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WHITEPAPER

Maximizing power generation

Improving reliability and asset performance
with real-time condition monitoring

Executive summary:

Power generation companies see the value in moving beyond traditional time-based maintenance and leverage condition-based maintenance (CBM) to lower maintenance costs and improve asset reliability and availability.

Overview

The power-generation industry is changing rapidly. Driven by industry deregulation, increased adoption of renewable energy sources, and a new emphasis on extending facility life cycles, electric-utility operators must carefully consider how to maximize resources and optimize operations.

Some plant operators choose to respond to these new pressures by focusing on a new, more efficient maintenance strategy: condition-based maintenance. CBM goes beyond calendar-based maintenance schedules to focus on the asset's actual condition using real-time operations data. When companies leverage CBM, they eliminate unnecessary maintenance, detect and mitigate potential failures before they happen, and increase reliability and availability of resources.

The real advantages of implementing CBM go far beyond lower maintenance costs. Performing maintenance at exactly the right time can play a critical role in ensuring overall fleet availability while reducing downtime costs and meeting regulatory requirements. By tracking asset health in real time and predicting outcomes, CBM can help electric utilities minimize outages and equipment failures while reducing the risk of generation losses and fines associated with schedule deviations.

In deregulated markets, utilities can leverage these new maintenance strategies to avoid losing real-time revenue streams and minimize the costly practice of procuring replacement power from competitors. By connecting real-time asset data and calculated values to work-management and materials-management programs, such as SAP Plant Maintenance and IBM Maximo, CBM can help optimize maintenance activity and better manage capital investments.

This white paper examines the challenges that electric-utility companies face and the pressures that drive demand for more proactive maintenance strategies. Next, it will outline how CBM specifically affects solar, wind, and thermal power plants and how it promotes more efficient and effective outcomes compared to planned-maintenance methodologies. This paper will also demonstrate how electric-utility operators are using CBM in concert with the PI System, a real-time data infrastructure that collects and manages operations data from both fixed and mobile assets.

New market challenges increase pressure on electric utilities

Experts predict that electric utilities will change more in the next ten years than in the past hundred. This is hardly news to power plant operators. Industry headlines are filled with topics ranging from alternative energy to smart grids, microgrids, distributed generation, electric vehicles, climate change, and customer preferences. While maintenance and asset health do not attract the public's attention, a growing number of asset managers realize that new maintenance strategies play a critical role in equipping utilities to meet today's unique challenges.

The following three major trends demonstrate that the value of CBM lies not just in lower maintenance expenses, but extends to higher asset availability, reliability, and effectiveness. Moreover, by shifting from reactive to proactive strategies, companies will use data and subsequent insights to drive action far beyond simple equipment maintenance. When plant operators leverage real-time asset data in conjunction with other forms of operations data, they can create a single source of truth to develop new asset-maintenance strategies. Such initiatives include planning capacity, developing market strategies, linking to ERP/EAM/CMMS or workflow management, and reducing overall utility costs.

Deregulation

Utilities operating in deregulated markets subject to competitive pricing often pay a heavy penalty for asset failure. Every operator's primary concern is ensuring that plant resources are available at all times to maximize revenue from open-market sales and avoid expensive energy purchases to meet contract obligations. This critical need for high availability demands new approaches to optimizing asset health and tracking maintenance needs.

Sustainable energy

Growing interest in carbon-free energy conversion and resulting electricity production is driving many electric utilities to add alternative energy sources such as solar, wind, and geothermal power to fleets. Given the variable performance of sustainable power sources dependent on weather conditions, operators must maintain a diverse combination of them across their fleet in order to meet demand. Plant operators must also constantly be aware of both the condition and availability of assets to perform this task reliably.

Extending plant life

Building new power plants is expensive. In an era of rapid technology change, electric-utility owners may be especially reluctant to add more capacity. Extending the plant's lifespan through the use of more proactive, or even predictive, maintenance strategies can give utilities more time to consider options without hefty infrastructure costs. In addition, almost all lifespan extension business cases benefit from the use of real-time condition monitoring compared to engineering calculations alone. In fact, most regulations governing lifespan extension requests require real-time condition monitoring. This is especially true for nuclear power plants.

Driving capital efficiencies through maintenance strategies

Studies show that the average power or utility plant spends more than 55% of its maintenance budget on highly expensive, reactive, run-to-failure strategies in which maintenance occurs only after an asset fails. In contrast, top-tier industry plants that utilize predictive technologies and proactive practices spend less than 10% of maintenance budgets on reactive strategies.

Alternative, more proactive maintenance strategies use complementary corrective, preventive, and predictive processes. These strategies leverage dynamic, real-time online asset monitoring using wireless sensors and other technology. This enables subject-matter experts, consultants, and OEMs to analyze data for CBM to maintain assets such as turbines, pumps, or condensers, or use predictive models to more accurately estimate asset life cycles. Predictive maintenance gives operators more time to plan capital expenditures and maximize availability.

Today, leading utilities continue to leverage real-time and historical data collection and advanced analytics to expand the adoption of CBM processes to drive down the high cost of reactive maintenance strategies (see Figure 1 on next page). CBM is generally defined as a set of maintenance processes guided by collection of data on utility assets to ensure that maintenance is performed only when needed. Unlike calendar-based maintenance strategies, CBM leverages asset data to reconcile maintenance schedules with real-time asset conditions, organizational priorities, and changes in the operating environment.

Effectiveness-efficiency

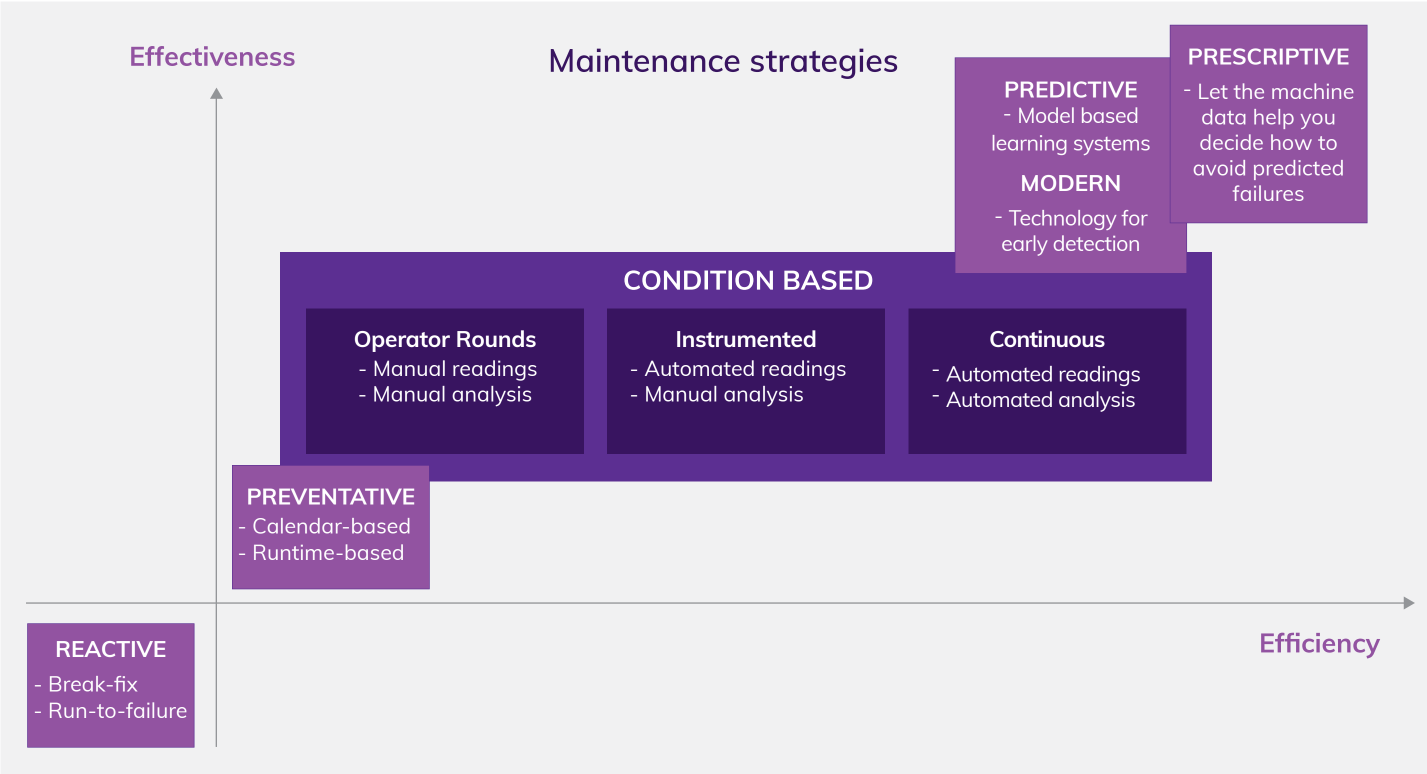

Figure 1: New maintenance strategies offer more efficient and effective alternatives to reactive approaches.

A CBM program begins by monitoring asset parameters, then evaluating these parameters in relation to limits, trends, and other asset data. Eventually, a successful CBM strategy ties real-time data to comprehensive work-management solutions.

When applied properly, CBM implementations offer several advantages over calendar-based maintenance plans, including:

- Reduced capital costs by extending asset lifecycles.
- Lower maintenance costs because equipment that is operating well is not repaired or replaced.
- Better asset reliability through early detection and more rapid response.
- Improved asset availability.
- Minimizing lost production time and outages by better predicting asset failures and end of life.
- Optimized maintenance intervals and prioritization based on current health and risk.
- Improved spare-equipment and spare-parts management.
- Introduction of failure-finding tasks for protected devices.
- Asset-performance management (APM), asset-replacement planning, annual charge adjustment (ACA).

Uniper: Predictive maintenance reduces CAPEX

In the world of energy generation, equipment failures are dangerous events that result in unplanned outages and leave customers out in the cold. Discovering performance issues across a wide range of assets before they become catastrophic is no small feat. For Uniper, predictive maintenance strategies and CAPEX planning held the key to future success.

Uniper migrated all its sensor data into one PI System and standardized all data streams into a single data model using Asset Framework (AF). In addition, teams installed smart sensors and mobile solutions to bring old power plants online. After standardizing KPIs across the organization, Uniper was ready to optimize maintenance.

Relying on PI System data, Uniper loaded the maintenance strategy for each piece of equipment into its tool for maintenance-strategy planning (MSP). This information included age, reliability needs, and live risk. Real-time asset data is streamed into the PI System and combined with commercial data from Uniper's data lake to map overarching power plant strategies.

Uniper configured 100-150 components that are major CAPEX drivers, including capacity and maintenance needs, to create baselines for every asset. The team defined drivers, such as time-based or operating hours, while historical data supplied maintenance time and cost. Now, Uniper plans which assets must be maintained at specific times using operating hours in MSP and PI System data.

Thanks to the PI System, plant managers are bundling maintenance needs, efficiently planning downtime, and changing maintenance strategies to ensure that the company is getting optimal lifetime out of its equipment. As a result, Uniper has reduced CAPEX planning by 16%.

Faster detection enables rapid action

How do CBM and proactive maintenance strategies contribute to higher availability? In strategies for calendar-based maintenance, asset replacement or repair is driven by vendor recommendations or internal experience. These recommendations have historically been time-based. If an asset's life cycle runs outside the historical projections, utilities and power-generation facilities run the risk of increasing costs by replacing or repairing the asset too soon or, worse, too late. A catastrophic failure can cause anything from a safety issue to a major system outage.

When an organization begins collecting real-time data for specific equipment parameters, the actual condition of the asset is always known and validated. In proactive maintenance strategies, real-time asset behavior and context drives maintenance requirements. Condition monitoring is performed while the asset is operating, enabling managers to detect an impending failure and plan accordingly.

The P-F curve in Figure 2 shows typical asset behavior as it nears failure. Point P represents the first possible point on the curve when performance deviations can be detected. By monitoring and intelligent filtering, any number of asset characteristics – such as a slight change in temperature, a higher-than-normal vibration, or a change in power usage – can be tracked. The F point represents the time of equipment failure. The time between those two points is the opportunity window for the organization to proactively prevent failure. Earlier detection on the P-F curve means more time for maintenance personnel to replace the asset, order parts or labor, or schedule an outage before the equipment fails.

In any facility, unexpected failures are the most catastrophic. Not only do failures present the greatest risk to availability, these failures are also the most expensive to repair. In a CBM/proactive system, early detection of performance degradation not only reduces or eliminates the unexpected and unplanned costs associated with a reactive-maintenance approach, but plant personnel also have more opportunities to plan maintenance activities and manage costs.

Moving left up the curve (things you can do with the PI System)

- Rate of change
- Actual vs. design
- Pattern recognition alarm
- Efficiency
- Count and rate of operations
- Operation limits (maximum T, vibration, or load)
- Dynamic threshold hi/lo limit notification

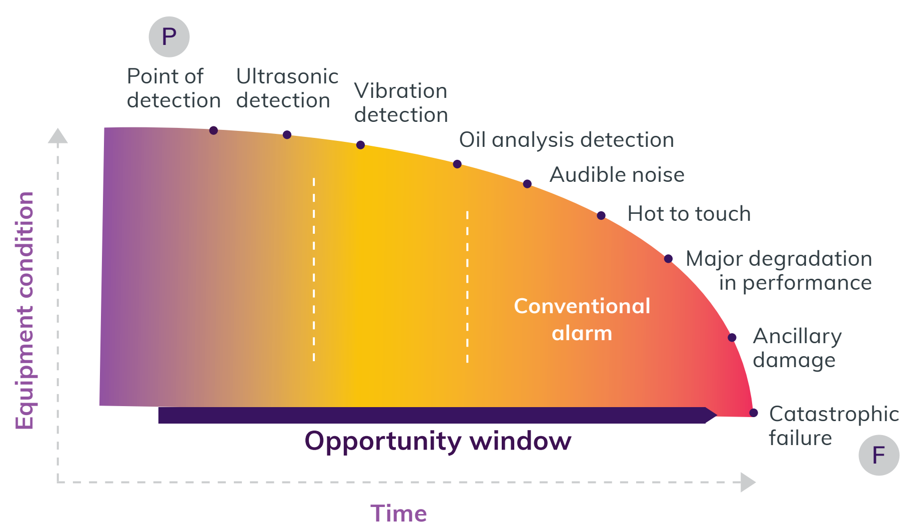

Figure 2: Initial failure detection depicted on a curve. The earlier point P occurs, the more time plant personnel have to solve the problem.

Organization-wide impact starts with condition monitoring

The core of CBM is real-time condition monitoring. This strategy supports preventative maintenance, the sweet spot of the PF curve, and can determine the overall health of assets. While condition monitoring does not require complex analyses or models, the benefits are great.

Maintenance personnel collect multiple pieces of data from an asset, analyze the data by looking at rates of change or comparing values to a norm, and create an algorithm for a group of assets based on multiple indicators. From there, personnel can calculate a health score for each asset based on how its rates compared to other pieces of equipment in its peer group.

By comparing maintenance histories of similar assets, plant operators can make confident, data-driven recommendations that reduce inventory costs, prevent overservicing, and improve overall operational variability.

Real-time operations-data collection can be highly useful not only for maintenance programs but also for guiding future capital expenditures or defining work-prioritization schedules.

Ultimately, early equipment-degradation detection can help utilities avoid going offline and reduce the risk of a forced outage or derating, as well as subsequent fines for schedule deviations. In unregulated markets, it can help utilities avoid buying expensive replacement power to meet commitments.

With industrial data-management software, such as the PI System, utilities can further use model tools for advanced pattern recognition (APR), developed by third parties, to leverage the data collected by real-time systems. By automatically analyzing large amounts of data, these APR tools can reduce the need for manual monitoring, detect anomalies in critical equipment very early in the performance-degradation process, and help support operations by avoiding equipment failures and optimizing maintenance schedules.

CBM/proactive maintenance strategies can be easily scaled from pilot projects and individualized pieces of equipment to fleetwide implementations. The PI System's highly scalable infrastructure, for example, enables plant operators to integrate fleet-maintenance requirements into corporate management systems such as SAP's PM or IBM's Maximo.

Vattenfall Hydro: From static to dynamic maintenance strategies

Vattenfall Hydro is the third-largest hydro power provider in Europe. The company has leveraged CBM for 15-20 years, but the company relied on an old system that used static data based on periodic inspections, tests, and a historian. Information was not available in real time, so Vattenfall's maintenance practices were often reactive. The company needed to move to a real-time condition-monitoring solution to reduce operational costs.

The company piloted a PI System project to capture data from modern DCSs, analog DCSs, a dam-instrumentation system, and a vibration monitoring system. In addition, Vattenfall imported its existing Conwide maintenance data into the PI System.

With this information, the Vattenfall team began performing trend analysis on approximately 25 basic conditions for each unit. The team used Asset Framework templates to perform trend analyses and create new elements. Operators now visualize operating conditions using PI Vision and receive email notifications if a unit is performing outside of set parameters.

Not only was the pilot program a huge success, the PI System also successfully replaced Vattenfall's Conwide maintenance system. Early projections indicate that Vattenfall will reduce overall maintenance costs by 1.5% by minimizing unplanned maintenance events.

CBM enables renewables to tackle difficult challenges

Renewable-energy adoption is skyrocketing. As demand increases, so does infrastructure, creating new and unique challenges for renewable power operations. CBM strategies not only pave the path to higher availability, these strategies also create a road map for a more sustainable future.

Preventing catastrophes at solar power plants

The electricity generated from photovoltaic energy systems is an important renewable energy source. However, capacity is not constant or predictable, due to the stochastic nature and behavior of solar radiation. A photovoltaic system is made up of many components and reliability is related to aspects such as temperature or power losses. However, integration of photovoltaic generation within the energy-distribution network must be considered. Events such as the appearance of reverse power flow can cause voltage spikes that can affect the installation, activating protections or causing disconnects and stoppages. CBM is critical for solar power not only for system control but also for security.

Many solar plants rely on corrective maintenance, or a leave-it-until-it-breaks approach. No action or effort is considered that maintains the equipment as detailed by the manufacturer and that is not a matter of extending its life. However, many plant operators are moving toward preventative maintenance, which focuses on maintaining and extending asset life.

Beyond preventative maintenance, predictive maintenance detects the appearance of system degradation before catastrophe strikes, enabling solar plants to take corrective action. With predictive maintenance, solar plants can reduce corrective maintenance from 60% to 20%, saving up to 50% on total maintenance costs.

While predictive maintenance is the goal, hurdles to adoption exist. Often, solar plants lack procedures for plant maintenance or the support systems necessary to aid in decision-making, or are unable to take action using operations data due to the sheer volume and number of data formats. By creating a dedicated team of professionals to implement accurate methodology and applying CBM to the most critical assets, solar-power plants can overcome hurdles associated with the maintenance strategy. Once the methodology is implemented, the work must be properly used and integrated into the management systems.

In the case of photovoltaic solar plants, CBM should be applied, as a minimum, to the inverter and the transformation center. These are both highly critical and highly complex and have a high number of failure modes that can reach the systems for the PV solar plant.

Driving wind farm maintenance efficiencies

Wind farms consist of large-scale rotating equipment often located in remote areas. Assets are expensive, and the cost of a single wind turbine, as of 2020, is approximately $1.3 million per megawatt (MW). A typical turbine capacity is 2 to 3 MW, and O&M costs are estimated at $42,000 to $48,000 per megawatt per year. It is estimated that unscheduled corrective maintenance for offshore turbines accounts for 66% of total maintenance budgets. While maintenance costs are high, the cost of failure is even higher. Power companies must detect potential problems and take action before a failure occurs.

Often, when a wind turbine fails, a crane is deployed for maintenance. Given the remote nature of wind turbines, crane deployment is expensive and time-consuming, especially for offshore turbines. With CBM strategies, wind farms can easily see whether any other components are near end of life and maximize each crane deployment. Often, such efforts can save as much as $100,000.

In addition to crane deployment, CBM can monitor rotating parts of wind-turbine generators to ward off bearing and component wear and prevent unplanned maintenance. This attention includes:

- Oil analysis
- Vibration analysis
- Alignment
- Ultrasound
- Infrared thermal imaging

Thanks to low-cost wireless sensors, CBM has become a more affordable solution for wind farms. As real-time asset data from multiple points informs maintenance strategies, wind farms can operate more efficiently and take preventative action before a catastrophe occurs.

Comprehensive maintenance insights in thermal power plants

Thermal power plants, whether fired with coal, natural gas, or nuclear reaction, are under tremendous financial pressure from renewable generation, microgrids, and distributed generation. Moving up the maintenance hierarchy from reactive to predictive maintenance can yield significant O&M savings for a conventional power plant.

Outside of efficiency improvements, which are often hard and or expensive to realize, O&M and inventory costs are the major controllable expense at thermal power plants. These costs can run from around $10 million at a small combined cycle plant to well over $100 million at a nuclear site.

The ability to push back time-based maintenance and overhaul expenses on equipment operating acceptably can lead to millions of dollars of savings a year at large thermal power plants.

Items that can be monitored and analyzed in the PI System include vibration analysis, oil analysis, and parameter rate of change calculations.

The PI System aids this journey in many ways, from simple calculations to enabling complex AI-related analysis, including:

- Activating motor-startup and run-time counters with the ability to automatically link to a maintenance-management system.
- Bringing wireless sensors and other classic PdM tools into the PI System.
- Creating water-chemistry dashboards with notifications for various action levels.
- Running equipment-efficiency calculations (turbine, pump, fan, etc.) that guide maintenance toward equipment that is deteriorating rather than simply equipment that is next in line.
- Incorporating manual data (for rounds and oil analysis) and qualitative data (inspection reports).
- Establishing easy tie-ins to advanced pattern-recognition programs.
- Incorporating of high-speed vibration data and waveforms.
- Using PI Cloud Connect to send prepared data to big data-analytics providers.

Obstacles to CBM implementation

Power-generation companies considering implementing CBM face several challenges. At the enterprise level, CBM typically requires data collection from disparate systems. Data must be consistently formatted, displayed, viewed, analyzed, and correlated. Data collected in real time must be time-stamped uniformly to correctly attribute it to specific events. Finally, users must have access to the right data to make informed decisions.

From there, an organization must define noncalendar logic to determine time to inspect or perform maintenance. In most cases, companies can lean on subject-matter experts or vendor information. The PI System provides a solid CBM foundation because most necessary measurement streams are already monitored. This includes equipment runtime since last maintenance, equipment starts and stops, and comparison with manufacturer specifications, as well as pump curves, turbine efficiencies, and more.

It is also imperative for power companies to create asset templates and hierarchies and align those to specific data points. Then, companies can build effective and accessible data-visualization strategies. Recent advances in CBM tools have simplified this task. For example, Asset Framework, the contextualization layer of the PI System, enables users to create templates across fleets, accelerating CBM deployment.

Successfully deploying CBM also requires a culture change, which can be one of the biggest challenges. Moving from an approach centered on calendar-based or reactive maintenance to one leveraging real-time asset data requires a significant initial setup. This is typically disruptive across the organization. Personnel in a variety of roles must participate in the implementation process, and getting everyone aligned and available at the same time can be difficult.

Often, PI System users have already laid the cultural groundwork by demonstrating value through improved equipment efficiency and reduced energy usage. From there, using the PI System for CBM is a natural next step.

Before the transition begins, however, management must instill faith in new systems across the organization. Typically, a CBM program affects a wide range of assets, and there is no single solution for one asset type. The prospect of making such a wholesale transition can seem overwhelming to many workers. Some managers overcome this concern by starting a CBM implementation with just a few critical assets. Power utilities can use the PI System to develop leading indicators, understand the value of the system, and use the inherent scalability to expand CBM to other areas of the enterprise.

Finally, before implementing CBM, management should consider the following up-front costs and potential liabilities:

- Staff training costs.
- Equipment-monitoring and instrumentation costs.
- Older assets that might require modifications to retrofit the system with sensors.
- Fatigue or uniform-wear failures, which are not easily detected with CBM measurements.
- Unpredictable maintenance periods.
- Time required to perform a failure modes and effects analysis (FMEA) – identification of potential failures and mean time between failures (MTBF) for each key asset.

The PI System: From preventative to predictive

The PI System is an industrial data-management platform that enables users to analyze real-time and historical data to extract critical insights about asset health. By connecting disparate data sources, plant management, subject-matter expects, and engineering, operations, and maintenance staff have access to a single source of truth and can share information and insights across the organization. The PI System seamlessly manages the data-collection process, enabling engineers to spend their time analyzing collected data and making recommendations. Unlike tools that employ calendar-based inspections and periodic assessments, the PI System detects small but critical equipment changes so teams can quickly take action.

By using the PI System for CBM, power utilities gain multiple advantages:

- Using the PI System alters the procedure from a static, or periodic, assessment to an online, dynamic, real-time assessment of asset health.
- The PI System enables engineers to conduct streaming analysis and create a subsequent condition score.
- Engineers can create additional context by organizing real-time PI System data by critical events. They can also perform calculations and leverage analytics to derive subsequent insights. These events supplement this new, highly detailed data analysis (see Figure 3).

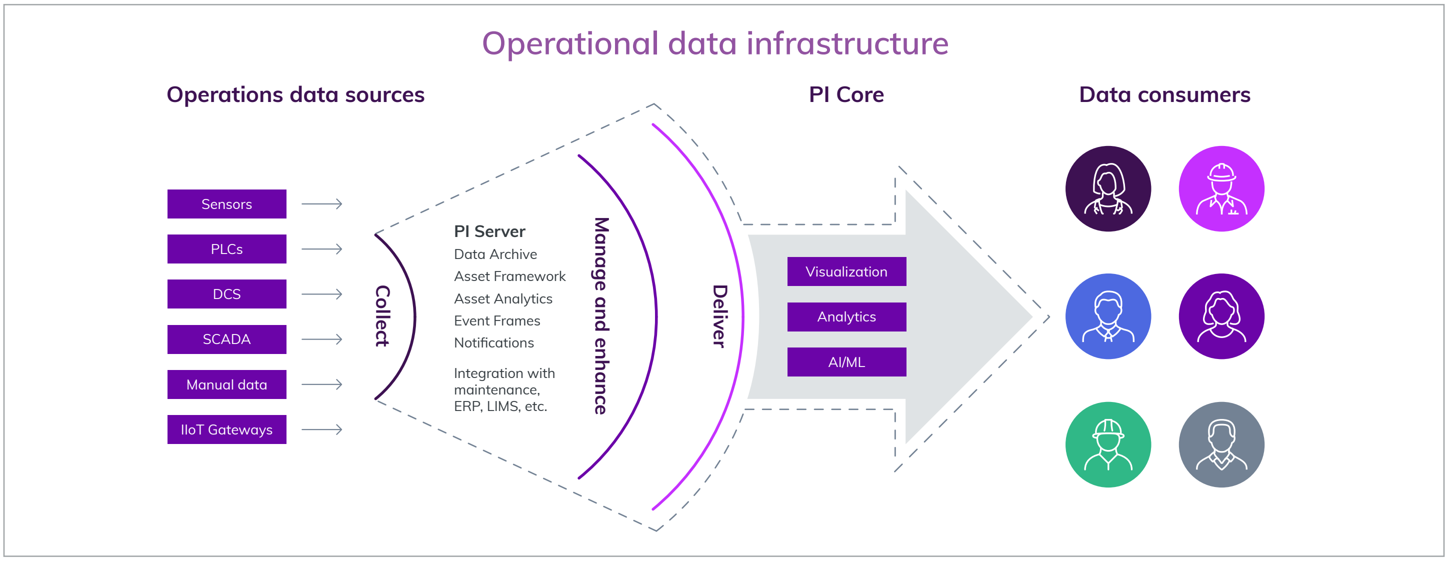

Figure 3. The PI Core software portfolio collects, enhances, and delivers real-time operations data in mission-critical environments.

Beyond real-time condition monitoring and preventative maintenance, the PI System lays the groundwork for future predictive maintenance strategies. Users can leverage historical and real-time asset data from the PI System to train artificial-intelligence (AI) and machine-learning (ML) models. Asset Framework provides necessary data structure and context, while PI Connectors and interfaces ensure a seamless data transfer to any external solutions. Once users leverage AI/ML tools to determine maintenance predictions, those predictions can be visualized by operators or maintenance staff directly within the PI System. Not only do these predictions offer unprecedented situational awareness, but teams can also easily see – and mitigate – potential catastrophic issues while optimizing asset availability. Power-generation suppliers use the PI System to better manage entire fleets of generator units, including reducing forced unit outages. A tiny decrease in forced outages can increase margin by millions of dollars. In addition, converting other forced outages to planned outages further increases margins by allowing the outage to be scheduled during a lower margin window.

Key PI System components for CBM

PI Interfaces and PI Connectors are a foundation of the PI System infrastructure and provide a standard mechanism for collecting time-series data and asset metadata from disparate data sources. The PI System supports more than 400 standard interfaces and a growing number of connectors.

Power-generation plants can use PI Interfaces and connectors to link to data sources such as DCS, supervisory control and data acquisition (SCADA) systems, and energy-management systems, sensors, servers, applications, networks, and other databases.

Capabilities include:

- Efficient, secure, and real-time data management from a variety of sources.
- Standardized and centralized data accessible across the enterprise.
- Numerous ways to display asset-health information, including custom dashboards and visualizations.
- Performance trending and analysis to determine each asset's maximum capacity.
- Organization of data streams and related processes through Asset Framework, giving critical context for future analysis.
- Conversion of raw data streams into meaningful events through Event Frames.
- Predictive warning notifications send alerts, enabling rapid response.
- Data served up to other advanced analytical tools and engines.
- Integration of business and operational systems to connect employees, business partners, suppliers, and markets.

Australian Gas Light: Democratizing predictive insights

Australian Gas Light (AGL) Energy was completely data blind and had no access to real-time data. That needed to change, so the company deployed the PI System to connect to all controllers and make real-time data available to everyone across the organization. After a single day of training, employees across the company were building displays, alarms, screens, and more. In just three months, AGL saw a 7% lift in the availability of its hydro units.

However, AGL was not content with real time; it soon moved to predictive modeling. Employees built 2,700 models to monitor 45,000 critical data points every five minutes. ECG Predict-It, a PI System partner solution, correlates incoming PI System data with historical data. When correlations vary, the team knows something is amok. While it cost $1.2 million AUD for initial setup and $620,000 AUD in annual operating costs, AGL quickly recouped a massive return on investment.

In the first three years, AGL saved $18.7 million AUD in reduced forced outages and optimized maintenance. But that was not all. In 2017, the company caught and prevented a catastrophic failure in a 560 MW hydrogen-cooled stator. PI System alarms informed the team that hydrogen exit temperatures were abnormal. The unit was inspected, but no one could identify the issue. After a recalibration, the data showed the problem was getting worse.

The team partially dismantled the unit and found that they were just a few short days away from a number of coils catching fire. Thanks to predictive insights from the PI System, AGL saved $50 million to $70 million AUD by preventing the catastrophic outage.

Storing, managing, and enhancing data

The on-premises software product, PI Server, includes several components specialized for managing industrial data.

Data Archive, an essential PI Server component, receives, archives, and distributes real-time and historical process data from operations and other sources. By organizing streams of business-critical data into a single comprehensive format, PI Server enables plant managers and executives to maximize plant productivity and efficiency and more accurately plan future business operations.

Asset Framework enhances data comprehension through a consistent naming convention or representation that can all PI System users understand. Asset Framework specifies each asset and its attributes in an easy-to-navigate infrastructure for accessing data, naming assets, and defining processes for an entire organization, ranging from the fleet level down to individual pieces of equipment. The use of standard templates simplifies the definition and addition of models, assets, processes, and calculations to the framework (see Figure 4).

Asset Analytics allows consistent equations, counters, and calculations to be applied to similar equipment across a generating system. Analytics can be simple, like counting starts on a 4-kilovolt motor, or more complex, like equipment-efficiency or system-efficiency calculations.

Event Frames automatically bookmark process events, and PI System data is related to a specific asset and related condition. Each event frame has a start and end time, enabling users to calculate the duration of an event and capture the associated data or condition.

Notifications leverages the flexibility of Asset Framework by allowing users to configure custom alerts based on any data source. With Notifications, users can configure the platform to send alerts whenever specified equipment exceeds preset parameters. Notifications can also integrate with line-of-business systems such as SAP or Maximo. With Event Frames and Notifications, one can automate condition detection through work-order generation for inspection or maintenance of an asset.

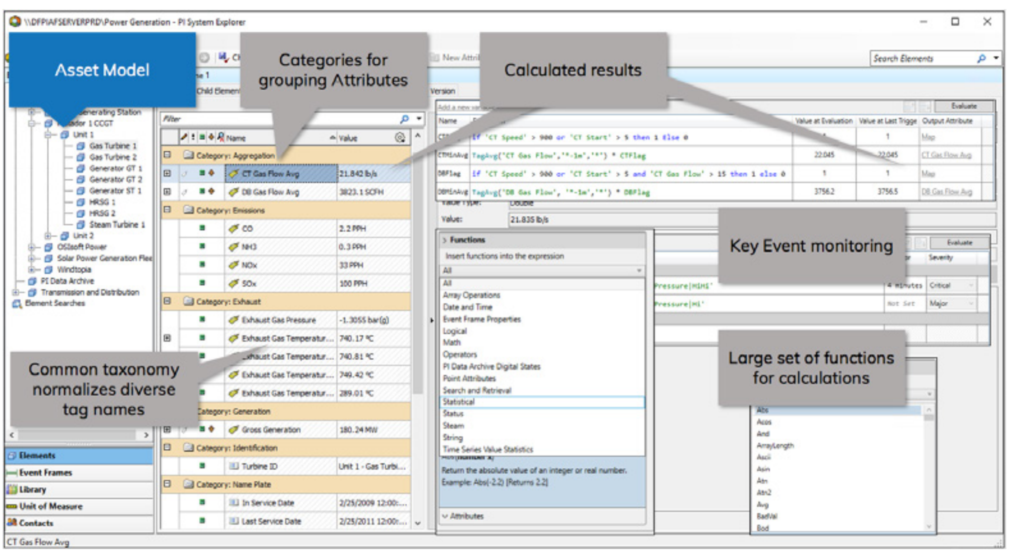

Figure 4. Asset Framework identifies organizational assets and equipment using a consistent naming convention

Data visualization and delivery

PI DataLink is an add-in for Microsoft Excel, enabling direct access to PI System data within a worksheet. DataLink enables the tools for gathering, monitoring, analyzing, updating, and displaying PI System data and events.

PI Vision is an intuitive, web-based visualization tool that delivers fast, easy, and secure access to all PI System data. Users gain insight into plant operations by creating interactive graphical displays or conducting ad hoc analyses. Users can create displays using either real-time or historical data residing in the PI System.

Figure 5. PI Vision display of wind turbine operations and asset health.

Conclusion: Maximizing today's resources drives future benefits

Today's power-generation market demands that electric utilities deliver high reliability, assured availability, and high efficiency – all at a low cost. However, many facilities still use multiple, disparate data systems, limiting visibility and leaving companies to rely on static equipment-condition assessments and reactive maintenance strategies. Reducing maintenance costs and preventing catastrophic failures hinges on proactive CBM-based techniques that leverage real-time operations data.

Not only can CBM reduce overall maintenance costs, it can also increase the efficiency of other operations processes across the enterprise. CBM data can inform asset-management strategies and vendor-performance reviews. CBM also enables root cause analysis techniques as well as environmental monitoring and regulatory compliance.

As CBM strategies mature, power-generation companies can optimize operations well beyond the control room to boost plant and system efficiency and optimize outage planning.

The PI System provides utilities with a single source of truth for operations data. The PI System collects and manages information from multiple, isolated sources across the enterprise and presents that data in a way that allows management, engineering, operations, and maintenance staff to share and analyze information. From there, stakeholders can work together to optimize operations, maximize asset life cycles, predict outcomes, and – ultimately – drive bottom-line results.

OSIsoft is now part of AVEVA