

How to Improve Performance Of Process Control Assets

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Summary

Most process plant personnel are unaware that their plant assets are under-performing. In fact, most plants do not even measure asset performance in real-time. Production, efficiency, quality, and cost are all measured after-the-fact.

Real-Time Asset Performance Management is the practice of getting all your assets to perform at their best, all the time. This is a proven practice which delivers significant financial results.

Asset performance management includes all of the following:

- Control Loop Monitoring and Diagnostics
- Condition Monitoring for rotating equipment
- Alarm Management
- Process Performance Management

This paper describes these practices, and demonstrates the value of integrating these tools to provide a complete picture of asset performance.

Overview

Process Plant Assets

Process Equipment is the most obvious of the process assets. This includes vessels, pumps, piping, dryers, distillation columns, filters, and many forms of rotating equipment, such as pumps, compressors, turbines, and kilns,

Control system assets include instruments, valves, and control systems, as well as the software, engineering, and configuration that control the process assets.

Operational assets include operators, operating procedures, and training materials. Some companies will refer to people as “their most important asset”. The skills, knowledge, and specific process experience of your company personnel is often the “asset” that makes the difference between success and failure.

Process Knowledge is one final asset that is often overlooked. This is what ties together all the physical assets listed above, to generate something useful. This may include fundamental (first principles) process knowledge, recipes, trade secrets, and quality control procedures.

All process industries face many of the same issues in managing the performance of these assets. Whether you are in an oil refinery or a paper mill, a chemical plant or an iron mine, you face similar performance issues with equipment, controls, operations, and process.

Typical Asset Performance

Most process plant assets are under-performing. That is, most plants can see significant gains in production, quality, efficiency and cost by making focused improvements to asset performance. Table 1 illustrates some high-level measures of asset under-performance.

Table 1. High-Level Measures of Asset Under-Performance

Metric	Typical Performance	Opportunity
Rate of alarms	15 per operator per hour. (Over 2X the EEUMA industry recommendation.)	Reduce confusion. Improve safety & environmental compliance.
Control Loops in Manual	30% of entire plant.	Stabilize operation. Faster response to upsets. Improve safety and quality.
Significant Process Oscillation	40% of plant oscillating.	Reduce energy costs. Improve quality & efficiency.
Rotating Equipment Failure	Unplanned, not known until catastrophic failure occurs	Early warning signs are seen. Maintenance occurs on a planned basis.

The data shown above is quite typical, as developed from ExperTune’s experience in thousands of plants across many industries. While there is some plant-to-plant, industry-to-industry and especially geographic variation, this table provides a relatively fair picture of the starting point in most plants.

Interestingly, prior to the start of an asset performance management program, most operations management personnel have absolutely no idea how they are performing relative to these very important metrics.

One study by the Gartner Group found that in process plants, 50% of maintenance work was not necessary, and 10% was actually harmful. You simply cannot afford to spend 50% of your time working on the *wrong things*.

What Real-Time Asset Performance Management Does

Real-Time Asset Performance Management is the practice of getting all your assets to perform at their best, all the time. The general approach to this is:

1. Monitor performance in real-time

2. Diagnose and prioritize root-cause issues
3. Improve the equipment/controls/process/operation
4. Track results and benefits

Software tools for asset performance management are capable of performing steps 1, 2, and 4 above. Of course, software can't complete the equipment repairs in step 3.

Benefits of Real-Time Asset Performance Management

Asset Performance Management brings an immediate focus to the most important things. When a plant has been running for years without paying attention to some of the key performance metrics, it is easy for problems to go unnoticed.

Almost immediately, when Real-Time Asset Performance Management is implemented, plant engineers and technicians will identify major, unforeseen issues within the existing plant. These issues have often been overlooked for years, and cause people to shake their heads when they realize that they have overlooked something that is now "so obvious". The sidebar labeled "Tales from the Field" gives an example.

Benefits of Real-Time Asset Performance Management vary from plant to plant, depending on the starting condition. Plants that are in the worst initial condition have the most to gain. But all plants can expect some gain in performance as measured by:

- Increased Production
- Improved Reliability
- Improved Quality
- Reduced operating costs
- Reduced Safety/Environmental Risk

Table 2 illustrates some typical results from Real-Time Asset Performance Management.

Tales from the field

While completing an asset performance study on a papermachine, we checked the condition of all control valves & dampers. Operators resisted the testing of one damper because it was required to stay full open for full production rate.

We insisted on the test, and operations relented. While closing the damper, production actually improved!

Why? Because the damper had been wired improperly. For 2 years, they had run at reduced rate, thinking the process was at maximum capacity.

Fixing the wiring led to an immediate **2% production rate increase.**

Table 2. Typical Results of Real-Time Asset Performance Management

Performance Metric	Before	After	Improvement
Service Factor: % of control loops not in full service. (Full service defined as: operating in AUTO, valve & sensor not at limit.)	>30%	<10%	3X
Control Loop Health: % of control loops exceeding plant-specific fault thresholds.	>10%	<1%	10X
Alarm Management: Alarms per operator per hour	15	<10	33%

Tools + Practices

Success in asset management comes from having the right tools AND the right practices in place. Tools alone do not solve problems. And practices without tools is highly inefficient. Asset management tools, such as diagnostics, performance tracking, and maintenance planning, help in the automatic identification, prioritization, and resolution of asset performance issues.

Control System Asset Performance Management

Control System Diagnostics

A typical process plant may have thousands of assets to manage. In most parts of the world, tracking and managing these assets manually is no longer possible, with so few people in the workforce. Diagnostic tools and software are a basic requirement to identify and diagnose problems.

Communication standards like OPC have succeeded in opening up proprietary control systems, so they can share real-time data directly from the DCS and the historian. Today, there is a huge warehouse for process and control data available for diagnostics. At the same time, we now have computers powerful enough to perform computationally-intensive operations. Add the right software, and extremely powerful diagnostics are possible.

Table 3 provides a few examples of the automated control system diagnostics that are currently available.

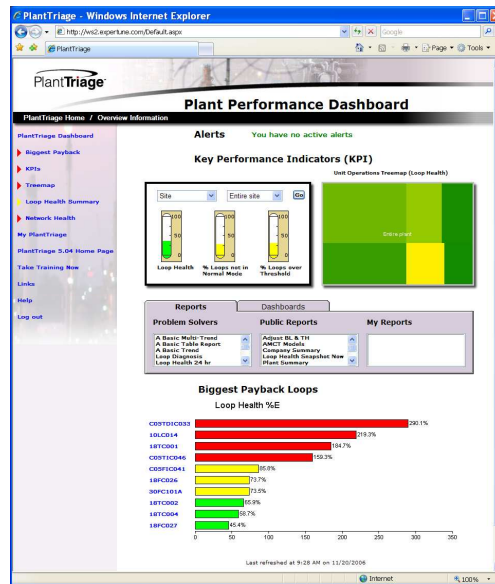
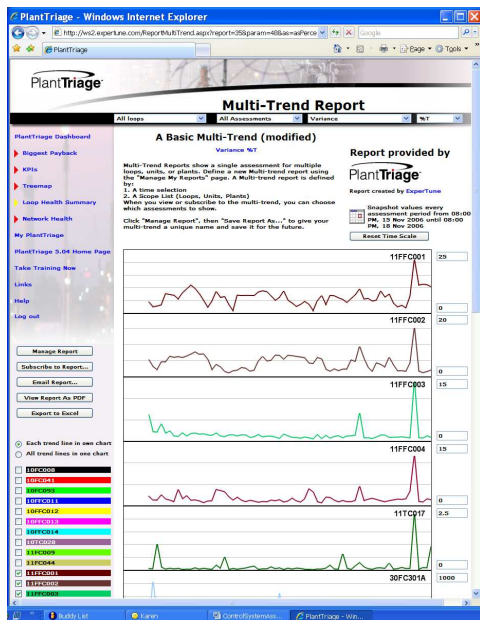


Table 3. Examples of Available Diagnostics

Asset Type	Available Diagnostic
Instrument / Sensor / Analyzer	Excessive noise, Communications Issues, Flat-lining, Under-filtered / Over-filtered, Over-spanned, At upper/lower limit.
Controller	Harris index, Oscillating due to tuning, Robustness, Response Time, Inappropriate Use of Derivative, Not in Normal mode
Control valves	Hysteresis, Stiction, Over-sized, Under-sized, Oscillations due to Valve. Excessive Valve Travel.
Process	Interactions, Oscillations due to load, Non-linearity, Energy Use, Cycle Time, Excessive alarming.
Software & Configuration	Sampling too slowly, Service Factor, Communications Errors



Control System Performance

Measuring raw diagnostics is a huge step in the right direction. But it is not enough. Asset history is an important part of understanding a problem. To accomplish this, diagnostic results should be historized and trended over time. It also helps to normalize the data for comparison. The figure at left contains a multi-trend performance report, clearly showing a recent spike in variance for all loops in Unit Operation 11. Identifying these problems quickly can help to determine the root cause and prevent recurrences.

In addition, most asset management programs involve some sort of maintenance planning or tracking tool. These systems:

- Maintain a database of asset parts and repair procedures.
- Allow for detailed documentation of the problem.
- Maintain a history of cost and effort associated with the asset.

Extending Asset Life

Many control valves are over-worked. That is, they are moving MUCH more often than they need to for good control: In some cases 10 times more valve movement than is

required. In some plants, the valve moves so much that the valve/positioner linkage arms are physically worn away. This excessive wear-and-tear leads to premature failure.

Alarm Management

Operators - The Most Important Asset

Arguably, operators are the most important “assets” in a modern process plant. In ideal conditions, a good operator can strike a balance between optimal production, cost, and quality. Companies can achieve a competitive advantage from skilled operators.

However, when a process upset condition occurs, control rooms can become a frenzied place. Alarms are sounding, radios blaring, phones ringing, and people running in and out to get directions, bring new information, or simply to find out what is happening. Under these circumstances, operator effectiveness is greatly reduced. As hundreds of alarms pour into the control room, the operator simply does not have enough time to read and respond to each one. In effect, the operator is reduced to fire-fighting, and can no longer focus on process performance.

Managing Alarms

Alarm management can substantially reduce confusion and chaos during upset conditions, and eliminate unnecessary distractions during normal operation. As in other asset performance efforts, alarm management starts with getting a good, real-time measure of current performance.

Once alarm conditions, frequencies, and persistence are identified, the first steps in alarm rationalization can occur. Some of the key bad actors can be diagnosed. This may include:

- Chattering alarms
- Meaningless alarms that require no operator action
- Alarms that are always on
- Redundant alarms

After diagnosis, specific actions must be taken to correct the root cause issues. This often includes adjusting alarm limits, alarm priorities, training, and annunciation strategy.

Of course, continued tracking of real-time alarm performance will help to sustain and improve overall performance.



Alarm Management Results

The most immediate results of alarm management include reduced alarm rates, quieter control rooms, and reduced operator distraction. This leads to a reduced frequency of operator errors, and an overall reduction in the risk of safety and environmental incidents.

When alarm management is applied in conjunction with other asset performance management tools, there can be a substantial improvement to process stability, reliability, product quality, and cost.

Condition Monitoring

Detecting Equipment Issues Early

Failure of rotating equipment is all too common in process plants, often resulting in unplanned shutdowns. The cost of an unplanned shutdown is more than 10 times the cost of a planned shutdown. The ability to detect equipment wear conditions and prevent failures is extremely important in improving the performance of the overall plant.

How Condition Monitoring Works

Condition monitoring tools directly measure the energy emitted from rotating equipment. With integrated analysis tools, users can detect, monitor, and prioritize equipment issues. Mechanical equipment wear issues can often be detected by looking at the characteristic frequencies of these failures for the particular equipment. Operational issues, such as poor lubrication, can also be detected when looking at the “sound signature”, or “heartbeat” of the equipment. Many of these issues can often be corrected “on-the-fly”, without a shutdown.



Condition Monitoring Results

In a traditional plant, over 50% of maintenance work is unnecessary, and 10% may actually be harmful. With condition monitoring, mechanical issues can be detected, and often diagnosed to the specific part that is failing. This ensures that maintenance teams can be fully prepared, with all the right tools and parts on hand, prior to the planned shutdown. Reduced maintenance costs and increased reliability are the end result.

Process Performance Management

Putting it All Together

Control performance, alarm management, and condition monitoring all add more value when they are put in the context of the overall process. Process context allows for better prioritization and decision-making.



How It Works

Process performance management adds the context of specific process knowledge to real-time information. Fundamental engineering principles are applied to the data, giving expert process analysis and advice, in real-time.

By monitoring process flows and temperatures, for example, you can calculate efficiencies, yields, and energy costs per ton of product. This information can be tracked, trended, and analyzed automatically, to provide process insights in real-time.

Process Performance Management Results

The Overall Operational Effectiveness (OEE) of an operation can be greatly enhanced with process performance management. Operators retain a situational awareness, and stay focused on the truly important aspects of process performance.

Integrated Asset Performance

Benefits of Integrated Tools

Each of the asset performance tools above can help to improve aspects of process performance. Integrated together, the whole is much greater than the sum of the parts.

For example, when Alarm Management data is combined with control system performance data, we can efficiently optimize. With a high alarm rate, and high levels of process variance on the same control loop, the focus should be on reducing process variance, not on adjusting alarm values. On the other hand, low process variance with high alarm rates requires improved alarm strategies.

Drill-down capabilities that cross over between the asset performance tools can streamline the process and help to get the



best value out of the most valuable asset – the skilled people operating the plant.

A holistic approach to Real-Time Asset Performance Management delivers a full spectrum of bottom-line performance improvements, including safety, environmental, cost, energy reduction, quality, throughout, and profit.

Conclusions & Recommendations

1. Process plant assets are under-performing.
2. Several tools are available to improve performance. They include:
 - a. Control System Performance Management
 - b. Alarm Management
 - c. Condition Monitoring
 - d. Process Performance Management
3. Individually, the tools above improve aspects of process performance.
4. Collectively, these asset performance tools lead to high levels of performance improvement, including the improving performance of the workforce.

Contact ExperTune to estimate the economic benefits that your plant can achieve with an integrated asset performance management system.

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About ExperTune

ExperTune has been improving process performance for 25 years. With award-winning products, such as the PlantTriage[®] performance Supervision System, ExperTune has the technology and the expertise that you need to make improvements to your plant.

About the Author

George Buckbee is Vice President of Product Development at ExperTune. George has over 25 years of practical experience improving process performance in a wide array of process industries, George holds a B.S. in Chemical Engineering from Washington University, and an M.S. in Chemical Engineering from the University of California.

About PlantTriage®

PlantTriage is a Plant-Wide Control Performance Monitoring System that optimizes your entire process control system, including instrumentation, controllers, and control valves. Using advanced techniques, such as Active Model Capture Technology, PlantTriage can identify, diagnose, and prioritize improvements to your process.

Glossary

Term	Definition
DCS	Distributed Control System. A centralized process control system that typically provides data collection, operator interface, and control functions.
OPC	OLE for Process Control. An industry-standard method for communication between real-time control systems.
OEE	Overall Equipment Effectiveness
PV	Process Variable. The measured value that is fed to a control loop.
ROI	Return On Investment. A measure of the length of time required to get full payback on a given investment.
RONA	Return on Net Assets