AI Driven Reliability and Performance

The end of unplanned downtime is here

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Industry challenges

Predictive maintenance can enable **10-20% reduction in OPEX**

Maintenance and performance optimization

70%

Operators are unaware of when to replace, upgrade or maintain assets [3]

Asset failures

82%

82% of asset failures are random[1]

Unscheduled downtime avoidance

$260K

Average cost of industrial asset downtime/hour [2]

Safety risk management

Major accident hazards

Failure to address major accident hazards leads to injury, loss of profits and reputational damage

Sources: 1. Arcweb.com, 2.Aberdeen 3. Vanson Bourne

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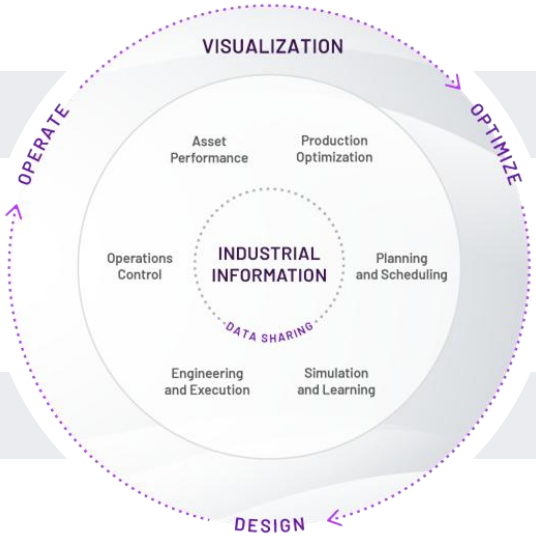
Convergence of two world-class software experts

Delivering end-to-end customer value with best of breed industrial software

AVEVA Connect cloud services platform and AVEVA Flex subscription program

AVEVA

Comprehensive industrial software to optimize engineering and operations



OSIsoft

PI System is the industry standard for industrial information management

1 Better data
Accuracy, reliability, context, scope and scale

2 Smarter solutions
With better integration, while maintaining neutrality

3 Proven results
Efficiency, agility, reliability, sustainability

Big Data | Industrial IoT/Edge | Cloud | Artificial Intelligence | Digital Twin | Connected Worker

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AVEVA

Delivering a complete digital thread, purpose-built for industry

Accelerate time to value with flexible, scalable, and trusted industrial hybrid SaaS solutions

DESIGN → OPERATE → OPTIMIZE

OPEN AND AGNOSTIC

Visualization

Multi-experience engineering and operations visualization across the enterprise

3rd party visualization

Simulation and Learning
Process simulation, operator training, enterprise learning

Engineering and Execution
Engineering, 3D design, project execution

Operations Control
Edge, supervisory, enterprise control

Asset Performance
Asset strategy, asset analytics, maintenance execution

Production Optimization
Operations execution, process optimization, production management

Planning and Scheduling
Feedstock management, supply chain planning and scheduling

3rd party apps and analytics

Industrial Information Management

Engineering: Engineering data collection, aggregation, storage and contextualization ⟷ **Operations:** Real-time data collection, aggregation, contextualization, events and self-service calculations

3rd party data sources, systems, and databases

DATA SHARING

SUPPORT YOUR HYBRID CLOUD ARCHITECTURE

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Delivering a complete digital thread, purpose-built for industry

Accelerate time to value with flexible, scalable, and trusted industrial hybrid SaaS solutions

DESIGN → OPERATE → OPTIMIZE

OPEN AND AGNOSTIC

Visualization

Asset Performance

Asset Strategy
Define, measure and optimize your strategy

- Reliability Centered Maintenance (RCM)
- Comprehensive asset library
- Asset strategy simulation and optimization
- Failure mode and effect analysis (FMEA)

Asset Analytics
Reduce unplanned downtime

- Predictive and prescriptive maintenance
- Time to failure forecast
- Root cause analysis (RCA)
- Case and collaboration management
- Comprehensive model template library and fault diagnostics

Asset Maintenance
Improve safety and reliability

- Mobile maintenance execution and workflows
- Condition-based maintenance
- Digital work permitting
- Safe job analysis

Industrial Information Management

Engineering: Engineering data collection, aggregation, storage and contextualization ⟷ **Operations:** Real-time data collection, aggregation, contextualization, events and self-service calculations

3rd party visualization

3rd party apps and analytics

3rd party data sources, systems, and databases

DATA SHARING

SUPPORT YOUR HYBRID CLOUD ARCHITECTURE

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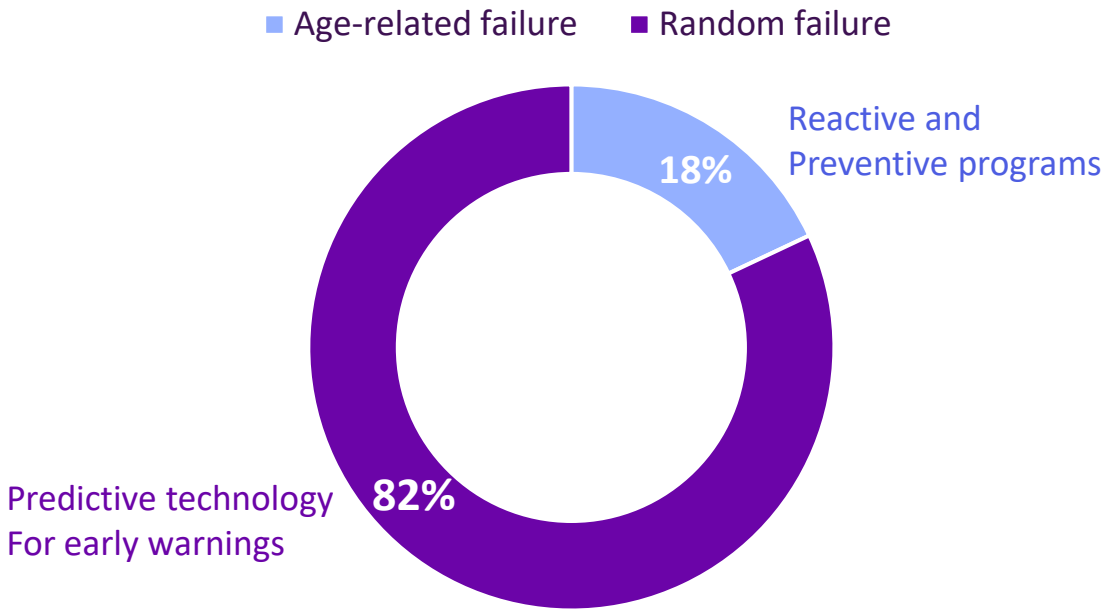
Optimize your asset reliability, maintenance and performance

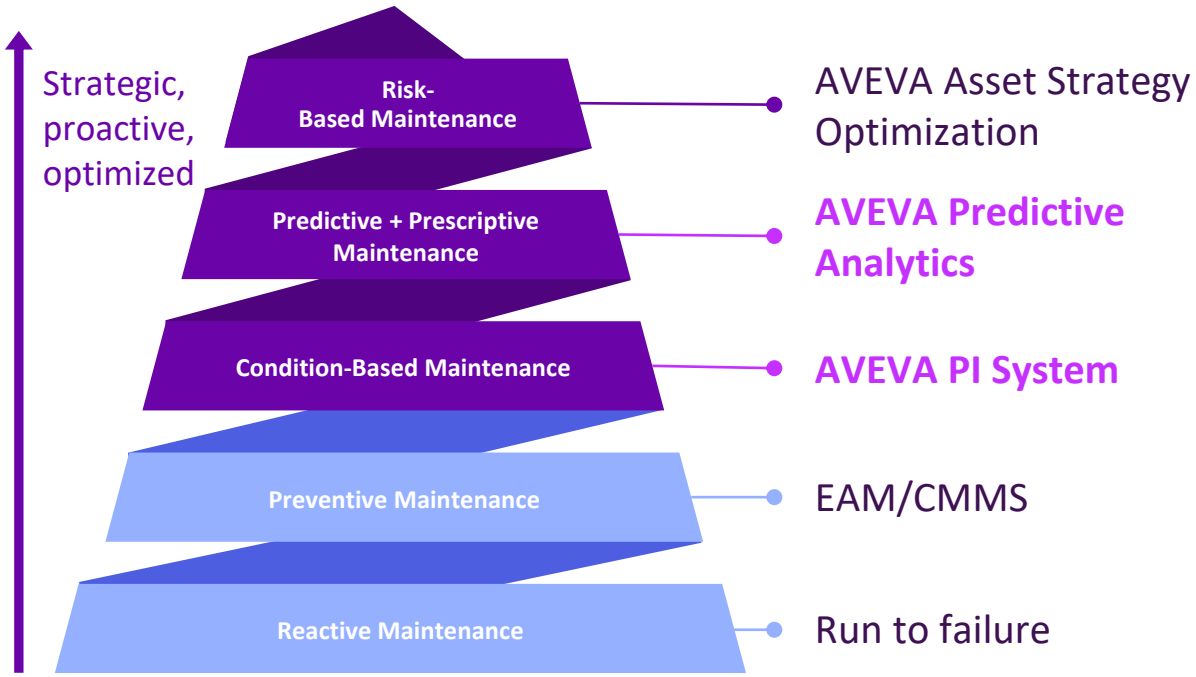
A journey in operational reliability with AVEVA PI System and AVEVA Predictive Analytics

Failure patterns



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



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Asset Performance - Leadership and Innovation

FROST & SULLIVAN

The Frost Radar - APM

VERDANTIX

Green Quadrant - APM

IDC Analyze the Future

MarketScope Worldwide - APM

Source: IDC, 2020

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AVEVA

Aveva Predictive Analytics + PI System

Air Liquide

Air Liquide uses AVEVA for SIO Predict digital transformation program

Artificial Intelligence based predictive analytics for early warning notification and diagnosis of equipment and process problems

Total

Total uses AVEVA for centralized predictive asset health and performance monitoring of assets

Artificial Intelligence based predictive analytics for early warning notification and diagnosis of equipment and process problems

BASF

BASF uses AVEVA for digital transformation initiative

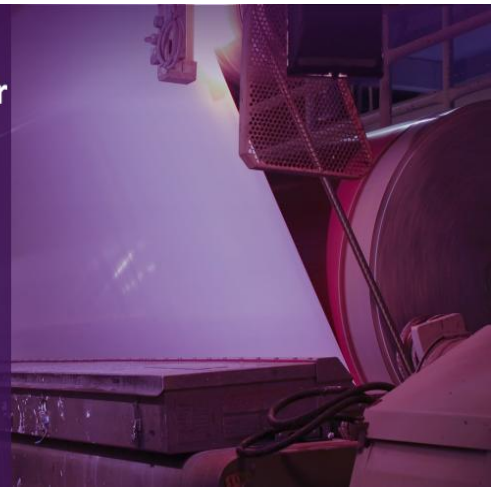
Artificial Intelligence based predictive analytics for early warning notification and diagnosis of equipment and process problems and augmented reality

International Paper

The Mill of the Future

Putting data governance to work

Streamline and improve performance, and accelerate sound and real-time decision making



Duke Energy

Duke Energy uses AVEVA for predictive fleet asset health and performance monitoring

Enabling $100's millions saving

Early warning identification and diagnosis of equipment problems – improved reliability and performance

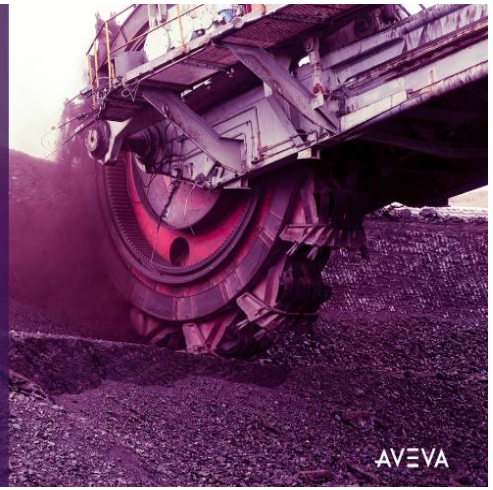
Rio Tinto

Provide advanced early warning notification and diagnosis of equipment problems and failures

Savings of SAG mill motor failure cost avoidance $12M USD

SAG mill maintenance cost avoidance $234K USD + 72 hours of downtime

Ball mill maintenance cost avoidance $146K USD



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Condition Based Maintenance - PI System

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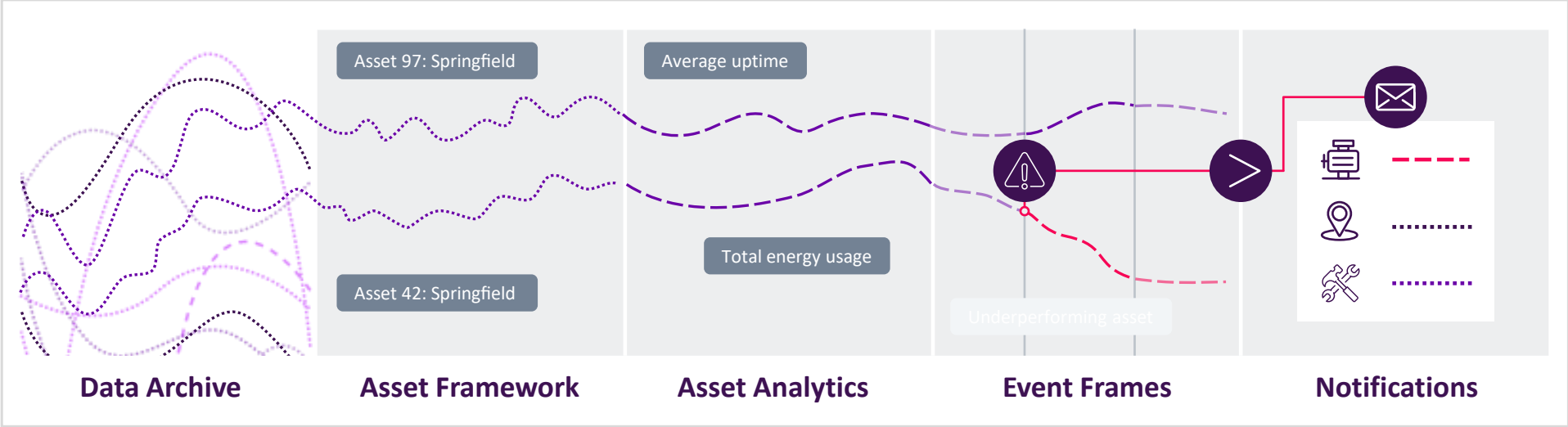
Condition-based monitoring with AVEVA PI System

Add structure and meaningful context to your operations data

Automatically **pinpoint important events** in your operations



Optimized storage & access to massive volumes of operational data

Transform raw data into actionable KPIs using streaming calculations

Send automatic alerts to the right people with the right information

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Predictive + Prescriptive Maintenance – Predictive Analytics

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Real AI, real results

Predictive failure detection for business-critical equipment

- No code AI and machine learning
- Advanced alert and case management for knowledge capture and reporting
- Data playback capability for testing models
- Templates accelerate configuration, deployment and scale-up

It’s the way you operationalize and scale AI for industrial operations

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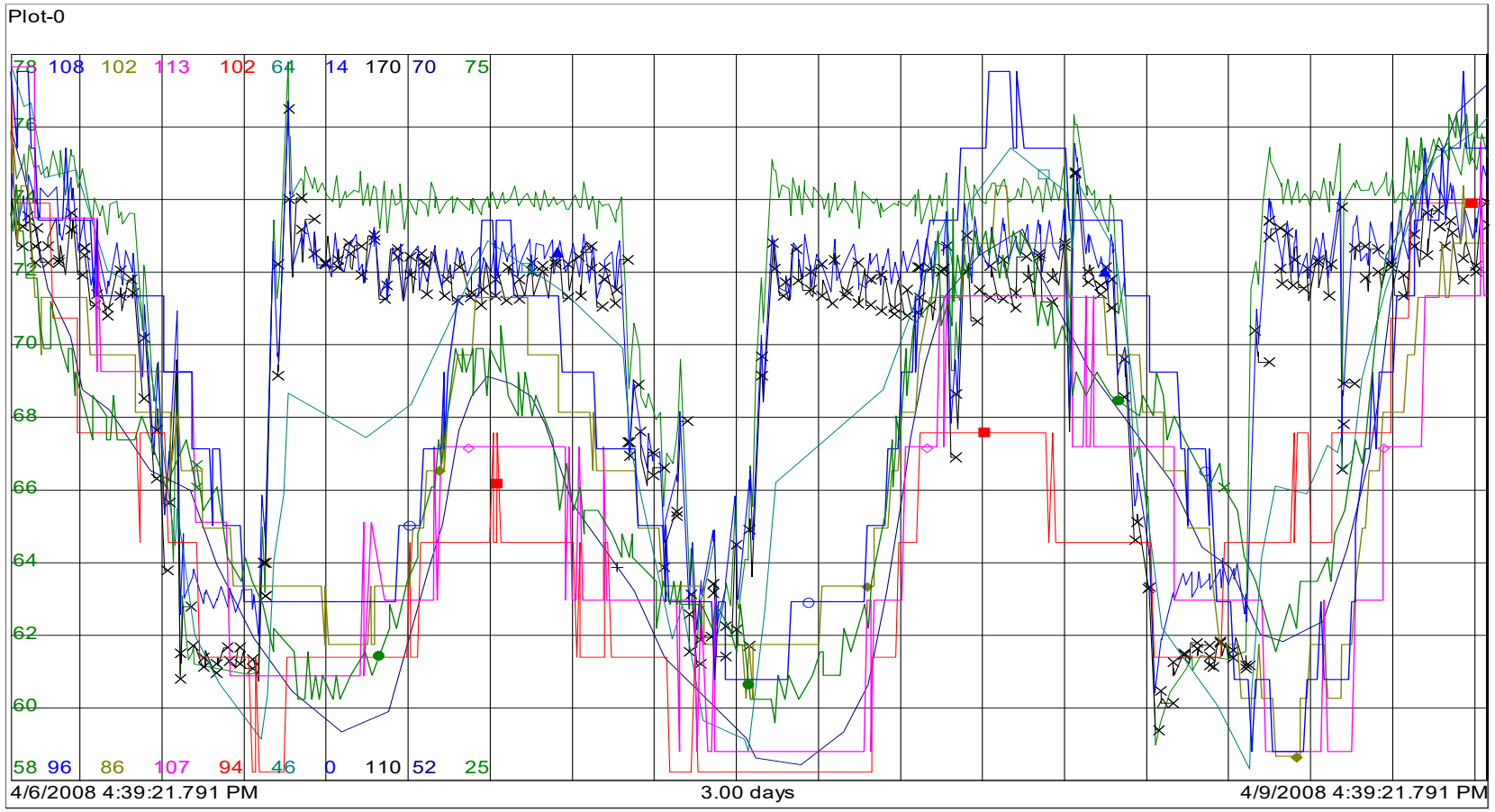
Monitoring Without Predictive Analytics



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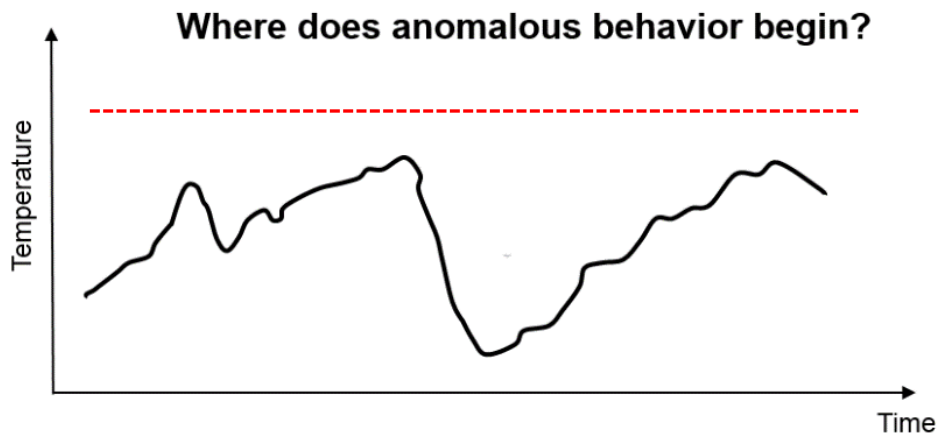
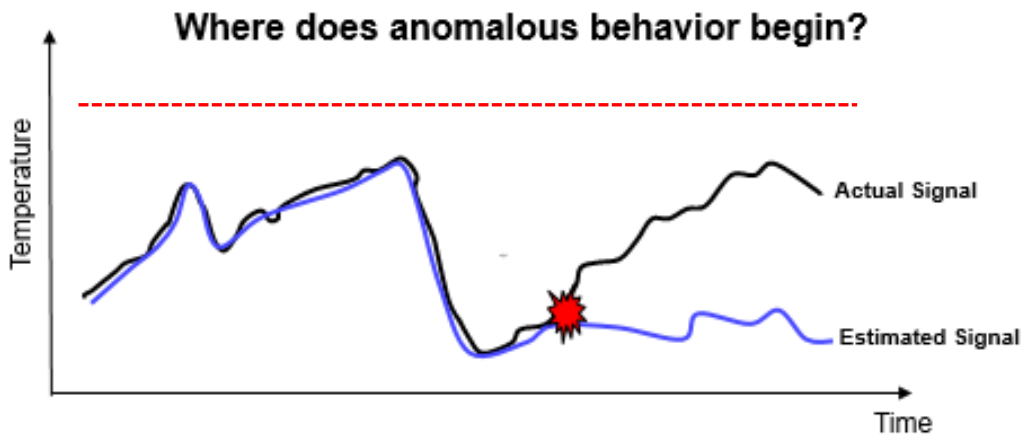
Monitoring Approach

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

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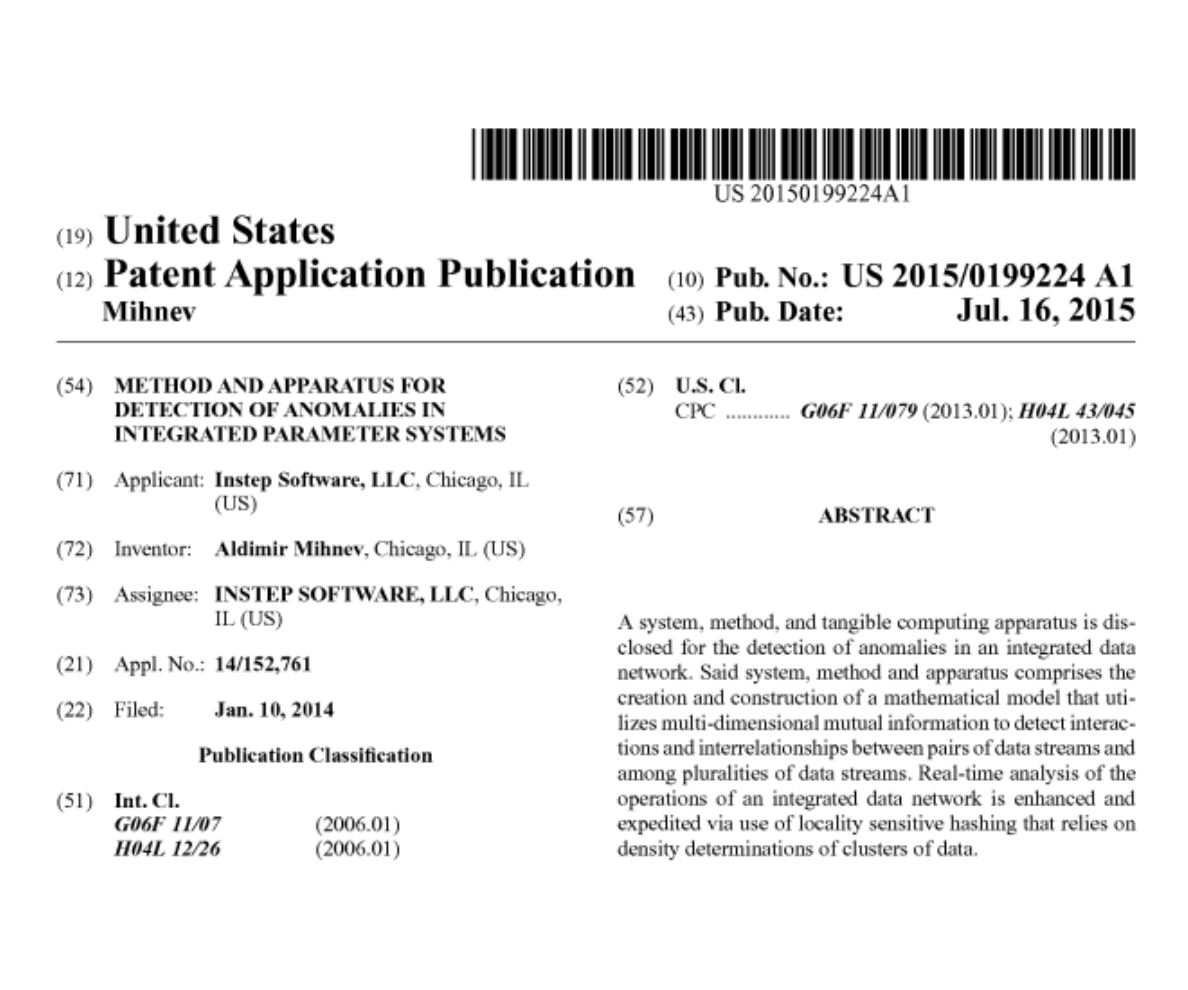
OPTiCS

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**

Mihnev

(10) **Pub. No.: US 2015/0199224 A1**

(43) **Pub. Date: Jul. 16, 2015**

(54) **METHOD AND APPARATUS FOR DETECTION OF ANOMALIES IN INTEGRATED PARAMETER SYSTEMS**

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

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

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

(21) Appl. No.: **14/152,761**

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

Publication Classification

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

(52) **U.S. Cl.**
CPC ***G06F 11/079*** (2013.01); ***H04L 43/045*** (2013.01)

(57) **ABSTRACT**

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.

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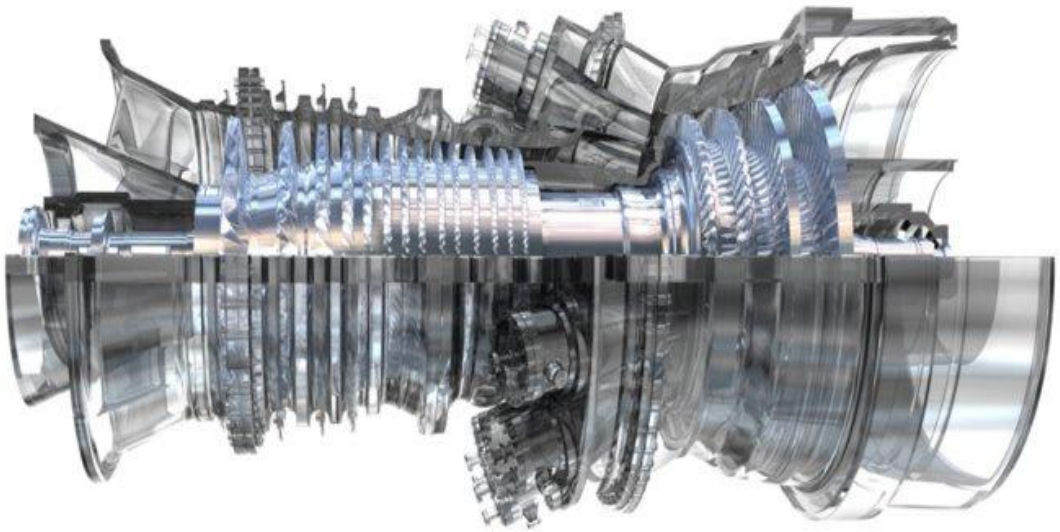
Holistic Monitoring Approach

- Compressors
- Expanders
- Pumps
- Gas Turbines
- Steam Turbines
- Motors
- Boilers
- Mills
- Gearboxes
- Heat Exchangers
- Valves
- Generators
- Fans
- Transformers
- Inverters
- Air Heaters



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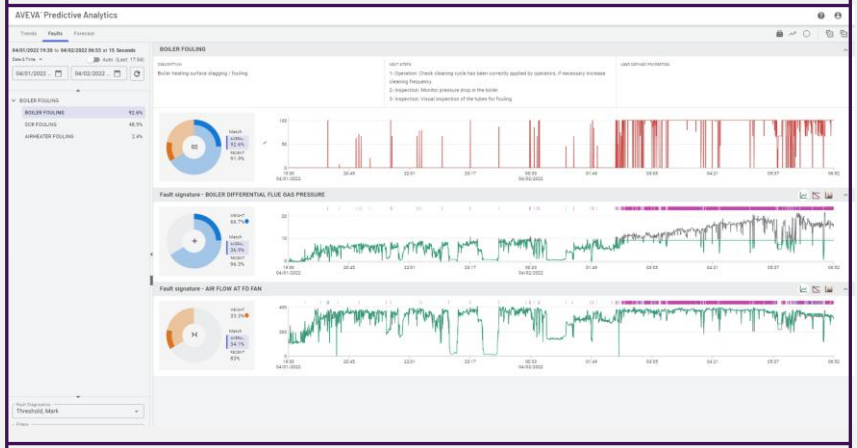
Deep and clear predictive analysis

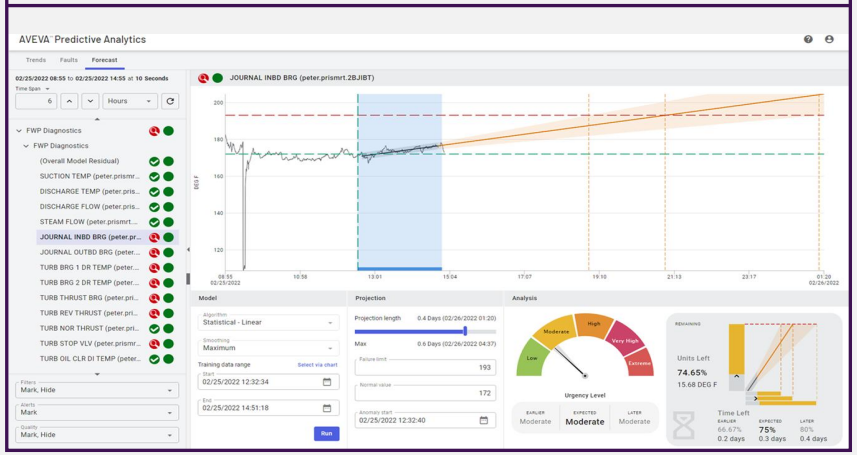
An anomaly was detected.
What are the next steps?

- Overall anomaly score trending
- Individual sensor deviations trending
- Sensor contribution score to anomaly
- Diagnostics based on sensor deviation signature
- Ranking of potential faults
- Fault match trending
- Prescriptive guidance for remediation
- Forecasting for time until failure
- Case tracking from alert inception until remediation

Which sensors are contributing to the anomaly?



What are the potential faults and related inspections?



What is the urgency level before breakpoint?

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Operational Scale Matters

Predictive Monitoring at Scale

- **Model Templates and Validation**
- **Fault + Prescriptive Diagnostics**
- **Performance Monitoring**
- **Case Management**
- **Alert Management**
- **Time Until Failure Forecast**
- **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*

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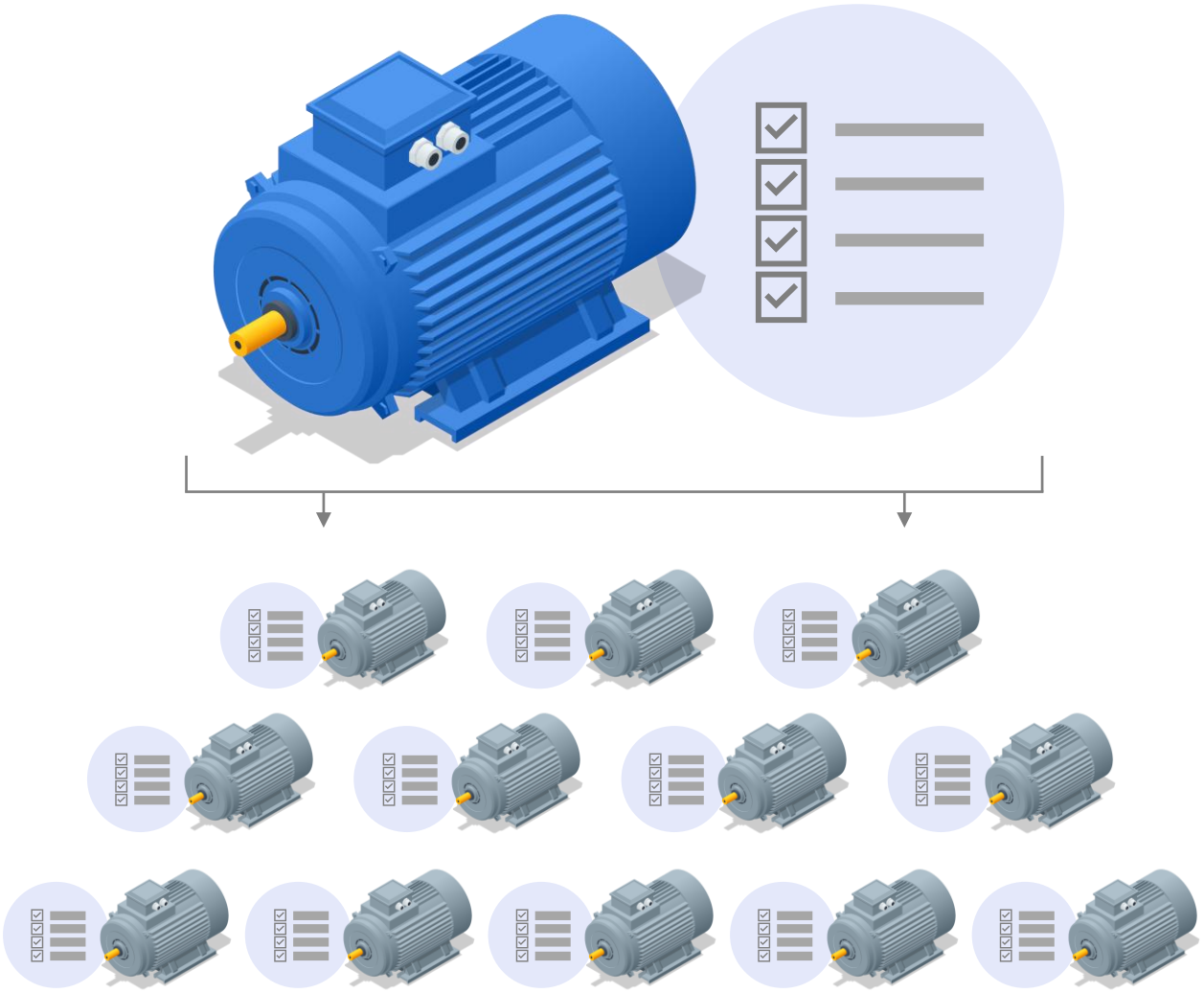
Automated model building

Deployment at scale for fast time to value

- Minimize manual work
- Model templating
- Automatic cleansing of the training data
- Automatically include filters, alert thresholds, and fault diagnostics
- Integration to PI Asset Framework or existing historian

Minimize errors
Ensure consistency
Improve labor productivity

Automated building model



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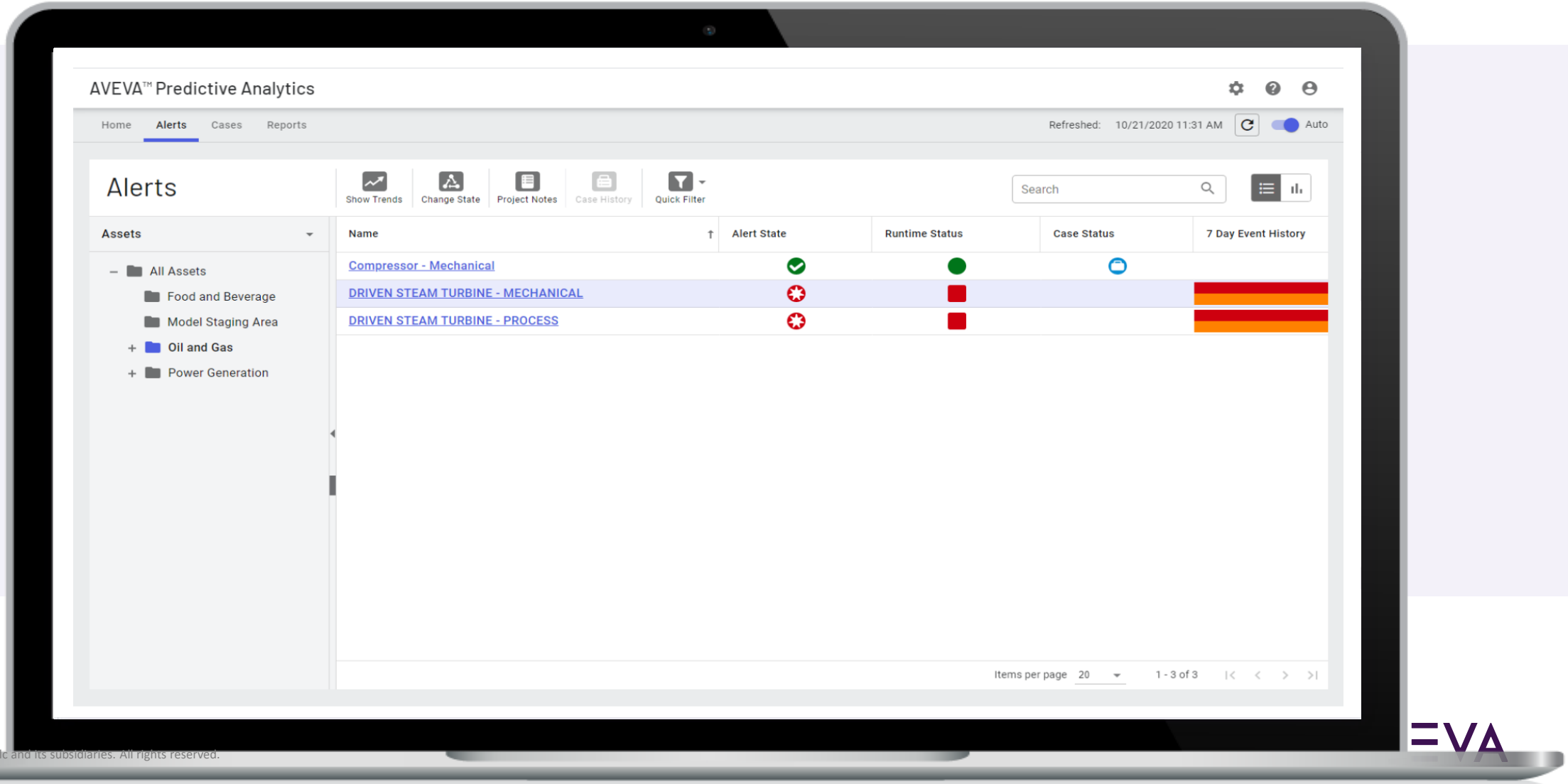
Web Alert Management and Diagnosis



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Problem Analysis

- Overall health indication
- Signal contribution to alert condition
- Signal actual vs predictive

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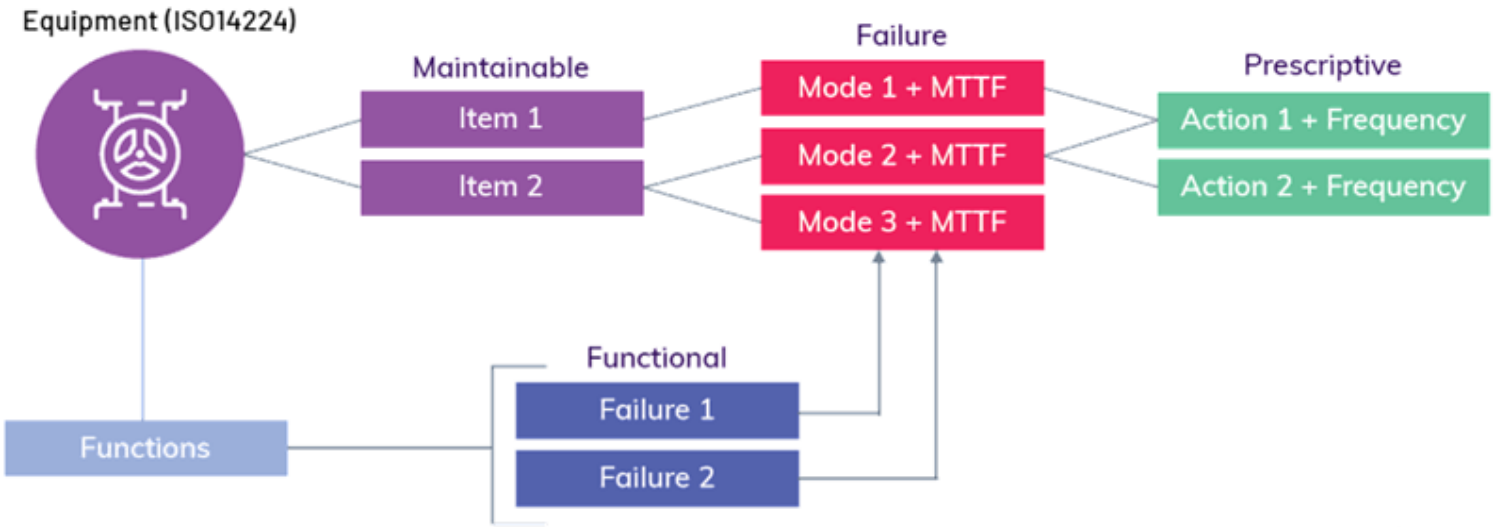
Fault + Prescriptive Asset Library - Deployment Acceleration

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

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Best in class fault diagnostics

- Visualisation and representation of fault diagnostics including fault trees for deeper insights.
- Probability on failure modes
- Remediating actions with prescriptive analytics

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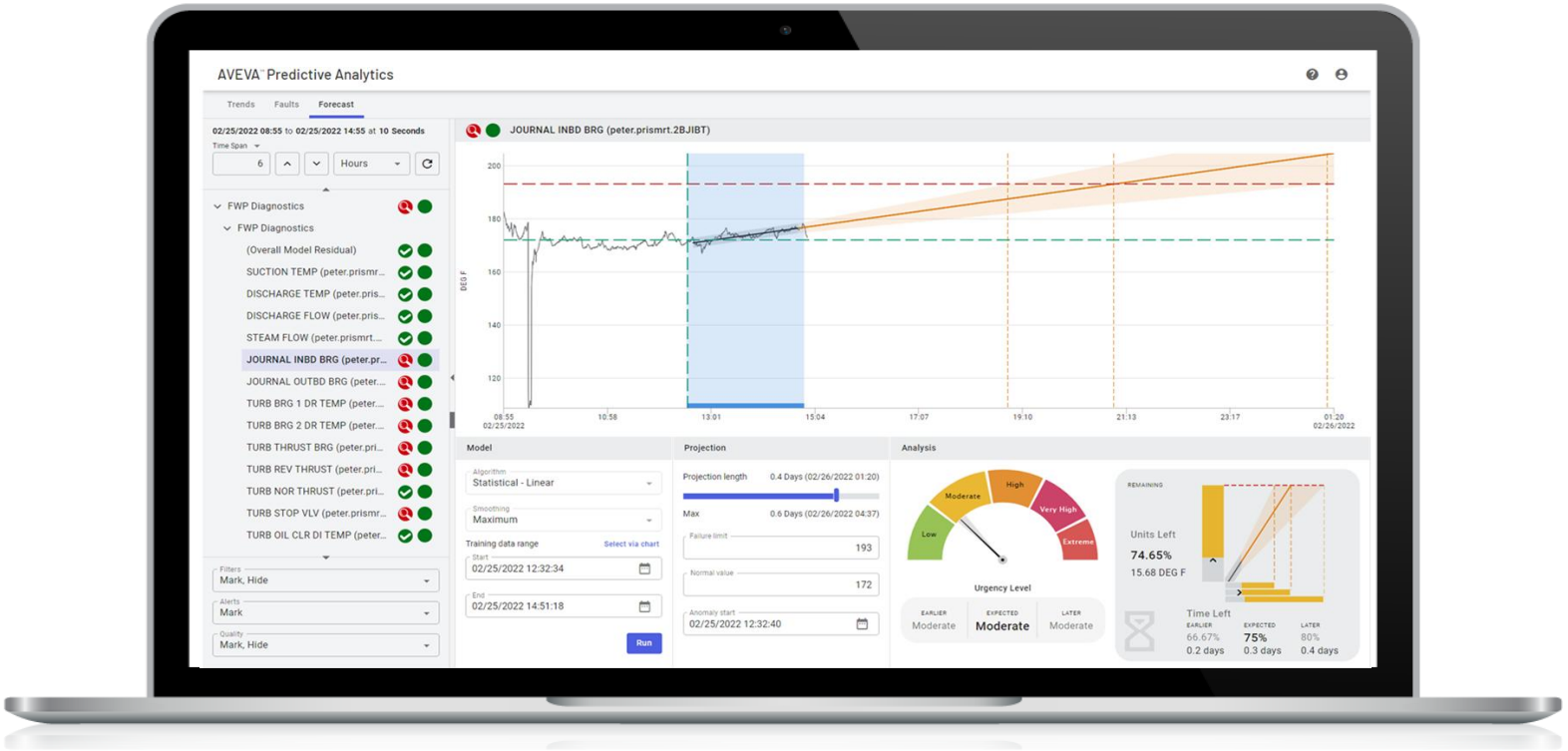
Time to failure forecast

Data driven decisions

- Determine the risk level of an operating asset and urgency for actioning the predictive alerts
- Estimate time to repair or replacement under current operating conditions



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Bring your own algorithm

Add value to current investments

Data scientists can create and deploy customized predictive algorithms while enjoying the deep pre-build functions and features of AVEVA Predictive Analytics to deploy at scale

Add value with:

- Pre-build model templates
- Automated model building
- Model back testing and validation
- Alert workflow
- Fault diagnostics
- Prescriptive actions
- Case management
- Time to failure forecasting

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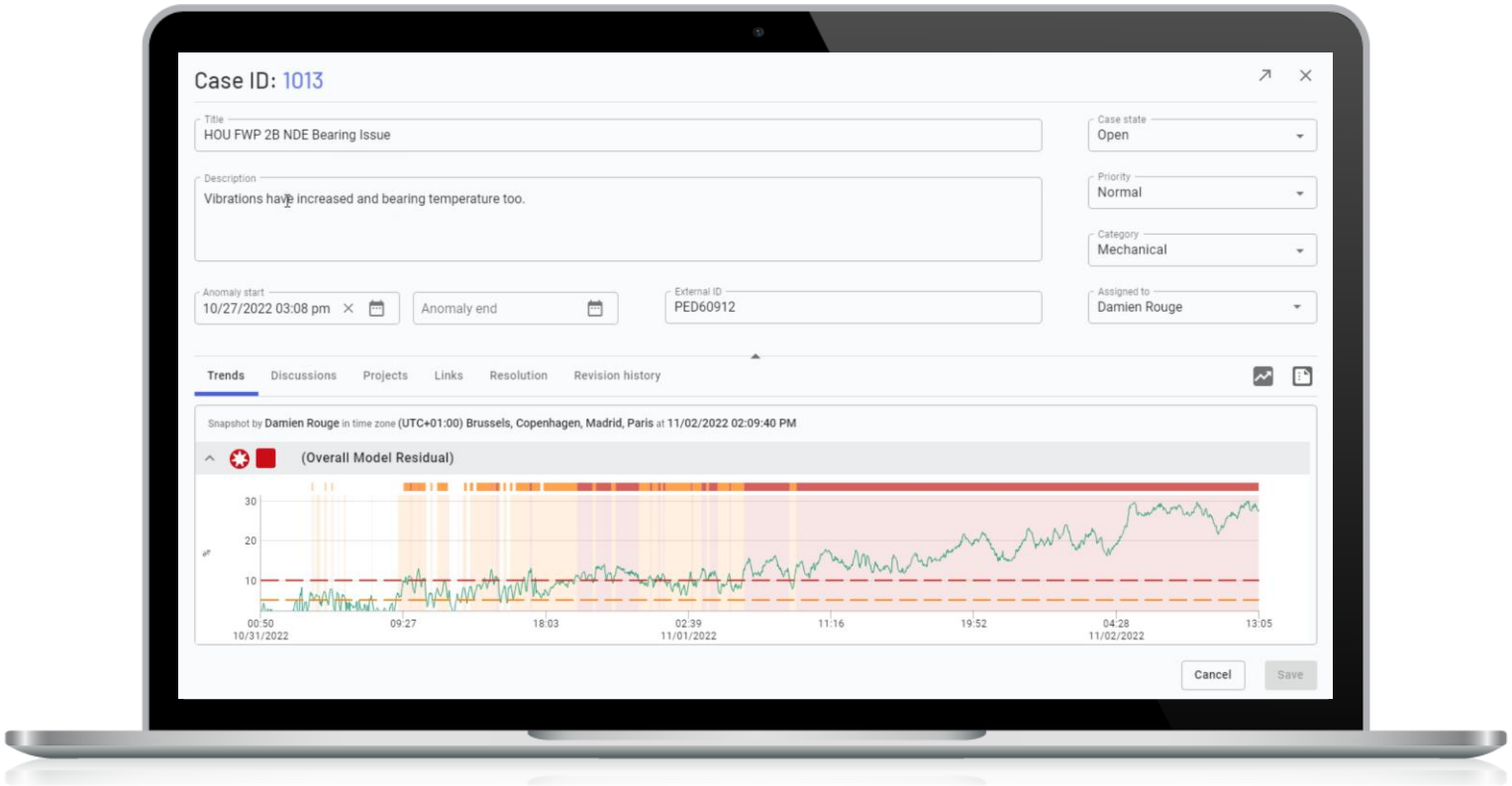
Comprehensive case management

Knowledge management for continuous improvement

- See predictive trends to cases
- Make better and faster decisions with increased access to information
- Highlight relevant cases when investigating fault diagnostics for anomalies
- Integrate the learnings of past anomalies with activities/comments from users
- Visualize trends
- Capture knowledge and best practices
- Track actions (who, what, when)



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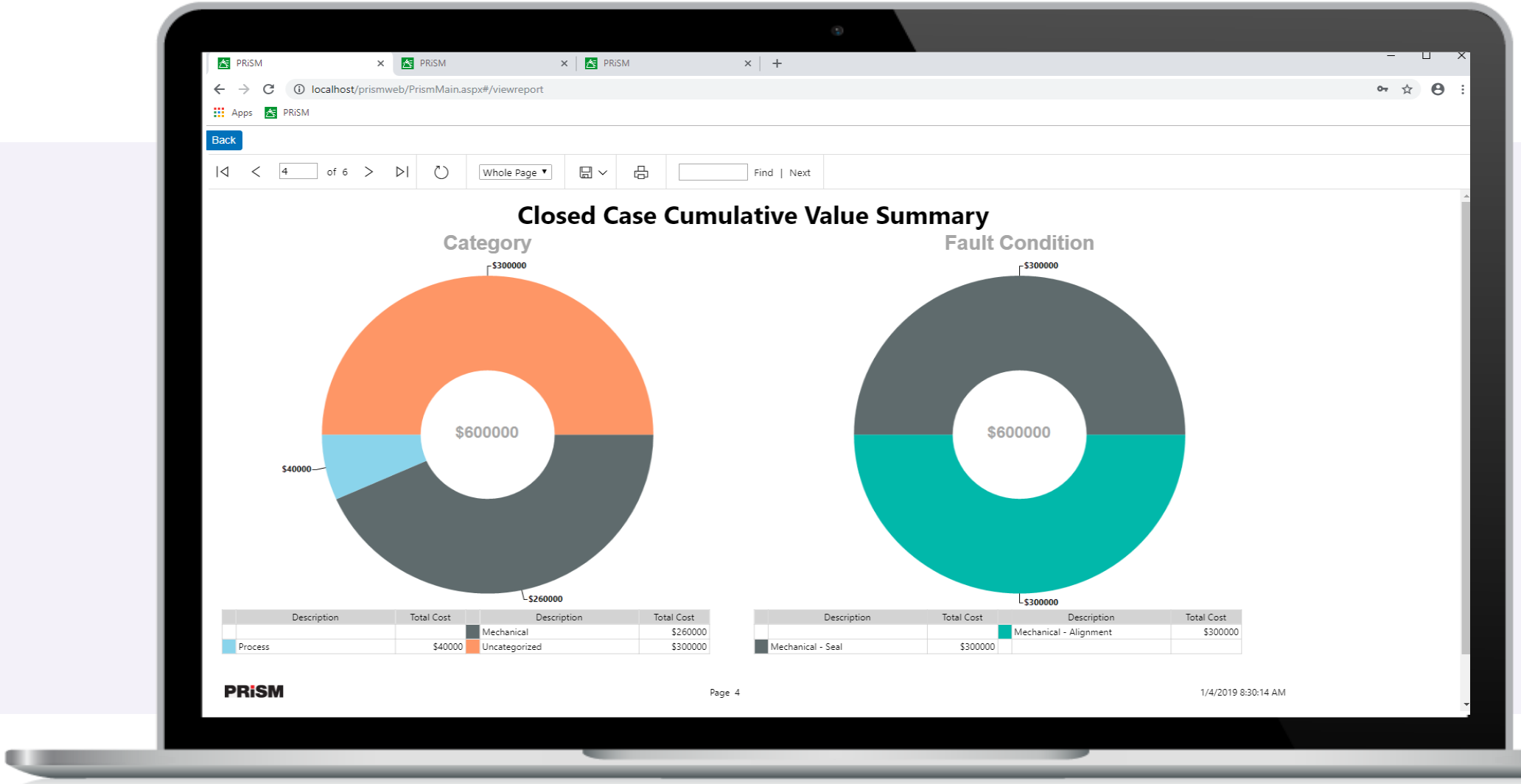
Reporting



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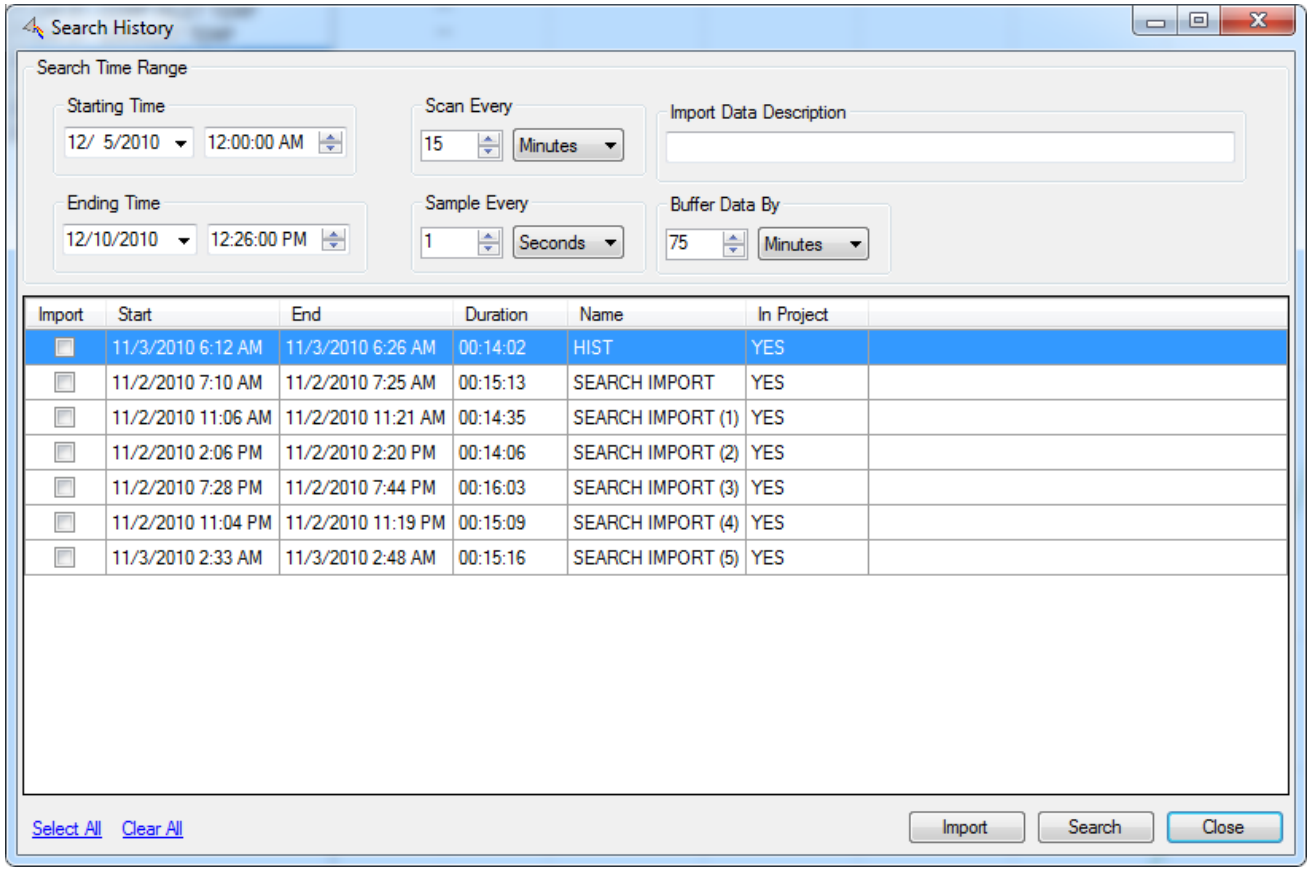
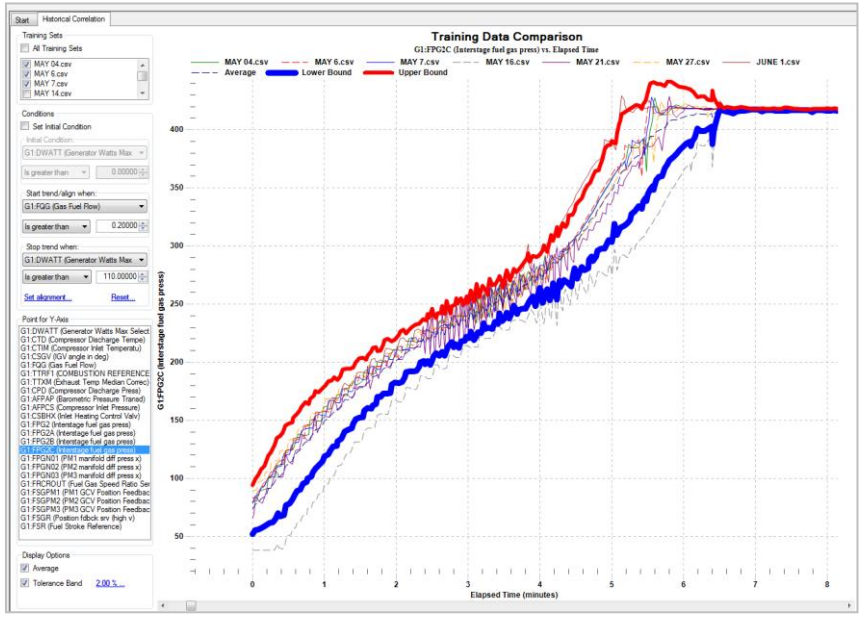
Transient Analysis



Turbine Startup/ Shutdown Monitoring



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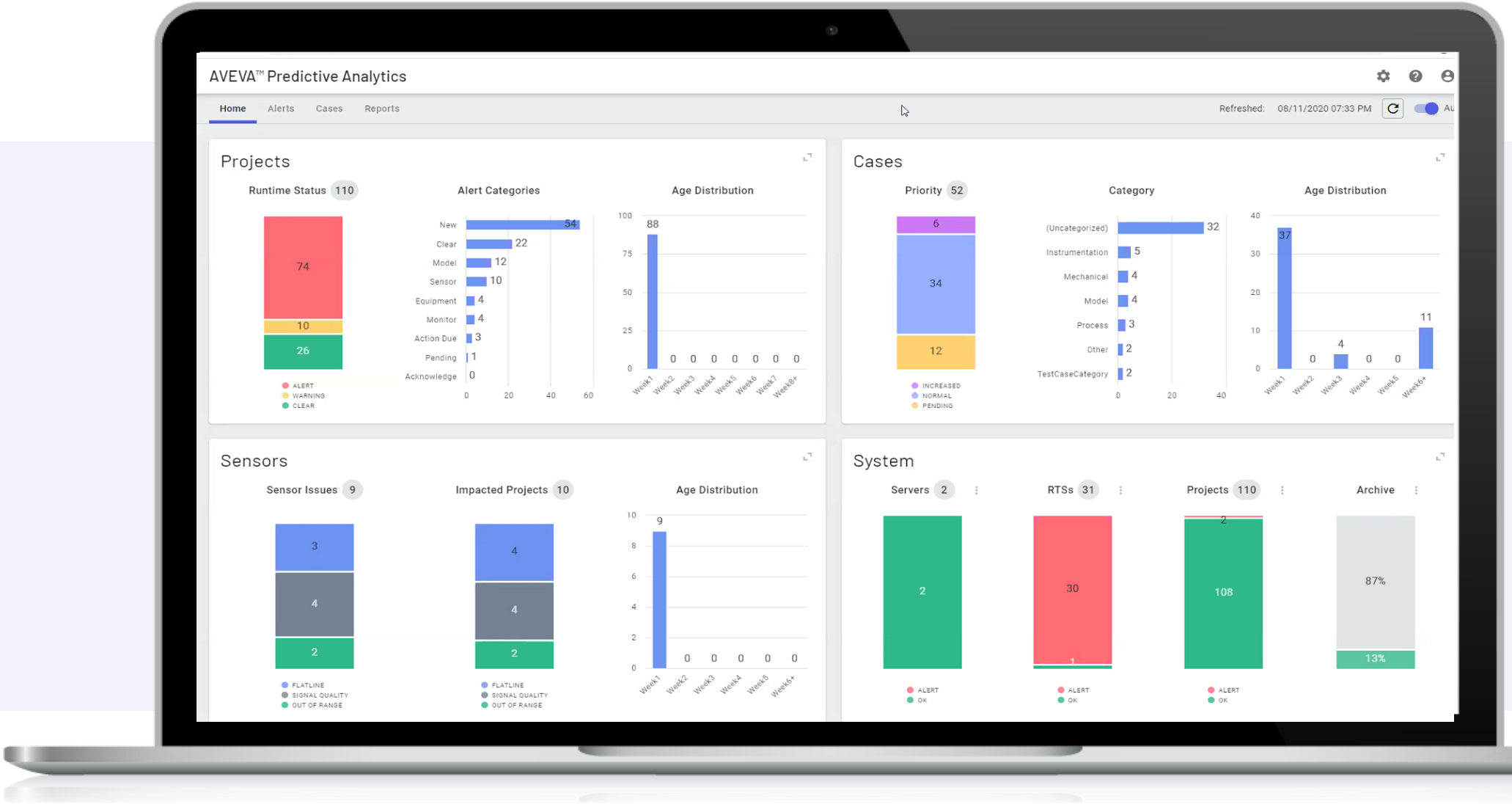
System Level Monitoring



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Deep integration to PI System

- Visibility to more people, integration of content to PI Vision
- Predictive Analytics results integrated in PI system for contextualized insights
- Integrated with PI Asset Framework enabling more efficient model building

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Case Examples

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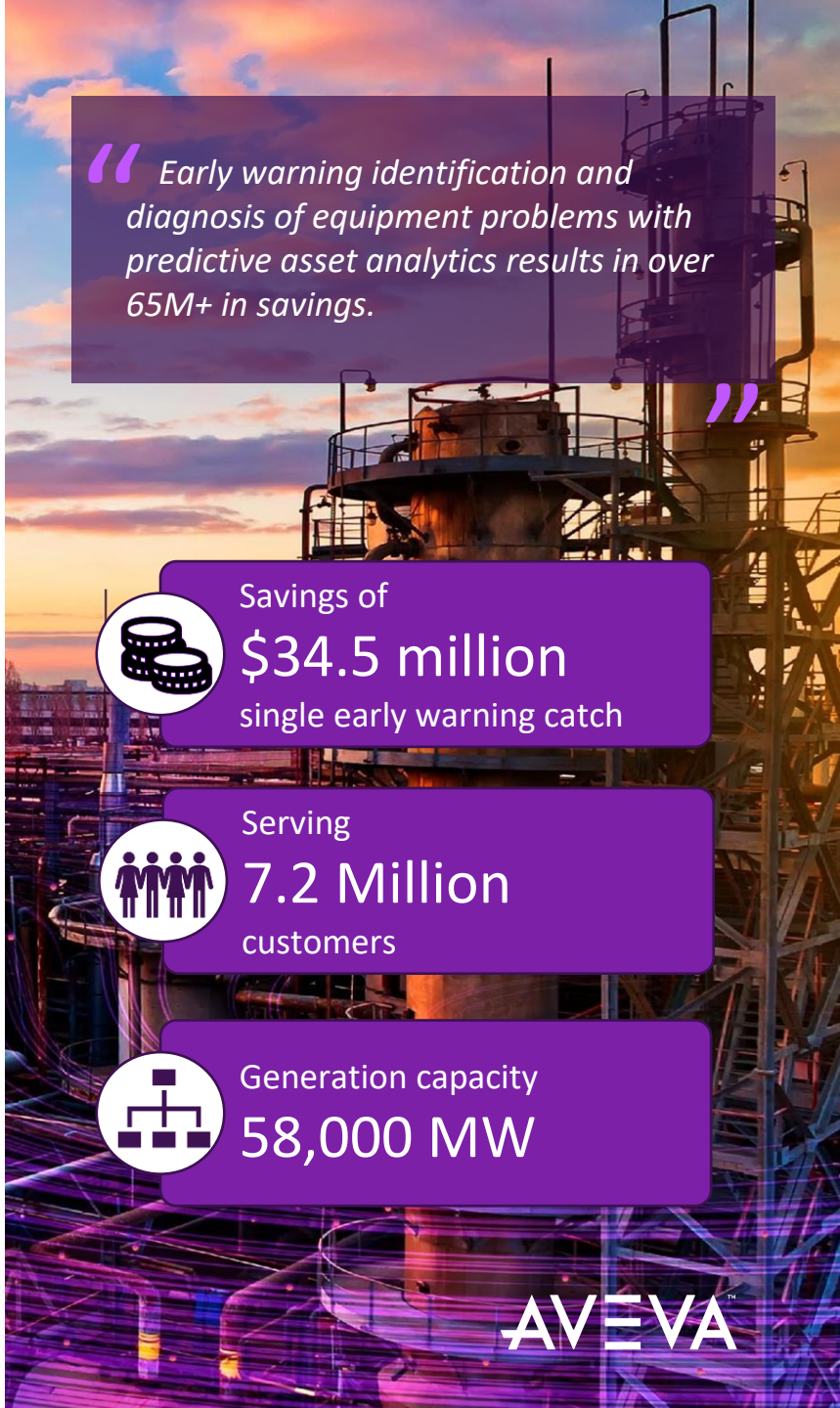
Duke Energy

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 System 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

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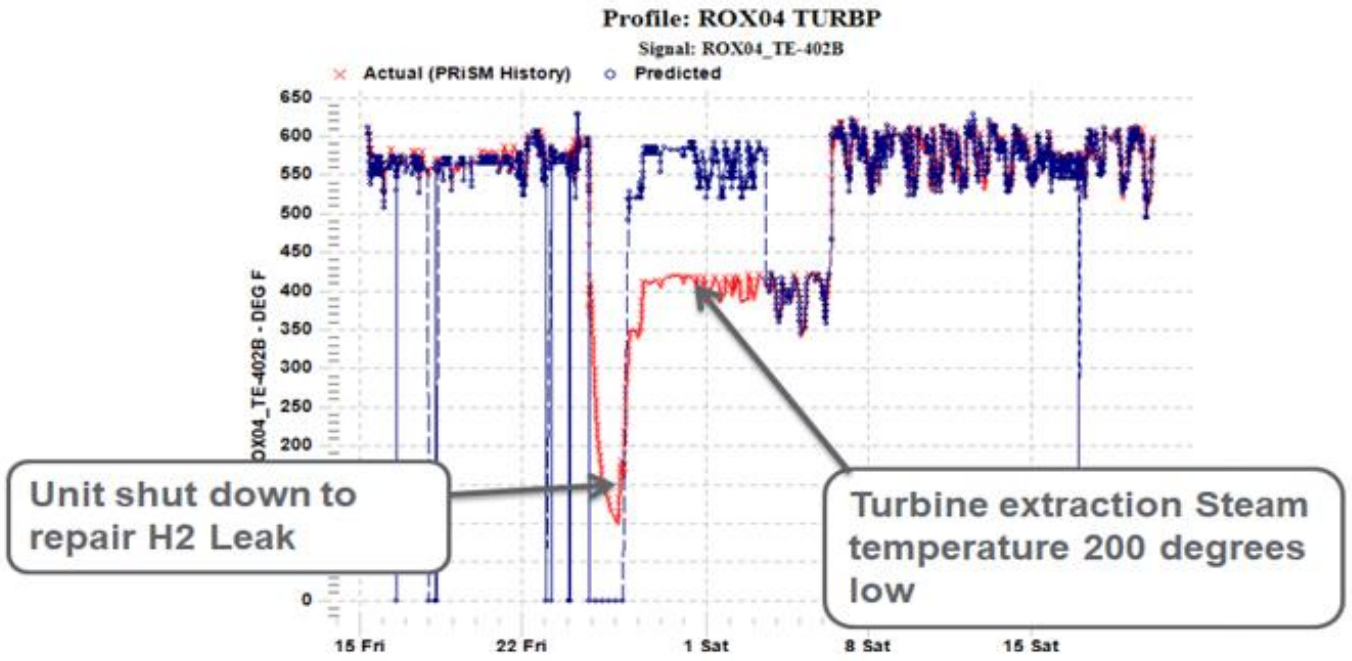
Duke Energy - Steam Turbine Efficiency Loss

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



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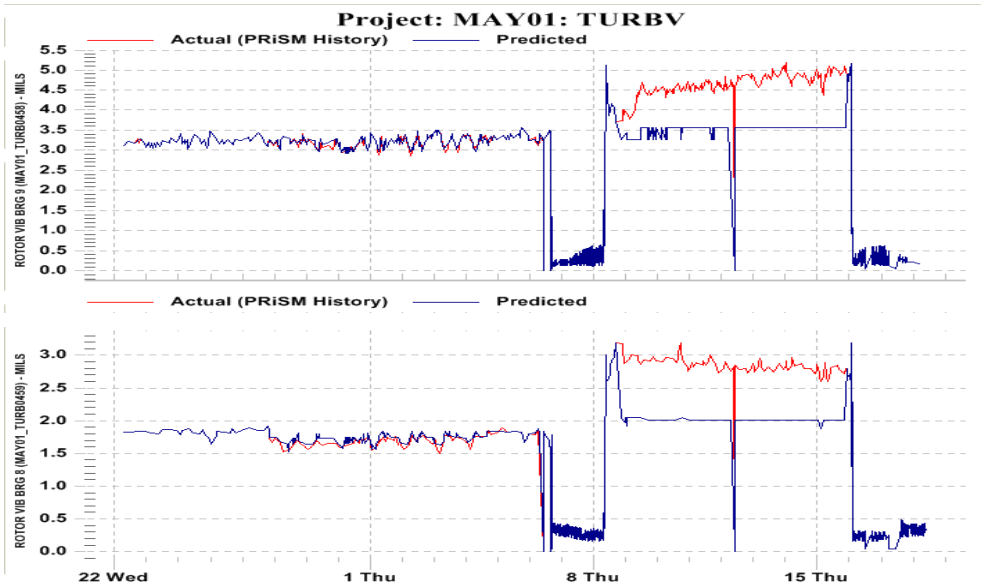
Duke Energy – LP Rotor - L-0 Blade Problem

- 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



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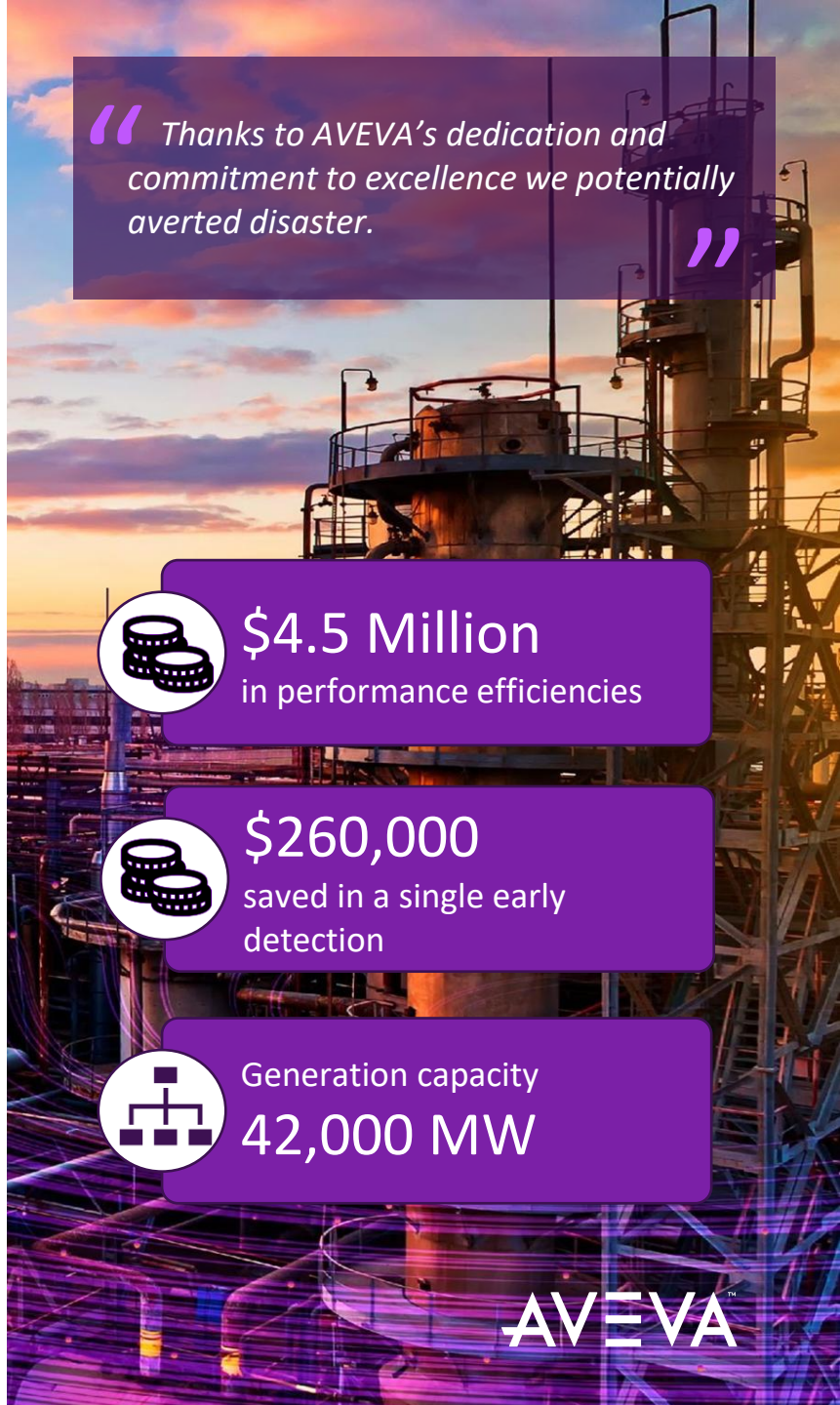
Southern Company

Achieving uninterrupted service with Predictive Analytics

- Challenges
  - Implementation of a centralized company wide predictive monitoring program to improve reliability and lower OPEX costs
- Solution
  - PI System is deployed across commercial operations, trading floor, wholesale power renewables, and retail fossil-fuel businesses
  - PI System is 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



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Southern Company – Boiler Feedwater Pump

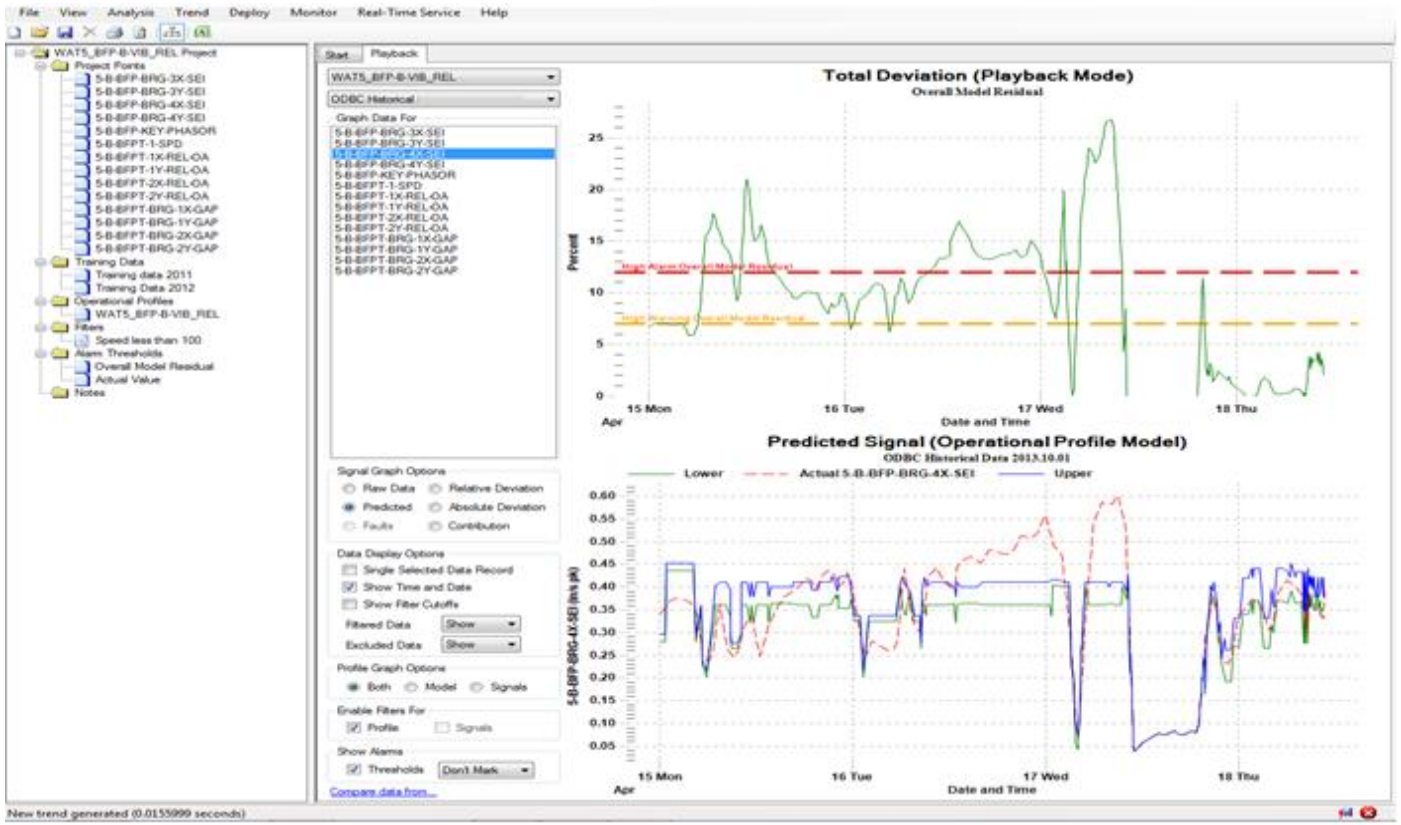
Early warning catch BFP coupling shim pack

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



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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."

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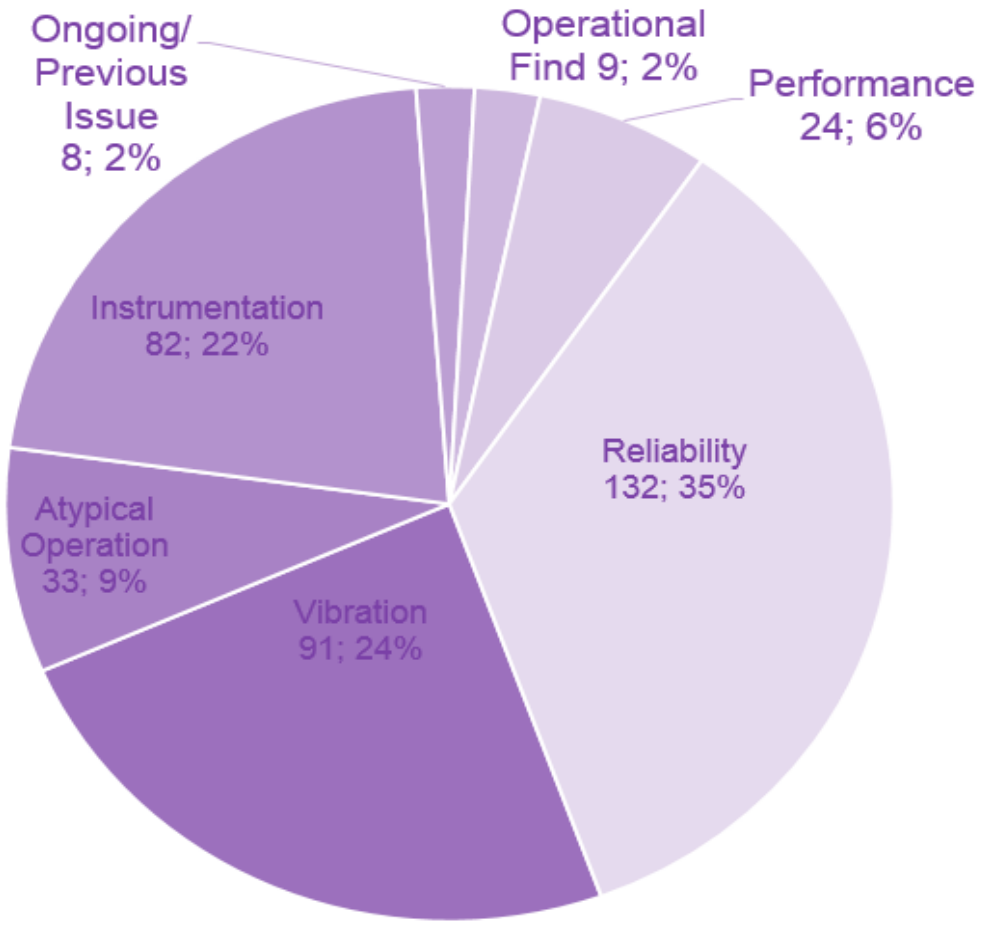
Southern Company - Issues Identified

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



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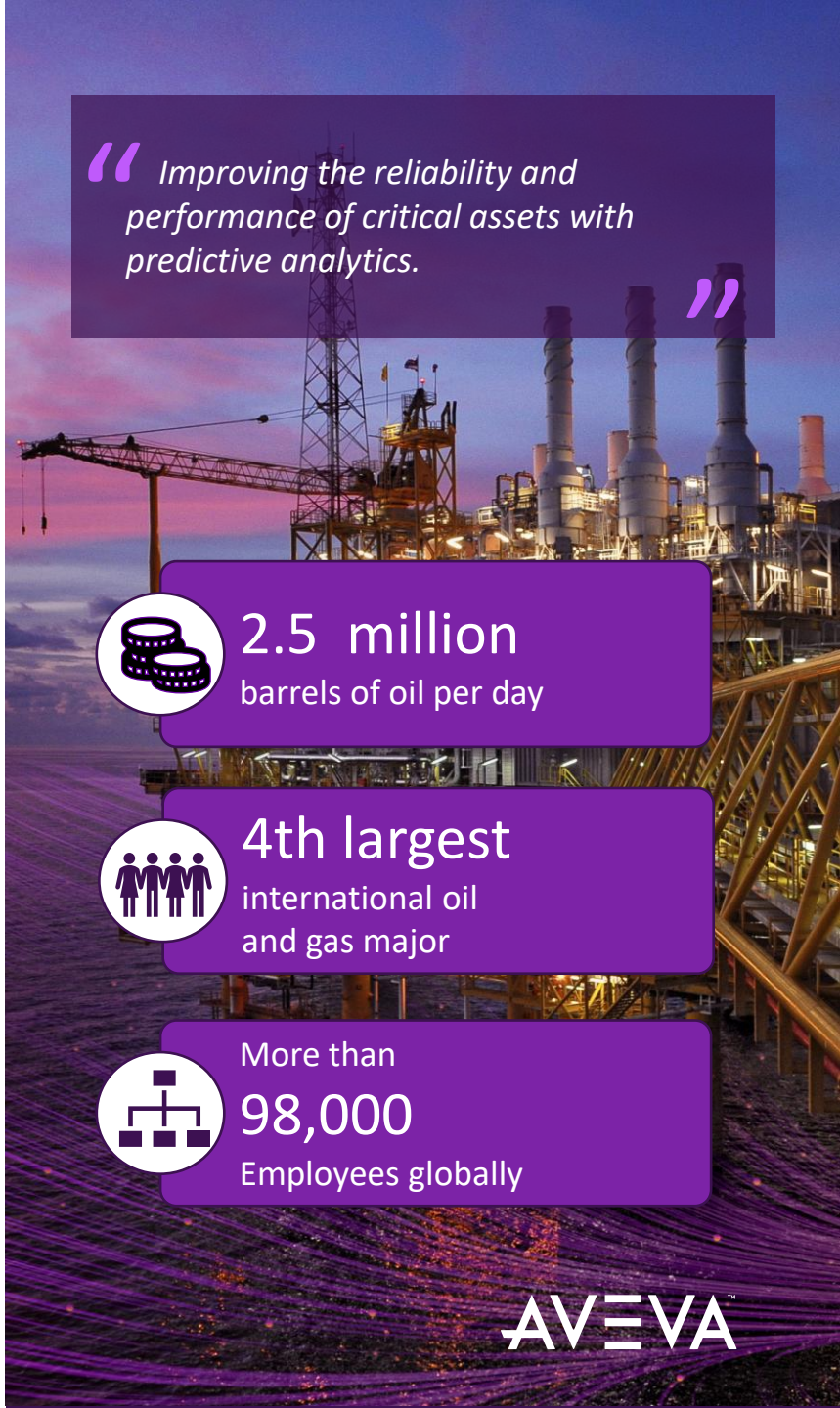
Total

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 (deployed for centralized monitoring of 12 refineries)
- 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.)



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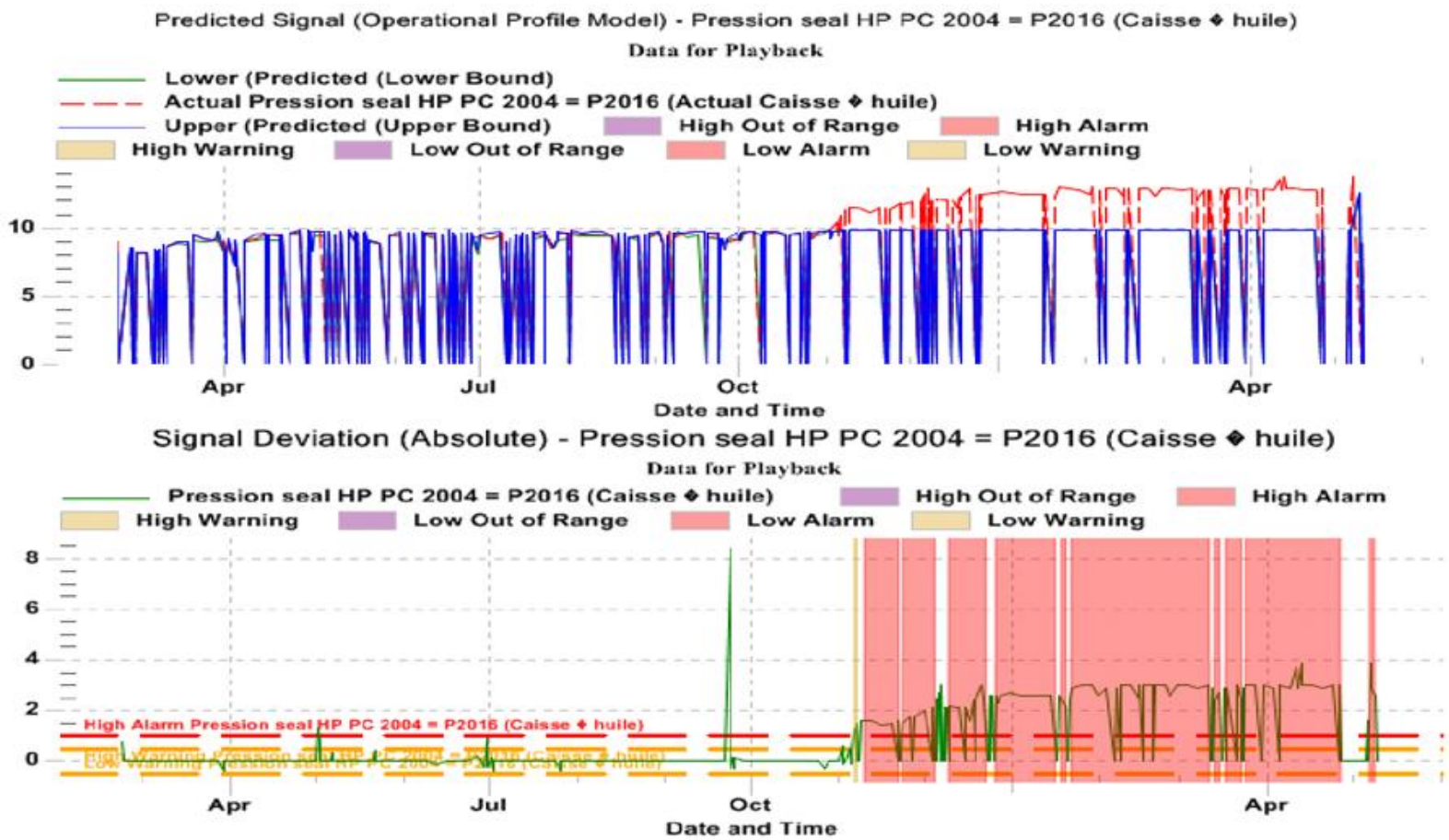
Case Study: Total

Playback – Business Case Validation (Pilot Project)



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Future is Now!

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50%

of all industrial data was created in the last 2 years. In 2024, that will still be true.

Source: Statista, Jun 2021

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According to Seagate,

only **32%** of the data available to enterprises was put to work

56%
of data is captured through operations

57%
of captured data is **used**

43%
remains largely **unused**

44%
of data goes uncaptured

68%
of data goes unleveraged

Source: The Seagate Rethink Data Survey, IDC, 2020

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Operate critical assets reliably, efficiently and safely

Focus on areas in need and improve asset reliability and efficiency with AI-powered guidance

DESIGN → OPERATE → OPTIMIZE

OPEN AND AGNOSTIC

Visualization

Multi-experience engineering and operations visualization across the enterprise

3rd party visualization

Simulation and Learning	Engineering and Execution	Operations Control	Asset Performance	Production Optimization	Planning and Scheduling
Process simulation, operator training, enterprise learning	Engineering, 3D design, project execution	Edge, supervisory, enterprise control	Asset strategy, asset analytics, maintenance execution	Operations execution, process optimization, production management	Feedstock management, supply chain planning and scheduling

3rd party apps and analytics

Industrial Information Management

Engineering: Engineering data collection, aggregation, storage and contextualization ⟷ **Operations:** Real-time data collection, aggregation, contextualization, events and self-service calculations

3rd party data sources, systems, and databases

DATA SHARING

SUPPORT YOUR HYBRID CLOUD ARCHITECTURE

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AVEVA

4IR - Future is Now!

- Integrated monitoring center supporting remote operations and decision making
- Connectors for 400+ data sources
- 1D, 2D and 3D visualizations
- Connected Information Model
- Dashboards w/real-time updates
- Asset Performance Management - Predictive Analytics (AI enabled) for up to 10,000 assets

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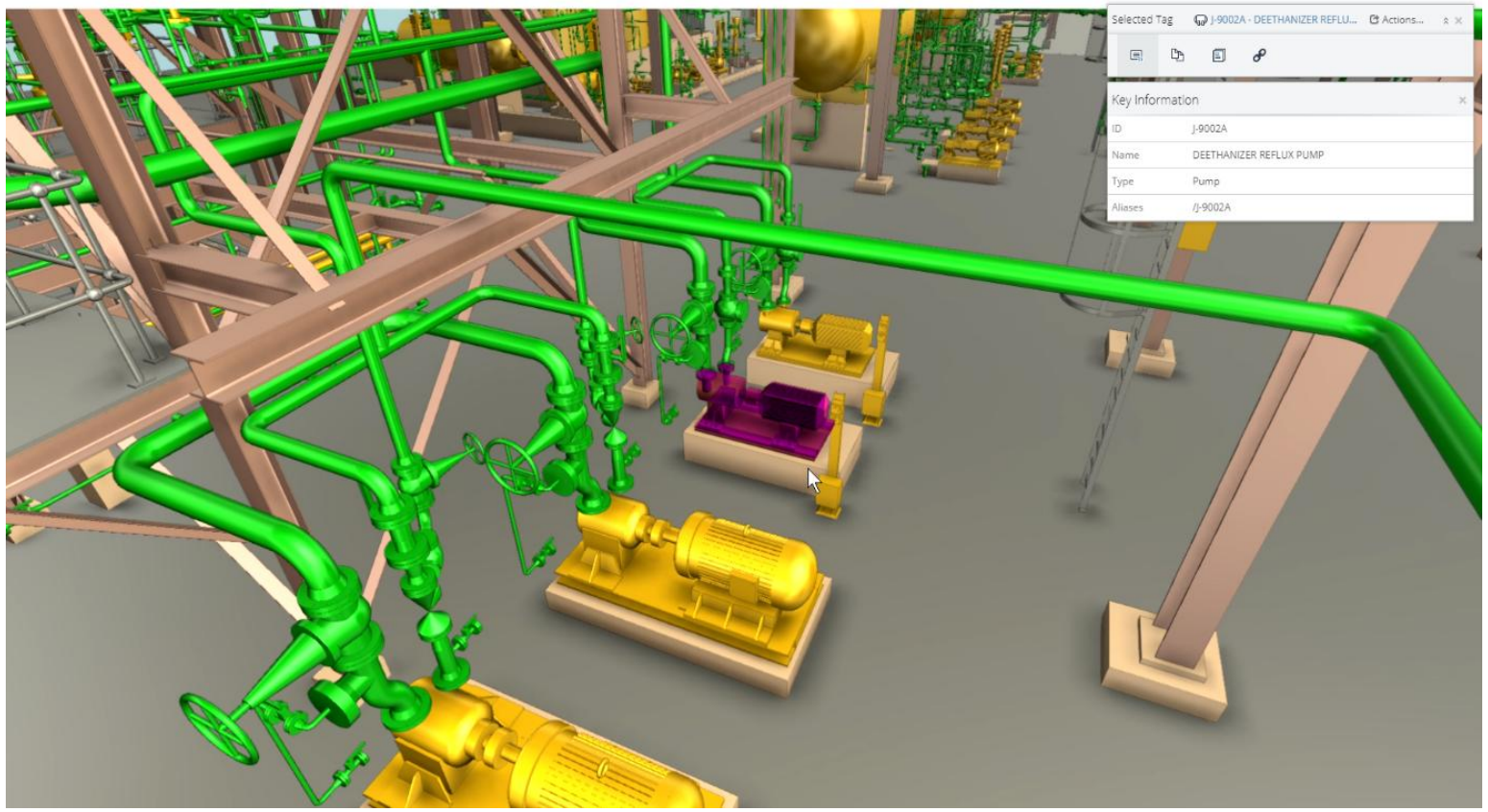
Information contextualization - 360° digital representation



Manage risk, diagnose reliability and performance problems and optimize work planning and execution with visual APM

- Problem diagnosis
- Remote work planning
- Risk assessment
- Safe job analysis
- Isolation plan assessment

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Market Differentiation – Why Aveva/Why Now

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AVEVA Predictive Analytics differentiators

Deployability

- Equipment agnostic
- No code AI
- Automated model building
- Industry specific templates
- Fault diagnostics
- Prescriptive actions

Scalability

- Leverages existing machinery sensor data
- Template driven model deployment
- Integrated alert management and workflow
- Minimal compute resources required

Maintainability

- Easy to use – no code
- Template driven model maintenance
- Simplified model updates
- Rapid model retrain
- Model change tracking

Usability

- No code democratization of AI
- AI results are fully explainable -> intuitive UI/UX
- Clear indication of contributing factors and fault diagnostics
- Prescriptive guidance
- Time to failure forecast
- Case management and Alert workflow

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Your partner in eliminating unplanned downtime

Market recognition

AVEVA is APM industry leader by the analysts that cover this market segment.

Product experience

Over 15 years of experience in delivering AI-based predictive analytics at scale.

Proven scalability

Our solution is proven at scale across many different industry market and asset types.

PI System extension

Native PI AF integration |
Native PI Vision integration |
Write predictive results to PI Server

The future is now

Definition of predictive analytics has evolved to incorporate a digital reliability platform approach. It’s no longer about the AI algorithm, it's about the application unto itself that enables sustainability of a predictive monitoring program at scale and democratizes AI for end users.

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AVEVA Predictive Analytics: An award-winning solution

Petronas wins Malaysia Technology Excellence AI and Analytics Award for oil and gas

SCG wins 2021 Hydrocarbon Best Asset Monitoring Technology Award

Suncor wins President Award with AVEVA Predictive Analytics

OPG wins Canadian Nuclear Achievement Award

NLNG wins President Award with AVEVA Predictive Analytics

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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

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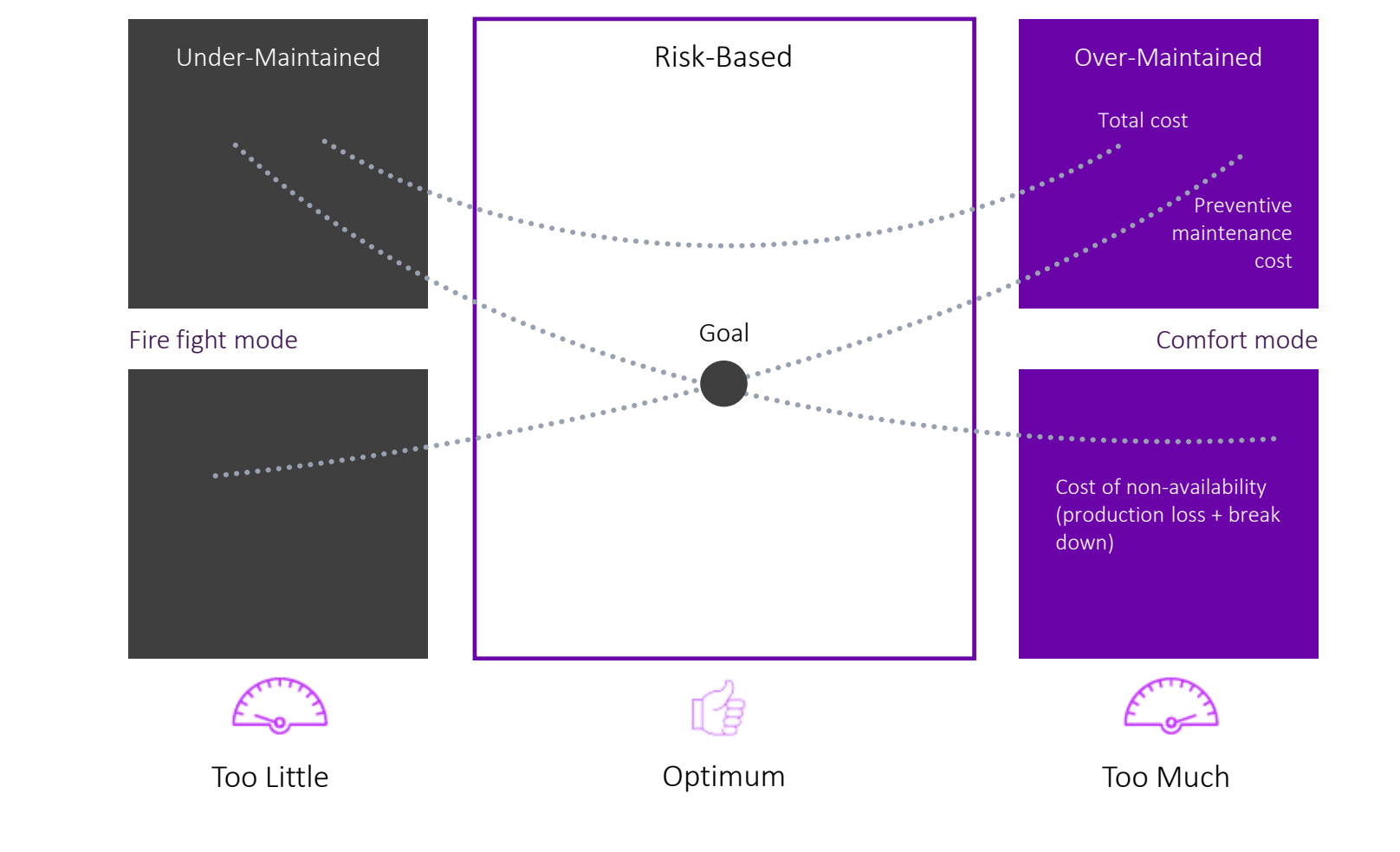
AVEVA

Asset Reliability and Performance Optimization



- Reduce Downtime
- Improve Reliability and Performance
- Reduce Maintenance Costs
- Improve Safety
- Optimize Labor Productivity
- Optimize Asset Strategy

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Performance and sustainability through innovation

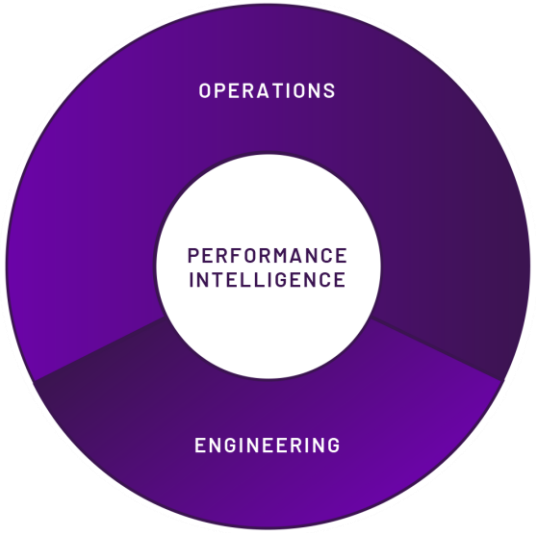
COLLABORATE

We empower teams to visualize opportunities, harness the cloud, solve challenges and realize transformative ideas.

20,000+ customers	**8+** industries
6,000+ employees	**5,500+** partners

CREATE

We develop flexible solutions to optimize engineering and operations, turning opportunity into sustainable business value.



PIONEER

We unlock operational efficiency using big data and artificial intelligence to empower people and communities, enabling industries to thrive.

20% reduction in capital project costs	**16%+** reduction in energy usage
30%+ improvement in overall equipment effectiveness	**$100M** saved from preventing asset downtime

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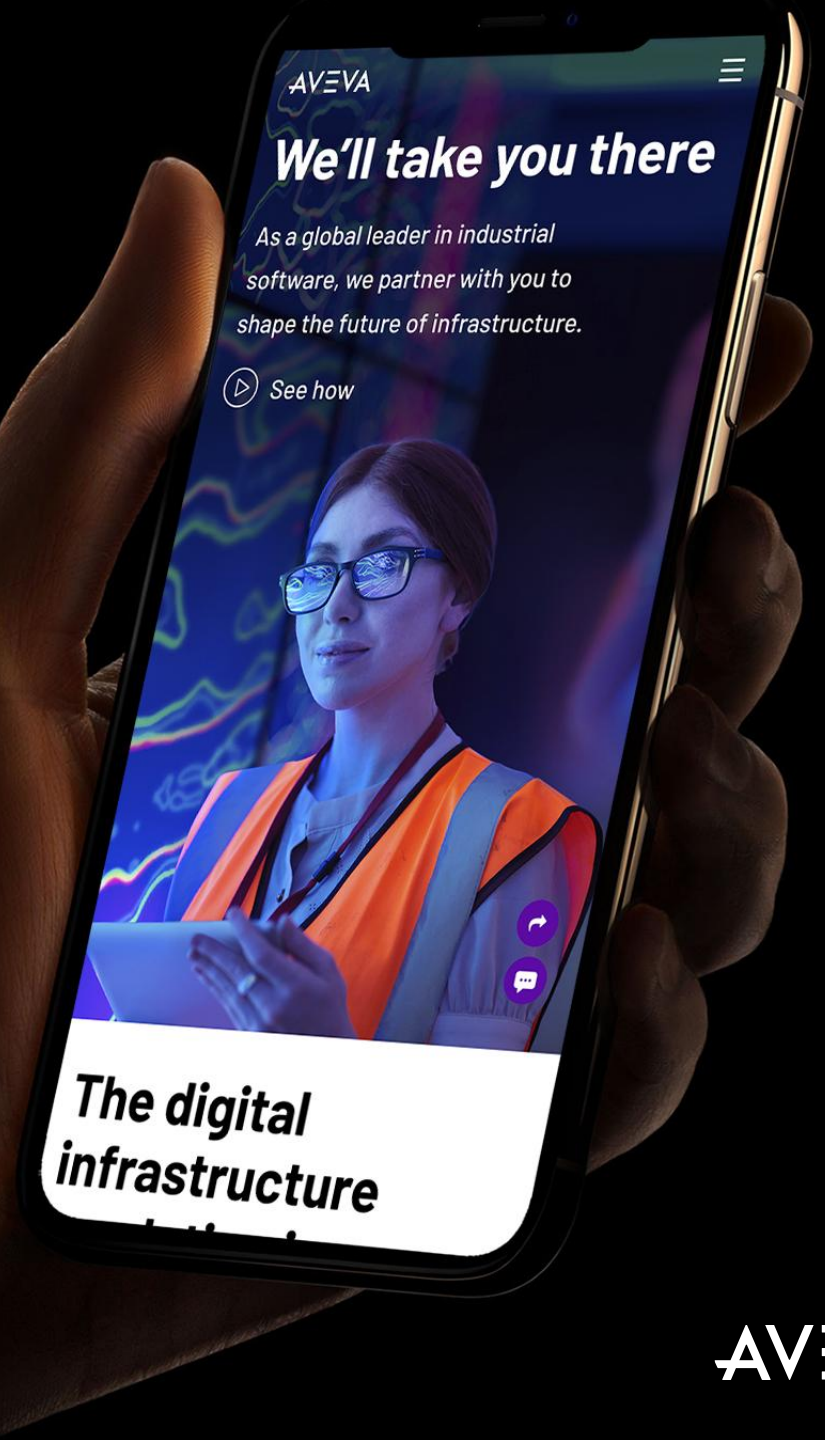
Questions?



AVEVA

AVEVA™

We'll take you there.

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The Company shall not be obliged to disclose any revision to these forward-looking statements to reflect events or circumstances occurring after the date on which they are made or to reflect the occurrence of future events.

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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.

aveva.com

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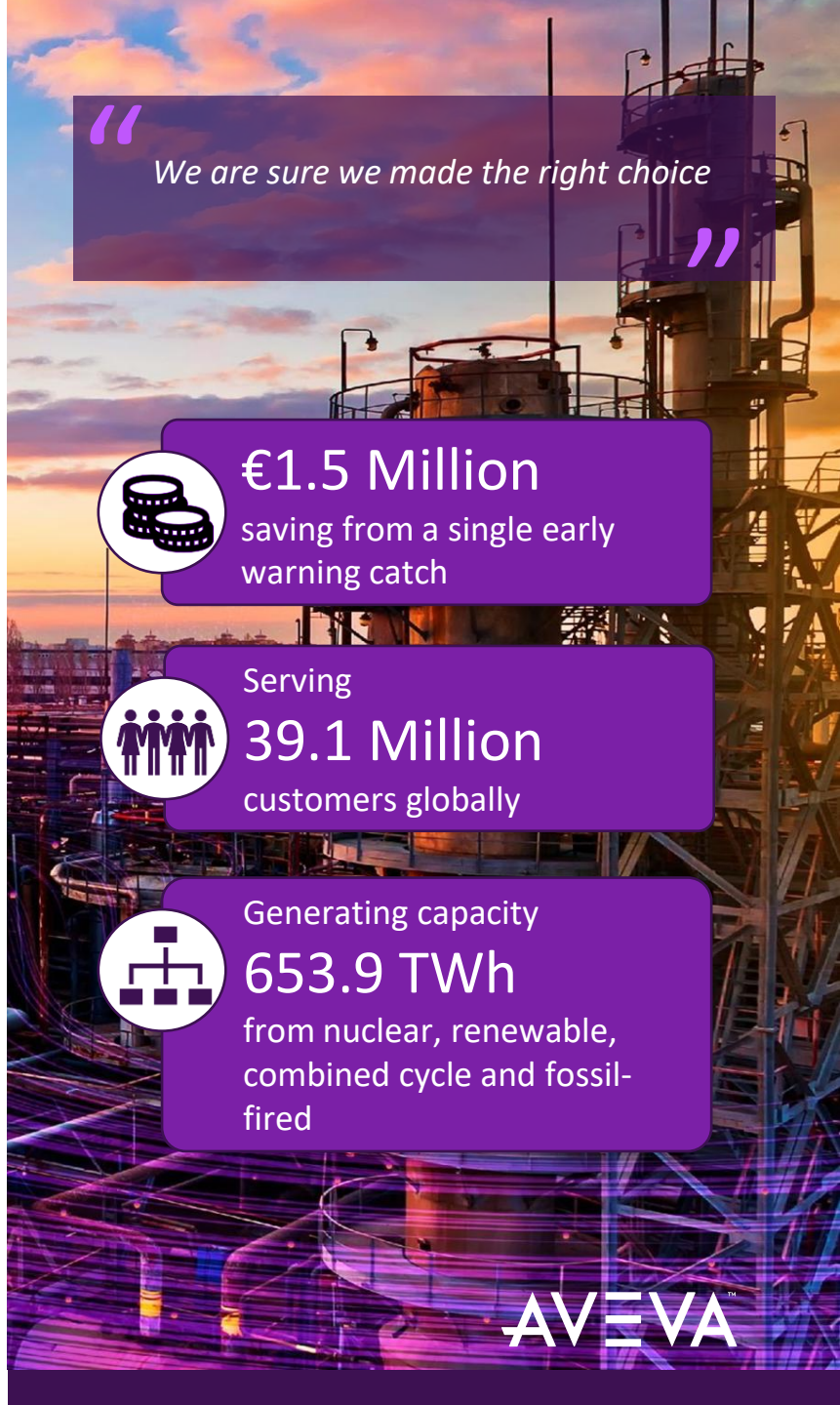
EDF

Fleet-wide monitoring with Predictive Analytics

- Challenges
  - With 39.1 million customers globally, the EDF Group's brand image is closely linked to continuity of service
  - Major failures could have been avoided before becoming severe, but the company did not have the capability to detect the early warning signs of future asset failures
  - They resolved to create 5 monitoring centers in order to monitor over 300 fossil, nuclear and hydro plants
- Solution
  - PI System deployed across fossil-fuel, nuclear, hydroelectric, renewables and district heating networks
  - PI System provides corporate reporting, performance monitoring, LTSA management, O&M management and planning and revenue loss assessment
  - AVEVA Predictive Analytics software is deployed to monitor assets across the entire fossil fleet
  - Power plants archive thousands of signals that are used by Predictive Analytics to analyze equipment health and performance
- Results
  - Avoidance of downtime resulting from equipment failure
  - €1.5 million saved from a single early warning catch



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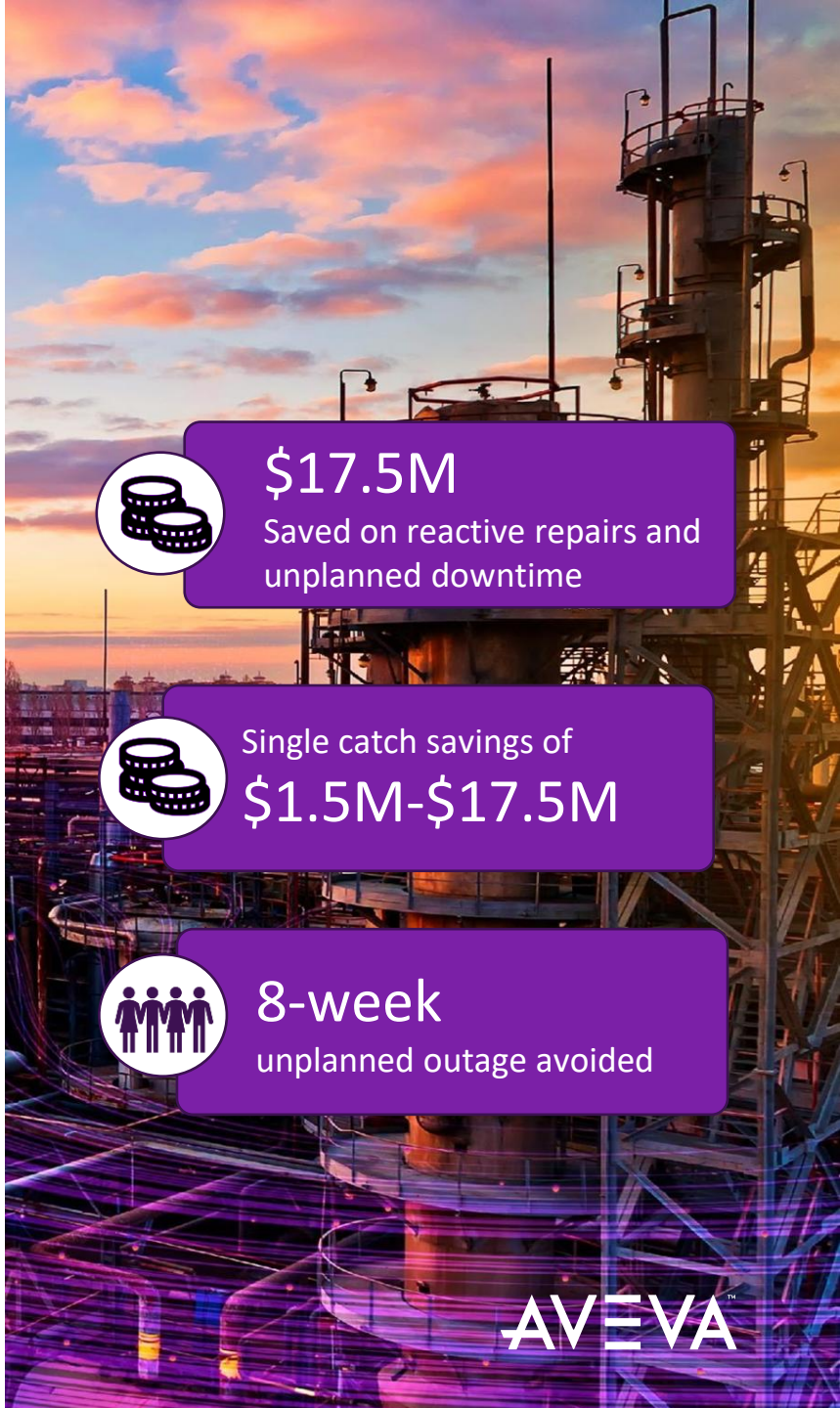
AEP

Avoiding forced outages with Predictive Analytics

- Challenges
  - Unplanned outages are too costly both in terms of lost production and damage to reputation
  - Finding a way to avoid such periods of downtime was paramount
- Solution
  - PI System deployed across the fossil and renewables power generation fleet – performance monitoring, cost avoidance, outsourcing of data for wholesale and bidding
  - AVEVA Predictive Analytics is deployed for monitoring AEP's power generation assets to provide early notification and diagnosis of potential failures
  - Repairs can therefore be carried out during scheduled opportunity outages instead of facing unplanned downtime
- Results
  - Predicted and avoided a potential 8-week unplanned outage
  - $17.5M saved on reactive maintenance repairs and unplanned downtime
  - Harness real-time information that brings plant operators and engineering experts together to collaborate



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ENEL

Centralized Monitoring of Power Generation Assets

- Challenge
  - Focus on transforming strategy and digital culture into results, the Digital Twin in its behavioral view need to apply to advanced diagnostics for anomaly detection, fault detection and transient analysis. Furthermore, this should drive full prescriptive maintenance capability, knowing how to respond, how much it will cost and how this relates to existing maintenance plans.
- Solution
  - PI System is deployed across entire power generation fleet of assets – performance monitoring, vibration analysis, reporting, problem analysis, data quality assurance
  - Deployed across 23GW of Thermal Fleet that represent 80% of company margins – further rollout to the rest of the fleet ongoing.
  - Predictive + prescriptive maintenance
  - Fully integrated into Operating Procedures and power plant management.
- Result
  - Joint AVEVA-ENEL approach to fault diagnostics enabled knowledge and experience of plant engineers to be incorporated.
  - Able to understand in advance specific faults that might be developing with a high level of confidence in the diagnostics with potential savings recorded on each event.
  - Prescriptive Maintenance reducing time to action and remote O&M Control Center reducing on-site crew

"100% positive results detecting faults from 5 months to 2 days."

Savings of
€10 million
in 18 months

221 events
early detected in 21 months of operation

Generation capacity
87,000 MW

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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

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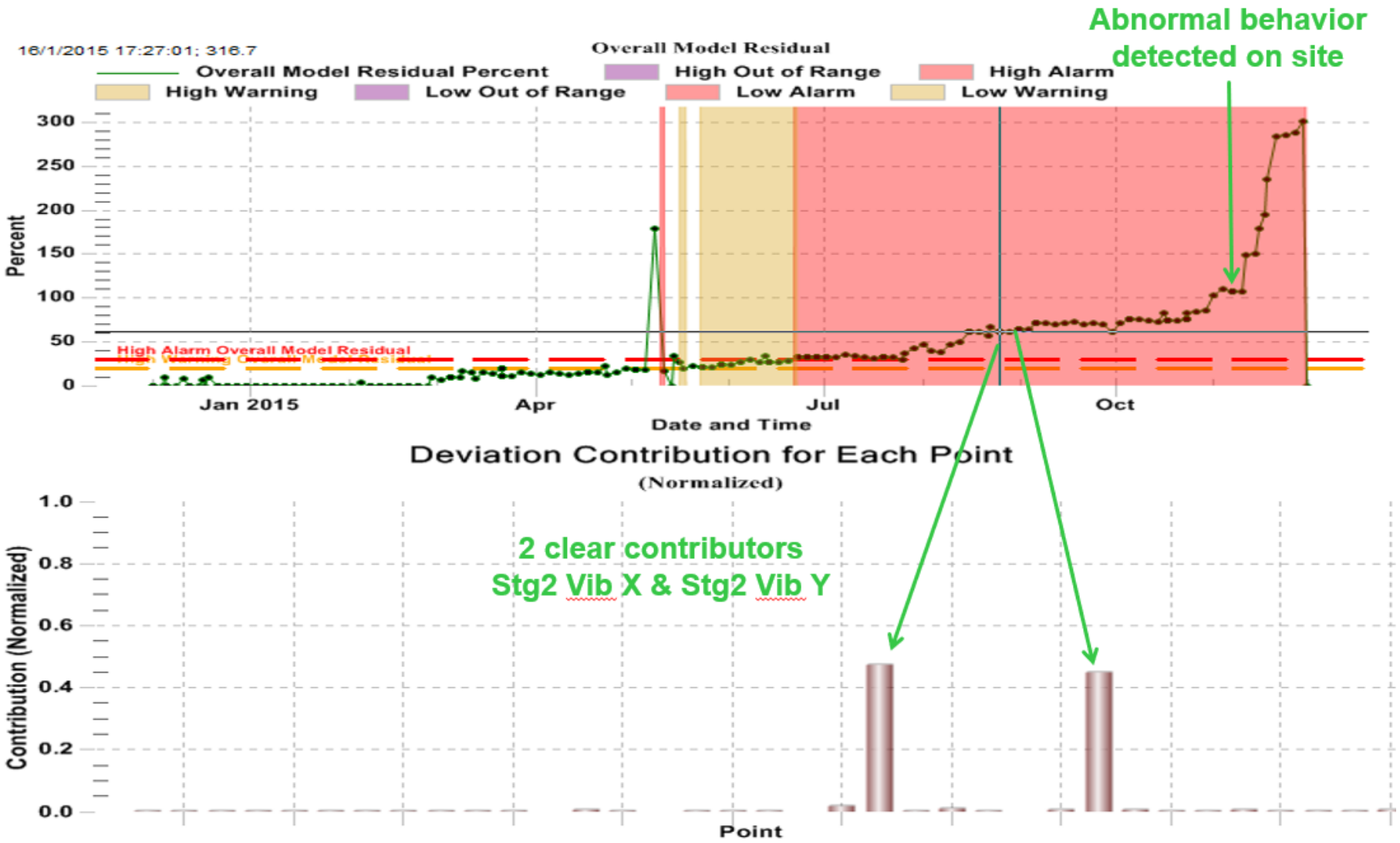
Compressor Problem



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Cracked Impeller

- Early warning with clear indicators of anomaly on the 2nd stage ~3 months before operators noticed it.
- No significant savings expected on the rotor repair as in any case the cracks were already developed
- Significant savings possible on:
  - Site activities (no emergency maintenance)
  - Production savings (a better window may be identified with the customer for the overhaul)

Saving estimation >$500k

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Petronas

AVEVA Predictive Analytics

- Challenge
  - The central monitoring and data science team had been partially successful in implementing in-house predictive solutions based on physics-based modelling techniques but were less successful with data-centric pattern recognition methods.
- Solution
  - PI System deployed as real-time industrial data infrastructure
  - Predictive Analytics was implemented to complement a strong existing Data Science approach to reliability solutions
  - Used to monitor onshore and offshore upstream Turbo-machinery, Compressors and Generators
- Result
  - 18 notifications and 12 cases raised in the first 6 months of monitoring
  - Avoided cost to overhaul equipment and related manhour spend
  - Protects against catastrophic failures
  - Institutionalized capability through internal knowledge base development

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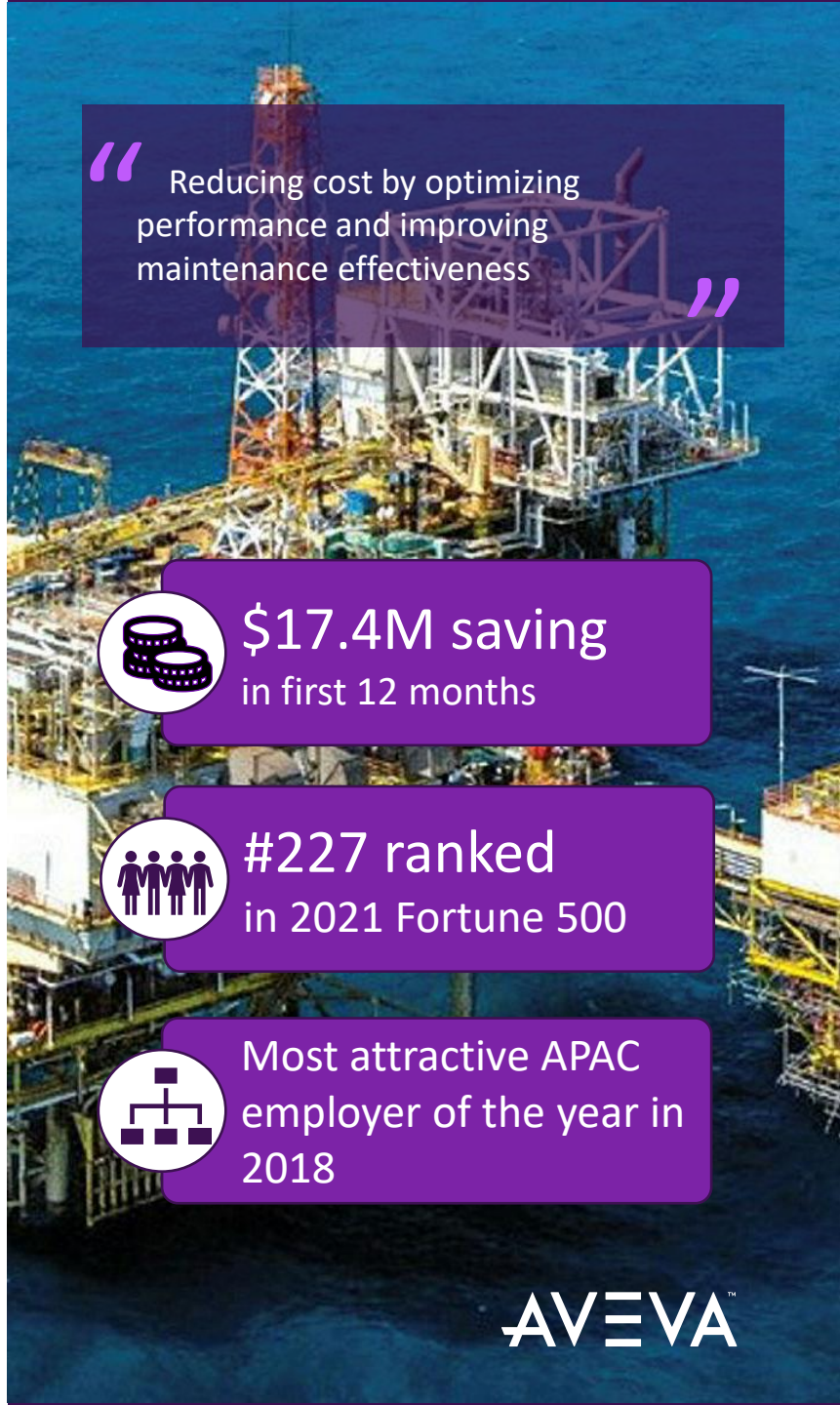

SCG

SCG Chemicals Thailand partners with AVEVA to create their Digital Reliability Platform

Extended their Digital Twin to operations to improve efficiency, reliability and safety

AVEVA

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SCG

Partners with AVEVA for Digital Reliability Platform

- Challenge
  - Implement a digital reliability platform across the entire business for upstream production of olefins to downstream production of 3 main plastics resins polyethylene, polypropylene and polyvinyl chloride
- Solution
  - AVEVA Predictive Asset Analytics provides real-time monitoring of critical assets
  - Virtual Plant Solution uses immersive and touch based visualization for inter discipline collaboration and accelerated access to plant information from anywhere
  - Rules Based engine (Policy Management) is used to find equipment health status based on online and offline data from different sources so remaining useful life of equipment can be calculated
  - Asset information management solution unifies and contextualizes information
  - Advanced Maintenance enables offline data entry, work order scheduling and transmission to SAP via Mobility software solution
- Result
  - Ability to effectively plan and schedule maintenance and outages around customer demand
  - Early warning detection and diagnosis of equipment problems
  - Conetexcualized Information access regardless of data source or information type (<3 min)

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BASF

BASF
The Chemical Company

Partners with AVEVA for Industrie 4.0

- Challenge
  - BASF started an Industrie 4.0 initiative to cover their entire value chain with multiple work streams including predictive maintenance and augmented reality. For the first pillar of the strategy, BASF selected AVEVA's Predictive Asset Analytics software and for the second Industrie 4.0 program AVEVA's Mobility software with integrated workflow for mobility and augmented reality.
- Solution
  - PI System deployed as real-time industrial data infrastructure
  - Predictive Asset Analytics
  - Augmented Reality and Mobility
- Result
  - Apply predictive maintenance to reduce unscheduled downtime, improve asset reliability, availability and performance
  - Improved maintenance planning and scheduling
  - Achieve mobile operator driven reliability through consistent execution of work processes
  - Mobility platform drives continuous improvement process

"Our Smart Manufacturing programme targets to increase the effectiveness of our plants and the efficiency of our production processes using digital technologies and data," said Uwe Hinsen, Vice President, Smart Manufacturing at BASF, "AVEVA's predictive maintenance and augmented reality solutions help us to achieve our target of an overall digital plant."

World's
Leading
Chemical Company

More than
112,000
Employees Globally

Augmented
Reality rollout at
400+ Plants
With 1,000+ end users

AVEVA

Suncor Energy

AI Powered Machine Learning for Maximum Reliability

- Challenges
  - Implement a predictive monitoring solution to improve the reliability and performance of their industrial assets. Application of Artificial intelligence and machine learning for early warning of equipment problems and diagnosis of these issues.

- Solution
  - PI System
  - Predictive Asset Analytics
  - ROMeo real-time optimization

- Results
  - Apply predictive maintenance to reduce unscheduled downtime, improve asset reliability, availability and performance
  - Apply 1st principle real-time performance monitoring (HDR models)
  - Centralized monitoring of all critical production assets
  - Early warning identification and diagnosis of equipment problems
  - Further optimization of the maintenance strategy

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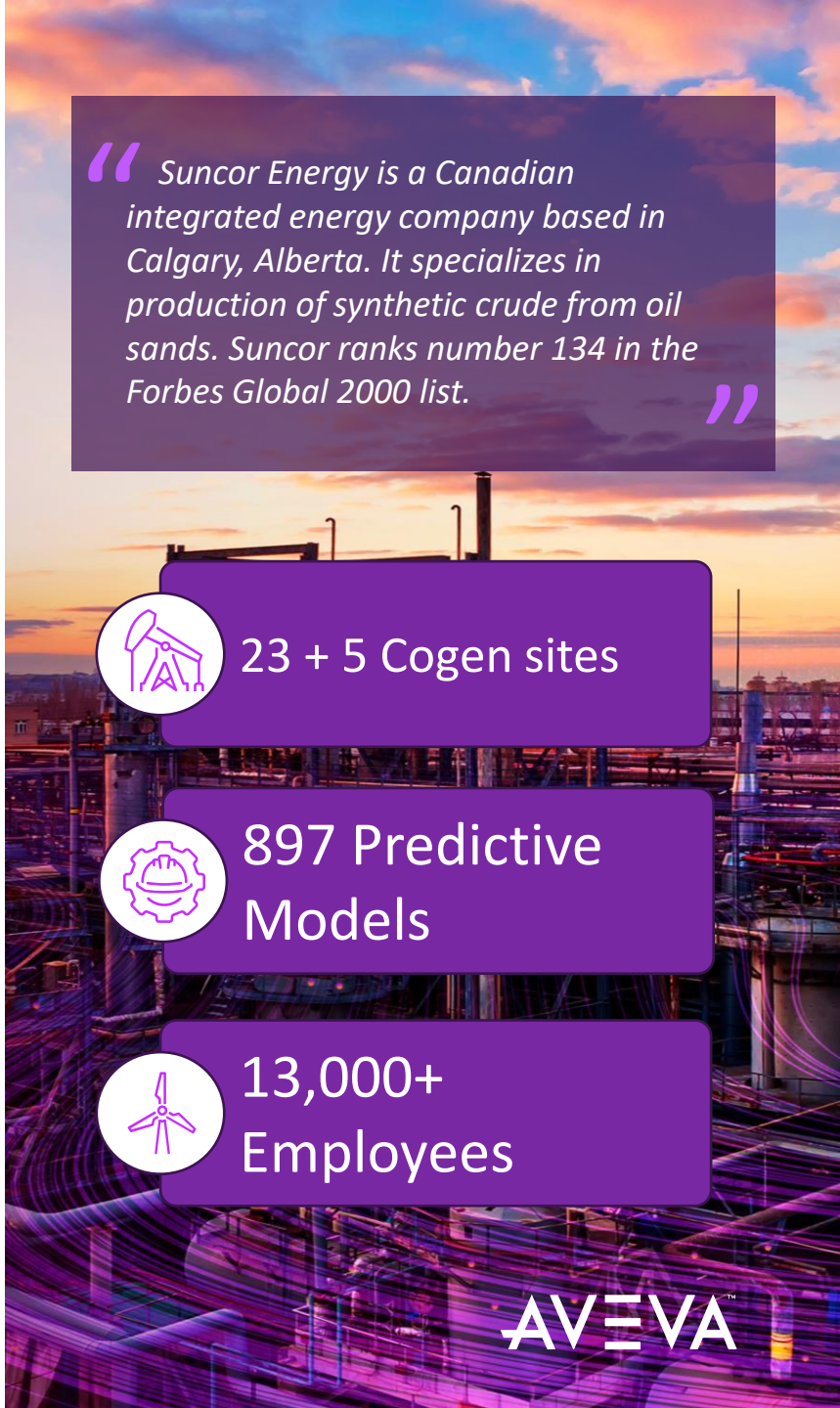


Nexa Resources

Increasing reliability at the largest zinc smelter in Latin America

Goals

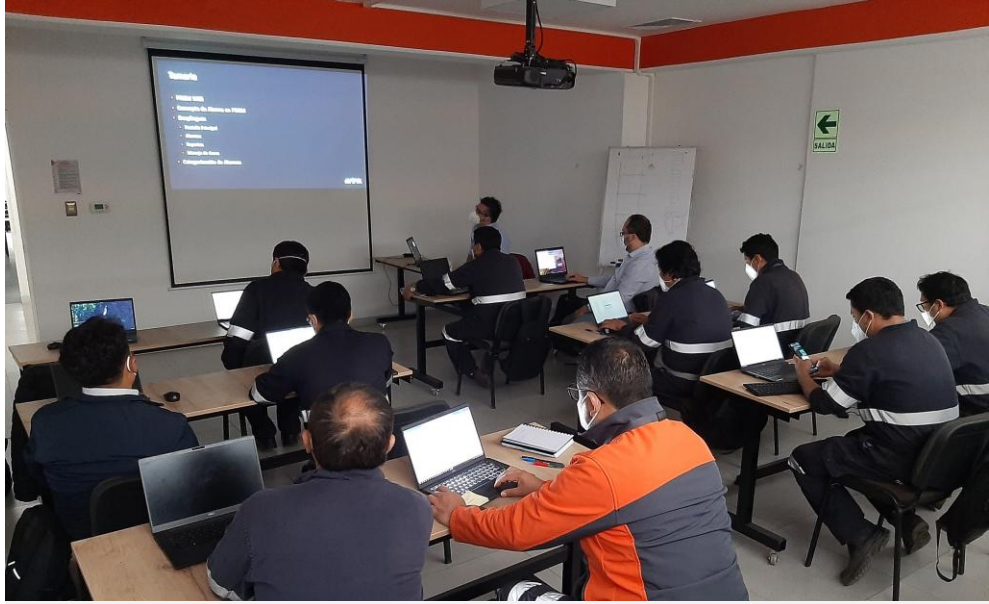
- Reduce downtime through predictive analytics
- Improve asset reliability
- Generates early warnings and diagnostics of equipment problems
- Reduces maintenance expenses
- Eliminates waste and production losses

Challenges

- 11 Predictive PoCs failed.
- According to a study for Digitalization of Maintenance, Roasting stopped 772 hours for corrective maintenance in 2021. 649 hours due to unscheduled downtime
- Lack of instrumentation and tags.

Results

- 12 models fine tunned with AVEVA Predictive Analytics and AVEVA PI System
- 75% reduction on unscheduled downtime hours
- Improve asset reliability
- Reduce the need for emergency maintenance purchases



Industry: Mining, Metals and Materials

Solution: AVEVA PI System, AVEVA Predictive Analytics

"I am a cash hunter and I only put money where I can save money. We have successfully implemented Predictive Maintenance with AVEVA Predictive Analytics combined with the PI System and achieved ROI of 300% within a few months."

Warley Jose Gomes Pereira, General Manager, Cajamarquilla

WATCH PRESENTATION

Source: https://resources.osisoft.com/presentations/nexa-resources---pi-system-and-predictive-analytics-for-zinc-industry/

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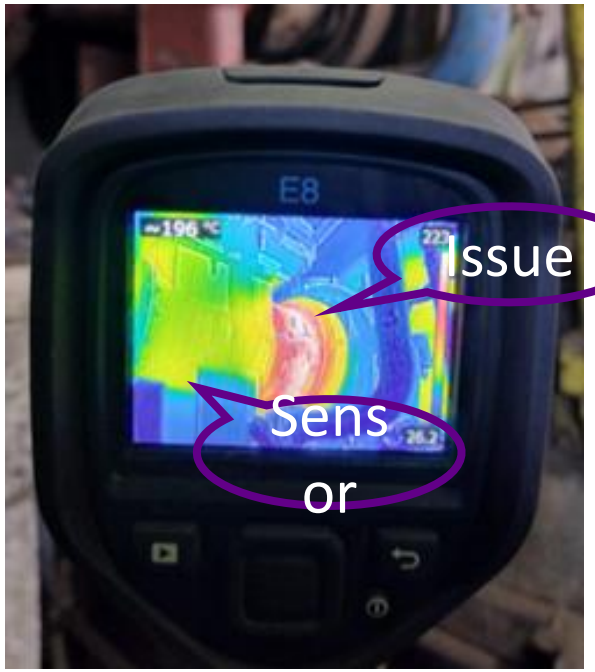
Increased Diagnostics – Few Sensors

Increased diagnostics with Ball Mill with limited number of sensors (8 tags).

- Increased OMR and Temperature (Only 4 degrees from Actual vs Prediction).
- Sensor´s 4 degree´s increased due to higher increase at another position of asset.

This single catch:

- Avoided Losses: **$2.1 M**



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TOP 10 Mining Company realizes major cost savings with AVEVA Predictive Analytics

- Challenges
  - Reducing the cost of mining operations and improving efficiency across the board.
  - Improve safety and day-today operations
- Solution
  - AVEVA Predictive Analytics was deployed as a means to provide advanced early warning notification and diagnosis of equipment problems and failures.
  - AVEVA Predictive Analytics enables diagnostics at corporate level, reducing manual inspection time.
  - Deployed for 327 assets across 8 plants for 3 years
- Results
  - In the first 6 months:
    - SAG Mill Motor failure Cost Avoidance $12M USD
    - SAG Mill Maintenance Cost Avoidance $234K USD + 72 hours of $2,136/hr operation loss
    - Ball Mill Maintenance Cost Avoidance $146K USD + 72 hours of $2,136/hr operation loss

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Votorantim Cimentos

Leverages Predictive Analytics to Reduce Failures and costs

- Challenges
  - Reliability 10 years behind on internal benchmark
  - Getting insight on degradation and improve maintenance strategy on all assets of the group
  - Reduce corrective maintenance costs through predictive maintenance
- Solution
  - PI System deployed as enterprise data infrastructure across all production plants
  - PRiSM Predictive Asset Analytics was deployed as a means to detect the anomaly and degradation behavior and anticipate asset failures
  - PRISM enables diagnostics at corporate level, reducing manual inspection time.
  - Deployed in 20 sites – 30 cement lines - 600 assets in less than 1 year
- Results
  - Savings of 1 Million in corrective maintenance costs during the PoC phase. ROI 1:19. The proof of concept for 60 assets already created the ROI for global rollout / 900 assets
  - Improved maintenance philosophy to predictive maintenance across sites
  - Corporate plant management is able to monitor and steer 20 sites and are still expanding

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Cement Industry – Example of assets monitored

- ✓ VERTICAL MILL / BALL MILL
  - ✓ Process
  - ✓ Mechanical
  - ✓ Oil System
- ✓ MOTOR
- ✓ GRATE COOLER
- ✓ CRUSHER
- ✓ COMPRESSOR
- ✓ CONVEYOR
- ✓ ELECTRICAL ROOM
- ✓ ELEVATOR
- ✓ FAN
- ✓ FEEDER
- ✓ FILTER PROCESS
- ✓ HOT GAS GENERATOR
- ✓ KILN
  - ✓ Base
  - ✓ Motor
  - ✓ Process
- ✓ LIMESTONE CRUSHER
- ✓ SEPARATOR
- ✓ POWER TRASNFORMER

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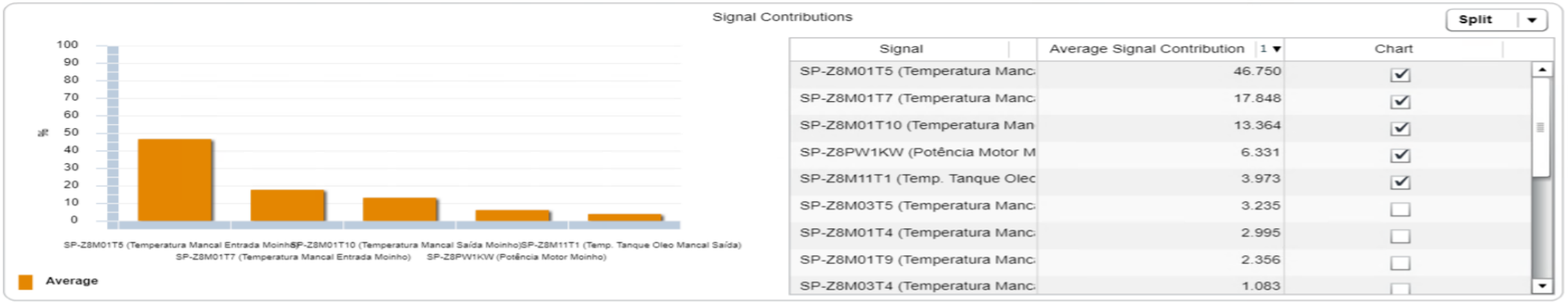
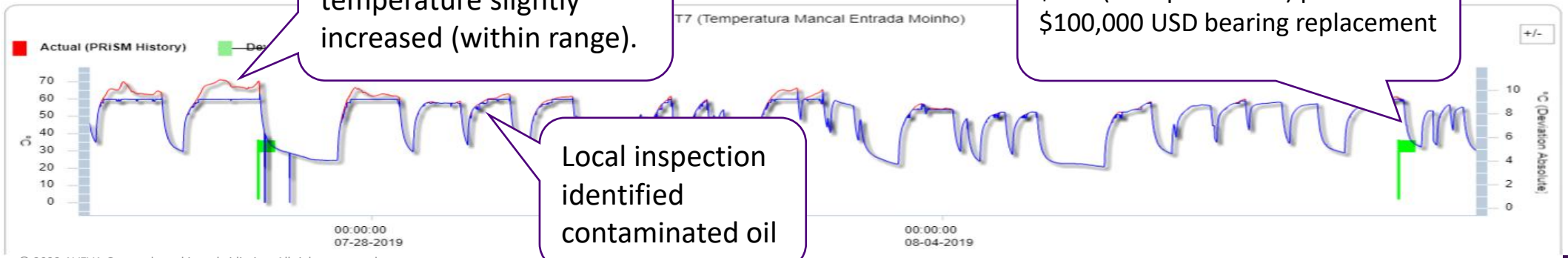
Ball mill





Ball mill´s Bearing temperature slightly increased (within range).

Local inspection identified contaminated oil

$100 (oil replacement) prevented $100,000 USD bearing replacement

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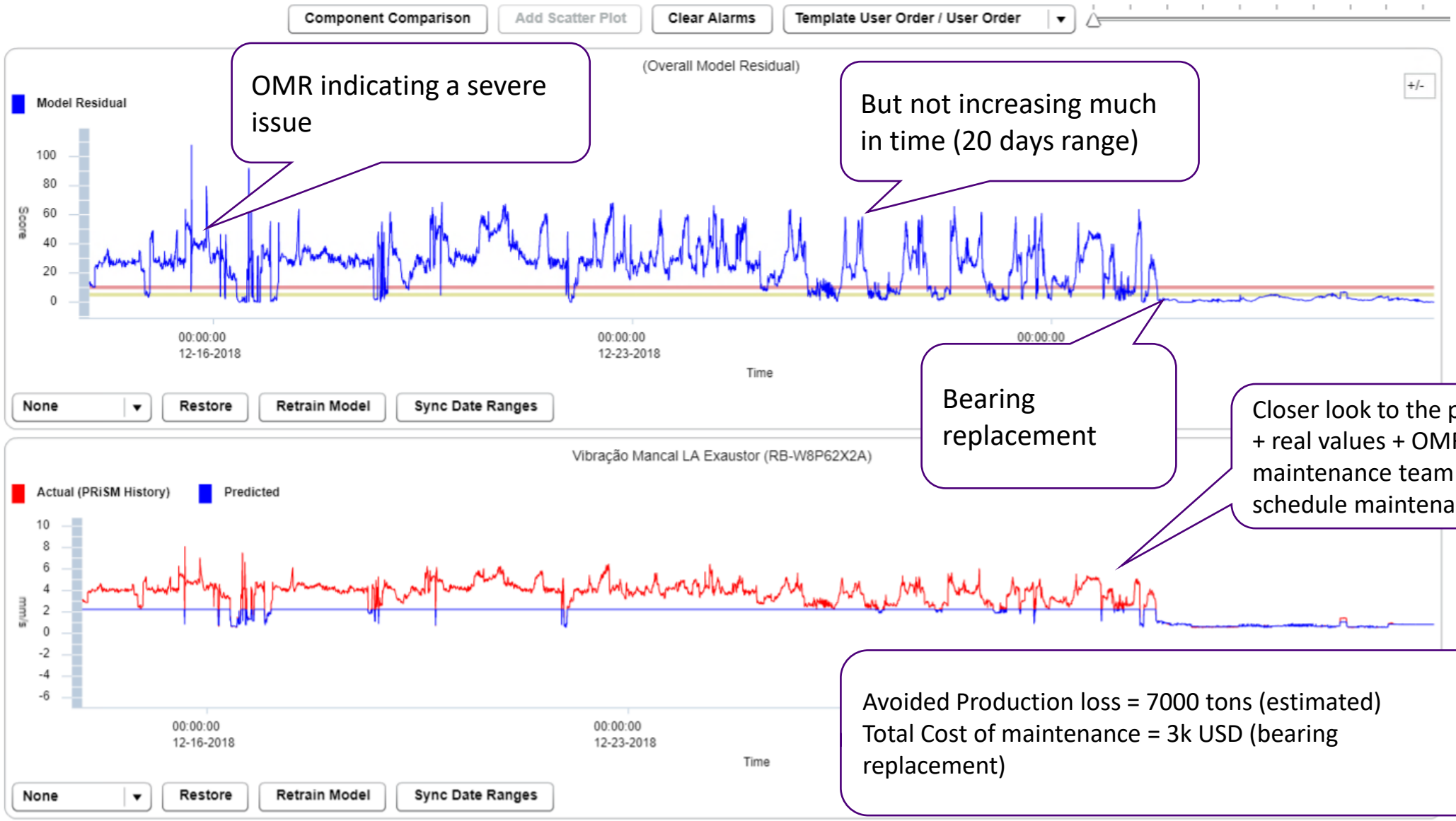
Kiln



OMR indicating a severe issue

But not increasing much in time (20 days range)

Bearing replacement

Closer look to the predictive values + real values + OMR allowed the maintenance team to wait for the schedule maintenance.

Avoided Production loss = 7000 tons (estimated)
Total Cost of maintenance = 3k USD (bearing replacement)

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Eskom

AVEVA Predictive Analytics maximizes reliability across 38 GW coal-powered generation fleet

Early warning detection and diagnosis of equipment problems

Predictive monitoring of critical assets (compressors, pumps, expanders, turbines, etc.)

Rio Tinto

AVEVA Predictive Analytics is deployed to monitor 327 assets across 8 plants

SAG mill motor failure averted saving $12M US

SAG mill maintenance cost averted saving $234K US and 72 hours of downtime

Ball mill maintenance cost averted saving $146K US

EDF

EDF uses AVEVA for centralized predictive asset health and performance monitoring of power production assets

Artificial Intelligence based predictive analytics for early warning notification and diagnosis of equipment and process problems

AVEVA

International Paper

CEO: We will "redesign processes to increase efficiency and reduce costs in maintenance reliability…"

CEO directive for $300M in structural cost reduction

Goal of building the mill of the future

Use technology and data analytics to create greater visibility and actionable insights

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Global Power OEM

"A 1% rise in gas turbine reliability can add >1.6 million MWH of power generation"

Opportunity started as a renewal

Account manager fully engaged APM team to develop customer need for reliability

Opportunity won based on ROI for customer instead of lower price for software

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