

NOVEMBER 2022

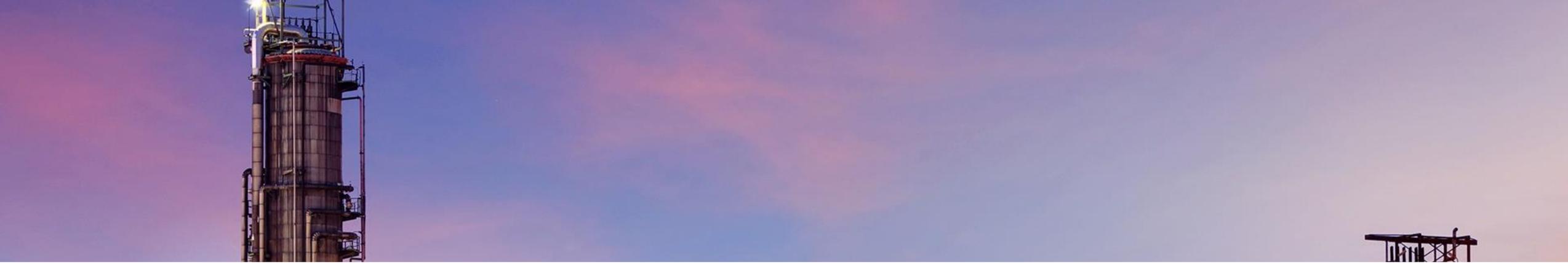
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# Integrating AVEVA™ Predictive Analytics with AVEVA™ PI System™

Brad Jones, Technical Account Manager

Dan Lopez, Principal Solution Consultant

**AVEVA**



## Achieve Asset Excellence

**100s**

of Millions Saved in Early  
Warning Catches

**30%**

Reduction in Maintenance  
Costs

**25%**

Improvement in Workforce  
Efficiency

**25%**

Reduction in Unplanned  
Downtime

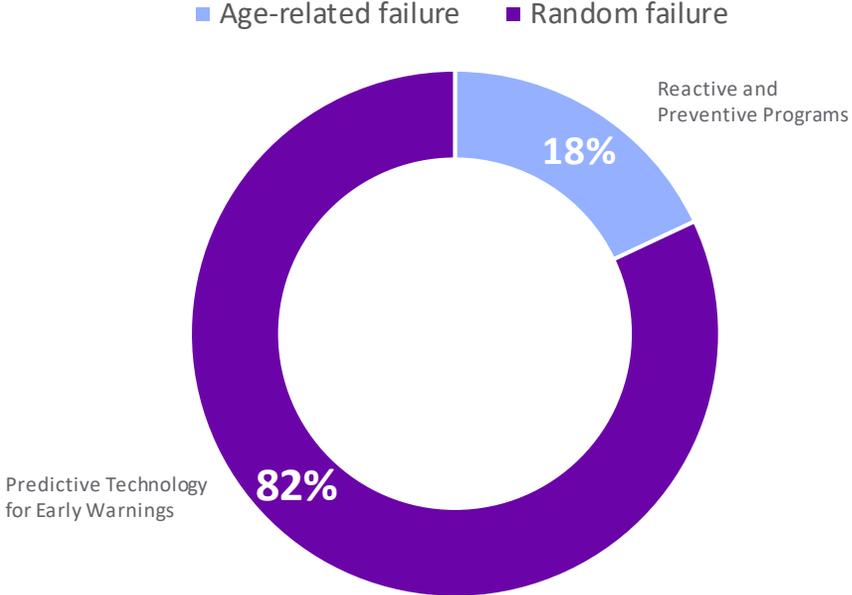


**AVEVA**

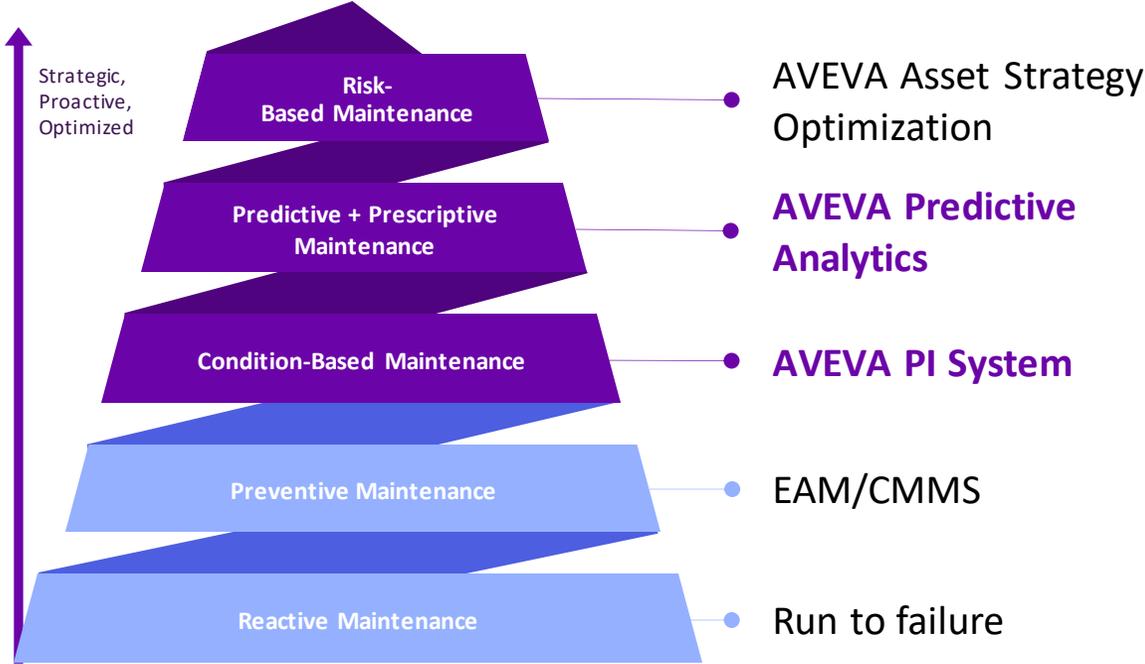
# Optimize Your Asset Reliability, Maintenance, and Performance

A Journey in Operational Reliability with AVEVA PI System and AVEVA Predictive Analytics

## Failure Patterns



## It's a Journey



▲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](http://WWW.ARCWEB.COM/LISTS/POSTS/POST.ASPX?ID=260)

# AVEVA™ Predictive Analytics

Trends **Forecast**

09/07/2022 13:49 to 09/08/2022 13:49 at 5 Seconds

Time Span

1 Days

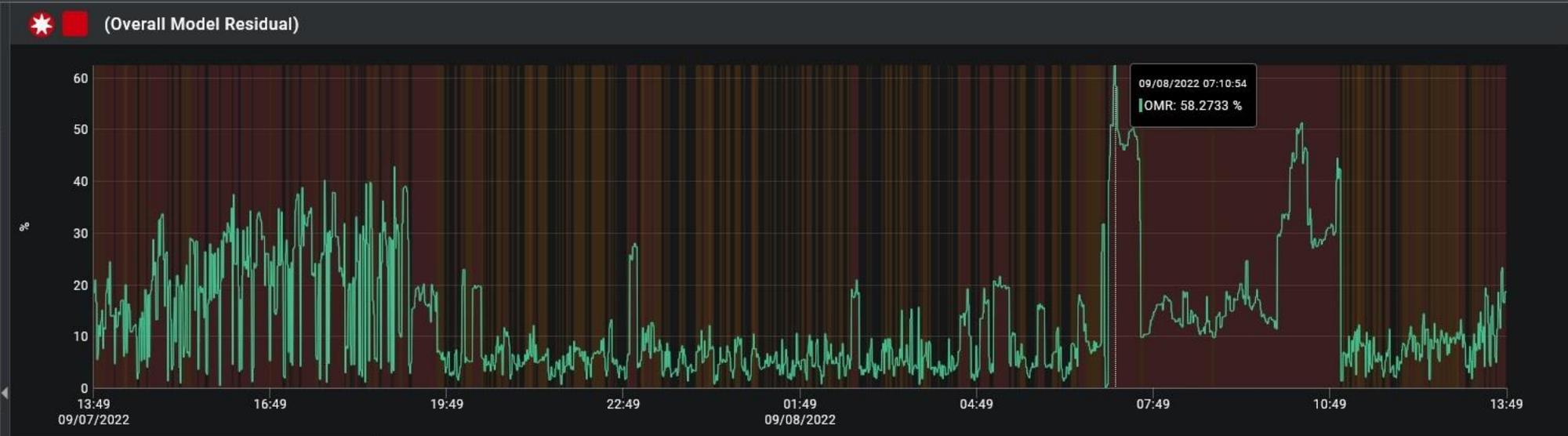
- PS0049 Pump B
- PUMP PROFILE
  - (Overall Model Residual)**
  - CENT PUMP SUCTION LVL (...)
  - CENT PUMP MOTOR CURRE...
  - CENT PUMP DISCH PRESS (...)
  - UPPER THRUST BRG TEMP ...
  - UPPER THRUST BRG TEMP ...
  - UPPER THRUST BRG TEMP ...
  - UPPER BRG TEMP 3 (PS004...
  - UPPER BRG TEMP 2 (PS004...
  - UPPER BRG TEMP 1 (PS004...

Filters

Alerts **Mark**

Quality **Mark, Hide**

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**Model**

Algorithm: **Linear**

Smoothing: **Average**

Training data range [Select via chart](#)

Start

End

**Run**



Start the analysis by running a failure model

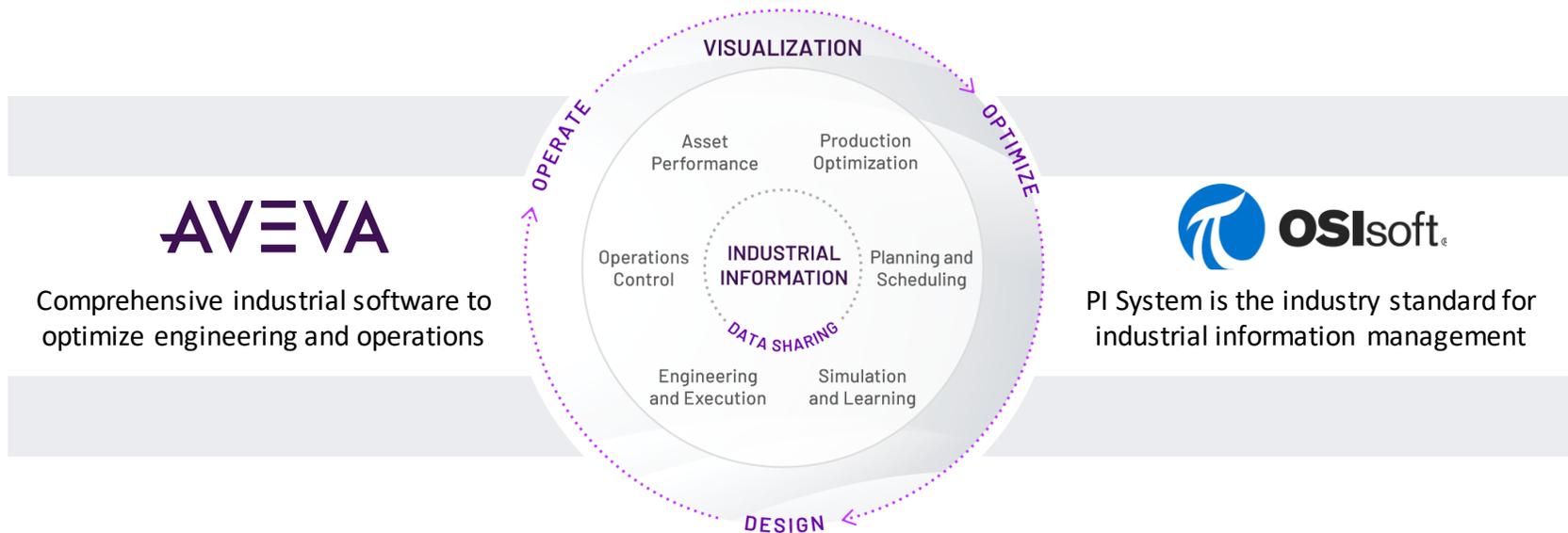
Analysis not available



# Bringing together 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



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



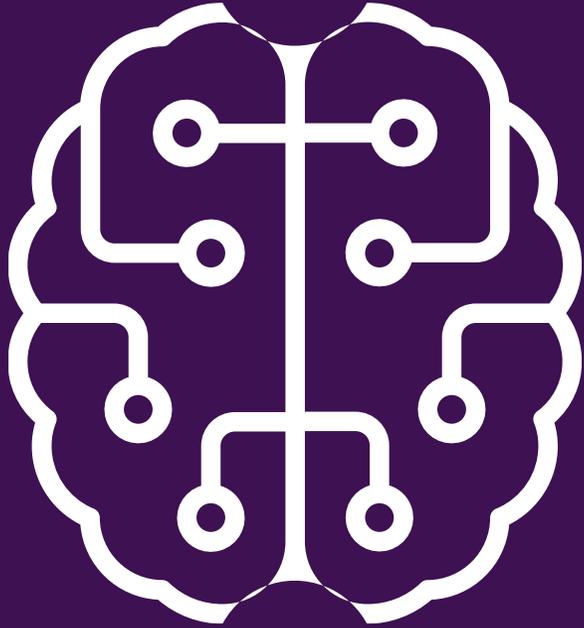
Artificial Intelligence



Digital Twin



Connected Worker



# Why?

# Predictive analytics can unlock the hidden potential of PI System data



## EMPOWERED PEOPLE

Asset maintenance technicians and control room operators focus on domain expertise.



## OPTIMIZED ASSETS

Condition and preventive maintenance of assets increases their lifetime value.



## EFFICIENT OPERATIONS

Predictive models and industry specific business logic closes the loop and optimizes efficiencies.

# Case in point: the power industry

“\$200 billion lost in annual revenue across the Power industry due to operational efficiency”

## Asset Failure



**82%**

Only 18% of asset failure are age related, 82% of asset failures are random and required advanced monitoring capabilities.<sup>1</sup>

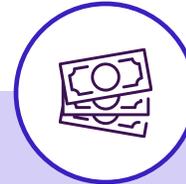
## COP21 Regulations



**2021**

COP21 regulations mean Power Utilities will have to find ways to keep costs low while ensuring compliance.<sup>2</sup>

## Aging Assets



**\$1.2 Tn**

Power industry has a diverse set of assets to manage and integrate with the rapidly aging set of existing assets, together worth about \$1.2 trillion.<sup>3</sup>

## Asset Management



**70%**

70% of Power & Utilities executives view asset management as increasingly challenging – E&Y.<sup>4</sup>

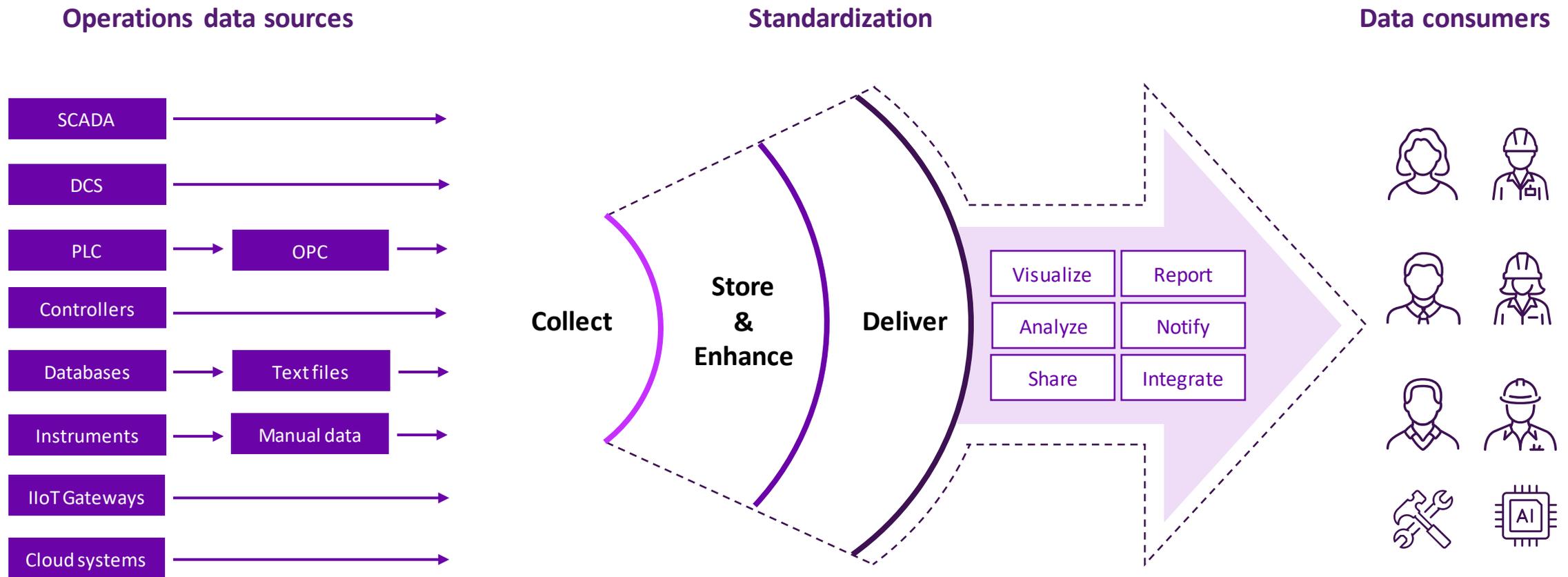
Sources: 1. [Forbes](#), 2. [PowerGrid](#), 3. [Deloitte](#), 4. [EnLitAsia](#)



# How?

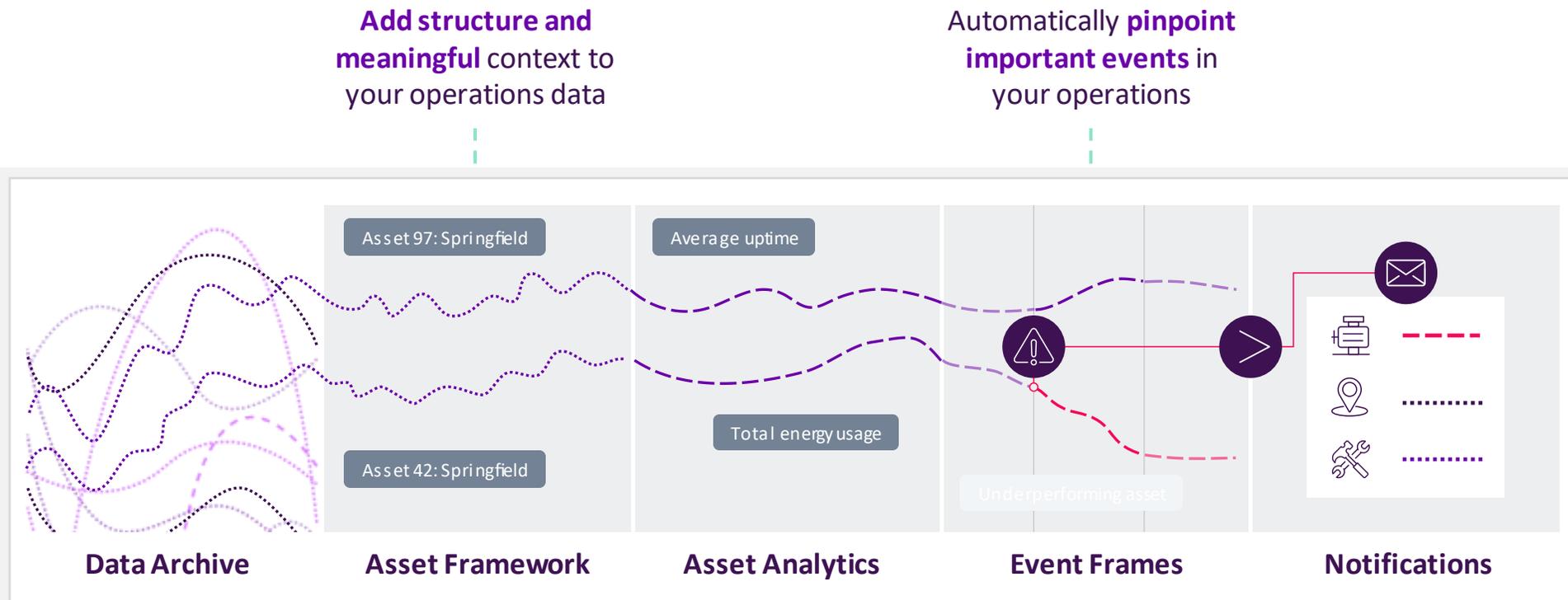
# The PI System provides a data infrastructure foundation

A single, **unified** source of truth, for project success both today and over time



# Simplify predictions using **descriptive** and **diagnostic** analytics

Using template-driven calculations to provide additional context for predictive analytics modeling



Add structure and meaningful context to your operations data

Automatically pinpoint important events in your operations

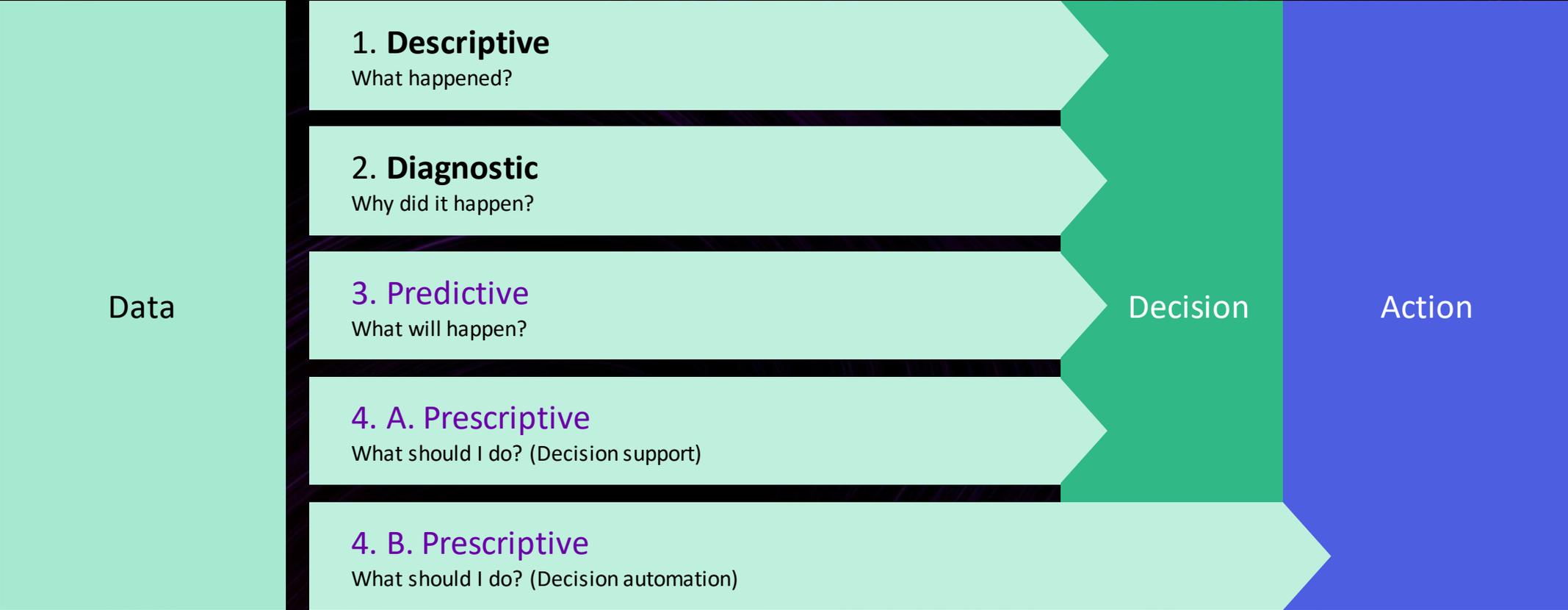
Optimized storage & access to massive volumes of operational data

Transform raw data into actionable KPIs using streaming calculations

Send automatic alerts to the right people with the right information



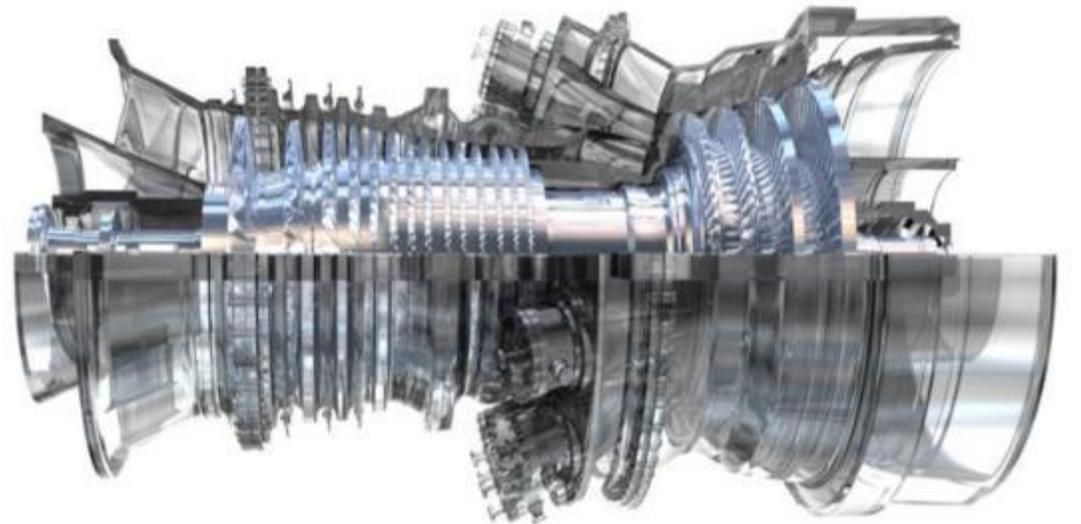
# LAYERS OF ANALYTICS



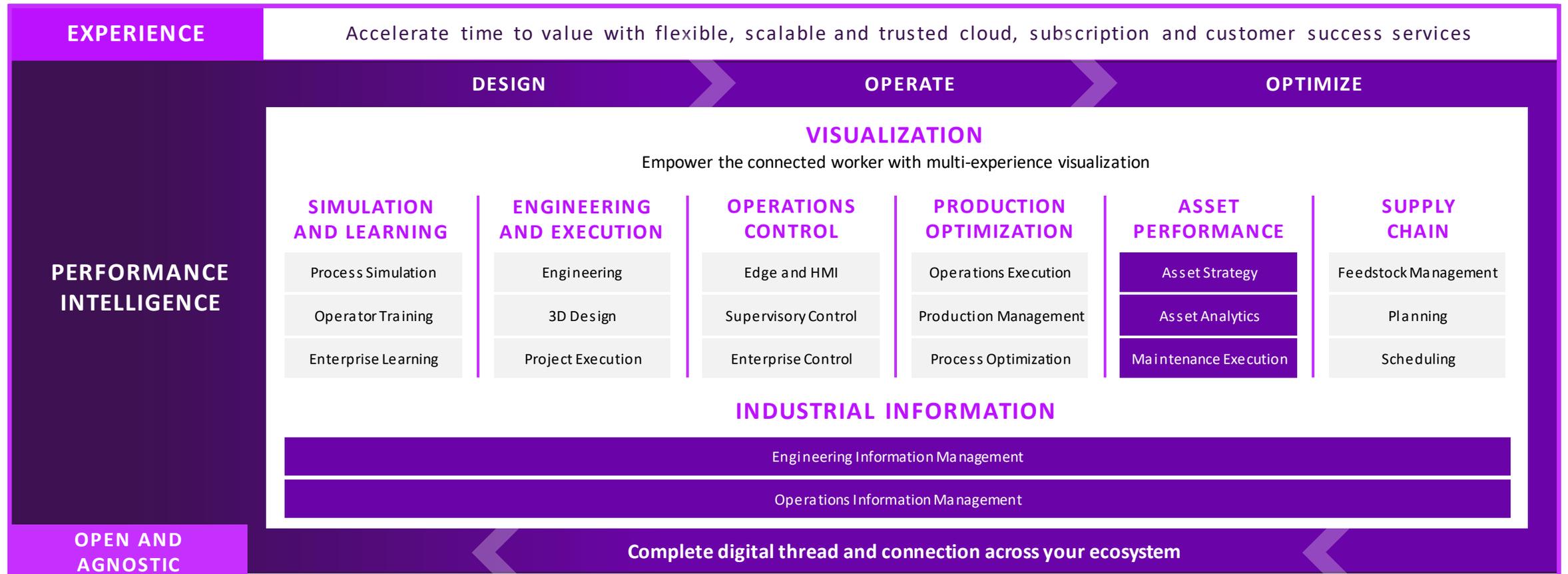
# Assets monitored by the PI System are great candidates for predictive analytics

Leveraging templates for faster roll-out at scale

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



All of this is possible within AVEVA's comprehensive solution portfolio



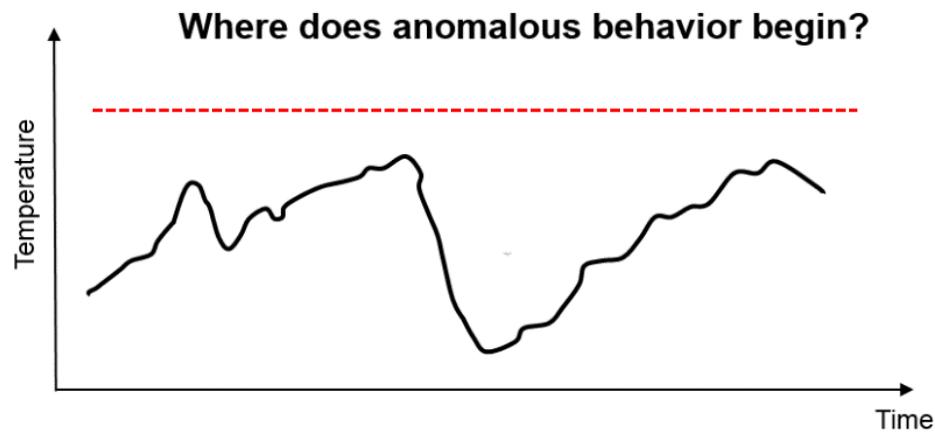
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# AVEVA's Predictive Analytics Solution



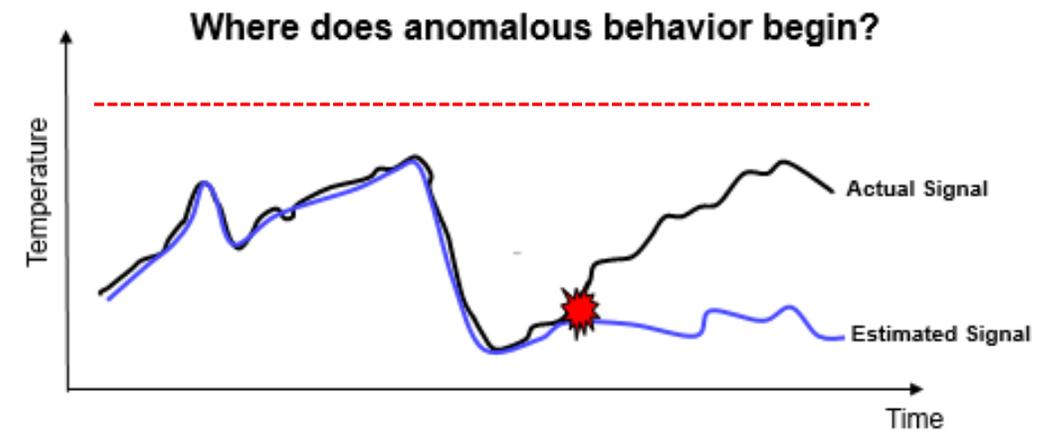
# A brief recap: AVEVA's approach to predictive analytics

## Traditional Monitoring



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

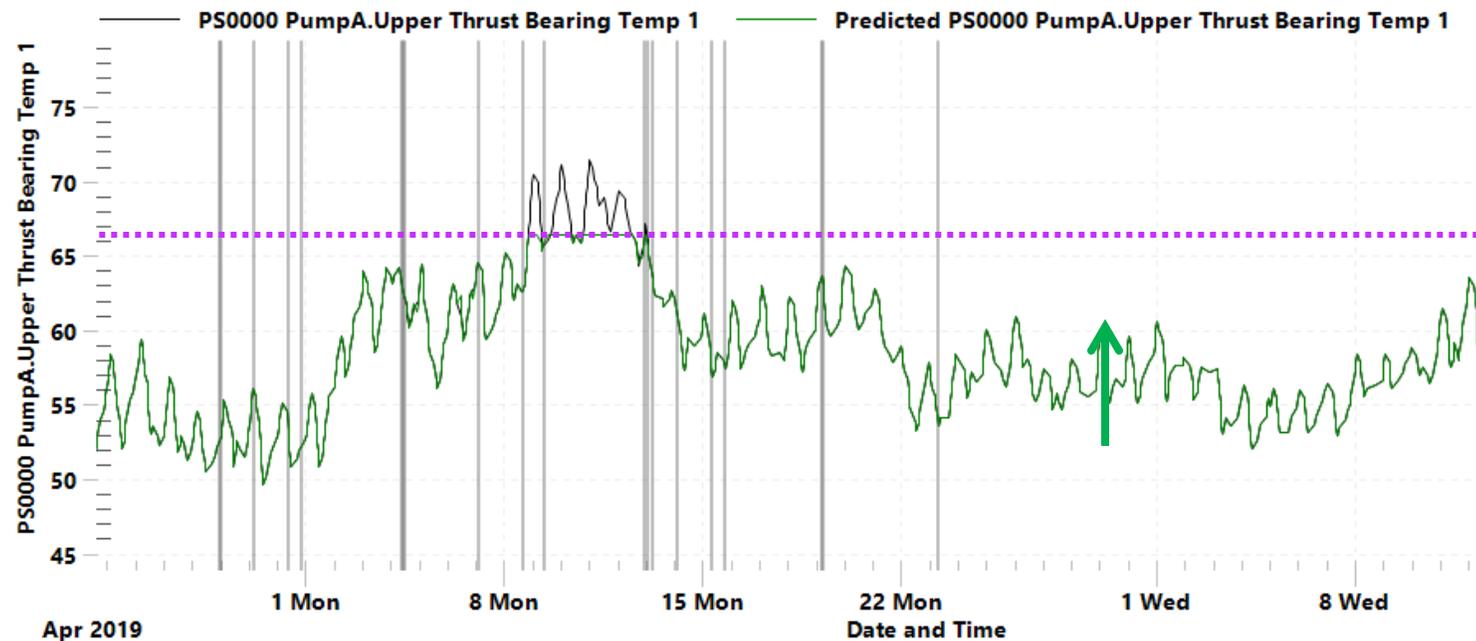
## Predictive Asset Monitoring



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

# Receive early warning predictions using PI System data

## Monitoring for anomalies in real-time



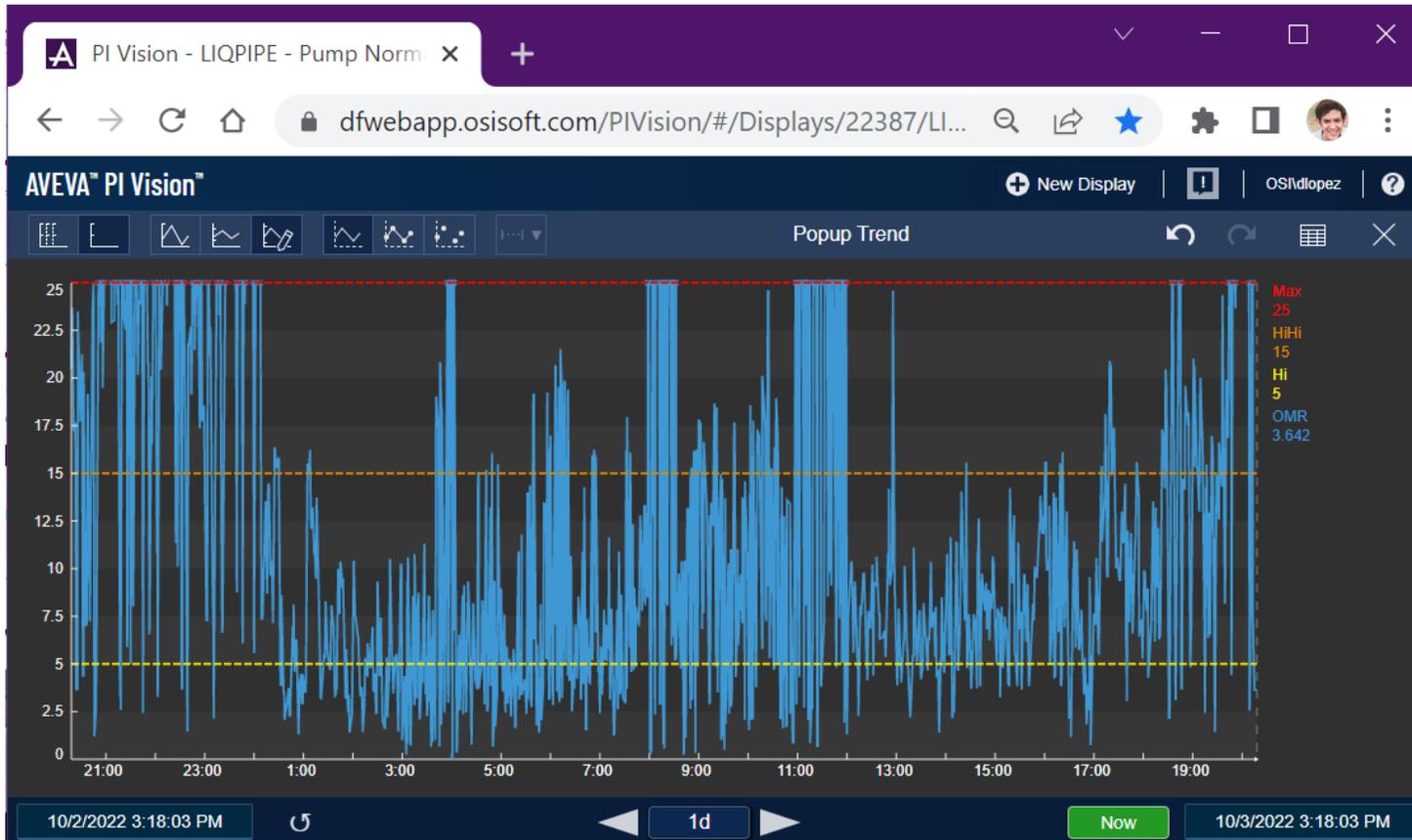
- Predictive Analytics automated alarms alert us when actual and predictive behavior separate
- Alarms set on the residual value: actual value minus the predicted
- Alarms are received earlier than typical DCS alarms

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# A Sneak Preview of What's Coming Soon

**AVEVA**

# Today: close the loop by historizing predictive results in PI System



STORE OMR WITHIN THE PI DATA  
ARCHIVE, AND VISUALIZE OMR  
OVER TIME WITHIN PI VISION

Stored results can be trending,  
configured as inputs to Asset  
Analytics, and even used within the  
PI Asset Framework as triggers of  
Event Frames and Notifications

# Upcoming: automate your predictive model building

## Quickly create many models at once

- Easily create many Predictive Analytics models at once with the Automated Model Building tool
  - Minimize errors
  - Ensure consistency
  - Save time
- Leverage the template functionality in AVEVA Predictive Analytics to automatically include filters, alert thresholds, and fault diagnostics with your models
- Import existing PI AF hierarchies or simply use the point names from an existing historian

How it works in 3 simple steps		
<b>Define Predictive Analytics template mappings</b>	<b>Run the model building tool</b>	<b>Fine-tune models and begin monitoring</b>
<ul style="list-style-type: none"><li>• Specify PI AF Template attributes or point names</li></ul>	<ul style="list-style-type: none"><li>• Automatically create models using your mapping definitions</li></ul>	<ul style="list-style-type: none"><li>• Review/tune the historical training data</li><li>• Follow your monitoring process</li></ul>

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# How to Begin



# AVEVA Predictive Analytics

Getting started in just four easy steps



Build Predictive Analytics Models



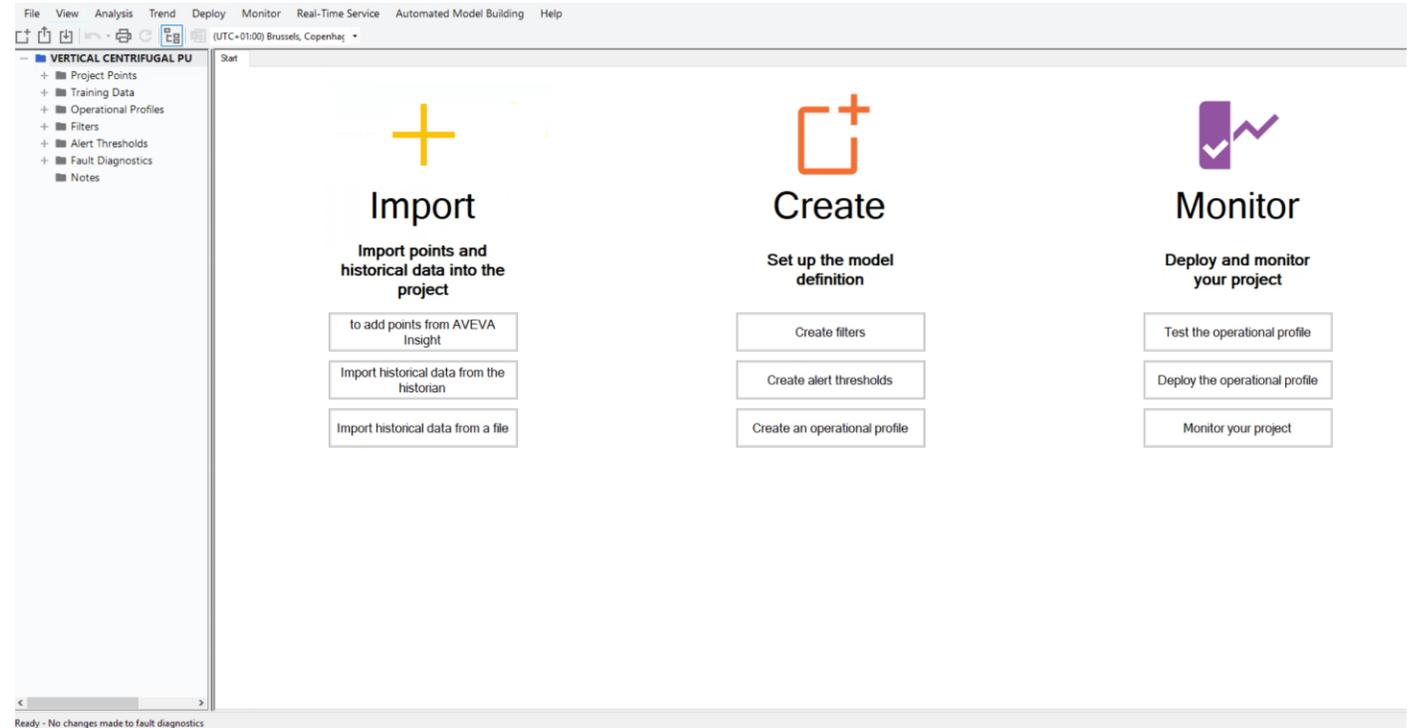
Create templates to share domain knowledge and best practices



Monitor and review model results using Predictive Analytics Web



Leverage AI-driven prescriptive actions for identified fault diagnostic



# AVEVA Predictive Analytics

Getting started in just four easy steps



Build Predictive Analytics Models



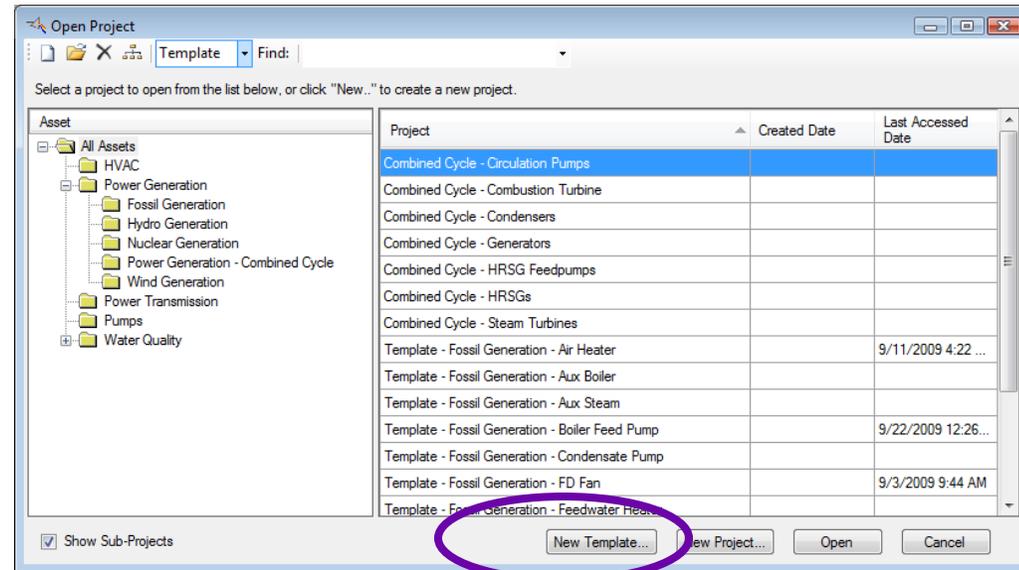
Create templates to share domain knowledge and best practices



Monitor and review model results using Predictive Analytics Web



Leverage AI-driven prescriptive actions for identified fault diagnostic



Make new templates or models based on templates

Recommended Instrumentation (Metrics)

Calculations

Alert Thresholds

Deployment Settings

Fault Diagnostics

Prescriptive Actions

# AVEVA Predictive Analytics

Getting started in just four easy steps



Build Predictive Analytics Models



Create templates to share domain knowledge and best practices



Monitor and review model results using Predictive Analytics Web



Leverage AI-driven prescriptive actions for identified fault diagnostic

Alerts

Show Trends Change State Project Notes Case History Quick Filter

Search

Assets	Name	Assigned To	Alert State	Runtime Status	Alert Age (Days)
- All Assets	<a href="#">COMP_1_MECHANICAL</a>	prashant.patil			
+ Food and Beverage	<a href="#">Conveyor Transport Line</a>	ariane.jayr			
+ Generic Models	<a href="#">Conveyor Transport System</a>				
+ Mining	<a href="#">Dans Test Project #1</a>				
+ Oil and Gas	<a href="#">Driven Steam Turbine - Mechanical</a>	ariane.jayr			
+ Power	<a href="#">Driven Steam Turbine - Process</a>				
	<a href="#">Gas Turbine 1 - Mechanical (Fault Data)</a>	alain.braibant			
	<a href="#">Gas Turbine 2 - Mechanical (Normal Operating Data)</a>	ariane.jayr			
	<a href="#">Gas Turbine 3 - Mechanical (Fault Data)</a>				
	<a href="#">HDR STEAM TURBINE - PROCESS (Fault Data)</a>				
	<a href="#">Project by user1</a>				
	<a href="#">Process Turbine Converter - Mechanical (Fault Data)</a>				

Items per page 20 1 - 17 of 17

# AVEVA Predictive Analytics

Getting started in just four easy steps



Build Predictive Analytics Models



Create templates to share domain knowledge and best practices



Monitor and review model results using Predictive Analytics Web



Leverage AI-driven prescriptive actions for identified fault diagnostic



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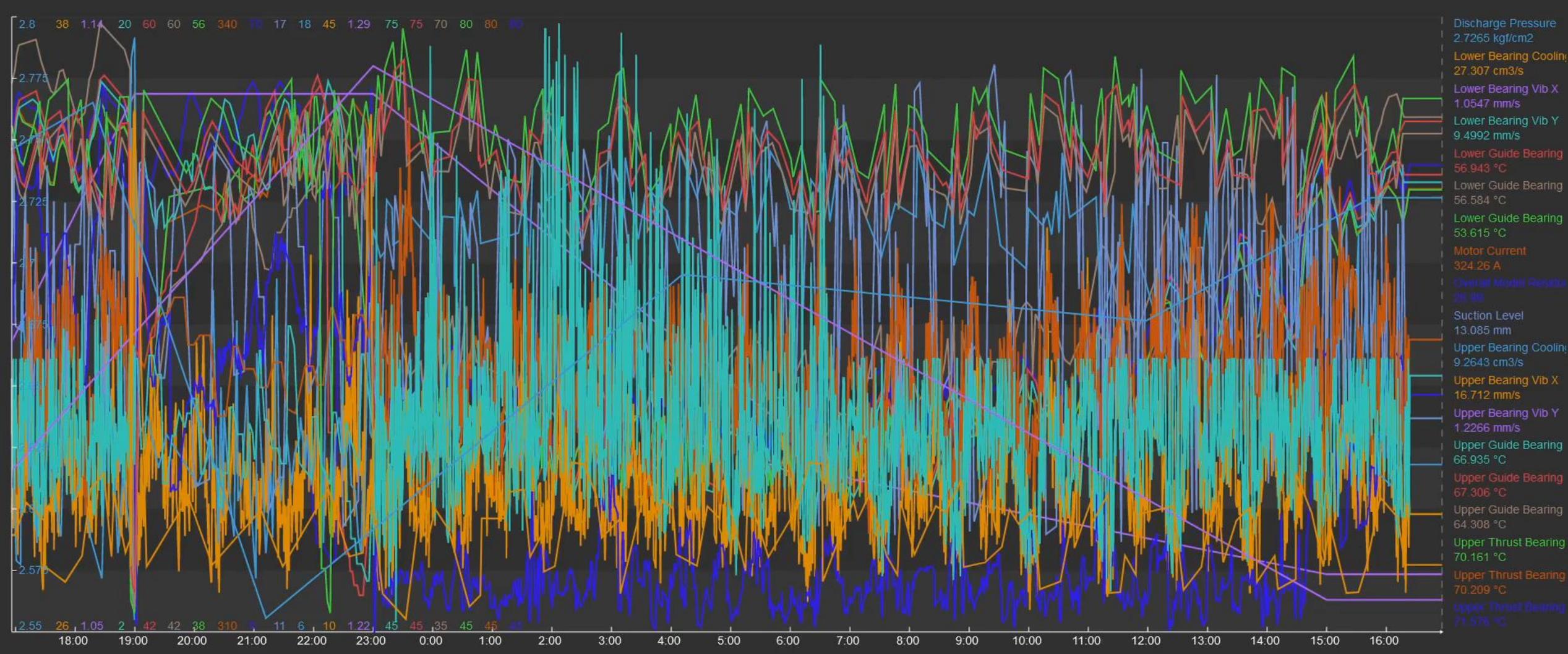
# Let's Look At Predictive Analytics in Action!

**AVEVA**

Chart toolbars: grid, zoom, pan, pan/zoom, pan/zoom/pan, pan/zoom/pan/zoom, pan/zoom/pan/zoom/pan, pan/zoom/pan/zoom/pan/zoom

Popup Trend

Refresh, Undo, Close icons



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# Our Roadmap: Looking Ahead

# Predictive Analytics and PI System: our integration roadmap

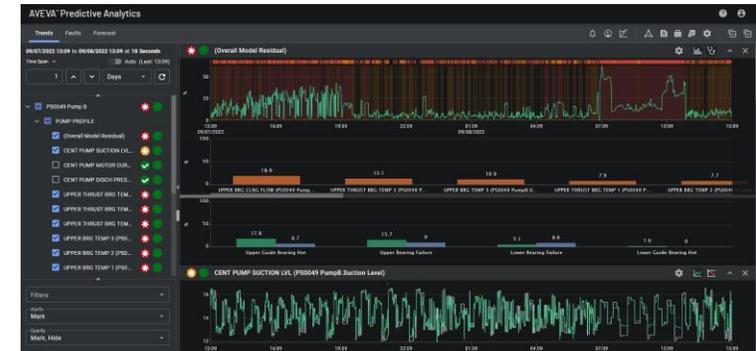
Level 1: Standard Point Integration: Proven in many sites

## Deployed Integration

AVEVA PI System



AVEVA Predictive Analytics



PI tag lists



Process data

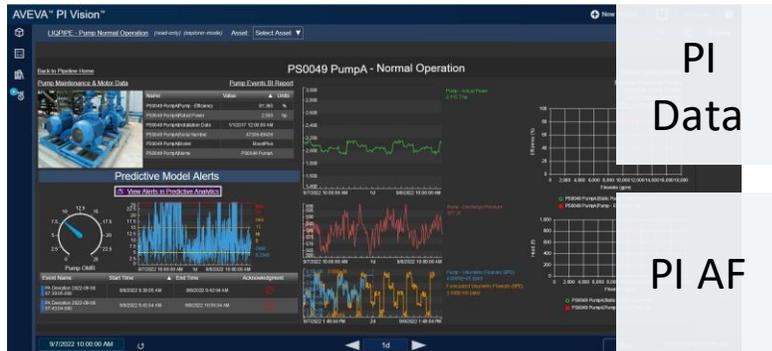
Available

# Predictive Analytics and PI System: our integration roadmap

## Level 2: Using Proven Integration Patterns - Services

### High-Performance Integration

AVEVA PI System



PI Data

PI AF

Process data & Performance analytics



Predicted asset health



Dynamic linking to Predictive Asset AI Models

AVEVA Predictive Analytics



PA Agent

*High availability is possible via the AF SDK*

Available

# Predictive Analytics and PI System: our integration roadmap

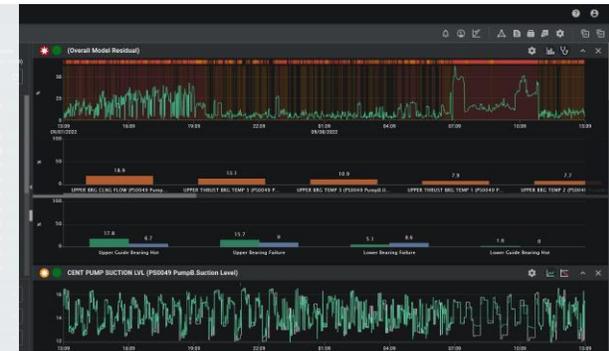
## Level 3: Native Integration

### Native Integration

AVEVA PI System



AVEVA Predictive Analytics



- Shared PI System internal data store
  - Shared PI AF hierarchy
  - Shared calculations
- Automated model building based on PI AF

Coming Soon

---

# How the Upcoming Automated Model Building Can Work

**AVEVA**

# How automated model building works

## 1) Define Predictive Analytics template mappings

A simple “mapping spreadsheet” format lets you define which points to use in the models

- Defining the spreadsheet closely mirrors traditional model planning

Two mapping methods are supported:

- AVEVA Predictive Analytics template metrics  $\leftrightarrow$  Point names in any historian
- AVEVA Predictive Analytics template  $\leftrightarrow$  PI AF Template Attributes

	A	B	C	D	E	F	G	H
1	Simple PA Steam Turbine	Exclude From Profile?	Template Calc?	CHI Turbine 1	CHI Turbine 2	CHI Turbine 3	CHI Turbine 4	CHI Turbine 5
2	ASSET FOLDER NAME							
3	RTS NAME							
4	GROSS LOAD			CHI.ST1.power	CHI.ST2.power	CHI.ST3.power	CHI.ST4.power	CHI.ST5.power
5	SHAFT SPEED	yes		CHI.ST1.53SI801	CHI.ST2.53SI801	CHI.ST3.53SI801	CHI.ST4.53SI801	CHI.ST5.53SI801
6	INLET STEAM FLOW			CHI.ST1.53FY107	CHI.ST2.53FY107	CHI.ST3.53FY107	CHI.ST4.53FY107	CHI.ST5.53FY107
7	INLET STEAM TEMP			CHI.ST1.53TI111	CHI.ST2.53TI111	CHI.ST3.53TI111	CHI.ST4.53TI111	CHI.ST5.53TI111
8	INLET STEAM PRESS			CHI.ST1.53PI155	CHI.ST2.53PI155	CHI.ST3.53PI155	CHI.ST4.53PI155	CHI.ST5.53PI155
9	EXH STEAM TEMP			CHI.ST1.53TI112	CHI.ST2.53TI112	CHI.ST3.53TI112	CHI.ST4.53TI112	CHI.ST5.53TI112
10	EXH STEAM PRESS			CHI.ST1.53PI157	CHI.ST2.53PI157	CHI.ST3.53PI157	CHI.ST4.53PI157	CHI.ST5.53PI157
11	TURBINE PRESSURE RATIO CALC		yes					

APA Template Metrics

Historian Point Names

	A	B	C	D
1	Simple PA Steam Turbine	Exclude From Profile?	Template Calc?	Simple AF Steam Turbine
2	ASSET FOLDER NAME			
3	RTS NAME			
4	GROSS LOAD			Power
5	SHAFT SPEED	yes		Speed
6	INLET STEAM FLOW			Steam Flow
7	INLET STEAM TEMP			Inlet Steam Temperature
8	INLET STEAM PRESS			Inlet Steam Pressure
9	EXH STEAM TEMP			Exhaust Steam Temperature
10	EXH STEAM PRESS			Exhaust Steam Pressure
11	TURBINE PRESSURE RATIO CALC		yes	

APA Template Metrics

PI AF Template Attributes

# How automated model building works

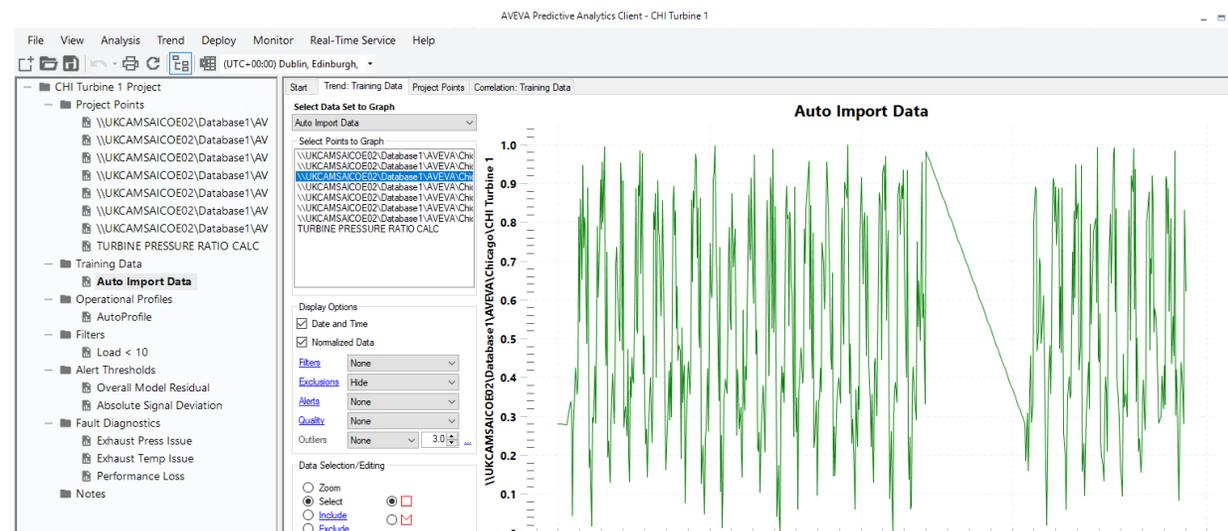
## 2) Run the model building tool

Supply the mapping spreadsheet, and enter your desired model settings in the tool, then click “Create Projects”

The tool will automatically:

- Create a new model
- Add the mapped points
- Apply the Predictive Analytics template (calc points, filters, alert thresholds, fault diagnostics)
- Import training data
- Analyze training data for outliers and remove them
- Finally, save and deploy the model

STEP 1: ENTER CONFIGURATION SETTINGS		STEP 2: CREATE PROJECTS	
Choose Mapping File		Choose Folder Containing JSON Files	
Mapping File Selected	C:/Users/alex.jenkins/Desk	JSON Folder Selected	C:/Users/alex.jenkins/Desk
Select Mapping File Type	PI Asset Framework		
RTS Name (Default)	UKCAMSACOEO2 Database		
Asset Folder Name (Default)			
Training Set Name	Auto Import Data		
Training Data Start Time	2022-09-01 00:00:00		
Training Data End Time	2022-09-30 00:00:00		
Training Data Frequency (s)	3600		
Run Model Every (s)	600		
Outlier Scale (0-100)	2.5		
Deploy Profile?	<input checked="" type="checkbox"/>		
Profile Name	AutoProfile		
--- PI Asset Framework Options ---			
AF Element Wild Card	*		
AF Database	Database1		
AF System	UKCAMSACOEO2		
Create JSON Files		Create Projects	
Status: ProjectLoader.exe has finished Please see the console output or log files for details.			



# How automated model building works

## 3) Fine-tune models and begin monitoring

The models will be deployed and available to you in the APA Asset Hierarchy

- If using PI AF, AVEVA Predictive Analytics and PI AF hierarchies will match

You can review the training data in the model to fine tune it

- Use your SME/engineering judgement to add or remove data from the model or make any other model-specific adjustments

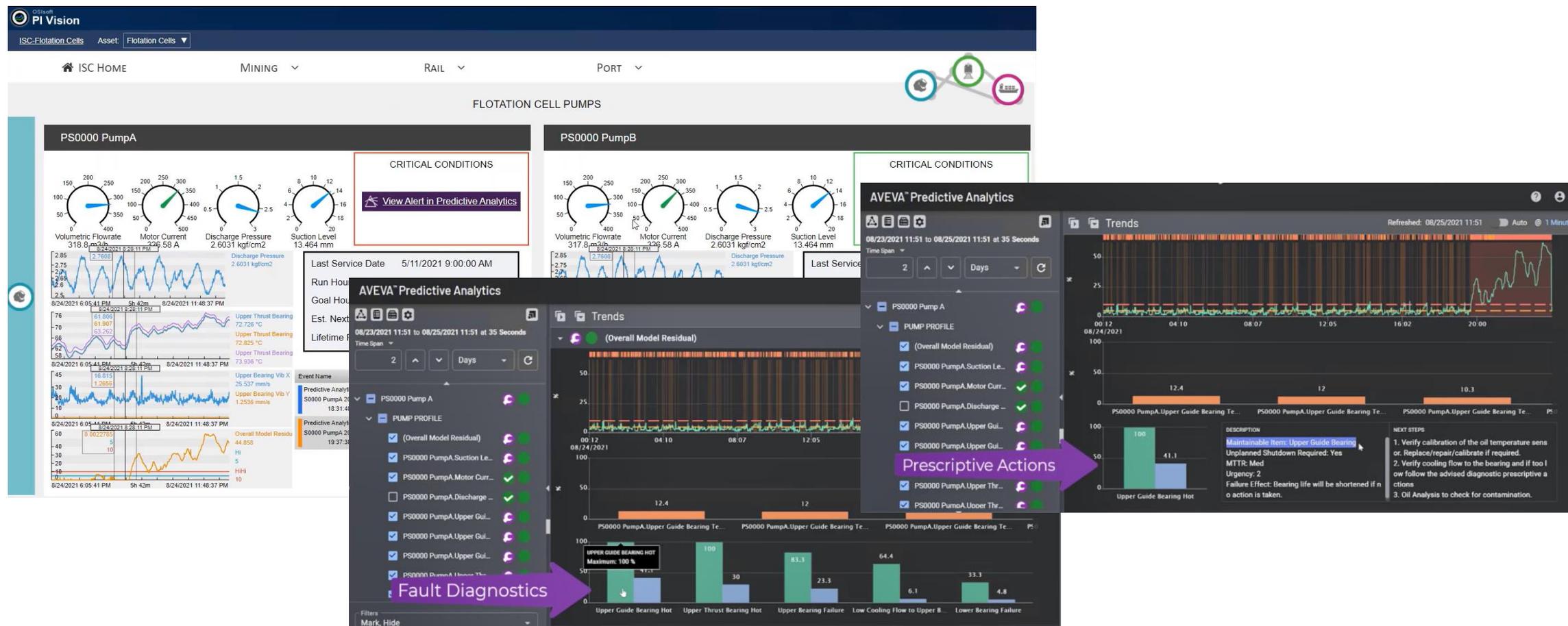
Finally, begin monitoring the models!

The image shows two side-by-side screenshots from the AVEVA Predictive Analytics interface. The left screenshot displays the 'Elements' tree view, which is organized into a hierarchy. At the top is 'Elements', followed by 'AVEVA'. Under 'AVEVA', there are five city-based folders: 'Chicago', 'Hyderabad', 'London', 'Paris', and 'San Francisco'. Each city folder contains a list of turbines, such as 'CHI Turbine 1' through 'CHI Turbine 9' under Chicago, and 'SFR Turbine 1' under San Francisco. The right screenshot shows the 'Alerts' page. It has a navigation bar with 'Home', 'Alerts', 'Sensors', 'Cases', and 'Reports'. Below the navigation bar are several icons for 'Show Trends', 'Change State', 'Project Notes', 'Cases', and 'Quick Filter'. The main content area is a table with columns for 'Assets', 'Name', 'Alert State', and 'Runtime Status'. The 'Assets' column is expanded to show 'All Assets' and 'AVEVA'. Under 'AVEVA', the cities 'Chicago', 'Hyderabad', 'London', 'Paris', and 'San Francisco' are listed. The table lists 18 turbines, each with a green checkmark in the 'Alert State' column and a green circle in the 'Runtime Status' column. A large purple arrow points from the 'AVEVA' folder in the left screenshot to the 'AVEVA' section in the right screenshot.

Assets	Name	Alert State	Runtime Status
✓ All Assets	CHI Turbine 1	✓	●
✓ AVEVA	CHI Turbine 2	✓	●
Chicago	CHI Turbine 3	✓	●
Hyderabad	CHI Turbine 4	✓	●
London	CHI Turbine 5	✓	●
Paris	CHI Turbine 6	✓	●
San Francisco	CHI Turbine 7	✓	●
	CHI Turbine 8	✓	●
	CHI Turbine 9	✓	●
	HYD Turbine 1	✓	●
	HYD Turbine 2	✓	●
	HYD Turbine 3	✓	●
	LON Turbine 1	✓	●
	LON Turbine 2	✓	●
	LON Turbine 3	✓	●
	LON Turbine 4	✓	●
	LON Turbine 5	✓	●
	PAR Turbine 1	✓	●
	PAR Turbine 2	✓	●
	PAR Turbine 3	✓	●
	SFR Turbine 1	✓	●

# Altogether: a holistic monitoring approach to predictive analytics

From KPI visualization to predictive fault diagnostics to prescriptive actions



## 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



## Petronas

Petronas uses AVEVA for centralized predictive asset health and performance monitoring of upstream and downstream assets

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

Petronas deployed the AVEVA Predictive Analytics asset performance management software with the PI System saving over 17.4M in 12 months

Uptime improved by 5%

Maintenance costs reduced by >10%



## 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



## ADNOC

Abu Dhabi National Oil Company (ADNOC) implemented the Panorama Command Center

Enabling \$100's millions saving per year

Improved visibility for faster decision making



# We invite you to learn from the successes of your peers!



**Reduced OPEX Costs & Risks**

---

**\$34.5M** on a single early warning catch for a turbine generator preventing catastrophic failure.



+



**Increased Productivity & Efficiency**

---

Avoid downtime of critical assets through Fleet-wide monitoring of **300** fossil, nuclear and renewable power generation plants



+



**Accurate Diagnostics**

---

Early warning of fouling on a pump suction filter: remaining useful life estimation determined **36 days** until reaching DCS setpoint.



+



**Minimized Unplanned Downtime**

---

**\$17.5M** saved on reactive repairs and unplanned downtime



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Our single takeaway from today

AVEVA

# The end of unplanned downtime is here



## 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 |

## 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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## Brad Jones

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- [brad.jones@aveva.com](mailto:brad.jones@aveva.com)



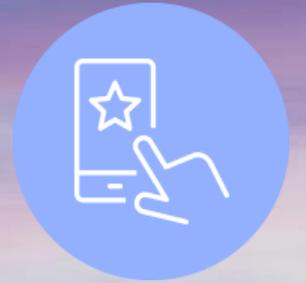
# Questions?

Please wait for the microphone  
State your name and company



# Please remember to...

Navigate to this session in the mobile  
app to complete the survey.



# Thank you

# AVEVA

This presentation may include predictions, estimates, intentions, beliefs and other statements that are or may be construed as being forward-looking. While these forward-looking statements represent our current judgment on what the future holds, they are subject to risks and uncertainties that could result in actual outcomes differing materially from those projected in these statements. No statement contained herein constitutes a commitment by AVEVA to perform any particular action or to deliver any particular product or product features. Readers are cautioned not to place undue reliance on these forward-looking statements, which reflect our opinions only as of the date of this presentation.

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 industrial software, sparking ingenuity to drive responsible use of the world's resources. The company's secure industrial cloud platform and applications enable businesses to harness the power of their information and improve collaboration with customers, suppliers and partners.

Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life's essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world's most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. With operations around the globe, we are headquartered in Cambridge, UK and listed on the London Stock Exchange's FTSE 100.

Learn more at [www.aveva.com](https://www.aveva.com)