Rockwell Automation

TechED™

Rockwell Automation TechED

Leveraging Your Digital Footprint for Better Asset Performance and Uptime

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June 11th – June 15th

Agenda

LEVERAGING YOUR DIGITAL FOOTPRINT

REMOTE MONITORING & ANALYTICS SERVICES

EXPLAINING PMaaS

USE CASE DEMONSTRATION

QUESTIONS AND CONVERSATIONS

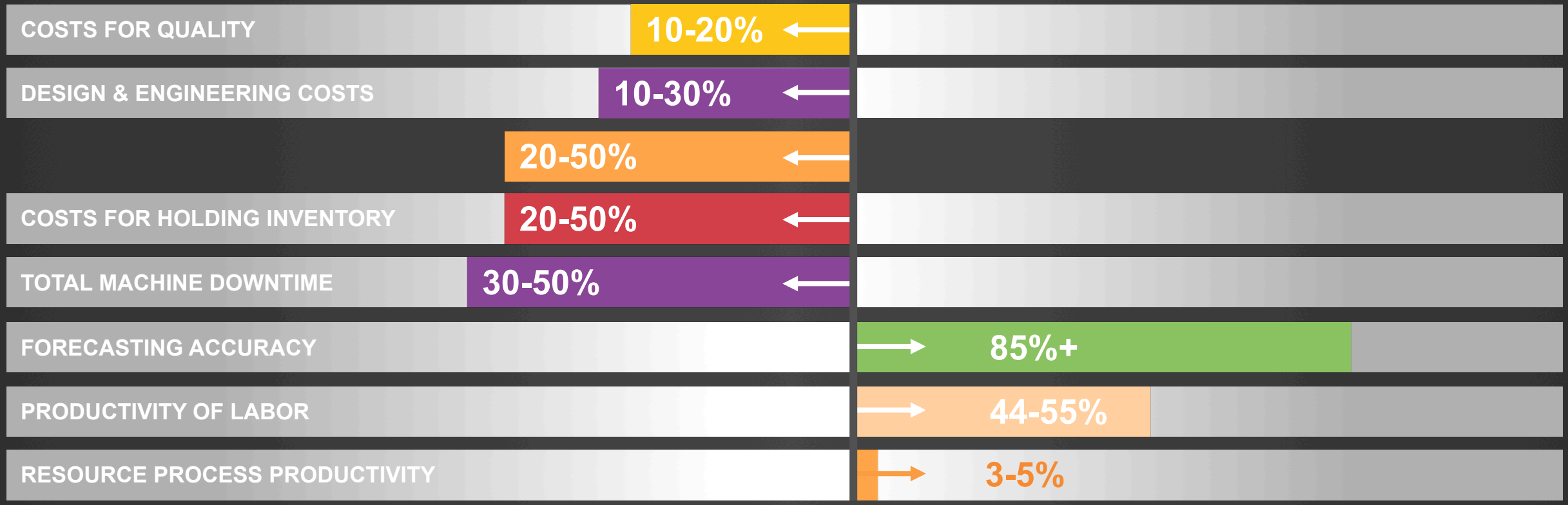
LEVERGAING YOUR DIGITAL FOOTPRINT

Why should I connect?

TIME-TO-MARKET

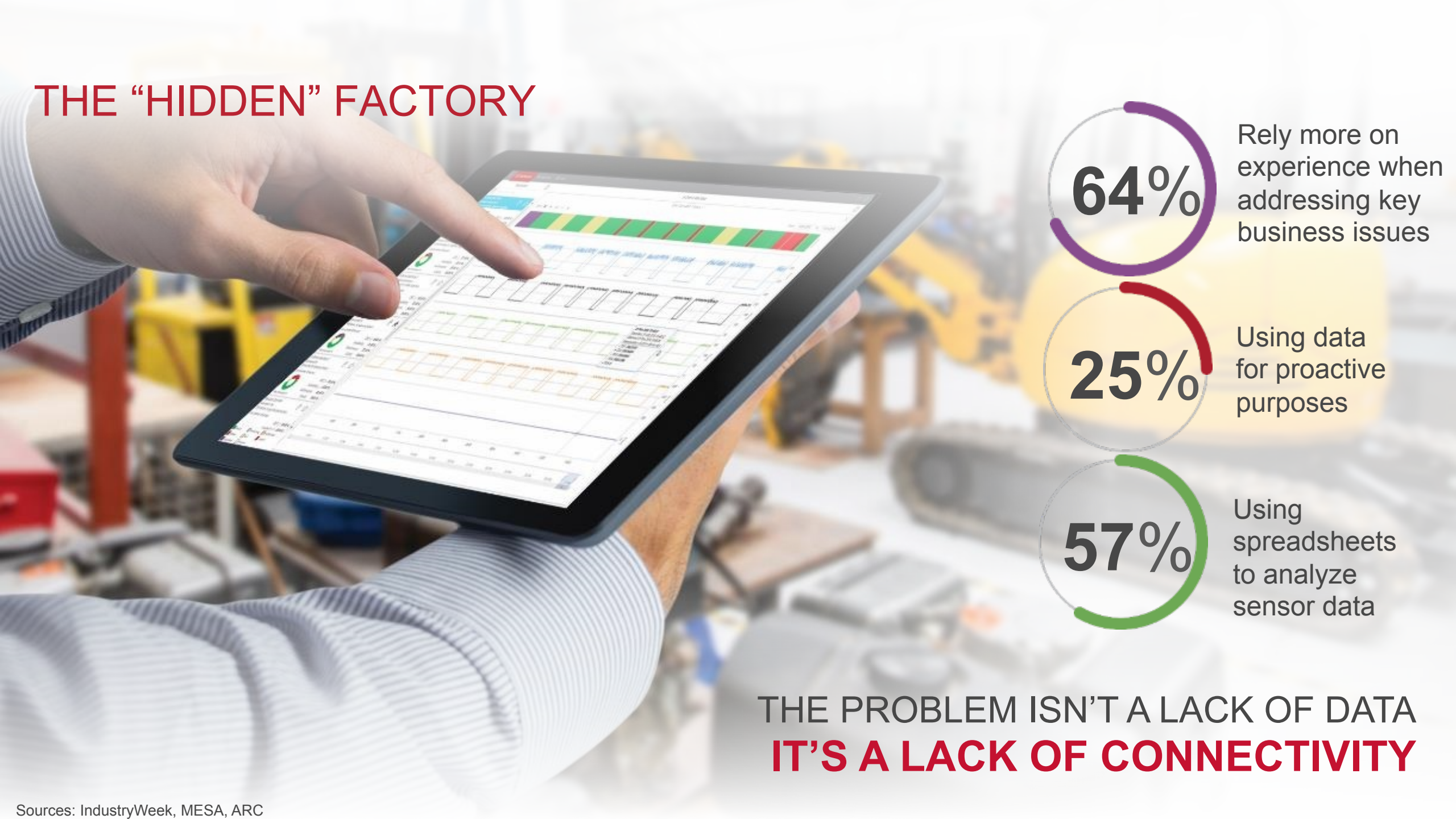
DIGITAL OPPORTUNITIES

that **Reduce Cost** within **Operations**



SOURCE: McKinsey

THE “HIDDEN” FACTORY



64% Rely more on experience when addressing key business issues

25% Using data for proactive purposes

57% Using spreadsheets to analyze sensor data

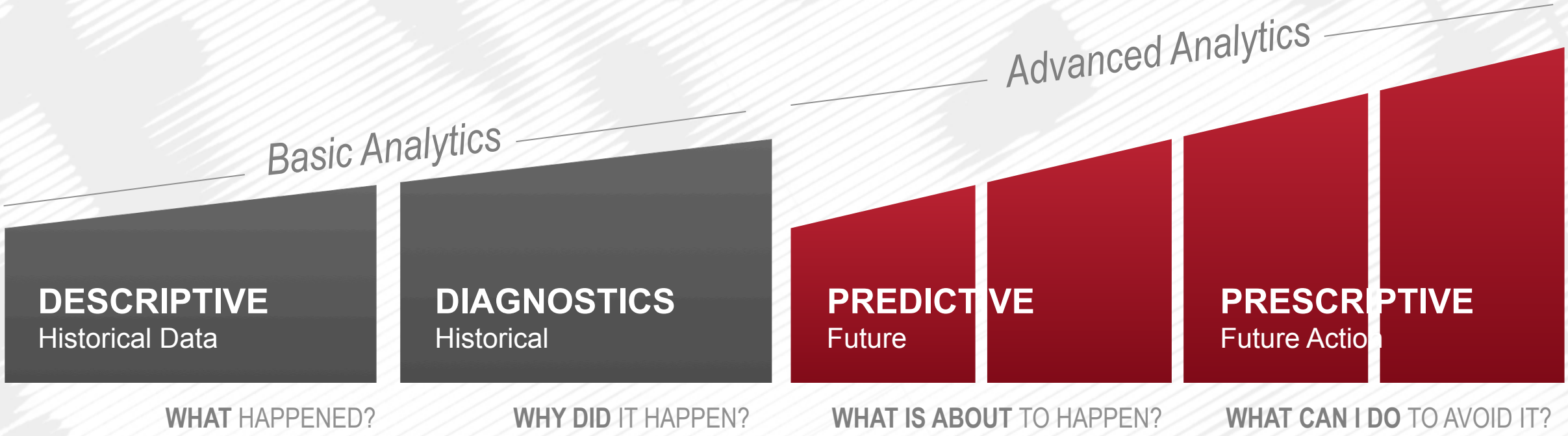
THE PROBLEM ISN’T A LACK OF DATA

IT’S A LACK OF CONNECTIVITY

Sources: IndustryWeek, MESA, ARC

ANALYTICS **VALUE**

Increasing Intelligence & Improving Performance



REMOTE MONITORING AND ANALYTICS SERVICES

I’m connected, what can I do now?

Offerings

Application Support and Monitoring

Infrastructure Management

Drive Monitoring

Predictive Maintenance as a Service

Application Support with Monitoring

Value Proposition:

Shorter time to resolution and greater availability of expertise for minimized downtime

Capabilities:

- Connect devices, applications, and systems to cloud-based monitoring for enhanced engineering support capabilities

Offerings

Application Support with Monitoring

Infrastructure Management

Drive Monitoring

Predictive Maintenance as a Service

Infrastructure Management

Value Proposition:

Management of OT network and server environment for increased availability

Capabilities:

- Monitoring and Adminstration for network/ server assets (IDCs, Stratix, Cisco Switches, etc)

Offerings

Application Support with Monitoring

Infrastructure Management

Drive Monitoring

Predictive Maintenance as a Service

Drive Monitoring

Value Proposition:

Leverage Rockwell Automation drive expertise for faster time to resolution

Capabilities:

- Active monitoring of PF7000, PF755, or PF755T Drives with automated alerts for faults and other issues

Offerings

Application Support with Monitoring

Infrastructure Managment

Drive Monitoring

Predictive Maintenance as a Service

Predictive Maintenance as a Service

Value Proposition:

Predict asset events before they occur to reduce unplanned downtime

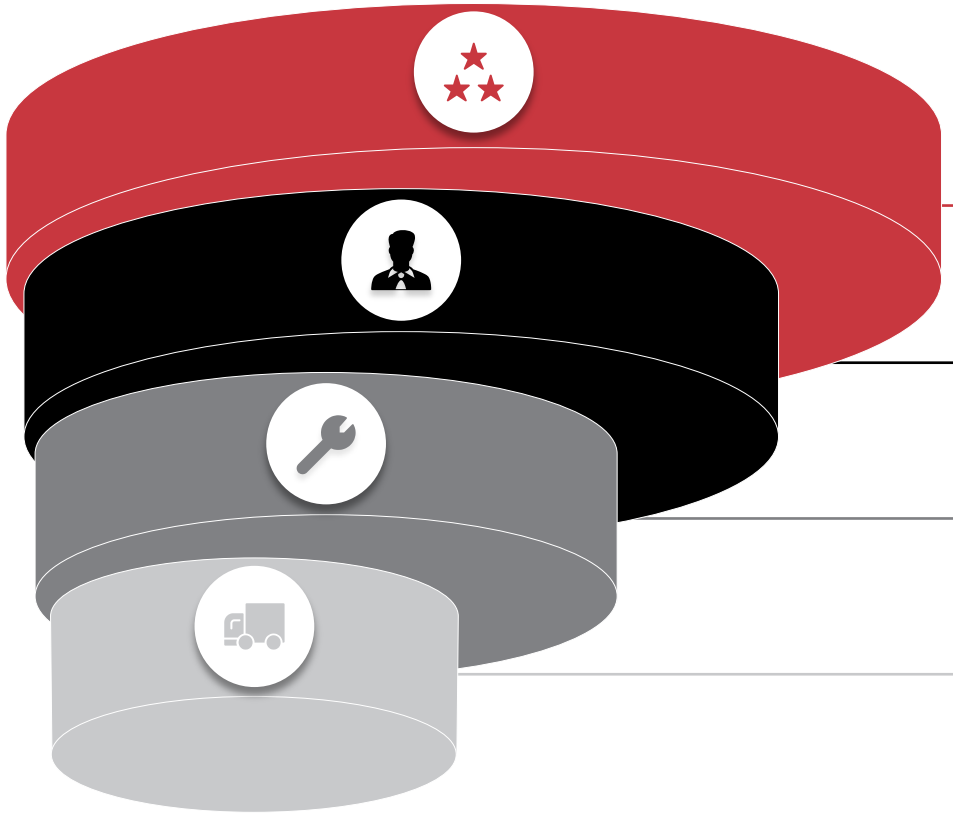
Capabilities:

- Engineering Support building predictions and analyzing asset data using machine learning technology to identify patterns indicating issues or potential issues

EXPLAINING PMaaS

What is a predictive maintenance service?

What is in PMaaS?



Customer Outcome: Predictive Alerts and Analysis

Customer will receive Predictive Alerts and receive detailed analysis without the need for them to engineer the solution or build data models

Engineering Support

Engineers with experience in building predictions and analyzing asset data with work with the customers to develop predictive models in the ML environment to alert to upcoming events or new operating states

Machine Learning Technology

Cloud-hosted ML technology to identify and monitor for data patterns associated with events, variations from “normal” or other areas of concern

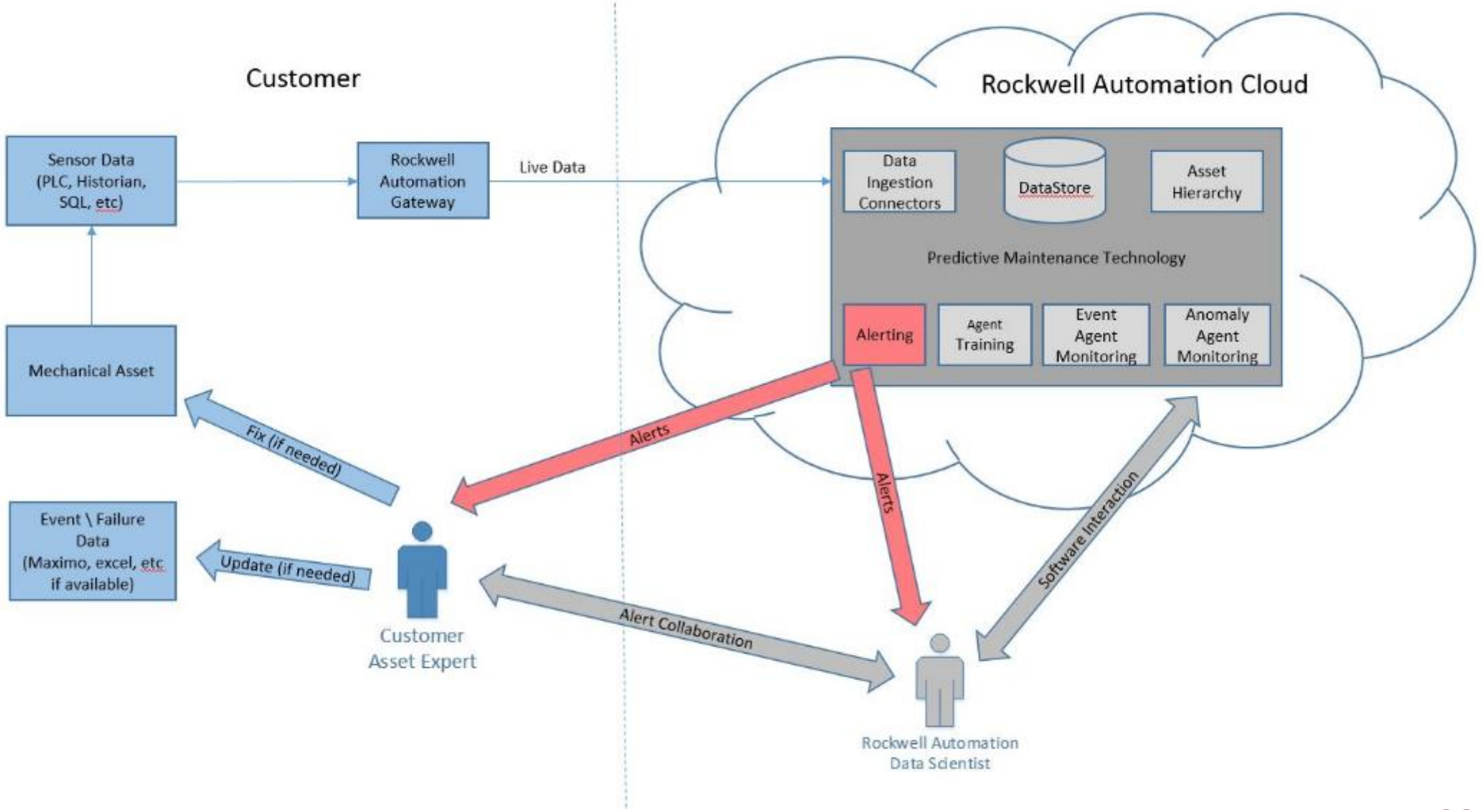
Data Collection and Storage

We connect to asset data, same as all monitoring services, and utilize the machine learning environment to build and monitor predictive outcomes

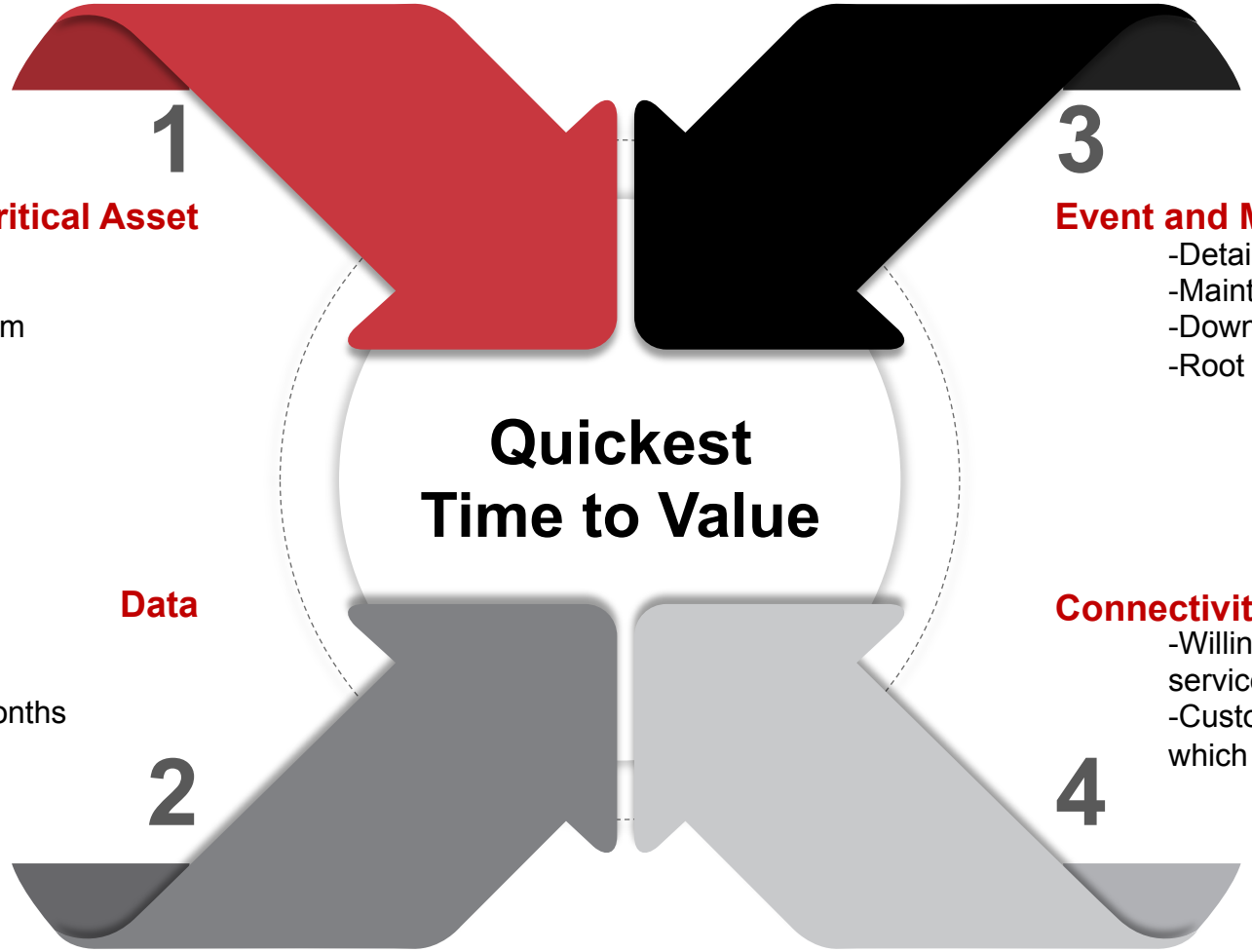
PMaaS Offering

This initial PMaaS offering delivers predictive maintenance outcomes to customers who have detailed asset data and a critical need to maintain asset uptime at the highest level possible. The service will deliver to customers the ability to monitor predictions and analyze details of an alert as a managed service without the need to do the actual engineering of the technology. Rockwell Automation delivers the data collection, ML, and engineering required to build and monitor predictions as a service.

PMaaS Ecosystem



Ideal Deployment



Critical Asset

->$200k in annual downtime cost per asset
->$100k in annual maintenance activity
-Critical asset that, if down, starves downstream production
-Some combination of the above

Event and Maintenance History

-Detailed operational status (up/down)
-Maintenance activity
-Downtime/Failure Log
-Root Cause detail of event

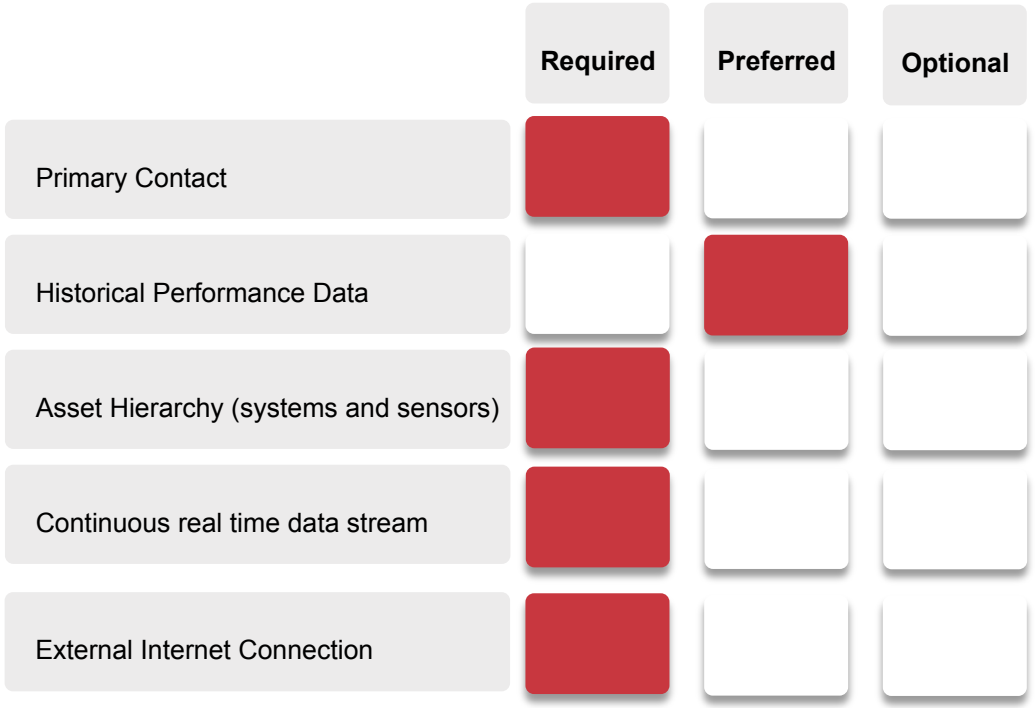
Data

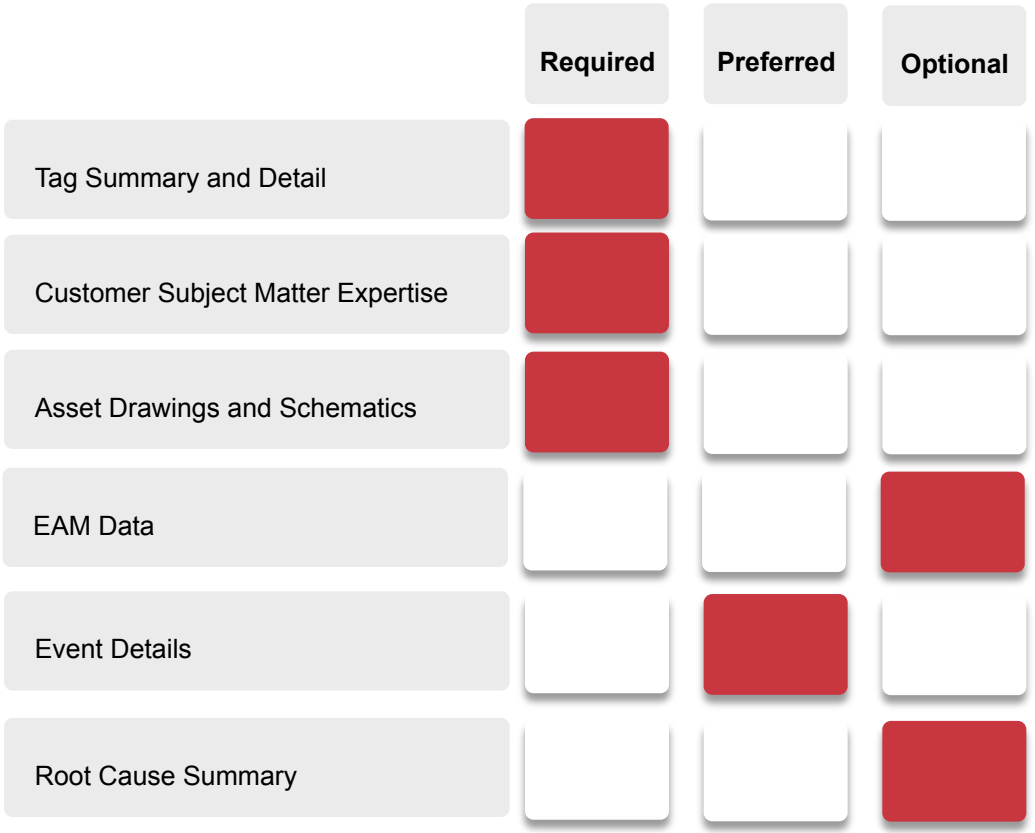
-At least 5 data parameters(more than 10 preferred)
-Historical database of at least 2 months (6 months or better)
-Data collected at minute data or better

Connectivity and Asset Expertise

-Willingness to connect data sources to cloud service
-Customer expert on application of asset on which service is deployed

System Requirement/Preferences for Service Suitability





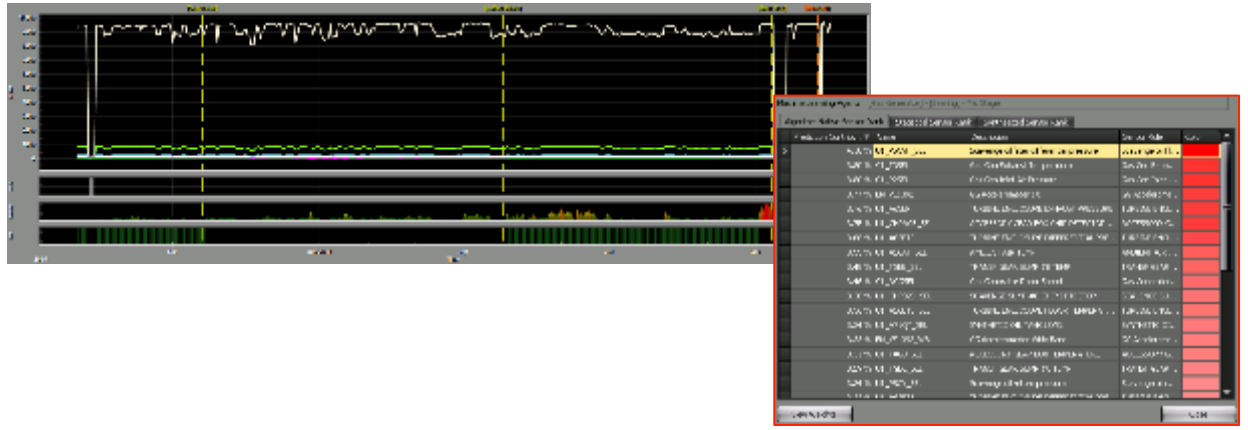
USE CASE DEMONSTRATION

How does this work in the real world?

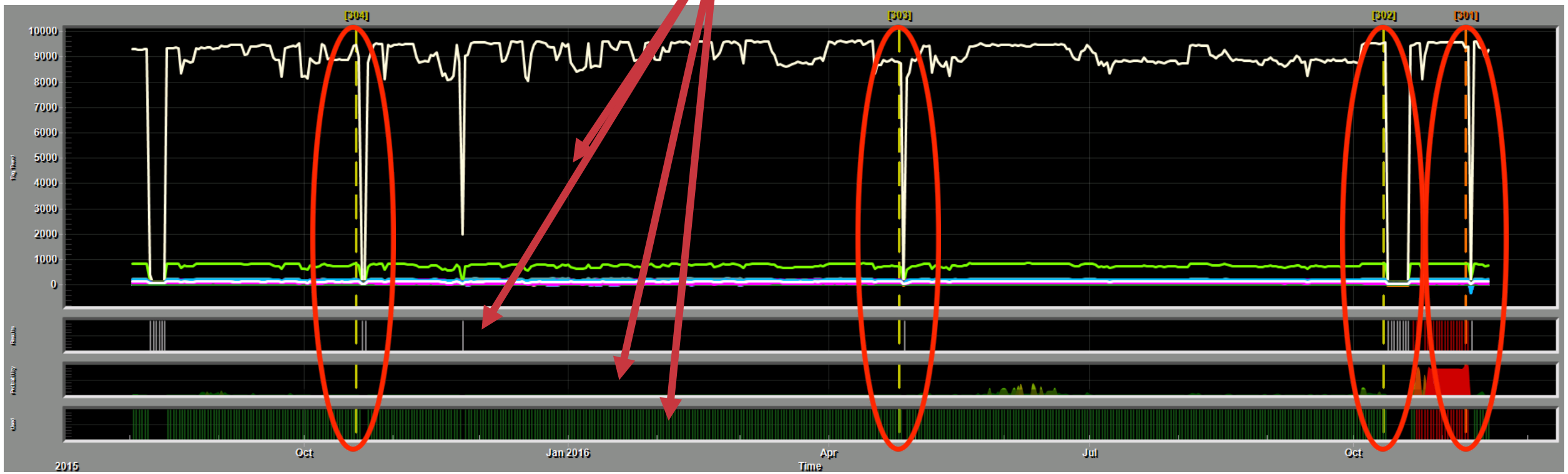
Example: Predicting a Bearing Failure

Application: High Value Compressor Station with a history of bearing failures

Situation: Failure event that resulted in over $3 million is lost productivity. Customer wanted to know if the event was predictable based on the available data

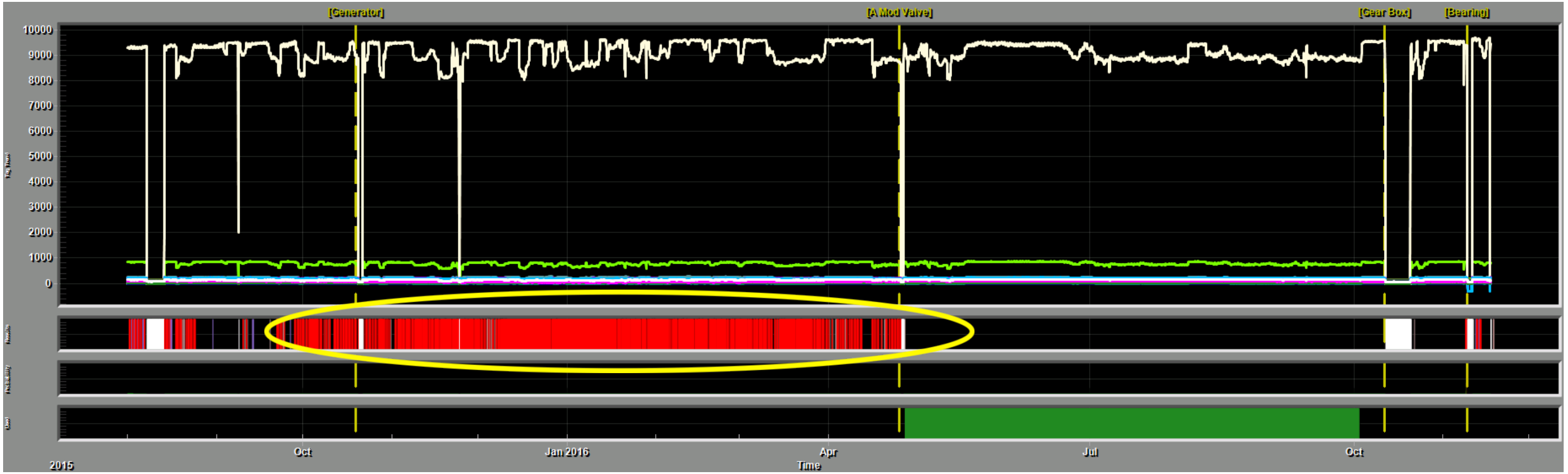


Understanding the Environment



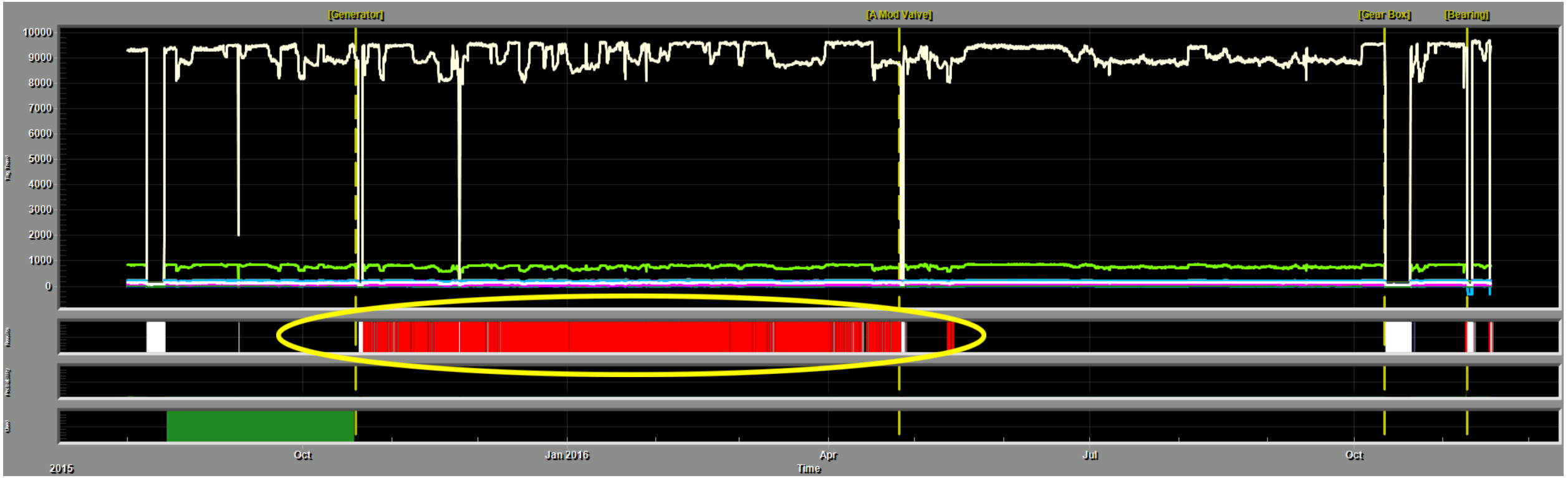
- [301] – Bearing failure — November 2016
- [302] – Fall maintenance (including gearbox replacement) — October 2016
- [303] – Spring maintenance (including a mod valve replacement) — April 2016
- [304] – Generator replacement — October 2015

Looking for Anomalies



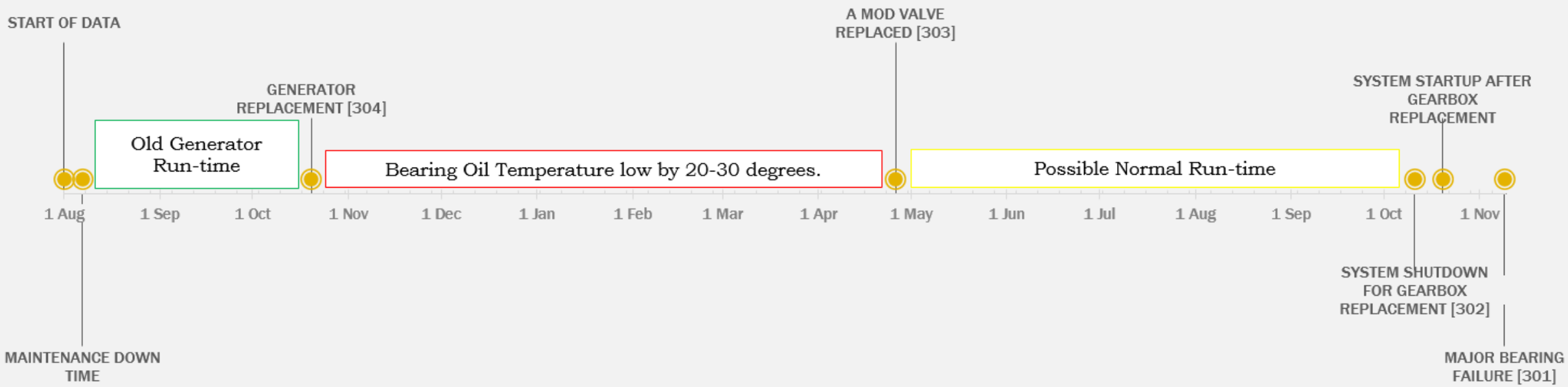
- We identified a section of the timeline to consider “normal” (green section – May though Oct)
- The anomaly detector shows there is a significant difference in run signatures (yellow circle)
  - We know that the a mod valve replacement was significant
  - Still unsure which run-time is good run-time
  - Also note: nothing happened after gearbox replacement

Looking for Anomalies



- The previous generator ran without problems, we shifted “normal” run-time to that earlier data
- This anomaly detector shows there is still a significant difference before the a mod valve change
  - We further confirm that the a mod valve replacement was significant
  - Also, we know the run-time prior to the valve replacement was NOT “normal”
  - We see the generator is running “normal” after valve replacement until bearing failure

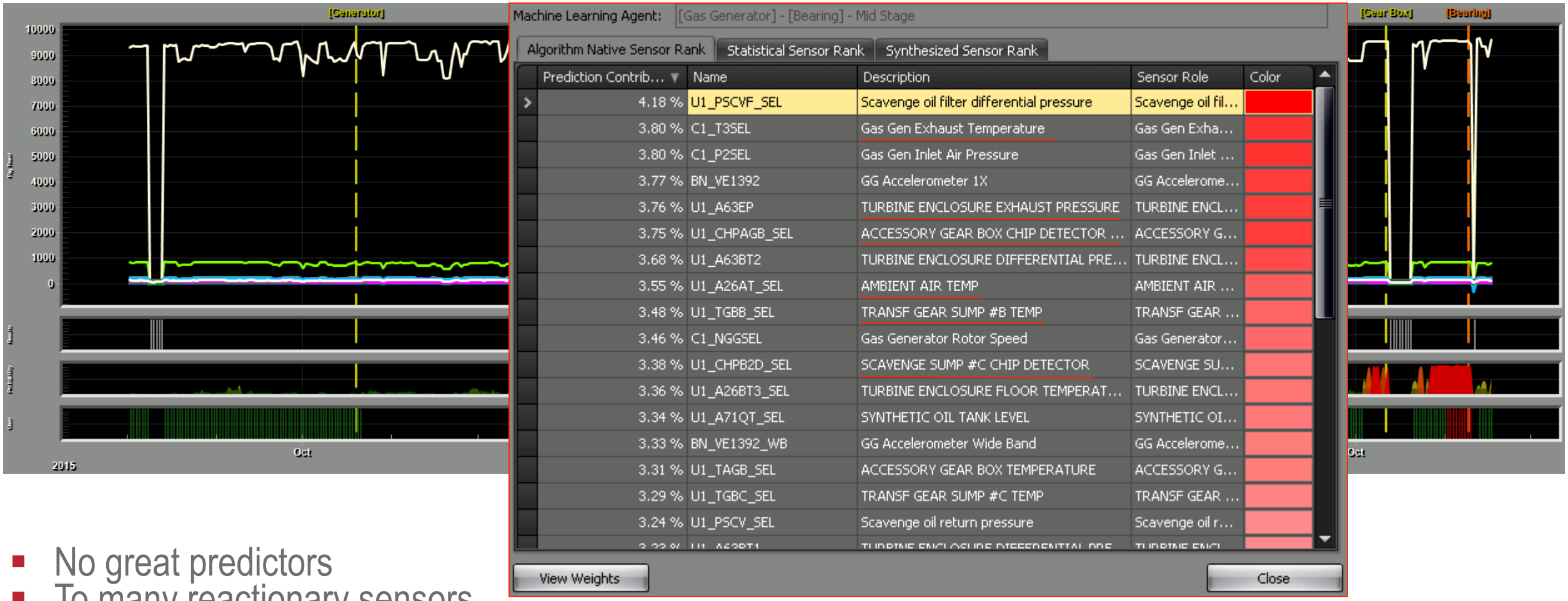
Asset Issue Timeline



Corrected “Normal”

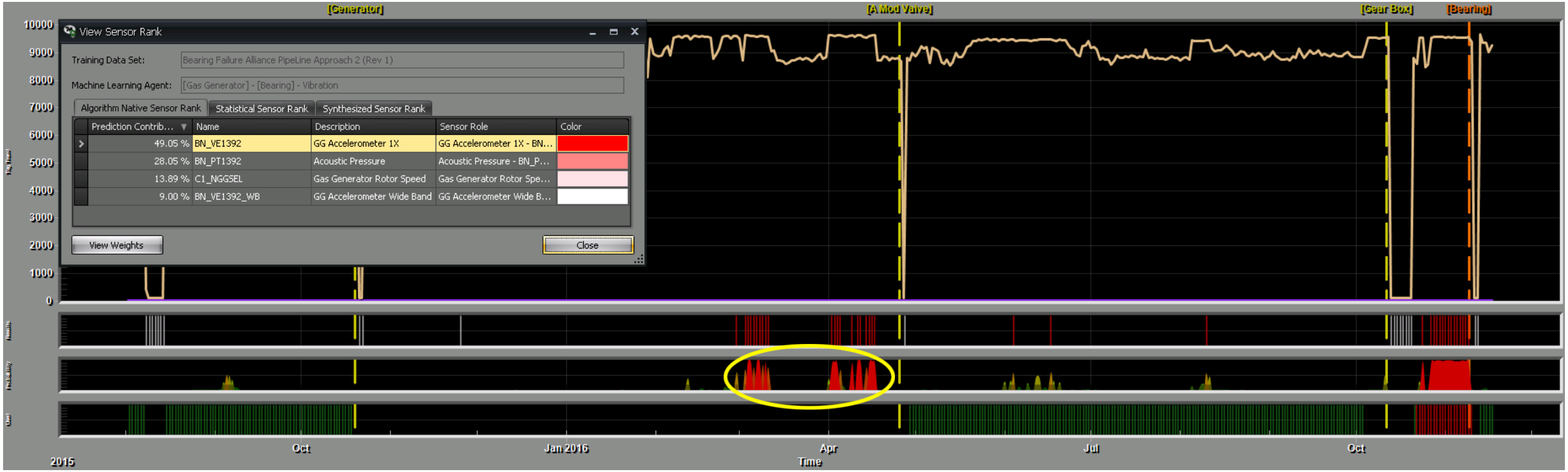
- With the updated “normal” run-time declared, we see more fault pattern areas
  - Only a few times does the fault pattern raise above 50% probability of a break down
  - Further analysis into the individual sensors is needed

What Data Matters



- No great predictors
- To many reactionary sensors
- Help eliminate downstream data

Refined Sensor Groups



- Using a smaller sensor group and focusing in on vibration tags, we see higher probability of failure
  - It is however troubling to see the signatures disappear until just before the failure

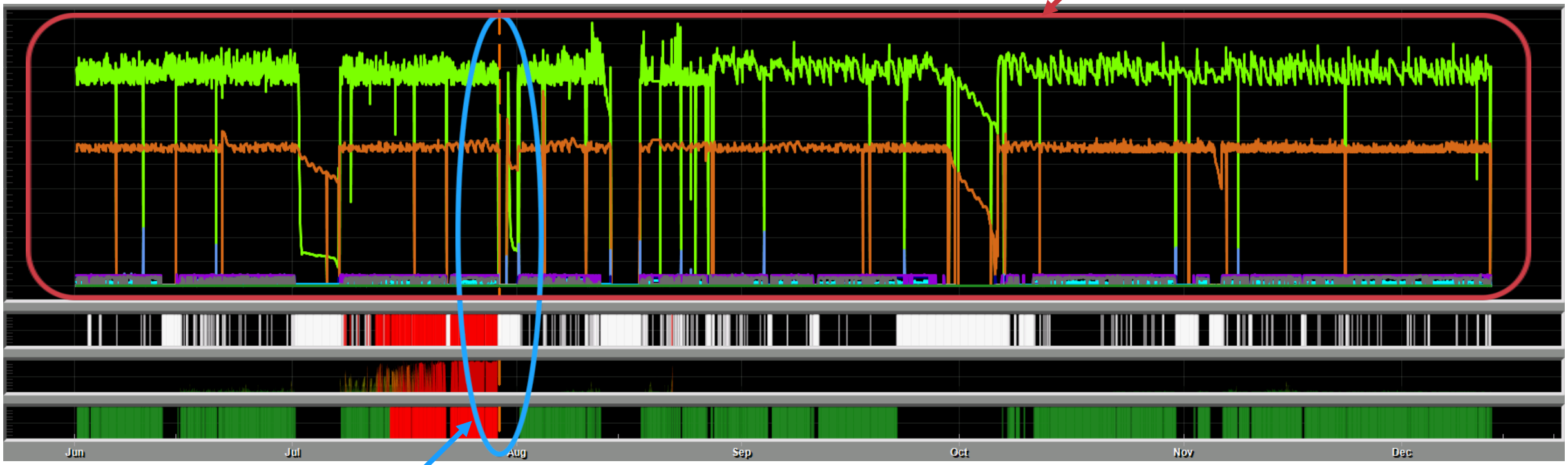
Example: Replace a Major Component

Application: Significant Rotational Asset critical to industrial process

Situation: Rotational core needs to be replaced from time to time based on operational wear. The need is to maximize the operational life of the core while preventing unplanned downtime due to failure

“Wear” Pattern found

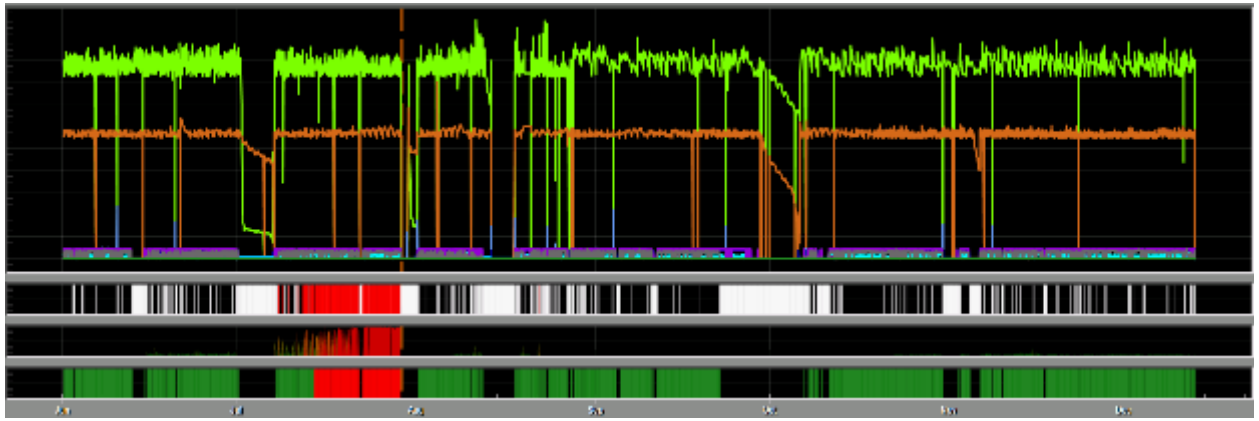
Data for 20 parameters over 7 months of operation



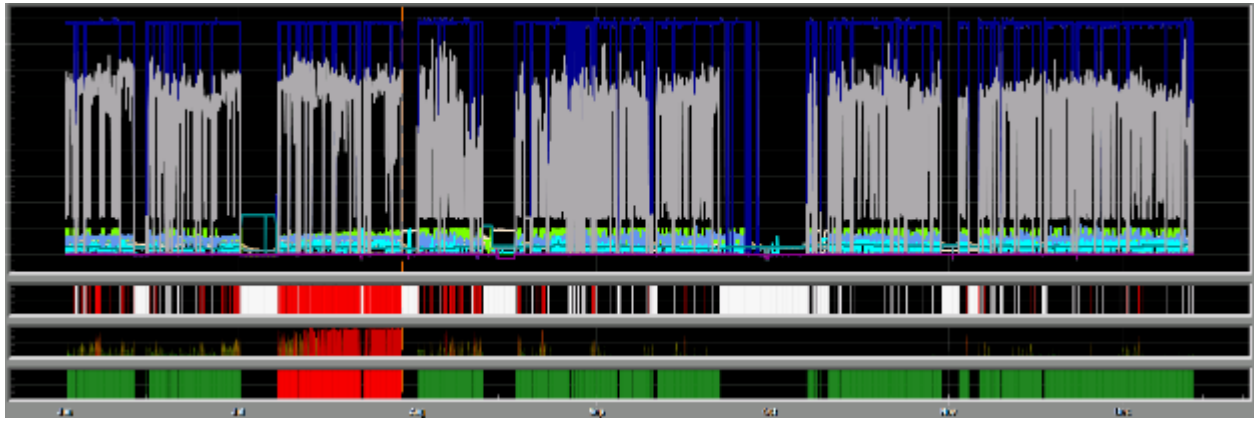
Core is replaced

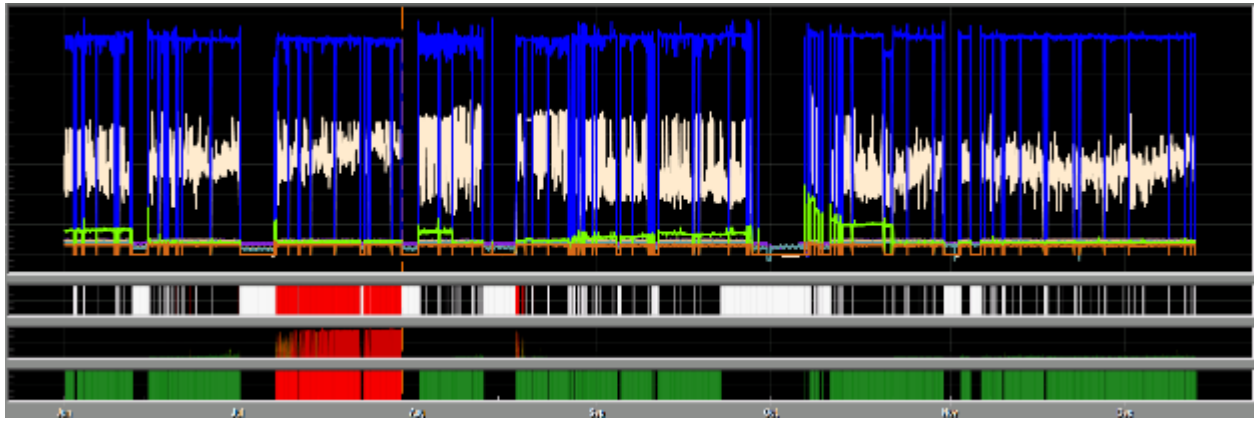
Refining the Prediction

All Sensors

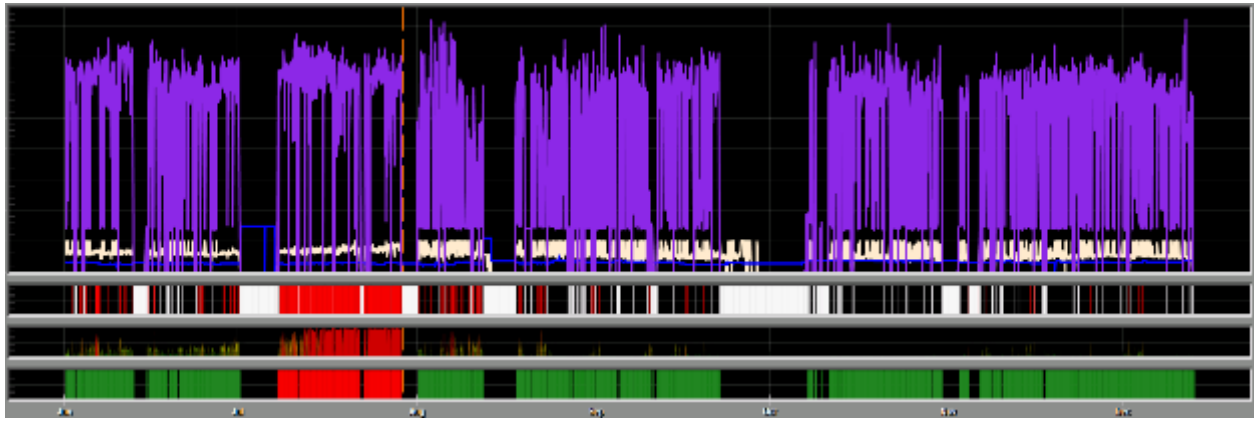


All Wear Sensors





Lubrication Sensors

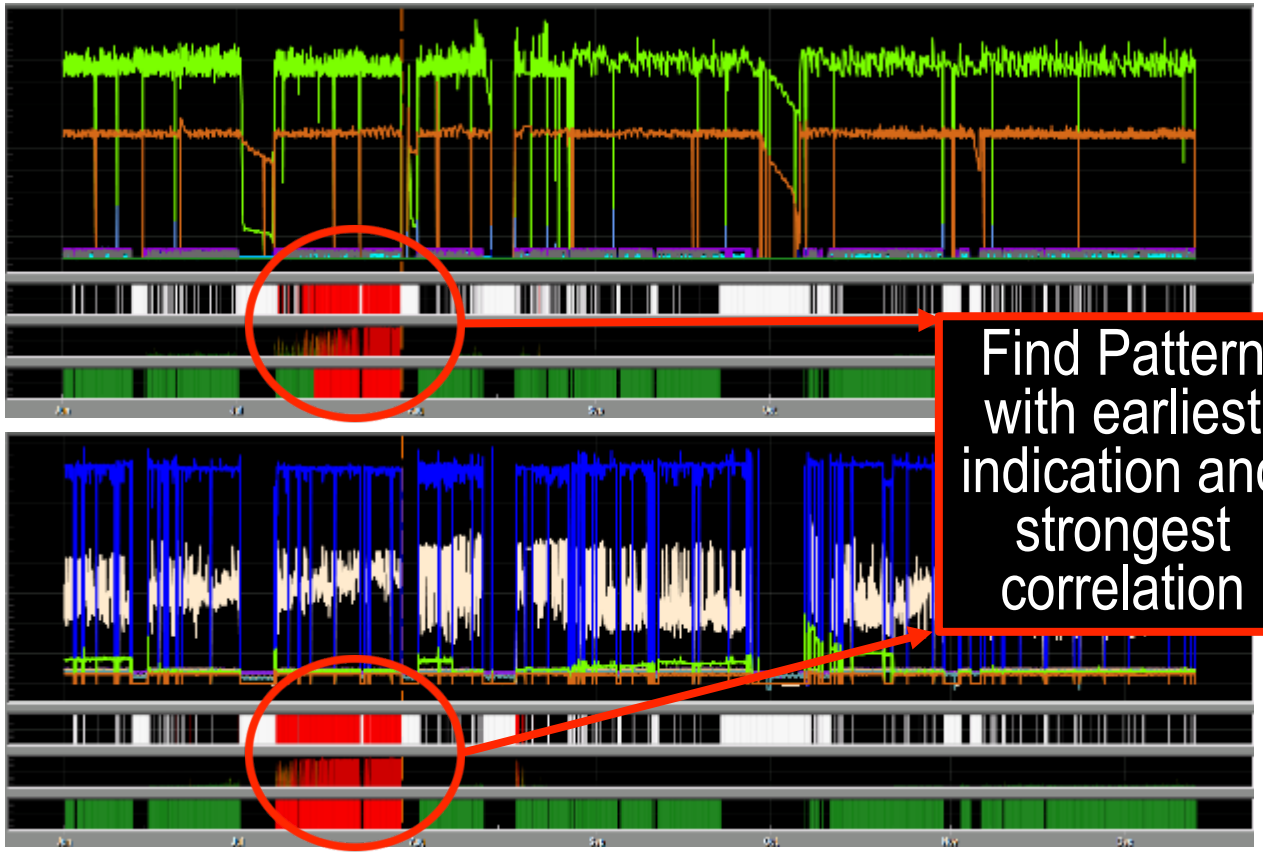


Critical Wear Sensors (3 total)

Refining the Prediction

All Sensors

All Wear Sensors



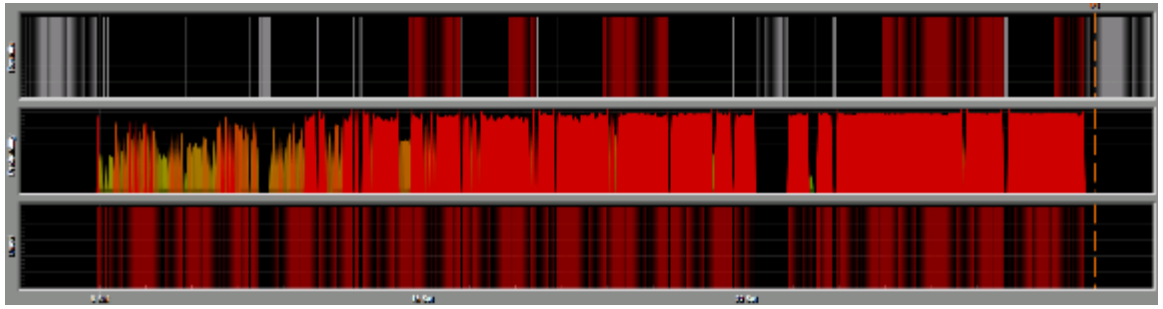
Find Pattern with earliest indication and strongest correlation

Lubrication Sensors

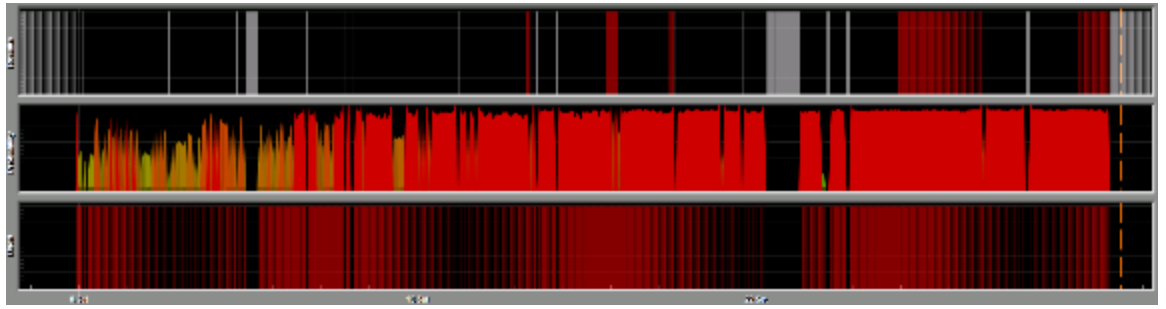
Critical Wear Sensors (3 total)

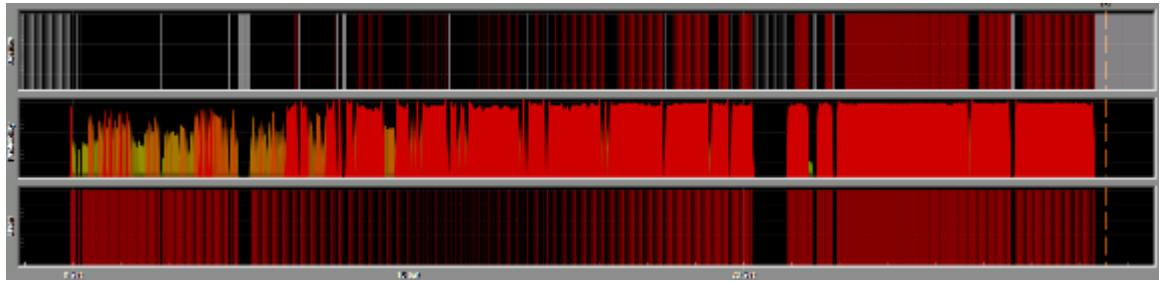
Optimizing Alerts

50% probability continuously for 24 hrs



85% probability continuously for 24 hrs





85% probability continuously for 4 hrs

Managing Alerts

Alert Triggered

Notification of alert is sent to primary customer contact and RA Support Team

Analysis and Reporting

RA Engineer investigates alert and provides context to customer

Customer Intervention

If a known event, customer intervenes as appropriate. If unknown, investigates and determines if an issue

Closing the Loop

RA Engineer closes alert based on customer feedback and retrains the system as appropriate

Alert Fired & Acknowledged

Alert Triggered in Agent

Alert Sent to RA Engineer & Customer

RA Engineer Acknowledges Alert in Application

Alert Medium (email/SMS) and Customer Contact Specified in SOW

Machine Learning Alert Detected

Agent Name: [redacted] Anomaly Detector - DHLV
Alert Severity: Medium
Asset: [redacted]
Machine Learning Agent: [redacted] - Anomaly Detector - (10/28/17 - 1/17/18) 2 run signatures - DHLV
Agent Trigger Date: 3/6/2018 1:57:00 AM (Server Time)
Agent Trigger Mode: Current
Work Item ID:
Machine Name: [redacted]
ML Result - Top 10 Sensors:

Tag Rank

Percent	Tag
3.2%	MyEnterprise[redacted]Children.Hydraulic.Hydraulic Valves.Clamping Accumulator Isolation -
3.1%	MyEnterprise[redacted]Children.Lubrication.Lube Tank.Oil Level Not Low Low -
3.1%	MyEnterprise[redacted]Children.Lubrication.Lube

Rockwell Automation Customer

We received an Anomaly Alert on your primary pumping station. The asset is displaying abnormal behavior at the XS6 vibration sensor. Are you seeing anything unusual?

Let me take a look!

Though it hasn't passed our alert threshold, I'm seeing inconsistent pressure readings on the back end. I'll investigate and call you back with more details.

In the meantime, I'll continue to monitor the asset and analyze the anomaly so we can take further action once you have more insight into the issue.

Anomaly Alert

Event Alert

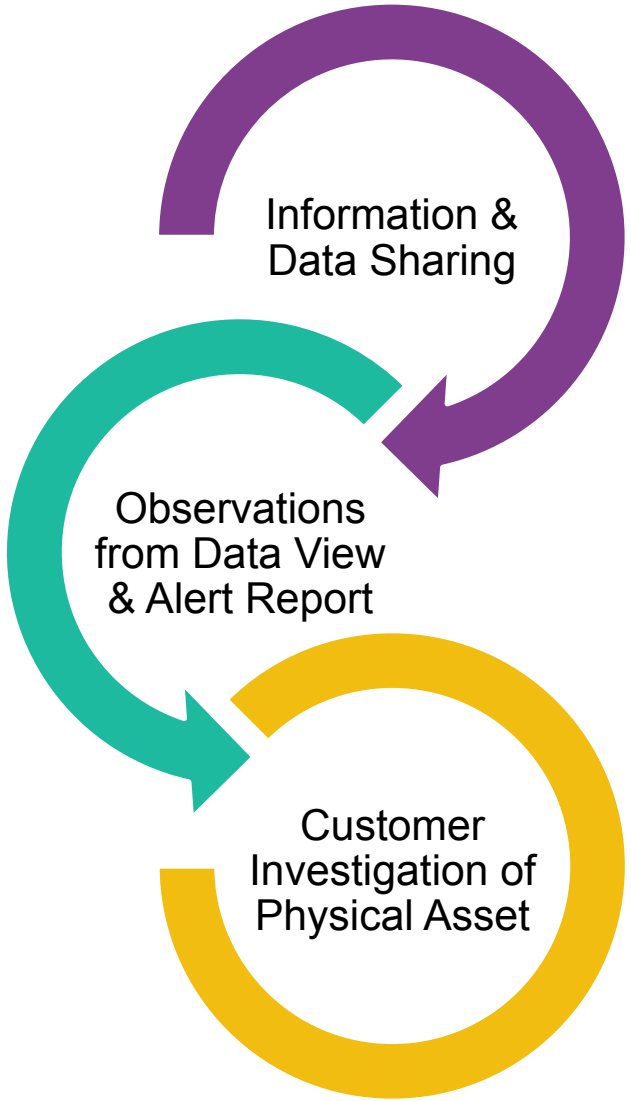
Rockwell Automation Customer

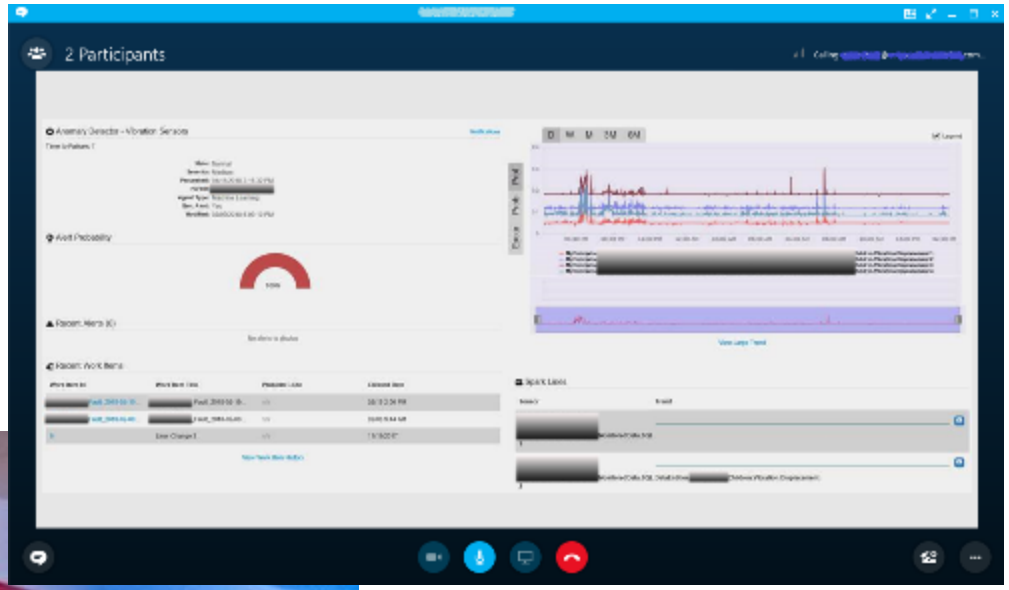
We're receiving an alert on an O-RING FAILURE Agent at your primary pumping station. The XS6 vibration sensor on the compressor is exhibiting behavior associated with a known O-ring failure event. Recommending you replace O-Ring #6 immediately.

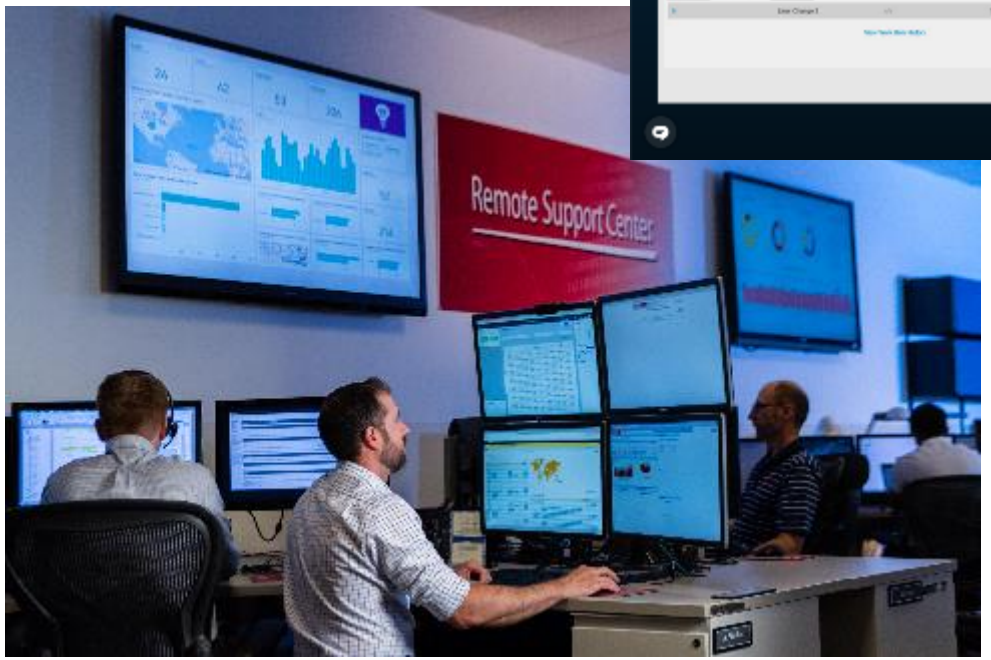
Thank you…though it hasn't passed our alert threshold, I'm seeing inconsistent pressure readings on the back end of the compressor. I'm deploying an engineer to replace the affected component now.

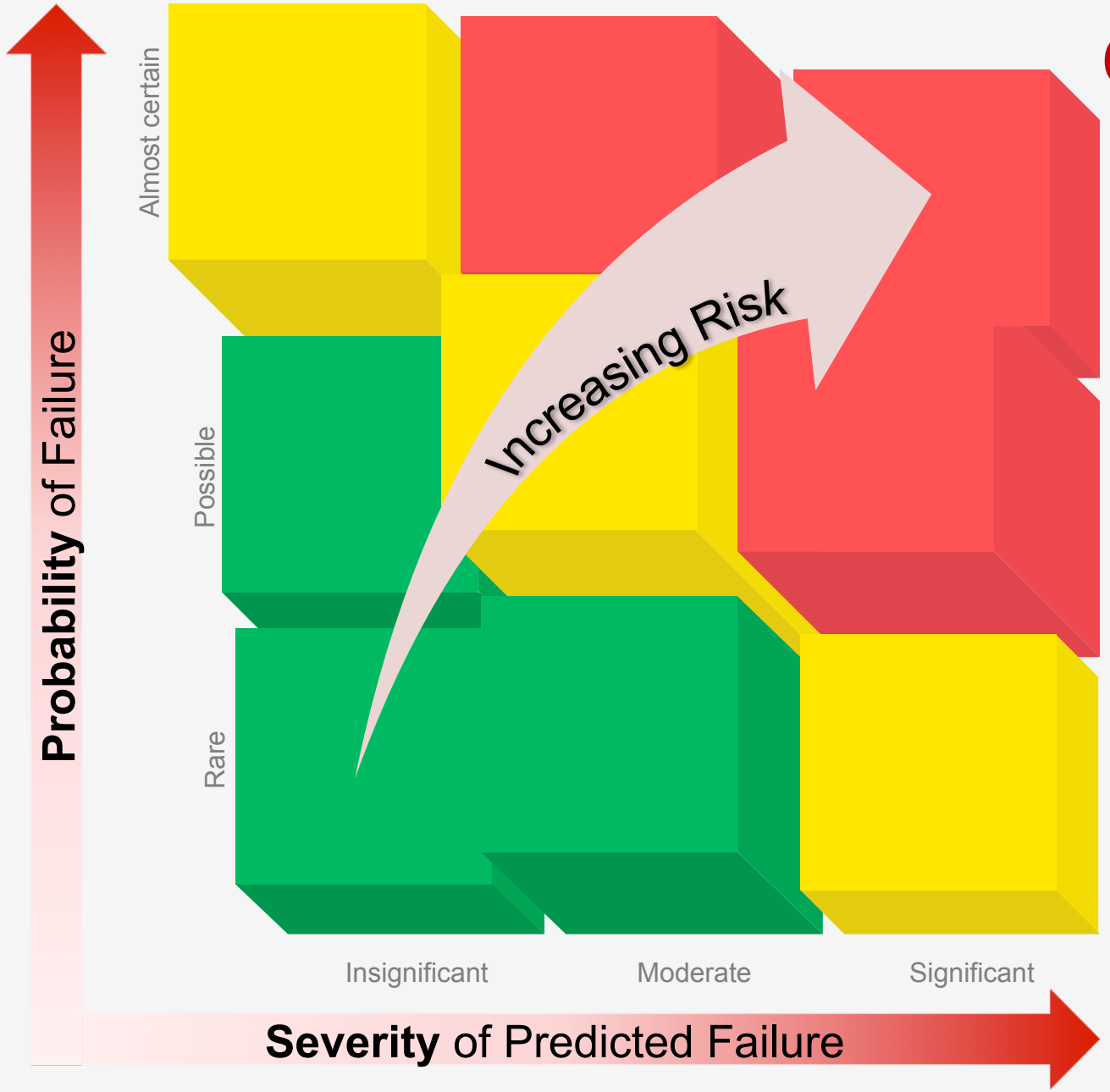
Please let me know what you observe in the system so we can retrain the Failure Agent if necessary. In the meantime, I'll continue to monitor the asset and notify you of any changes.

Information Sharing & Investigation









Customer Response

High Risk Intervene & Mitigate

Stop Machine & Begin Maintenance

Moderate Risk Monitor & Prepare

Allow Machine to Run Until Scheduled Maintenance

- Root Cause Analysis
- Critical Components Replacement
- Spare Parts Orders

Low Risk Monitor & Observe

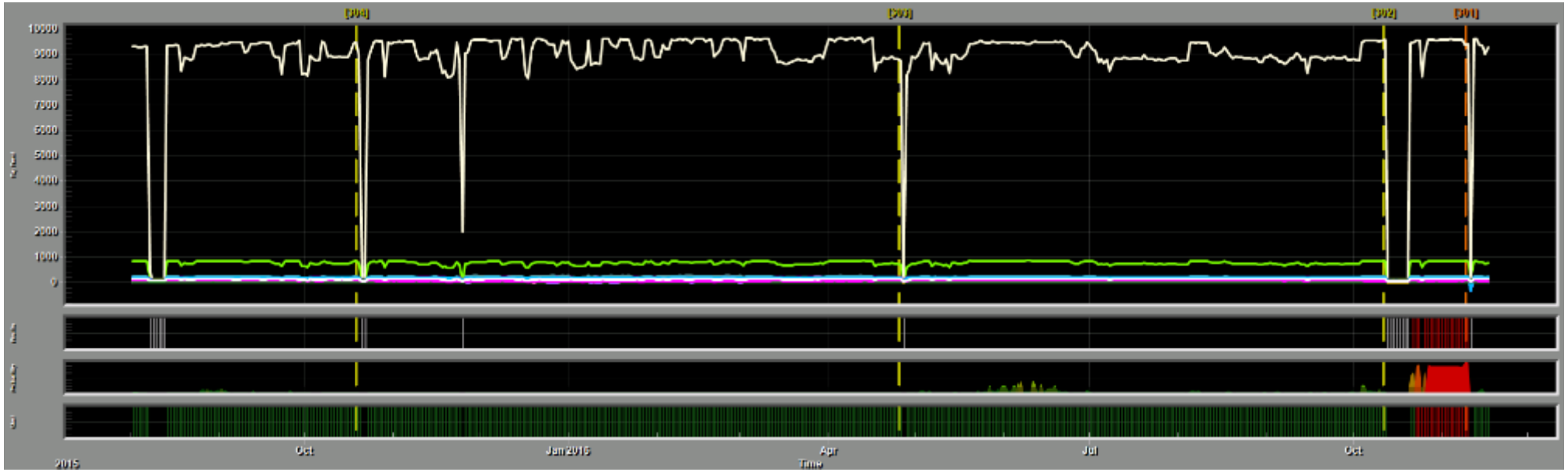
Allow Machine to Run Until Normal Operation Resumes or Failure is Predicted

RA Action for New Faults

Close alert as:

- New Operating State
- New Fault
- Unknown

→ Build New Agents as Needed → Retrain Existing Agents → Deploy a "Best Fit" Agent



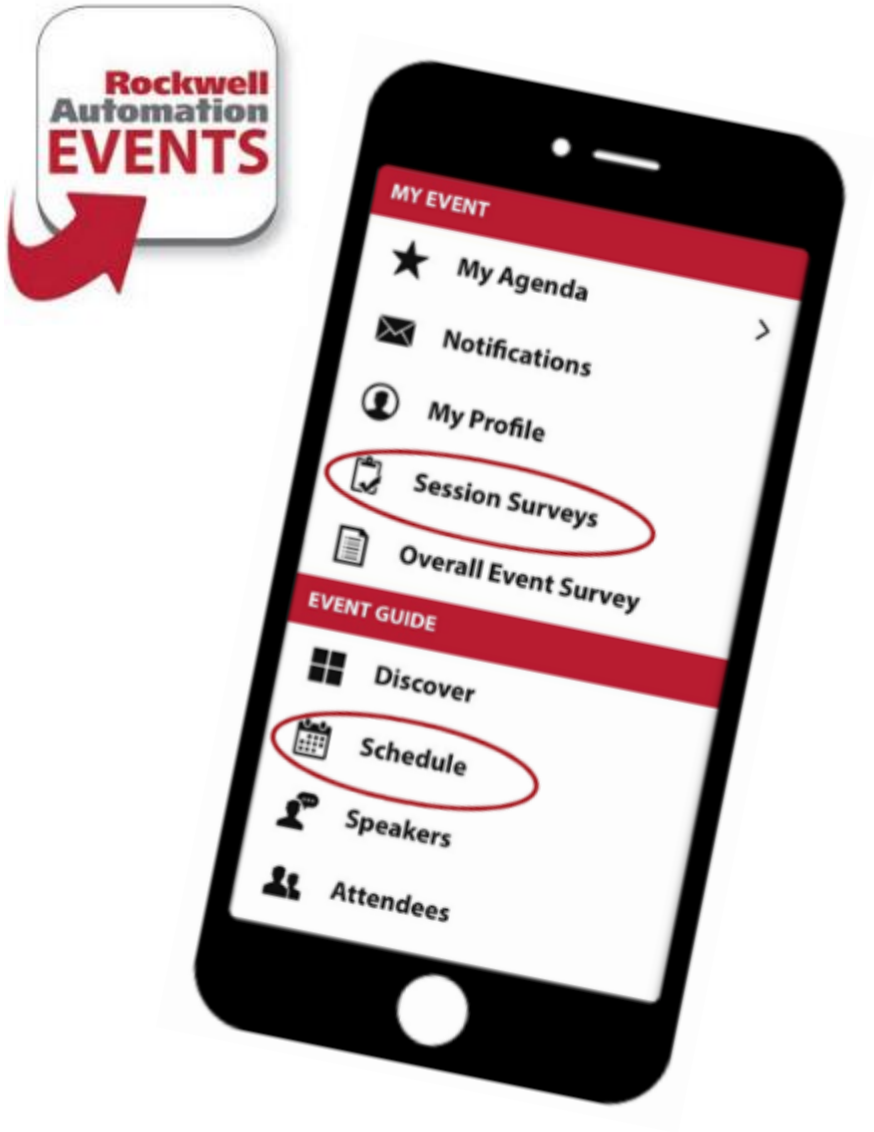
Agent Builder used to build new and retrain existing agents

QUESTIONS AND CONVERSATIONS

Share your Feedback

Please complete a session survey on the mobile app

- Download the **Rockwell Automation Events App**
- Select **Rockwell Automation TechED** and login
- Click on **Session Surveys** or **Schedule** in the main menu
  - Select the session you are attending
  - Click on the survey tab
  - Complete the survey and submit



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Thank You!

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