

EXPLOITING PROCESS HISTORIAN DATA TO IMPROVE PROCESS PERFORMANCE

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ABSTRACT

Most plants have invested millions of dollars in DCS and historians; they can now get a return on their investment. Many plants have a historian such as OSI-PI system [1] to collect and archive data. 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. 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!

KEYWORDS

Process control, Archiving system, Historian, Optimization, OPC, OPC-DA, OPC-HDA, Data compression, Key Performance Index, Proactive maintenance, Performance supervision, Asset management

INTRODUCTION

Historians have been used for many years and archived data sometimes covers years of operation. Information is collected from 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 providing users with tools to timely analyze their processes.

- How to convert data into diagnostics?
- 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 to do predictive, reliable and centered maintenance.

CONNECTING TO YOUR HISTORIAN

To connect to a historian, it is now possible to use standards developed for the process industry.

OPC or OLE for Process Control [2] is a standard set by the OPC Foundation for fast and easy connections to controllers. 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 when it comes from the process to the historian. To use OPC DA, the historian supplier must provide this software compatibility. Most suppliers now offer this option.

Advantages

You benefit from the structure, networks, and computers already installed to collect data. Data is grabbed when it comes into the archiving system – before it is compressed, filtered or altered by the historian program.

Disadvantages

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

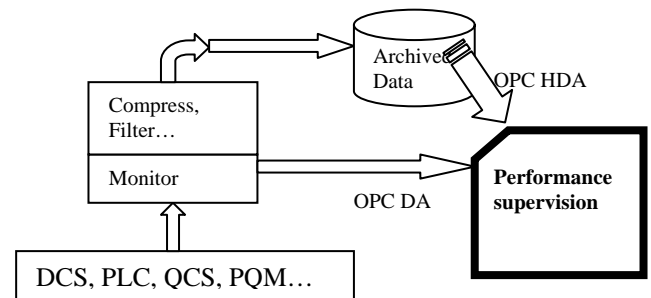


Figure 1. OPC DA and OPC HDA from Historian

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 allows control engineers to view past data and apply tools to diagnose, optimize, model, tune, linearize and decouple problems.

Advantages

Past data can be used. Data is stored in a single place. This approach reduces stress on the control network. Users are already familiar with the historian.

Disadvantages

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 these modifications. Performance analysis produces better results with raw data; compression and filtering reduce the quality of diagnostics.

PERFORMANCE SUPERVISION

Added value

In today's strongly 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 to the manufacturer's management team. 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 an 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. Increased reliability, minimal downtime, and optimal efficiency are possible thanks to timely and pertinent information.

These packages pinpoint opportunities for achieving the optimal economic impact 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, saving 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. These 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 'drilling 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 the pulp and paper industry, variability has been tracked for years. It has been pushed in a quandary! This is not enough anymore. Management and engineers also need to do proactive and predictive maintenance and diagnoses for identifying areas that need attention... The performance supervision software will monitor, analyze, diagnose, and establish priorities.

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 team

Others

- Problems specific to certain grades
- Problems specific to season
- Problems specific to production rate
- Problems specific to 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. [3]

Performance monitoring

Performance monitoring and supervision consists of analyzing incoming signals (process variables, transmitter signals, measurements, generated setpoints, states) and outgoing signals (controller outputs, setpoints) 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 performance supervision software 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-101 coming 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 positionner.

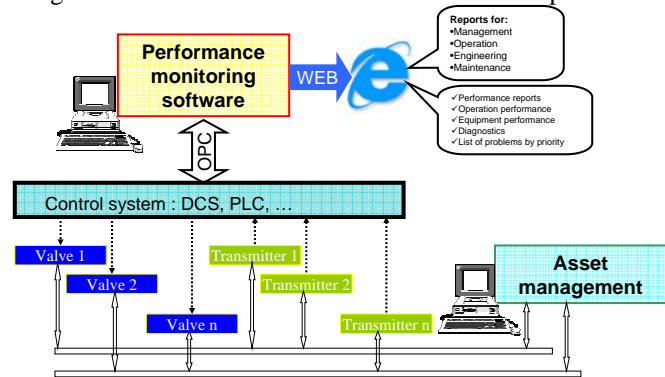


Figure 2. Asset management and performance supervision

DETERMINING THE SAMPLING RATE

Historically, historians have been used mainly to analyze steady state. For diagnosing, troubleshooting and identifying problems, the sampling rate has to be fast. When using OPC HDA, archives have to be configured differently. With OPC DA, actual configuration can remain but data collection is likely to need to be faster.

Ideal and realistic sampling

Ideally, the sampling rate should be faster than any phenomenon that is to be analyzed. However, most industrial instruments are unable to react so quickly. For example, a

flow signal read from the pulp flow on a paper machine could contain fast cycling coming from screens or vibration in pumps, but the instrument and the input card (digital or analog) are unable to read signals that are faster than one tenth of a second – maybe only one second.

Practical considerations

Instrument and DCS input circuitry

Ideally, the scan rate should be fast enough to capture everything that is read by instruments. In pulp and paper mills, it would be around 10 samples per second.

PID function scan rate

To select the scan rate, another beacon could be the PID function speed of calculation. In most control systems, the PID function update time is between 0.1 and 1second.

Loop dynamics

The scan rate should at least capture all oscillations from the loop. The loop dynamic depends on the process model and controller parameters. Since one of the analyses concerns controller parameters, fastest loop dynamics can be used to select the scan rate. The loop dynamics depends mainly on dead time (t_d) [4,5].

Network overload

Sampling thousands of signals over a network could generate too much stress on this network. Tests must be performed during the worst conditions to ensure that the network can support the load.

Hardware constraints

Legacy control systems could have constraints on the polling speed. For example, some DCSs cannot process data faster than once per second.

Practical scan rate

Considering all constraints, one should sample as fast as possible.

Common choices

- Flow loops, pressure loops: 1 s
- Consistency loops: 2 s
- Level loops
 - Small tanks: 2 s
 - Large reservoirs, chests: 10 s
- Temperature loops: 5 s
- Analysis loops: 10 s
- Others: $\ll t_d$

Examples

- 1- Faster than expected cycling
- 2- Same as PID Function
- 3- Based on loop dynamics
- 4- To reduce overload on network
- 5- To meet hardware constraint

	1	2	3	4	5	Selected
	<	=	<<	<	>	
Head box pressure	ms	0.5s	10s	-	N/A	1s
Pulp flow to mixing	0.1s	0.5s	50s	tests	1s	1s
Pulp consistency	ms	0.1s	75s	tests	N/A	2s
Latency chest level	min	1s	min	tests	N/A	10s
Steam header pressure	ms	0.2s	30s	tests	N/A	1s

Table 1: Examples of scan rates

ALERTS, REPORTS, 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 performance supervision software so that they receive reports periodically.

The performance supervision software 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." [6]

Batch processes, product codes, 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 with a historian offers the following benefits:

- o Resources are used where they are really needed
- o Process control systems are used to their full potential

- o 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
- o Maintenance and engineering are efficiently used:
 - Efficient maintenance
 - Repairs at the right time
 - Quick troubleshooting
 - Elimination of cycling
- o Performance remains at its best
- o Warnings for equipment, operation, process, design problems, etc.
- o Automated troubleshooting and diagnostics
- o Automated modeling
- o Automated interaction analyses
- o Proactive maintenance – interventions sorted by priorities
- o Poor performers immediately identified
- o Process benchmarks (comparison with world class processes, other processes, or the process itself)
- o Reports available via the web to all categories of users

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