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6 ways to switch from run-to-fail to run-to-profit

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How many companies want to buy more maintenance? None, obviously. Management wants to invest in predictability, cost-effectiveness and on-time delivery. Yet most plants still operate in run-to-fail mode and spend too much on repairs. This, despite the availability and affordability of both basic and advanced technologies that can be part of an effective predictive maintenance (PdM) program, and despite the myriad proven financial benefits of equipment reliability.

So why have so few plants made the move to PdM?

Many top managers simply don't understand how reliability affects the bottom line, says Tracy Strawn, director of international programs with Marshall Institute in Raleigh, N.C. "Predictive maintenance is a tool for increasing uptime and production and reducing maintenance costs," he says. "Maintenance personnel have to continuously demonstrate that to management with metrics."

"Predictive maintenance programs have to be taken in context of the overall asset management life cycle," says Dick MacDonald, senior vice president of product management with SPL WorldGroup, San Francisco, Calif., and former president and CEO of Synergen, which recently merged with SPL. "Companies need to look at asset management as a core competency — look at how the various assets work together, define the critical elements of the overall system, then tie it into a condition assessment program."

Some organizations avoid starting a PdM program, or implement their programs incorrectly, because of misperceptions. For example, Strawn says manufacturers often pin their hopes on PdM to solve all their problems. "Predictive maintenance doesn't fix anything — it simply identifies potential failures early so that appropriate corrective action can be taken. Identifying problems early can ensure maximum reliability and uptime at the lowest costs, but you still have to follow through on the corrective actions to realize that," he explains.

Then there are the workload and cultural barriers. Setting up a PdM program takes extra effort that can create resistance in the maintenance organization. "Maintenance managers often feel burdened implementing a predictive program," observes Rich Padula, president of Syclo in Hoffman Estates, Ill. "It's extra work for them."

1 Understand costs of failures

A new definition of failure is emerging that no longer means equipment has stopped running. Plants that are using reliability, rather than maintenance, as the measure of performance define failure as "equipment that isn't performing at the level at which we need it to perform."

Plants need to look at predictive maintenance not as a maintenance tool, but as an operational optimization tool. A predictive program should be set up to improve the overall availability of the plant, the reliability of equipment, the cost of goods sold and reduce the life-cycle cost of the assets.

Steelmaker Dofasco in Hamilton, Ontario, is Canada's second largest steel manufacturer. In the late 1980s, the company embarked on a strategic project to evaluate its maintenance operations. The process that evolved over the following years created a different way of thinking about maintenance that focuses on equipment reliability in the context of "manufacturing process reliability." This provides predictable, stable operations that allow Dofasco to meet its business objectives for customers.

"The key is to make sure there's a line of sight to maximizing shareholder value," explains Ron Thomas, Dofasco's senior equipment reliability

“Maintenance programs come and go, but a business process defines the way you do business.”

consultant and project manager. “We don’t talk about maintenance anymore, we talk about equipment reliability.”

The company’s equipment maintenance programs for individual assets are the focus of the company’s maintenance function. “We develop technically based equipment maintenance programs that identify the activities we need to maintain the level of capability of our assets,” Thomas explains. “Predictive maintenance is integrated into the asset’s equipment maintenance program. We rely fairly heavily on condition monitoring.”

The strategy for equipment reliability has five primary components:

- Adopt a business process for equipment reliability.
- Incorporate best practices for performing maintenance.
- Support that process with enabling technology, such as CMMS software.
- Develop an implementation approach that respects the change management approach to the process.
- Sustain it through proactive management.

Québec Cartier Mining (QCM), based in Port-Cartier, Quebec, also has had success using reliability-driven maintenance solutions. QCM is one of the leading producers of iron ore products in North America. The company has added $7 million to the bottom line through increased equipment availability and decreased operating costs.

For example, the QCM plant gets more total performance from its wheel dozers with only half the fleet. The operations costs of large wheel loaders have dropped by 43.4%, while the lifespan of 190-ton off-highway trucks has been extended by more than 60%. In addition, worker efficiency is up by 5.1%, and spare parts inventory values have decreased by almost $10 million.

Industrial gas supplier American Air Liquide uses reliability as a business strategy to gain new business by minimizing costs and maintaining product availability. To assure high quality, the company has 17 national suppliers for maintenance services such as safety valve maintenance, compressor overhauls and electrical maintenance.

Partnering with Azima DLI, Air Liquide centralized its PdM program at 112 U.S. sites. Data gathered from lube oil condition monitoring, infrared scanning and vibration analysis programs is stored in a central database accessible through the Web.

“We need to make sure that we are reliable as we can be, says Brad Medlock, Manager of National Maintenance and Operations for Air Liquide Large Industries, “in order to do that you must have a good preventative and predictive maintenance program.

Product must be available on the pipeline at all times. We can’t jeopardize being down for long periods of time due to repair equipment.”

Azima DLI provides Air Liquide with advanced reporting that reflects valuable ROI and Composite Risk Index (CRI) information. Maintenance professionals often struggle to provide substantive, quantifiable data that

showcases the value of their work. Azima DLI's reporting capabilities highlight cost savings and risk reduction– in terms of increased productivity and reduced downtime and overall equipment health improvement – so executive management understands the impact of the program on the company's long term operational goals.

2 Accept investment

The first obstacle is the cost to get started. Because of the recent recession, many plants delayed spending the money on predictive technology and training. However, the smart companies recognize that they need predictive maintenance even more in tough economic times, to focus on reliability. That will impact the bottom line.

Energy provider Calpine Corp., San Jose, Calif., did just that. The utility's business strategy is to expand generating capacity and optimize production capability to reduce the frequency and duration of forced outages, thereby increasing revenue and maximizing profits.

To date, 35 of Calpine's 91 plants are enrolled in the program with about 21,000 points of data being collected from 2,100 pieces of equipment. In the first half of 2003, the program helped avoid approximately $1 million in repair costs.

The recession didn't stop Ford Motor Company's Dearborn Stamping Plant either. The plant produces the doors for the Ford F-150 series pickup truck. Management charged Process Engineer Jim Jackson with implementing infrared monitoring as part of the PdM program.

"Many preventive maintenance programs are paper-intensive, passing paper from one person to another," says Jackson. "I wanted to get the decision-making process about maintenance needs to the level of the guy doing the inspection. And I wanted more than just a camera."

The program started in March 2004 and included training for the technicians and getting the infrared cameras, software and other devices in place. Now, the Dearborn Stamping Plant has the highest daily part output of Ford's large plants, with 10,500 to 11,500 parts per day. The second highest producer is making 6,000 parts per day on similar equipment. Jackson says Dearborn's high productivity is directly attributable to heightened awareness of the PdM program and use of infrared monitoring.

3 Quantify payback

Part of getting a return on investment (ROI) means buying predictive technologies only when there's an actual need. MacDonald stresses the need to determine which assets will offer the most benefits from predictive technology investments. "You don't just go out and buy predictive analysis software and expect to get huge returns," says MacDonald, "because that might not be the area of significance to your particular facility. Step back and look at what can improve the longevity of the asset over its full life cycle."

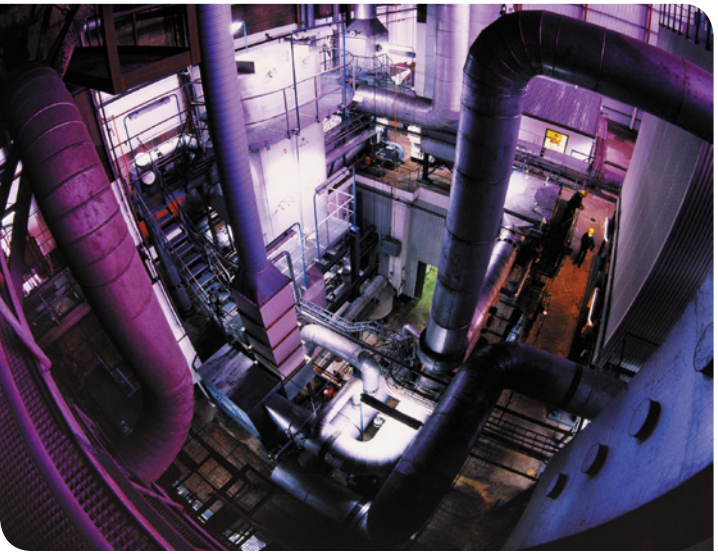
Payback for total PdM can be even higher. Experience has shown that if you do predictive maintenance the way it was intended to be done, as an optimization tool, an organization can realize up to 30:1 return on its investment.

At Dofasco, performance analysis focuses not only on results, but also on the business process that produces those results, including work identification, planning, scheduling, execution and follow-up. "That's set up so it feeds back into performance analysis, so you're always looking at the performance of the maintained asset against

If you do predictive the way it was intended to be done — as an optimization tool — you can get 30:1 return on your investment, and that includes your recurring costs.

required performance to support business goals," Thomas says.

Personnel review two types of measurements. The first is results measures, which look at the measure of reliability, or equipment failure rates. "We're measuring downtime as a contributor to asset availability, both planned downtime and unplanned," he explains. "We're also looking at maintenance costs as a contributor to total operating costs. Those are all results measures,



often referred to as lagging indicators of performance."

Dofasco also examines leading indicators, or business process metrics, which look at the individual elements of the business process. These reveal if they're planning well, scheduling well and executing well. "You don't manage results, you manage the process," states Thomas.

At Calpine, one of the challenges Predictive Maintenance Engineering Manager Kevin Nordenstrom faced was getting each of the individual plants on board with the predictive maintenance program. In particular, he found it difficult to demonstrate the value of the PdM program because of difficulties in measuring and documenting the cost savings of a potential event that was prevented and ultimately never occurred.

"Cost avoidance is a difficult concept to communicate," Nordenstrom says. "It's a complex calculation, and since you have avoided an event from happening, its potential impact is difficult to measure with tangible numbers."

Still, the plants have been able to record some impressive examples. In one instance, Nordenstrom and his team used PdM technology tools to identify an impending water pump failure. The problems were traced to a bad bearing on a 2,000-hp motor. Calpine opted to remove the motor and replace the bearing, resulting in minor downtime and minimal repair costs. By taking a proactive approach, Calpine avoided an expensive motor replacement and unplanned downtime costs that would have totaled an estimated $370,000.

At Air Liquide the results are indisputable: since partnering with Azima DLI, unplanned maintenance actions reduced by 95% over three years representing millions of dollars in avoided cost and unknown savings in avoided lost production. More importantly, Air Liquide has changed behaviors across a broad swath of its production operations by using web based reporting tools and dashboards to measure program compliance, rank order risk, prioritize maintenance initiatives, and to raise general awareness about the health of production operations among executives and plant managers alike.

Communication has been a key ingredient to the success of the program, both internally and between Air Liquide and AzimaDLI. The two companies rely on a number of scheduled and unscheduled channels to communicate including bi-monthly conference calls, customer satisfaction surveys, automatic alerting via the Reliability Portal, periodic training sessions and email newsletters.

Internally, Air Liquide has monthly, fleet-wide reliability conference calls with the Reliability Engineers assigned to each zone. These include the participation of corporate-level technical experts who support the Reliability Engineers responsible for implementing the reliability programs that are distinct to their zones. The two-tier structure captures and preserves the knowledge base originating throughout the company's fleet of plants, leading to better detected fault pattern recognition, and the efficient dissemination of best practices.

By collaborating on the development of ground-breaking performance metrics that serve the needs of both production operations and executive management, Air Liquide and AzimaDLI believe they have successfully expanded the efficiency frontier in production operations and increased the potential yield of the Air Liquide installed fleet. Using state-of-the-art predictive technologies and thoughtful communications strategies, Air Liquide is transforming its culture and introducing behaviors that will be vital to sustaining a truly predictive enterprise.

4 Build the business case

Lack of management support and the resources that come with that support is one of the most common obstacles to implementing an effective PdM program. For plant personnel operating in

reactive mode who already feel too busy to do anything else, it's tough to transition from reactive to predictive mode.

To overcome these hurdles, the maintenance organization needs a PdM champion to develop a business case and present it to management. The business case presents the financial opportunities and the cost assessment for the benefits of the PdM program.

The type of metrics to include in the business case depends on the drivers important to each company's success. However, every company has some measurements in common.

Sam Hess, director of software development and integration services at Revere, Birmingham, Ala., recommends including costs for an outside consultant to help set up the program. He says metrics to include are statistics on the current maintenance level, which includes lost production time; percentage of work spent on preventive maintenance; percentage of work spent on breakdown maintenance; inventory costs; and spare part costs.

Experienced PdM professionals recommend that companies remember to include front-end costs such as capital investments for predictive technologies and the cost for at least one week of training for technicians to use that technology. Certification training for vibration and infrared vendors costs should be included, as well as effective, repeatable data acquisition training for technicians.

Other components to include are database development; an asset criticality assessment; continuing education for the technicians and analysts; and calibration, refurbishment and upgrades for new generations of equipment and software.

Plant managers might be startled by the initial start-up costs as well as long-term recurring costs, but if the business case was prepared properly, they should not be surprised. The key is to remember the ROI.

5 Assault resistance to change

Even armed with the knowledge of the financial benefits, many maintenance personnel resist PdM because they prefer the way they've always done their job.

Getting buy-in is a key to overcoming

resistance to change. Ford's Jackson knows this well. "One of the first obstacles we ran into is realizing that people have to buy into the need for preventive maintenance," he says. "They have to understand that if you can keep the equipment ready to be used, you're saving money because if I don't incur any downtime when I'm trying to make product, I'm making money."

"When we started our infrared program, we initially trained 12 people," he says. "As time progressed, we ended up with three guys that were committed to the program. Some people didn't quite understand what we were trying to do, so they decided to return to their original positions in the plant. It's a different way of thinking. Many people struggled with the requirements and the level of technology being introduced."

When it comes to software, technicians who might not be computer savvy tend to be overwhelmed by the many fields, tabs and functions of the technology. According to Marty Osborn, vice president of product strategy for Datastream Systems in Greenville, S.C., vendors are responding by simplifying the user interface, providing more information on one screen to make data entry and analysis easier and faster.

6 Think big, start small

When it's time to implement a PdM program, it's important to clearly understand your company's performance and financial goals, equipment and maintenance needs, and long-term internal capabilities. The following are several key steps:

- Perform an asset criticality analysis. Focus your predictive needs on the critical assets that make you money — not on the auxiliary fans, pumps and fuse boxes. The criticality assessment determines what equipment should go with your predictive program.
- Perform a simplified failure modes and effects analysis on the critical assets so you understand how they're going to fail.
- Select the predictive technologies you need. Look for the specific failure modes of the critical assets.

If you're not sure about your goals, start small. Run a pilot program in part of your facility and try a technology, such as vibration analysis, as a baseline. Make sure you have a controlled area you can analyze so you can bring data back to management. Also, make sure any outside company you deal with shows you how they're going to help you get ROI.

Even if you do have clearly defined goals, start small. It's important to get started system-by-system so you start seeing value quickly. Build asset-by-asset until you've covered the entire plant. Then you don't have a huge implementation when you go live."

Padula has seen his share of customers who have tried to do too much too fast, and then became disappointed because their PdM program wasn't as effective as they had hoped. "Set up the program so that it's not one big goal like, 'We expect to have less downtime.' Instead, work your way into the goal, like, 'We want to increase downtime 10% in the next 3 months, 25% in the next 6 months, and 50% in the next 12 months.' Setting internal expectations appropriately can really make the predictive maintenance program successful."

The last piece of advice is to just do it. "Sometimes you have to be the maverick," Ford's Jackson says. "Now, people from other plants are coming here asking us, 'What are you doing? How are you doing it? Why did you do it this way? Teach us.' Good news travels fast." ■

HELPFUL LINKS

Why Troubleshooting Tools are Inadequate for Predictive Maintenance

A Study in Machinery Failure Detection

Machinery Vibration Analysis - Fact vs. Speculation

From Chaos to Calm – A ConocoPhillips Case Study

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