Leveraging Asset Performance Management (APM) for Operational Efficiency & Optimization
Power generation plants, be it fossil fuel-based or renewable sources-based, rely on their critical assets of operation to support their day-to-day operations. This is restricted not only to energy generation but also to evacuation at the right time and the right price to meet fluctuating market demands. From solar inverters and wind turbines in renewable parks to boilers and steam and gas turbines in power plants, the success hinges on functional assets. Any slight malfunction can result in availability issues impacting generation and network stability, leading to huge financial repercussions along the supply chain.
New-age plant maintenance involves taking a prognostic approach to asset lifecycle management. Though power plant maintenance is typically carried out based on planned schedules, breakdown maintenance is not warranted, and a lot of effort is spent to streamline reliability issues. This is because the costs of unplanned maintenance and plant shutdowns pose a huge loss in revenue.

By aligning the corporate strategy towards better asset performance management, a company can gain from reduction in maintenance costs, longer asset lifecycles and improved productivity. Power plants achieve these by incorporating intelligent and proactive maintenance strategies and tools that provide them with the advantage they need to optimize operations and improve results.

Impact of asset performance on operations

The challenges faced by Energy & Utilities companies are surmounting in the context of safety and service delivery from every possible perspective—customer, stakeholder and shareholder. The pressure to deliver is high despite an ageing infrastructure, the emergence of disruptive technologies in areas of generation and storage and EV penetration.

The inevitable question is—how to maintain, grow and modernize generation and transmission and distribution assets within the gambit of permissible optimization in terms of cost, risk and performance?

Optimization of asset performance could be planned and orchestrated well if the key contributors to lack of asset performance are identified and understood clearly:

- Siloed and inconclusive data points across similar assets or plants
- Lack of asset-level visibility—current asset health or minimal knowledge on emerging health issues
- Unplanned downtimes with loss in productivity and high cost of emergency repairs
- Uncaptured institutional knowledge as the existing expert workforce approaches retirement
- Delays in critical information reaching the decision table
- Current practices that may have no relevance to asset criticality and history
An innovative approach to assess the impact of asset performance on operations is to provide a complete framework on the business, encompassing generation, availability, efficiency as well as penalty settlement processes. The management of asset performance does not stop with ensuring a better or budgeted availability of an asset and the efficient running of the asset within operational constraints but also providing end-to-end services at the best cost including factors that affect the settlement of the energy pricing market.

As new regulatory compliance measures come into force in various trading or energy markets, the penalty of high deviations against the committed generation or the action of buying them in real-time market and the costs incurred for frequency deviations contribute a lot to lowering the yield and net revenue on a business entity.

Taking cues from Transmission & Distribution entities, power generation companies have to adopt a proactive approach towards building an Integrated Asset Management System wherein all the business systems are integrated into an Enterprise Asset Management (EAM) platform. This will help them harness the power of disruptive technologies like data science and advanced analytics to generate actionable intelligence that can provide recommendations on improving asset performance, boosting productivity and making the right decisions at the right time.

Reducing unplanned downtimes and improving the operating efficiency of an asset are key performance indicators.

Gone are the days when generation or asset availability takes the priority over efficiency of generation. Today, responding to market needs at the hour of the day is the key.

How the utility responds to market needs brings effectiveness into operations, and the service delivery assets are classified based on the time and the agility of the response and the gradient scale-up period the utility can provide to the fluctuating energy demand at any point in time.

According to industry estimates, unexpected disruptions cost 3% to 8% of the annual capacity of the energy generation or close to US$10 billion.
Today, the way with which asset performance optimization could be approached is not different between newer utilities and older ones. In the latter, the difficulty arises in the addition of multiple applications and technologies that serve the purpose of integration, monitoring, diagnosis and analysis of asset performance. The emergence of IoT, digital TWIN, Industry 4.0 and AI/ML—all contribute in their own way to accomplish the desired outcome.

However, the following concerns still remain in the minds of power operators:
- Data collection and aggregation, to have a single-truth table for an asset
- Ensuring authenticity in data points related to asset health/condition
- Scenario planner to assess impact
- Quantifying performance improvement
- Demonstrating ROI in line with the business objective

A power generation unit today generates millions of data points that are confined to the asset performance analytics regime from various applications across operations management and maintenance management areas. But this may still not yield a solution to the above concerns if there is no proper integrated technical asset management.
### Integrated asset management draws critical information in two distinct areas

#### Key components of Integrated Asset Performance Management

**Asset efficiency**

The Asset Efficiency Assessment provides key performance indicators on event management, root cause analysis, data visualization and benchmarking. All the typical issues concerning generation are brought into these assessment criteria.

**Asset condition and health monitoring**

Asset Health and Condition (all along the life cycle with data points from core applications) assessment provides key performance indicators with condition monitoring, criticality analysis, knowledge management, predictive maintenance and reliability analysis.

Additionally, reports such as inspection reports, operation logs, lab reports, diagnostic inferences and strategic optimization initiatives also hold important data points to help achieve optimized asset performance.

### Benefits of integrated Asset Performance Management

- **Transforms unplanned downtimes into planned downtimes, thereby, reducing the period of unavailability of the critical assets and providing a proper planning horizon for major downtimes.**
- **Transforms preventive maintenance into predictive and prognostic maintenance on optimized cost and risk measure of entire operating generation unit.** This enhances the maintenance maturity index and asset management capability.
- **Converts period of low operating efficiency into one of optimized efficiency by addressing areas of concern within operational constraints and planning maintenance actions in tandem to reduce the deviations.**
- **Facilitates operation and maintenance strategies to respond to the changing needs of the market where cost, demand and price fluctuate as per the need of the hour.**
Power utilities have evolved phenomenally in the past decade, specifically with advancement in network speed, data storage capacities, cloud computing, Edge computing, Internet of Things (IoT), cybersecurity, augmented and virtual reality, Artificial Intelligence and Machine Learning leading to Industry 4.0.

These new technologies can be leveraged for more reliable and fast real-time data exchange, easy capturing of large data points from connected devices in real time, storing and processing large quantities of data and driving transformational analysis of structured and unstructured data like video and sound to achieve enhancements in various areas like predictive analytics, automated operations like equipment monitoring and demand signals, real-time tracking like fuel requirements and blending levels, analytics-driven optimization like for heat rate, etc.
Key technologies that can have a deep impact on asset optimization

**Internet of Things (IoT)** Production equipment can be fitted with IoT sensors to collect large amounts of data points which can be used to know the health of the equipment, process or operation and exchanged with other systems for status and decision analyses.

**Cloud computing** Companies can use Cloud computing for short on-boarding and reduction in adaptation time to new applications and technologies with size fit to needs at one point in time. Cloud computing can help with storing and processing of last structured and unstructured data more efficiently and cost-effectively. In addition, it brings reliability, flexibility and sustainability to the production process.

**Artificial Intelligence and Machine Learning** Companies can use AI and ML to analyse large volumes of data generated by the IoT ecosystem and to integrate data from other systems like SCADA, DCS, CDMS, HRSG, QS, EAM, ERP, etc. to provide in-depth insights at equipment and process levels and other levels. This can help with gauging equipment health, production quality, equipment performance, operational efficiency, etc. which can improve the accuracy of predictability and facilitate automation.

**Edge computing** Real-time data analysis is key to production operations optimization. Companies can use Edge computing for critical real-time analysis which is required to be done at the source of data creation. This minimizes the time between data creation and response to data. This reduces security risks and data also stays near its source.

**Augmented and Virtual Reality** Companies can use augmented and virtual reality technologies for safety trainings, real-time maintenance assistance and tracking real-time employee performance.
While the industry has progressed at a rapid pace, Predictive Analytics has become an important layer that leverages data from all these key technologies to track, assess and predict the performance of assets and their availability to provide critical decision intelligence to optimize asset performance.

BCT’s retina360 is a powerful, patented, award-winning IIoT data intelligence and predictive analytics platform, which uses Artificial Intelligence, Machine Learning and Deep Learning models to offer a 360 view of remote assets. Millions of data points are curated to sense anomalies and disruptions, predict performance, and achieve and sustain KPIs. The result is yield and performance improvement and cost-savings from the remote monitoring of assets across energy parks, facilities and geographies.
Success story

How a renewables company overcame asset availability challenges and reduced losses from a staggering 100-day downtime

Challenges

A 5-year-old renewable park in the USA with a power generating capacity of 200 MW with 100 Wind Turbine Generators (WTGs) of 2 MW each was facing critical challenges in asset availability. The assets experienced component failures related to gear box, generator, main bearing and pitch motors. The combined lost generation in 2019 was at a staggering 100 operating days in a cumulative fashion for the 9 WTGs that were impacted by the loss in availability as the concerned assets were under OEM contract for maintenance.

As the overall availability of the entire park was well within the contractual limits, not much could be initiated with respect to OEM. But the management decided to opt for an analytical solution to check the viability of predictive analytics in these scenarios, and check if a risk- and cost-based optimization could be initiated to mend the loss. The business value of the lost generation was huge and needed to be attended to sustain the competitive market.

Solution

Predictive analytics and asset management solutions deployed

BCT deployed its award-winning patented predictive analytics platform retina360 and implemented the asset performance management solution customized for renewable park operations. The integration was done with SCADA data for the operational parameters at a frequency of 10 sec. The OEM information on the life cycle behaviour of the asset was obtained. The alarms and events from the asset were integrated into the solution.
AI Models built for predicting failures

AI models were built to predict the component temperatures at varying operational loads. This highlights the emerging issue in asset health even at partial loads or varying load conditions like that of a wind speed for WTGs. When the deviation between the predicted component temperatures and the actual crosses the threshold, the solution generates an alert which is validated by the asset manager and the maintenance team is initiated with a corrective plan.

Results
The renewable park reported identification of 1.7% of annual energy production instances that could be prioritized for maintenance actions and the business impact was US$192K.

Real-time integration of data points
After validating the predictive models with past failures for the critical components, the solution went live with real-time integration of all data points. To reduce false alerts from the predictive analysis, the oil reports and the inspection report were fed into the system, which resulted in improving the accuracy from 73% to 86%. The integrated asset performance approach has resulted in providing ample planning time for major downtime activities and has reduced the asset downtime to 5-7 days for a gear box change which otherwise would be 4-5 weeks, if the downtime is unplanned. The forewarning on the component failure for different components ranged from 2-8 weeks.

WTG COMPONENT FAILURES FOR A 200MW 7-YEAR OLD PARK

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The power industry (Power Generation & Power Transmission and Distribution) is in the process of adapting or planning to adapt to Industry 4.0. This primarily is to take advantage of new technologies, existing data and new IoT data points, and developing AI and ML models to deliver improved asset health, employee health and safety, operations efficiency and reduction in carbon footprint and better cost optimization.

Many organizations in the early stages of the digital transformation journey are working to streamline data points, data models, optimizing maintenance strategies and operating cost models. On the other hand, organizations that already have a definitive futuristic view have started investing in advanced visualization and control tools for harnessing data and leveraging AI & ML models for real-time predictability. In either case, it is critical to have a clear understanding of the organization's current digital maturity, budgets, culture and execution capabilities - this will help determine the scope and inclusion of new technologies in its digital transformation roadmap. Rather than scouting for a vendor to implement point solutions, it is advisable to look for an experienced partner that can guide you right from planning and execution to optimising and maximising of results in the long term. The power industry is increasingly adapting this approach to ensure successful implementation, faster ROI and rapid go-to-market.

In sum, the road ahead for Energy & Utility organizations would be to assess their digital maturity, prioritise asset efficiency and asset health goals and make them integral to their business sustainability plans.
About Bahwan CyberTek

Established in 1999, Bahwan CyberTek (BCT) is a global provider of digital transformation solutions in the areas of Predictive Analytics, Digital Experience and Digital Supply Chain Management, and has delivered solutions in 20 countries across North America, the Middle East, Far East, Africa and Asia. Driving innovation through outcome-based business models, proven and powerful IP solutions, BCT is a trusted partner for over 1000+ customers, including Fortune 500 companies. With strong capabilities in Digital Technologies, BCT has over 3000 associates with technical and domain expertise, delivering solutions to the Oil & Gas, Telecom, Power, Government, Banking, Retail and SCM / Logistics verticals. With a focus on joint innovation, BCT has partnered with leading global technology organizations such as TIBCO, IBM, SingleStore, Zycus and Oracle to deliver differentiated value to customers. BCT is recognized at CMMi level 5 and is an ISO certified organization.

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Dhanesh comes with over 20 years of experience in consulting, design, development and delivery of complex solutions around Enterprise Asset Management, Enterprise Mobility, Integrations, Analytics & Industrial IoT with expertise in IBM solutions in multiple geographies in various industry domains including Energy & Utilities, Oil & Gas, Manufacturing and Facilities Management. He has been part of some of the largest, innovative, and trendsetting solutions for clients like Dhafar Power Company, Scotia Gas Networks, British Petroleum, Irish Water, Kuwait National Petroleum Company, Petrochemical Industries Company, Cummins, Johnson Controls, Resorts World at Sentosa, Hongkong International Airport, PSA Singapore. His area of interest includes Business Process Optimization, Integrated Asset Modelling, Predictive Analytics for Maintenance, Performance Optimization and Asset Management & Enterprise Mobility Governance, Strategy and Roadmaps.

Krishna comes with 25 years of experience in the manufacturing vertical positioning software applications in the areas of Enterprise Integration, Process Optimization with advanced Process Control, Energy Management, Quality management and Asset Performance Management. One of the pioneer in the application of AI/ML techniques for process improvements and asset reliability analysis, since 2000, he has extensively utilized the power of data in enabling proactive/predictive maintenance as well identifying process degradation with Causal Analysis in many of the verticals including Metals & Mines, Energy & Utilities, Oil & Gas, Manufacturing and Transportation. The transformational projects on digital enablement include Contour Global Eversource, Veolia, Southern Power, Harvard Medical School @US, Ratch & Engie @Australia, Hindalco & Simpsons @India, Petroleum Development of Oman, Road Transport Authority of Dubai.