Industry Solution

Predictive Asset Analytics at Power Utilities
Overview

With pressure from new regulations and consumers, operating with the highest levels of efficiency, reliability and safety is a top priority for utilities. With the demand for electricity slowing, capital expenditures rising and competition from new market entrants, the utility industry is in the midst of a major financial restructuring. The growth of distributed generation and diversification of power sources bring operational system challenges, including loading issues, less switching flexibility and the potential for reverse power flow, among others. In addition, an aging infrastructure and workforce is also driving the need for asset renewal prioritization and knowledge capture.

Utilities are continually looking for ways to effectively overcome these industry challenges and remain relevant in the changing energy marketplace. Adapting to new rules, innovating new offerings and investing in cost-saving technologies are just a few of the avenues for transforming these challenges into opportunities. The amount of data available today is providing utilities with the information needed to operate more efficiently, effectively and safely, consequently allowing them to overcome some of these disruptive obstacles. For example, Navigant Research estimates that utilities will spend almost $50 billion on asset management and grid monitoring technology by 2023. Using predictive asset analytics software, utilities can improve equipment reliability and performance while avoiding potential failures. Additionally, these solutions provide the information needed to prioritize maintenance and reduce operational and maintenance expenditures.

Achieve Reliability, Performance and Safety Improvements

Predictive asset analytics software enables operations and maintenance personnel to address equipment issues before they become problems that significantly impact operations. Unscheduled downtime can be reduced because personnel receive early warning notifications of developing issues. These advanced analytics solutions can identify problems days, weeks or months before they occur, creating time for personnel to be proactive. Instead of shutting down the plant immediately, the situation can be assessed for more convenient outcomes. Loads could be shifted to reduce asset strain or the necessary maintenance could be scheduled during a planned outage, if possible. Maintenance costs can also be reduced due to better planning; parts can be ordered and shipped without rush and equipment can continue running. Additionally, some suggested maintenance windows can be lengthened as determined by equipment condition and performance. Other benefits include increased asset utilization and the ability to identify underperforming assets.

Not only do plants reduce expenses by extending equipment life, lengthening maintenance windows, increasing asset efficiency and increasing availability, other savings are realized when considering the costs that “could have been,” including loss of power, replacement equipment, lost productivity, additional man hours, etc., when a major failure is avoided. Additionally, predictive analytics solutions that transform raw data into easy-to-understand and actionable insights help personnel to further improve availability, reliability and decision-making.
With predictive analytics, personnel know and understand the actual and expected performance for an asset’s current ambient, loading and operating conditions. They know where inefficiencies are and their impact on financial performance and can use this information to understand the impact of performance deficiencies on current and future operations. This information also helps utilities assess the risk and potential consequences associated with each monitored asset and can be used to better prioritize capital and operational expenditures.

Another benefit for utilities using predictive analytics software is the capability for knowledge capture. This is increasingly important as many utilities are facing an aging workforce due to an influx of workers retiring. Knowledge capture ensures that maintenance decisions and processes are repeatable, meaning that after more experienced personnel leave the company, the information and decision-making insights remain available for other staff.

Reliability and efficiency improvements also translate into increased customer satisfaction rates. Consumers can experience more reliable service with less outages because utilities have the insight needed to avoid potential equipment failure and forced outages.

**Maintenance Practices**

**Reactive Maintenance**
Reactive Maintenance is the most basic strategy and involves letting an asset run until failure. It is only appropriate for non-critical assets that have little to no immediate impact on safety or the reliable generation of electricity and have minimal repair or replacement costs so that they do not warrant an investment in advanced technology.
Preventive Maintenance
On the other hand, Preventive Maintenance (PM) approaches are designed in hopes that an asset will not reach the point of failure. The preventive maintenance strategy prescribes maintenance work to be conducted on a fixed time schedule or based on operational statistics and manufacturer/industry recommendations of good practice.

Condition-Based Maintenance
Condition-Based Maintenance (CBM) focuses on the physical condition of equipment and how it is operating. CBM is ideal when a measurable parameter is a good indicator of impending problems. The condition must be definable using rule-based logic, where the rule does not change depending on loading, ambient or operational conditions.

Predictive Maintenance
If a potential asset failure could result in significant damage, safety issues or power outages, the risk is obviously much higher, and a more proactive maintenance approach is required. Predictive Maintenance (PdM) relies on the continuous monitoring of asset performance through sensor data and prediction engines to provide advanced warning of equipment problems and failures. PdM typically uses Advanced Pattern Recognition (APR) and requires a predictive analytics solution for real-time insights of equipment health.

Predictive asset analytics solutions are a key part of a comprehensive maintenance program to ensure that assets are operating optimally and with little risk to the organization. According to research by ARC Advisory Group, only 18 percent of assets have a failure pattern that increases with use or age. This means that preventive maintenance alone is not enough to avoid failure in the other 82 percent of assets and a more advanced approach is required.

Risk-Based Maintenance
Risk-Based Maintenance (RBM) is a comprehensive prognostic strategy that allows utilities to make decisions using PdM, CBM and PM outcomes. As a result, maintenance planning and the operation of equipment is more reliable and safe. RBM enables organizations to balance the probability and consequences of an activity in order to gain the most value from their assets.
Avantis PRiSM

Schneider Electric’s predictive asset analytics solution, Avantis® PRiSM, supports PdM by providing early warning notification of equipment issues. The software uses APR to derive predictions from empirical models generated by “learning” from an asset’s unique operating history during all ambient, loading and process conditions. PRiSM uses data from an enterprise historian for the model-building process. The model effectively becomes the baseline to determine the normal operational profile for a piece of equipment or system.

PRiSM is equipped with templates that simplify and streamline the model-building process. The intuitive process allows models to be built in minutes rather than hours and does not require any programming or specific equipment knowledge. When implementing a predictive asset analytics solution, the user first identifies which assets to monitor based on criticality, equipment history and site goals. Implementation can be conducted in phases, and assets that have had continuous problems, directly impact availability or are likely to have a quick return on investment may be modeled first.

Additionally, because PRiSM uses existing real-time and historical sensor data, special instrumentation is not required. The ability to gain added value without requiring additional instrumentation and extensive programming experience helps to validate the business case against other predictive analytics solutions that are usually more costly, invasive and take longer to implement.
Use Case: Early Warning of Equipment Failure

Predictive asset analytics solutions provide early warning of equipment failure and abnormal operating conditions that may go unnoticed with other maintenance practices. For example, consider a 110MW steam model turbine with seven bearings (including generator bearings). According to the maintenance records for this asset, over a one year period this turbine demonstrated sporadic isolated issues, followed by an escalating condition that eventually resulted in the shutdown of the unit. The maintenance personnel identified turbine bearing vibrations and took corrective action. Upon completion of the maintenance, a similar cycle of sporadic issues began again, in addition to the introduction of new problems.

This unit’s raw historical data was played back over the same period, and the data was sent to PRiSM. The results were substantial; had a predictive asset analytics solution been in place, plant personnel would have received early warning that turbine thermal expansion issues were developing and becoming chronic over the year. The APR model was able to detect the fault patterns with early warnings apparent six months prior to the failure. The model showed that the bearing vibrations were a symptom while thermal expansion issues were the primary cause. Initial maintenance would have corrected the thermal expansion problem before it led to bearing vibration issues and shutdown of the unit, providing significant savings on maintenance costs as well as increased unit availability. Estimated savings were in the millions of dollars, taking into account 35 days offline and associated maintenance costs.

Figure 1 is an Overall Model Residual trend, which represents the total deviation from predicted operation of the asset, demonstrating how engineers would have identified the ongoing problems with this turbine. This trend highlights the deviations between predicted operation and actual performance, making it apparent that an early warning provided by the software could have diverted the unit shutdown. In particular, the software would have identified the increasingly deteriorating conditions that caused a forced outage in April (followed by the subsequent issues the remainder of the year), and the operating crew would have been able to take action that would have abated, or completely avoided, the unit shutdown (with associated loss of availability and increased maintenance costs).
Conclusion

Predictive asset analytics solutions help grid operators, systems engineers, controllers, and many other plant personnel to take advantage of the massive amounts of data available today and use it to make real-time decisions that have a significantly positive impact on reliability and performance. Advanced pattern recognition software provides early warning detection and diagnosis of equipment problems to help personnel work more effectively by providing early warning notification and allowing more lead time to plan necessary maintenance, ultimately avoiding potential equipment failure and improving performance.

Power generation and delivery utilities can transform their maintenance strategies by leveraging data and predictive asset analytics solutions to spend less time looking for potential issues and more time taking actions to get the most out of every single asset. Using Avantis PRiSM predictive asset analytics software, power utilities can monitor critical assets to identify, diagnose and prioritize impending equipment problems — continuously and in real time.

For more information about Avantis PRiSM software, please visit [software.invensys.com/avantis](http://software.invensys.com/avantis)
References
