

Revealing Analysis

By using real-time analytical software, companies are gaining greater insight into processes, detecting problems faster, and improving quality.

By Jack Wilkins.

Process Analytics and Intelligence – sometimes called Manufacturing Intelligence – has transformed the way companies produce goods, understand their manufacturing processes, and ensure a quality product in ways we could not have foreseen ten years ago. Today, best-in-class manufacturers use large volumes of real-time process data, generally stored in a process historian, as the foundation to drive real-time analytics and dashboards which improve their ability to detect and react to process bottlenecks or quality issues.

In many cases, real-time analytics have replaced the legacy concept of running reports. While reports that represent a static picture of a process at a fixed point in time are great tools for compliance audits and long term warranty analysis, they may not accurately represent the “as-is” state of a process.

With many reports, the user is often expected to know how to interpret the data and has a limited ability to drill-down and view data by a sub-category

or sub-classification. Analytics, on the other hand, are generally used to summarize and further dissect the data in forms that require minimal input from the user. Instead of users having to interpret the data, presentation in graphical form enables them to more easily explore the data and draw a conclusion based on real-time information.

Obtaining data

The cornerstone of any real-time process analytical and intelligence solution is its data storage and retrieval capability. In manufacturing applications, data is generated from a multitude of sources, from devices as simple as a weigh scale to as complex as a PLC controlling a high-speed bottling line. To capture this data it’s important to look toward standards, and in manufacturing we have a ready-made standard for the interconnection of devices: OPC (www.opcfoundation.org). Using OPC simplifies integration of manufacturing devices to a process historian.

Process historians are specifically designed to handle the high-speed, high-volume data generated by manufacturing processes. Historians capture the data and store it in a highly efficient format. Some historians compress the data, resulting in gaps or voids, while others capture and store it using lossless compression.

Capturing data with a high degree of fidelity drives an organization’s ability to rapidly filter and drill down through huge volumes. To ensure optimal performance when selecting an historian, look for high-end performance characteristics such as 500,000 samples (consisting of Time, Value and Quality data – referred to as TVQs) inserted per second; the ability to extract 1,000,000 or more samples per second for display in client applications; and the ability to support large numbers of concurrent users.

The trending of process data is a quick and effective way to see what’s happening. Creating and displaying trends (Figure 1) can be done in a variety of ways: trends can be embedded within an HMI/SCADA application; a separate software package can produce standalone trends; or trends can be displayed on a web page.





Figure 1: Trend plots are the basic tool of process analytics.

Inside the HMI

HMI/SCADA products offer a rich capability to control and visualize many different types of processes, whether it's running a single bottling line or a complex multi-site refinery application. HMI/SCADA applications often have built-in trending capabilities, or they can embed products to view and analyze process data in real time.

The trends displayed within these applications tend to narrowly focus on the specific process being controlled by the HMI/SCADA, which gives the operator a detailed understanding of how the process is currently performing. When performing process analytics we find customers "centerline" the process data (Figure 2) and monitor a large number of process parameters in a single chart. This allows users to reduce the complexity of their HMI/SCADA screens and gives operators a single place to focus, allowing them to manage analysis by exception.

This also simplifies the effort required for an operator to spot a problem. When the process parameters are centerlined, the ideal state is what appears as a single line in the chart. If, for some reason a process parameter deviates from its line on the chart, it will show as spikes and the operator can zoom in on this for additional details.

Crystal Growing Systems (CGS) in Hanau, Germany, which produces silicon crystals, was struggling with historical data collection and trending analysis using its Wonderware InTouch HMI. Historical data in the format they needed to analyze issues was not immediately available without a timely delay, because of their dependence on the IT department to make the necessary conversion.

CGS added Canary Labs' Trend Link software into its Wonderware system, which now takes data directly from a Siemens Simatic S7 PLC, thus bypassing the IT department and its historian. Trend Link acquires 75 tags from the crystal growing machine and stores in an internal historian.

In the plant, the machine operator uses the trending data to monitor the behavior of critical process values in live mode and control the machine to provide optimum quality of the crystal. Process engineers use the historical data to analyze and optimize the crystal growing process. Trending data is reviewed with Trend

Link and can be exported into CSV files. A total of 180 days of data is maintained online; this historical record provides for review of past production errors.

Taking off-line

This same method can be applied to analyze process data away from the plant floor. Off-line users can analyze data using commercially available, standalone trend tools, with which an engineer or quality auditor can get process analytics and intelligence right on their desktop.

Trend software must be easy to use and configure, so users can focus on improving the process, without learning a programming language just to create a trend. The trend tool must also offer a rich feature set geared toward process analytics, with capabilities such as support for OPC-HDA and OPC-DA data sources, real-time updates and plotting, stackable pens (auto banding), user configurable time domains, and legends that include engineering and real-time data. In general, standard HMI charting tools lack this functionality, which is required for effective real-time process analytics and intelligence.

When it comes to analyzing data, team members often have responsibility for many processes within the plant so it's important that they can quickly switch between the various processes they're managing. Here too we see the use of centerlining for getting the big picture view and as a tool to help determine where to focus process improvement efforts. When issues are detected, they drill down to analyze the raw data and get a better understanding of what factors are influencing the process in a negative manner.

When using trends to explore data, it's often useful to compare the current process with how it ran in the past (Figure 3). Trend tools typically offer the ability to time-shift historical data, allowing the engineer to see older data and current data on the same trend. Once issues have been identified, it is useful to add an annotation in the event the data is revisited sometime in the future. The annotation capability provides a long-term record of what happened and how it was resolved, and it reduces the need to depend on a process engineer remembering what was done to fix the problem.

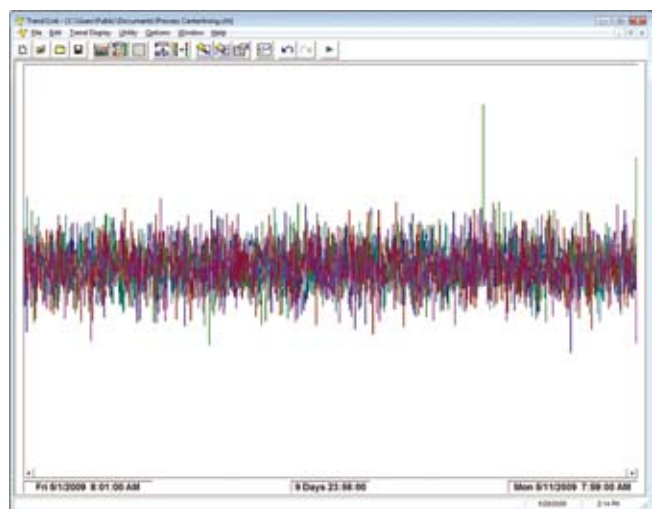


Figure 2: Centerlining data (multiple variables centered on the screen) allows operators to spot 'spikes' and then drill down to investigate further.

Valero Energy's refinery in Delaware, US., is an example of a company that uses process analytics for real-time control and off-line analysis. The trend software tool collects more than 70,000 tags of historical data from 17 different process units within the plant. The data is archived on two centralized historian machines. Historical and real-time data is then accessed via the network at 50 viewer stations.

Three months of one-second data, one year of one-minute data and five years of one-hour historical data are available to users on-line. Off-line high resolution data is available dating back to early 1990s. Because the Canary system conforms to the OPC industry standards, the viewer can access and display data from other vendor historians, such as the Honeywell PHD Historian. Trend Link is used as an ActiveX control embedded within web pages to provide a customized display for users to select the appropriate data and predefined charts.

Operators now have a clear and reliable view of both the real-time and historical trend pattern in order to build a good understanding of the current plant conditions. Through the improved visibility into plant operations, process engineers have been able to increase productivity from 185,000 bpd to 210,000 bpd, a significant output gain and incremental revenues for the refinery. This increased production was done without any impact to EPA requirements on air quality and emissions.

Getting on the web

In many applications the preferred method for process analytics and intelligence is to deliver the trends via Internet Explorer. Delivering process analytics via a web browser allows you to reach a broad audience with a wide variety of dashboards, trends and summary data. It allows anyone in the organization, from the plant floor to the board room and beyond, even the supply channel and customers, to run process analytics.

Using familiar tools like SharePoint Designer (formerly FrontPage) and Trend Web, it's relatively easy for non-web developers to create intranet pages that remotely deliver process analytics and intelligence data. For extranet, it's best to work with your in-house web development team to create and manage these as there is usually more extensive requirements (like security) that must be adhered to.

Another emerging trend is the use of software that combines the functionality of HMI/SCADA style displays, standalone trend charts, Excel reports and web content all a single solution. Such software, like Canary's InfoLink, enables the delivery and analysis of real-time data in the context of the manufacturing operation while allowing a look back in time at compliance reports or exceptions.

Using built-in designers enables the creation of displays with multiple layers that provide finger-tip access to the data. Organized and efficient displays give users the ability to look at all of the information in one place so that they can focus on analyzing the process data, not searching for the information in separate applications.

Key features like a Playback mode use historian data to drive the displays, creating a historical look into the past, with graphics and trends depicting the data exactly as it happened. Being in control of the playback speed allows users to pause and step through the process at a critical time when a failure occurred (like having a digital video recorder). Other uses include training sessions that use the replay, stop and slow motion features to teach new users what happens at critical transitions in the process.

Real-time process analytics and intelligence has the potential to expose a significantly greater amount of process data than traditional reporting is capable of delivering.



Figure 3: Being able to compare data from a previous run (2008 v 2007) allows an engineer to spot what was different.

Report time

Once issues have been identified and resolved the engineer needs to communicate the findings to others in the organization, usually via email or PowerPoint presentation. Many trend tools support a copy-and-paste capability for taking a snapshot of the trends for reuse in other applications.

One of the most popular tools used for creating process analysis and intelligence reports is Microsoft Excel. It's extremely flexible and many users already have it installed on their PCs. Reports of this nature usually represent static data and can be very useful for distribution to others in the organization or for compliance reporting. While Excel-based forms are readily available for many traditional reporting applications, there is a limited number of forms that target process analytics and intelligence.

If Excel is the reporting platform, there may be a significant amount of time and energy required to design and produce a report. While it has the capability to connect to Access or SQL Server databases, it does not have built-in capabilities that enable it connect to process historians. However, there are several Excel Add-ins available, like Trend Reporter, that extend the ability to deal with process data and streamline report creation and maintenance.

When using Excel to create and deliver process analysis and intelligence reports, these Add-ins will greatly simplify the process

of pulling data in, formatting it and enhancing the delivery of the report. Many of the Add-ins that support process analytics and intelligence come with a series of templates that can be tweaked or used as is.

Using templates and retrieving data stored in the process historian can greatly reduce the time spent each month pulling together data for internal production meetings or regulatory compliance reports. Repetitive reports like these take advantage of the static nature of the report content and are ideally suited to using Excel in conjunction with a process trending Add-in as a process analytics and intelligence reporting tool.

For example, after installing a trending package to monitor its wastewater plant, Martinsburg discovered that the trending software could also eliminate a great deal of tedious work involved in producing monthly environmental reports for submission to the Pennsylvania State Environmental Agency. Previously, these reports were hand calculated, and the process required several days.

Now, daily results from lab data are entered into the Trend Historian by the operator using the Manual Lab Data entry program, taking five minutes per day, and the reports are automatically generated and formatted using Microsoft Excel and the Trend

Reporter Add-in. The operator simply specifies a year and month. Excel retrieves the data from the Trend Historian, loads the spreadsheets with the appropriate computations, and formats the reports – all within a few seconds.

Real-time process analytics and intelligence has the potential to expose a significantly greater amount of process data than traditional reporting is capable of delivering. This requires managing how data are collected, distributed and presented.

While reports that provide data to knowledgeable users allows them to interpret and draw conclusions from the data based on their domain knowledge and understanding of the process, these reports may not be the best vehicle to deliver information to the majority of company personnel.

Real-time, graphical analytics, however, helps to bring process issues into focus. While it may not answer all the questions, it can help to expand the understanding of the issues behind the data.

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