

AVEVA PI WORLD

Extend Your PI System with AI

Increase Asset Reliability and Performance
with No Code AI

Presented By: Sean Gregerson – AVEVA VP Global APM Sales

AVEVA

Connect the power of information and AI with human insight

Two world class industrial software experts combine to deliver integrated value

AVEVA's end-to-end industrial software to optimize engineering and operations



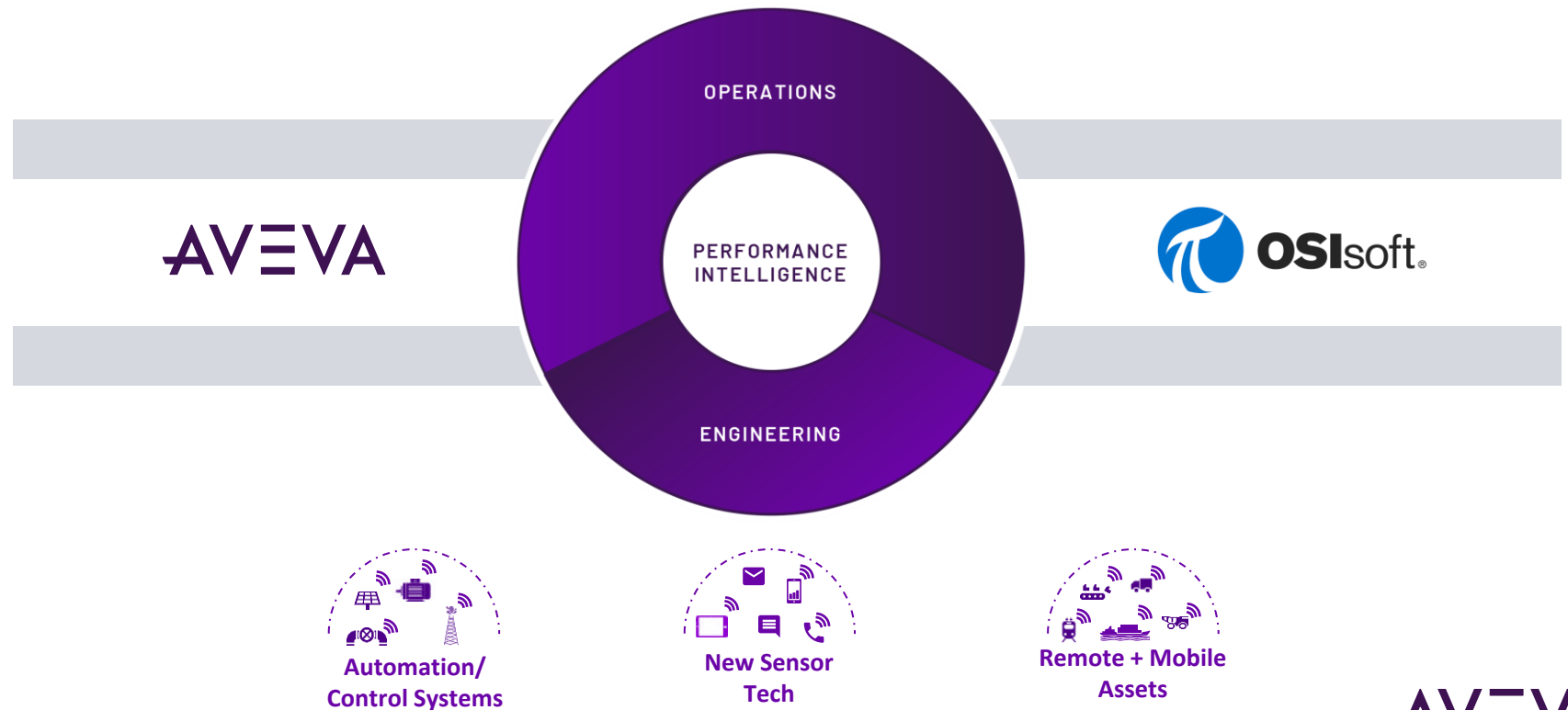
OSIsoft's PI System is the industry standard for industrial information management

1 Run **agile, continuously optimized** operations to protect the bottom line

2 Increase **asset reliability and safety** with reduced manual supervision

3 Provide remote teams rich data and **decision support** to **collaborate** and work efficiently

4 Maximize CapEx and drive the highest levels of **engineering efficiency**



Predictive Asset Analytics

Profits are hit by unscheduled downtime, inconsistent work execution, over and under maintenance.

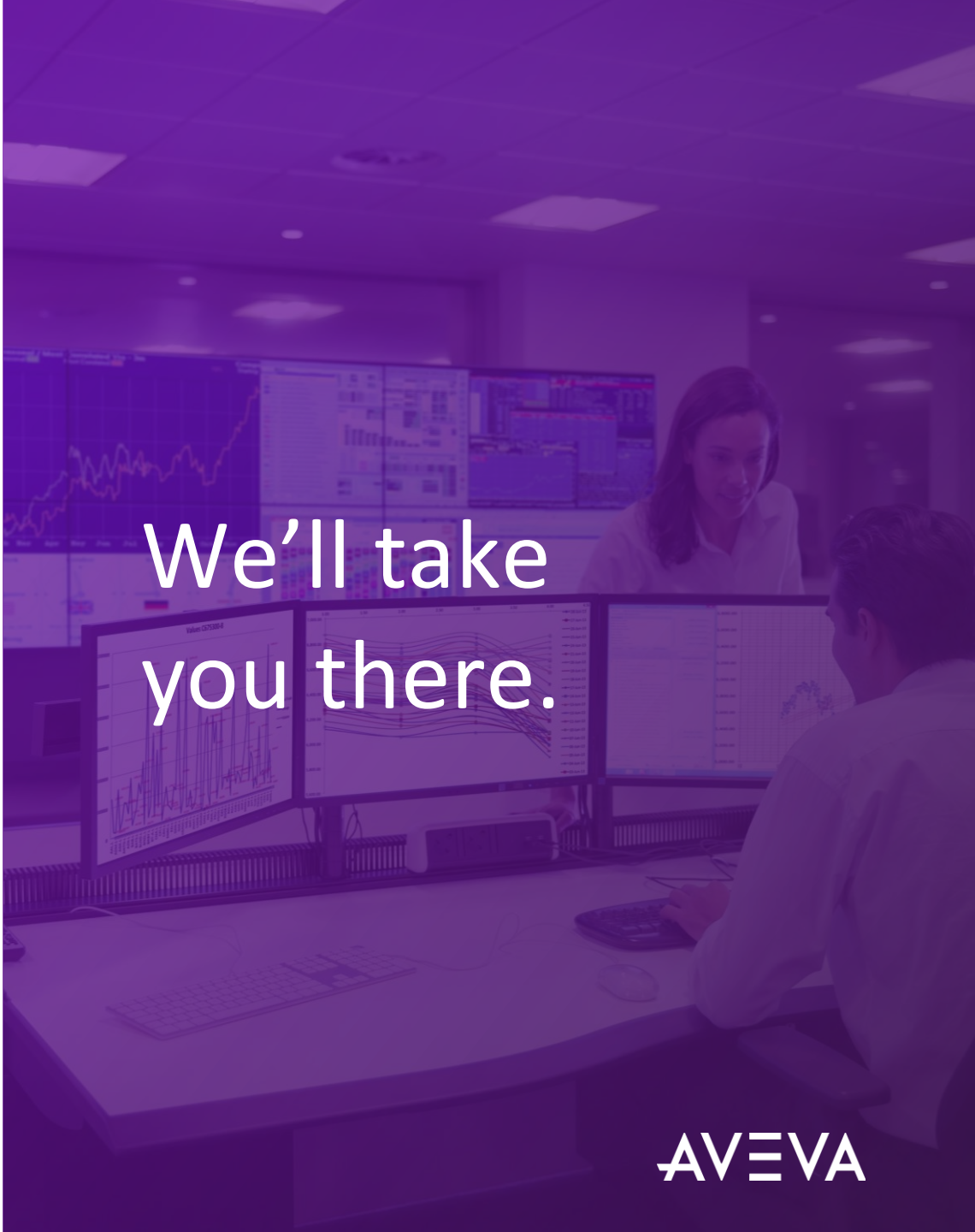
What if you could get early notification of asset issues before they lead to unscheduled downtime?

What if you could reduce operational expenditure by improving efficiency and reliability?

AVEVA Predictive Analytics takes the rich data available in your PI Server and transforms it into actionable insights to prevent equipment failures.

Together we help Air Liquide, BASF, Duke Energy, EDF, ENEL, Petronas, Suncor, Total and many others save tens of millions of dollars, reduce maintenance costs by 30%, increase workforce efficiency by 25% and reduce downtime by 25%.

Overall OPEX reduction of 10%-20% can be achieved with Predictive Analytics.



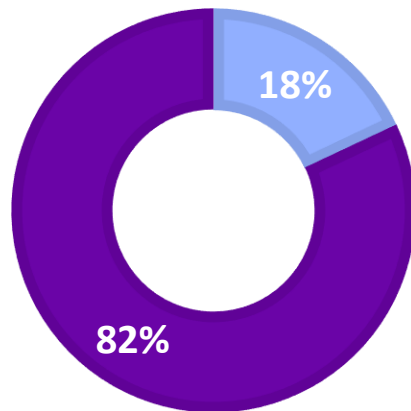
We'll take
you there.

AVEVA

AVEVA APM connects Asset Strategy to Corporate Objectives

Failure Patterns

■ Age-related failure ■ Random failure

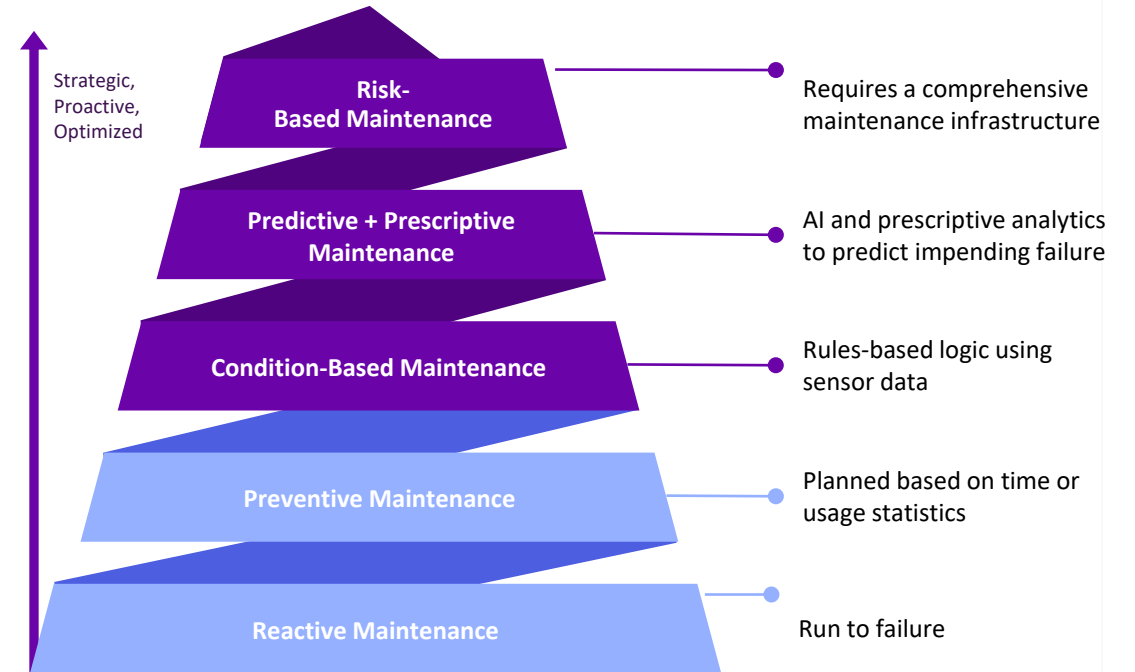


Reactive and Preventive Programs

Predictive Technology for Early Warnings

ARC STUDIES SHOW ONLY 18% OF ASSET FAILURE IS AGE-RELATED. BASED ON THESE DATA, PREVENTIVE MAINTENANCE PROVIDES A BENEFIT FOR JUST 18 PERCENT OF ASSETS AND MONITORING FOR PREDICTIVE MAINTENANCE IS A RECOMMENDED OPTION FOR THE REST. WWW.ARCWEB.COM/LISTS/POSTS/POST.ASPX?ID=260

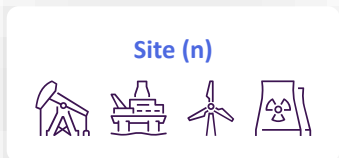
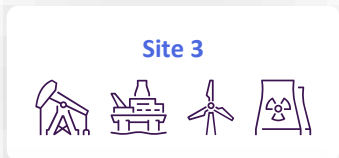
It's a Journey



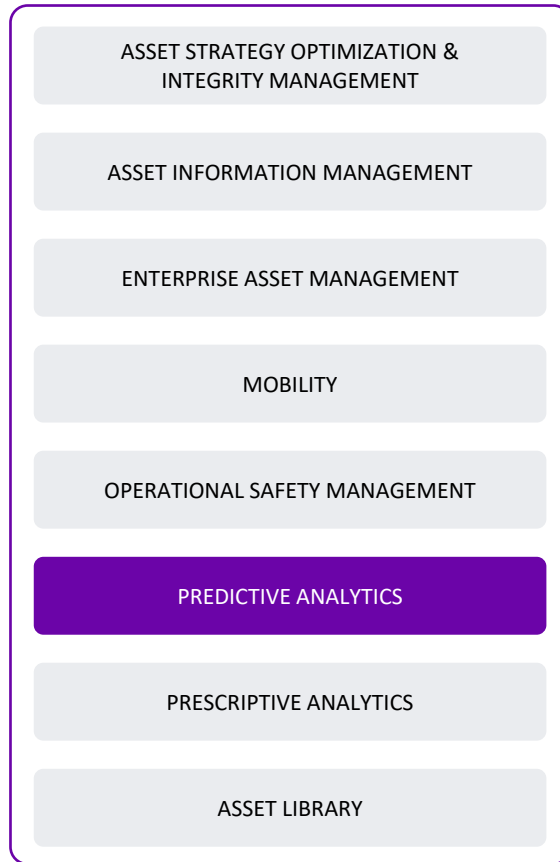
PI System + AVEVA APM – the Complete Picture



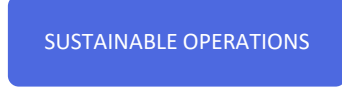
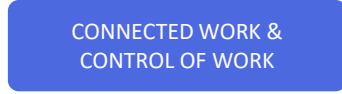
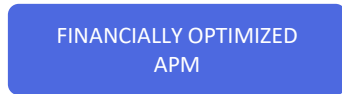
ASSET PERFORMANCE MANAGEMENT



Data Infrastructure



DATA DRIVEN OUTCOMES



AVEVA DIGITAL TWIN



Operational Scale Matters

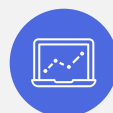
Predictive Monitoring at Scale



**Model Templates
and Validation**



**Fault + Prescriptive
Diagnostics**



**Performance
Monitoring**



**Case
Management**



**Alert
Management**



**Remaining Useful
Life**



Transient Analysis



**Asset Comparison
and Reporting**



**Integrated Alert
Workflow**

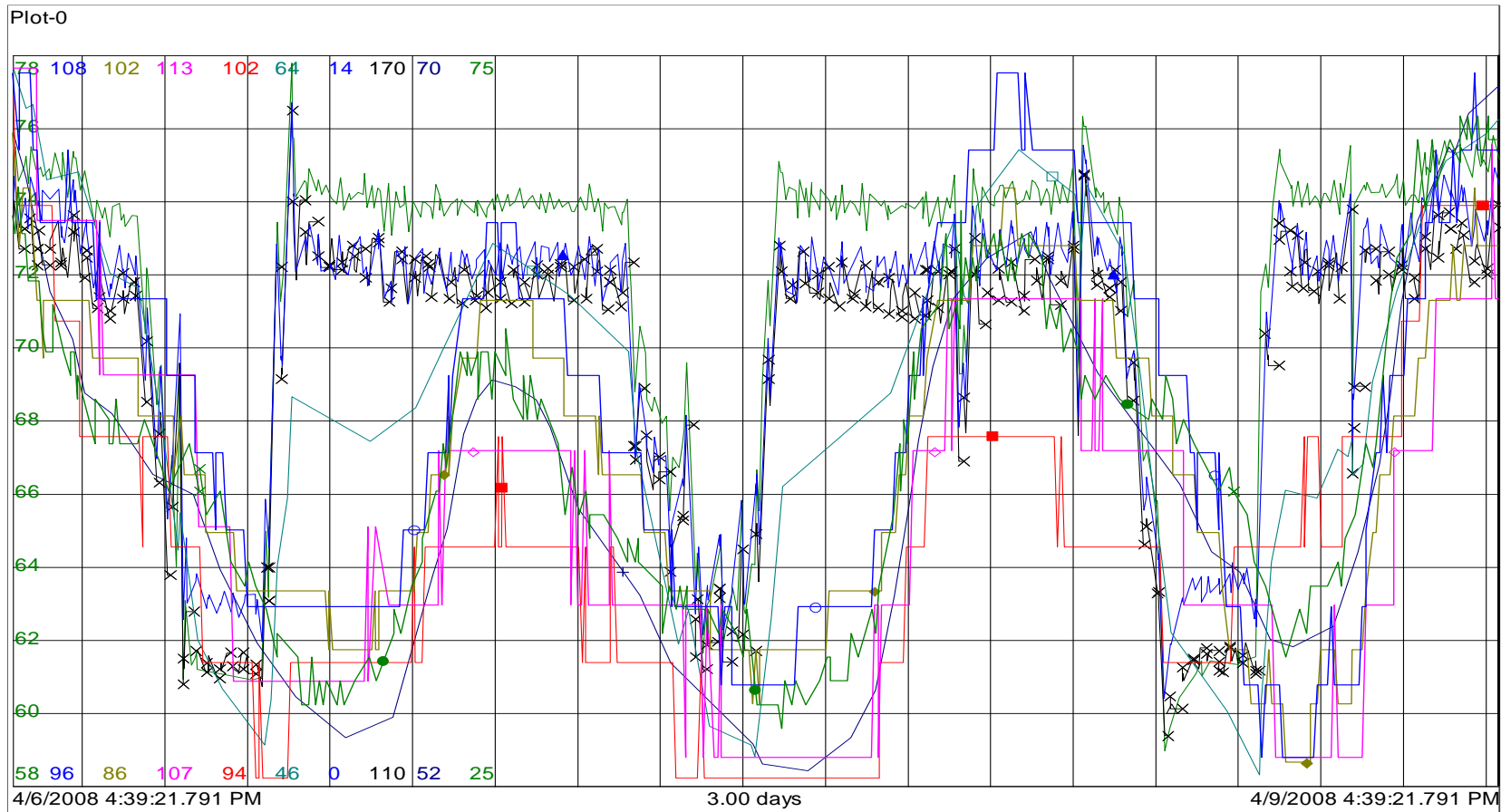


*AI/Machine learning is the
easy part.*



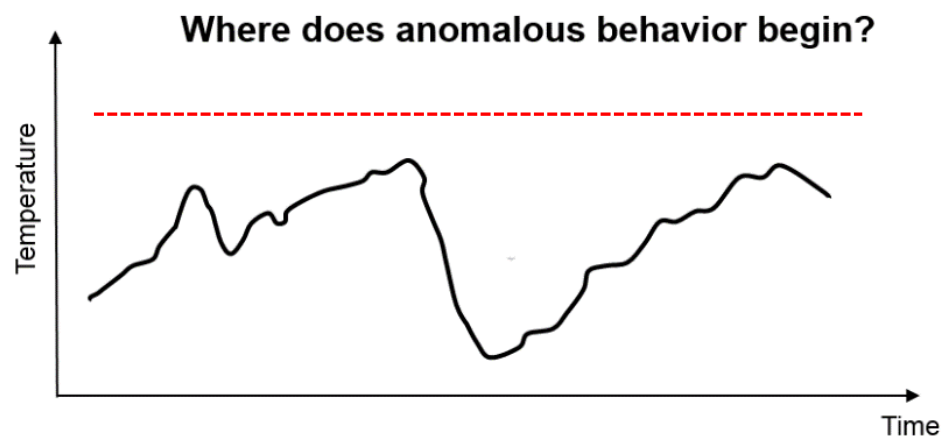
*Operationalizing AI at scale is
the difference between
success or failure*

Monitoring Without Predictive Analytics



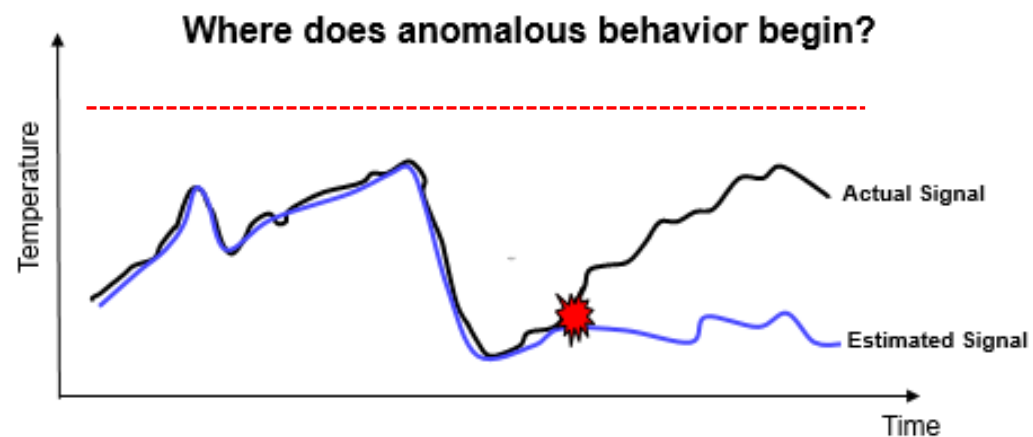
Monitoring Approach

Traditional Monitoring



- Constant alert/alarm limits are typical
- Damage accumulates prior to reaching limit

Predictive Asset Monitoring




- Actual minus estimated (residual) signal detects anomaly as-soon-as-possible

OPTiCS

Algorithm – Industry Leading

- Automatically classifies model inputs in correlated subgroups
- Makes creation of models for assets without templates much easier



US 20150199224A1

(19) **United States**
(12) **Patent Application Publication** (10) **Pub. No.: US 2015/0199224 A1**
Mihnev (43) **Pub. Date: Jul. 16, 2015**

(54) **METHOD AND APPARATUS FOR DETECTION OF ANOMALIES IN INTEGRATED PARAMETER SYSTEMS** (52) **U.S. CL.**
CPC *G06F 11/07* (2013.01); *H04L 43/045* (2013.01)

(71) Applicant: **Instep Software, LLC**, Chicago, IL (US) (57) **ABSTRACT**

(72) Inventor: **Aldimir Mihnev**, Chicago, IL (US)

(73) Assignee: **INSTEP SOFTWARE, LLC**, Chicago, IL (US)

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(22) Filed: **Jan. 10, 2014**

Publication Classification

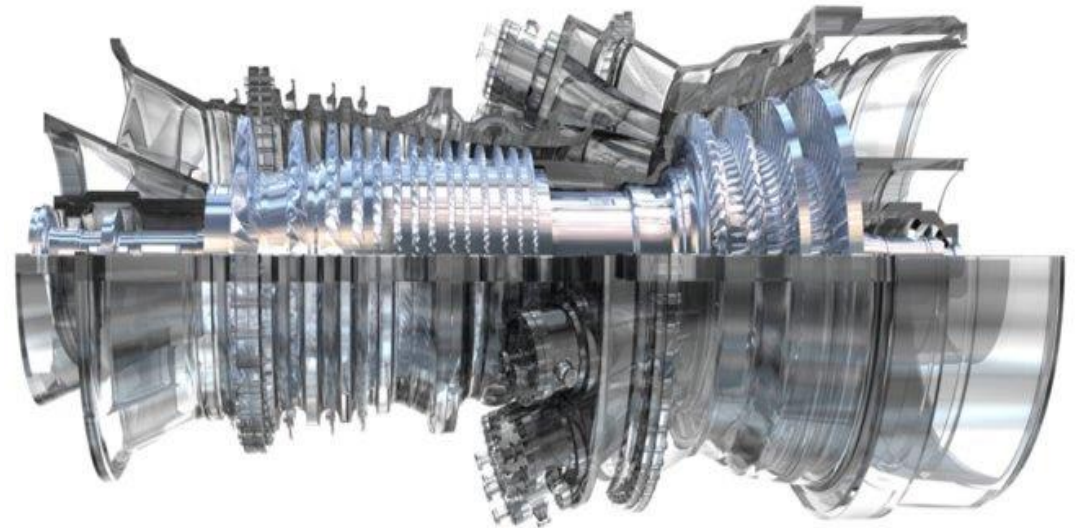
(51) **Int. Cl.**
G06F 11/07 (2006.01)
H04L 12/26 (2006.01)

A system, method, and tangible computing apparatus is disclosed for the detection of anomalies in an integrated data network. Said system, method and apparatus comprises the creation and construction of a mathematical model that utilizes multi-dimensional mutual information to detect interactions and interrelationships between pairs of data streams and among pluralities of data streams. Real-time analysis of the operations of an integrated data network is enhanced and expedited via use of locality sensitive hashing that relies on density determinations of clusters of data.

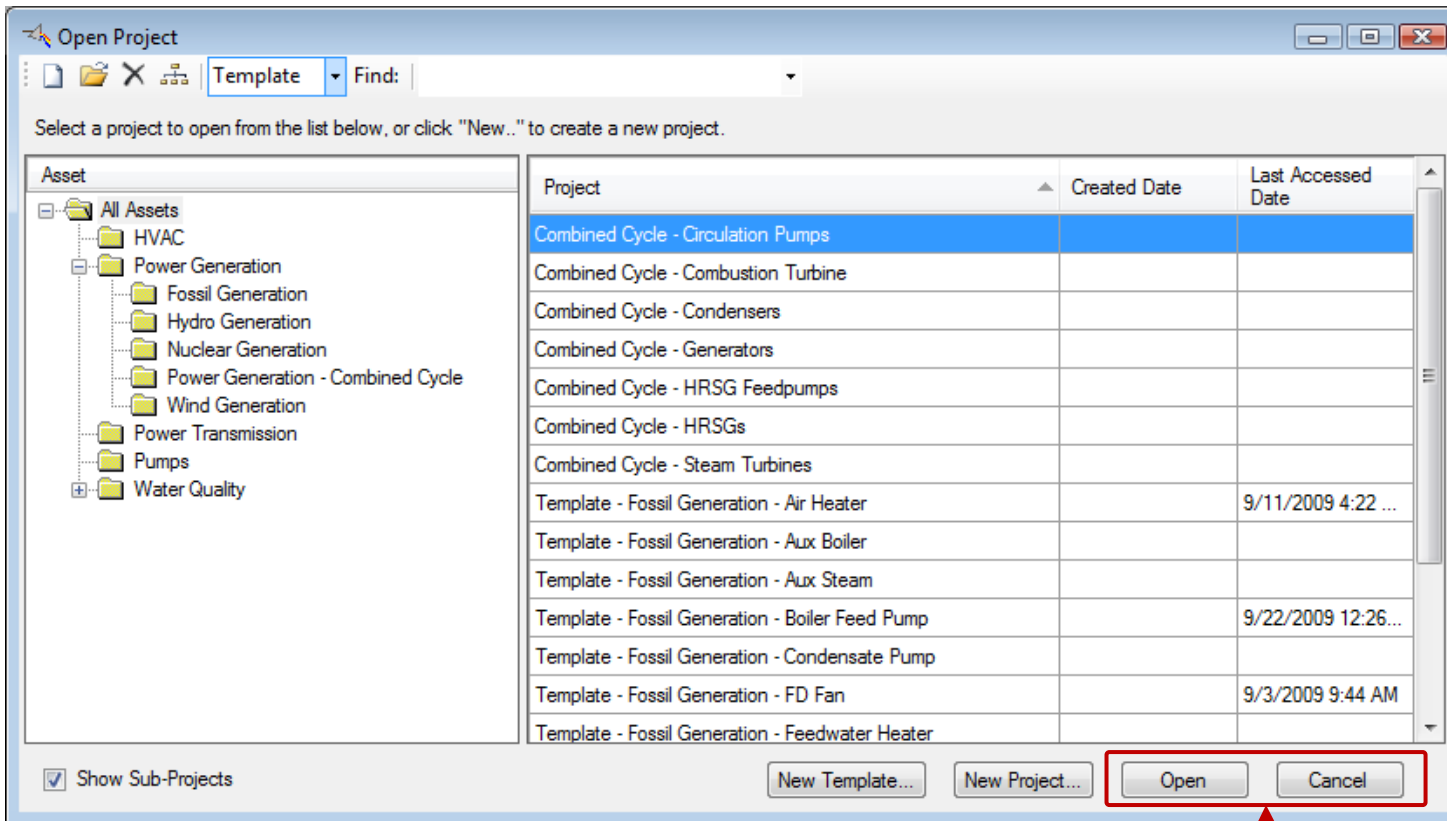
Holistic Monitoring Approach

- Wind Turbines
- Hydro Turbines
- Gas Turbines
- Steam Turbines
- Generators
- Compressors
- Boilers
- Pumps
- Motors
- Gearboxes
- Heat Exchangers
- Valves
- Mill's
- Expanders
- Fans
- Transformers
- Inverters
- Air Heaters

*Partial list of assets



Model Templates



Make new templates or projects based on templates

- Develop core models once – reusability
- Centralized model updates
- Integrated security template layer
- Normalized sensor metric naming
- Asset comparisons
- Case library integration

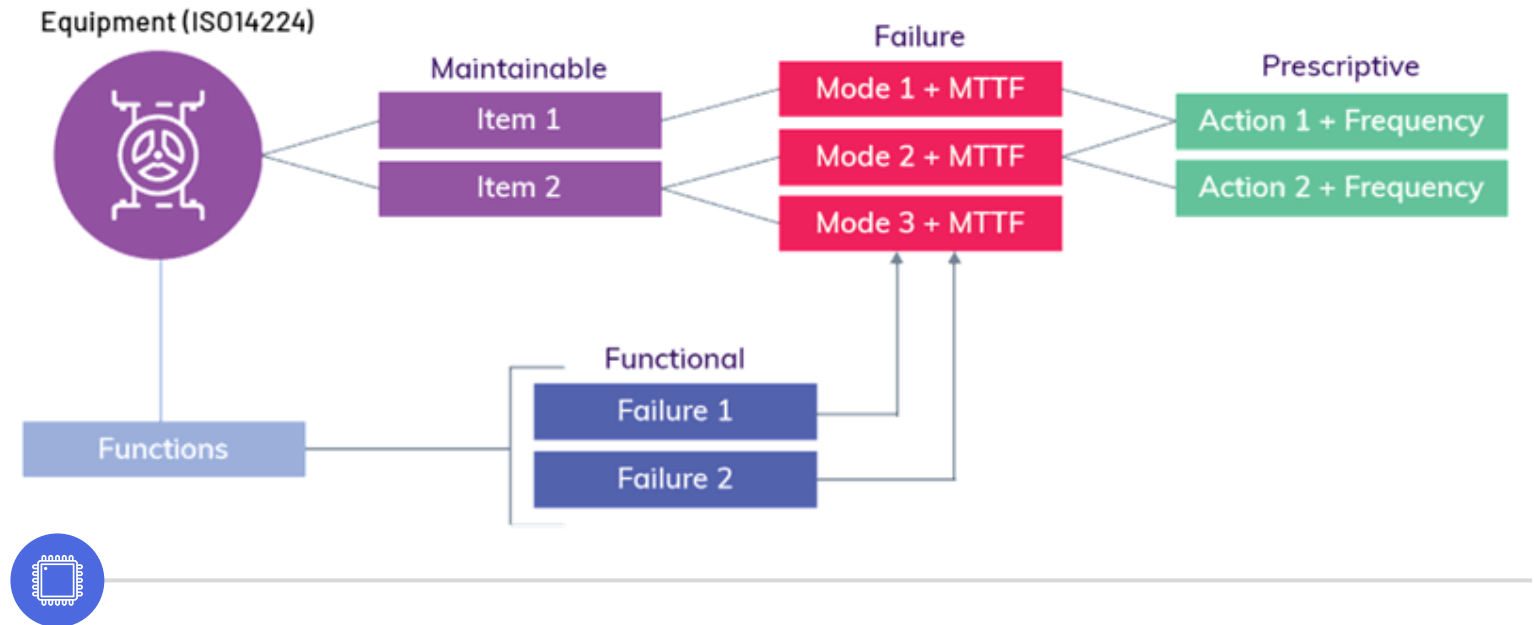
Fault + Prescriptive Analytics Library - Deployment Acceleration

AVEVA Asset Strategy Library



By adding data and asset templates to the solution strategy deployment can be done up to 90% faster.

The AVEVA Asset Library contains RCM-based equipment failure data and preventive maintenance for the most commonly found asset types in asset-intensive industries:



- 1,000 components
- 1,500 failure causes with failure conditions
- 2,000 preventative tasks
- 5,000 prescriptive tasks
- 20 years and 22,000 man-hours of experience

Fault Diagnostics



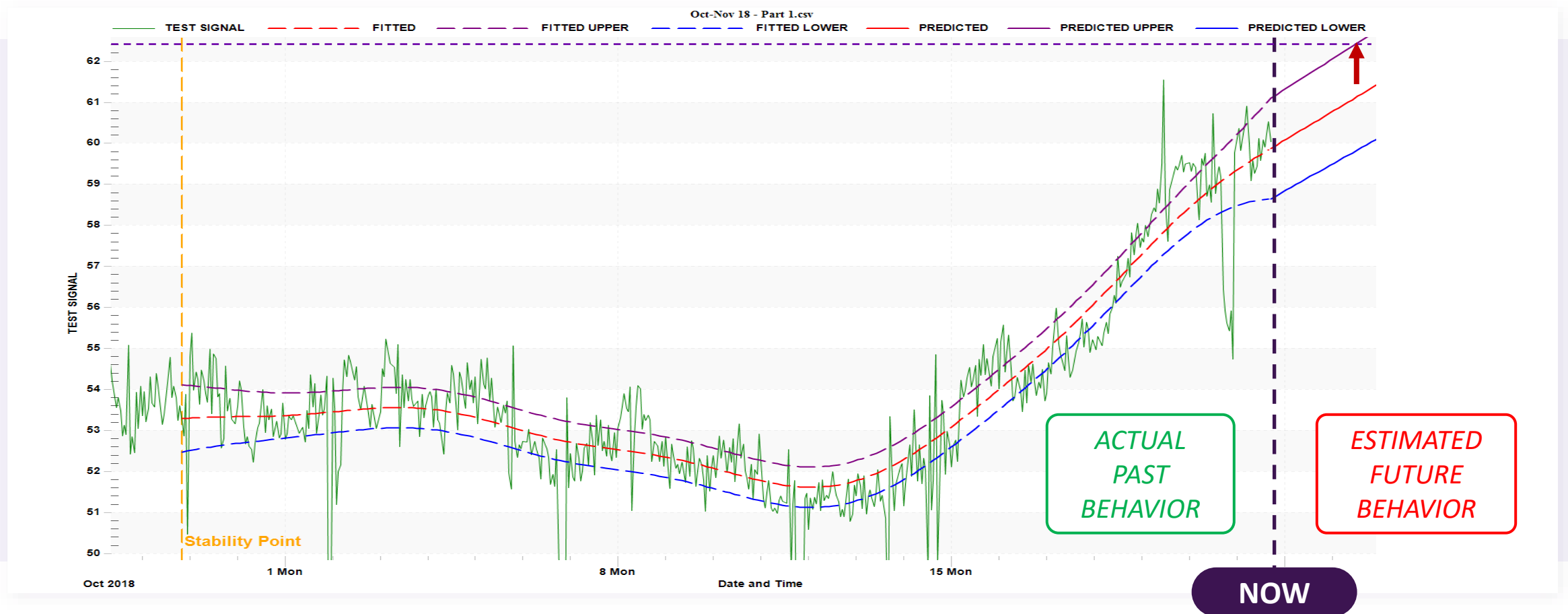
Overall health indication

Fault Diagnostics

Signal actual vs predictive

Remaining Useful Life Estimate – Deep Learning

The earliest time when a projected value in the risk / uncertainty envelope cross the threshold



Collaboration and Knowledge Transfer

The screenshot displays the AVEVA Predictive Analytics web application. The main header shows 'AVEVA™ Predictive Analytics' with navigation links for Home, Alerts, Cases, and Reports. The 'Cases' section is active, showing a 'New case' button and a list of assets including Food and Beverage, Model Staging Area, Oil and Gas, and Power Generation.

The detailed view for Case ID: 2006 is shown, with the following information:

- Title:** Driven Steam Turbine - Shaft Alignment Issue
- Case state:** Closed
- Priority:** Normal
- Category:** Mechanical
- Assigned to:** prismuser
- Description:** ST1 provides process steam for the oil extraction process at our APAC site. Case Alert: High OMR on ST1. High bearing temperatures detected. Moderately increased vibration. Diagnosis: Misalignment of drive shaft on ST1 after scheduled maintenance. High OMR detected on startup. Resolution: ST1 shutdown and high speed vibration analysis conducted. Shaft mass rebalanced and return to normal operation.

The 'Discussions' tab is selected, showing a list of discussions. The first discussion is:

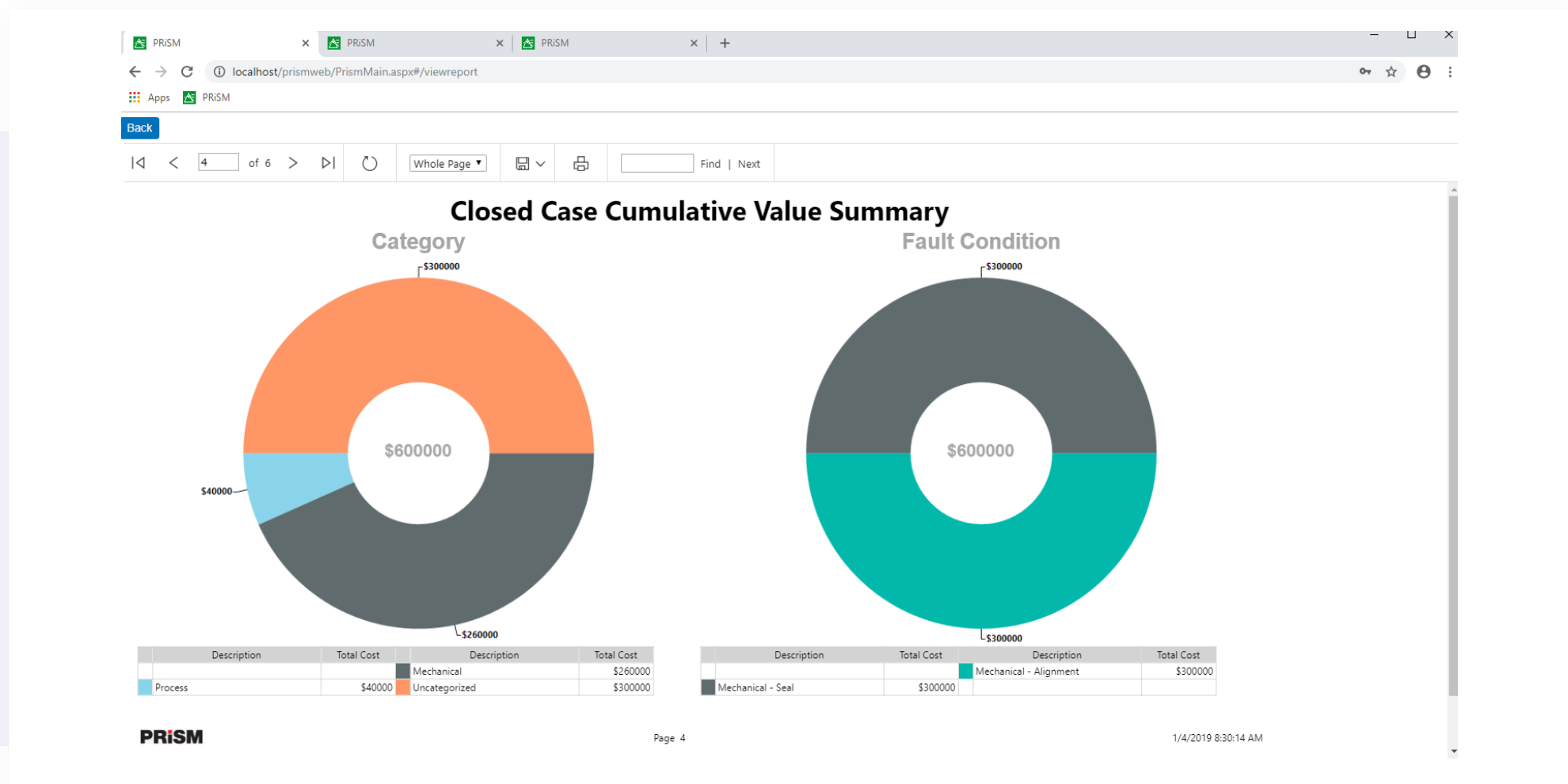
- Author:** prismuser
- Date:** 10/21/2020 11:40:54 AM
- Category:** Diagnosis
- Content:** Case closed. Diagnosis provided in Case Description

The second discussion is:

- Content:** High OMR detected on ST1. Case notes provided in the description. Assigning case to site maintenance team.

At the bottom of the interface, there are controls for 'Items per page' (set to 20) and '1 - 3 of 3' items.

Reporting



AVEVA PREDICTIVE ANALYTICS

Case Examples



Duke Energy

Leverages IIoT and Predictive Analytics to Reduce Failures

- **Challenge**
 - Implementation of a centralized company wide predictive monitoring program to improve reliability and lower OPEX costs
 - Avoid catastrophic failures at power plants. Duke Energy had a transformer failure that cascaded into other transformers and two turbines, causing over \$10 million in damages
 - Data analysts at Duke Energy were typically spending 80% of their time collecting the data and only 20% of their time analyzing it
 - Inconsistent diagnosis and limited risk assessment
- **Solution**
 - PI Server deployed across 65+ power generation plants. PI Server data back to 1984.
 - Centralized predictive monitoring solution to fill the time gap between inspections, engineering determined that online continuous monitoring was needed
 - AVEVA Predictive Analytics software solution was deployed as part of Duke Energy's SmartGen program
- **Result**
 - Empowering people with early warning notification of equipment problems
 - Optimizing assets with low-cost sensors and connectivity for high-fidelity data access enabling predictive maintenance
 - Improving operations with contextualized insights

“ Early warning identification and diagnosis of equipment problems with predictive asset analytics results in over 65M+ in savings. ”



Savings of
\$34.5 million
single early warning catch



Serving
7.2 Million
customers

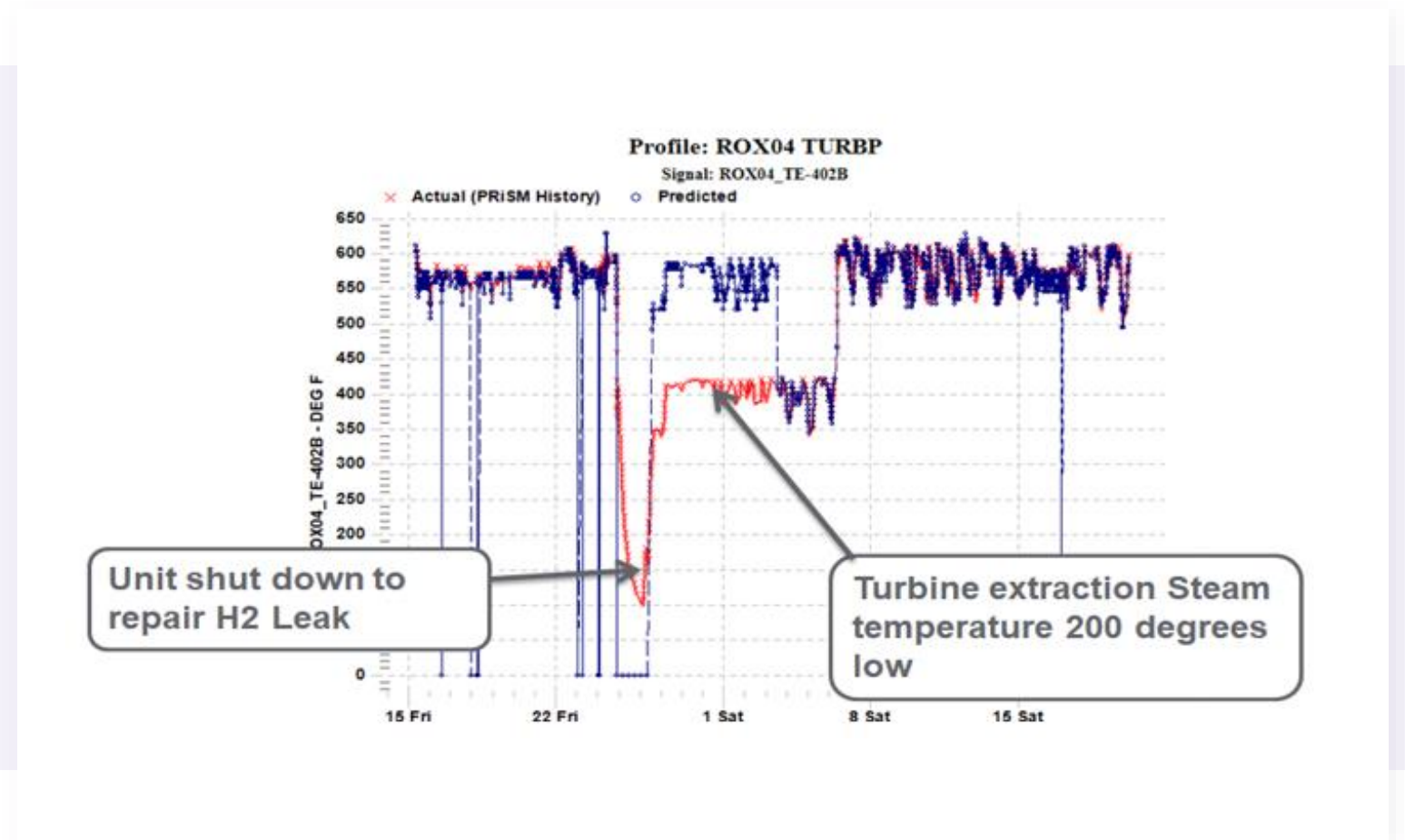


Generation capacity
58,000 MW

Duke Energy - Steam Turbine Efficiency Loss



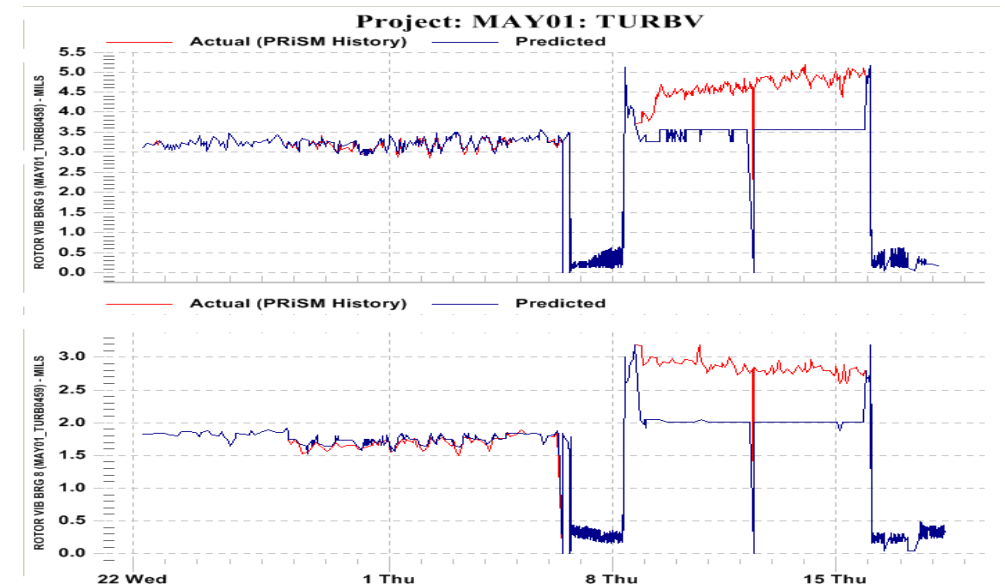
- Received alarm on low extraction steam temp
- \$\$\$\$ additional fuel burned over 8 days
- Could have gone a week or more before plant found it



Duke Energy – LP Rotor - L-0 Blade Problem

- Unit was started after an outage and there was a vibration step change on one of the LP turbines (Vibration levels were well below the alarm level)
- Engineering and the plant were notified
- Vibration data was collected and unit was retired for an inspection
- Bolts on lower half of flow sleeve had broke and flow sleeve contacted L-0 blades

- Upper half of flow sleeve was no longer supported by lower half
- Although we had minor damage to the LP blades, we avoided damaging multiple stages of blades, packing, and diaphragms if we had a severe blade liberation.
- Estimated avoided cost - \$4.1M



Southern Company



Achieving uninterrupted service with Predictive Analytics

- **Challenges**
 - With approximately 4.4 million customers across the SE United States, Southern Company's customer reputation is highly dependent on providing uninterrupted service
 - Yet, with 27,000 miles of transmission lines and 3,700 substations, detecting potential failures through scheduled maintenance and inspection was proving challenging
- **Solution**
 - PI Server deployed across commercial operations, trading floor, wholesale power renewables, and retail fossil-fuel businesses
 - PI Server used in remote operating center, fleet monitoring, unit availability and performance reporting and improving maintenance utilization and response times
 - AVEVA Predictive Analytics now provides Southern Company with early warnings of potential failures, enabling engineers to address issues and avoid shutdowns
 - 2,000 models have been created across the company's gas and biomass power stations
- **Results**
 - \$4.5 million saved in performance efficiencies
 - \$260,000 saved in a single early detection of a BFP coupling shim pack on the verge of failure

“ Thanks to AVEVA's dedication and commitment to excellence we potentially averted disaster. ”



\$4.5 Million
in performance efficiencies



\$260,000
saved in a single early detection



46,000 MW
and 27,000 miles of transmission lines

AVEVA

Southern Company – Boiler Feedwater Pump

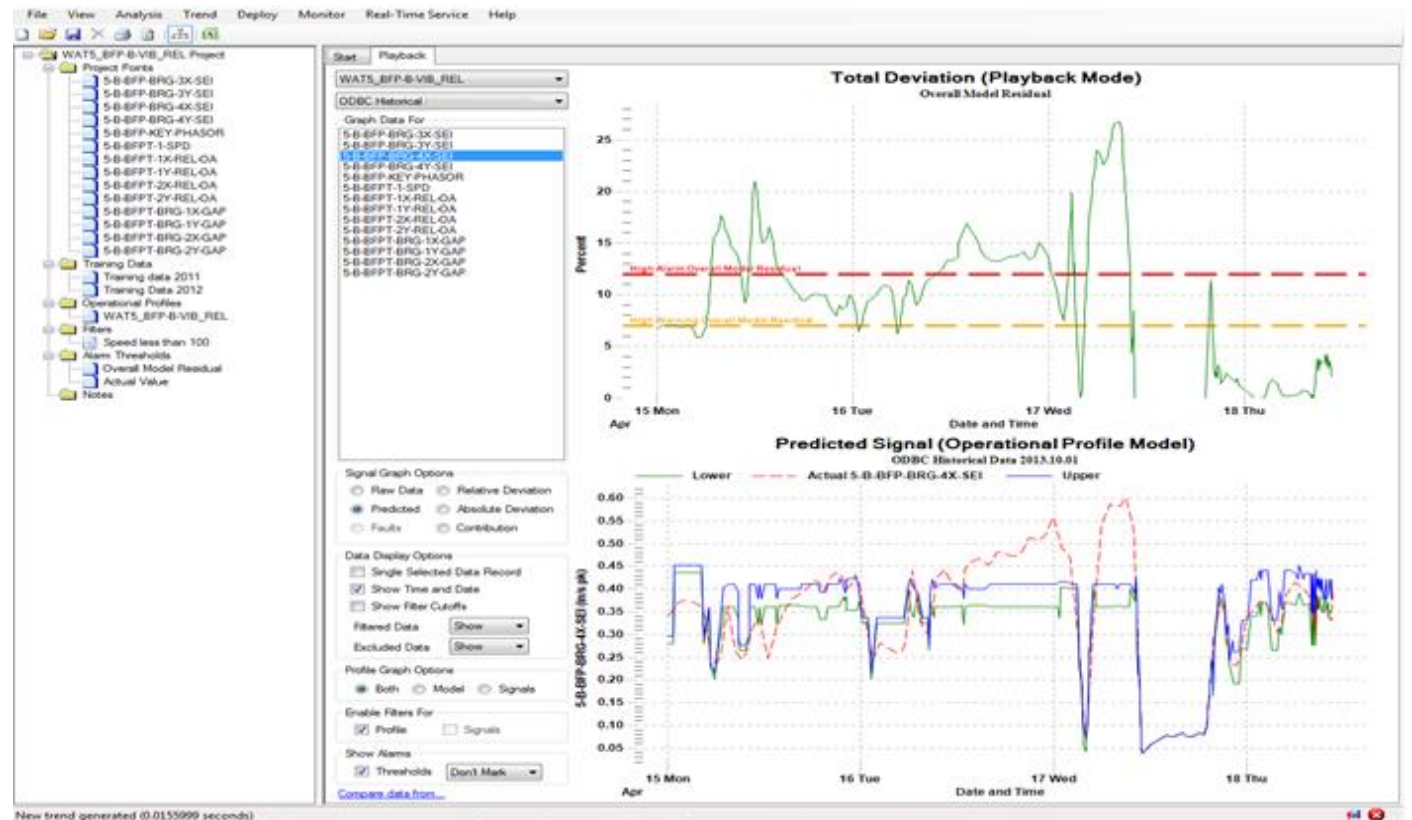
Early warning catch BFP coupling shim pack

Observation

- Model is indicating an increase in vibration on multiple bearings

Results

- A BFP coupling shim pack that was on the verge of failure
- Estimated avoided cost - \$260,000



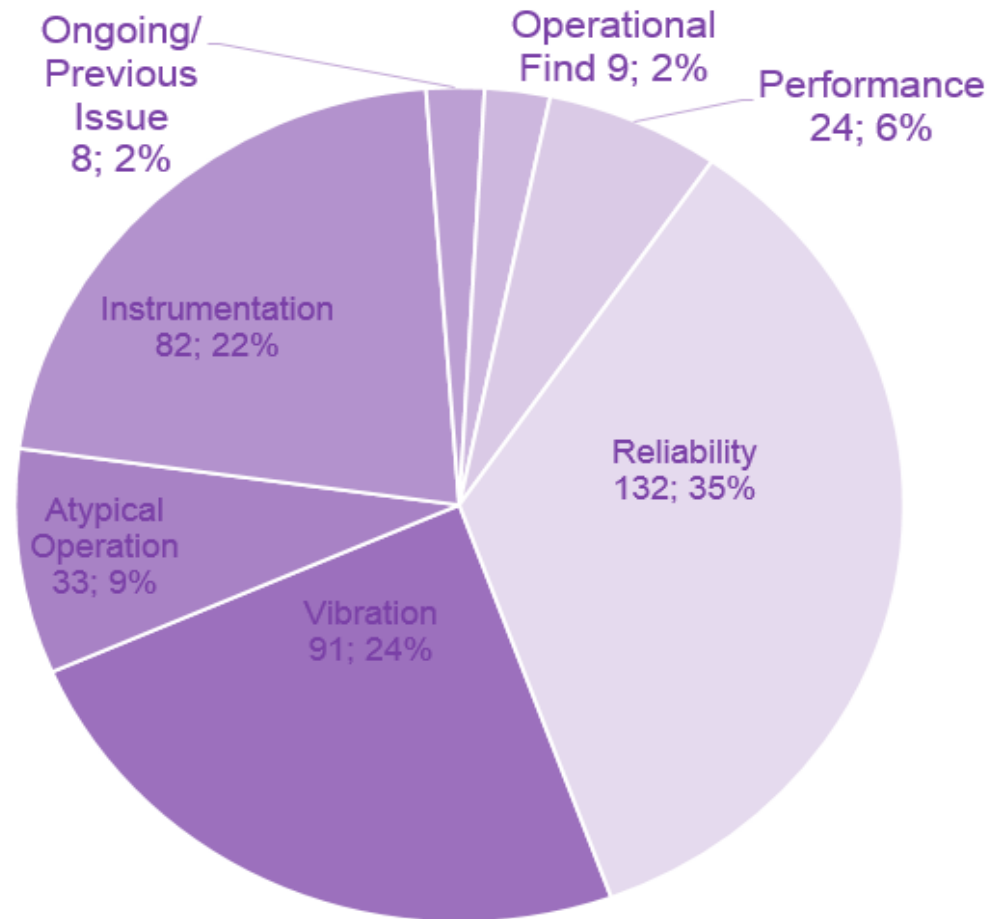
Letter of Thanks from Plant Manager



"I just wanted to let you know what a great job your guys are doing. We received a call this morning from the M&D Center notifying us of a change in vibration that was noticed on our 5B BFP. Further investigation has revealed that we had a coupling shim pack that was on the verge of failure. Had it not been for the attentive work of the M&D Center staff we could have been facing a potentially catastrophic event. Thanks to their dedication and commitment to excellence we potentially averted a disaster. We still have some work to do to make repairs and return the pump to service, but we are truly grateful that we are not facing a worse situation thanks to your team."

Issues Identified with AVEVA Predictive Analytics

- Early indication of potential reliability issues
- Identification of operating anomalies



Air Liquide

Partners with AVEVA for Predictive Asset Analytics

- **Challenges**
 - Our competitor had a successful pilot running with the customer and customer was far into their decision process
 - We had not previously monitored some of the compressor types that Air Liquide wanted to monitor
- **Solution**
 - PI System is deployed as real-time industrial data infrastructure solution provides incident analysis, asset performance reporting and situational awareness.
 - Air Liquide has centrally deployed AVEVA Predictive Asset Analytics software in 3 remote monitoring centers (Europe, North American and Asia) for monitoring their critical production assets (compressors, motors, turbines, etc.)
 - The software will be deployed for monitoring up to 500 of their large industries plants as part of their Smart Innovative Operations digital transformation program
- **Results**
 - Ability to effectively plan and schedule maintenance and outages around customer demand
 - Early warning detection and diagnosis of equipment problems
 - Predictive monitoring of critical assets (compressors, pumps, expanders, turbines, etc.)

“ Reliably and confidently meeting customer commitments with their SIO Predict program. ”



World's Largest
Supplier of industrial gases



Plan to deploy globally at
500
large industries plants



More than
98,000
Employees globally

Total

Selects AVEVA for Predictive Analytics

- Challenges
 - Our competitor had a significant install base of their software at Total for many years for the upstream side of Total's business
 - Total was looking for a solution that was easier for engineers to quickly learn
- Solution
 - PI System is deployed as the real-time industrial data infrastructure for the Total business.
 - AVEVA was able to demonstrate to Total that AVEVA's Predictive Analytics was best in class predictive maintenance solution resulting in AVEVA being selected for the entire downstream business.
- Results
 - Improved the reliability of Total refining operations
 - Early warning detection and diagnosis of equipment problems
 - Predictive monitoring of critical assets (compressors, pumps, expanders, turbines, etc.)



“ Improving the reliability and performance of critical assets with predictive analytics. ”



2.5 million
barrels of oil per day



4th largest
international oil
and gas major



More than
98,000
Employees globally

AVEVA™

Digital Transformation

Centralized Monitoring

Integrated monitoring center supporting remote operations and decision making

Digital Twin

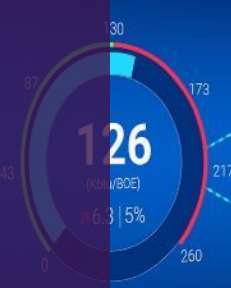
Adding AVEVA Predictive Analytics for 10,000 assets

Installation completed remotely securely & to time, during lockdown

ENERGY INTENSITY KPI

CORPORATE

ENERGY INTENSITY KPI



DOWNSTREAM

ENERGY INTENSITY KPI



ENERGY (MMBtu/h)

71.0K
-2.4 | 4%

PRODUCT (MMbbl/d)

13.6K
-226.0 | 2%

UPSTREAM

ENERGY INTENSITY KPI



ENERGY (MMBtu/h)

71.0K
-2.4 | 4%

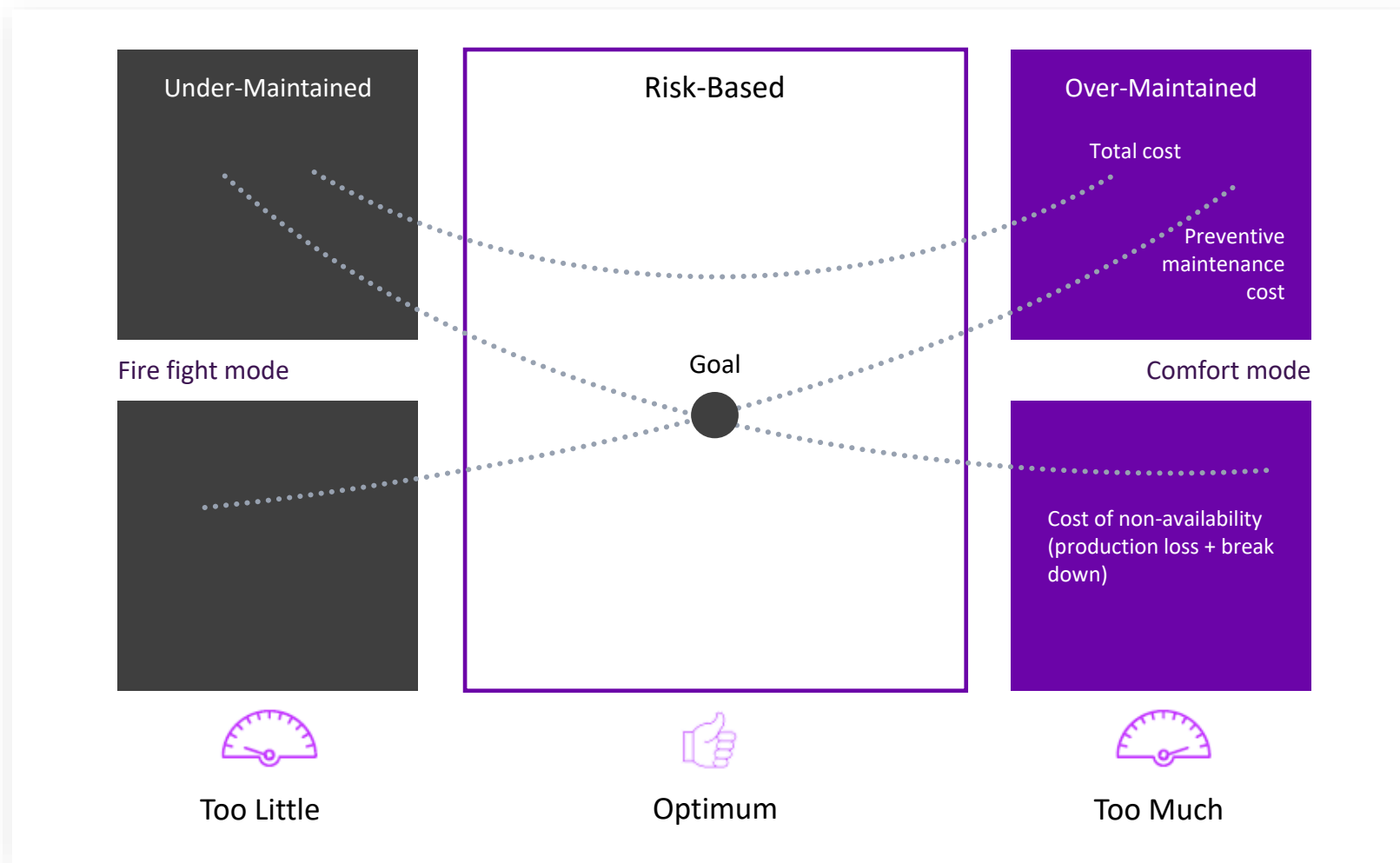
PRODUCT (MMbbl/d)

13.6K
-226.0 | 2%

HYDROCARBON DISCHARGE TO MARINE



Is your asset strategy optimized?



- Reduce Downtime
- Prevent Asset Failures
- Reduce Maintenance Costs
- Improve Safety
- Extend Equipment Life
- Optimize Asset Strategy



Why Now?

10%-20% OPEX SAVINGS



“Few technology areas will have greater potential to improve the financial performance and position of a commercial global enterprise than Asset Performance Management.”


Stephen Prentice, Gartner


AVEVA™

We'll take you there.

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ABOUT AVEVA

AVEVA is a global leader in engineering and industrial software driving digital transformation across the entire asset and operational life cycle of capital-intensive industries.

The company's engineering, planning and operations, asset performance, and monitoring and control solutions deliver proven results to over 16,000 customers across the globe. Its customers are supported by the largest industrial software ecosystem, including 4,200 partners and 5,700 certified developers. AVEVA is headquartered in Cambridge, UK, with over 4,400 employees at 80 locations in over 40 countries.

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