

19 MAY 2022

Drive Sustainability and Asset Reliability Using AVEVA PI System and APM Solutions

Ilaria Michelizzi | Principal Consultant | EMEA APM Presales Lead | AVEVA

Curt Hertler | Principal Pre-Sales Engineer | AVEVA

AVEVA

PI WORLD 2022

Agenda

AVEVA Vision of Asset Performance

Condition-Based Maintenance - AVEVA PI System

Predictive Maintenance – AVEVA APM

Use Case: Closed Loop Predictive Maintenance



PI WORLD 2022

Agenda

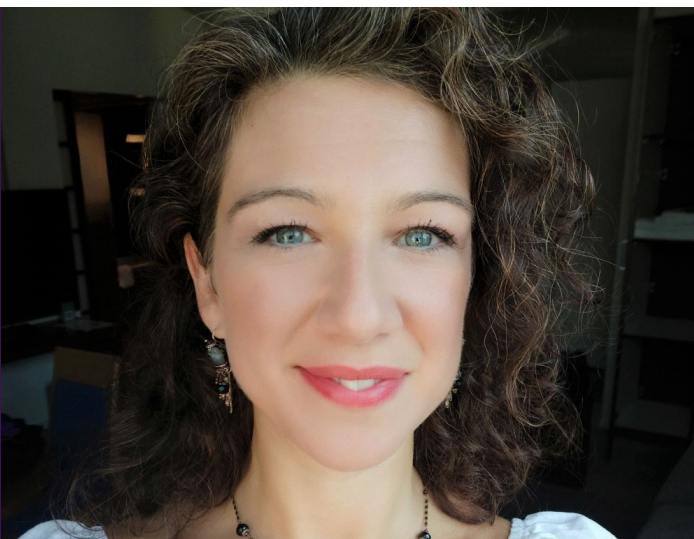
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Industry & Market Pressures

“Operationalizing Artificial Intelligence at scale is the difference between success and failure”

Asset Failures Risk



82%

82% of asset failures are Random.¹

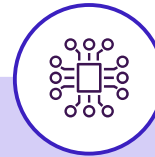
Maintenance Optimization



70%

Almost 70% of maintenance transformations fail to deliver the desired outcome.²

Digital Investment



51%

51% of the respondents cited artificial intelligence/machine learning as the top digital technologies they plan to invest in over the next 3-5 year.³

Data Management




~30%

About 15-30% of the time is spent on searching and verifying the required information.⁴

Sources: 1. [Forbes](#), 2. [McKinsey](#), 3. [Accenture](#), 4. [Geovia](#)


Required Capabilities



Reduced OPEX Costs & Risks




Predictive Asset Monitoring




Fault Diagnostics & Prescriptive Analytics

▼


\$400k - \$112m gained through production increase by avoiding outages



Optimized Asset Strategy



Asset Strategy Optimization



Asset Strategy Library

▼

89% planned maintenance achieved
\$4m costs avoided



Workforce Efficiency




Mobile Workforce Digitization




Procedural Enforcement

▼


\$175k - \$3m in maintenance savings



Increased Productivity



360° Digital Twin

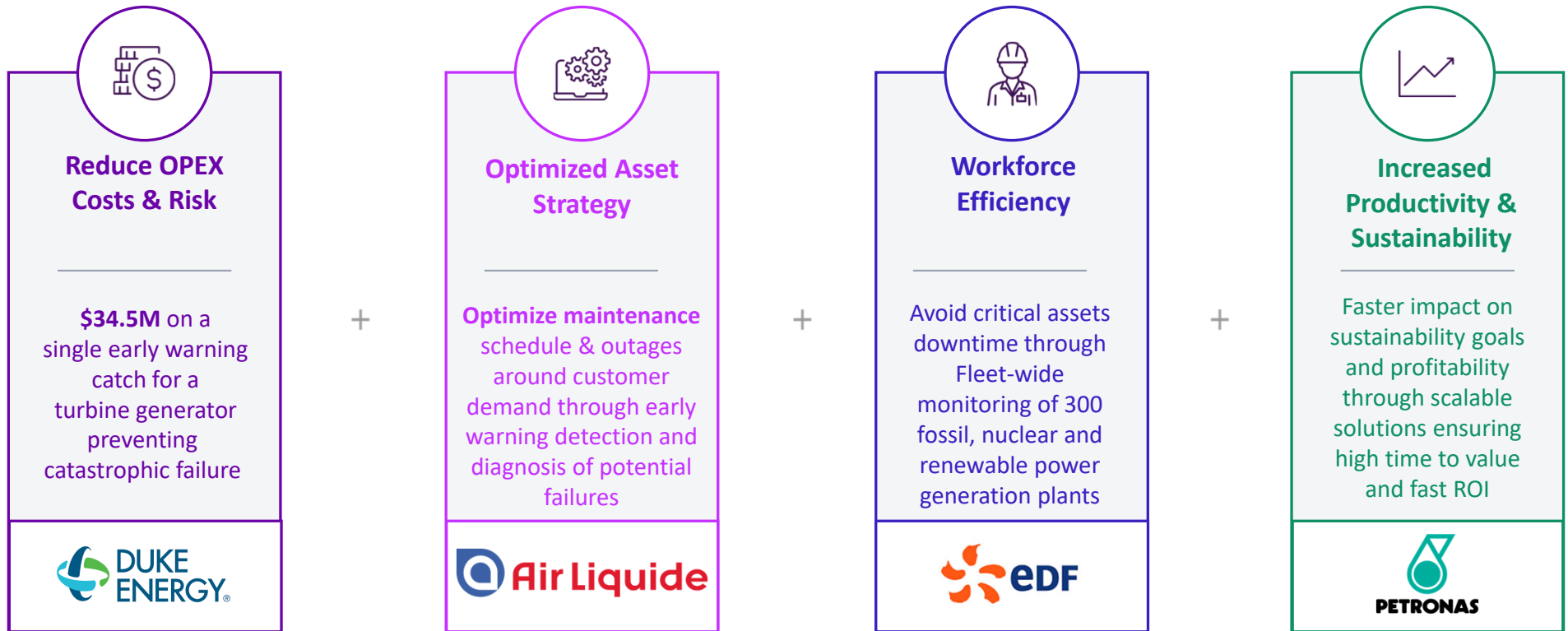


Asset Visualization

▼

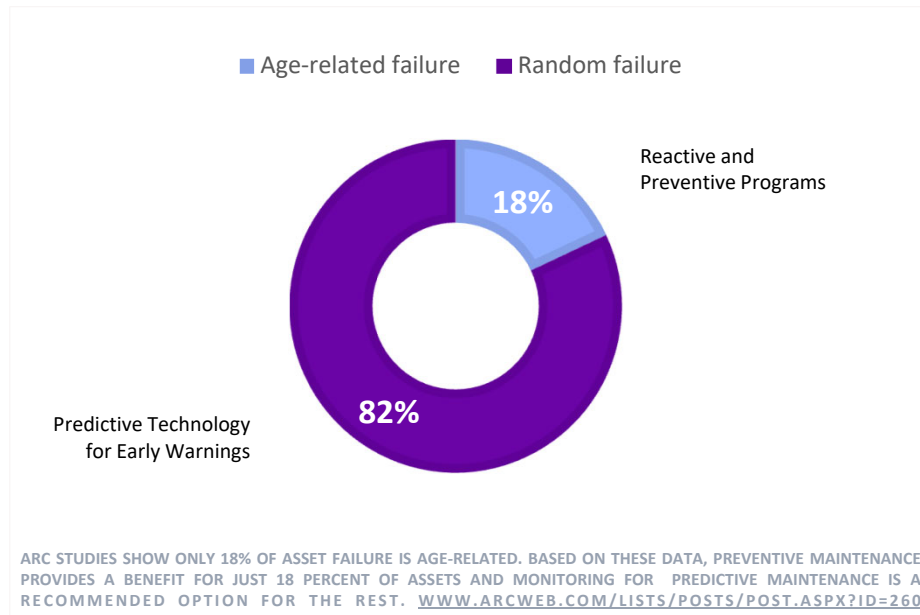
<3 minutes - target time for retrieving actionable information

AVEVA PI & Predictive Analytics Proven Success

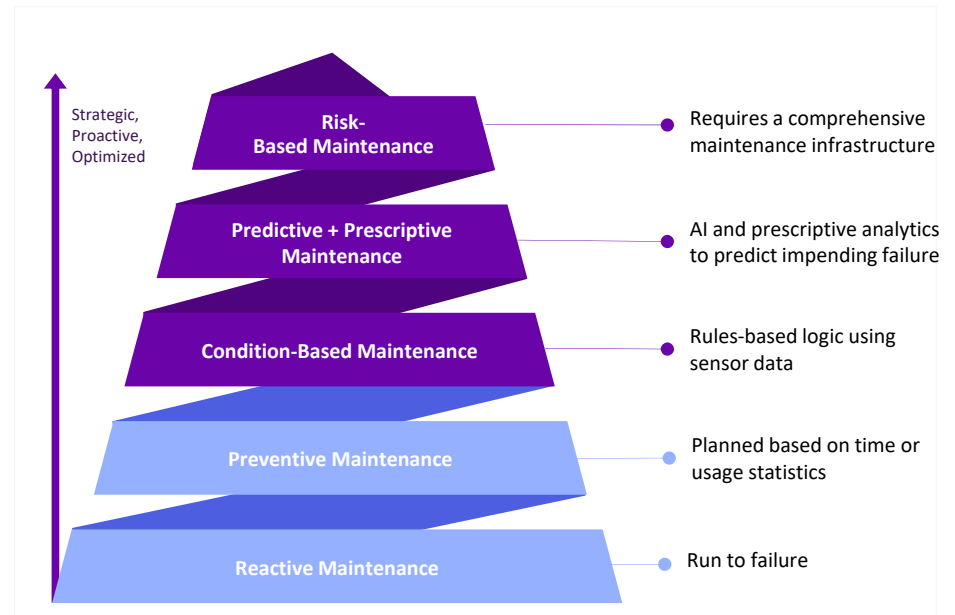


AVEVA APM connects Asset Strategy to Corporate Objectives

Failure Patterns



It's a Journey



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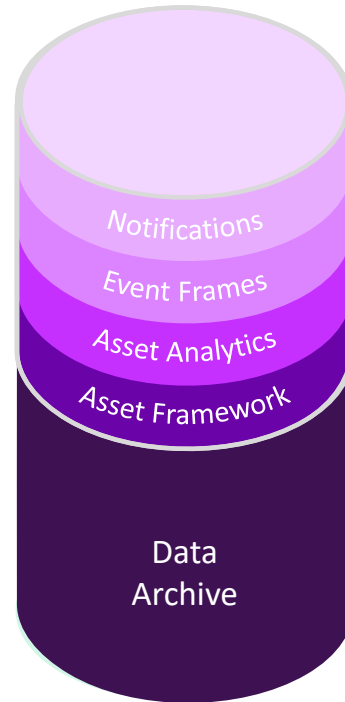
Characteristics of Asset Performance Analysis

Asset Strategy	Preventative	Condition-Based	Predictive/ Prescriptive	Risk-Based
Characteristic	AVEVA PI System Asset Analytics		AVEVA Analytics	AVEVA Asset Strategy Optimization
Mathematics	<i>Physics Based \ Algebraic</i>		<i>Statistical \ Complex</i>	<i>Statistical \ Complex</i>
Skill Set	<i>Domain Expert</i>		<i>Domain Expert</i>	<i>Domain Expert</i>
Toolkit	<i>Configuration</i>		<i>Application</i>	<i>Application</i>
Data Context	<i>Sensors</i>		<i>Assets and Processes</i>	<i>Asset Lifecycle</i>

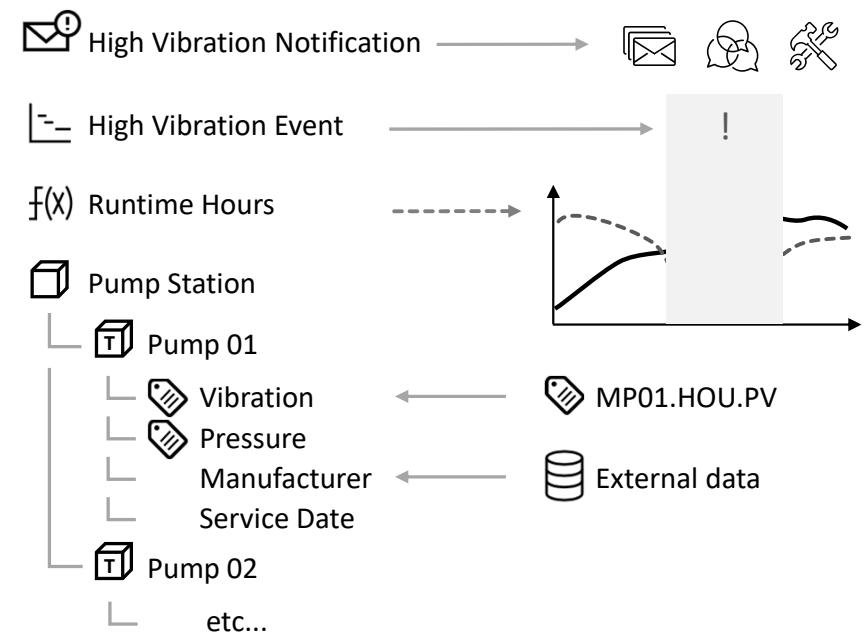
PI Server

PI Server layers data enrichment services on top of an industry-leading real-time operations data store.

- Data Archive: real-time data storage
- Asset Framework: adds context to raw data streams
- Asset Analytics: user-defined calculations
- Event Frames: bookmark important events
- Notifications: send email or alerts when action is needed



PI Server



PI Vision: Real-time data visualization for decision makers

- An **easy to use, self-service, scalable** visualization solution
- Dynamic displays
- Access real-time OT data from **any device** – phone, tablet, laptop, desktop
- **Share** real-time displays across your organization



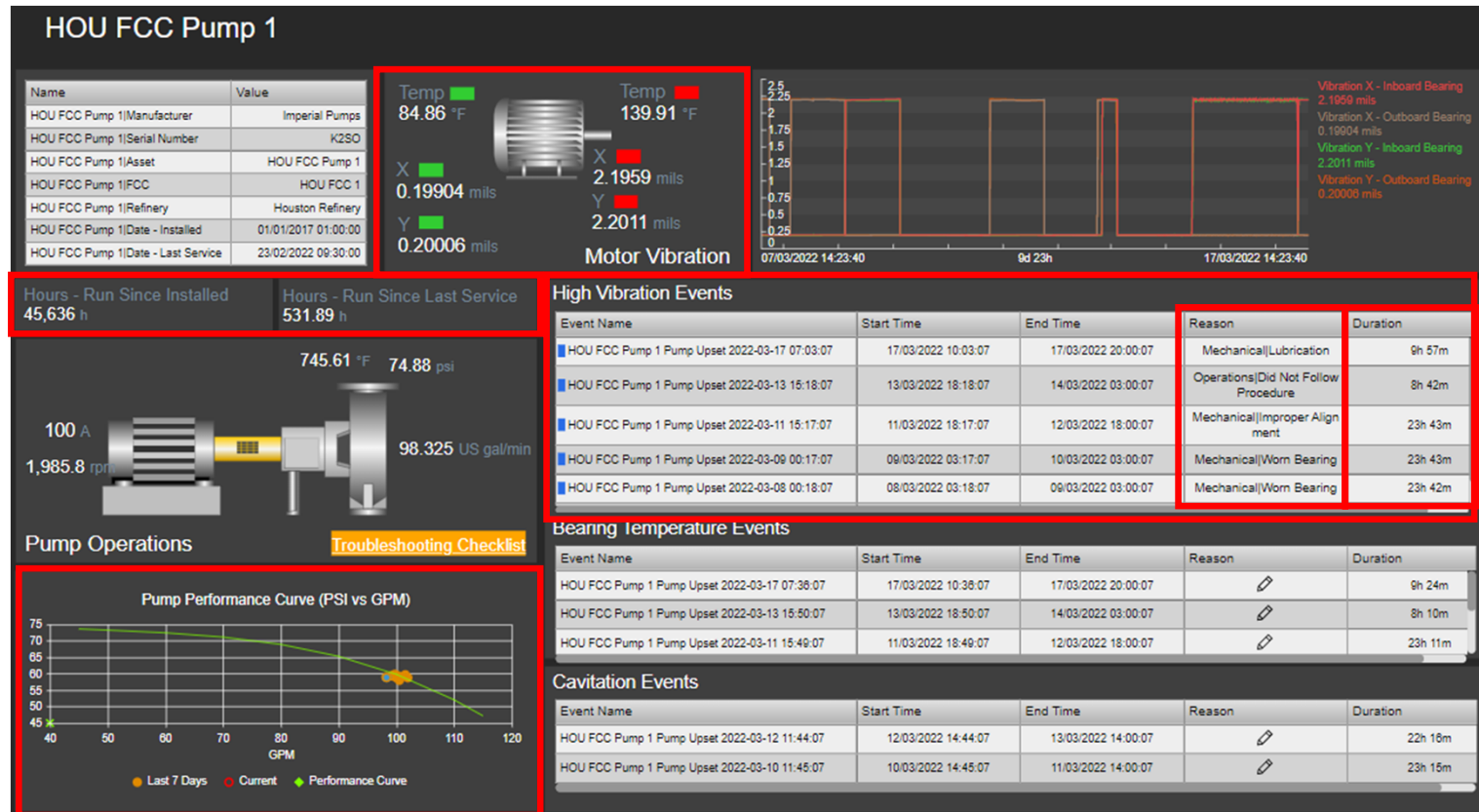
PI Vision Asset Health Dashboard

Asset Use (Preventative)

- Motor run-hours
- Compressor starts/stops
- Switch operation counts

Asset Condition

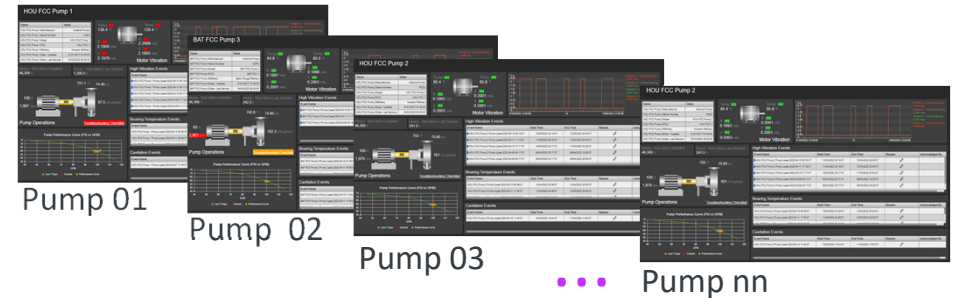
- Pump performance
- High vibration
- Bearing Temperature
- Forecasted vs. Actual
- Pressure differential across filters



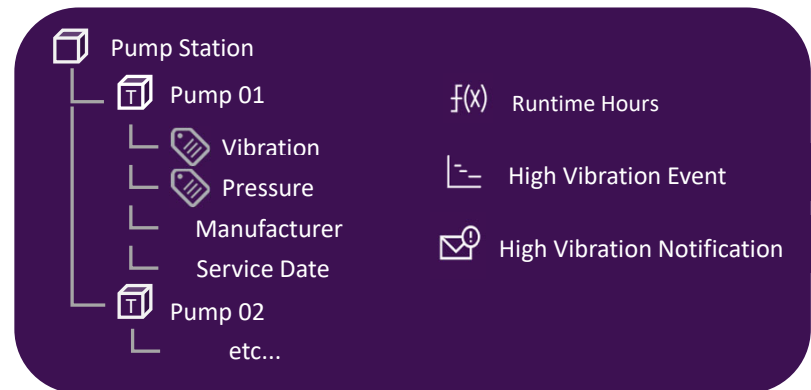
Asset Analytics Designed for Scalable Asset Assessment

- Configurable calculations provide transparency at scale
- Units of Measure observed
- Preview and testing tools
- Backfill to populate historical data
- Future data for predictions and forecasts

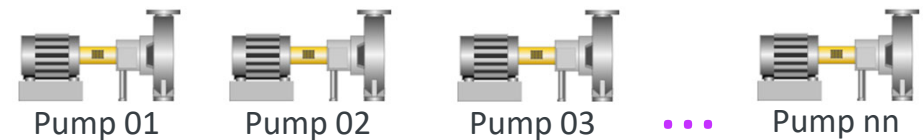
Asset
Relative
PI Vision
Dashboard



Asset
Framework
& Asset
Analytics



Assets



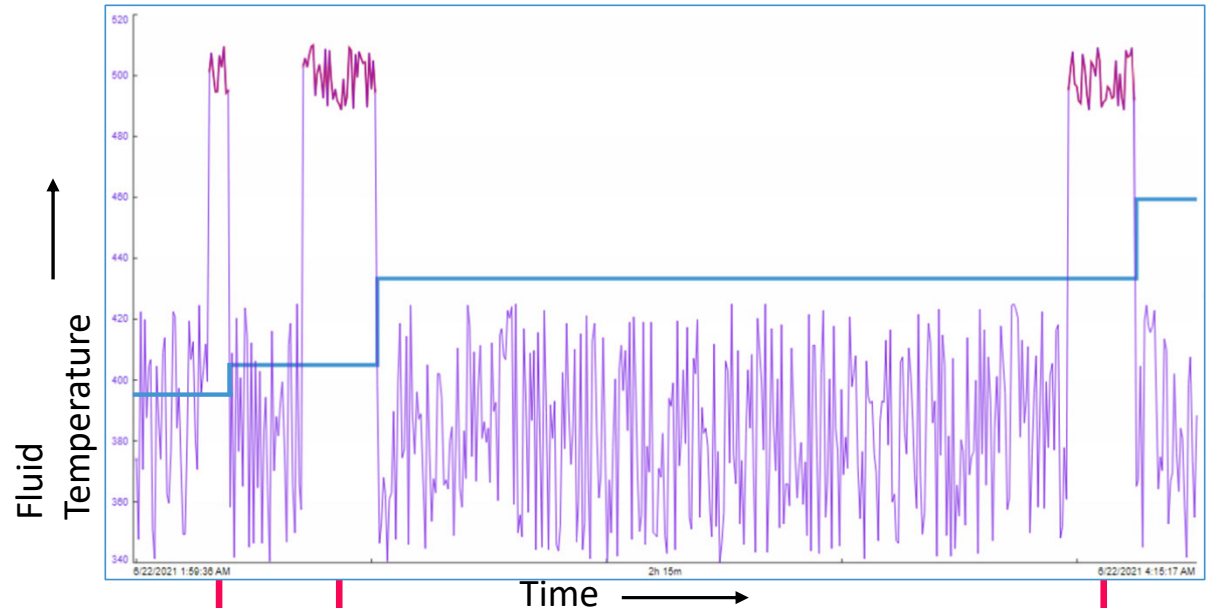
Event Framing Example: Pipe Corrosion Exposure

High Temperature Hydrogen Attack

- Pipe corrosion occurs when the fluid temperature inside the pipe exceeds a limit determined by its hydrogen content and the pipe's metallurgy.

Solution Approach

- Look-up temperature limit knowing hydrogen content (Nelson curve)
- Configure Event Frame Generation analytic and preview results
- Add Event Frame duration to total exposure time, PI tag
- Backfill using historical data and schedule analysis
- Configure Notification



Event Name	Start Time	End Time	Duration	Average Temp...	High Temp Limit	Average H2 PP ▲
Vessel1 - High Temperature - 2021-08-22 03:58:56	6/22/2021 3:58:56 AM	6/22/2021 4:07:36 AM	8.7	496.2	442.6	2,303
Vessel1 - High Temperature - 2021-08-22 02:21:17	6/22/2021 2:21:17 AM	6/22/2021 2:30:45 AM	9.5	498.5	442.7	2,460.4
Vessel1 - High Temperature - 2021-08-22 02:09:19	6/22/2021 2:09:19 AM	6/22/2021 2:11:58 AM	2.7	494.1	442.7	2,467.5

Total Exposure Time → 20m 47s

Pipe Corrosion Exposure

High Temperature Hydrogen Attack

Asset Analytics

- Total exposure times used by Maintenance
- Prioritize inspections
- Forecast pipe replacement

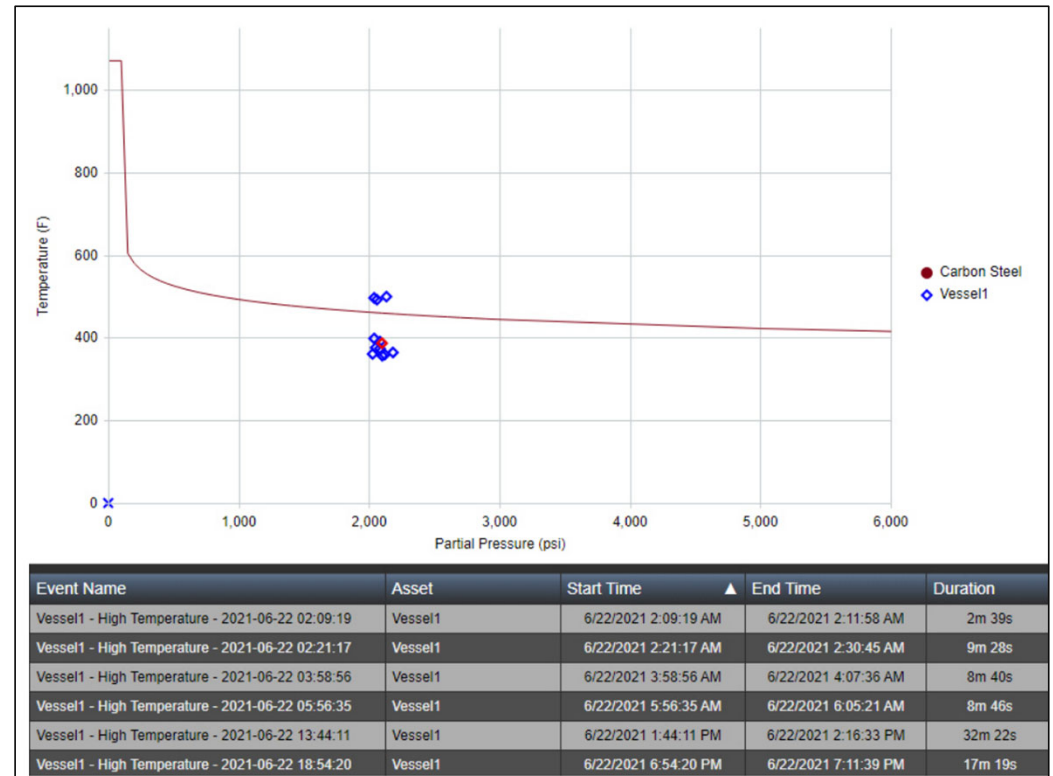
PI Vision

- Current operation versus Nelson curve, XY Plot

Notifications

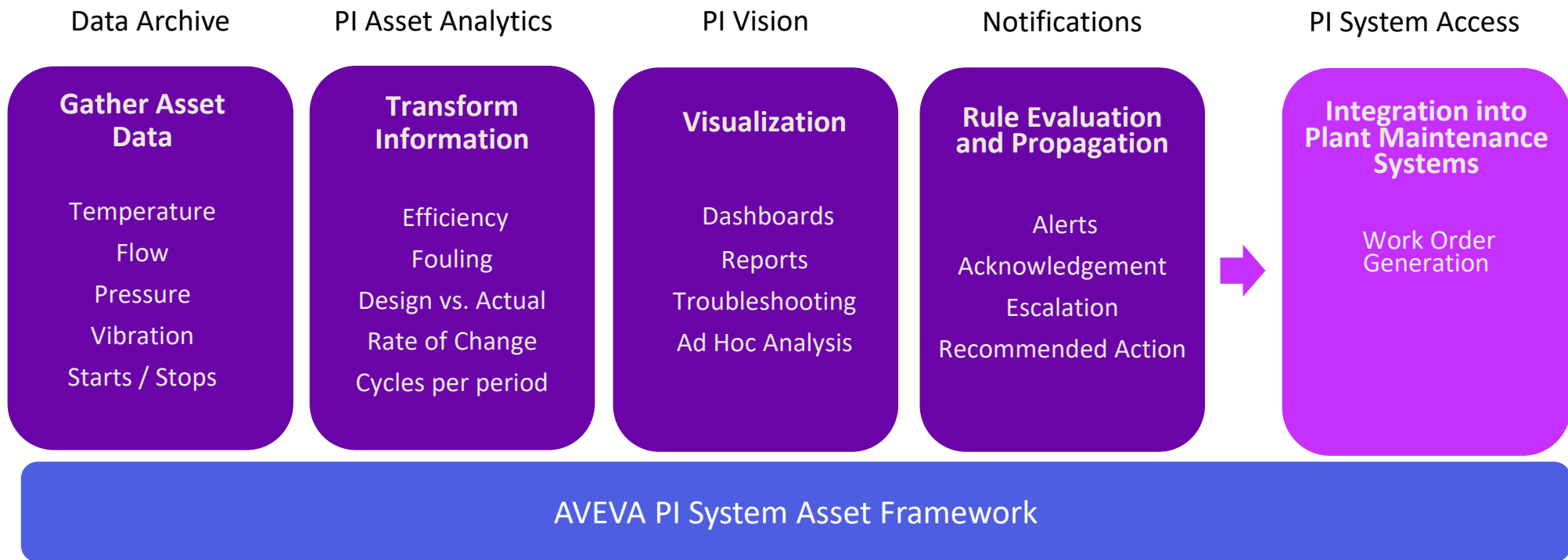
- Proactive operator awareness

Tested and rolled out in 6 refinery processes in less than 1 week.¹



1. [“Delivering Business Value in Downstream Oil & Gas with Predictive Analytics and Machine Learning”, MOL, 2016 OSIsoft Users Conference](#)

Asset Health Monitoring using the AVEVA PI System



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AVEVA Vision of Asset Performance

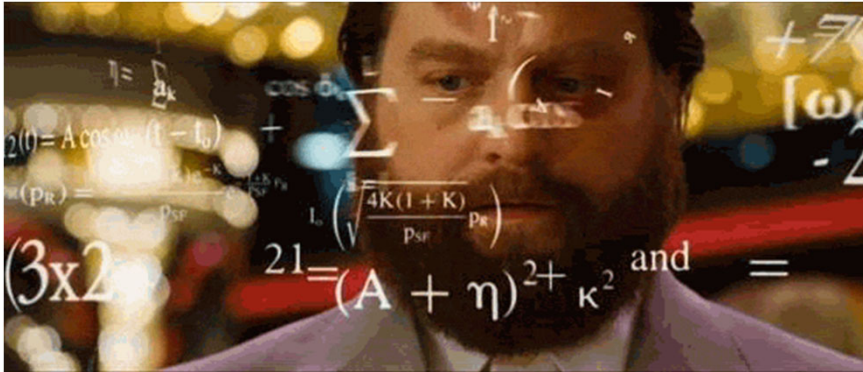
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Use Case: Closed Loop Predictive Maintenance



DATA



Connect the power of information with artificial intelligence and human insight to optimize asset performance

Asset Strategy

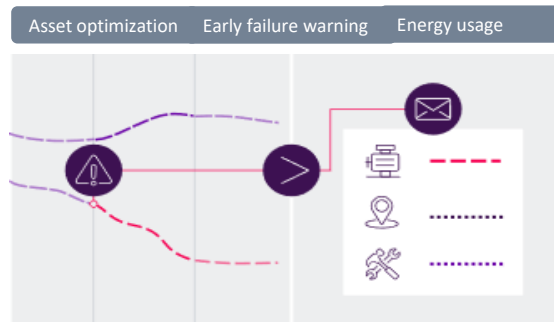
Asset Analytics

Maintenance Execution

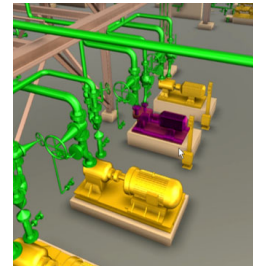
Define
optimized
Asset
Performance
Strategy



Rich real-time data



Predictive & Prescription

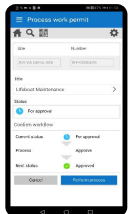


Visualization



Field Remediation

Fit for
purpose,
actionable
insights



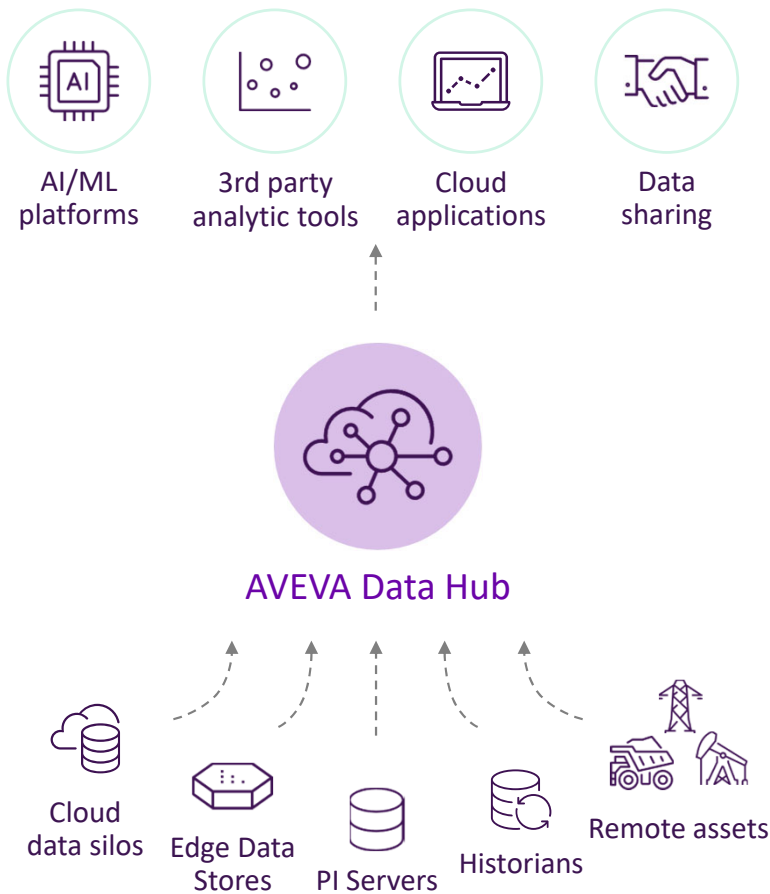
Access to massive volumes
of rich operational data

Collection of **stranded**
asset related data

Apply **machine learning** and
AI for business outcomes
Leverage **experience** in Asset
Library for closed loop
remediation

Engineering
information in context
to optimize planning
and scheduling

Safe and **efficient**
execution of work



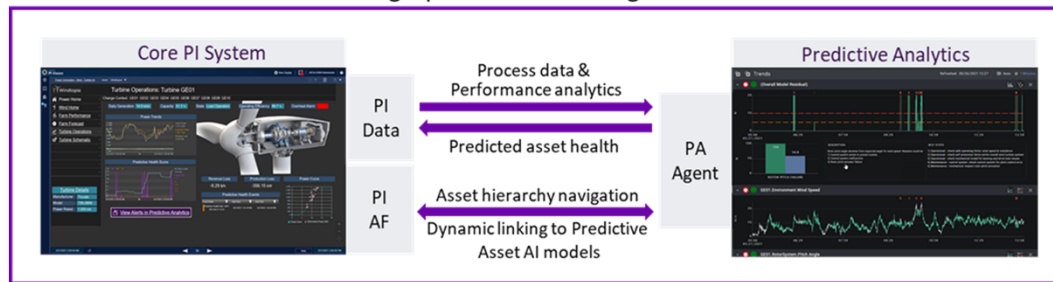
A cloud-native platform for aggregating, storing, enriching, accessing, and analyzing real-time operations data from historians, edge devices, and more

AVEVA

Predictive Analytics and PI System

From proven integration patterns towards a native integration

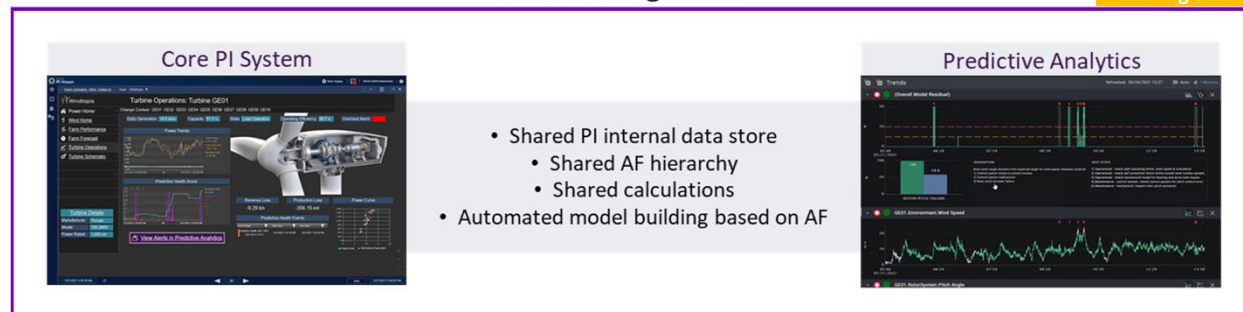
High-performance Integration



(High-availability through AF SDK)

Native Integration

Coming Soon



AVEVA

Multi Experience Visualization

Enterprise view of asset base



Transparent and Collaborative

Full visibility of data, no more silos, everyone working together on a single version of the truth

Operationally Valuable

Seamlessly integrates with all operational systems to deliver faster, better, more efficient decision making

Agile and Responsive

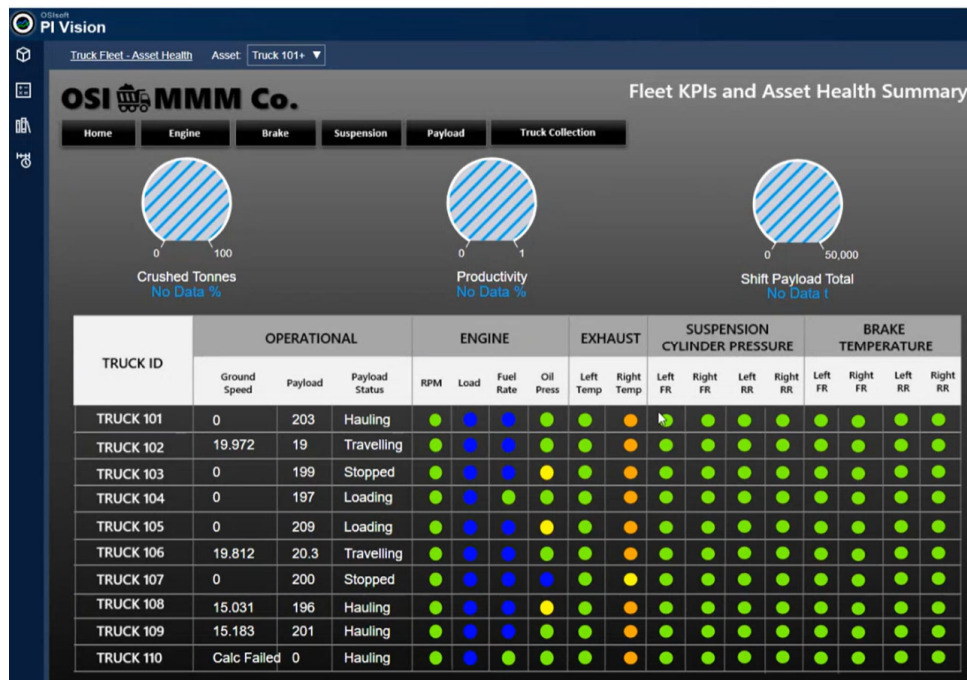
Be agile, with informed teams to speed crisis response, and maximize performance opportunities

Predictive and not Passive

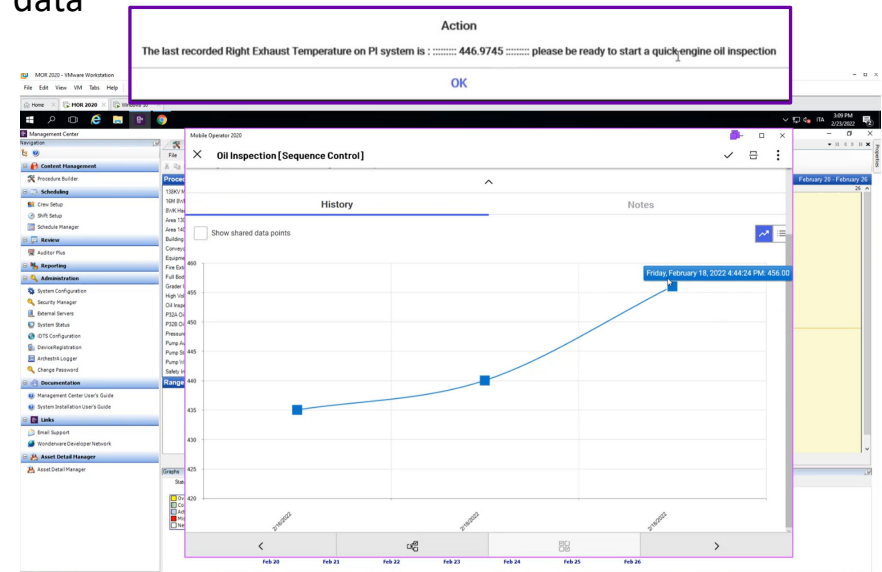
Swap crisis mitigation for active risk management by spotting problems before they occur

Holistic Monitoring Approach of Asset Health through PI Vision

Leverage your Inspection Data to improve reliability with AVEVA Mobile Operator

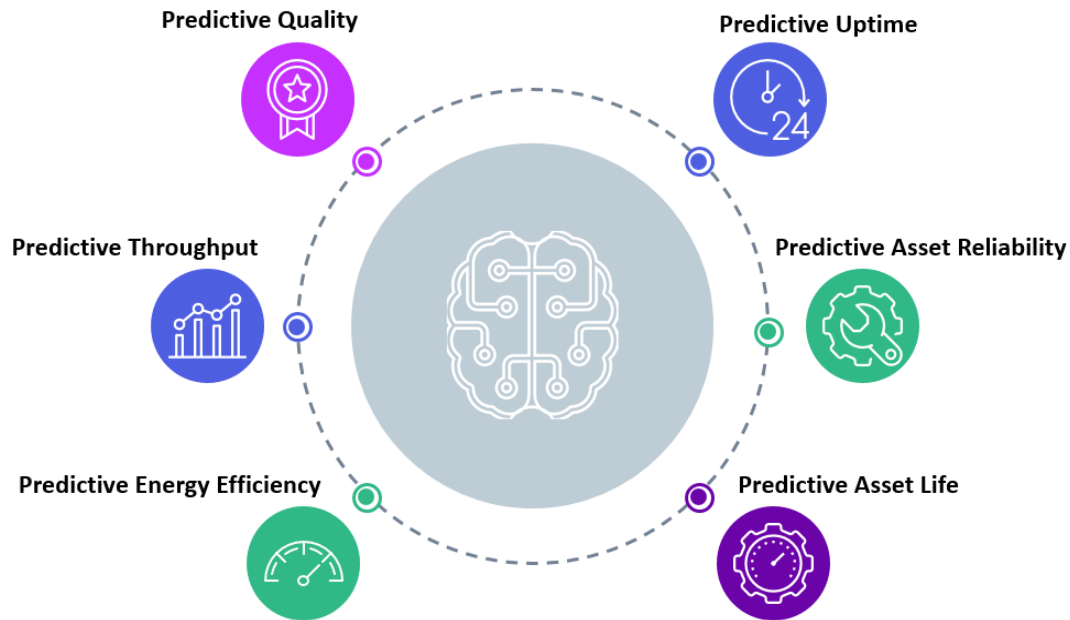


- Historize inspection manual recordings into PI Vision for condition-based maintenance
- Trigger situational awareness inspections based on PI data



AVEVA Analytics Capabilities

Fit for Purpose Predictive Asset and Process Analytics



Industrial Analytics Made Accessible

Apply the best analytical mode and models to accommodate use cases, available data, and users

Proactive Optimization

Provides early warning notification and diagnosis of issues days, weeks or months before intensification

Pre-built Library

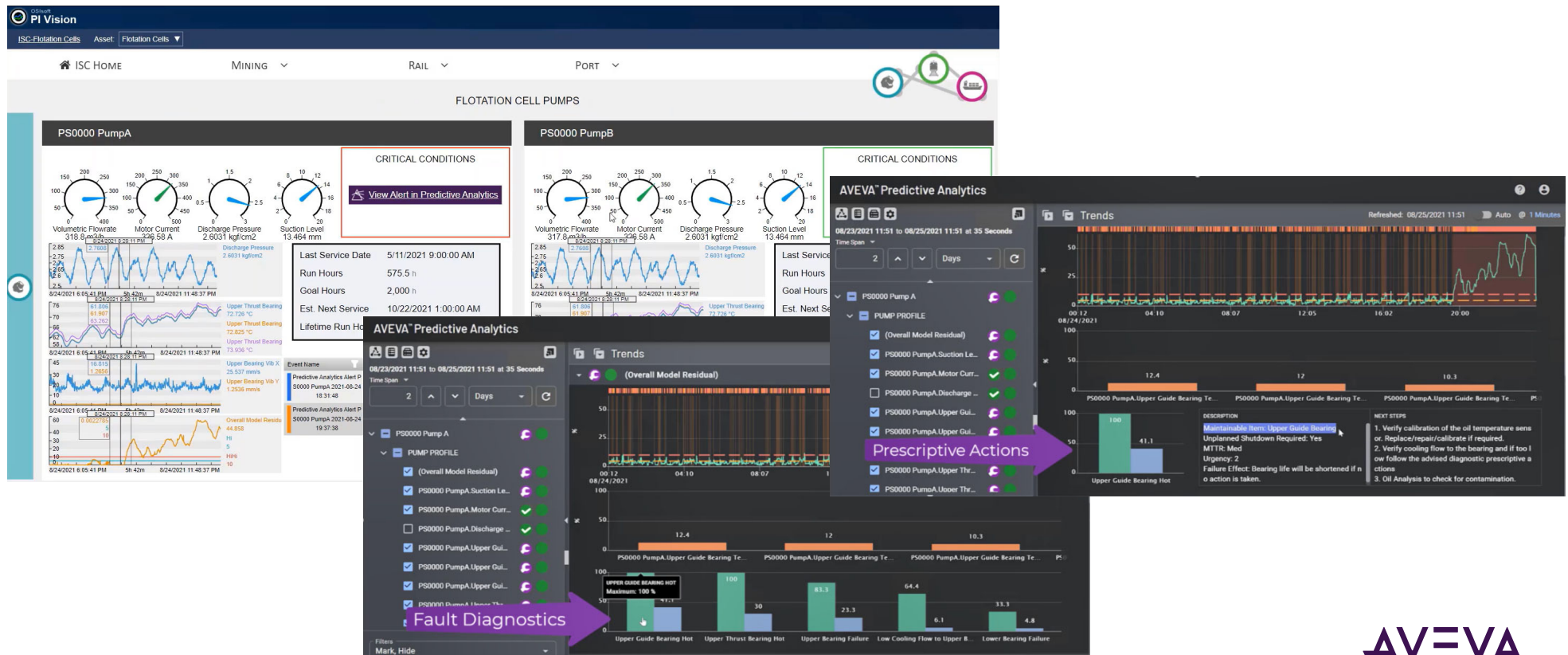
Pre-built templates enable users to build a model for a specific asset type and then duplicate this same template for all other assets of the same type

Scalable on-premises or in the Cloud

Highly scalable, on-premises or in the Cloud, to monitor a single asset, facility or hundreds of remote assets across multiple sites

Holistic Monitoring Approach of Asset Health through PI Vision

From KPIs Visualization -> Predictive Fault Diagnostic -> Prescriptive Actions



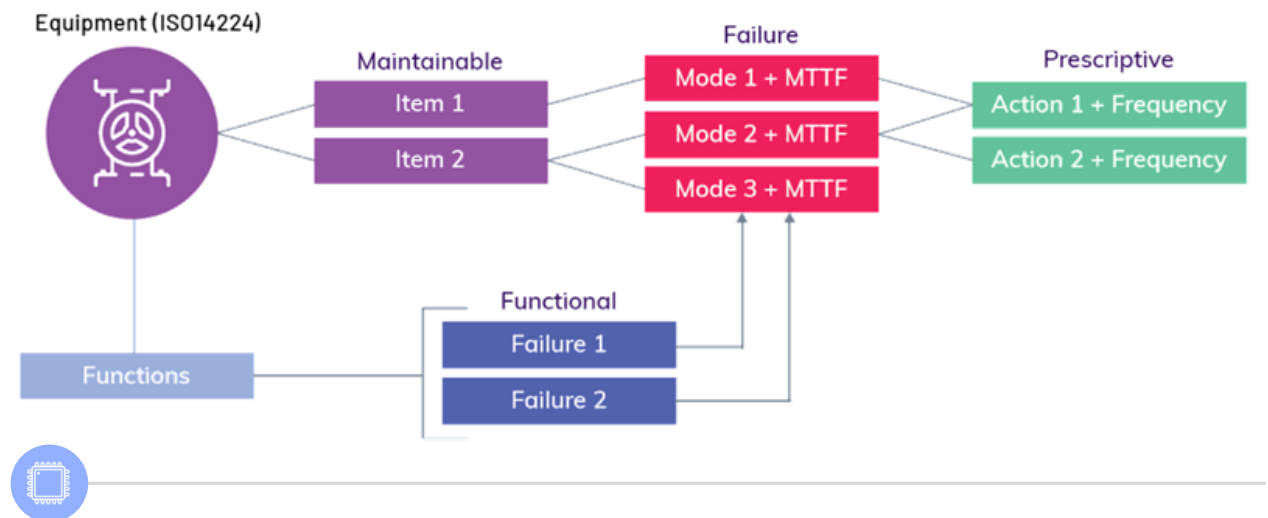
Fault + Prescriptive Analytics Library - Deployment Acceleration

AVEVA Asset Strategy Library



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

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

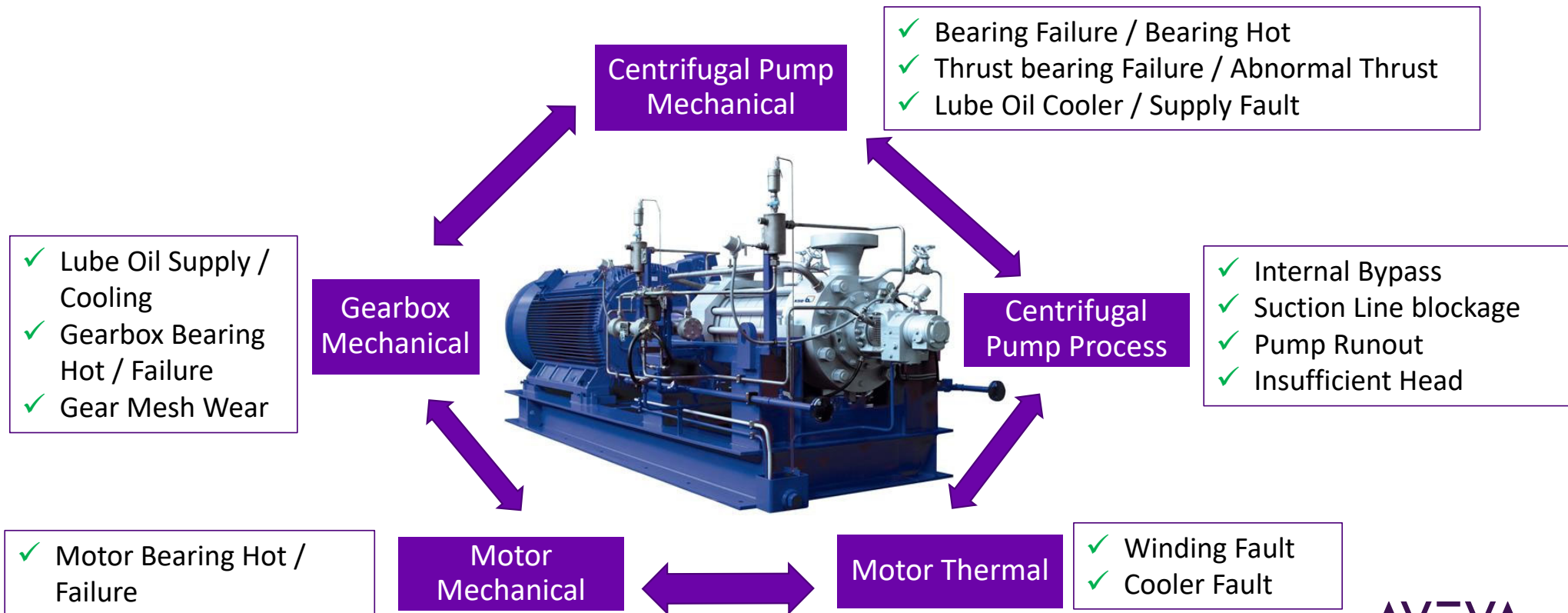


- 1,000 components
- 1,500 failure causes with failure conditions
- 2,000 preventative tasks
- 5,000 prescriptive tasks
- 20 years and 22,000 man-hours of experience

AVEVA

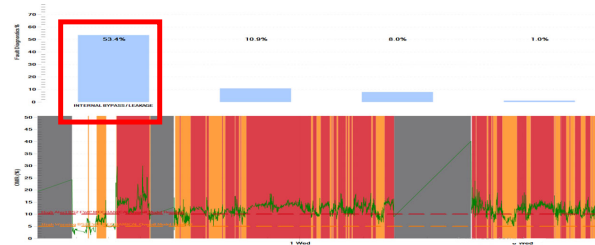
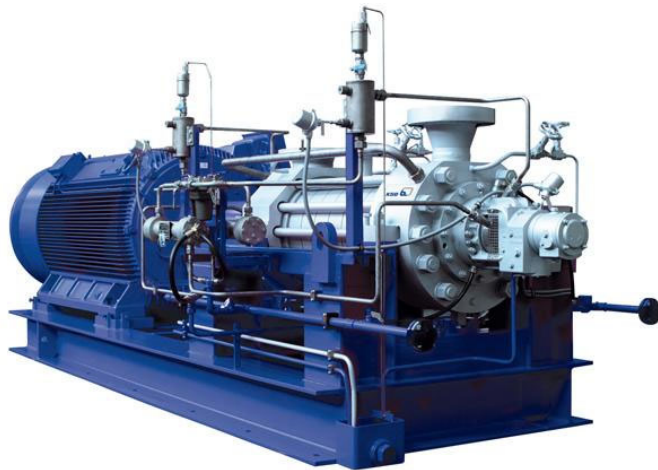
AVEVA Predictive Analytics to Prescriptive Actions

Equipment -> Maintainable Item -> Predictive Analytics Model Template -> Fault Diagnostic



AVEVA Predictive Analytics to Prescriptive Actions

Predictive Analytics Model Template -> Fault Diagnostic -> Prescriptive Actions



Centrifugal Pump Process

- Internal Bypass
- Suction Line blockage
- Pump Runout
- Insufficient Head

PRESCRIPTIVE CATEGORY and ACTION

- | | |
|----------------|---|
| 1. Operational | Compare DCS discharge pressure measurement with local instrument reading |
| 2. Operational | Assess current operational envelope against OEM limits |
| 3. Operational | Run Remaining useful life estimation to assess expected further degradation |
| 4. Operational | Assess operational impact of switching to stand-by Pump |
| 5. Maintenance | Plan maintenance intervention to inspect / repair / replace seals |

FAULT DIAGNOSTIC	PREDICTIVE ANALYTICS MODEL	EQUIPMENT CLASS	SUB-UNIT	MAINTAINABLE ITEM	FAILURE MODE	FAILURE EFFECT
INTERNAL LEAKAGE / BYPASS	Centrifugal Pump Process	Pump – Centrifugal (PUCE)	Pump Unit	Pump Barrel	Seal Damage / Failure	Effect is higher pump speed required to maintain discharge pressure and flow at desired level and possible capacity limitation.

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Use Case: Closed Loop Predictive Maintenance



Driving decarbonization & net zero goal

Areas of potential improvement

Current Business Challenges



Assets under-utilization, excessive inventory & preventive/corrective maintenance



Inefficient operations, increasing production scrap, energy waste & CO₂ emissions



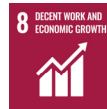
Random failures & accidental hazards impacting environment, safety, O&M costs



New generation workforce & decentralized maintenance reducing productivity



Regulatory compliance & SDG commitments



AVEVA's Digital Initiatives



Asset Lifecycle Management | MRO Spares & Maintenance Strategy Optimization



IIoT Data & Artificial Intelligence | Predictive Maintenance / Quality / Energy Efficiency



AI Prescriptive Guidance | Mobile Maintenance | Control of Work



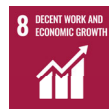
360° Digital Twin | Fleet-wide Monitoring | Operators Training | Connected Worker



KPIs Visibility | Energy Monitoring | Safety & Compliance Management

AVEVA INSIGHT,
AVEVA PREDICTIVE ANALYTICS,
AVEVA MOBILE OPERATOR

Closed Loop Predictive Maintenance



Asset Lifecycle Management | MRO Spares & Maintenance Strategy Optimization



IIoT Data & Artificial Intelligence | Predictive Maintenance / Quality / Energy Efficiency



AI Prescriptive Guidance | Mobile Maintenance | Control of Work



360° Digital Twin | Fleet-wide Monitoring | Operators Training | Connected Worker



KPIs Visibility | Energy Monitoring | Safety & Compliance Management

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Use Case: Closed Loop

Challenges:

- Prevent random equipment failures
- Minimize asset downtime improving
- Maintenance planning optimization

Implications:

- Lack of visibility into asset health and
- Inconsistent diagnosis and limited
- Unexpected downtime impacting

Business Outcomes:

- Early warning identification and dia
- Ability to effectively plan and sched
- Extended equipment life, increase a
- Avoided cost to overhaul equipment

Success Stories

- BASF Mobility platform drives conti
- Implementing predictive mainte
- Improving maintenance planning
- and consistent execution of work processes



AVEVA PL Systems

AVEVA Insight,
Analytics,
erator



AVEVA

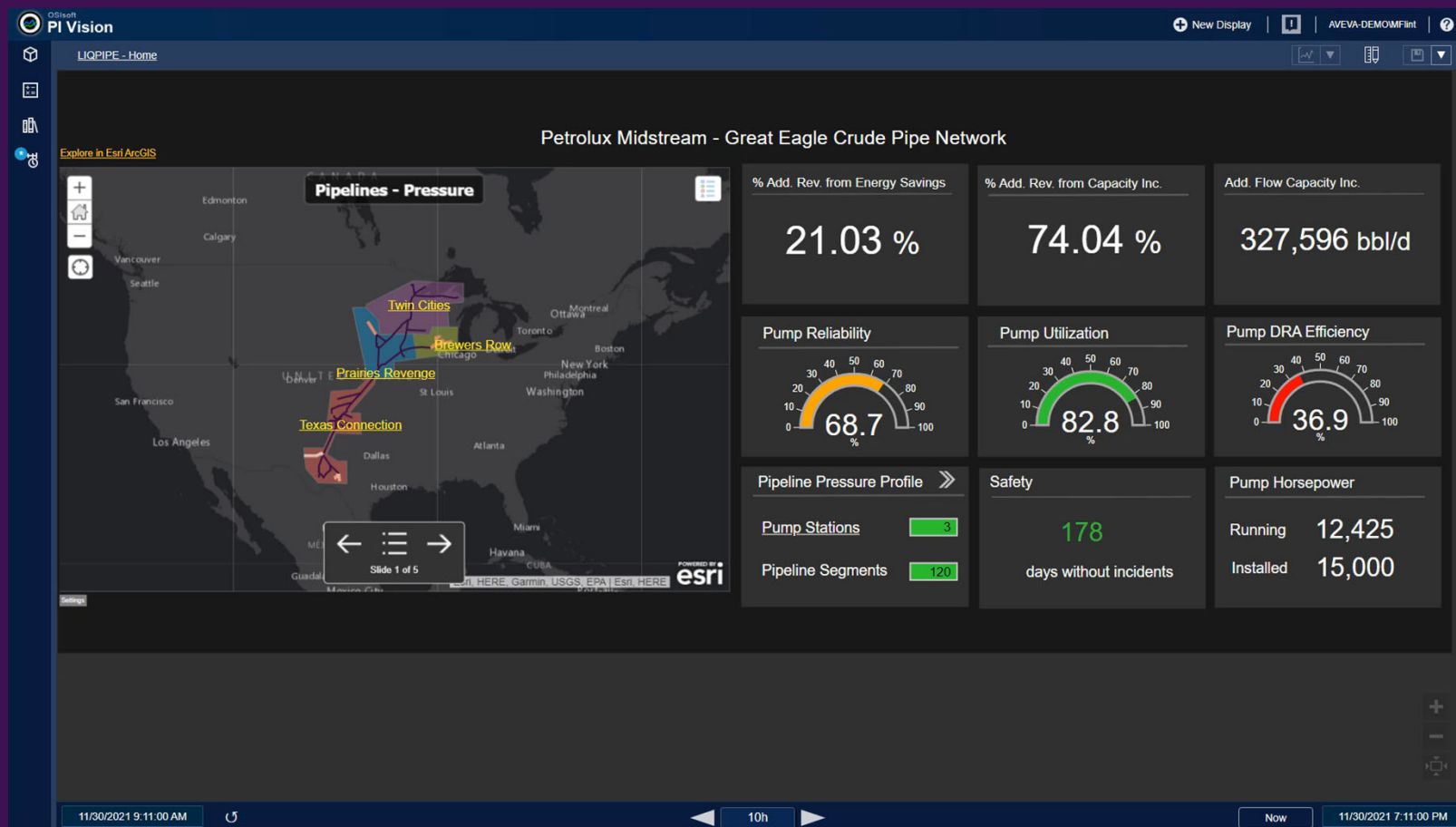


Process Engineer

MONITOR
Plant Pumps
Operation/OEE



Early Anomaly
Identification





Process Engineer

IDENTIFY
the cause of
alarm

ANNOTATE
on the asset
trend anomaly



Early Anomaly
Identification

Alert for 'PU1300 Wort Pump Bearing Temperature - High' in 'WonderBrew-EMEA' - TRUE - detected by AVEVA Insight - Message (HTML)

File Message Help Tell me what you want to do

Ignore Delete Archive Reply Reply All Forward More H1 Sales Plays To Manager Done Team Email Reply & Delete Create New Rules OneNote Actions Assign Policy Mark Unread Categorize Follow Up Translate Select Find Read Aloud Zoom Highspot Phish Alert Report Phish Alert Insights

Alert for 'PU1300 Wort Pump Bearing Temperature - High' in 'WonderBrew-EMEA' - TRUE - detected by AVEVA Insight

AI AVEVA Insight <feedback@aveva.com>
To: Matt Billing

If there are problems with how this message is displayed, click here to view it in a web browser.
Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

CAUTION - This message originated outside AVEVA

Right-click or tap and hold to open the context menu.

Condition violation detected

Hello,

AVEVA™ Insight detected a condition violation.

[View this alert and related data in a chart.](#)

Alert from condition: PU1300 Wort Pump Bearing Temperature - High - TRUE - detected at 2021-03-24 03:52:27.000 AM (UTC)

Condition: LondonConveyor.PU1300 MOTOR BRG TEMP 1 NDE is greater than 70

Value:

Tag	Operator	Value	Last Values Received
LondonConveyor.PU1300 MOTOR BRG TEMP 1 NDE	is greater than	70	70.16309, 71.09023, 71.02755,

Insight solution: WonderBrew-EMEA

Owner of alert: matt.billing@aveva.com

Consequence	Applicable
Safety	Not Analyzed
Environmental	Not Analyzed
Production	Not Analyzed

Prescriptive actions:



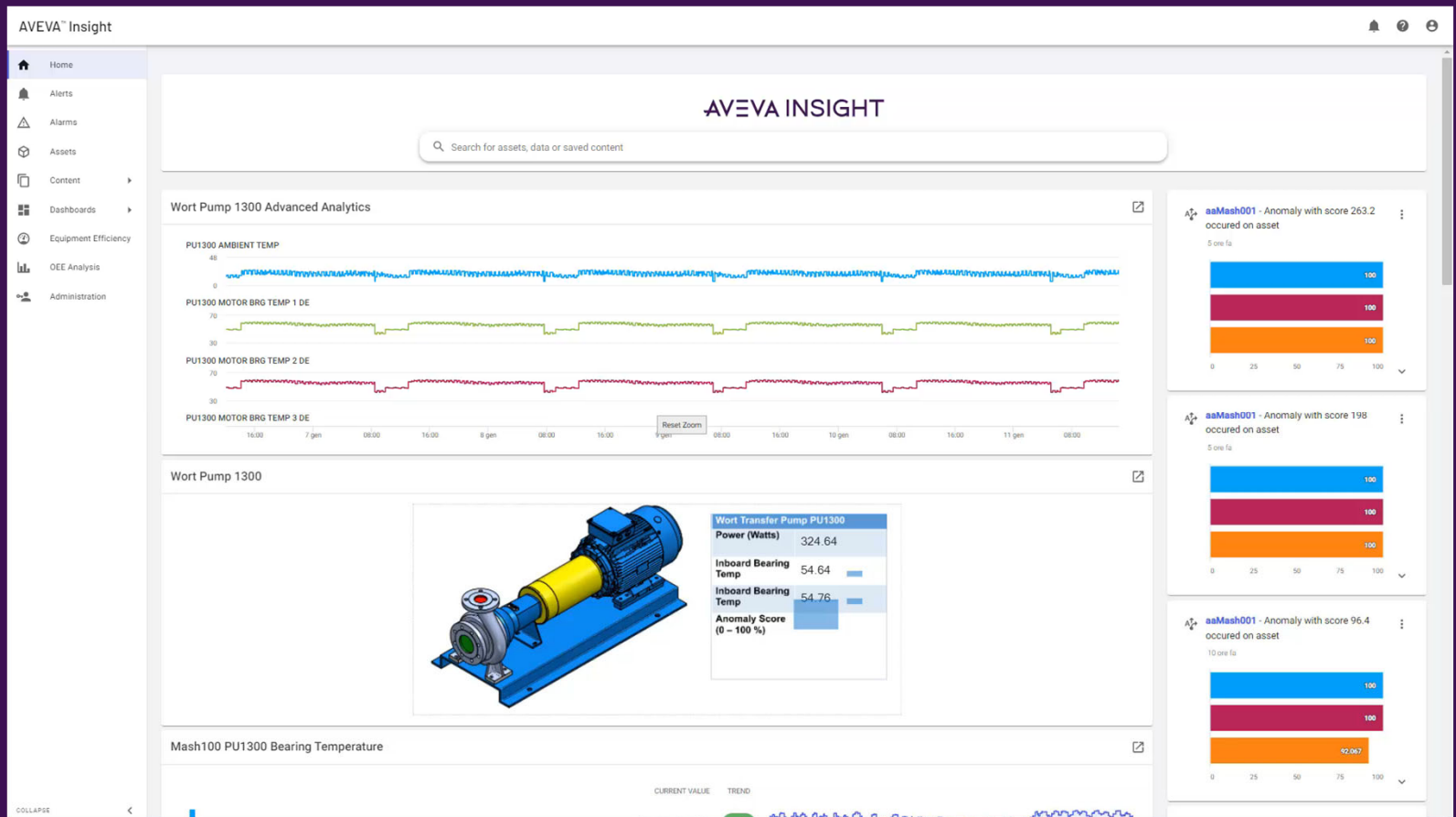
Reliability Engineer

CREATE
Automated AI-model driven
alert and WOR

PRESCRIBE
actions to
investigate issue
in case of alert



AI Prescriptive
Guidance





Operator

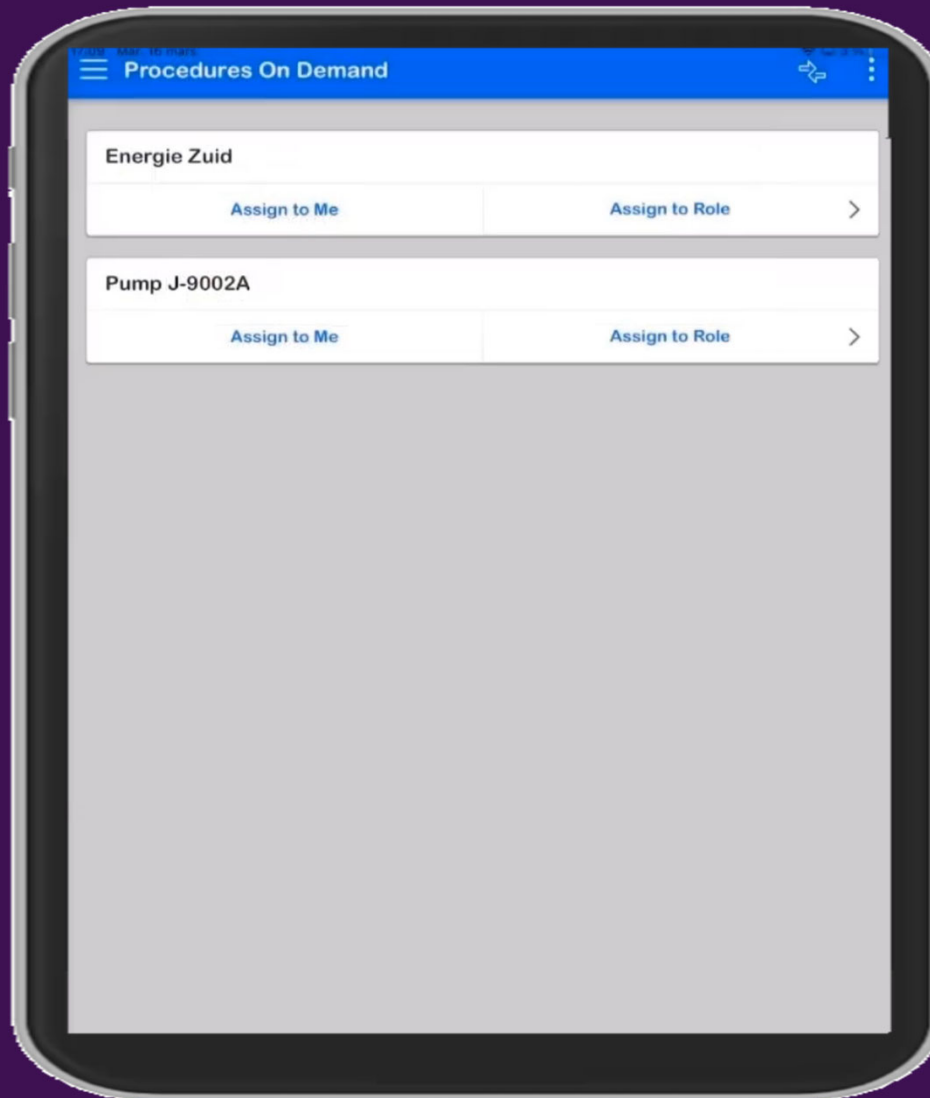
INSPECT
the faulty
asset on site



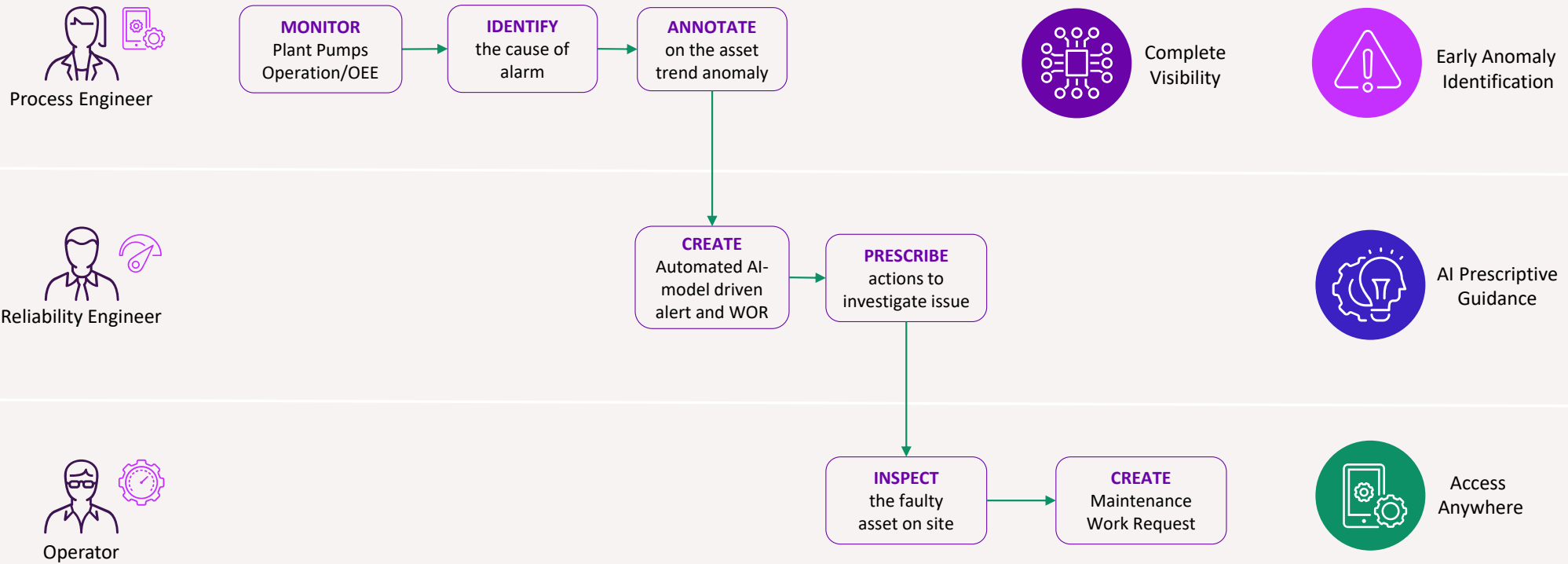
CREATE
Maintenance
Work Request



Access
Anywhere



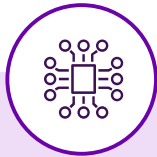
Closed Loop Predictive Maintenance Use Case



Conclusions

“Operationalizing Artificial Intelligence at scale is the difference between success and failure”

Start small
and think big



**Keep in mind your final
goal and vision**

Preparing your **data** for accelerating
successful scale deployment starts
from how you handle them.

Start digital transformation with your
future in mind.

CBM to start improving
your asset strategy



Drive quick time to value

for equipment having repetitive and
easy to understand patterns through
Condition based maintenance

Leverage calculations easy to
configure and deploy at scale to start
reducing corrective maintenance

Predictive analytics
accelerate reliability
and sustainability



Artificial intelligence

is not just a trend for technology's
sake, it can help you **solve complex
problems** that are not easy to
identify by know behaviours.

Keep in mind: **easy to use tools** are
those your experts will adopt

Your data can drive
efficient and agile work



**Close the maintenance
strategy loop**

An optimized asset strategy
enhanced by **AI** intelligence should
also be **actionable**.

Connecting your data to **proven
remediations** will empower efficient
and agile **connected workers** with
insightful information

Conclusions

The added value of extending your PI capabilities into AVEVA Predictive Analytics



Unique Functionalities Delivering quick ROI

- Unique asset model **health indicator**
- Proven **scalability** accelerated by coming **native PI connectivity** and **automated model building**
- **Increased asset reliability** and performance from transients to steady operation to anomaly forecast on any asset type
- **Quick retraining** to only trigger consistent alerts



People Productivity & Efficient Process

- Leverage existing monitoring practices through PI Vision
- Enhanced workforce **productivity** and decision making provided by **fault diagnostics and prescriptive** actions
- Sensor management to **separate instrumentation from asset** issues
- Integrated workflow to effectively deploy remote **centralized monitoring at scale**



Full Ownership & Adoption

- Quick **adoption from domain experts**, not data scientists
- User-friendly interface
- **Full ownership** of model templates
- Your **competitive advantage and best practices** embedded in fault diagnostics and prescriptive actions

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Duke Energy leverages IIoT and predictive analytics to reduce failures by empowering people with early warning notification and insight of equipment problems before failures occur

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

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Air Liquide has deployed PI System as real-time industrial data infrastructure solution and AVEVA Predictive Analytics software for monitoring their critical production assets, for up to 500 of their large industries plants, from 3 centralized remote monitoring centers.

“Reliably and confidently meeting customer commitments to effectively plan and schedule maintenance and outages around customer demand, as part of their Smart Innovative Operations digital transformation program”



EDF

EDF runs fleet-wide monitoring of solar, wind and energy storage using AVEVA Predictive Analytics combined with PI System operational data management. The system saved £1.5 million in a single early-warning catch.

“The PI System is designed to support our goals of operational intelligence. The idea is you build systems that take raw data and turn it into actionable information so you can make smarter decisions.”

David Rodriguez, Sr. Analytics & Intelligence Engineer, EDF Renewables



AVEVA



PETRONAS increased operational efficiency and output at its brownfield refinery at Mekala.

Petronas deployed the complete suite of AVEVA asset performance management software, built on PI System.

- Uptime improved by 5%
- Maintenance costs reduced by >10%

“We want to make the [PI System-based] solution more integrated and more embedded to the engineers that really need to use it...because we know it's simple, and because we know it works.”

-- Khairil Azwan Khabri, Head Reliability Manager, PETRONAS







Framing slides for you to insert
into your deck

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.

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ABOUT AVEVA

AVEVA is a global leader in industrial software, driving digital transformation and sustainability. By connecting the power of information and artificial intelligence with human insight, AVEVA enables teams to use their data to unlock new value. We call this Performance Intelligence. AVEVA's comprehensive portfolio enables more than 20,000 industrial enterprises to engineer smarter, operate better and drive sustainable efficiency. AVEVA supports customers through a trusted ecosystem that includes 5,500 partners and 5,700 certified developers around the world. The company is headquartered in Cambridge, UK, with over 6,500 employees and 90 offices in over 40 countries.

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