



Equipment Reliability: Basics Matter Now More Than Ever

How changing operations and market dynamics put a renewed focus on cost-efficient plant-wide reliability



GE Digital



UTILITY DIVE

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DESPITE A GLOBAL REDUCTION IN ENERGY USE IN 2020, A DECADE-OLD TRANSFORMATION OF THE POWER SYSTEM TO INCLUDE MORE INTERMITTENT RENEWABLE GENERATION HAS CONTINUED TO GAIN MOMENTUM.

A recent report by the International Energy Agency (IEA) found that 90% of new electricity generation installed around the world in 2020 came from renewables, while only 10% was gas and coal.

The report also forecast that generation from wind, solar and other renewables would replace coal as the world's largest power source by 2025, when it would supply one-third of the globe's electricity. In its most recent World Energy Outlook report, the IEA declared solar "the new king of electricity," thanks to supportive policies, technology advances, and sharp and continuing cost reductions. To survive and thrive, traditional generators are adjusting. And a renewed focus on plant reliability is fundamental to success.



Changed operations emphasize the importance of reliability

The implications of these accelerating changes on how fossil fuel power plants operate are profound. They underscore not only the increasing need to function in ways for which they weren't originally designed but also the vital importance of enhancing asset and plant reliability and availability. Rather than provide consistent baseload power, for example, many coal and gas power plants cycle often or operate in low-load or load-following modes in response to the increase in intermittent renewable generation.

These flexible operations can take a toll on the turbines, generators and other equipment that make up the power island of plants originally built for baseload operation. For example, metal components can weaken and fatigue when temperatures fluctuate inside a turbine. These new modes of operation can make equipment more vulnerable to breakage and outages when maintenance can't ensure reliability.



Careful maintenance of this core equipment is critical — it is often covered under a monitoring contract with the equipment supplier. But plant outages and unnecessary equipment maintenance costs are just as likely due to faulty reliability of balance-of-plant equipment. New operating models bring additional risk to these assets. Traditional time-based maintenance attempts to balance risk and cost were based on well-defined usage patterns. Today's new operating conditions demand a more intelligent, dynamic and real-time assessment that only predictive analytics and maintenance strategies can provide.





Gas Combined Cycle

- Gas and Steam turbines
- Generators
- HRSG
- Condenser
- Condensate pump
- Boiler feed pump
- Auxiliaries
- Accessories and skids



Steam

- Steam turbine
- Pulverizer
- FD Fan
- PA Fan
- Air heaters
- ID Fans
- Generator
- Condenser
- Condensate pumps
- Boiler feed pumps
- Feedwater heaters

The question is this: What can power plant owners and operators do to make their fossil fuel power plants more reliable and available? And how can they cost-effectively manage those moving toward retirement? If anything, reliability is only becoming more important for utilities.

For example, 19 states and Washington, D.C., have either implemented or considered performance-based ratemaking. Unlike the traditional cost-of-service approach, ratemaking tied to performance determines utility rates of return based on a company's achievement of defined metrics, including reliability.



Room for reliability improvement

One important measure of plant reliability excellence is EFOR (equivalent forced outage rate), an accepted industry benchmark for reliability and operations and maintenance (O&M) costs. The financial implication of unplanned (forced) outages can be severe. The Abnormal Situation Management (ASM) Consortium, a research organization, found that unexpected disruptions result in \$10 billion in lost production each year.

According to the North American Electric Reliability Corp.'s Generating Availability System, the 2019 EFOR for all fossil fuel generating units was 12.97 — meaning that **13% of planned operations were interrupted by unplanned downtime**. At 4.68, combined cycle units had far less forced outages than average, though gas-powered units were significantly higher overall, at 22.67.

For a utility, forced outages can mean purchasing expensive electricity to meet demand that it expected to cover with a generator that is no longer operating. Unplanned outages can also trigger fines for not delivering expected capacity to the market. While EFOR is critically important for many power plants, startup availability is essential for peaker plants that earn the bulk of their revenue in shorter windows of time, when electricity demand is high.



The importance of predictive maintenance software and analytics to bolster reliability

Achieving exceptional reliability is complicated by the fact that investments in the power sector have declined as energy consumption has fallen. According to the IEA's "World Energy Investment 2020" [report](#), 2020 will see a 10% reduction in capital spending in the power sector.

A recent [analysis](#) by Boston Consulting Group (BCG) offers suggestions for how to create value in the power and utilities sector given the rise of renewable energy, declining revenue and the ongoing effects of COVID-19. The analysis was based on research that included a survey of 53 power and utility companies around the world, including fully regulated and semi-regulated utilities as well as transmission and distribution grid operators.

BCG concluded that, over the short term, conventional generation assets may face maintenance disruptions because of investment



constraints while, over the long term, utilities need to focus investments on extending the lifespan of their power plants.

One way to increase the lifespan and gain a long-term competitive advantage is to use digital tools to drive down O&M costs. "By combining their data with advanced analytics, companies will be able to unlock greater efficiencies and strategic insights," BCG analysts wrote. "Data-driven solutions and intelligent sensors will enable companies to carry out predictive maintenance, provide remote technical support and inspections, and protect themselves from cyber attacks." The World Economic Forum backs up BCG's prioritization of digital tools. The group issued a [report](#) that calculated that **the use of digital technologies to optimize utility assets could generate \$387 billion in new value over a decade.**





To be clear, the potential benefits of predictive maintenance are enormous. Plant operators can now tap into data from asset sensors, enterprise asset management (EAM) and information technology (IT) systems to monitor power island and balance of plant equipment health in real time. Plant operators can use this data to predict and prevent unplanned outages and prioritize maintenance activities in ways that align with a utility's business objectives.

A move from traditional time-based O&M toward digitally enabled predictive maintenance improves reliability and lowers O&M expenses.

In fact, a report issued by the U.S. Department of Energy (DOE) found that predictive maintenance has the potential to

- **Reduce maintenance costs 30%**
- **Slice downtime 45%**
- **Increase production 25%**
- **Reduce equipment breakdowns 75%.**





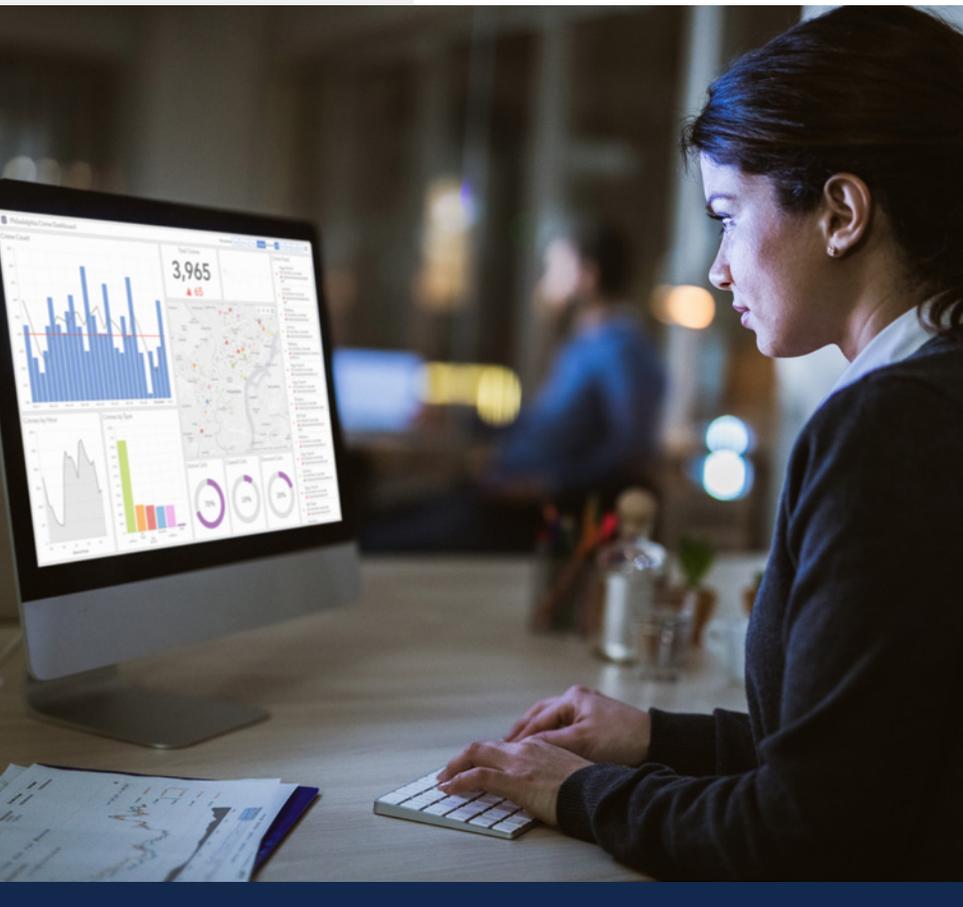
Asset performance management is key to predictive maintenance

In recent years, asset performance management (APM) has emerged as an important tool to bolster the reliability and performance of physical assets, including power plants.

In fact, research company Gartner estimated that by 2020, 60% of asset-intensive organizations would depend on APM, software that combines data capture, integration, visualization and analytics.

GE Digital is a leader in APM software, with a comprehensive solution for asset health, reliability and overall O&M planning and execution. Core to GE APM are the use of predictive analytics based on digital twin technology, and the support of standard workflows for efficient and effective O&M execution.





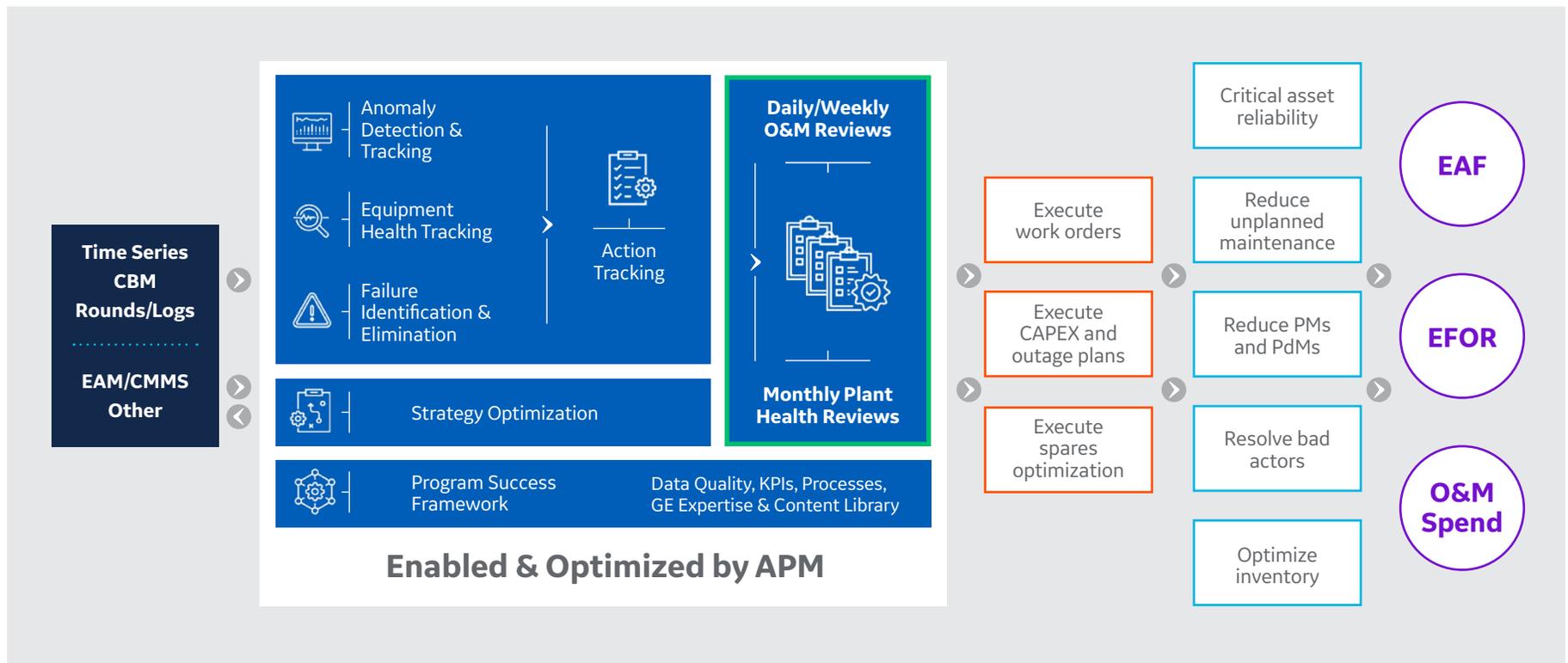
Among the features of GE APM that enhance and improve equipment reliability and O&M workflows are:

- **Centralized data collection and use.** Equipment reliability and effective O&M depend on data from many sources, such as sensors, historians, operator rounds and EAM/CMMS systems. GE APM brings this disparate data together and uses it to power predictive analytics, asset health dashboards, root cause analysis, maintenance strategies and other tools that ensure reliability.
- **Predictive and diagnostic analytics via digital twins.** The core of predictive maintenance is analytics. APM includes access to digital twin analytics, which provide strategies and content to efficiently maintain hundreds of common plant assets. Digital twin analytics are predictive and diagnostic, meaning that they both identify anomalies before they become a problem and provide solutions to address any issues. These features lead to streamlined troubleshooting and repair when issues are identified. Digital twins are built and continuously updated by leveraging GE's decades of manufacturing, maintenance and services experience.



- **Reliability analysis tools.** Predictive and diagnostic analytics cannot always identify the cause of underlying or chronic equipment issues. That's why APM includes a comprehensive toolset to support reliability engineers as they diagnose and remediate issues, identify and apply new preventive measures, uncover bad actors and perform in-depth plant reliability analysis.

- **Complete toolset and workflows for condition-based maintenance.** APM analytics are integrated into a comprehensive set of functions that include alerting, analysis, action assignment and tracking, and case management. In turn, these functions are an integral part of APM workflows that span all aspects of equipment monitoring, maintenance execution, strategy planning and overall plant O&M activities.



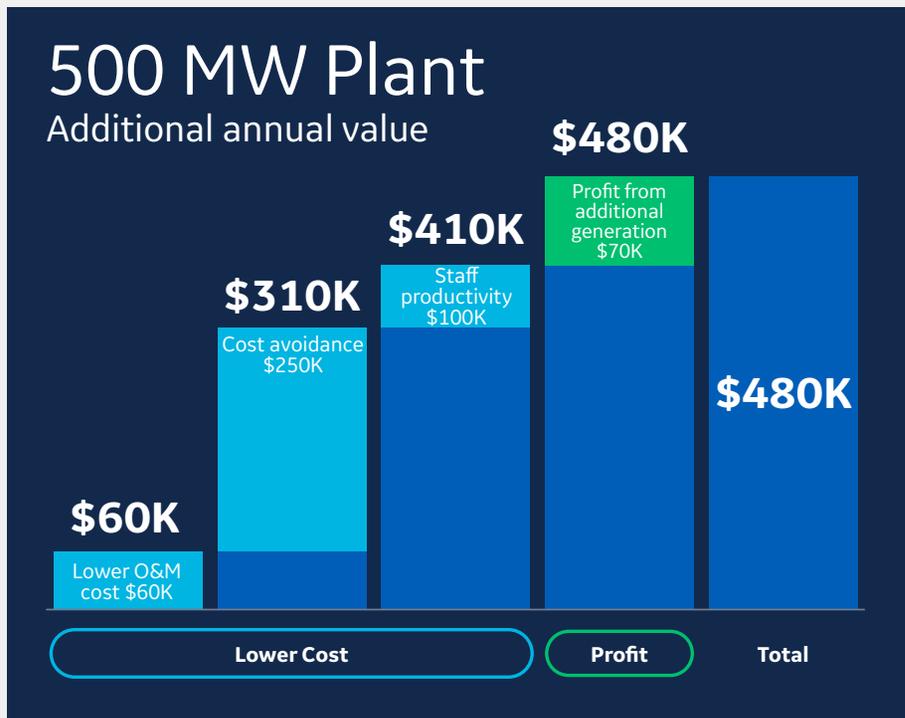
- **Optimized operator rounds.** The role of manual data collection and readings from equipment remains an important part of maintaining reliability. GE APM provides a complete Rounds solution and mobile application that manages route scheduling and automates data collection for use in predictive analytics and overall asset health tracking.

- **Industrial managed services deliver simplicity and guidance.** With an array of offers from turnkey APM-based asset reliability services to product guidance and O&M best practices, the GE Digital Industrial Managed Services team can help you meet your reliability goals.

GE Asset Performance Management (APM)

is a sophisticated suite of software and digital twin analytics that help power generators **increase asset reliability, plant availability and O&M efficiency.** Leading generators around the world depend on APM as the backbone of their operations.





O&M cost reduction (\$60k/yr.)

O&M cost reduction due to shift from calendar to condition-based maintenance, leveraging health indicators, Reliability analytics, rounds and dashboards

Unplanned maintenance cost avoidance (\$250k/yr.)

O&M cost avoidance due to predictive analytics with pre-built content and delivered via managed service

Improved profit opportunity (\$70k/yr.)

EFORd improvement due to less unplanned downtime from predictive analytics

Staff productivity (\$100k/yr.)

Digital rounds, automated dashboards, reliability analytics and data reporting (GAA, lube oil, ...)

Assumptions: 500MW plant running at 80% capacity; Spark Spread of \$7 USD. Based on GE customer results using APM Health & Reliability modules

Predictive maintenance enabled by APM can increase reliability and plant availability while lowering O&M costs.

Research firm IDC reported that implementing an APM solution could lower maintenance labor costs 15% to 20%, improve asset availability 20% and elevate mechanical efficiencies up to 10%.

GE customers that have implemented APM have seen significant results. For example, at one 500-megawatt plant, the customer reduced O&M costs \$60,000 per year by moving from time-based to condition-based maintenance and leveraging analytics and equipment-health indicators. The customer also avoided \$250,000 in unplanned annual maintenance, improved profit opportunities by \$70,000 and elevated staff productivity by \$100,000 per year.



A photograph of a male worker in profile, wearing a white hard hat and an orange safety vest over a white shirt. He is holding a laptop and looking towards the left. The background is a blurred industrial power plant with several tall, cylindrical structures under a clear blue sky.

As the power system continues to evolve and change, power plant owners and operators will face greater reliability challenges. But like power generation strategy — which increasingly operates existing equipment under new conditions — reliability today involves effectively harnessing the old and the new. By combining the workflows and fundamentals that have always been essential to reliability with advanced software and analytics that monitor all of the components of a power plant, traditional power generators can become more reliable even as their operations change.

A renewed focus on the basics of plant reliability augmented by sophisticated software helps achieve high levels of reliability and profitability in a challenging operating environment.





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