AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

AIM313-R2

Implement predictive maintenance for industrial equipment

Brant Swidler
Sr. Technical Product Manager AWS

Alicia Trent
Sr. Specialist, AWS AI

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Agenda

- AWS Industrial
- Problem statement
- Amazon Lookout for Equipment
- Demo – Amazon Lookout for Equipment
- How to scale to thousands of assets
- Demo - Through the eyes of a process engineer
- Q&A - White boarding discussion

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Key customer needs across common industrial workloads

aws industrial



Engineering and design



Production and asset optimization



Smart products and machines



Worker safety and productivity



Supply chain management



Quality management

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

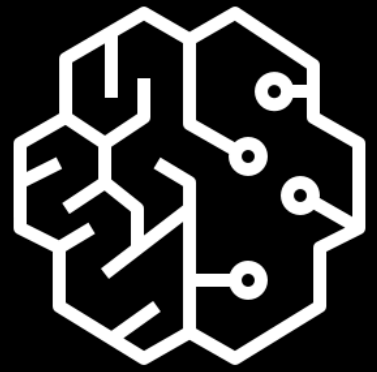
Predictive maintenance service options



Amazon Monitron



Amazon Lookout for Equipment



Amazon SageMaker

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

The problem statement

The situation

- You are the head of operations/engineering and are tasked with improving productivity costs
- You have lots of sensor data and now want to progress to condition based maintenance
- You have hundreds or thousands of pieces of equipment that need to be monitored

Constraints and requirements:

- Your team has minimal bandwidth to give any support for custom development
- You already have existing systems that your team is familiar with
- You need an accurate solution that works with your existing equipment/process conditions
- You need a solution that will scale in a repeatable and sustainable way across hundreds of asset types and thousands of machines

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

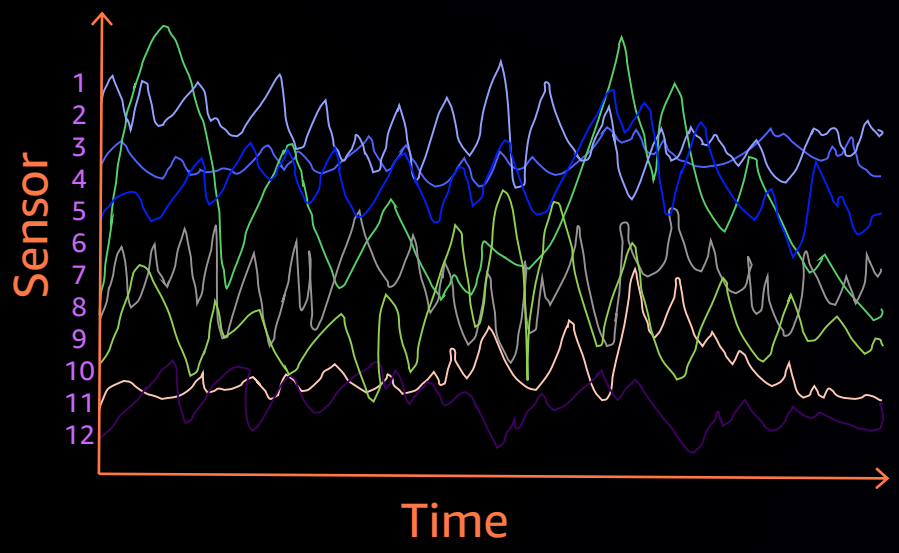
Amazon Lookout for Equipment

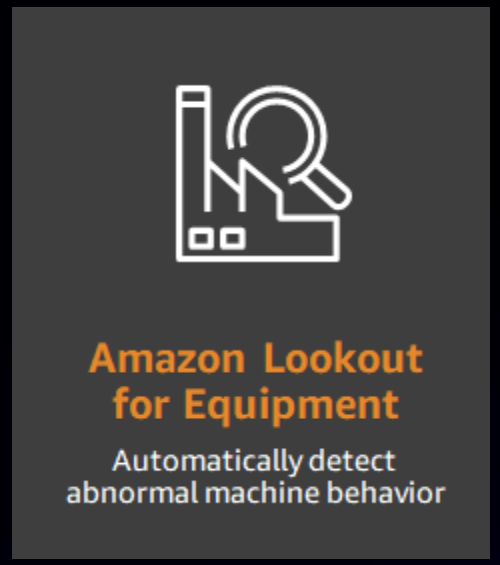
- Back-end analytics service
- Automated ML for multivariate time series anomaly detection problem

Take in up to 300 sensors on an asset

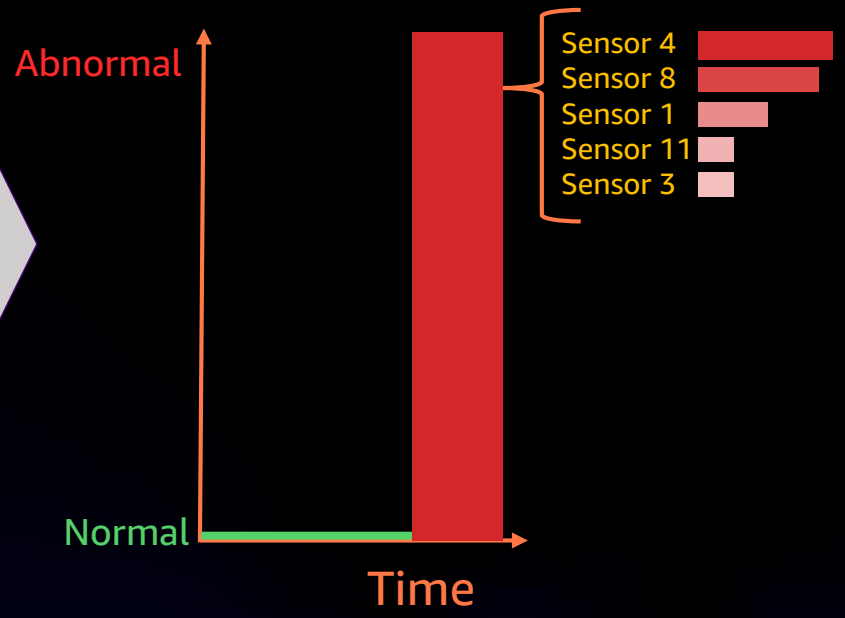
Trains, builds, and deploys an asset-specific model

Data comes out structured for actionable and relevant alerts





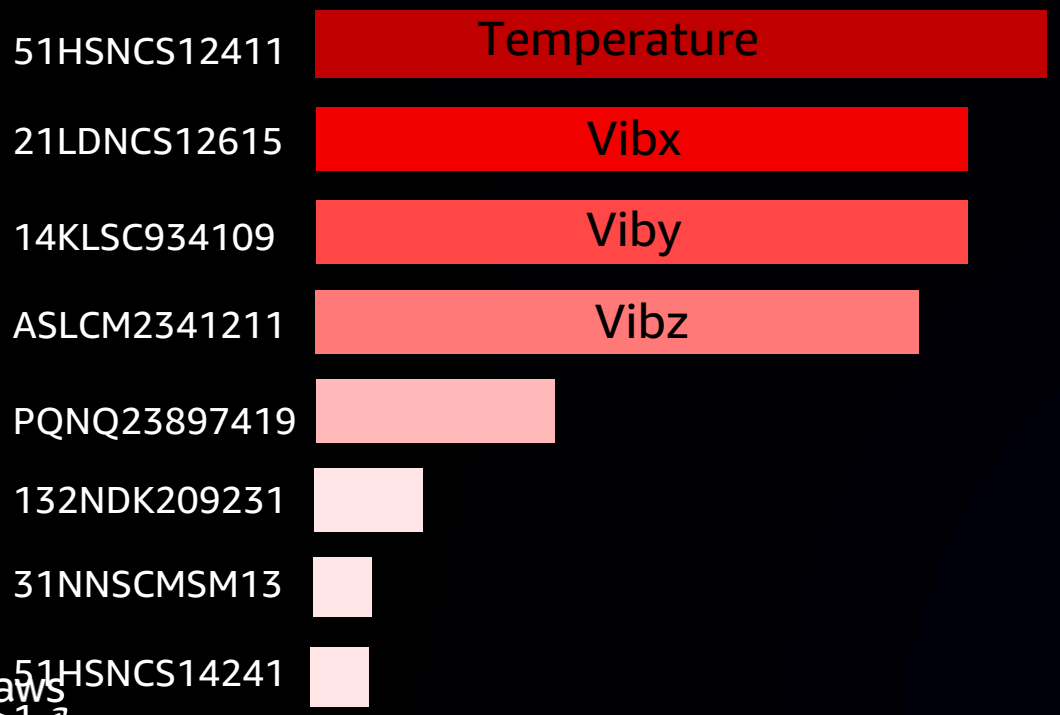
Unsupervised ML

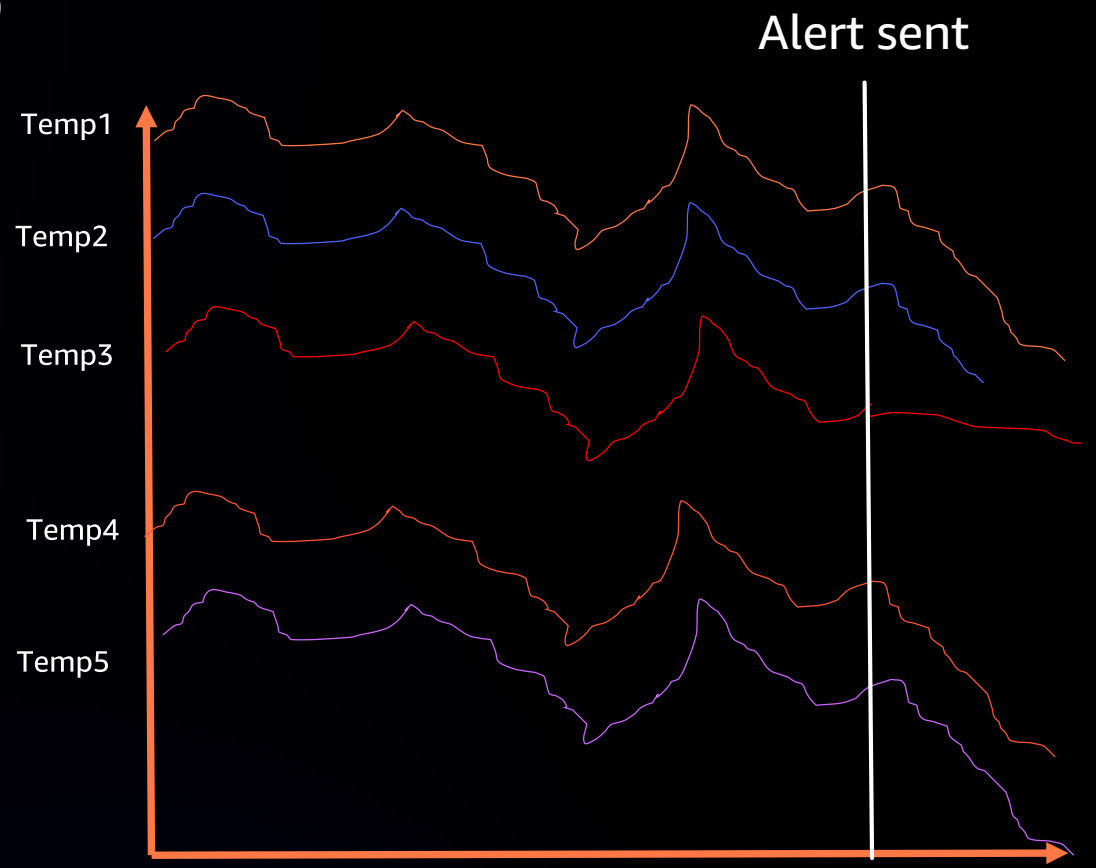


© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Example: Bearing failure

- 55 sensors on a compressor (vib, temp, rpms etc)
- Lookout For Equipment detected an anomaly and highlighted 3 radial vibration tags and one temperature tag as the top contributing factors





Thresholding did not catch this

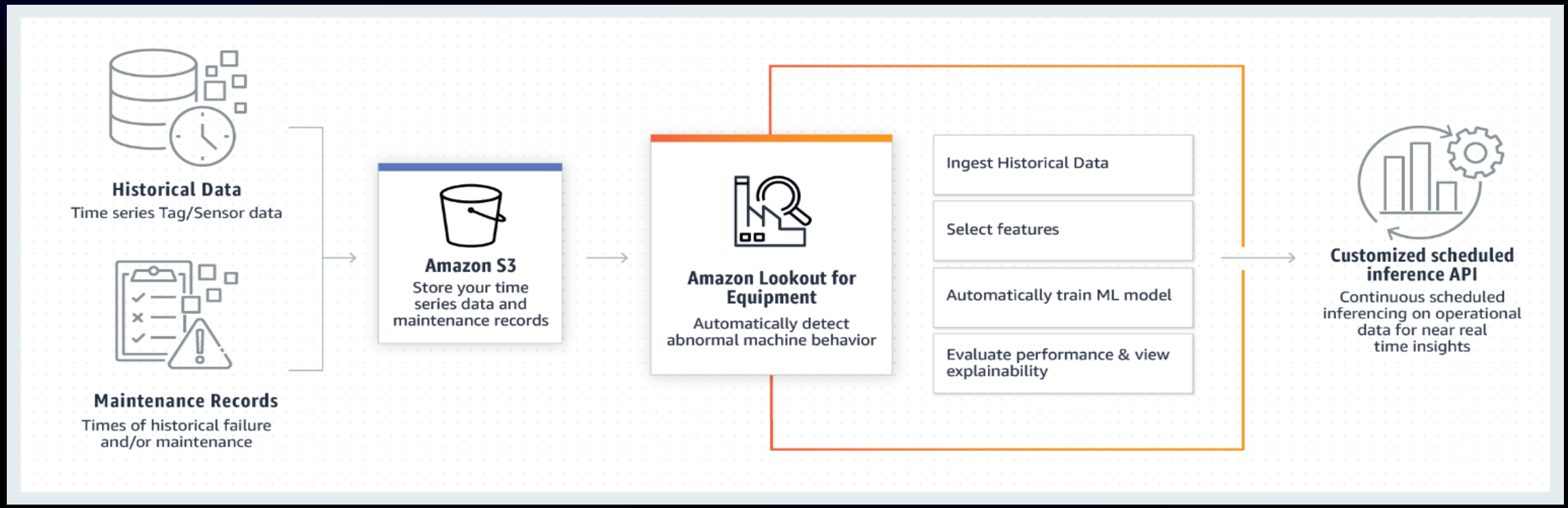
Univariate Statistics did not catch this

Univariate Time Series did not catch this

Physical models did not catch this

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

How Lookout for Equipment's APIs work



1 Ingest data direct from S3

2 Select sensors and build a model with AutoML

3 Real-time inferencing

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

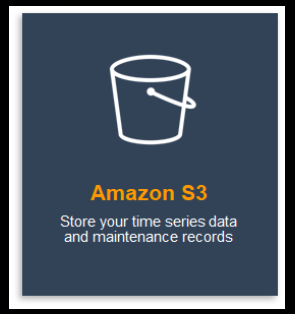
Amazon Lookout for Equipment demo

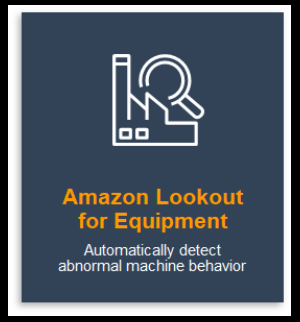
Historical data format:

Pump1.csv

Timestamp	Sensor1	Sensor2	Sensor3	Sensor4	Sensor5	Sensor6
1/1/2019 0:00	0.588976	0.586661	0.519183	1.108068	0.596139	2.223855
1/1/2019 0:01	0.133684	0.578206	0.509381	0.54327	0.84509	0.31234
1/1/2019 0:02	0.462376	0.555803	0.243351	0.935819	0.32941	1.81193
1/1/2019 0:03	0.168711	0.605362	0.823515	0.091927	1.836087	0.386341
1/1/2019 0:04	5.136293	0.987393	0.482155	0.146168	1.568247	1.748107
1/1/2019 0:05	0.140252	0.777203	0.380821	1.41695	0.101128	0.788733

One time



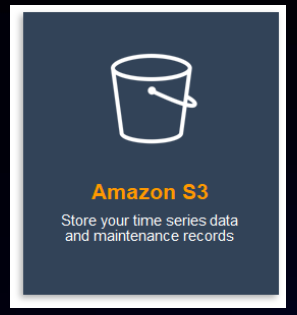


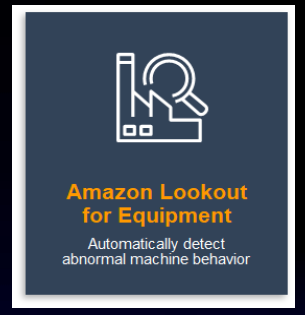
Real-time data format:

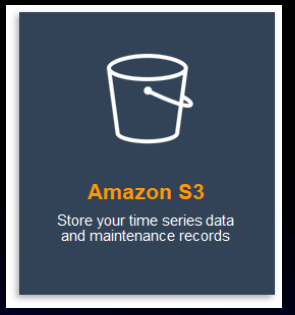
Pump1_202112011200.csv

Timestamp	Sensor1	Sensor2	Sensor3	Sensor4	Sensor5	Sensor6
1/1/2019 0:00	0.588976	0.586661	0.519183	1.108068	0.596139	2.223855
1/1/2019 0:01	0.133684	0.578206	0.509381	0.54327	0.84509	0.31234
1/1/2019 0:02	0.462376	0.555803	0.243351	0.935819	0.32941	1.81193
1/1/2019 0:03	0.168711	0.605362	0.823515	0.091927	1.836087	0.386341
1/1/2019 0:04	5.136293	0.987393	0.482155	0.146168	1.568247	1.748107
1/1/2019 0:05	0.140252	0.777203	0.380821	1.41695	0.101128	0.788733

Every 5min





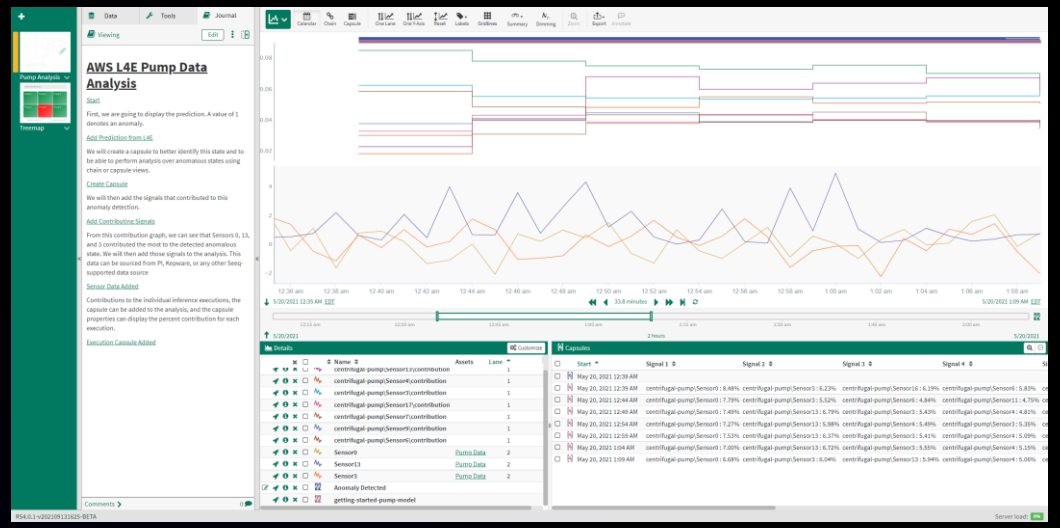


© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

How to scale – Asset Monitoring w/ ML

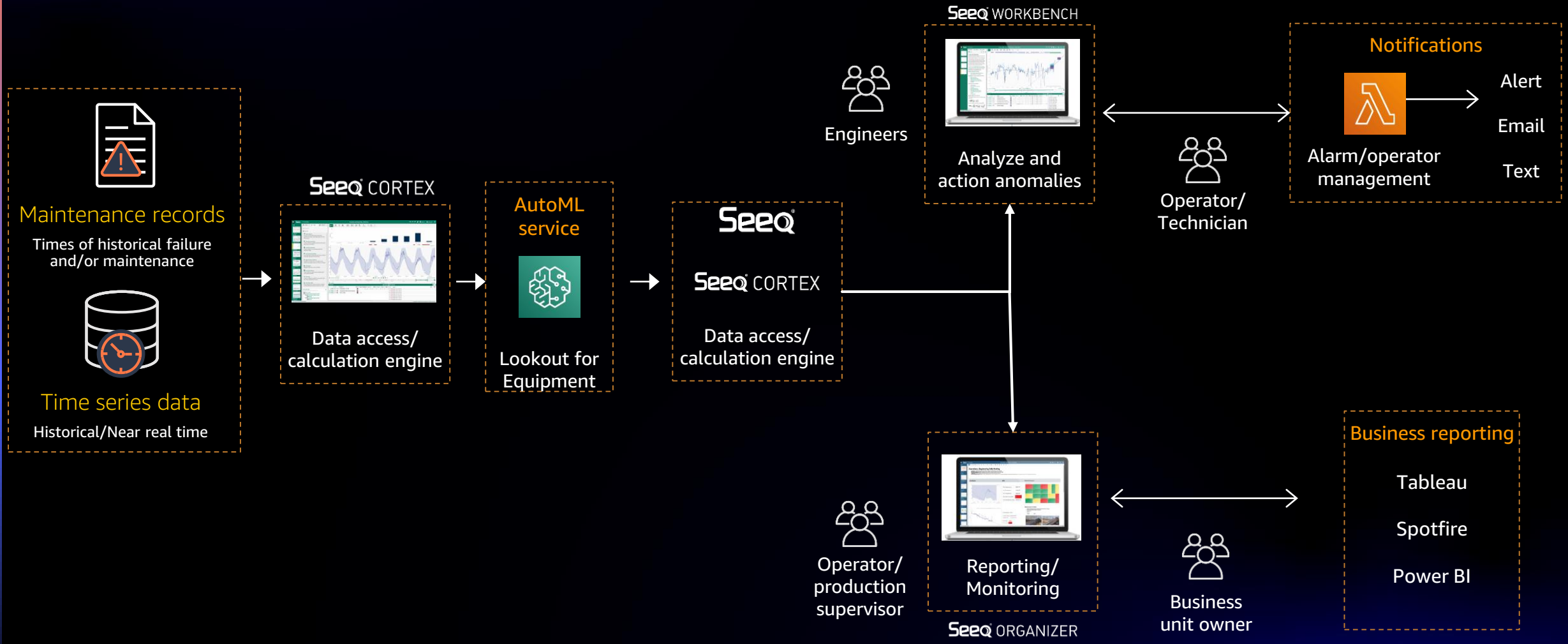
Automated end-to-end workflow

DEFINE	dataset for model training
VALIDATE	initial model output
INVESTIGATE	inference results and review anomalies
ITERATE	with new labeled data for model retraining



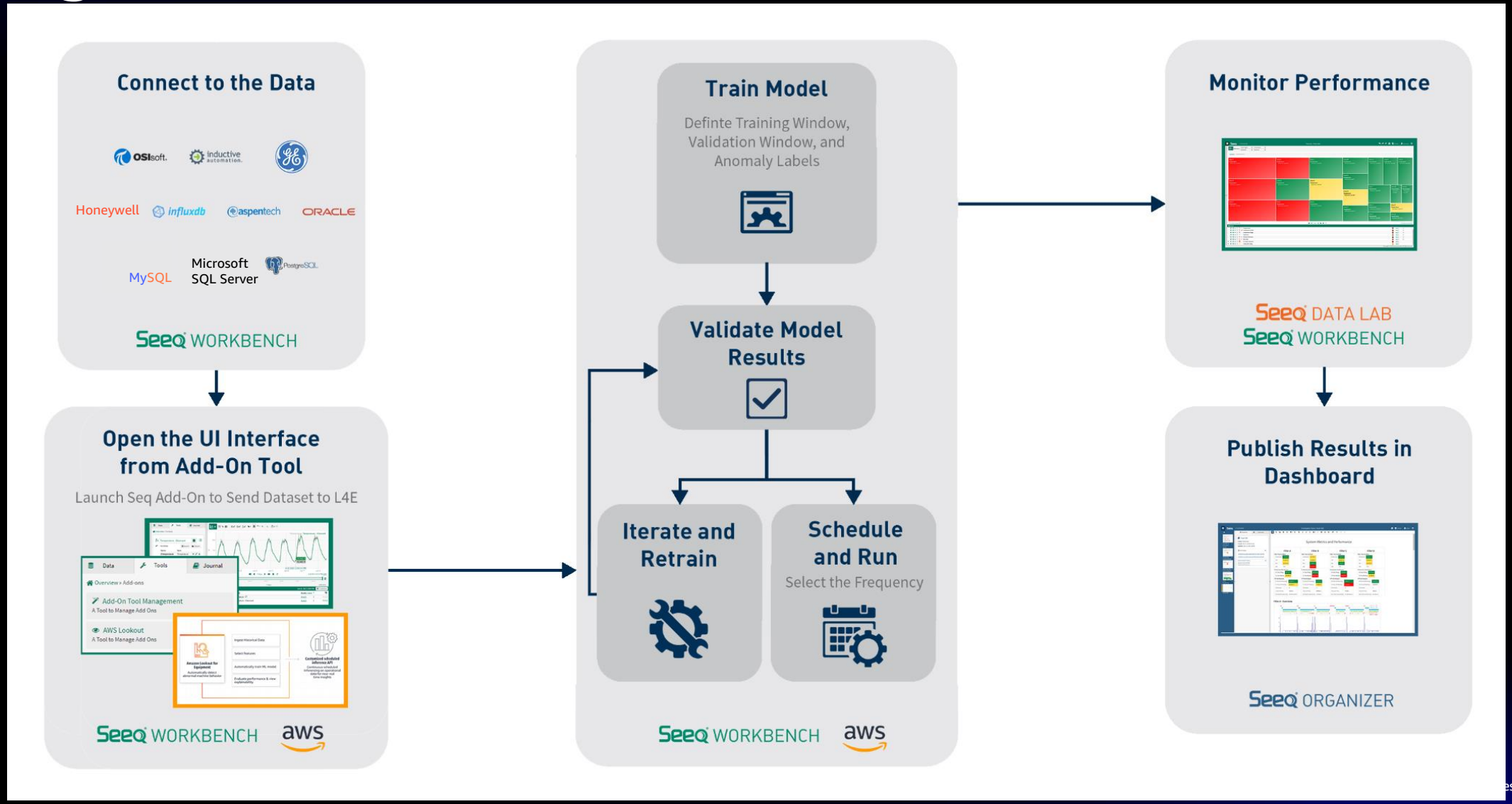
© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Condition monitoring with AWS Partners



© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Lookout for Equipment and Seeq – Engineer workflow demo



es. All rights reserved.

This isn’t just theory or for POCs

- Currently monitoring hundreds of assets
- Deployed on critical assets across power generation, oil and gas, process manufacturing
- Have caught multiple critical failures ahead of and in lieu of existing systems

All of the above required no initial input from an SME besides sensor selection and were completely automated ML

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Thank you!

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.