

NOVEMBER 2022

Going beyond condition-based maintenance

with Predictive Analytics and Prescriptive Guidance

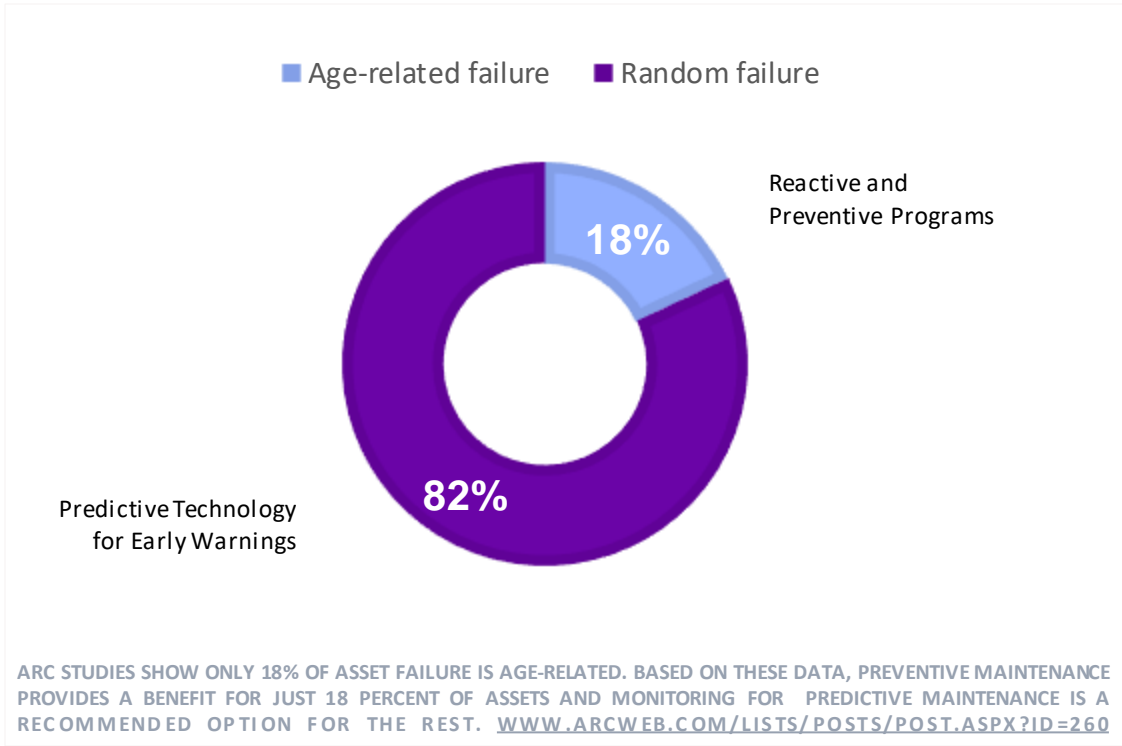
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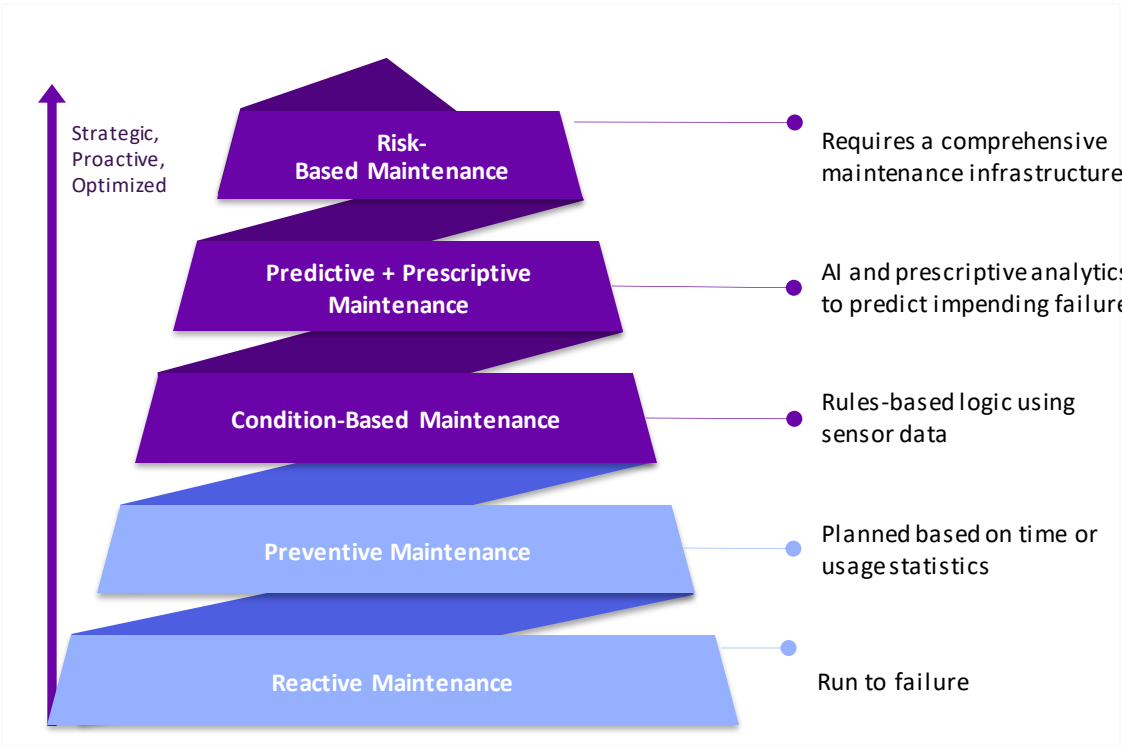
AVEVA

AVEVA APM connects Asset Strategy to Corporate Objectives

Failure Patterns



It's a Journey



AVEVA APM Blueprint

10%-20% overall OPEX reduction; **25%** reduction in downtime; **30%** maintenance cost savings

Manage risk cost and performance while ensuring safe and reliable operations and workforce



Asset Strategy Optimization

Balance Risk, Cost and Performance in your Asset Strategy

- Align asset strategy to enterprise goals
- Asset criticality
- Reliability-centered maintenance
- Failure mode and effects analysis
- Asset library
- Root cause analysis
- Risk simulation and management



Asset Analytics

Reduce Downtime with Predictive and Prescriptive Analytics

- Predictive analytics
- Prescriptive maintenance
- Case and collaboration management
- Turnkey MDSC capabilities
- Artificial intelligence
- Machine learning
- Condition-based Maintenance



Asset Maintenance

Improve Safety and Reliability in Maintenance

- Operational safety management
- Control of work
- Digital work permitting
- Hazard analysis
- EAM Integration
- Mobile maintenance
- Connected worker



Asset Information Management

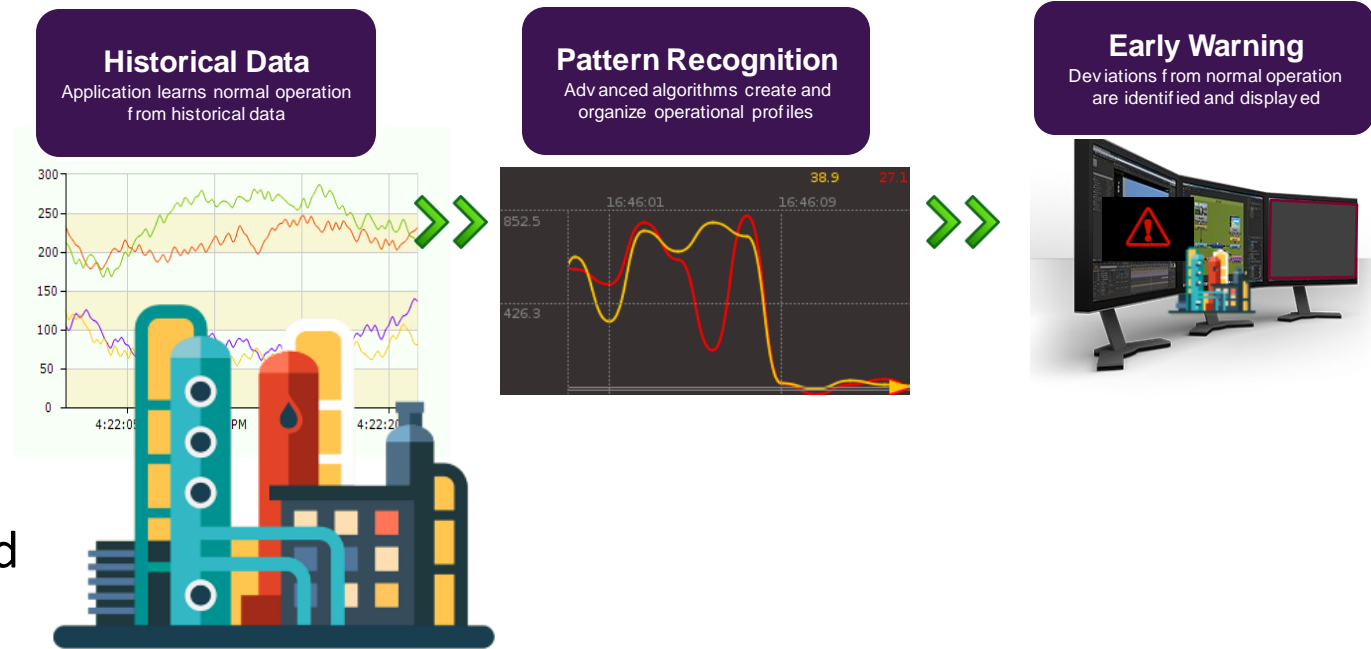
Accelerate Accurate Decision-making with holistic information management

- Engineering data
- Operational Data
- Maintenance Data
- Big Industrial Data
- 1D, 2D, 3D
- Asset Health

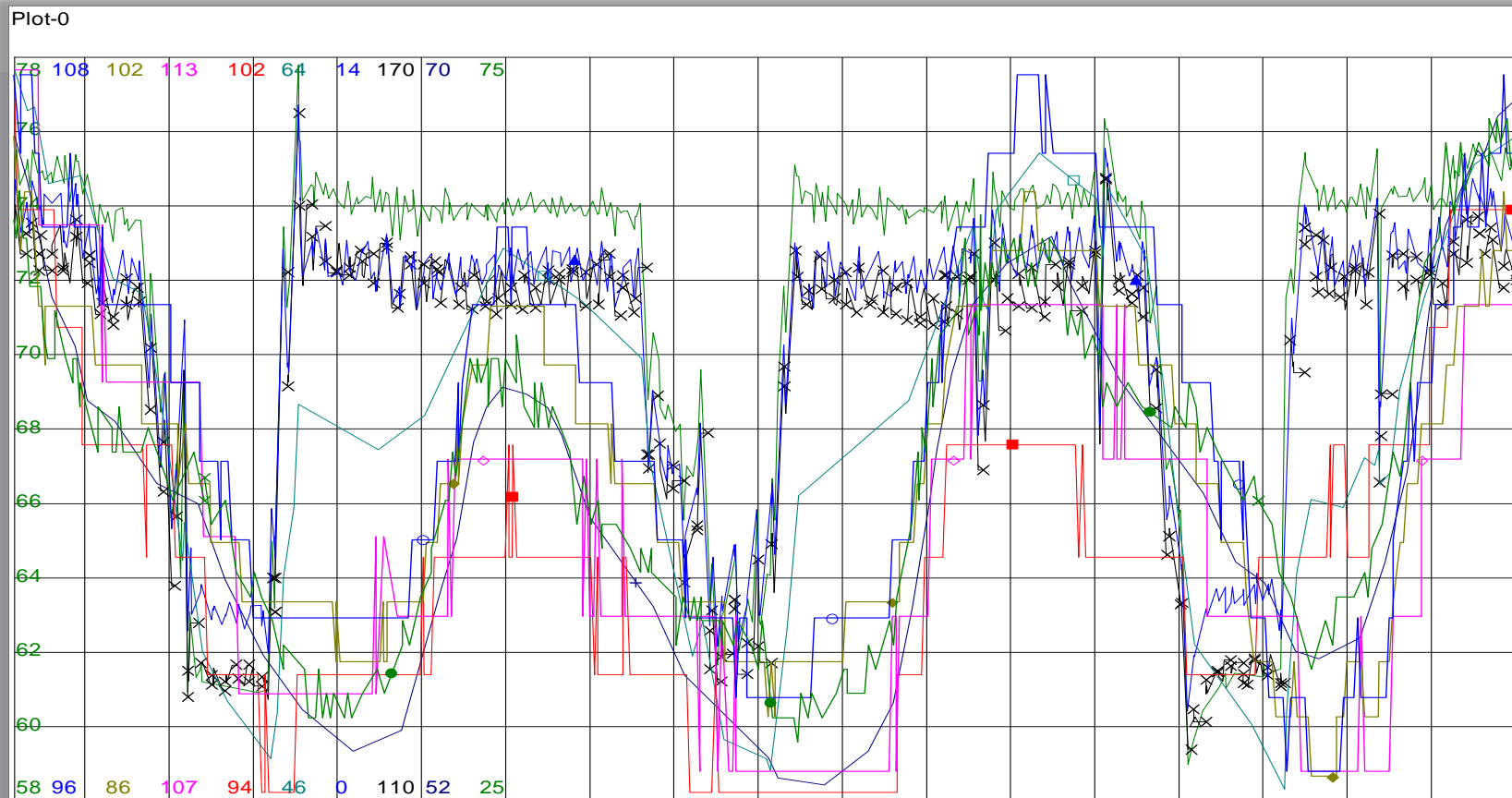
AVEVA Predictive Analytics™

Apply the Right Strategy

- Artificial Intelligence continuously monitors behavior in real-time
- Alerts when the operation differs from the historical norm
- Early warning detection of equipment problems
- Advanced analysis capabilities including problem identification and root cause analysis
- Continuously monitors for degradations 24x7

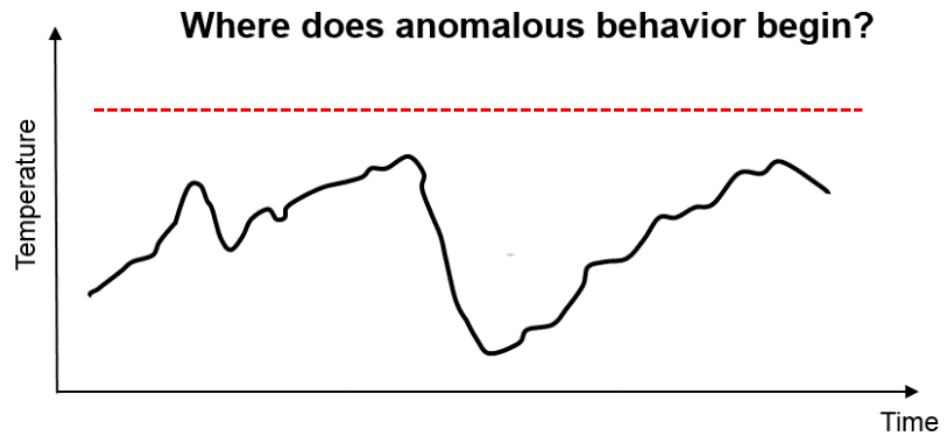


Monitoring Without Predictive Analytics



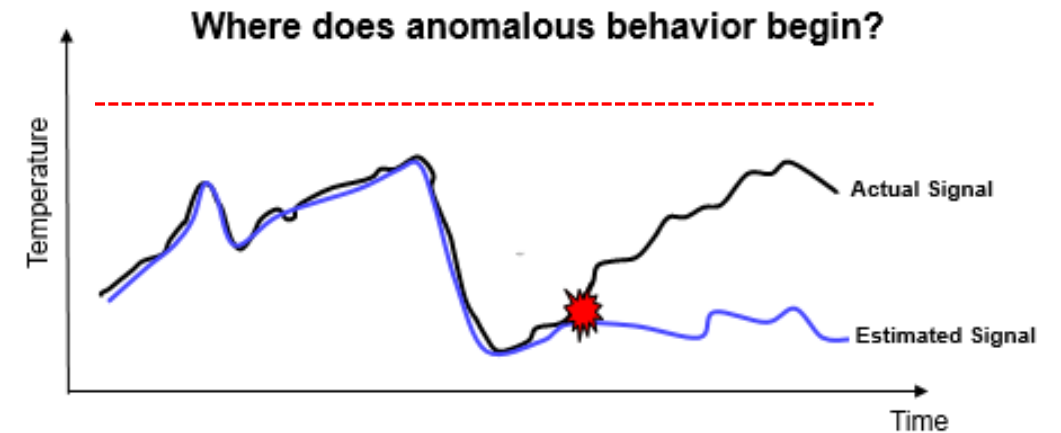
Monitoring Approach

Traditional Monitoring



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

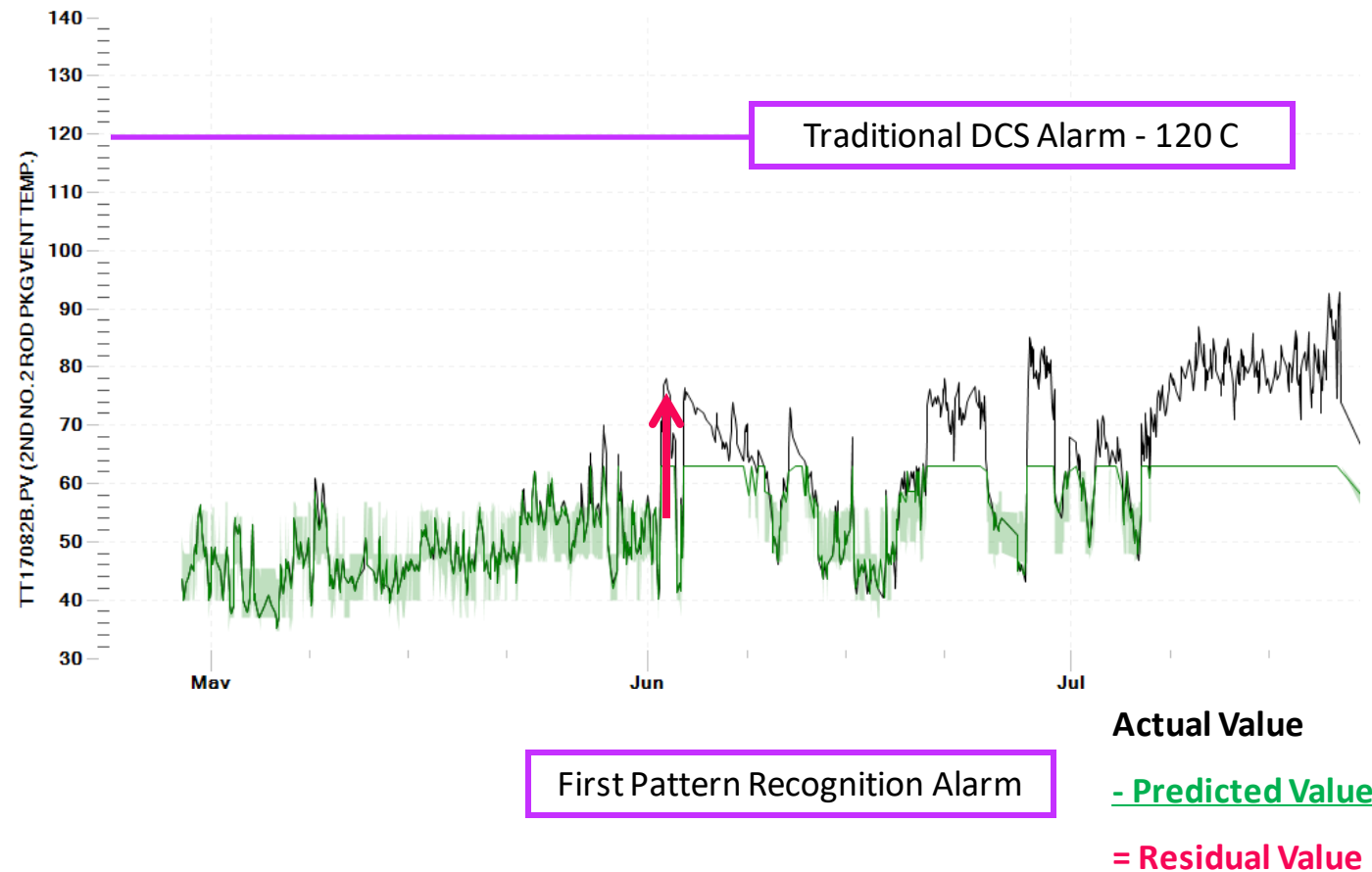
Predictive Asset Monitoring



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

Early Warning Prediction

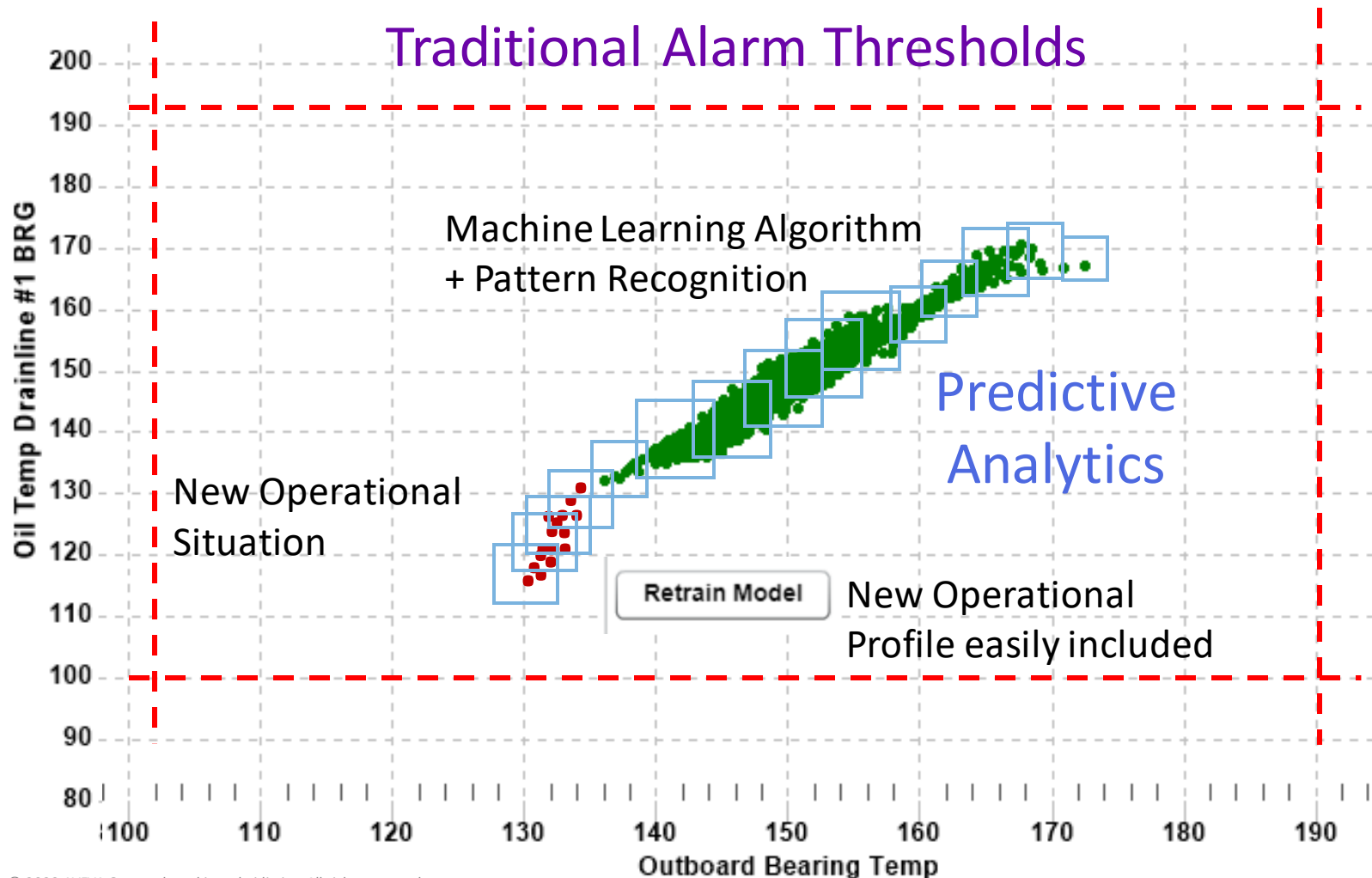
Monitoring for Anomalies



- Predictive Analytics automatically alerts us when actual and predictive behavior deviate
- Alerts are set on the residual value: actual value minus the predicted
- Predictive Analytics alerts are received earlier than typical DCS alarms

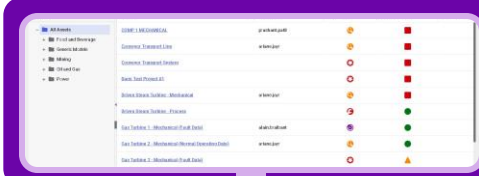
AVEVA Predictive Analytics – How Does It Work?

Operational modes



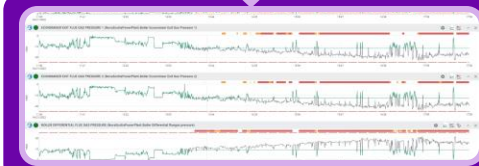
- Asset historical data is encoded using AVEVA's OPTiCS patented algorithm
- Operational modes describe known relationships in data across N sensor dimension
- New data is compared against the relevant operational mode to detect deviations in behavior in real-time
- Algorithm computes magnitude of deviations and which sensor(s) are contributors

Alert analysis process



Alert list

- Filter on assets of interest
- Filter/Sort by priority



Sensor and prediction trending

- View actual, predicted and deviation trends for each sensor in the model, plus OMR
- Easily hide or highlight periods with model filters, alerts, bad data



Fault Diagnostics

- Fault Tree: Get an overview of failure conditions, faults and relevant sensors
- Get probability match for each fault and sensor contributions



Prescriptive guidance

- For each fault, get prescriptive guidance on inspections and other tasks to confirm the root cause of the anomaly



Forecasting

- Get an estimate of the remaining time to reach thresholds or failure points
- Schedule periodic updates of the forecast to help alert prioritization

Alert List

All models have an alert State and runtime status

Users can filter and order the list by all fields including:

- Asset hierarchy
- Alert state, age, importance, persistence
- Runtime status: OK, Warning, Alert, Off, Out of service
- Cases
- Forecast urgency and TTF

Benefits:

- Monitoring users can manage the state of alerts throughout their lifecycle (days, weeks, months) and prioritize their analysis.

AVEVA Predictive Analytics

Home Alerts Sensors Cases Reports Refreshed: 03/04/2022 10:26 PM Auto

Alerts

Show Trends Change State Project Notes Cases Quick Filter

Search

Assets	Name	Alert Criticality	Assigned To	Alert Importance	Alert State	Runtime Status	Alert Age (Days)	Alert Persistence (%)	Case Status	Open Cases	Closed Cases	7 Day
All Assets	BOILER COMBUSTION EMISSIONS PERFORMANCE			Increased	✖	●	23	6				
	BOILER FOULING			Increased	⚠	●	274.2	8	🔵	1	1	
	COMP 1 MECHANICAL			Increased	✖	▲	23	89	🔵		1	
	Conveyor Transport Line			Increased	✖	⬛	23	28	🔵	1		
	Conveyor Transport System			Increased	⚠	⬛	23	27				
	Driven Steam Turbine - Mechanical			Normal	⚠	⬛	274.4	25				
	Driven Steam Turbine - Process			Normal	✓	⬛						
	FD FAN MECHANICAL			Normal	⚠	●	23	44				
	FD FAN PROCESS			Increased	✖	●	22.9	0				
	Gas Turbine 1 - Mechanical (Fault Data)			Increased	⚠	●	22.8	26	🔵	2		
	Gas Turbine 2 - Mechanical (Normal Operating Data)			Increased	✖	●	415.5	1				
	Gas Turbine 3 - Mechanical (Fault Data)			Increased	⚠	▲	415.8	46	🔵	1		
	HDR BPA HEATER			Normal	✓	⚠						
	HDR CRUDE FURNACE HEATER			Increased	✖	⚠	274.1	0				
	HDR MPA HEATER			Normal	✓	⚠			🔵		1	
	HDR STEAM TURBINE - PROCESS (Fault Data)			Normal	🔵	●	415.5	15				
	HDR TPA HEATER			Normal	⚠	⚠	411.1	0				
	J-9002A	avevaint1220755\ilaria.mi...		Increased	⚠	●	23	11	🔵	1	1	
	SCR PROCESS			Increased	✖	●	23	13				
	Steam Turbine Generator - Mechanical (Fault Data)			Increased	⚠	⬛	23	62				

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Sensor Alert Management

All sensors in models have an alert state and runtime status

Users can filter and order the list by all fields including:

- Asset hierarchy
- Alert state, age, issue reason, persistence
- Runtime status

Users can also:

- Override sensor state manually
- View historical trend of sensor
- Adjust sensor processing rules

Benefits:

- Central visualization of all sensors
- Keep track of sensor issues and state
- View which models are impacted

AVEVA™ Predictive Analytics

Home Alerts **Sensors** Cases Reports

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Sensors

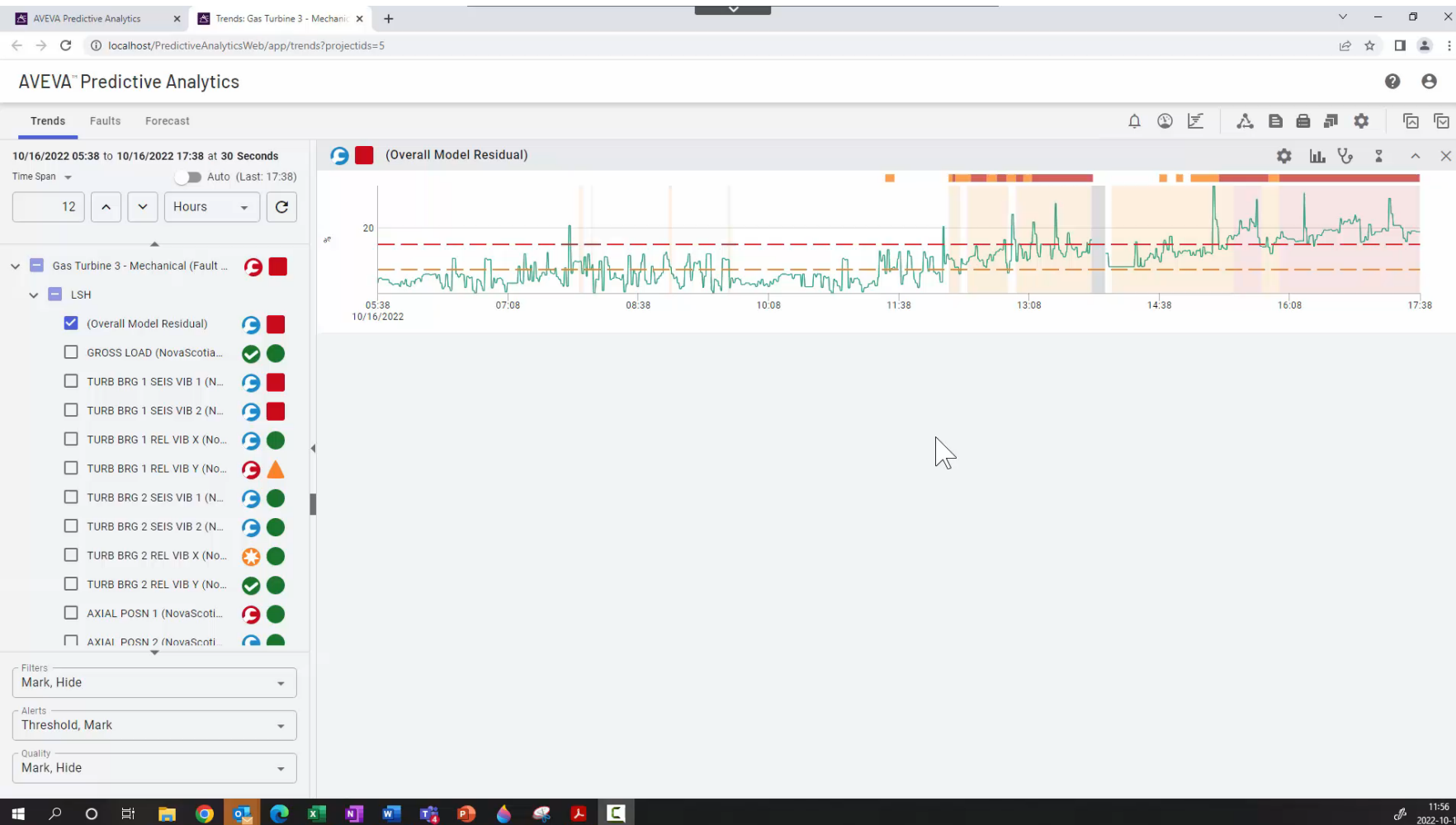
Show Trends Change Alert State Quick Filter

Search

Assets	Name	Assigned To	Alert State	Runtime Status	Sensor Issue Reason	Alert Age (Days)	Alert Persistence (%)	7 Day Event
▼ All Assets	Economiser Exit Gas Pressure 1		✓	●				
> Food and Beverage	NovaScotiaPowerPlant.Boiler Economiser Exit Gas Pressure 2		✓	●				
> Generic Models	NovaScotiaPowerPlant.Boiler Furnace Exit Flue Gas Pressure		✓	●				
> Mining	NovaScotiaPowerPlant.Boiler Gross Power Generation		✓	●				
> Oil and Gas	NovaScotiaPowerPlant.Boiler Mill A Fuel Flow		✓	●				
> Power	NovaScotiaPowerPlant.Boiler Mill B Fuel Flow	avevaint1\akshay.varshney	✓	●		428.2	0	
Test	NovaScotiaPowerPlant.Boiler Mill C Fuel Flow		✖	●		428.2	0	
	NovaScotiaPowerPlant.Boiler Mill D Fuel Flow		✖	✖	Manual Override	428.2	0	
	NovaScotiaPowerPlant.Boiler O2 AFTER ECO AVERAGE		✓	●		428.2	0	
	NovaScotiaPowerPlant.Boiler O2 At Economiser Exit 1		✓	●				
	NovaScotiaPowerPlant.Boiler O2 At Economiser Exit 2		✖	✖	Out of Range	428.2	0	
	NovaScotiaPowerPlant.Boiler O2 At Economiser Exit 3		✖	●		428.2	0	
	NovaScotiaPowerPlant.Boiler O2 At Economiser Exit 4		✖	●		428.2	0	

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Fault Diagnostics and Prescriptive Guidance



Diagnostics are available to identify the root cause of anomalies

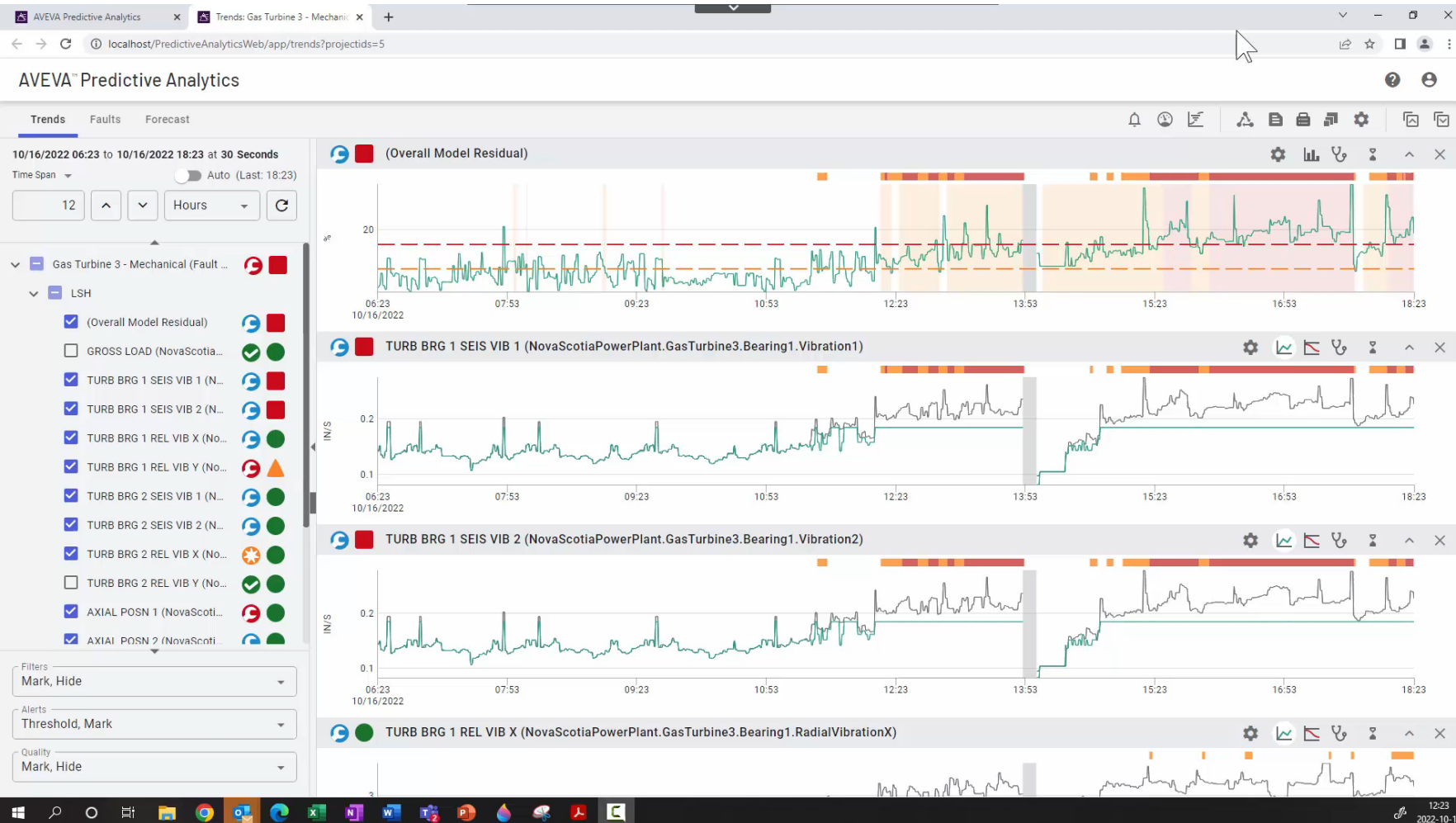
Fault Diagnostics:

- Failure modes current and historical probability
- Fault Tree diagram for overall view of failure modes for model/asset
- Sensor contribution to fault – current, recent and historical
- Identification of related past faults
- Prescriptive guidance from our asset library to further diagnose/inspect assets

Benefits:

- Facilitates identification of possible failure modes
- Continuously improve with information from similar previous faults

Forecast view



Estimate time to failure and identify urgency level with sensor forecasting

Forecast view:

- Run a projection for critical sensors up to threshold
- System evaluates remaining time range and distance to threshold to determine urgency level
- User can schedule forecasts for periodic execution, helping prioritize alerts

Benefits:

- Contributes to the evaluation of remaining time to failure
- Evaluates overall risk of continuing operating the asset in current conditions
- Allows for maintenance plans adjustments instead of being in reactive mode

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**



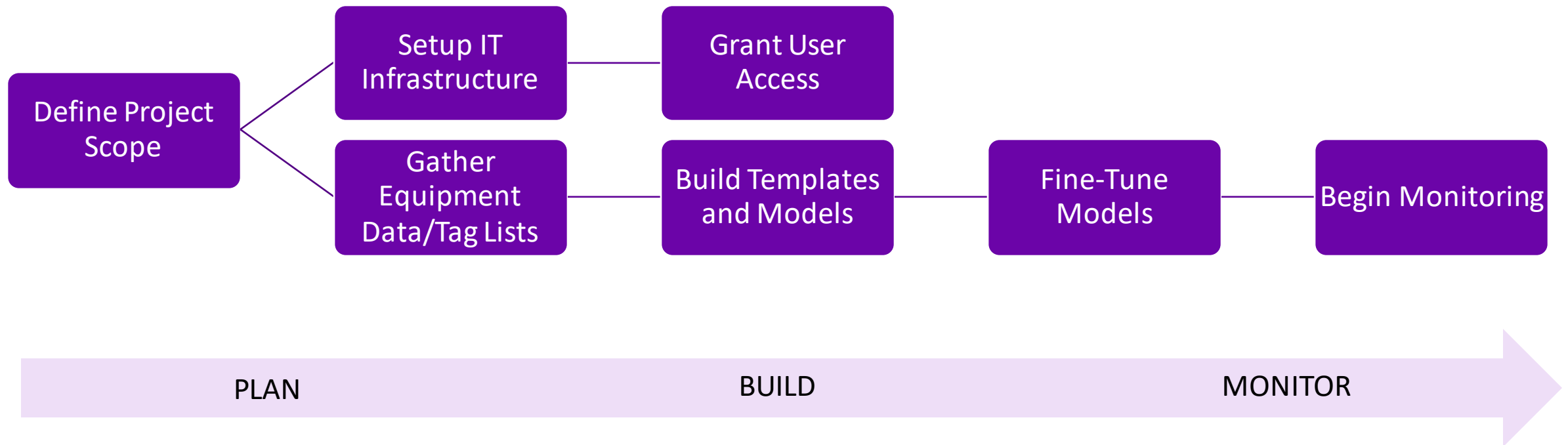
**Integrated Alert
Workflow**



*Algorithms/Machine Learning is just one part of the solution
Operationalizing AI at scale is the difference between success or failure*

Implementing a Predictive Analytics Solution

Steps for Success at Scale



Highlights from roadmap

Subject to change!

What's coming at end of 2022 (2022 R2)

- Automated model building (see session Integrating AVEVA Predictive Analytics with AVEVA PI System)
- Deploy models based on external algorithms
- View which models are impacted by a sensor issue
- Auditing of confirmation and runtime changes
- Web API and Direct link navigation for application integration

What's coming in future releases

- Web Model Building
- PI subsystem archive
- Modes and profile deployment by asset
- Support for Amazon RDS and Microsoft SQL Azure
- Enhanced notifications
- Hybrid solution:
 - BI model
 - Asset Library
- AVEVA SaaS Predictive Analytics

Check out these great presentations!

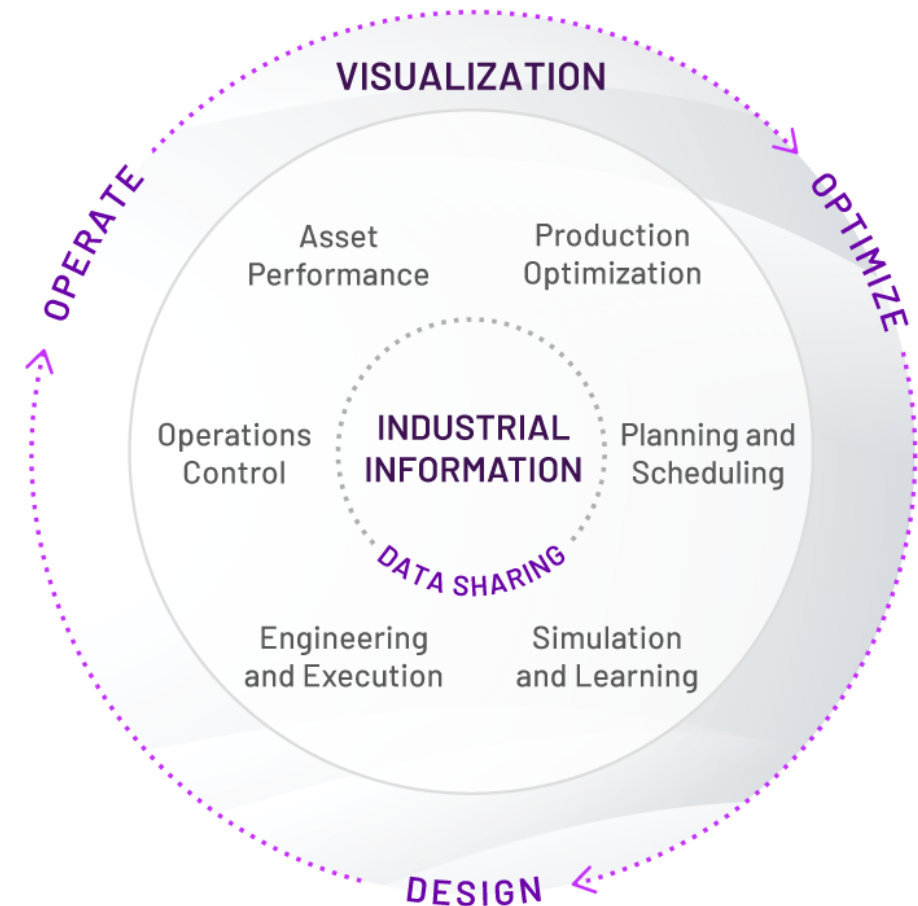
Underscoring the value and driving into the details

Wednesday:

- ENEL Remote Predictive Diagnostic Center and cutting-edge technologies in AI with AVEVA
- AI-enabled Online Monitoring and Diagnostics of ENEL's Geothermal Power Plants
- Renewables monitoring with PI and Predictive Analytics at Southern Company
- Predictive On-Line Monitoring of Co-Generation Plants at Suncor
- Building a Winning Business Case for Predictive Asset Analytics at Saudi Aramco

Thursday:

- Going Beyond Condition-based Maintenance with Predictive Analytics and Prescriptive Guidance
- Integrating AVEVA Predictive Analytics with AVEVA PI System





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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

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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.

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