Realizing APM

Matt Kirchner
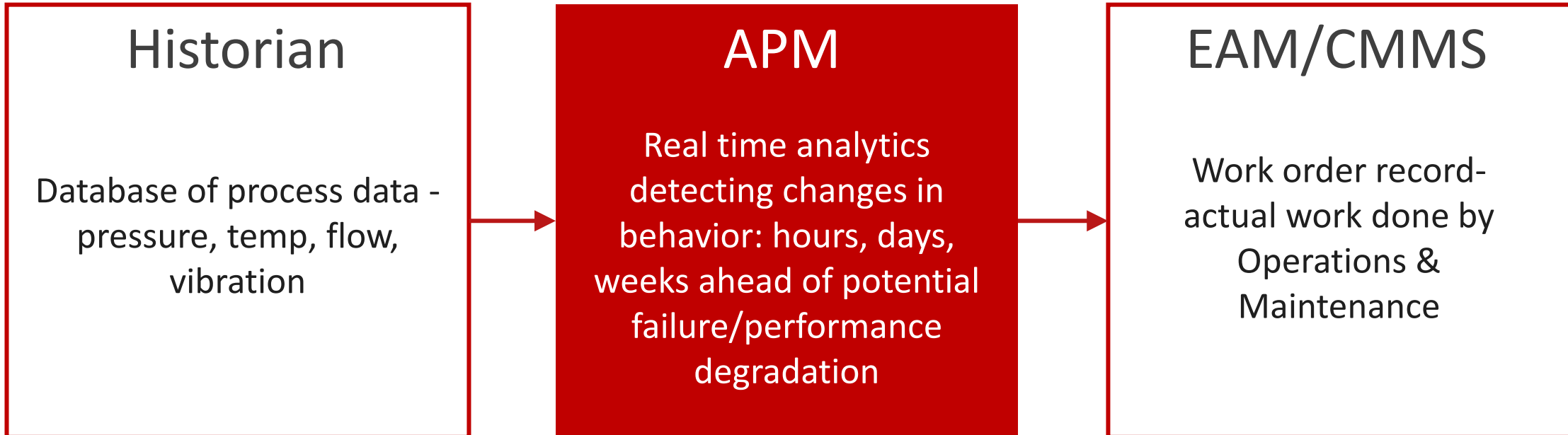
Matt Kirchner
Chief Product Officer, APM
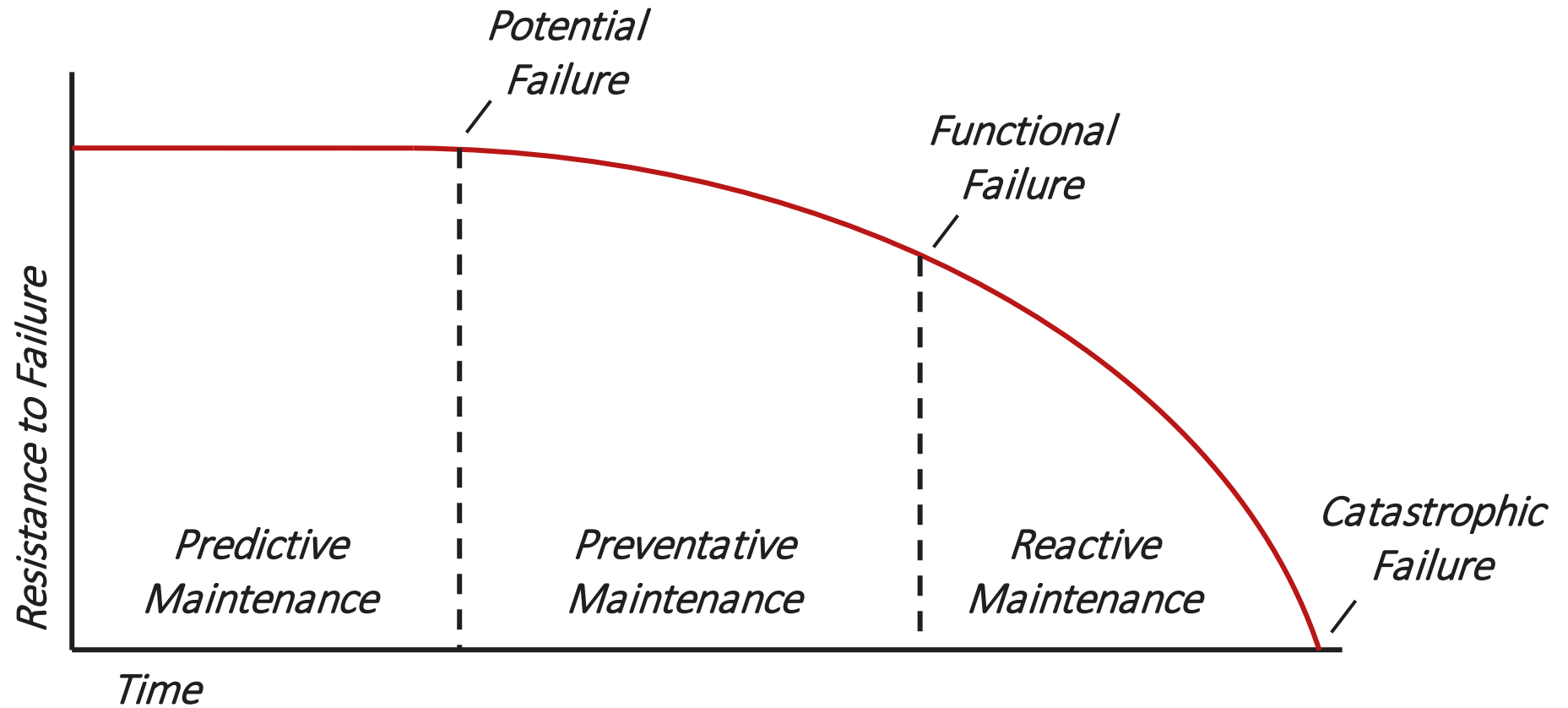
Asset Performance Management Intro

Definition:
APM is the use of data and analytics to improve reliability and efficiency of assets.

Historian	APM	EAM/CMMS
Database of process data - pressure, temp, flow, vibration	Real time analytics detecting changes in behavior: hours, days, weeks ahead of potential failure/performance degradation	Work order record- actual work done by Operations & Maintenance

Asset Performance Management Intro

Industry Challenges

Downtime Is a Headache

$15k
Average hourly cost of paper machine downtime
- International Journal of Engineering, Science, and Technology

$1M
Average daily cost of refinery outages
– Arc Advisory Group

$20B
Estimated annual cost of unplanned downtime in chemical industry
- American Institute of Chemical Engineers

Analytics Can Be Ineffective

40% of companies say it takes more than 1 month to deploy a single Machine Learning model into production
- Algorithmia
40%

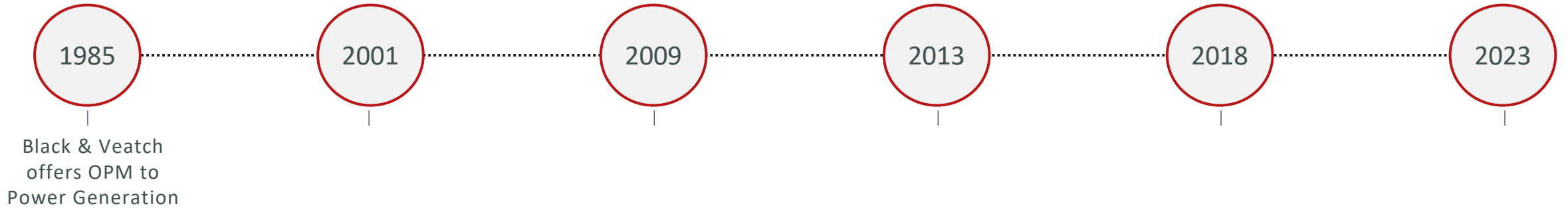71% of companies say they are NOT good at connecting analytics to action
- Forrester
71%

Multiple experts required to deploy and maintain standalone analytics
- Plant Services
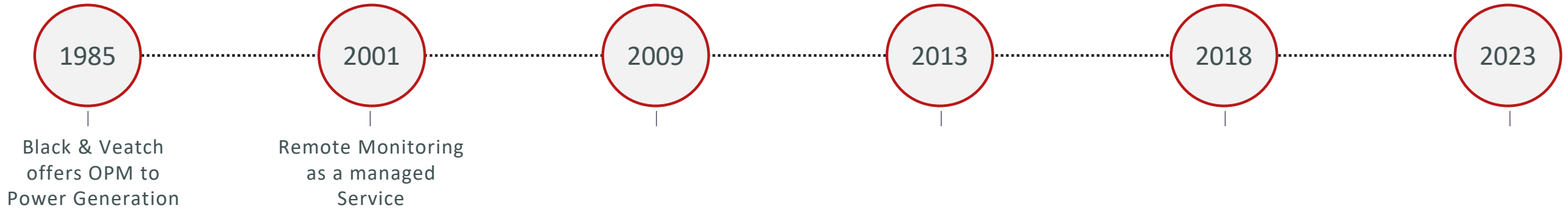**3+**

Prometheus APM History

1985 .... **2001** .... **2009** .... **2013** .... **2018** **2023**

Black & Veatch offers OPM to Power Generation

" I have measured data, but I'd like to understand equipment and process performance "

Prometheus APM History

| 1985 | 2001 | 2009 | 2013 | 2018 | 2023 |

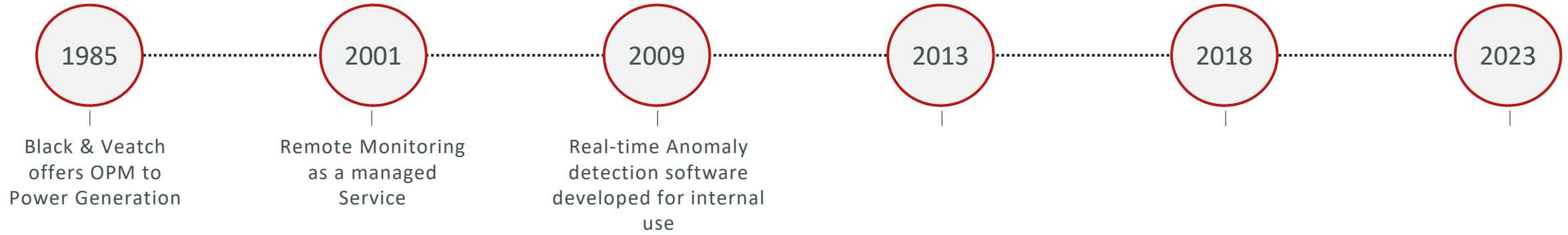**1985** — Black & Veatch offers OPM to Power Generation

2001 — Remote Monitoring as a managed Service

" These trends and dashboards are great, but I don't have time to look at all this data. "

Prometheus APM History

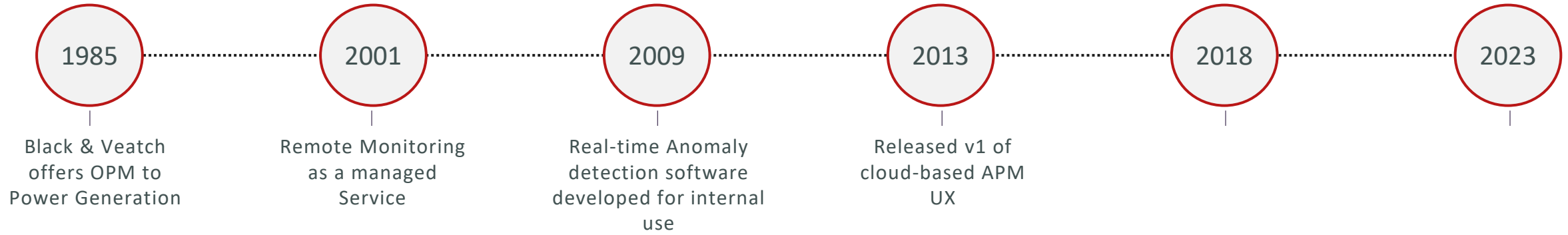**1985** · · · · · · · **2001** · · · · · · · **2009** · · · · · · · **2013** · · · · · · · **2018** · · · · · · · **2023**

Black & Veatch offers OPM to Power Generation

Remote Monitoring as a managed Service

Real-time Anomaly detection software developed for internal use

"
Sometimes issues arise quickly.
"

Prometheus APM History

1985 — Black & Veatch offers OPM to Power Generation

2001 — Remote Monitoring as a managed Service

2009 — Real-time Anomaly detection software developed for internal use

2013 — Released v1 of cloud-based APM UX

2018

2023

"That monitoring tool is pretty cool! Can we have access to it too?"

Prometheus APM History

1985	2001	2009	2013	2018	2023
Black & Veatch offers OPM to Power Generation	Remote Monitoring as a managed Service	Real-time Anomaly detection software developed for internal use	Released v1 of cloud-based APM UX	Launched Atonix Digital	

"
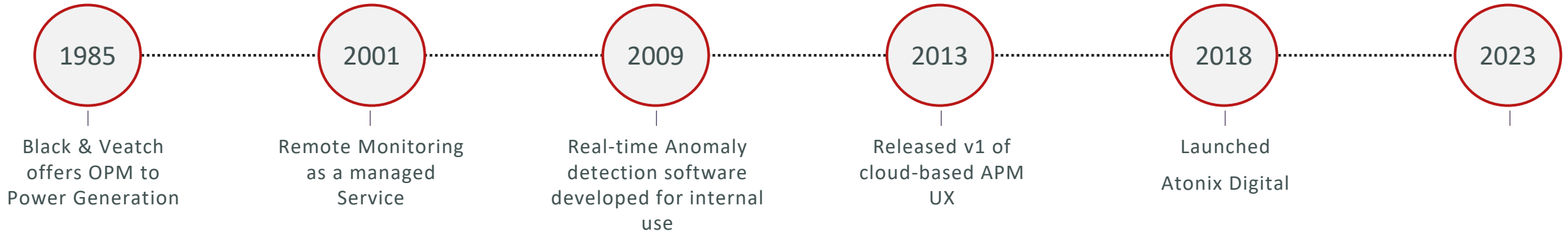
We'd like to user our in-house experts to monitor our plants.

"

Prometheus APM History

1985 — Black & Veatch offers OPM to Power Generation

2001 — Remote Monitoring as a managed Service

2009 — Real-time Anomaly detection software developed for internal use

2013 — Released v1 of cloud-based APM UX

2018 — Launched Atonix Digital

2023 — Prometheus Group Acquires Atonix Digital and introduces Prometheus APM
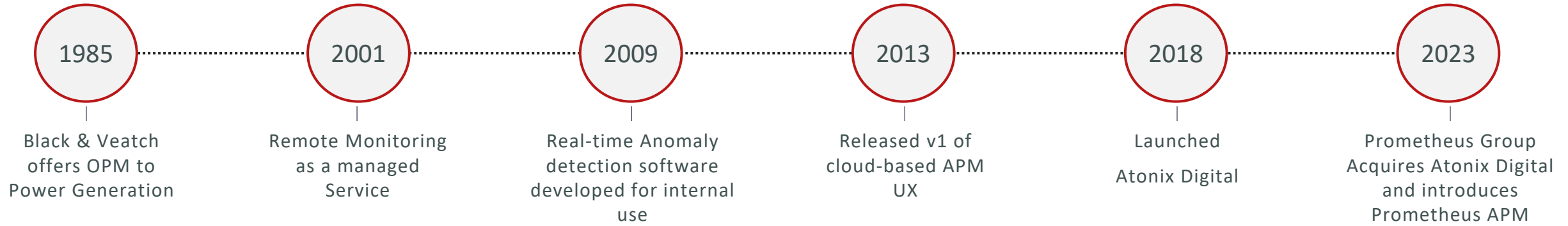
"
We'd like this system to have a closer connection to our EAM/CMMS.
"

Prometheus APM History

1985 — Black & Veatch offers OPM to Power Generation

2001 — Remote Monitoring as a managed Service

2009 — Real-time Anomaly detection software developed for internal use

2013 — Released v1 of cloud-based APM UX

2018 — Launched Atonix Digital

2023 — Prometheus Group Acquires Atonix Digital and introduces Prometheus APM
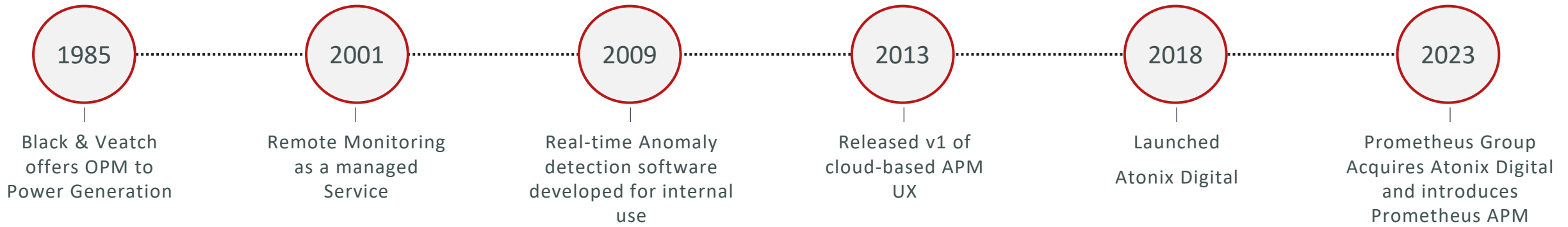
30+
Years of Product Development & Evolution

100's
Of Industry Experts Involved in Creating Platform

1000's
Of Machine Learning Model Templates

Decades of iteration leading to software that drives a highly-refined plant monitoring process

Realizing APM - Prometheus Approach

Realizing APM

1. Use Asset Experts for modeling and evaluation

Role	Skills	Effective Use
Asset Expert	• Experts at asset/process failures and causes • Understand Process Data Relationships • Desire full plant coverage	*Empower with tools that make analytics easy*
Data Scientist	• Experts at Data and Mathematics • Limited Expertise of assets & process • Build Great Individual Models	*Focus on the new & complicated problems*

1. Use Asset Experts for Modeling and Evaluation

2. Templatize and Automate

Modeling Process	Identify the Problem	Collect the Data	Clean the Data	Select the Features	Select the Model Type	Deploy and Alert
Traditional Approach	Only critical assets and critical failure modes	Op expert determines inputs	Visual inspection of long-term trends	Correlation matrices and scatter plots	Experiment	Manually determine sensitivity
Automated Approach	Library of Failure Modes for all assets and systems	Templates select appropriate inputs	Use Rules to Clean the Data	Correlation scoring of all combinations of inputs	Scoring algorithm to determine best math type	Relative Alerting Logic with multiple time horizons

Project Start to full site analytics coverage in 1 month!

2. Templatize and Automate

Project Start to full site analytics coverage in 1 month!

2. Templatize and Automate

3. Focus on the Process, Not Just the Analytics

Detect.

Diagnose.

Resolve.

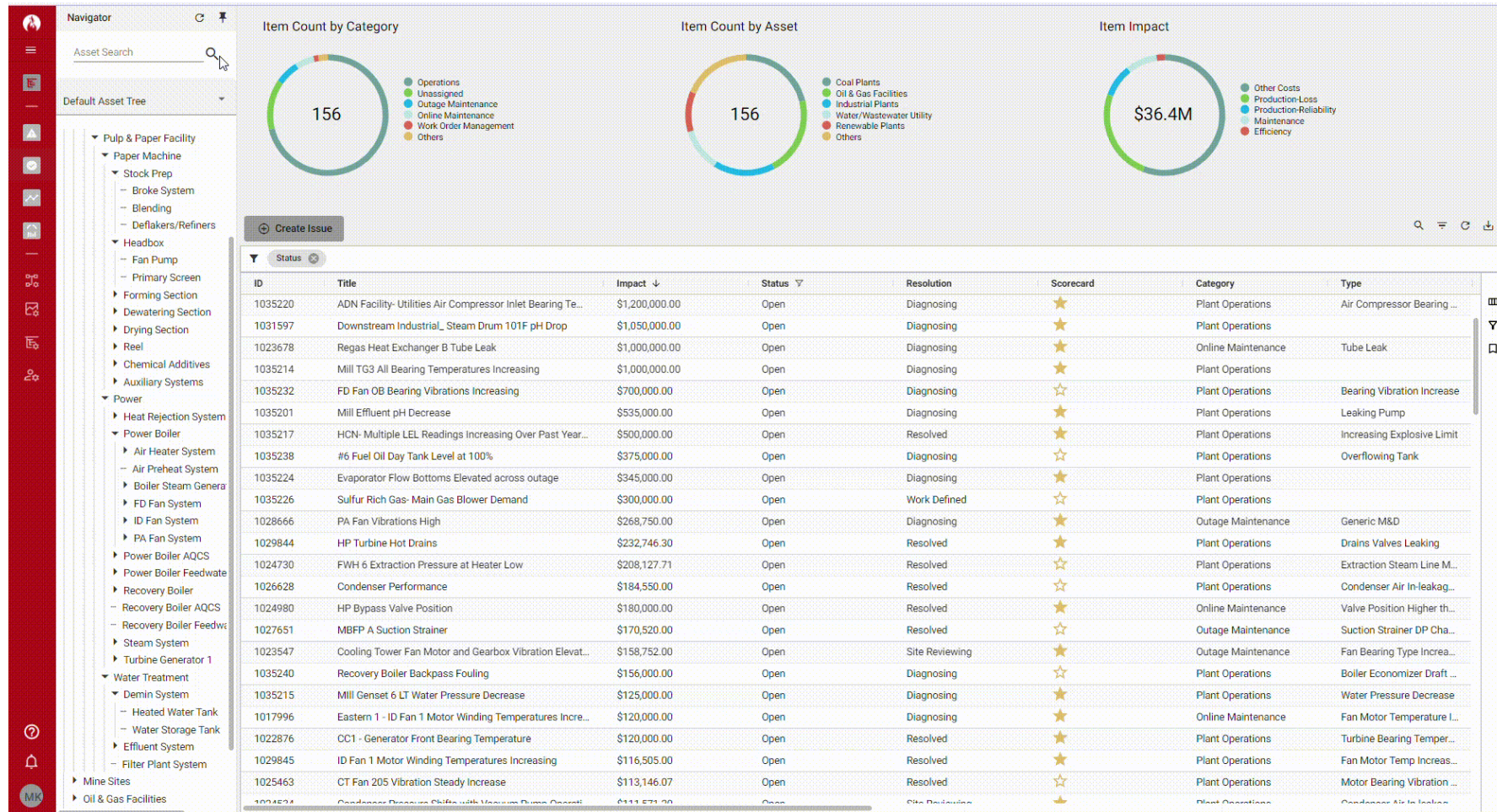100,000s of Measured Data Points

10-20 Actionable Issues
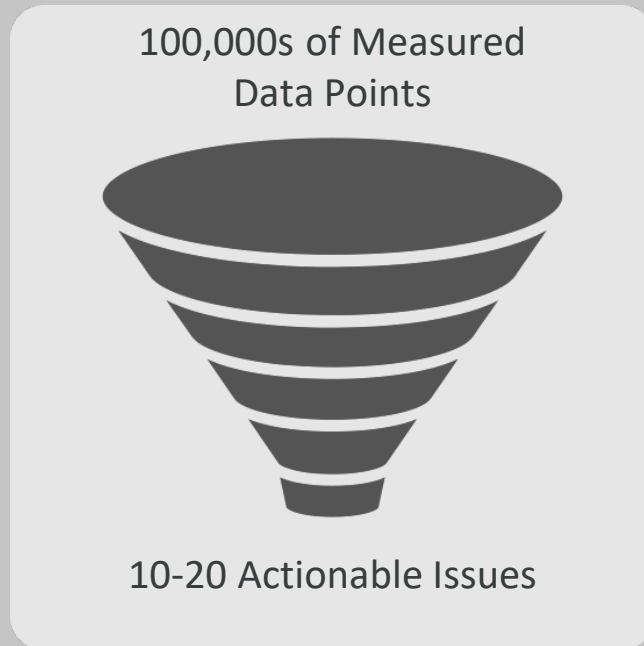
- Most companies are thinking of APM as an analytics problem
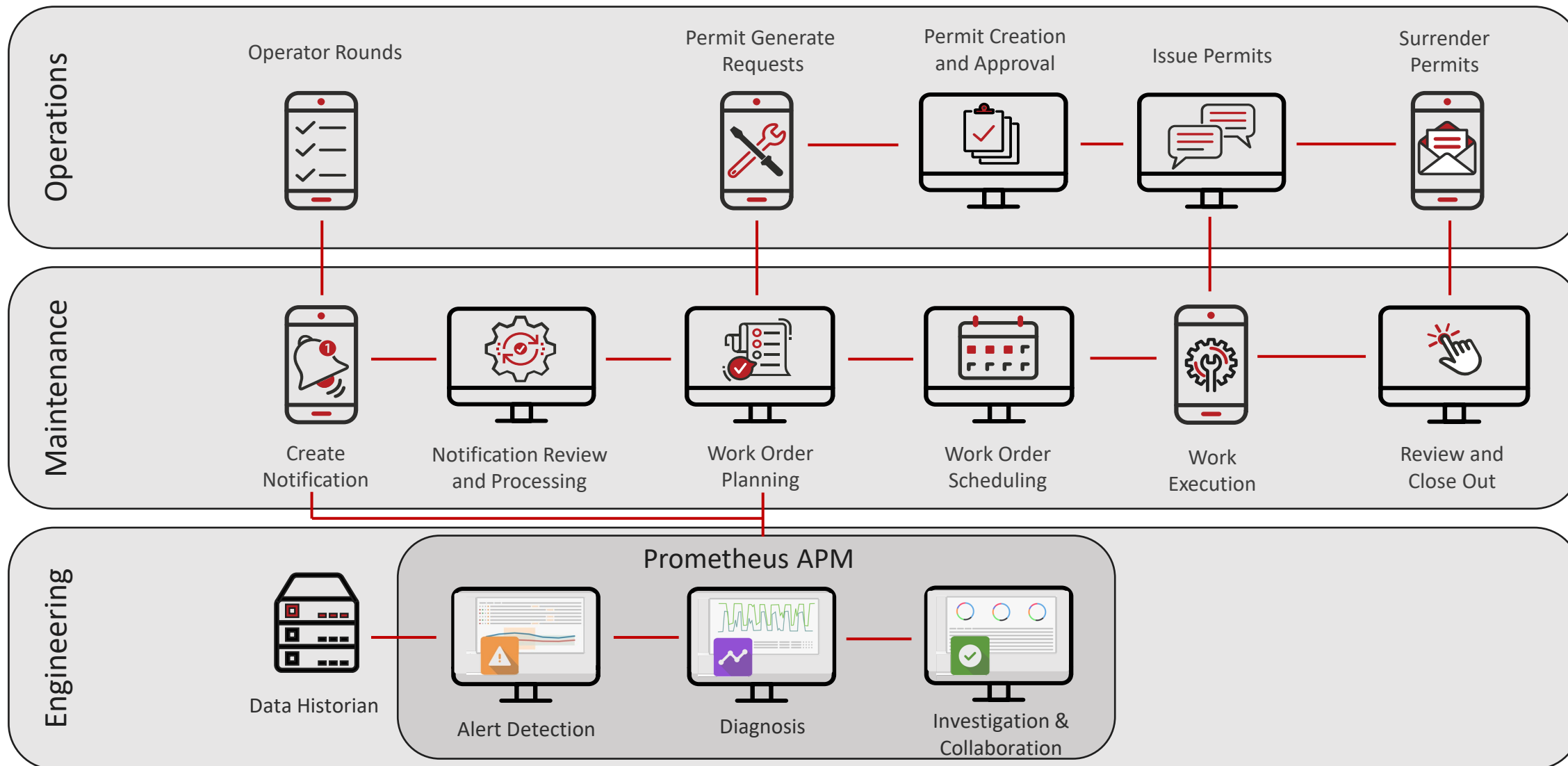- Prometheus APM drives a complete process that ensures analytics lead to action.

Analytics only provide value if they lead to action.

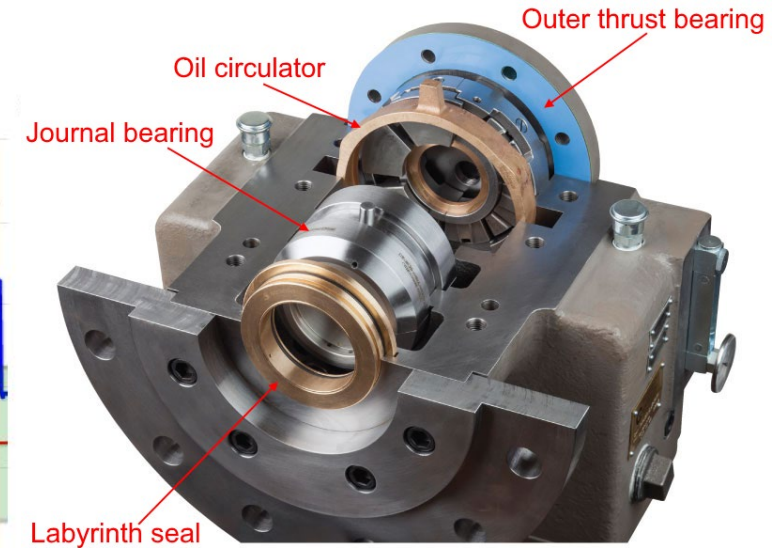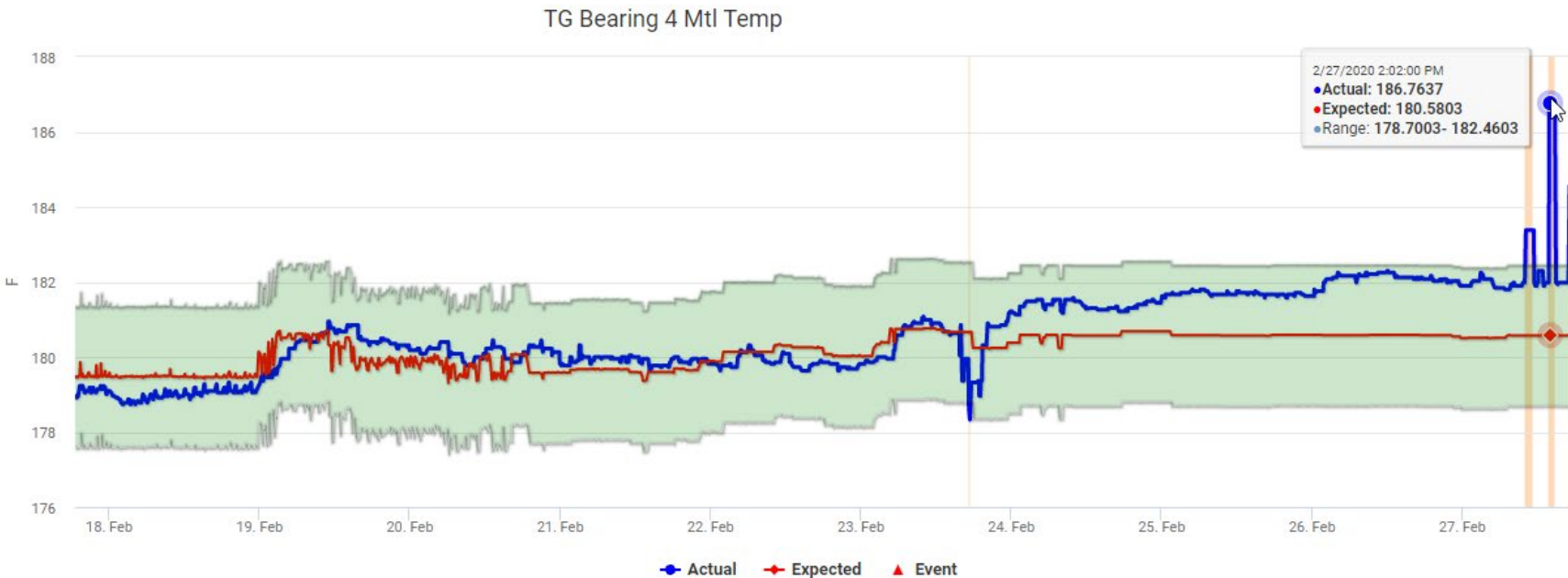# 3. Focus on the Process, Not Just the Analytics

PG + APM = Fastest, Most Complete Solution

Operations

- Operator Rounds
- Permit Generate Requests
- Permit Creation and Approval
- Issue Permits
- Surrender Permits

Maintenance

- Create Notification
- Notification Review and Processing
- Work Order Planning
- Work Order Scheduling
- Work Execution
- Review and Close Out

Engineering

- Data Historian

Prometheus APM

- Alert Detection
- Diagnosis
- Investigation & Collaboration

21

Examples

Turbine Bearing

TG Bearing 4 Mtl Temp

2/27/2020 2:02:00 PM
- Actual: 186.7637
- Expected: 180.5803
- Range: 178.7003- 182.4603

Legend: Actual — Expected — Event

Diagram labels: Outer thrust bearing, Oil circulator, Journal bearing, Labyrinth seal

- **Detect** - Power Turbine Bearing #4 Metal Temperature spiked up from historically steady 180 degF to 186 degF. High frequency data revealed 1min spikes to > 2,000 degF.

- **Diagnose** - Built in diagnostics trends showed that 1) All other bearing metal temperatures were steady 2) All bearing vibrations remained steady with no change 3) Lube oil conditions were steady and 4) Loading on the equipment was not abnormal.

- **Resolve** - Operations took opportunity of existing upcoming weekend outage to pop the bearing cap and inspect locally. It was determined that a coolant oil system was leaking into the lubrication oil, causing varnish on the #4 bearing - resulting in the increased bearing temps.

- **Plant quantified the cost avoidance at > $2,000,000 due to what would have been a future forced outage avoided!**

Cooling Tower Fan
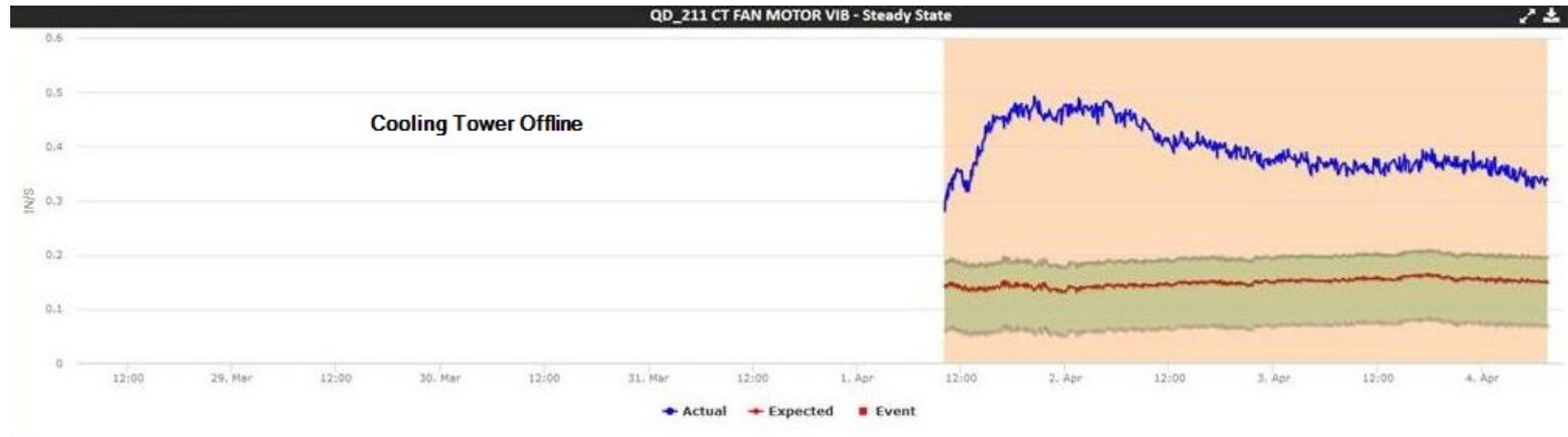
- **Detect** - Upon startup, Cooling Tower motor vibration 2-3X higher than expected.

- **Diagnose** - User guided context to determine motor & gearbox vibration high. Both were highest vibrations over past year. Additional context determined Cooling Tower vibration was higher than the other 15 cooling towers on site (same instrumentation).

- **Resolve**

  - Local inspection validated vibrations were high. Operations took 'slow motion' video of CT shaft, noting severe vibration.

  - High vibrations below DCS alarm limits, noticed by Plant Operations, and Plant was going into planned outage - would have not done maintenance - and indicated this fan would have torn apart - **$150k impact.**
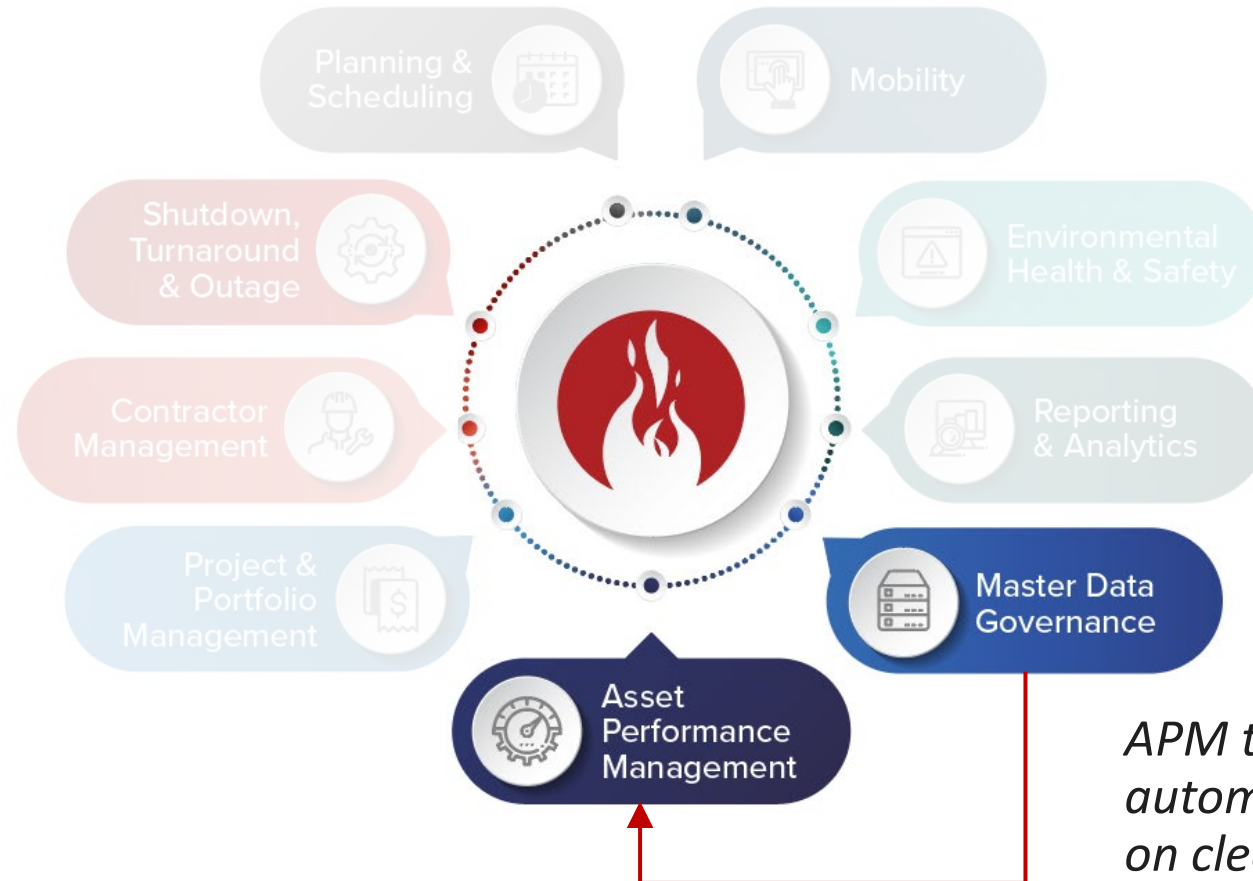
The Roadmap

Development Initiatives

Prometheus Platform Integrations

APM generates maintenance projects that need to be scheduled and executed, many of which need to happen at the next planned downtime
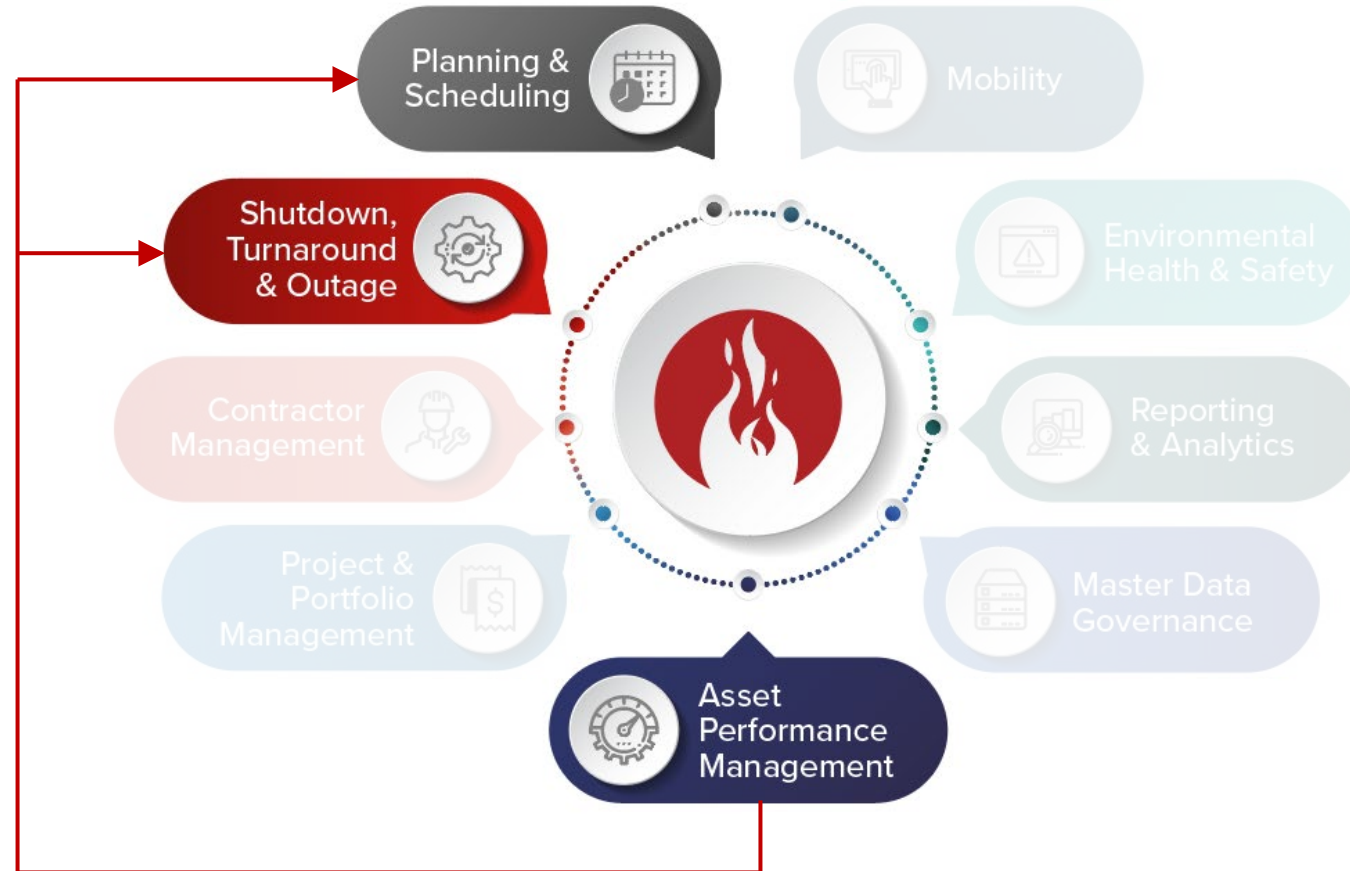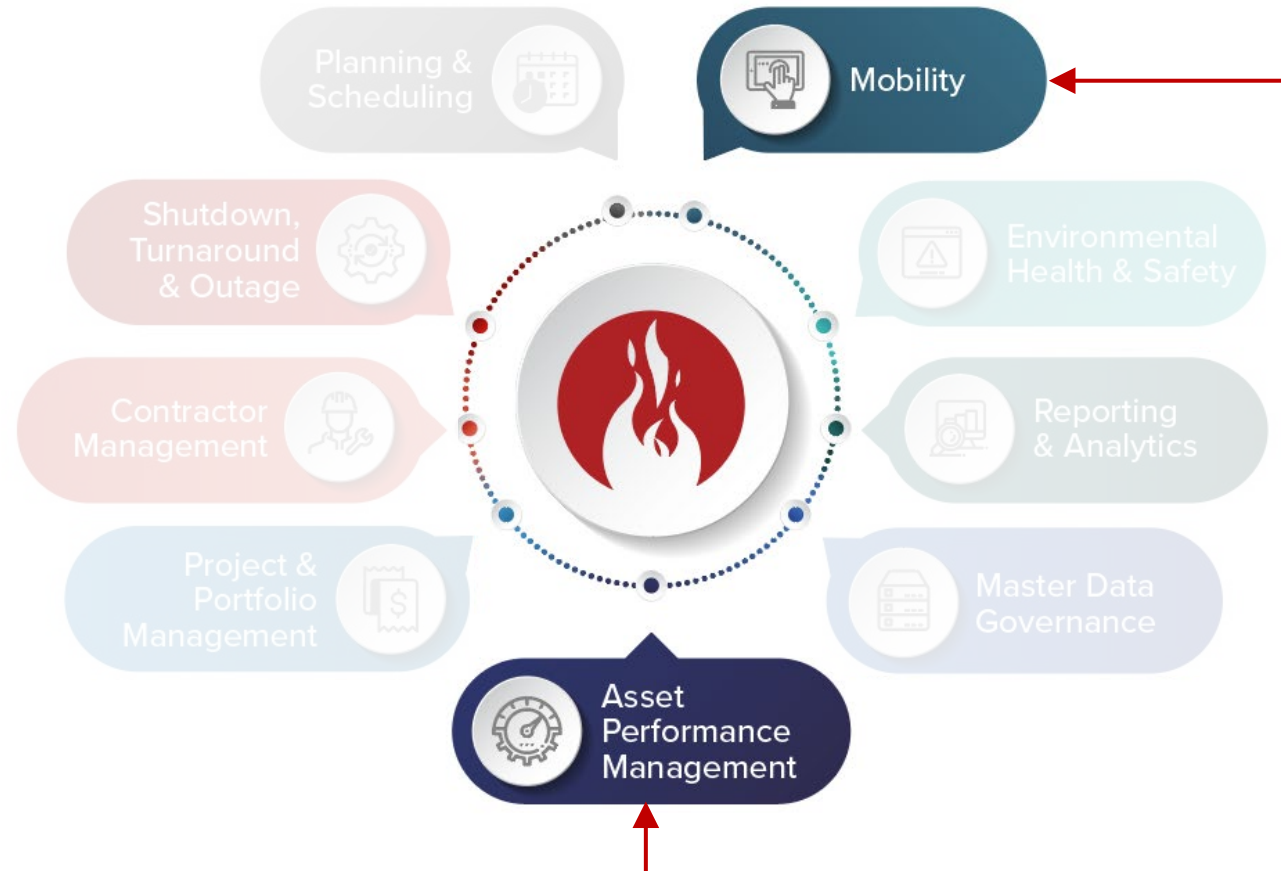
Development Initiatives

Prometheus Platform Integrations

APM templates and automation are based on clean master data
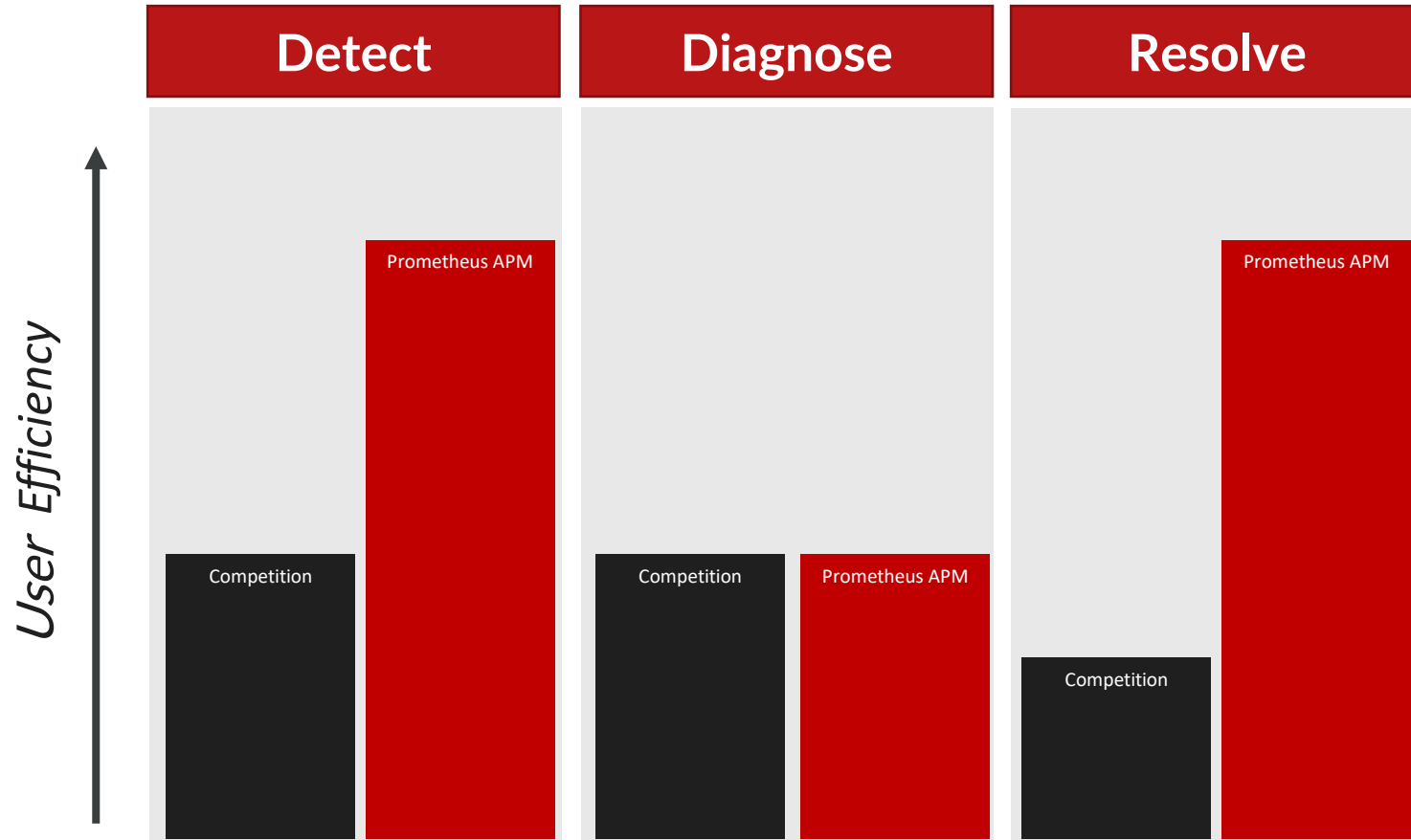
Development Initiatives

Prometheus Platform Integrations

The diagnosis and resolution of issues requires field investigation

Development Initiatives

Custom Predictive Analytics

Prometheus APM is the fastest APM solution to implement, but there is still room for new and innovative modeling tactics.

Proven Returns

75,000	$1B	500
Customer Issues Detected	**Probability-weighted Savings**	**Plants Monitored**

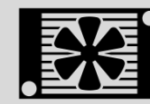|		
$2M Turbine Flow Restriction	$750K Fan Failure	$185K Heat Exchanger Efficiency
$150K Cooling Tower Failure	$100K Aeration Blower Failure	Safety Chemical Explosion

Questions?

PROMETHEUS GROUP | USER CONFERENCE

35

Thank you