PREDICTIVE MAINTENANCE FOR INDUSTRIAL OPERATIONS

What's possible and how it works

Businesses with an eye on the future want to see significant improvements in asset reliability and a boost in cost efficiency. Increasingly, reliability leaders and engineers are looking for ways to improve and optimize their current preventive maintenance programs rather than continuing to just maintain their equipment based on manufacturer recommendations.

It's an important change as the cost associated with equipment downtime is severe. Unplanned downtime of equipment such as turbines, pumps, compressors, and aircraft engines, can cost organizations millions of dollars per day.

This is where predictive maintenance enters the stage. Predictive maintenance helps optimize when and how often to execute maintenance on industrial machine assets using data. The ability to discover patterns and signals from sensor data enables organizations to look around corners, apply maintenance strategies at the right time, and ultimately predict the next catastrophic event.

For most cases today, the objectives of predictive maintenance programs can be boiled down to three outcomes:

- Improved production efficiency
- Improved maintenance efficiency
- Improved operational efficiency

This is just the beginning of the benefits created by calculating predictive outcomes. Predictive maintenance opens the door for predictability in other areas of operations and provides the ability to uncover new opportunities for organizations to function more efficiently as a whole.

But an effective predictive maintenance program requires certain technologies and techniques.

Predictive vs. preventive maintenance

Most organizations are concerned with two types of maintenance — unplanned and planned. Unplanned maintenance, also known as reactive maintenance, is conducted when the failure of parts has occurred and needs replacing. On the other hand, planned maintenance is conducted before a failure has occurred. The goal of all organizations is to achieve more planned maintenance to realize reliability.

There are two types of planned maintenance: predictive and preventive maintenance. Done at scheduled regular intervals while the equipment is still functioning, preventive maintenance preempts failures caused by known wear and tear. While this allows manufacturers to move from a repair and replace model to a regular maintenance model, the costs of early or over-maintenance associated with preventive maintenance still remain.

Predictive maintenance helps to avoid costly repairs while maximizing the utilization and availability of the equipment in service by using predictive analysis — which relies on data, statistics, machine learning, and modeling to make predictions about future outcomes. Predictive maintenance takes into account estimated service intervals as well as data-driven insights based on the measurement of operating conditions to monitor and diagnose equipment issues in real time. As a result, it catches anomalies in automated operations before they become major challenges that could impact the business.

The role of data and machine learning

The way organizational assets are viewed is completely changing with the ongoing explosion of inexpensive sensors and accessible big data technology. Critical, forward-leaning analysis of operations is no longer a matter of "what if" but of "when" and "how." This is a massive benefit for

industrial operations, where opportunities that leverage operational technology (OT) data could potentailly disrupt overall bottom lines.

This is especially true in the case of asset maintenance as organizations begin to shift from preventive to predictive maintenance. The ability to analyze data and predict when it's the optimal time to do maintenance or predict failures of critical operational assets can positively affect cost, profit, and overall performance of the business.

This is done via machine learning algorithms that analyze the data, build knowledge of critical assets, and, ultimately, predict when machinery will fail and what type of failure it will be in real time. Since this process can include millions of observations, machine learning has the power to continually learn and improve accuracy in different contexts.

Applications of predictive maintenance

While manufacturing production lines have the most obvious application of predictive maintenance technology, it's also becoming widely adopted in other industries.

In aircraft maintenance, maximizing the utility of your fleet's engines is a key component in ensuring the availability of your service. An optimal maintenance solution would take in the performance information

that indicates the real health of the engine such as data points on distance, altitudes, acceleration, deceleration, directions, air quality and more to accurately determine the number of flights particular engines could fly.

In a renewable energy production facility such as a wind farm, we have complex machines with sensors that not only control each wind turbine, but also send constant readings of the state of each component on each wind turbine. A turbine located in a warm climate would have completely different operational conditions than the turbine sitting in a cooler location that experiences freezing temperatures and storms. Predictive maintenance could help precisely identify risks and failures, and enhance our ability to respond to the unique pressures on each machine.

In the energy sector, Zeppelin is analyzing the performance of every single spark plug in its combined heat and power (CHP) plants and using algorithms built using Splunk Machine Learning Toolkit to identify possible machinery faults ahead of time. It is now be aware of warnings of potential shutdowns. In addition to predictive maintenance, Zeppelin extended its Splunk usage to absorb more data from its VMware, Nutanix, and SAP systems to detect anomalies in the data. This has optimized application and operating system performance across the entire group.

How predictive maintenance works

Splunk predictive asset maintenance works through a series of steps.
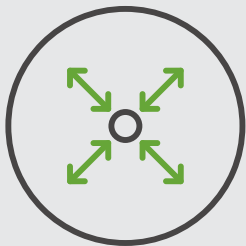
1. **Collect.** Easily collect and ingest data from different systems, and make industrial data available for predictive analysis.

2. **Explore.** Use transformation and visualization tools to understand and distinguish datasets associated with wear and tear.

3. **Analyze.** With an understanding of the data and the problem, select an analysis technique that is appropriate for the problem.

4. **Operationalize.** Apply the model to a broader implementation, and create reports and alerts for operational actions.

Implementing a predictive maintenance strategy

A proper predictive maintenance strategy enables organizations to increase service availability and minimize maintenance costs. The key is to invest in the right technology along with an understanding on how to process the data and then apply machine learning techniques to achieve the desired results.

1. **Begin identifying key outputs to predict**
   This could be the failure of a machine, or the remaining time until a failure of a machine or its component. By looking at your data, you may be able to create the models that measure these key outputs.

2. **Establish the correct platform for your program**
   You must have a platform in place to collect, explore, analyze, model and operationalize massive amounts of device data. This system needs to streamline data flows from real-time collection to immediate insight, understand what each piece of data represents, and provide quick expansion of predictive maintenance applications enterprise-wide.

3. **Select machine learning technique**
   After collecting and exploring the data, choose the machine learning technique that would be most effective in predicting the desired outcomes. Keep in mind that you will need to retrain your predictive models as more data becomes available and your equipment changes.

4. **Create effective workflows**
   As your platform collects enough data and begins predicting events, ensure tools are in place to create reports and alerts for the right technician and that they are dispatched at the most opportune time.

5. **Iterate and grow**
   Once you have a platform in place that you know will work for your business, you can then expand from there, leveraging IoT data and machine learning to improve other areas of the business.

For help on implementing a predictive maintenance program, download the Splunk Essentials for Predictive Maintenance to learn the essential analytics methodologies required to apply predictive maintenance to your data-set.

Try Splunk Industrial Asset Intelligence for free or learn more about it here. Want to do more than infrastructure monitoring with Splunk? Try Splunk Enterprise or Splunk Cloud for free to see first hand the benefits it can bring to your organization.

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