MANAGING ASSETS USING PERFORMANCE SUPERVISION

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ABSTRACT

In today's highly competitive worldwide market, it is becoming extremely important for managers to make sure that all resources are affected where needed the most. That way, all resources are generating added value, process control equipments are maintained in an optimal state for best performance and final product is produced at least cost. Performance monitoring is the only way to ensure that everyone is working on top priorities toward the same goal. How can we add value to these warehouses of data? The data is there and the information is hidden; it is just waiting to be extracted.

A process performance monitoring is able to determine if a loop, a system, a unit or a plant meets the expected performances. The system prioritizes the areas that need attention. It also provides historical reports of the plant status by areas, by loops, and by identified problems. This information is provided to different categories of users in an appropriate format for each one. The system also includes diagnostics and tools to detect and analyze problems.

INTRODUCTION

As many industries, the mining industry capitalizes on economic variables and benefits from a favorable market cycle. To remain competitive, managers try to leverage human and strategic resources. They adopt “best practices” and set performance incentives, while complying with security, health and environmental norms.

World markets have forced many firms to rationalize their operations. World overproduction has allowed customers to become very demanding regarding the quality of finished products: they define precisely the characteristics they desire. The good old days are gone when the only measure of success was quantity. Large scale changes are happening.

Even if profitability is back, companies of the twenty-first century are fighting on a much larger scale than in the past. They must be more efficient than competitors; the difference will often be their profit margin.

Today, quality and production costs are so important that they mobilize efforts within the companies that succeeded in servicing the competitive market of the 90's. Many experts in the process control field confirm it: control systems contain unexploited possibilities. Performance monitoring and supervision is the only way to ensure that everyone is working on top priorities toward the same goal. That way, all resources generate added value, process control equipments are maintained in an optimal state for best performance and final product is produced at least cost.

In that context, information is a critical resource: if used and managed properly, it can become a solid competitive advantage. Thanks to network protocols, information is ever more accessible. However, companies often lack resources and processes to exploit the available information at its full potential.

ARE PROCESS CONTROL SYSTEMS USED TO THEIR FULL POTENTIAL?

Optimization of processes and control systems produces the largest gains for the investment. In fact, the principle is: "Use your existing equipment to its full potential."

Control loops in American plants are divided as follows:

Typical control loop problems and performances	Percentage
Control valves of poor quality or in poor condition	30%
Poor controller tuning (unacceptable values)	30%
Poor controller tuning	85 %
Poor loop design	15%
Controller in manual mode	30%
Control loop not performing accordingly to control objective	85%
Loops that perform better in automatic than in manual mode	25%

Even if 25% of loops perform better in automatic mode than in manual mode, they do not necessarily perform to their maximal capacity. In three out of four cases, the controller not only does not improve the performances of the finished product, but it worsens them.

WHAT IS PERFORMANCE?

When a plant is performing well, all assets are used at their best potential, and the human and material resources are used where they are really needed – that is, where they increase the bottom line.

Operation and production are optimal:

- Better yield
- Uniform production within tolerances
- Less production losses
- Energy costs reduced
- Productivity increased
- Less wear and tear on equipment
- Less production breakdowns
- Less time for start-ups and for grade changes
- Variability reduced

Why would the performance of loops decline as time goes by? We have noticed over years that performance declines at a rate of about 50% every 6-12 months. This means that after a year or two, we have lost 75% performance of what we used to have right after the optimization. Therefore, the half-life of performance is 6-12 months. Figure 1 shows this performance decline over time and illustrates how performance supervision can maintain a high degree of performance. It is then crucial to use the resources where they are really needed.

Performance declines because:

- Operation procedures change
- Raw material quality varies
- Equipment wears out
- Maintenance has been done
- Process has been modified
- Etc.

Users rely upon different key performance indicators with regards to process control:

- Management ensures that the process control equipment meets the firm's objectives.
- Production improves planning and benchmark units.
- Engineering improves process performance, reduces costs, and improves quality.
- Maintenance identifies poor performers and uses tools to fix them.

Maintenance and engineering are efficiently used:

- Efficient maintenance
- Repairs at the right time
- Quick troubleshooting
- Cycling removed

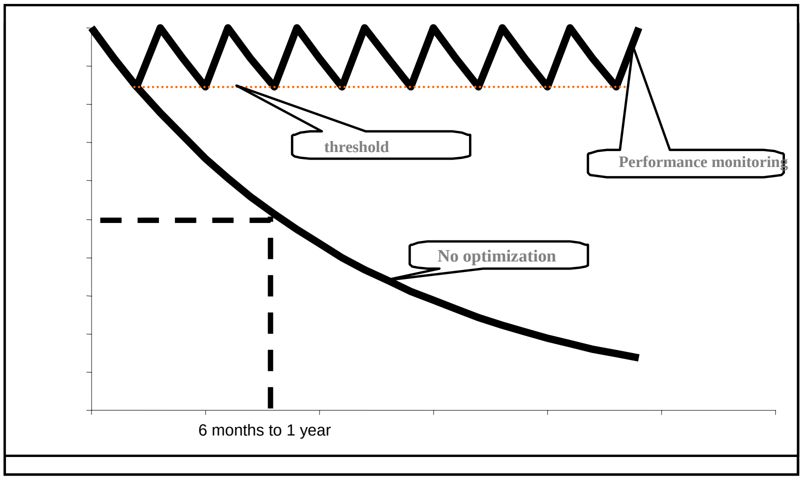

Figure 1. Performance decline

CONVERTING DATA INTO DIAGNOSTICS

Most plants have invested millions of dollars in distributed control systems (DCS), data reconciliation programs and historians; they can now get a return on their investment. Over the years, they have installed hardware and software to fetch data all over the mill. Production, engineering, maintenance and even management departments now have access to plant history.

Historians have been used for many years and archived data sometimes covers years of operation. Information is collected form a multitude of sources and archived into a single historian. This data has been useful to display operational information, providing comprehensive visibility into operations and allowing users to timely analyze processes.

- How to convert data into diagnostics?
- How to improve profits and reduce costs?
- How to capture process models?
- How to use this data to troubleshoot processes, debottleneck areas, and tune loops?
- How to use this data for identifying valves and transmitters to be repaired before planning a shutdown?
- How to identify areas or loops that need attention?

To add value to this data, a performance supervision program can analyze data; this allows doing predictive, reliable and centered maintenance.

COLLECTING DATA

Data is accessible using standard protocols such as OPC [1]. OPC or OLE for Process Control is a standard set by the OPC Foundation for fast and easy connections to industrial systems. Data is also accessible via historians that are already deployed.

Connecting to your historian

With historians, two approaches (or both) can be used to access the data with performance supervision programs:

- **OPC DA** or Data Access - for accessing real-time data
- **OPC HDA** or Historical Data Access - for accessing data on historians

OPC DA

With OPC DA, data is captured directly from the systems. The sampling rate has to be fast enough to capture fast dynamics in your process. To use performance supervision, you might have to configure your historian differently. For example, flow loops are ideally sampled every second.

Data flow

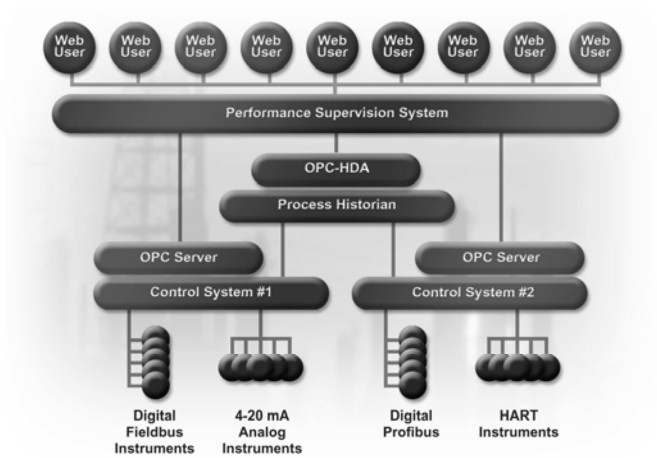

Figure 2. OPC DA and OPC HDA from Historian

OPC HDA

With OPC HDA, data is fetched from the archived data. To use OPC HDA, the historian supplier must provide this software compatibility. Most suppliers now offer this option. For many companies, this opens the door for generating greater efficiency and profitability from existing plant and procedures, without expensive installations. This approach reduces stress on the control network. Users are already familiar with the historian. The sampling rate has to be fast enough to capture fast dynamics in your process. Data is analyzed after it has been compressed, filtered or altered by the historian program. The configuration needs to be modified to reduce theses modifications. Performance analysis produces better results with raw data; compression and filtering reduce the quality of diagnostics.

Common choices for sampling rates [2]:

- Flow loops, pressure loops: 1 s
- Density loops: 2 s
- Level loops
  - Small tanks: 2 s
  - Large reservoirs, chests: 10 s
- Temperature loops: 5 s
- Analysis loops: 10 s
- Others: << *dead time*

PERFORMANCE SUPERVISION

Added value

In the competitive market of manufactured products, the difference between profits and losses can come from plant floor decisions as well as boardroom decisions. These decisions are directly attributable to the quality of information available. Data is not sufficient to make appropriate decisions: value needs to be added to this information, and diagnostics must be extracted from these warehouses of data.

Performance supervision programs include dashboards, reports, and alerts that enable senior managers to view real-time performance benchmarks of the entire company.

These analyses enable engineers to drill down for more detail into individual sites, plants, unit operations, and finally loops – revealing a wealth of useful information while conducting a rigorous health check.

Using it

Users can capitalize on hidden savings from their process with the power and flexibility of this type of program. These programs enable engineers and managers to identify bottlenecks, take remedial actions, get the optimal performance from legacy plants, and meet their objectives. Thanks to timely and pertinent information, reliability is increased, downtime is minimized, and efficiency is optimal.

These packages pinpoint opportunities for achieving the optimal economic impacts on operations, increasing reliability, efficiency, and profit. They maximize profits and minimize costs without adding bricks and mortar or personnel.

Results

Results, analyses and diagnostics are continually archived; this saves the time that is usually required to repeat important tests or to capture cause-and-effect patterns from prior events. Assessments for all control loops in the plant are now accessible plant-wide, via an OPC HDA interface. Results are also available for other programs via OPC-HDA since packages are not only OPC clients but also OPC servers. The performance supervision program also models process dynamics from historical data. Therefore, important process models can be developed, validated, and refined from historical data. This saves time and money, and eliminates the need for potentially costly tests on the plant.

Drilling down

A dashboard allows users to view the performance of the entire organization, allowing "drillling down" to any site, plant, or unit operation. The dashboard is available to anyone via a secure Web browser connection.

How to calculate return on investment, added value

Variability is not the only goal

In many industrial sectors, variability has been tracked for years. It has been pushed in a quandary! [3]. Nevertheless, this is not enough anymore. Management and engineers also need to do proactive and predictive maintenance and diagnoses for identifying areas that need attention. They need a system that monitors, analyzes, diagnoses, and establishes priorities.

Improve the bottom line

Performance supervision allows reducing energy costs, increasing through output, reducing costs of chemical additives, etc.

Added value: capturing models

The program automatically captures models. Therefore, when a loop or a part of the process needs attention, models are ready: no more bumps are needed to analyze the process, tune the loop or analyze the equipment. Engineers and technicians are ready to act.

If an advanced control system is added, models are already found; this greatly reduces the commissioning costs.

Added value: detecting equipment problems before they cause a shutdown

The program automatically identifies problems. Here are some examples:

- Valve problems and terminal element:
  Sticky valves, oversized and undersized valves and pumps, excessive usage causing wear, equipments often at their limits
- Transmitter problems:
  Overrange and underrange transmitters, noisy transmitters, blocked impulse lines
- Control problems:
  Loops needing attention, loops needing tuning, poor performers (based on economics)

Interactions (process interaction mapping quickly pointing to troublemakers, oscillation detection, root/cause analysis)

Multi-variable control problem (MPC)

- Process problems:
  Pumps capacity, fouling in lines, reduced thermal exchanges, entrapped air
- Operation problems:
  Loops forgotten in manual mode, loops on which operation makes frequent set point or mode changes, different behavior with specific teams
- Others:
  Problems specific to certain grades, season, production rate, or chemical products

ASSET MANAGEMENT SOFTWARE AND PERFORMANCE SUPERVISION

Asset management program

Asset management software directly reads data from equipments (valves, transmitters, variable speed drives, rotating monitors, etc.). The software displays alarms and statistics based on simple selected thresholds. For example, if a valve cannot follow the incoming signal anymore, its positioner reports an alarm. With this system, the equipment is monitored. Only the digital equipment connected to a computer via a digital communication link can be monitored. Also, when troubleshooting a unit, it requires time to analyze all the data. On the other hand, it provides a quick access to the equipment to diagnose, configure, re-range and monitor conditions. [4]

Performance monitoring

Performance monitoring and supervision consists of analyzing incoming signals (process variables, transmitter signals, measurements, generated set points, states) and outgoing signals (controller outputs, set points) to determine if the expected performance is reached.

All signals are read from the control system (distributed control systems, programmable logic controllers, quality control systems, etc.) via digital communications. The system detects oscillations, equipments that do not behave as benchmarked, process control problems, process problems, operation problems, etc.

For example, if a pump is not functioning well, the pressure loop starts to oscillate. The asset management software will not report it since the transmitter and the valve are working properly. The performance monitor software will report: “Oscillation on PIC-101coming from the process”.

If a valve has a stiction problem, the asset management software will report a valve problem such as: “Valve FIC-102 unable to follow command”. The performance supervision software will report: “Oscillation on FIC-102 coming from the valve”. In this case, the personnel will use the asset management software to interrogate the positioner instead of using a hand-held device to communicate with the positioner.

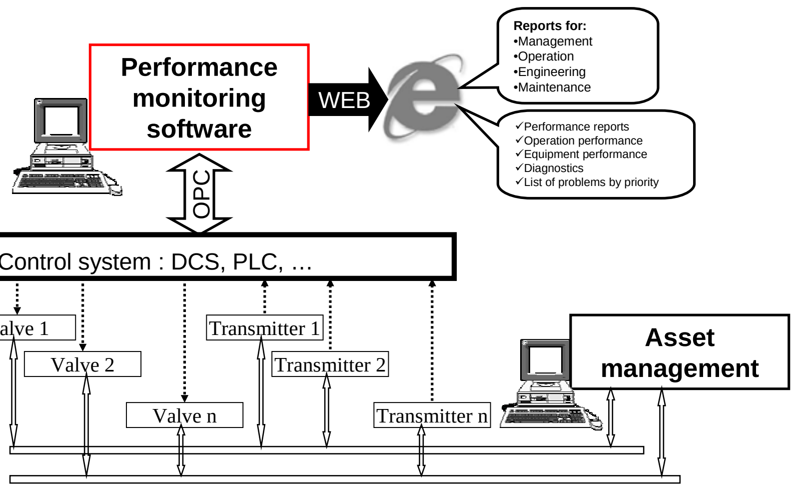

Figure 3. Asset management and performance supervision

ALERTS, REPORTS, AND DASHBOARDS

Users are alerted of abnormal conditions before these conditions actually become problems. As a result, they are proactive and more efficient. They don't have to look at displays or read reports; they are just notified if something changes. They can also configure the system so that they receive reports periodically.

The system automatically sends technicians and engineers an email if a controller or process area behaves abnormally. Alert emails are sent before an abnormal condition becomes a problem. This can minimize the quantity of low quality products, reduce inefficient operations, and eliminate shut-downs.

Performance monitoring programs can also be useful for start-ups. For example, in 2003, Kruger started up a new paper machine. They chose to install a performance monitoring program (PlantTriage by ExperTune) in order to do the start-up as quickly as possible. The program helped them surpass their start-up curve by 3 months. The Kruger Wayagamack mill manager said it was "one of the best start-ups ever in Kruger history".

Within 2 weeks of receiving the software, Kruger had installed it and was receiving diagnostic information which identified trouble spots in the plant. It prevented at least 3 shut-downs in the early start-up phase of the paper machine. The superintendent of production explains: "The paper machine start-up began on November 1, 2003. We made the first ton of light coated paper on November 7, 2003. Within one week, we were able to produce the final paper for the grades we wanted." [5]

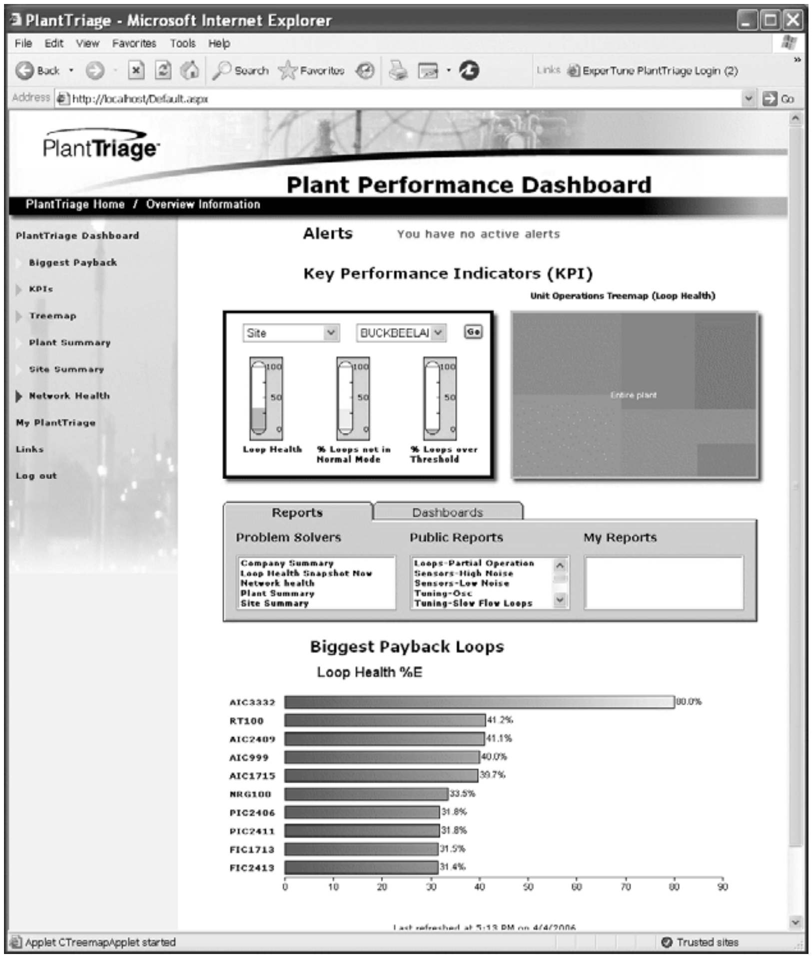

Figure 4. Dashboard for a whole plant

Batch processes, product codes, and grades

Analyses are organized for continuous processes and batch processes. Users can view and sort results by grade or product code. They can define their own performance indices or select indices that are already available in the program.

CONCLUSIONS

Using performance supervision software offers the following benefits [6]:

- Resources are used where they are really needed
- Process control systems are used to their full potential
- Operation and production are optimal:
  - Yield improvement
  - Uniform production within tolerances
  - Reduction of production losses
  - Reduction of energy costs
  - Reduction of wear and tear on equipment
  - Reduction of production breakdowns
  - Reduction of time for start-ups
  - Reduction of time for grade changes
  - Reduction of variability
- Maintenance and engineering are efficiently used:
  - Efficient maintenance
  - Repairs at the right time
  - Quick troubleshooting
  - Elimination of cycling
- Performance remains at its best
- Warnings for equipment, operation, process, design problems, etc.
- Automated troubleshooting and diagnostics
- Automated modeling
- Automated interaction analyses
- Proactive maintenance – interventions sorted by priorities
- Poor performers immediately identified
- Process benchmarks (comparison with world class processes, other processes, or the process itself)
- Reports available via the web to all categories of users

WHAT ARE THE RESOURCES NEEDED TO SUPERVISE PERFORMANCE?

Implementing the software and connectivity, configuring the reports and benchmarking will require 2 persons during 2 to 6 weeks. There is no need to dedicate personnel to work on the system, but a champion should ensure that staff is using it.

Maintenance and engineering will use the system to determine where the resources can really improve the bottom line.

Production and management will use the reports for meetings and planning; they will determine where interventions can improve economical results.

WHAT ARE THE BENEFITS OF MONITORING AND SUPERVISING PERFORMANCE? WHAT IS THE RETURN ON INVESTMENT?

The total costs for implementing the system vary from $100 to $400 per loop. For example, a 500-loop system will represent an investment of $120,000 to $170,000 depending on the network, the computers and the control system connectivity.

In most cases, the return on investment is realized in less than 3 months.

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