The Next Big Leap in Asset Management Comes with Predictive Maintenance at Scale

By Inderpreet Shoker

Keywords

Artificial Intelligence (AI), Machine Learning (ML), Predictive Maintenance (PdM), Digital Transformation, Condition Monitoring, Historian, Customer Success, Industrial Internet of Things (IIoT), Streaming Analytics, Advanced Analytics, Automated Machine Learning (AutoML)

Introduction

Predictive maintenance is not a new term in the asset management world. Strategies and technologies that can help manufacturers monitor and evaluate the condition of assets to predict when maintenance should be performed fall under the term, predictive maintenance (PdM). PdM techniques, often involving data analysis to anticipate asset failure, have been around for some time. However, infusion of a range of advanced technologies such as cloud computing, artificial intelligence, industrial internet of things, and real time analytics has significantly enhanced the capabilities of and outcomes from PdM technology.

By employing advanced modeling and machine learning (ML) technologies, PdM software solutions can analyze growing volumes of process parameters for emerging issue detection, allowing manufacturers to take action before it is too late.

Current State of PdM

PdM is an extremely broad category. Many end users consider a range of non-intrusive testing techniques to be part of the PdM spectrum, including vibration analysis, infrared thermography analysis, oil analysis, corrosion monitoring, ultrasound analysis, and motor current analysis. All these techniques help manufacturers predict when maintenance should be performed and avoid unplanned incidents. Another popular term for these techniques is condition-based monitoring (CBM).

Advancements in technology have increasingly enabled data analytics as a PdM tool. Many manufacturers already employ basic data-driven PdM, including rudimentary types of anomaly detection, using enterprise asset management (EAM) systems or other asset management systems. In these use cases, an alarm is typically triggered when operating parameters exceed certain threshold limits.

In contrast, advanced PdM solutions leverage artificial intelligence (AI) and machine learning (ML) to help manufacturers comprehensively analyze very large datasets of process parameters over time. Advanced PdM can also leverage historical asset data to predict impending failure sooner and act immediately before opportunity passes, compared to other techniques such as CBM.

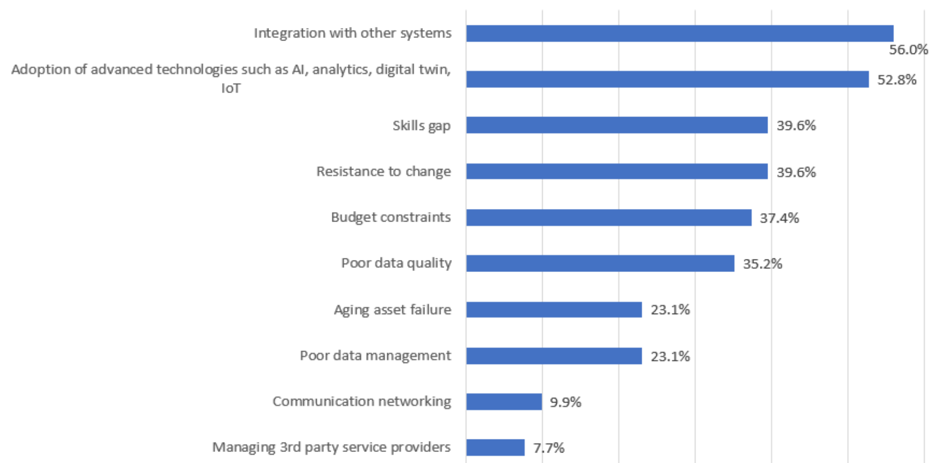
AI and ML-based PdM allow for broader coverage and improved understanding of complex interactions in real time across various process parameters, which often go beyond a subject matter expert's (SME) physical understanding of a process. Manufacturers eager to adopt advanced PdM, however, are faced with many challenges.

Industry Challenges with PdM

The rapid adoption of new digital technologies such as AI, cloud computing, edge computing, digital twins, and more means that the sector also is creating huge demand for more software engineers, data analysts, and data scientists to support digital transformation efforts. A major challenge for the sector remains its inability to attract the needed talent to support all the leading digital initiatives. The manufacturing sector is also losing a wide range of SMEs as many continue to retire and exit from the workforce. Although manufacturers would like to accelerate their PdM journey, the skills gap faced by the industry poses a major challenge on this path. Manufacturers are looking at technology to help address this challenge. Advanced technology can help embed learnings into the process, which lowers the historic risk of losing institutional knowledge.

An effective PdM implementation requires a comprehensive strategy that leverages data from all major sources. Key steps in a good PdM program include data collection from historians, control systems, and asset management systems for the PdM application. It should also include fault detection and diagnostics by the PdM application, and prescriptive guidance for maintenance scheduling and planning. To achieve highly reliable results, it is imperative that the PdM application receives key historical and real-time data from all relevant applications, sensors, devices, and systems.

To realize the benefits of PdM, it is also important to integrate PdM applications with other systems to leverage its analysis and create a close-loop solutions. For example, if the PdM system indicates an alarming condition, it is crucial to get that alarm in the EAM system so that the issue can be surfaced to an equipment operator if immediate action is needed. While manufacturers understand the importance of integrating their various asset management solutions, a recent APM survey conducted by ARC Advisory Group showed that over half of the respondents indicated this to be their biggest challenge.



Asset Performance Management Challenges
Source: ARC Advisory Group APM Survey

Across industries, we see manufacturers investing in advanced data-driven PdM. While many have been successful in implementing small pilot projects, scaling these pilots across different asset classes and different plant sites remains a major challenge for the industrial sector.

Better Outcomes with Advanced PdM

Much of the data gathering aspect of PdM is now automated, with the help of sensors and devices. PdM solutions can now leverage data coming from a wide range of sources including non-intrusive condition monitoring devices along with historical data from historians and various other systems. The large volume of data from different sources plays a key role in understanding equipment operations and developing reliable predictive models. While this adds to complexity, it is necessary to achieve success with PdM programs.

Leading software providers that specialize in AI and analytics are in an excellent position to help manufacturers with their complex PdM initiatives. For example, many systems rely heavily on large data repositories, and this can become a hindrance for many looking to adopt AI and ML-based PdM. There have been several advancements addressing this challenge. Advanced analytics solutions are now available that develop algorithms to quickly baseline newly instrumented processes or monitor processes with sparse failures (i.e., lacking properly labeled data for a model).

Along with advanced analytics, a range of technologies, such as cloud computing, data mining, and data management need to be applied to streaming IoT data to get the best value out of an organization's data in real time. Software providers with capabilities extending through all these technologies are proving to be extremely helpful to manufacturers building a strong PdM program.

To successfully discover operational faults, find root cause, analyze failure modes, review signals of wear, and explore failure mechanisms, PdM algorithms need data from various sources and need to be well integrated with different systems. AI and advanced analytics leaders that have the necessary tools across the analytics lifecycle and years of experience are best suited to help manufactures with their integration challenges. Manufacturers should seek an analytics leader that provides the flexibility to integrate existing systems and platforms with native data integrations, open APIs, etc.

Most manufacturers' PdM programs remain limited to certain assets and fewer sites, as they usually build their anomaly detection models asset by asset, failure mode by failure mode. This manual approach slows down the scaling process considerably. Analytics leaders with scalable solutions can help manufacturers address this issue by offering analytics pipeline accelerators that automate the development and validation of machine learning algorithms. With workflow automation, an SME (non-data scientist) can be empowered to build ML models without code or deep understanding of analytic methods. This expands the resource pool for addressing PdM challenges, and provides the following benefits:

- Promotes broader coverage and facilitates improved scalability.
- Enables organizations to move from pilot to production more quickly.
- Increases the value captured from PdM initiatives.

As organizations embark on the PdM journey, they are inevitably faced with the challenges of managing and governing analytic models, which have become critical assets for their enterprise. The ability to leverage automated analytic pipelines greatly simplifies ongoing maintenance and retraining of models following repairs, replacements, and process changes. Automated analytic pipelines also free up resources to focus on innovation and value expansion, without the traditional sustainment overhead of legacy systems.

Conclusion and Next Steps/Recommendations

PdM plays a key role in the manufacturing world since maintenance is a significant portion of an organization's production costs. Effective PdM strategies can help manufacturers avoid unplanned downtime, reduce diagnostic time, save on maintenance costs, and extend useful life of industrial assets. Most manufacturers are realizing the value of effective data-driven PdM programs but have limited knowledge in the field and struggle with adoption and scaling.

Companies specializing in analytics and data management with years of experience with related technologies are in an excellent position to help manufacturers automate and scale their PdM initiatives. Manufacturers looking to reap the benefits of PdM technology should work closely with data specialists to carefully craft their PdM adoption and scaling strategy.

Beyond model training, manufacturers should pursue technologies that automate the packaging and deployment of AI and ML models across their enterprise, including containerized delivery across edge and cloud servers. Without this operational support, scaling PdM initiatives can be slowed or become a complete barrier to adoption.