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AspenTech Automated Machine Learning Solution Enables Organizations to Move Up on the ARC Asset Management Maturity Model

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Summary

The evolution of Industrial IoT and advanced analytics technologies - coupled with the increasing availability of proven, affordable hardware solutions - is transforming approaches to how industrial companies of all sizes manage their critical assets.

Against the backdrop of a trend towards technology-enabled proactive approaches to minimizing unplanned equipment downtime, ARC recently met with executives of AspenTech to discuss the Aspen Mtell software offering, a fully automated, machine learning-based prescriptive maintenance solution that forms a key part of the company's Aspen Performance Management (APM) suite.

Across the board, owner-operators are realizing that the largely reactive nature of conventional asset management strategies alone is inadequate for maintaining the equipment uptime necessary to maximize production and profitability. Increasingly, APM is recognized as a shared responsibility between maintenance and operation groups and new predictive solutions are emerging that help provide much earlier warning of impending breakdowns.

ARC Advisory Group research indicates that downtime – especially unplanned downtime – can be a huge drain on profitability in the process industries. Enabled by technology, a wider and more comprehensive approach towards maintaining the integrity of plant assets can help industrial organizations minimize equipment downtime and thus maximize profitability.

ARC recently met with US- and Asia-based executives of AspenTech to discuss how the company's latest APM software portfolio can help meet plant

asset management challenges. As we learned, the Aspen Mtell software, which is central to AspenTech's APM portfolio, employs fully automated advanced machine learning technology to provide an advanced prescriptive maintenance solution. With its agent-based methodology, this solution is designed to "democratize" machine learning technology for process and other capital-intensive industries.

Within the last year, AspenTech has rolled out the software in several pilot projects at client sites; accruing high levels of interest, notably among customers in Asia Pacific.

A Level Up in Maturity

Unplanned downtime impacts businesses significantly. Consequently, industrial companies seek to invest in more sophisticated asset management solutions. For example, in the oil and gas industry, an ARC survey revealed that most respondents rate lost production, caused by unplanned downtime, at 3 to 5 percent of total annual production.

In 2016, the National Association of Manufacturers indicated that global manufacturing amounts to $14 trillion in annual business; with 10 percent of the losses attributed to unplanned breakdowns – $1.4 trillion each year. ARC estimates that in the process industries alone, unscheduled downtime results in $20 billion of annual production losses. To reduce such losses, companies are eager to complement existing maintenance strategies with new techniques to further minimize downtime.

ARC research indicates that few companies have evolved beyond conventional maintenance, with most still depending on reactive and preventive approaches (see ARC Asset Management Maturity Model on next page). ARC advocates the benefits of adopting higher levels of predictive and prescriptive maintenance; especially for critical assets.

Competitive pressures to do more with less and the impact of high-tech solutions geared for mass audiences (such as the iPhone) compel companies to seek simpler, easier solutions that implement rapidly and scale quickly without necessarily requiring specialized skills. In response, the Aspen Mtell software provides a fully automated, prescriptive solution designed to enable plant and process engineers to mitigate unplanned downtime in an easy-to-implement, easily supportable, and cost-effective manner.

Approach	Description	Asset Attributes
Prescriptive	Pattern identification points to explicit diagnosis of root cause and indicates precise action to change outcome	Complex assets requiring advanced skills for problem diagnosis
Predictive (PdM)	Multi-variate with equipment specific algorithms or machine learning, and typically using automated data collection & analysis	Critical assets where unplanned downtime has significant business impact
Condition Based	Monitor a single data value for bad trends or other rules-based logic. Includes inspections and manual data collection.	Assets with a random or unpredictable failure pattern
Preventive	Service in a fixed time or cycle interval	Probability of failure increases with asset use
Reactive	Run to failure and then repair	Failure is unlikely, easily fixed and/or non-critical

ARC Asset Management Maturity Model

Advanced Machine Learning for Maintenance

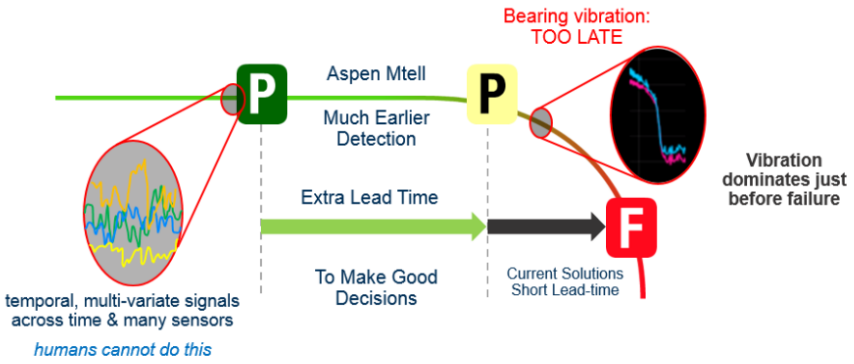
In October 2016, AspenTech purchased Mtelligence Corporation (Mtell) of San Diego, California. Mtell, a pioneer in predictive and prescriptive maintenance, focuses on enabling companies to increase asset utilization, availability, and avoid unplanned downtime by accurately predicting when equipment failure will occur and prescribing what to do to avoid the failure, thus helping minimize costly production disruptions.

Aspen Mtell software deploys advanced machine learning, a type of artificial intelligence (AI) that does not require explicit programming and which provides the ability to detect, in timely fashion, new patterns in large, unstructured datasets that indicate oncoming equipment degradation and eventual failure situations.

Aspen Mtell's predictive and prescriptive maintenance capability is incorporated in the AspenTech APM software portfolio. Aspen Fidelis Reliability, another key software offering, minimizes uncertainty for decision makers through data-driven quantification of risks and benefits relative to different asset investment decisions.

The Aspen Mtell software deploys machine learning, a field of computer science that does not require explicit programming. Unlike traditional programs that use rules, statistical models, and engineering equations, machine-learning based systems learn patterns in data and use them to predict future outcomes. State-of-the art machine learning systems automate these learning, adapting, and predicting activities.

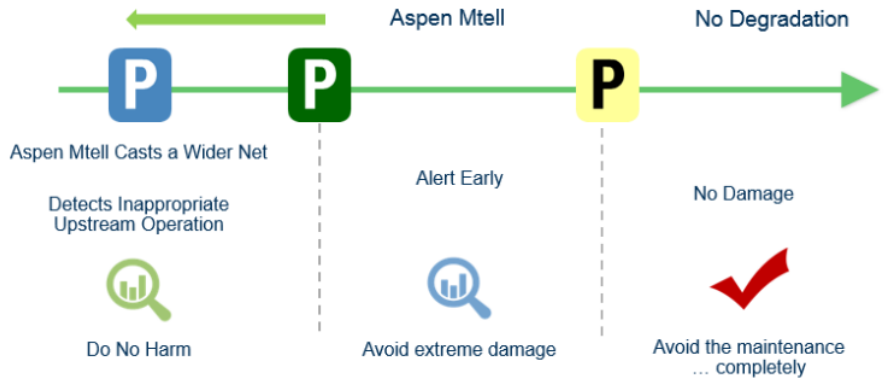
While machine learning technology was developed in the 1990s, it is only now that relatively low-cost computing power takes it into commercial applications. Significant application examples include credit card fraud detection, voice recognition in Siri, Alexa, Google Assistant, software that powers self-driving cars, and facial recognition functionality on Facebook.



More Time = Better Decisions (Source: AspenTech Mtell)

For industrial asset performance management, Aspen Mtell software's prowess lies in its Agent-based Methodology. This approach, which the company believes is market-differentiating, democratizes machine learning by making it relatively easy to predict asset failures from detected patterns that indicate ensuing equipment degradation and eventual failure situations.

While statistical techniques, engineered equations, or other model-based prediction approaches can sometimes detect impending asset failure, they do not provide as much forewarning of asset degradation and failure. Producing such methods is intensely difficult and the models can contain inaccuracies, deliver many false positives, and are extremely constrained. The methods also cannot capture the biggest root causes – upstream process distress that results in equipment operating outside safety and design limits. Without early heads up, continuing damage leads to costly breakdowns.



Catch Operational Errors and Avoid Unneeded Maintenance (Source: AspenTech Mtell)

To provide early warnings of impending mechanical asset problems and undesirable process perturbations,

the Aspen Mtell software focuses on "measuring" very precise normal and failure patterns. Using a combination of information, the software configures pattern "fingerprints" (precise normal and failure signatures) to detect behaviors likely to adversely affect the asset operation and lead to breakdown. The software then automatically generates "Anomaly Agents" and "Failure Agents" that monitor 24/7 for exact fingerprints.

The interaction of mechanical and process behavior requires comprehensive monitoring. According to the company, unlike other solutions, its Anomaly Agents provide both extremely early detection and prescriptive advice for process issues that could lead to process failure. As a result, the operator can adjust the process to stop the degradation, for example, prevent liquid carry-over causing seal and bearing damage; thus, eliminating both maintenance and process interruptions.

The software provides a two-agent approach to capture failures. According to the company this provides two major advantages:

1. Anomaly Agents detect deviations from normal behavior. Where subsequent human inspection reveals actual failure conditions, a Failure Agent captures the signature to provide earlier and more accurate detection of recurrences than other anomaly detection solutions. Where inspection shows a change in operation, the Anomaly Agent adds the pattern to its normal signature, avoiding false alarms. The Anomaly Agents adapt automatically and self-improves over time, requiring minimum human interaction.

2. Clicking on a single button automatically generates Failure Agents for all recorded failures of an asset – process and mechanical. Thereafter, prescriptive advice can eliminate process-induced maintenance. For unavoidable mechanical degradation, the Failure Agents allow early planning to promise the least operations disruption and minimum product losses.

With the ability to provide machine learning-enabled predictive and prescriptive analytics, Aspen Mtell software enables organizations to deploy those maintenance strategies which are at the top of ARC's Asset Management Maturity Model.

Wide Applicability across Industry Sectors

AspenTech deploys its range of software solutions in the oil & gas and chemical sectors as well as mining, pulp & paper, pharmaceuticals, water & wastewater, and transportation.

For example, a freight carrier in the US uses Aspen Mtell software agents to improve the reliability performance of its rail fleet. Starting with 30 locomotives, the carrier identified all the commonly occurring failures and then generated the appropriate Anomaly and Failure Agents carrying the signatures of normal and precise failure behavior. The agents were added to each locomotive; scaling rapidly to the entire fleet of 4,250 locomotives. The company reported financial savings of many millions of dollars during the project trial phase. These savings have grown by an order of magnitude in a two-year timespan.

AspenTech's core business in the energy and chemicals markets provides immediate major opportunities for growth. Use cases in these core markets include compressors that are historically subject to frequent, costly failures. With its advanced Failure Agent methodology, the software has detected a pattern suggesting a breakdown with eight weeks' notice. Failing to heed the warning, it was seven weeks later when the existing vibration monitoring system detected the oncoming failure. By then, serious damage had occurred, forcing an immediate shutdown and emergency overhaul with contingent product losses.

Since it was designed from the ground up as a machine learning solution for industrial (rather than commercial) applications, Aspen Mtell software is intended for use by engineers in the plant, rather than hard-to-find data scientists.

The Aspen Mtell software prescriptive maintenance solution not only looks at the equipment but the surrounding process. For example, this technique reveals the root cause of liquid carry-over into the compressor. Development and deployment of the relevant Failure Agent has increased failure warnings to eight weeks or more. This provides clear returns by eliminating the need for equipment repairs and avoiding product losses.

Learning from Pilot Projects

Over the last several months, AspenTech has been building awareness with existing customers. A pilot project typically comprises working with the customer to identify problem assets in the plant, training site personnel to use

the software, and developing the appropriate Anomaly and Failure Agents for the target assets.

During implementations, AspenTech takes advice from experienced mechanical and process engineers to incorporate their knowledge of historical failures, downtime causes, key measurements, etc. Machine learning requires human input to provide context and guidance to find the correct solution. This helps get AspenTech's customers up and running quickly to a level of expertise allowing them to handle all subsequent projects themselves.

Intended for use by plant engineers, the Aspen Mtell software was designed for industrial applications and built specifically to help prevent machine failures. ARC's discussions with AspenTech's Asia Pacific team reveal a high level of interest from regional customers. This includes interest from operators in developed and technologically advanced economies such as Korea and Japan, as well as the developing economies of Indonesia, Thailand, and others. In the region, the company's direct sales teams manage opportunities stemming from the oil & gas and chemical markets, while channel partners handle the rest of the global economy markets.

Conclusion

With a fully automated agent-based methodology as its core, the Aspen Mtell software was designed to democratize machine learning with a comprehensive approach that looks at both process and mechanical equipment issues to identify asset failure causes. The solution also helps industrial organizations advance to the highest, prescriptive level of asset management maturity.

In doing so, customers can also eliminate expensive and disruptive unplanned downtime. ARC believes that the software could also help owner-operators progress in the digital transformation journey.

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