

Implementing a “Best Practices” Predictive Maintenance Program: Avoiding the 10 Most Common Pitfalls

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In an effort to increase equipment reliability and reduce unscheduled downtime, many organizations have taken the proactive step of implementing a Predictive Maintenance (PdM) Program. Unfortunately, only an estimated 20% of these initiatives actually achieve the anticipated results, but knowing how to avoid the ten most common pitfalls substantially improves PdM results.

In a global marketplace, it is imperative that industrial and manufacturing organizations operate as competitively as possible. Maintenance has an enormous impact on an organization. It influences equipment reliability, equipment availability, production throughput, and eventual bottom-line profitability, so it is critical that informative and cost-effective equipment management strategies be employed. PdM/Condition Monitoring, if implemented properly, is a very effective strategy.

I have worked at an engineering and technical services organization that provided PdM services and at a manufacturing facility that contracted out Condition Monitoring services and later developed an internal PdM program. Through these experiences, I saw first-hand how important it is to establish and manage a successful predictive initiative and learned what shortcomings prevented companies from reaching desired program results. This paper identifies the ten most common pitfalls that can trip up a new PdM program and offers tips to ensure your company avoids these mistakes.

Organizations that have achieved a high level of success in their predictive maintenance efforts recognize that establishing such an initiative is a comprehensive effort and cannot be accomplished by simply buying some test instruments and putting them in the hands of untrained plant personnel. Critical factors to establishing a successful PdM program include the five following areas:



It is important to understand that the realization of a successful PdM initiative occurs only after recognizing the numerous elements involved in establishing a successful program and following a systematic process of developing, implementing, managing, measuring, and continuously improving the Condition Monitoring effort at your site. The following are the top ten most common pitfalls.

1. Improper Equipment Selection

To identify equipment health and then increase plant equipment reliability, it is important to select the right assets to monitor. One major mistake that companies can make is skipping an Equipment Criticality Analysis (ECA) and a Reliability Centered Maintenance (RCM) failure management strategy. Bypassing these two key steps can result in overlooking plant equipment that should be tested on a regular basis and failing to apply additional Condition Monitoring technologies to assets where one technology may not be appropriate for mitigating all failure modes. To ensure the team has a comprehensive list of machines that must be monitored with various predictive technologies, it is critical to have a populated CMMS/EAM database with an associated Equipment Criticality Ranking (ECR) or, at minimum, a simple list of the equipment register sorted in a ranked order. The best approach is to go through a formalized RCM analysis and identify opportunities to mitigate failures by using PdM technologies on various plant equipment. This effort will capture the assets that are candidates for the various technologies and reduce unnecessary PMs associated with those assets.

2. Improper Personnel Selection

A common mistake is selecting the wrong personnel to conduct PdM testing and analysis. When staffing for an internal program, many organizations hastily assemble a team of their best firefighting mechanics—individuals who have “saved the day” over the years. Although their loyalty is typically very commendable, there are many other key attributes to consider when selecting staff for an internal PdM program. Some of those characteristics include:

- A diverse familiarity with plant equipment and system functions
- Some degree of mechanical or electrical aptitude based on the PdM technology being utilized
- Detail oriented
- Analytical in nature
- Excellent problem solver
- Computer savvy
- Improvement oriented
- Documentation and metrics driven
- Seeks training and self development

If contracting out PdM data collection and analysis, the following should be considered in terms of the service provider’s personnel:

- Does the service provider possess personnel with experience on your type of plant equipment and processes?
- How long have technicians been performing this type of work?
- What type of training have they received?
- Are they certified?
- Do they comply with ISO standards?
- Do they have experience using multiple PdM technologies?
- Will you have a regular technician, or will they substitute whoever happens to be available?
- How well are their communication skills? Will you be promptly notified if equipment requires immediate attention?

3. Providing Inadequate Training

Often new PdM technicians receive little or no training beyond traditional vendor system “button-pushing” training. In fact, many PdM specialists are starved for valuable training that directly impacts their effectiveness and the success of the PdM program. Ideally PdM technicians should receive the following initial training:

- Basic introduction to predictive technologies
- Equipment reliability strategies in general
- Test instrument hardware training
- PdM software training
- Report writing training
- CMMS/EAM user training

Future training should encompass:

- Advanced PdM application technologies
- RCFA training
- Certification training after ample time has been spent in the field collecting data and performing analysis
- Power transmission/rolling element bearing
- Precision shaft alignment
- Precision balancing
- Lubrication practices

For the Condition Monitoring program to succeed, it is critical that the personnel performing the PdM data collection and analysis are properly trained. A shortfall in this area will directly impact the quality of the overall initiative.

4. Lack of Repeatability

Repeatability leads to reliability, so it is important to ensure your program is based on consistency. There are many potential variables that can impact the accuracy of the data being collected, thereby affecting the accuracy of the analysis/recommendations on machinery health and related corrective actions that may be taken. Some of the variables that should remain consistent are:

- Utilizing the same technicians to collect data (consistent grip pressure, probe angle, etc.)
- Collecting data in the same location (utilize a paint pen or pad to measure at consistent points)
- Collecting data in the same surface conditions (clean surface, free from dirt and debris)
- Utilizing the same instrument settings when testing the same equipment
- Ensuring machinery being tested is loaded at the same operating parameters from test to test

5. Not Collecting and Analyzing Data in a Timely Manner

Although this item may seem obvious, many programs do not keep up with the site’s data collection activities or are delinquent in performing the associated analysis. An inconsistent effort in collecting and analyzing data will lead to unidentified equipment failures and unscheduled downtime, resulting in negative program publicity. A few of the more common reasons for this occurring include:

- Absence of establishing PdM routes
- Lack of established PdM work orders coming out of the CMMS/EAM system
- Poor planning/scheduling practices
- Little-to-no review of delinquent PdM work orders
- Lack in proper training of the PdM technician/analyst causing them to be hesitant in performing their tasks
- Lack of motivation or understanding of importance by the data collector/analyst of their tasks
- Lack of accountability in performing PdM tasks in a timely manner
- PdM crew repetitively being pulled off their Condition Monitoring duties to aid in firefighting plant “emergencies”

It is important to be protective of your Condition Monitoring personnel and to ensure that they are performing PdM tasks that will contribute to the success of the program. Be aware of the many gremlins that will inhibit them from fulfilling their responsibilities. Do not allow your data collectors to become dust collectors!

6. Not Taking Corrective Action

If there is anything worse than not collecting and analyzing the data in a timely manner, it is receiving the support and funding to develop a PdM program and identifying the proper equipment to monitor with the ideal PdM technology, used by the best trained technician in a timely manner and accurately analyzed by a qualified specialist and then simply taking no action on identified equipment degradation conditions. Your program will be sure to come under justifiable scrutiny as machinery anomalies are flagged and no corrective action occurs, allowing critical plant assets to fail in spite of having the information required to proactively take mitigating action. Ideally this would never take place, but here are a few reasons why this may occur:

- A process for converting identified equipment to be reconditioned or repaired has not been established (The work request or work order process for PdM work has not been developed or is not clear to those involved in the process)
- The reliability/Condition Monitoring specialist has not been trained on entering work requests into the plant CMMS/EAM system
- The PdM follow-up work is not being planned
- The PdM follow-up work is not being scheduled
- The PdM follow-up work is not being executed

7. Failing to Measure and Document Program Successes

A frequent deficiency in PdM programs is the lack of predictive metrics that are captured and reported. This includes shortfalls in documenting and communicating the overall program wins or successes. It is common to fail to identify predictive KPIs, so it is important to perform the following exercise when measuring program performance:

- Identify the PdM program metrics to be measured
- Identify the target goals for each metric
- Identify the individual(s) who will measure and report each key performance indicator
- Agree on the formulas to use in how the metrics will be measured
- Select the frequency of measurement
- Agree on the target audience to report this information to
- Select the ways in which to communicate

There is often inconsistent documentation of program successes. Although some organizations initially report program wins, many companies quickly falter and no longer document the good things that the program is providing to the organization. For this reason, it is strongly recommended that a consistent template be created to document program successes. This PdM Program Scorecard should capture the number and nature of events that were realized as a result of having an effective Condition Monitoring program in place as well as the annualized cost savings that are achieved. It is important to quantify the amount of savings realized, so it may be necessary to sit down with some of your financial and senior leadership staff members to accurately identify what dollar savings should be reported. Regardless of the template format, it is important to consistently provide this document to those who are in a position of influence over the future of your program.

If some Condition Monitoring teams have experienced or expect to experience a great deal of scrutiny within their organizations, you may consider utilizing a PdM P&L document. This proactive template would capture the costs associated with the program on a monthly or quarterly basis compared to the benefits the program realized in that same period. The purpose of capturing these dollars would be to show ongoing justification for the program.

Some final thoughts on the subject include ensuring that:

- The metrics and successes reports are generated on a consistent and timely basis
- The proper personnel are on these distribution lists and are receiving these documents
- That everyone understands the reports (people may be hesitant to admit that they don't understand, so be sure they are clear on what the data is saying)

8. Lack of Program Support

Perhaps one of the most recognizable elements required to develop a successful PdM initiative is program support. Having a program sponsor at the beginning of the process and throughout the life of the program is essential. The following items represent some of the areas in which a program sponsor adds value:

- Providing a vision of what the PdM program could be at your facility
- Assisting in selling the benefits of the predictive initiative to senior leadership
- Constructing the budget and acquiring the funds to take the program from conception to reality
- If an internally staffed program, ensuring the program receives the personnel, test equipment, training, tools (work stations, computers, etc.), and time to execute the program successfully
- If pursuing an external program model, ensuring the program spells out the service provider requirements as well as seeing that proper contractor management is being performed
- Being a consistent lobbyist for the PdM program with senior leadership

9. Only Using PdM as an Equipment Health Tool

One of the downfalls that often occurs is solely using predictive testing as a measure of machine condition. The capabilities of PdM technologies are extremely diverse, and Condition Monitoring teams are generally required to prove the value of what their group brings to the organization, so it is important to utilize these tools in a number of different areas. Some of the more common applications include:

- Machinery health/Condition Monitoring of installed equipment
- Performing incoming, acceptance testing of repaired equipment
- Conducting incoming, acceptance testing of new equipment and lubricants
- Performing motor circuit analysis on critical spare motors in the storeroom/warehouse
- Conducting energy conservation surveys with ultrasound and infrared (compressed air system, steam traps, building enveloping)
- Performing built-up roof inspections with infrared thermography
- Using the technologies as part of RCA/RCFA efforts

By utilizing the numerous and diverse capabilities of the various PdM technologies, you will be sure to show added value not only in the early days of the program but for years to come.

10. Not Adopting a Continuous Improvement Mindset

The last common pitfall is a stagnant Condition Monitoring program. One of the keys to a successful program is that it must be dynamic in nature. As things change over time, so does the need to update your PdM program elements. Key components of a continuous improvement effort include program leadership, periodic reviews, performance metrics, and data to analyze change over time. A few of the items that commonly need to be reviewed are:

- The equipment to be monitored: As old equipment is retired and new equipment is commissioned, your list of equipment to test will change. This is also true for assets that were not originally on the list until an equipment failure proved that an asset needs ongoing monitoring.
- The frequency of monitoring: As some assets enter into alarm conditions or experience latter stages of failure, it may become necessary to increase the monitoring frequencies. On the other hand, if several months of monitoring less critical machinery shows no indication of machine wear whatsoever, the decision may be made to moderately extend the testing frequency intervals.
- The test instruments being used: As hardware and software programs change and improve, a different brand of instrument or simply a newer instrument with much-needed enhanced capabilities may be selected.
- Additional training and/or certification: There may come a point when additional training or even certification in a specific discipline will be of benefit to pursue.
- Utilizing additional technology applications including:
 - Ultrasound to identify slow speed bearing failures versus traditional vibration analysis
 - Ultrasound in conjunction with infrared scans to identify corona, arcing, or tracking in electrical cabinets
 - Ultrasound in seal integrity applications
 - Ultrasound for process gas leak and steam trap survey versus the traditional compressed air leak surveys
 - Infrared thermography in mechanical heat-related opportunities versus the traditional electrical distribution application
 - Infrared thermography in built-up roofing and building enveloping applications
 - Off-line motor circuit analysis versus traditional in-service/on-line testing
 - Learning to use the balancing program in your vibration data collector to perform precision balancing

Work to ensure the spirit of continuous improvement is an integral part of your Condition Monitoring program. Actively seek ways to keep it fresh by finding new applications and opportunities to increase equipment reliability. A comparison could be made between the traditional P-F curve of a failing asset and a failing PdM program. If the primary objective (function) of your predictive program is to monitor the health of critical plant equipment and ensure required corrective maintenance activities to be identified, planned, scheduled, and executed at the optimal time, then the PdM program has failed if necessary repairs are performed prematurely or too late.

Like the P-F curve, there are many early indications that the program is showing signs of failure. Ten such indicators of PdM initiative failures have been outlined here. By understanding the consequences of incorrectly implementing a PdM/Condition Monitoring program, you will be armed with a template for successfully executing an effective program at your facility, resulting in untold cost savings (typically hundreds of thousands of dollars) in additional production revenues, extended equipment life, reduced equipment repairs and replacements, decreased maintenance overtime, and reduced spare parts and expedited shipping fees. Avoiding common pitfalls will help you successfully implement a predictive maintenance program based on proven industry best practices.

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