While most technology investments require proof before a purchase can be made, each production facility has unique attributes for which general industry-wide benefits don’t necessarily apply. A short-term, highly focused evaluation can equip manufacturers with clear financial evidence. Equally important, an evaluation illuminates how the associated KPIs both align with the facility’s annual production goals and allow management to remain on top of progress.
What gets measured gets managed. We all know that one. It’s an age-old mantra that emphasizes the need to track performance against stated goals. In our world of manufacturing there are innumerable aspects of production that are constantly under scrutiny. From inputs to outputs the typical production facility is wired to record a broad array of performance metrics. Much of the data is collected digitally and the analysis is computed automatically. Feedback is fast, especially when the trends point anywhere other than up. The purpose is simple: To assure that performance relative to those stated goals is actively, appropriately managed.
For any manufacturer a great deal depends on the ability to monitor and evaluate the performance of staff and facility alike. In terms of assessing the performance of production systems, the plurality of facilities rely on KPIs trended by supervisory control platforms. While the analysis is essential, the metrics focus more on maintaining safe, consistent output and less on optimizing the underlying regulatory control layer. As a result the PID controller responsible for regulating each of a facility’s many, highly interactive control loops is routinely overlooked until its performance is linked to a slip in productivity. Indeed the typical DCS doesn’t have metrics for Stiction, Oscillation, and Output Reversals. Measurements that proactively assess the PIDs effectiveness have only recently been viewed as a means of both improving overall performance and avoiding costly downtime.

A central question to ask is: What’s the true economic value of improving regulatory control? As with most questions related to industrial automation the answer depends. Clearly value differs from the manufacturer whose brand is based on the highest level of quality versus the producer of bulk commodities that sells based on lowest per unit price. Similarly, the benefit of reducing energy consumption has a different implication for a steel mill that operates an arc furnace as compared to an average chemical plant whose energy bill is largely attributed to overhead lighting. Even so, what’s common across all segments of manufacturing is the steady appreciation in performance expectations – more output, less cost.

While regulatory control assessment and optimization tools have been in use for over a decade, published analysis of the category’s cost-benefit remains limited. Most information about the potential gains associated with improving regulatory control is generalized for the entire process manufacturing industry. The lack of segment-specific data leaves manufacturers without a clear rationale for adopting such technology. The inability to link control loop performance monitoring solutions to achievement of their stated goals has stimulated demand for individualized audits and technology evaluations.

A short-term, highly focused evaluation can equip a manufacturer with clear financial evidence. Equally important, an evaluation illuminates how the associated KPIs both align with the facility’s annual production goals and allow management to remain on top of progress.
Like an audit, an evaluation of CLPM technology should provide a complete picture of a facility’s regulatory control environment in terms of the current status and opportunities for potential improvement. Using the technology’s KPIs the evaluation should establish simple benchmarks for measuring the performance of loop-, unit- and plant-level operations. Metrics should help to promote a culture of control and allow management to track progress against the facility's stated objectives.

Following are several examples that enabled manufacturer to understand how the use of CLPM technology could impact their primary production objectives. In each case the evaluation was performed over a ninety (90) day period.

**Output: Reducing Cycle Time**

The linkage between cycle time and output is obvious. In the context of a multi-phase production process it’s the bottleneck that represents the single most relevant production constraint. For a manufacturer of automotive wheel locks and specialty lug nuts the value of CLPM technology was established through the identification and isolation of variability within various secondary loops. The disturbances hampered control of the facility’s primary multi-zone furnace application and extended production time unnecessarily. Refinements to the process strategy and tuning of the bad actors resulted in a 9% reduction in cycle time and a corresponding increase in output of >13%.

- Industry: Automotive
- PID Loops: 27
- Processes: Furnace/Quench Temperature, Waste Water pH, Cooling Fan Speed
- Issues: Oscillations, Loop Interaction, Tuning
- KPIs: Oscillation, TuneVue™, Absolute Average Error

**Quality: Eliminating Defects**

Every defective unit weighs on a facility’s production level. For semiconductor manufacturers those defects can be devastating due to the high cost of production inputs such as titanium. Control limits associated with ultra-purified water in particular are essential to the manufacture of complex chip sets are extremely unforgiving. Even the smallest of impurities in the water can hamper the chip cleaning process and result in product that can neither be sold nor repurposed. With DCS metrics unable to assess control loop performance, CLPM technology
was needed to establish the initial benchmarking and the continuous improvement of core processes including ultra-purified water. Regulatory control enhancements simultaneously improved quality and reduced defects, enabling Payback of less than one (1) year on the subsequent technology investment.

» Industry: Semiconductors
» PID Loops: 200
» Processes: Ultra-Purified Water Temperature, Air Handler Humidity, End of Line Pressure
» Issues: Valve Sizing, Loop Interaction, Tuning
» KPIs: FCE Health, Output Travel/Distribution, Power Spectrum

Energy: Decreasing Costs

Even with prices on a steady decline the cost of energy remains significant relative to a process manufacturer’s overall production cost. That is especially true for manufacturers of basic materials such as steel, cement, and others that rely on energy to transform raw materials into finished products. Maintaining effective control over furnaces and kilns can be challenging due to their high level of inertia, propensity to overshoot, and contributions to downstream variability. Manual control is often a consequence even though that approach routinely results in even higher levels of variability and energy consumption. An evaluation performed at a ceramic proppant mill uncovered issues ranging from manual control and mechanical problems to overly aggressive controllers – all of which impacted production costs. While only a portion of these issues were resolved during the evaluation the mill successfully reduced its annual energy consumption by over $100,000.

» Industry: Basic Materials
» PID Loops: 176
» Processes: Kiln Temperature, Fluidized Bed Dryer Temperature, Ammonia/Blunger Inlet Flow
» Issues: Manual Control, Valve Stiction, Ratio Control
» KPIs: Mode Changes, Average Absolute Error, Stiction, TuneVue
Downtime: Avoiding Failure

Few things worry plant management more than unplanned downtime. When equipment fails unexpectedly production halts. Unlike traditional oil companies energy producers in the Canadian oil sands cope with steam-related equipment issues. They apply a form of enhanced recovery called steam-assisted gravity drainage (SAGD) that continuously injects high pressure steam within the Earth's substrata in order to liquefy petroleum captured there. Two concerns related to steam quality: 1) high moisture content results in premature valve failure, and 2) excessive variability causes water hammer which destroys the associated piping. Analysis performed on ~20% of the facility's PID loops isolated valve Stiction that indirectly undermined steam quality and jeopardized uptime. Corrections immediately improved quality by more than 2.0% and mitigated the threat of downtime.

Industry: Oil & Gas
PID Loops: 200
Processes: Steam Quality, Air/Fuel Ratio
Issues: Valve Stiction, Loop Interaction, Tuning
KPIs: Output Travel, Stiction, TuneVue, Cross-Correlation, Power Spectrum

Aligning Technology With the Different Stages of Control

Whether your goal is focused on uptime, throughput, or quality, CLPM solutions provide meaningful insight into a facility's performance. Still a question remains: How should a facility prioritize its control loop issues? As with most engineering questions, the answer depends. It can differ from one location to the next based on the maturity of the facility's automation practices and the experience of its staff. Some CLPM solutions include tools that support a variety of prioritization methods, aligning with the facility's stage of control—both current and future.
Economics — Not all loops are created equal. There’s the “bottleneck” loop that can restrict throughput, the “start-up” loop that can slow batch cycle time, among countless others. Although a precise value may not be known for each of them, these PID control loops drive a facility’s profitability. Some CLPM solutions assign an economic value to each loop, allowing those loops with the greatest impact on profit to rise to the top when their performance slips. It’s assumed that all manufacturers are mindful of their bottom line. That said, this approach lends itself to facilities with limited resources and basic automation practices in place.

Variability — The negative effects of oscillatory behavior unfailingly infiltrate downstream processes and undermine control. The effects touch on production in terms of both output and quality, and they unnecessarily accelerate wear and tear on costly process instrumentation. Correcting the performance of excessively dynamic loops is often a quick win for process manufacturers. For that reason this approach is ideal for facilities with basic automation practices, but those with moderate and advanced practices also benefit from timely corrections associated with sudden increases in variability.

Automation — The core value proposition of automation is that it allows for more effective and efficient control of complex production processes. When automation investments are not being fully utilized, production is presumably less effective and efficient. Identifying loops that are not operated in their ‘normal’ mode is another approach for manufacturers. Those facilities that are in transitioning – either from basic to moderate or moderate to advanced automation practices – tend to benefit most from this approach.

Change — Change at a production facility is rarely a good thing. It indicates that something is no longer performing as intended. Whether relative to the previous day, week or month, identifying control loops that demonstrate the greatest degree of change allows practitioners to isolate the source of change as time progresses. Correcting those ‘Troublemakers’ is often a good approach for facilities that have advanced automation and optimization practices.

General — Loop monitoring solutions typically base their overall health metrics on a composite of KPIs. It incorporates performance attributes associated with control loop tuning and the relative health of the loop’s final control element as well as reflects relevant economic attributes and the process strategy in general. This approach to prioritization often results in the identification of loops with a variety of issues and no clear culprit. Although this method is suitable for all types of automation practices those facilities with advanced capabilities tend to benefit most – they have the resources to address more subtle changes in process dynamics and to benefit from their correction.

Processes are highly dynamic and so is your production facility. When choosing a CLPM solution consider how it aligns with your facility’s monitoring and optimization needs — both today’s and tomorrow’s.
Most production processes are highly dynamic and constantly changing, so much so that it’s not hard to stumble upon issues that hamper performance. The real challenge for practitioners is prioritizing limited time around their facility’s most pressing issues. To optimize their effectiveness practitioners need access to information that is both accurate and insightful. That applies equally to their facility’s PID controllers as it does to process instrumentation. If you require improved awareness of your facility’s production performance issues, look no further than PlantESP!

• Plant-Wide Control Loop Monitoring
• Timely Alerts and Detailed Reports
• Targeted KPIs and Advanced Forensic Tools
• Actionable Recommendations for Corrective Action

Contact us today to learn how PlantESP is enabling manufacturers across the process industries to accurately diagnose complex control loop performance issues and to quickly correct them for increased production and enhanced efficiency.