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Learning to identify and avoid these recurring traps in your maintenance program will help you be more effective in the application of both preventative and predictive maintenance techniques.

There's no need to extol the virtues of predictive maintenance (PdM) to any maintenance professional who hasn't been marooned on a desert island for the past 20 years or so. Numerous organizations have cut their maintenance costs dramatically through effective PdM efforts—while at the same time improving quality, safety, reliability and productivity. Unfortunately, there are some veritable tiger traps into which unsuspecting organizations can fall as they seek to capture the countless benefits this approach offers. Understanding and recognizing these traps will enable you to steer clear of them and set up a truly effective PdM program.

Pitfall #1: Capital expenditures for equipment, but not for training

When maintenance budgets are submitted, and ultimately pared down, many companies fail to provide dollars for adequate training to support the new equipment. Take, for example, the organization that hired this author for vibration and oil analysis. When they were questioned about infrared thermography, company personnel pointed to a camera they had previously purchased. A year and a half later, the camera was little more than an expensive dust collector. To this day, no one knows how to properly use it or interpret the results.

While training is essential, not just any training will suffice. Investment in the right kind of training is critical. Vendors may provide basic how-to-use training, but it may be inadequate to ensure the success of a PdM program. Vendor training is usually abbreviated—in some cases,

only a few hours at most. My personal preference is brand-neutral or independent training for a particular technique. The independent training focuses on every aspect of the technology and less on "why our equipment is better than theirs." Brand-neutral sessions are typically more in depth than vendor training, and may last up to a week. For example, in thermography training, maintenance personnel might spend an entire day on electrical inspections. Students receive practical, hands-on experience. In addition, independent trainers usually conduct a competency test, and may provide certification for those who pass. They also may teach the principles of reflection, emission and transmission.

In contrast, vendor training may instruct students to simply leave the emissivity at a certain figure, such as .95, but then fail to define what emissivity is and how it can—and often will—affect the reading. Information obtained from thermography without an adequate understanding of these concepts can lead to false or missed results. Although someone might be able to operate a thermographic camera and perform basic scans, without a grasp of the factors that can affect the image, he/she could fail to accurately interpret the information. This would, in turn, result in unnecessary work orders or machine breakdowns for the company.

Training dollars should be allocated for more than one employee. A company might choose to invest in just one individual as the "in-house expert" to use the equipment, interpret the results and relay the information to the planning and scheduling function. That can be disastrous for any number of reasons, including the fact that people often leave companies or—heaven forbid—ask for promotions or transfers.

Remember, people may come and go, but systems will sustain. Predictive maintenance needs to be a position—not a person—with minimum training requirements built into the job description. We often hear maintenance managers lament losing people they have trained to other companies. The sadder scenario—and bigger danger—involves making do with the ones that are not trained, not losing the ones that are.

Pitfall #2: Applying one predictive technique for all situations

If the only tool you have is a hammer, then every problem looks like a nail. For instance, if you only have a vibration analyzer, would you be able to identify loose connections in an electrical enclosure? Understanding the proper application of the different predictive tools is paramount to implementing and sustaining your system.

The most practical way of selecting which PdM technique to either purchase or contract is to

identify the most expensive problems the plant has experienced. At that point, you can look for a predictive tool or technique that could have identified the problem early. Most predictive techniques work in concert to improve reliability, aid in root cause analysis and improve safety. They will provide the time necessary to properly plan, kit, schedule and execute corrective maintenance work orders.

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For example, listening with an airborne ultrasonic device before opening a switchgear door to perform an infrared inspection is very prudent. The user may hear arcing and tracking before opening the door and exposing himself/herself to an arc blast. Likewise, looking at shaft couplings with an infrared camera to determine which one needs to be realigned can save downtime.

Experiment with different techniques when you find a problem. If something has been identified by infrared thermography, look at it with a different device, such as a vibration analyzer. You may find a better way to detect or verify that the problem condition exists.

Organizations have obtained good results using a combination of predictive techniques like contact ultrasound, vibration analysis, oil analysis and thermography on gearboxes. Doing so—and identifying a failing component instead of replacing the entire assembly—they have been able to cut repair costs significantly. This approach can be successful throughout your facility.

Pitfall #3: Failing to properly re-inspect after corrective work is complete

Regrettably, the following scenario occurs all too often, in far too many operations.

Charlie finds an anomaly with the infrared camera—it's a hot connection at a circuit breaker in an electrical panel. A corrective from predictive work order is planned and scheduled. The supervisor gives it to Sparky, who tightens the connection, fills out the paperwork, wipes the sweat from his brow and heads back to the shop.

How does Sparky know his repair was effective without using the same technique that identified the problem initially? The job plan should include re-inspection, preferably immediately after the repair, to ensure the repair was successful. Ideally, this re-inspection should be done with the infrared camera. If an air leak were discovered with airborne ultrasound, that air leak should be inspected again with the same technique to ensure proper repair. This particular area is critical to ensure success.

Predictive maintenance identifies problems that usually are undetectable by human senses. If the problem could only be seen with the predictive equipment, then the same reasoning should be applied when re-inspecting it. There are many instances where a repair has left the equipment in worse condition than before. For example, corrosion develops inside an electrical connection and maintenance makes the situation worse by tightening the connection. Or, in disassembling piping to repair an air leak, mistakes are made when putting the piping back together.

Without proper re-inspection, we would have no idea of the havoc we have caused in our own system. When you are using predictive techniques to identify a problem, ensure that your system requires re-inspection to be done using that same technique. Don't fall into the trap of relying on human senses.

Pitfall #4: Corrective work orders falling through the cracks

Organizations that haven't made the transition from reactive or breakdown maintenance to preventive maintenance will not be very effective in adding predictive maintenance to their plan of attack. In a reactive environment, those who scream the loudest will get their work done. There is no formal prioritization of work orders. Thus, when it comes to corrective from predictive work orders—which deal with equipment that is functioning—no one is being a "squeaky wheel" until something breaks down. Maintenance supervisors, when distributing work, will tend to allocate craft time for more obvious problems.

One example of this that stands out in my mind occurred when I was conducting vibration analysis and found a problem with a gearbox. The maintenance manager wanted to remove the

offending unit and have it rebuilt. A technician was given a corrective from a predictive work order to complete the job. He went out to the machine, looked at the gearbox that was to be changed and didn't see a problem with it. Reasoning that it didn't need to be changed out, he promptly closed the work order.

On my next visit to the site with my vibration analyzer, I was puzzled by the fact that the bad gearbox hadn't been changed. Checking into it, the maintenance manager showed me the closed work order.

We investigated further and found the new gearbox had been placed back on the shelf in the storeroom. The maintenance technician apparently didn't have a good ave a good understanding of why he was to have changed the gearbox; neither did he include any comments on the work order.

All personnel involved in the maintenance process—especially those that have been working in a "reactive" maintenance mode—need to understand that predictive work orders are a priority. The savings can be tremendous when parts are replaced before they fail. Personnel also need to understand that they will not see the usual carnage of broken parts when they go to do a repair. Predictive maintenance replaces parts before they fail—and this is a mindset that only comes with training and practice.

Pitfall #5: Lack of a supporting maintenance system

A preventive/predictive maintenance program can be likened to a one-legged chair—it may take some of the load off, but in and of itself, it's not very stable. For the chair to be reliable, the other legs need to be attached.

Those other legs include a work order control system, good storeroom practices, planning and scheduling and training. The glue that holds them together consists of auditing, metrics, PM Optimization and continuous improvement. Results must be measured and adjustments made accordingly. These all contribute to an efficient maintenance system.

While many companies will spend enormous amounts of time and money on tools, equipment, parts and materials, they will not focus on developing the foundation of a good maintenance organization—the maintenance system. Using predictive techniques without an effective maintenance system in place only optimizes your reactive maintenance program. It will result in marginal savings and less-than-anticipated payback. Predictive maintenance is good, but you must have the other programs in place to support it.

Watch your step

In summary, recognizing and avoiding the five pitfalls of PdM can add substantial value to a maintenance organization. Getting where you want to go is not especially difficult. You'll just want to put some real thought into the journey and tread carefully on your way to success. **MT**

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