loops with those needing attention the most bubbling to the top. This enables the Process Control Specialist or Technician to work on the loops that will yield the greatest economic impact. This answers the question "What is the most important thing I can do to help my plant make money today?"

LOOP OPTIMIZATION

When triage identifies the priority of loops to work on, an optimization package should be readily available to troubleshoot, analyze and optimize the loops. The package should be integrated with the loop monitoring system so that plant data can be passed seamlessly to the optimization package.

IDENTIFY AND CURE CYCLING

If the assessments identify cycling in the loop, there should be tools in the optimization package to pinpoint and verify the source of the cycle. Valve tests should include stiction and hysteresis checks. Power spectral analysis can verify the period of the cycle.

LINEARIZATION AND CHARACTERIZATION

The optimization software should include a check for the linearity of the loop and include design tools to build a characterizer. Implementation of the characterizer would remove non-linearities making large productivity gains.

PID TUNING

The optimization package should also include a PID tuning engine that works with only plant data without requiring process knowledge or a process model. It should include a safety factor that the user can adjust based on engineering judgment on the loop.

CONCLUSION

A process monitoring and optimization package should continually monitor and assess the plant for problem loops. It should identify those loops and provide seamless integrated tools for optimizing them.