

Prometheus APM: Closing the Maintenance Loop

April 9, 2024



Speaker Introduction






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Chief Product Officer, APM



APM Background

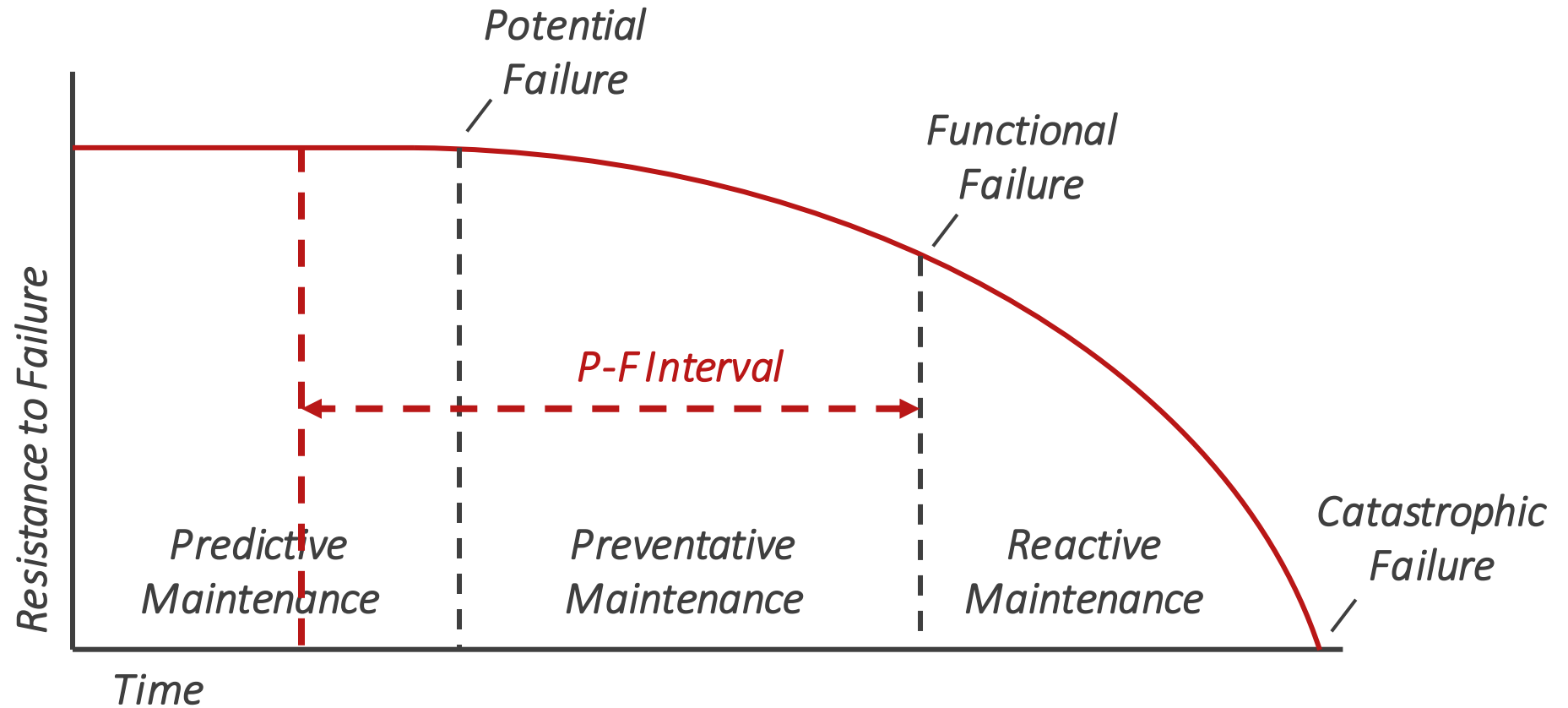


Identify Early – Drive Resolution

-  Connect
-  Detect
-  Diagnose
-  Resolve



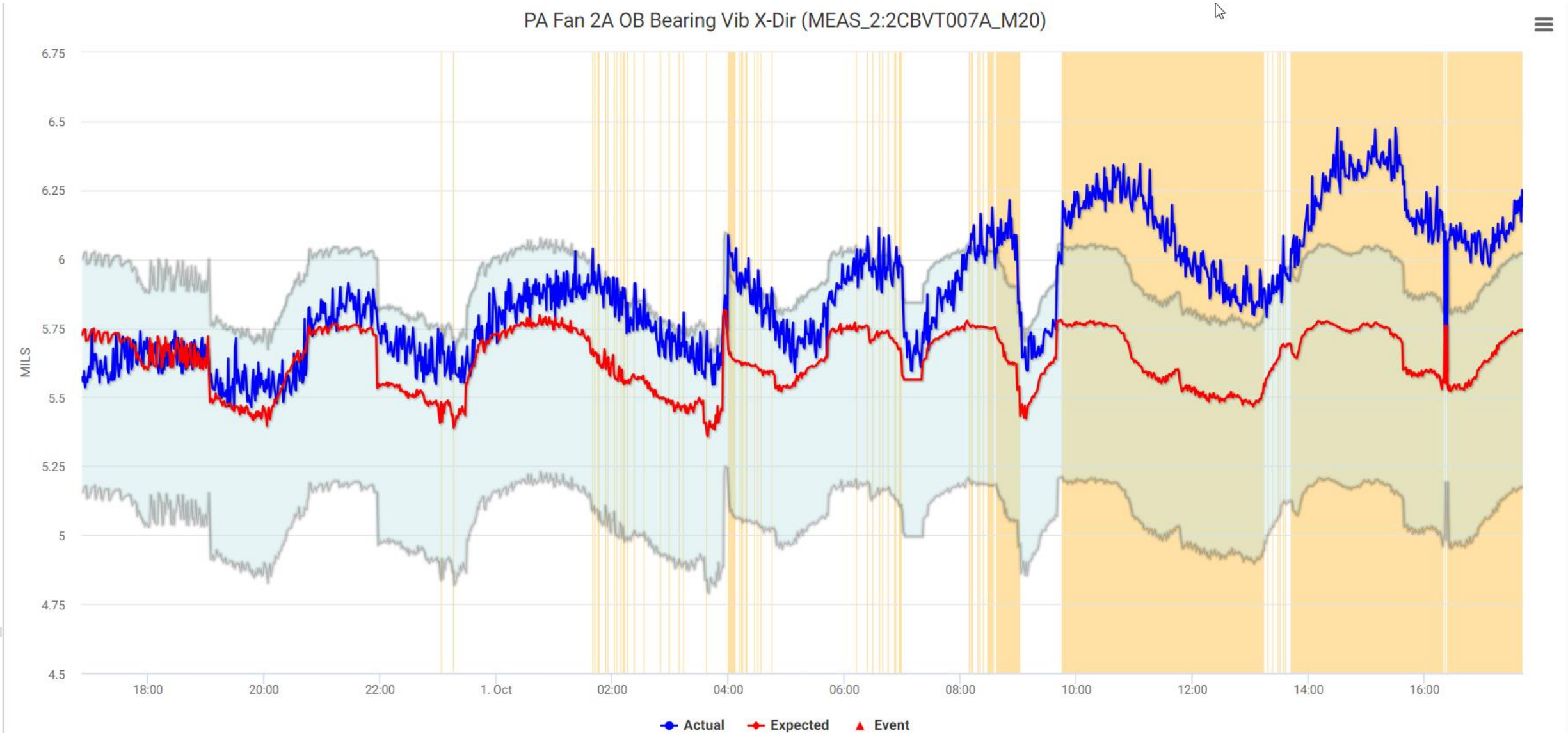
The P-F Interval



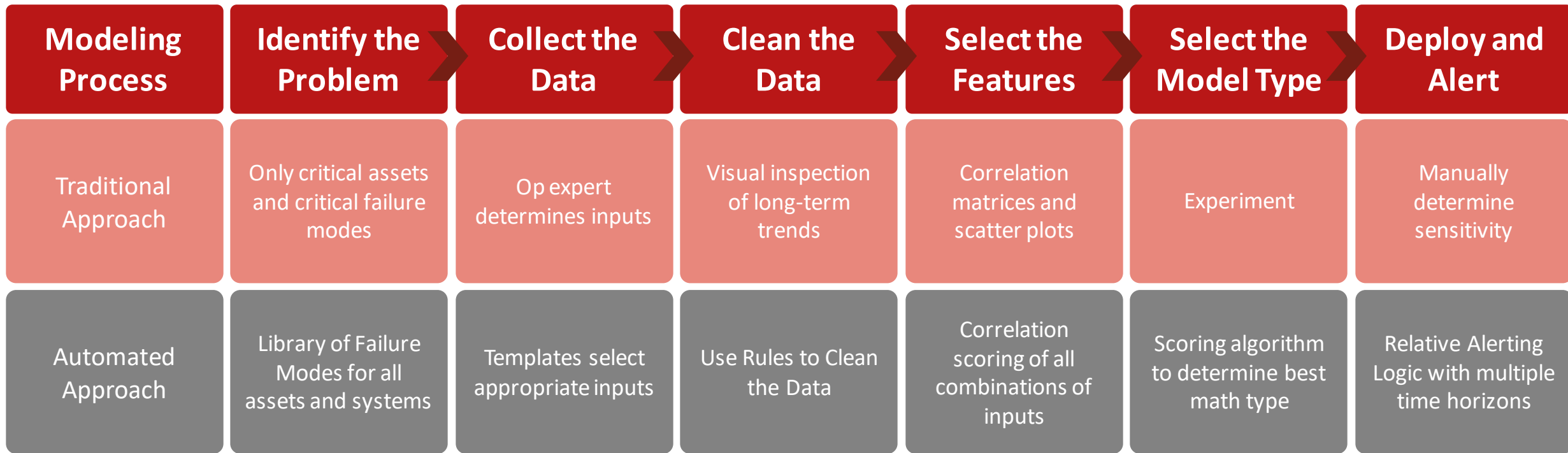
Identify Early



Identify Early



Templatize and Automate



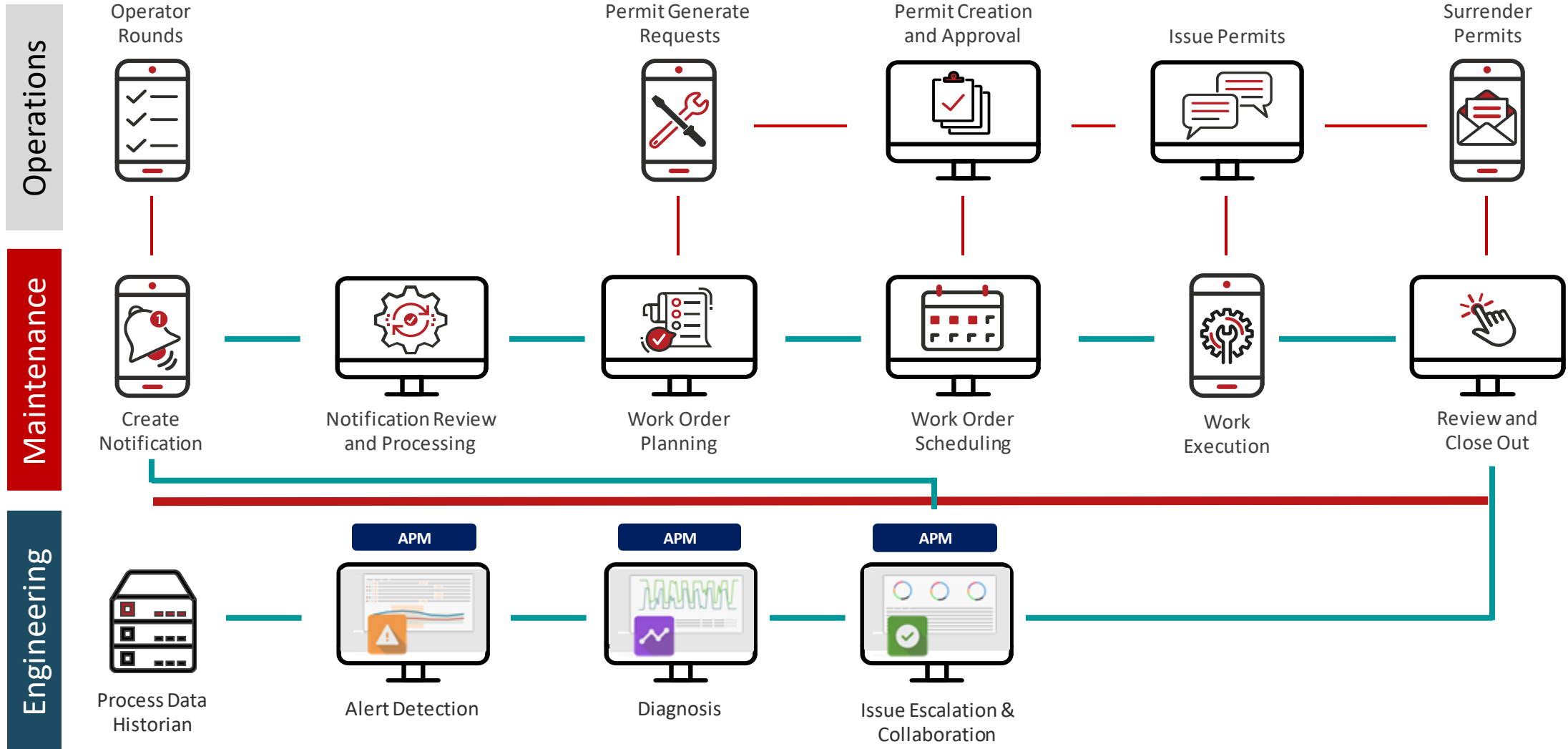
Project Start to full site analytics coverage in 1 month!



Closing the Loop



Connected Tools and Processes



SAP Integration



View open Notifications/WOs



Create Notification



Notification Updates



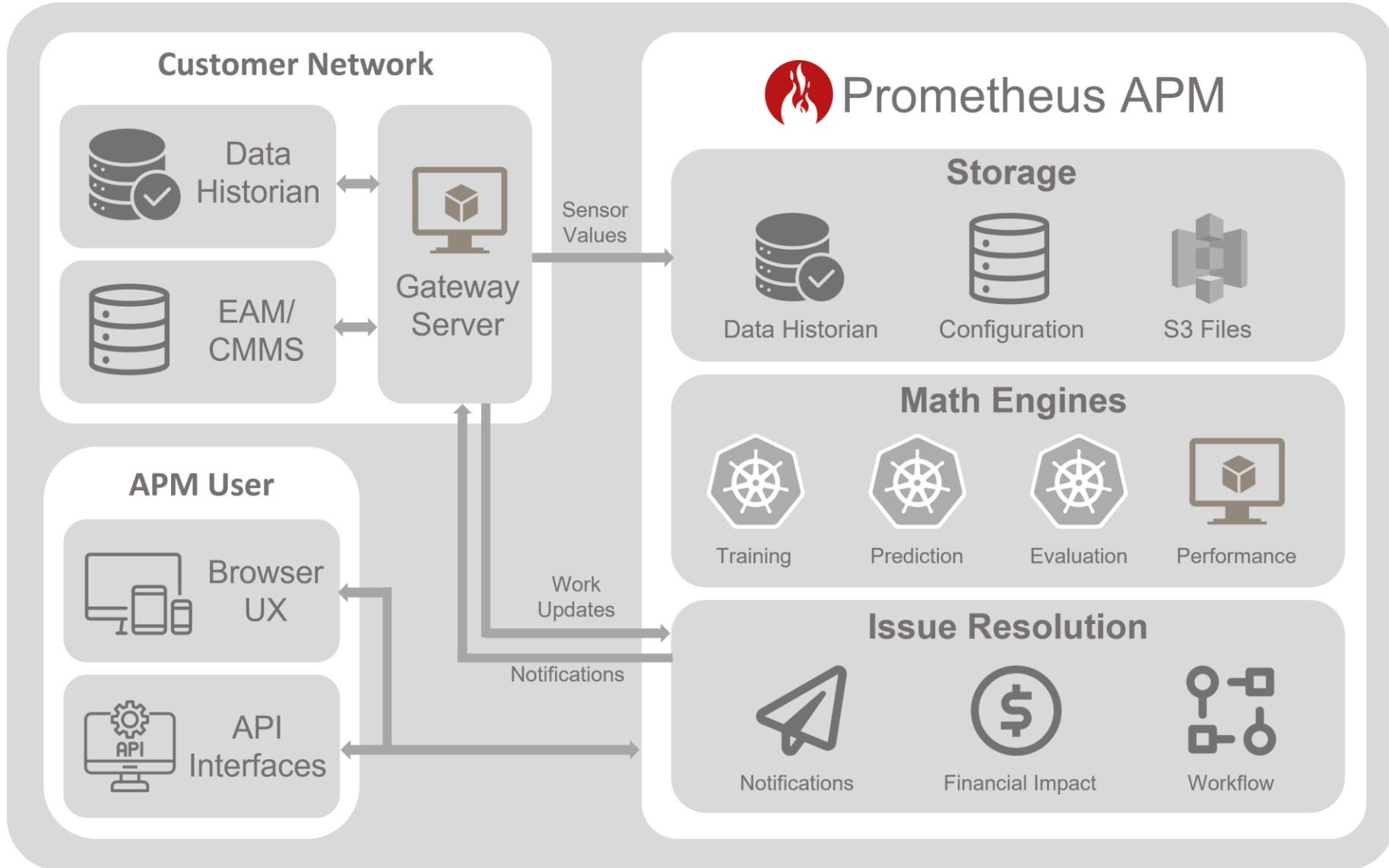
Issue Updates



Related Work Orders & Statuses



SAP Integration



APM - SAP Integration Demo

#1023547: CT Fan Motor/Gearbox Vibration Elevated

Status: Open

Created By: user531@customer28.atx May 3, 2017 4:20 PM

Age: 7 years old

Last Modified: SAPAgent@prometheusgroup.com Mar 28, 2024 1:35 PM

Resolution Status: Site Reviewing

Assigned To: [User]

Resolve By Date: [Calendar]

Priority: High

Save Following Send

211 CTF Inspection - 4/7/17

user531@customer28.atx May 4, 2017, 7:41:22 AM

PdM analyst vibration-tested fan and had operations immediately remove from service. Fan was at a full 1.0 in/sec at the outboard position of the motor. A slow motion video shows excessive movement of the driveshaft. Work Request 1703575 was written to have maintenance personnel inspect the couplings for damage and the driveshaft for delamination. It is probable that this driveshaft would have come apart and taken out the blades and shroud. The full PdM report and files will be uploaded later when they become available.




Image: Vibration Graph.png

New Discussion Post - 4/4/17

user531@customer28.atx May 3, 2017, 4:27:25 PM

211 CT Fan Motor and Gearbox vibrations spiked up to a 365 day highs of 0.48 IN/S while expecting 0.13 IN/S upon motor startup. The vibration velocity is still elevated at 0.33 IN/S. However it looks like something did change. Motor amps and outside temperature did not change during this event.

See the attached trends for details.




Image: 211 CT Fan Motor Vibrations Alert.jpg




Image: 211 CT Fan motor and Gearbox Vibrations 10 days.jpg




Image: 211 CT Fan Motor and Gearbox Vibrations 1 year.jpg




Image: 211 CT Fan Gearbox Vibrations Model Inputs.jpg




Image: All CT Fan Motor Vibrations 10 days.jpg

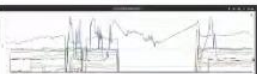


Image: All CT Fan Gearbox Vibrations 10 days.jpg

SHORT SUMMARY

211 CT Fan Motor and Gearbox vibrations spiked up to 0.48 IN/S on 4/4. Vibration test measured 1.0 in/sec vibrations at outboard position of motor. Slow motion video shows excessive movement of driveshaft.

DETAIL

Fan Bearing Type Increasing

Potential Causes

Issue Class: M&D

Issue Category: Outage Maintenance

IMPACT

Impact: \$148,048.49

Monthly Average: \$0.00

ASSET

Unit

Issues by Owning Asset: 13

Alerts by Owning Asset: 0

ISSUE KEYWORDS

Keyword Search. ENTER adds the key. Add Keyword

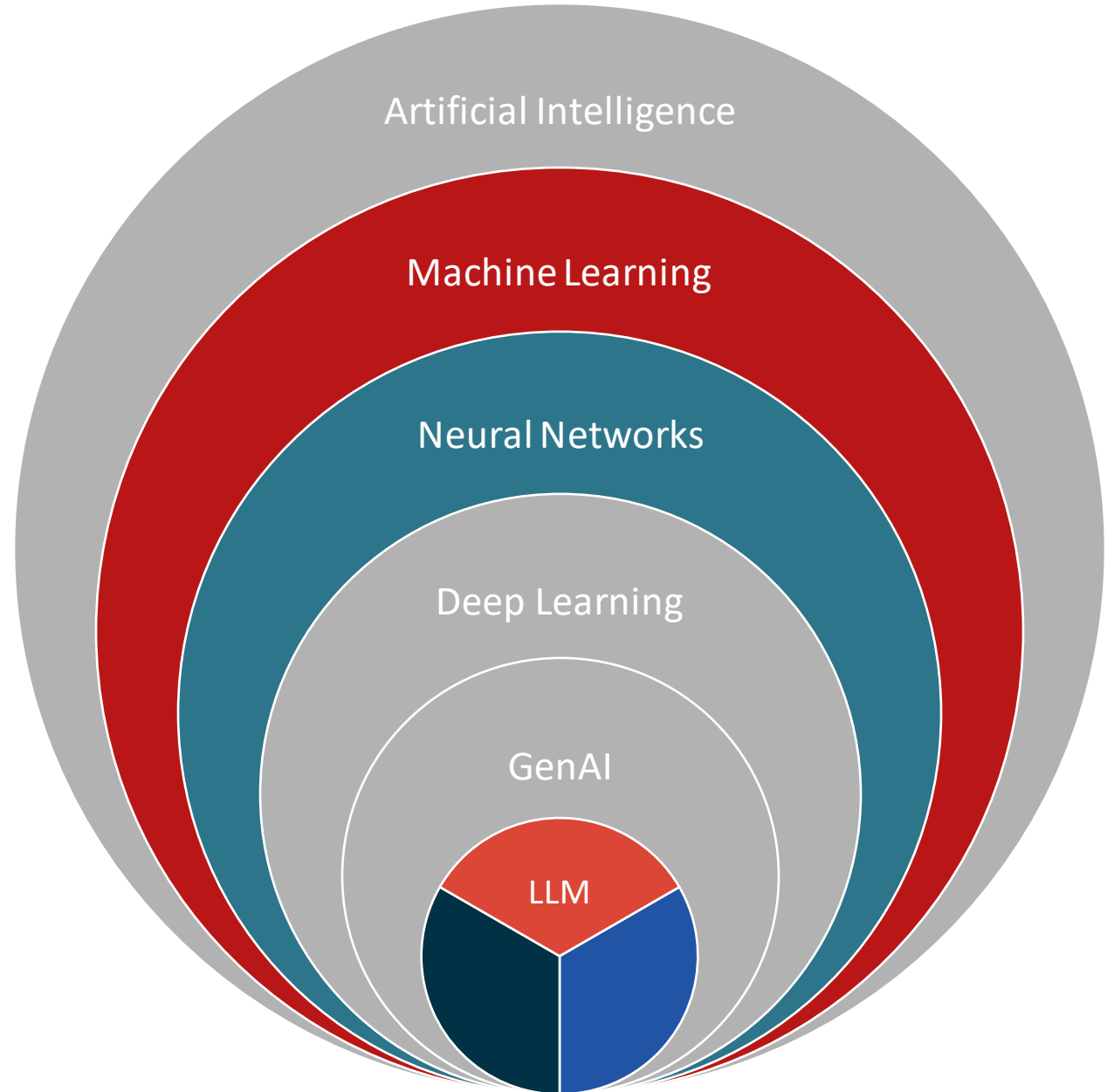
Find of the Week Outage Demo

APM and AI



Prometheus AI

- APM Recommended Actions
- APM Predictive Analytics
- APM Diagnostics
- MDaaS BOM Analysis
- MDaaS Material Cleanse/Enrich



Prometheus AI

- **APM Predictive Analytics**

- Learn Historical Operating Behavior
- Alert on Process or Reliability Issues

- **APM Recommended Actions**

- What should I do with this Alert?
- Snooze, Escalate, Retrain Model?

- **APM Diagnostics**

- What's causing this Alert and What should I do about it?
- Possible Causes, Diagnostic Actions, Historical Issues, and Maintenance



APM AI Demo – Predictive Analytics

The interface displays a list of predictive models with their current status and performance metrics. The selected model, PA Fan 2A OB Bearing Vib X-Dir, is highlighted in blue.

Alert	Watch	Ignore	Issues	Model Name	% OOB	% EXP	Actual	Lower	Expected	Upper	Units
!	👁	🚫	> 1	GSU Transformer Top Oil Temp	222	41	109.4	67.36	77.33	87.29	DEGF
!	👁	🚫	> 1	Hotwell Pump Strainer A DP	573	383	0.1525	0.01361	0.03157	0.04953	PSID
!	👁	🚫	> 1	HP Turbine NO.11 Bearing Vib X	822	166	2.343	0.721	0.8797	1.038	MIL
!	👁	🚫	0	ID Fan A Axial Brg Temp	2064	-19	156	191.9	193.6	195.3	DEGF
!	👁	🚫	0	PA Fan 2A OB Bearing Vib X-Dir	139	11	6.313	5.463	5.713	5.964	MILS
!	👁	🚫	0	NH3 Synthesis Loop Feed to Co...	516	21	425.5	341.3	353.1	364.8	MMscfd
!	👁	🚫	0	Syngas Compression- Recycle G...	371	16	389.9	325.4	336.7	348	MMscfd
!	👁	🚫	0	NH3 Synthesis Loop- Purge Gas	888	42	7.187	4.864	5.077	5.291	MMscfd
!	👁	🚫	0	NH3 Synthesis Loop- Converter ...	162	-9	364.4	387.1	401.2	415.2	*F
!	👁	🚫	0	CW Pump A- OB Bearing Vib X-Dir	209	16	6.455	5.294	5.578	5.861	Mils
!	👁	🚫	> 1	QD_001X Total Suspended Solid...	0	-33	1.178	0.5	1.751	3.694	
!	👁	🚫	0	Cooling Tower Level	39	10	100.6	84.85	91.44	98.02	%

The chart below shows the historical performance of the selected model, PA Fan 2A OB Bearing Vib X-Dir (MEAS_2:2CBVT007A_M20). The Y-axis represents vibration in MILS (4.5 to 6.75), and the X-axis shows time from 25 Sep to 1 Oct. The chart displays Actual (blue line), Expected (red line), and Event (yellow vertical bars) data.

Alerts Actions: Current Status: In Alert (12/14/2023, 3:28 am). Watch: 6 Hours, 24 Hours, 7 Days, Custom. Clear Diagnose, Model Maintenance, Add Note.

Model Diagnostics: Model Configuration, OP Mode Configuration, Data Explorer, Diagnostic Drilldown, Show Related Models, Show Related Issues, Create Issue.

Model Description: Asset Description: PA Fan A Motor OB Bearing.



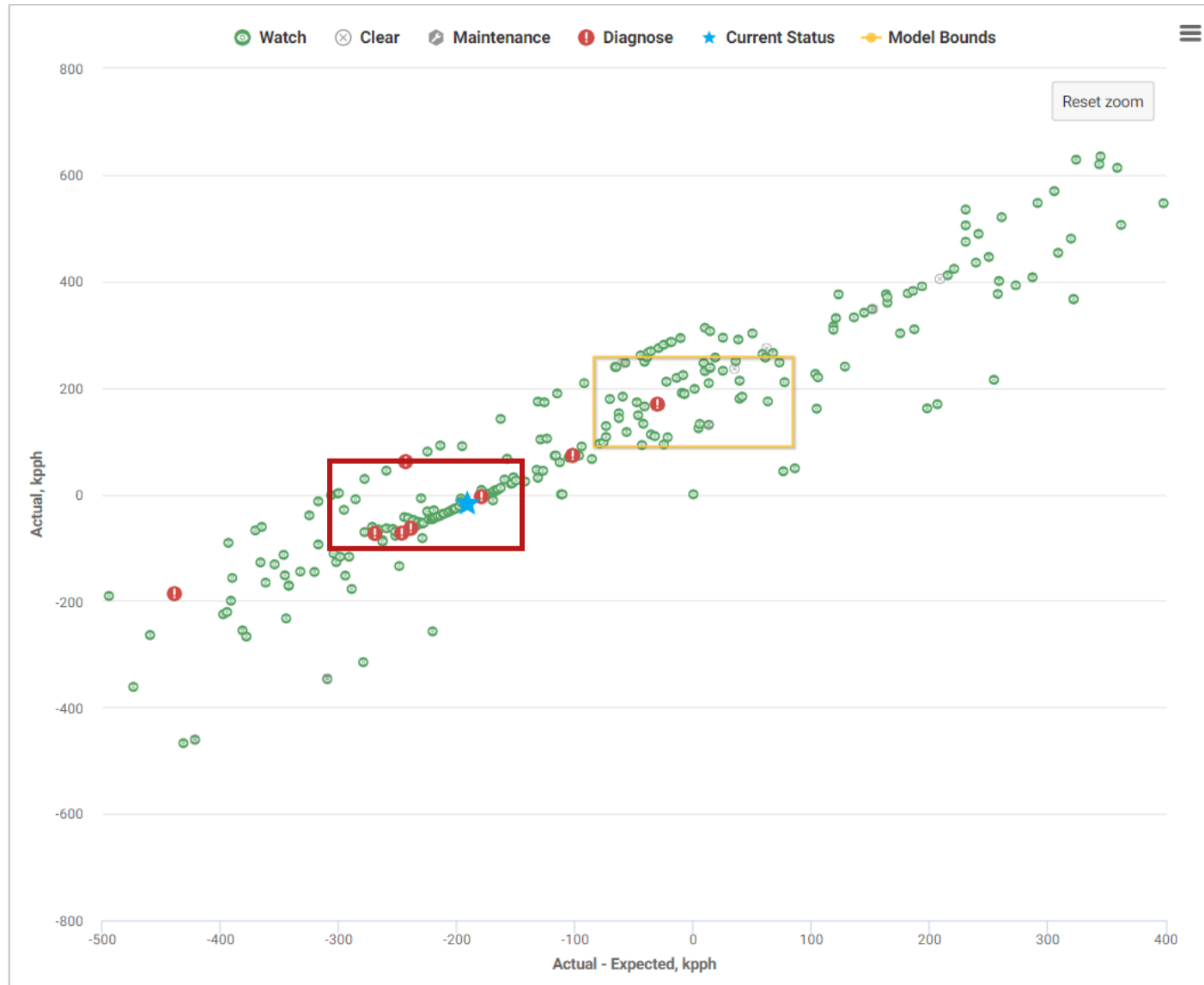
APM AI Demo – Suggested Actions

The screenshot displays the APM AI interface with the following components:

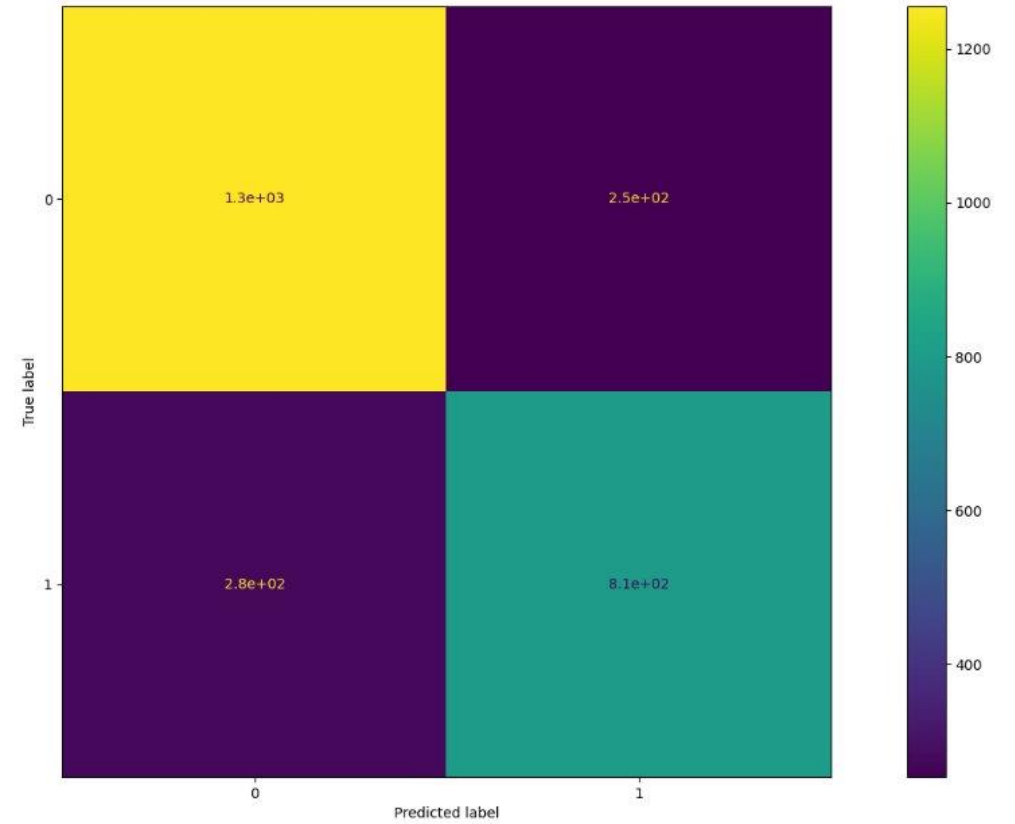
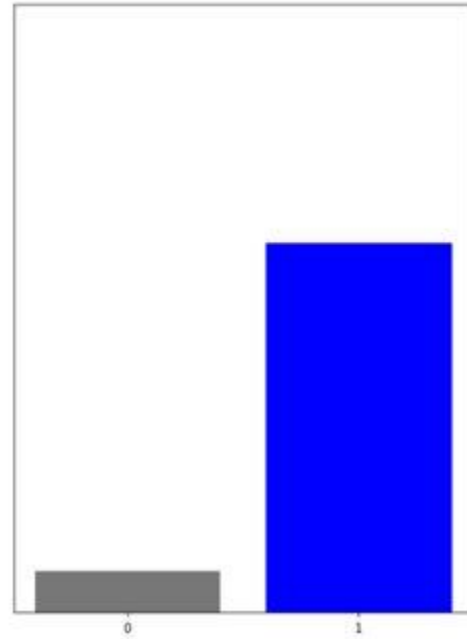
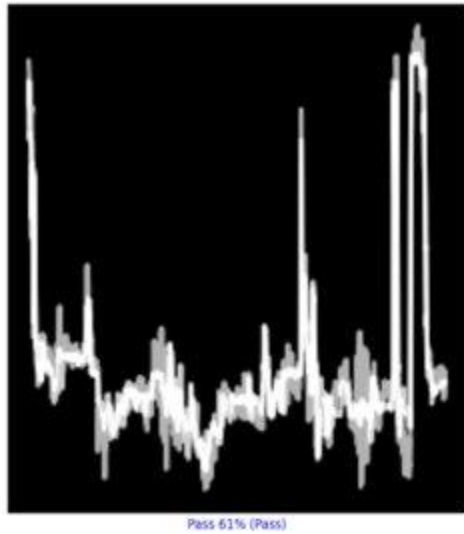
- Navigator:** A sidebar on the left showing a tree view of assets, including Central Station, Central CC1, and various systems like AQC, Combustion Turbine, and HRSG.
- Alerts Table:** A table at the top center showing issues for different models. The highlighted row is 'Econ Bank 2 Press Diff - Steady State' with 14 issues, -234 OOB, and -133 EXP.
- Time-Series Chart:** A chart titled 'Econ Bank 2 Press Diff - Steady State (Econ Bank 2 Press Diff)' showing 'Actual' (blue) and 'Expected' (red) values over time from Dec 3 to Dec 12. The y-axis is labeled 'INCH' and ranges from -5 to -1.
- Suggested Action Panel:** A panel on the right titled 'Suggested Action' with a red border, containing the text 'Diagnose Alert' and '100% (Confidence)'. Below it are 'Model Diagnostics' options like Model Configuration, OP Mode Configuration, and Data Explorer.
- Bottom Panel:** A timeline at the bottom showing dates from 11/23 to 12/20, with a 'Jump To' button and a 'Live' indicator.



APM AI Demo – Suggested Actions



APM AI Demo – Suggested Actions



APM AI Demo – Suggested Actions

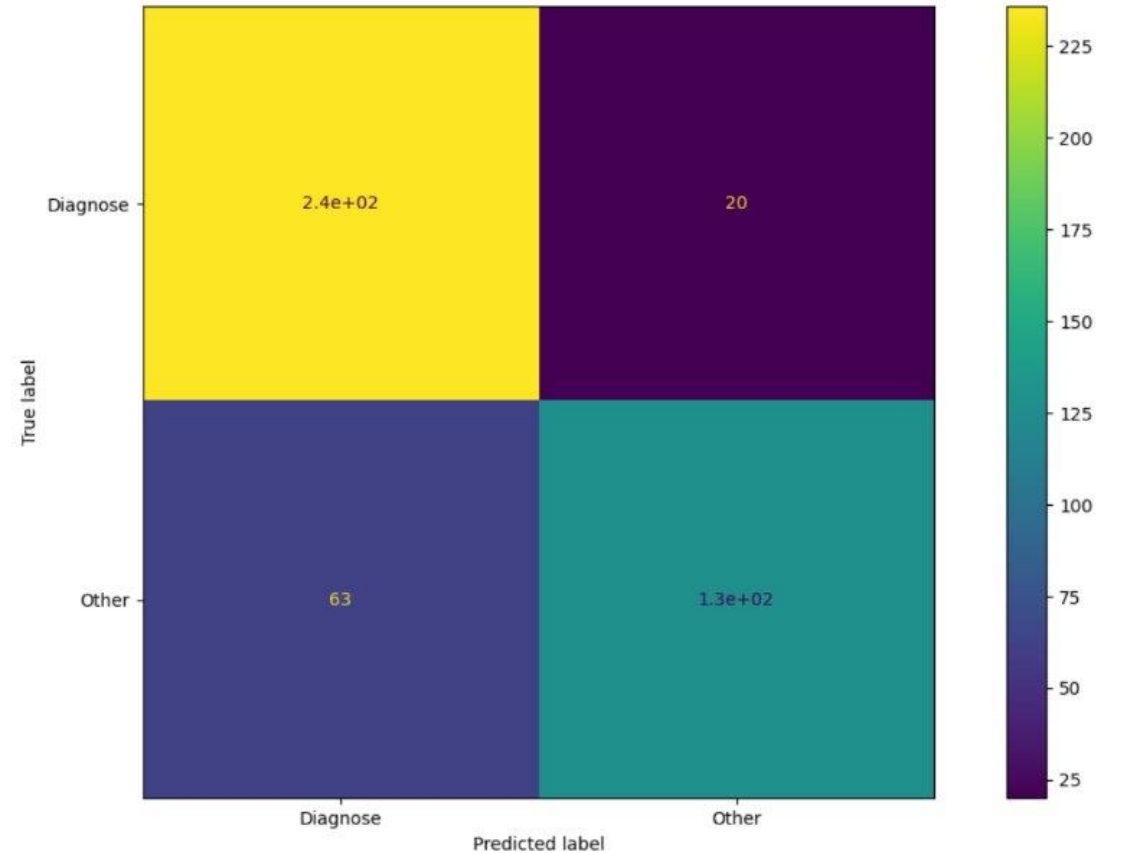
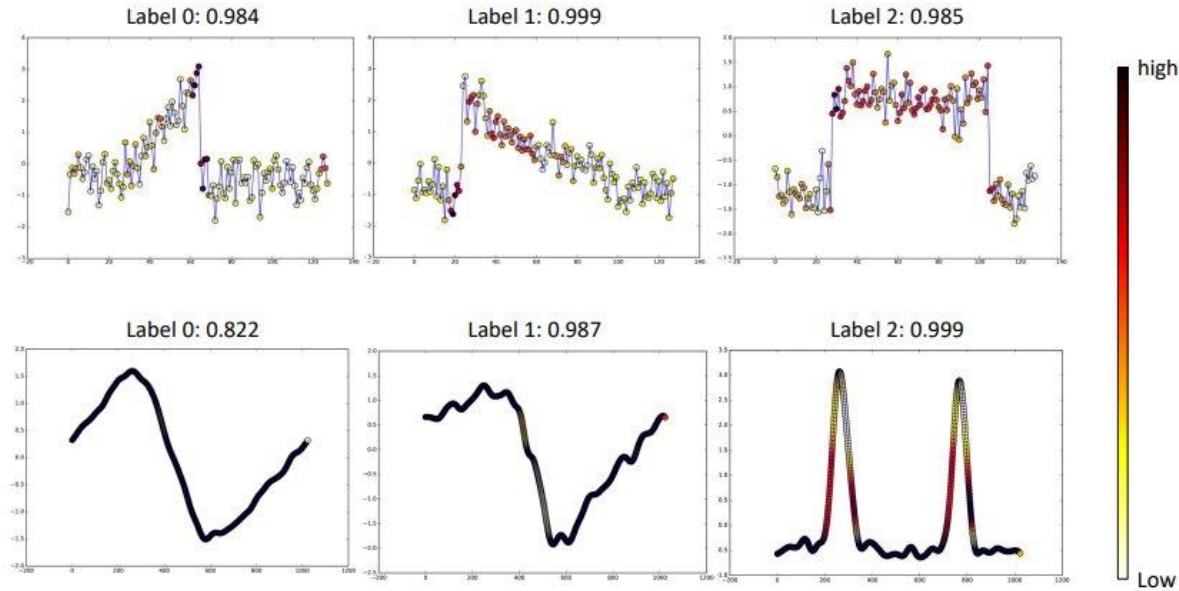
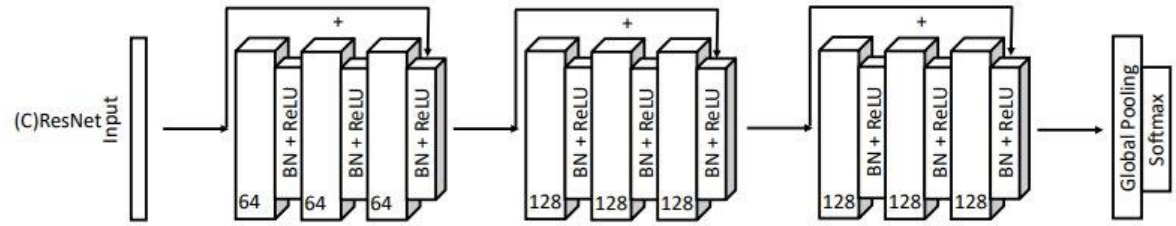


Fig. 3. The class activation mapping (CAM) technique allows the classification-trained FCN to both classify the time series and localize class-specific regions in a single forward-pass. The plots give examples of the contributing regions of the ground truth label in the raw data on the 'CBF' (above) and 'StarLightCurve' (below) dataset. The number indicates the likelihood of the corresponding label.

APM AI Demo – Generative AI (LLM)

The screenshot displays the APM AI interface with the following components:

- Navigator:** A tree view on the left showing the asset hierarchy, including Ammonia Plant 1 and Ammonia Plant 2.
- Table:** A table listing issues for the asset 'Econ Bank 2 Press Diff - Steady State'. The table has columns for Issues, Model Name, % OOB, % EXP, Actual, Lower, Expected, and Upper. The current issue has 11 occurrences, with an actual value of -4.72 and an expected value of -2.023.
- Chart:** A time-series chart titled 'Econ Bank 2 Press Diff - Steady State (Econ Bank 2 Press Diff)' showing 'Actual' (blue line) and 'Expected' (red line) values from December 3rd to 12th. The y-axis is labeled 'INCH' and ranges from -4 to -1.
- Diagnostic Panel:** A panel on the right showing the current status as 'In Alert' (05/02/2023, 10:00 am) and a 'Diagnose Alert' with 100% confidence. It also includes a 'Suggested Action' section and a 'Model Diagnostics' section with options like 'Model Configuration', 'OP Mode Configuration', and 'Data Explorer'.



APM Roadmap





Prometheus APM Roadmap

2024

AI Diagnostics

- Possible Causes
- Diagnostic and Mitigative Actions
- Historical Issues and Maintenance

Issue Management

- AI Issue Creation
- Maximo, HexEAM Integration

Implementation Enhancements

- Bad Status Awareness
- Suggested Alert Actions
- Updated Standards and Templates
- Import Op Modes
- Multi-model Creation

Calculated Tag Editing

- Build Simple and Complex Calculations

2025

AI/Smart Tools

- AI Trending Assistant
- AI-Assisted Trend Analysis
(*What's interesting about this trend?*)

Deeper Diagnostics

- Symptom Based Cause Identification
- Action Recommendation

Issues Management

- Process Data association
- HexEAM Integration

Standards Editing

- UI for creation/edit of standards and templates

BEYOND

Asset Reliability

- Asset Criticality
- Root Cause Analysis
- Failure Mode Effects Analysis

Predictive Analytics Enhancements

- Process Data + Maintenance Records + Inspections + Lab

Roadmap items reflect current plans at the time of original distribution of this document. Items or timelines are not promised and are subject to change without notice. Recipient agrees not to share this slide or its content in any form beyond the originally intended audience.

Thank You!

Questions?



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