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Fine-tune *the* process

Before moving to advanced control, correct instrumentation issues

Overachieving

Using diagnostics can optimize production assets.

By Rustin Ekness

To reach the productivity goals that most companies must attain to be competitive today, their production assets need to be more efficient.

For example, studies conducted by the Fisher Valve division of Emerson Process Management reveal that more than half of the valves in process plants perform below peak efficiency, resulting in lower productivity.

Elsewhere, monitor systems that pinpoint degradation of process equipment performance frequently identify conditions that cost companies millions in lost production. In one case poor compressor performance in an oil and gas storage facility in the North Sea cost Amerada Hess nearly $2 million in reduced shipments over a three-month period. Even where advanced systems using diagnostic information to help identify underperforming assets are in place, plenty of other operational problems can exist. A study conducted by the Canadian firm Entech Inc. showed that up to 80% of the control loops in process industry plants contribute to increased variability—a sure sign of inefficiency. Here are some other indicators:

- controllers operating in manual
- control valves always controlling near the closed position
- cycling process variable
- control valves not responding to inputs
- changes in the control of a loop for no apparent reason
- large process deviations following a load disturbance

When the basic elements of production systems operate efficiently, productivity improves and plant availability remains at levels that keep plant managers smiling. This goes beyond the smooth functioning of control loops with minimal variability. It includes all aspects of the process—instruments, valves, motors, pumps, fans, turbines, compressors, and the electric power that drives them.

Time, energy savings

At a time when two-thirds of sorties to the field by maintenance personnel result in "no corrective action" and nearly one-third of all dollars spent on maintenance "is wasted," companies clearly need better procedures. One promising solution is predictive maintenance, which some industry pundits call "the salvation of the maintenance function." Under this concept, production assets that could cause an unexpected plant shutdown get maximum attention by maintenance personnel to prevent failure. Pieces of equipment that would not greatly affect plant operations if they failed receive only routine maintenance to preclude premature demise.

Effective predictive maintenance depends on the availability of accurate past and current operating information for critically important production equipment. Such information has been hard to get because condition reports generally depended on human inputs, which are inconsistent at best and inaccurate at worst. Today's predictive maintenance programs rely largely on intelligence delivered to analytical software by advanced monitoring technologies, including asset management and condition monitoring. Typically, these technologies also raise alarms if the components they are watching suddenly develop symptoms of impending failure, so a user can take immediate action.

Accurate diagnostic information on the condition of field devices, valves, pumps, motors, fans, etc., enables plant personnel to determine with some precision whether to take immediate action to prevent an impending failure or whether they can do the work at the next regularly scheduled shutdown. Actions based on predictions increase the reliability of critical components, and costly interruptions diminish as a result.

Next step

Some progressive companies are now implementing programs that look at all vital assets in a plant to move toward asset optimization—a blending of technologies and services that unleashes underutilized capabilities so the production system begins to deliver or exceed the operating results. Optimizing assets can increase plant revenues 3% to 5%.

The optimization of plant assets can take on a variety of forms because there are so many different kinds of critical production assets—mechanical equipment, process equipment, electrical systems, instruments, and valves. Improving the operation of each part of the process will do the job partially, but for maximum return a company needs an integrated approach. Elements of asset optimization include:

- a balanced approach that starts with a plan to implement the most advantageous strategy
- intelligent management of instruments and valves
- machinery health management
- performance monitoring and real-time optimization of mechanical and process equipment
- electrical reliability services
- improving work processes based on new information

Intelligent devices

The growing infrastructure of intelligent devices is taking on a level of importance above and beyond its basic measurement and control functionality. These instruments with their microprocessor chips generate a vast amount of information about their own condition and the condition of equipment to which they connect. Technology has existed for several years to access data relating to the operational condition of smart field devices, giving instrument technicians the means to improve maintenance. But they always had to go into the plant, locate each specific device, hook up a handheld tool, and punch in a series of commands to extract bits of information—better than having no information at all but still haphazard and time consuming.

This changed with open system architecture and advanced asset management software (AMS). Now, a user can access diagnostic information from a wide array of smart instrumentation through a software package via open communication protocols.

Diagnostic information generated by field devices and captured from the control network can integrate with an enterprise asset management (EAM) system or computerized maintenance management system (CMMS), providing those applications with accurate information on which to base decisions or issue work orders.

Savings come from start-up and ongoing maintenance, including configuration, calibration, online monitoring for device alerts, documentation, and elimination of unnecessary work by maintenance personnel. All of the following figures come from the experience of current users of asset management software.

- One-time commissioning and start-up costs reduce by up to $150 per device, enough in most cases to pay for the software, hardware, and installation.
- Start-ups are faster. At a Noltex L.L.C. ethylene vinyl alcohol plant in LaPorte, Texas, engineering tests indicated AMS could reduce the time for instrument installation and checkout by nearly two weeks. Purchase of the software was justified on the basis that the unit could begin production—and generate cash flow—at least twelve days sooner.
- Configuration time goes down because entire configurations can download to field devices via "drag and drop" techniques rather than by keying in the parameters one at a time. One company, which configures approximately 500 devices annually, reported configuration savings of $50,000 per year or about $100 per device.
- Calibration time also reduces dramatically with menus that efficiently lead technicians through the process using calibration information about each device in a database. A pharmaceutical company, which calibrates some 8,000 devices per year, reported estimated annual savings of $264,000 in reduced calibration time.
- Device alerts are the basis for a predictive maintenance environment that helps reduce unnecessary maintenance activity, for even more dramatic savings. Automatic scanning identifies devices truly in need of attention, allowing maintenance resources to deploy accordingly.

Based on the above numbers, the ongoing savings possible by applying field-based asset management could be as much as $997 per device per year—plus one-time start-up savings of $150 per device.

Monitoring machines

A user can monitor the operating condition of critically important machines using permanently installed measuring equipment, which communicates directly to a remote computer.

A user can monitor the condition of machines of less importance to the production process using portable equipment to take readings systematically at one piece of machinery after another. In both cases, specialized software processes the data, providing in-plant vibration analysts with a complete picture of the health of plant equipment. The ability to overlay fault frequencies and match fault frequencies to peaks allows trained personnel to efficiently analyze the data to determine the current condition of a specific piece of machinery.

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A remote vibration monitoring and analytical service from any location worldwide provides analysis and reporting. Participating plants receive periodic assessment reports and immediate alerts on any machine showing signs of impending failure that could cause an unplanned shutdown. End users receive the benefits of an in-plant predictive maintenance program without investing in equipment, staff time, or training. The technology is consistent and scalable. It can go on a few or many machines in a plant, or in multiplant operations. Formal cost-benefit analysis and continuous improvement programs are standard parts of the service.

A totally integrated condition monitoring package, combining vibration monitoring and analysis, oil analysis, thermography, and ultrasonic examinations, is currently in use on high-speed test stands operated by the U.S. military. Prior to the adoption of this predictive maintenance technology, a test stand failure sent fragments of steel through nearby walls and cost the government more than $750,000. Following installation of the totally integrated monitoring package, close vibration monitoring indicated a potential problem and shut down the test stand before catastrophic damage could occur. This one incident more than justified the expense of initiating machinery health monitoring at three test facilities.

Performance monitoring

Monitoring the actual performance of plant equipment and comparing that against its design capacity is another means of informing maintenance and production personnel of potential problems. Does a pump deliver the intended volume of fluid at full throttle? Does a compressor produce the desired pressure? Does a turbine generate its rated amount of electric power?

Performance monitoring is especially beneficial for remotely positioned equipment or unmanned locations, where an Internet connection enables the transmission of recorded data to any monitoring location in the world. Rigorous monitoring software provides highly accurate information to users, eliminating instrument noise, errors, and bad data. Users can evaluate the effect of certain pieces of plant equipment or the efficiency of the entire plant in terms of throughput, downtime, stability, etc. With this software, users can make essential decisions based on hard facts. Users can then optimize maintenance schedules to extend run times and plan upkeep activities accurately.

The value of performance monitoring as a predictive maintenance tool is well established:

- Performance monitoring has been used for the past two years on the Triton Floating Production Storage and Offloading vessel operated by Amerada Hess in the North Sea. The system identified degraded performance on a compressor that, following maintenance activity, increased performance by more than 10%.
- Web-based equipment performance monitoring and real-time online optimization analyze the underlying performance of boilers and steam turbines in BP's integrated power station and combined heat and power (CHP) plant at the Grangemouth site in the U.K. This project plays a key role in helping BP reduce the annual energy bill at the site by 3%.
- Thaioil, one of Thailand's most complex oil, petrochemical, and energy-related companies, is realizing savings of more than $1 million per year by implementing performance monitoring at the Sriracha Refinery.

Improving work processes

Technology is a wonderful thing, but work processes represent another important aspect of asset optimization. You can achieve substantial cost reductions even before introducing new technology by carefully examining current maintenance work processes and changing the way some things are done. Using new diagnostic tools allows you to focus more effort on value-added activities, thus reducing manpower requirements while improving overall productivity.

Making work processes more efficient is a necessary step toward realizing the full potential of automated maintenance systems. Well-organized maintenance work processes incorporate four phases:

- Initiation/prioritization/purging: Diagnostic information should be your guide in evaluating potential projects and determining the order in which they should be done. Purging should also go on to ensure that proposed projects add value to the plant while eliminating unnecessary work or projects that are marginally beneficial.
- Scheduling: Capable personnel and necessary material must come together at the right time and place. Careful scheduling can eliminate wasted effort and cut 20% to 30% off the time required to complete a job.
- Execution: The use of asset management software and other software systems can speed up the execution of routine maintenance tasks, such as the configuration and calibration of field instrumentation.
- Analysis: Accurate data collection, root cause analysis, and standard reliability engineering principles should be used to determine whether maintenance was really needed, and this can be a guide in the future.

—Rustin Ekness

Electrical reliability

No plant can operate efficiently without reliable electric power. Whether the power comes from outside sources or is generated internally, the electrical gear used to distribute it throughout the site must undergo periodic testing and maintenance in a high operational state.

This involves work on high-voltage cables, transformers, switchgear, and circuit breakers that is beyond the capabilities of most journeyman electricians. For this reason, major power consumers spend hundreds of thousands of dollars annually on highly qualified electrical reliability services to ensure an uninterrupted power supply.

Nagging electrical infrastructure problems were costing a Silicon Valley company $1 million per year in repairs and lost revenues due to downtime before an outside service company took over the testing and maintenance of those facilities in 1995. Since then, uptime at the company's high-technology data center and manufacturing plants has risen to greater than 99.99%. Downtime due to electrical systems/component failure in critical facilities is no longer a factor, and electrical code violations are nil. Since the electrical reliability service company became the "owner's representative" for electrical design and construction, electrical construction costs have been reduced by up to 10% through improved design and lower engineering costs.

Full commitment

Asset optimization can be put into practice at any time and to any degree, but making a commitment to a total program is the best way to ensure significant results in the shortest time. That will drive your efforts and enable you to realize the full benefits. In simplest terms, asset optimization supports maximum output while incurring minimum costs.

A user can maximize output by fast, reliable startups, by adopting predictive maintenance strategies designed to ensure the reliability of essential production assets, and by using all available field-based information and diagnostics to identify potential trouble and avoid it. You can also maximize output by carefully planning and executing plant turnarounds to minimize their duration and to extend the intervals between turnarounds. According to past experience in this area, an asset optimization program should result in a 1% to 3% improvement in product throughput, generating enough additional revenue for payback in three to six months.

✍ **Behind the byline**

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