Monitoring productivity of industrial operations with AWS IoT SiteWise

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Agenda

- AWS IoT SiteWise
- Customer: Bayer Crop Science
  - Use Case
  - Demo
  - What’s Next

If you knew **the state of every thing** and could **reason on top of that data…**

what **problems** would you solve?

aws

AWS IoT architecture

How can I make sense of my IoT data and take actions to solve business problems?

How can I connect, manage, and secure my devices at scale?

How can I build devices that operate at the edge that work with AWS by default?

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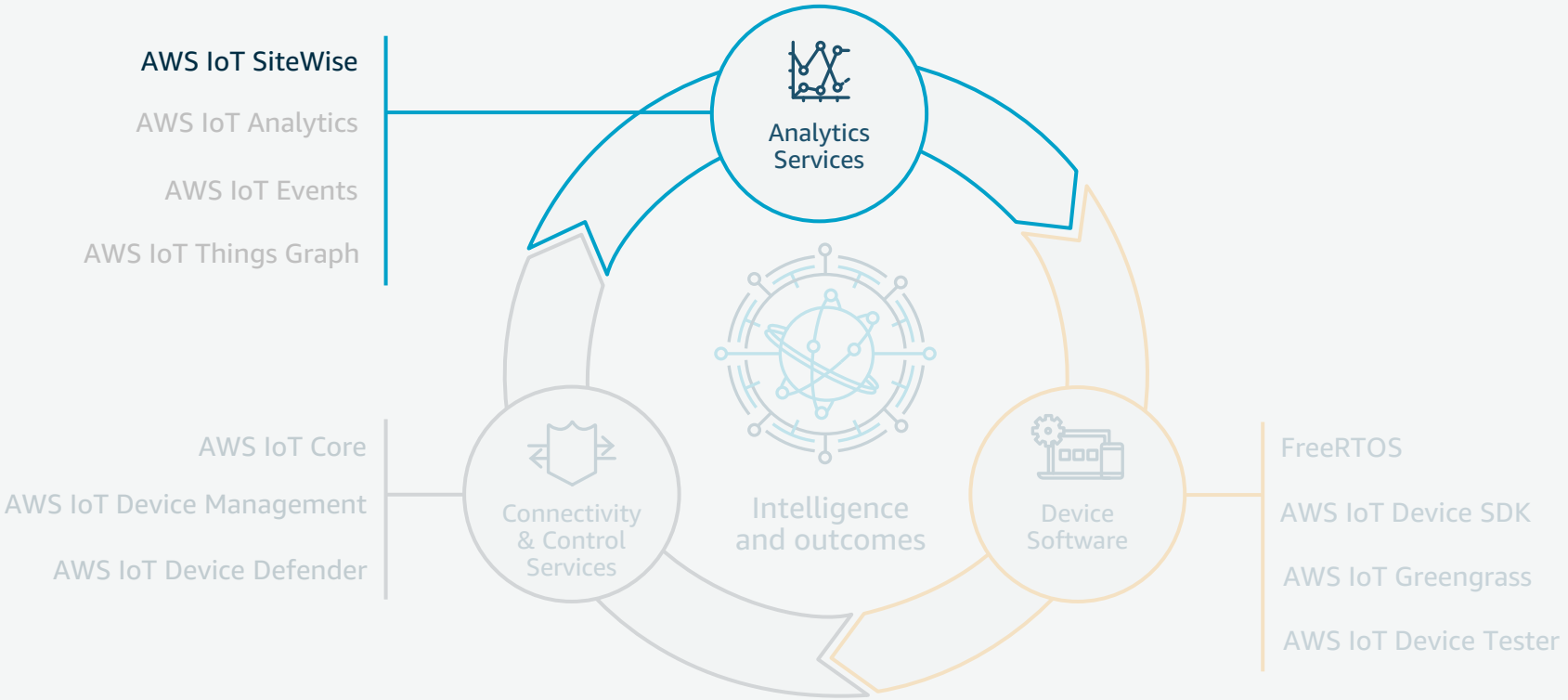
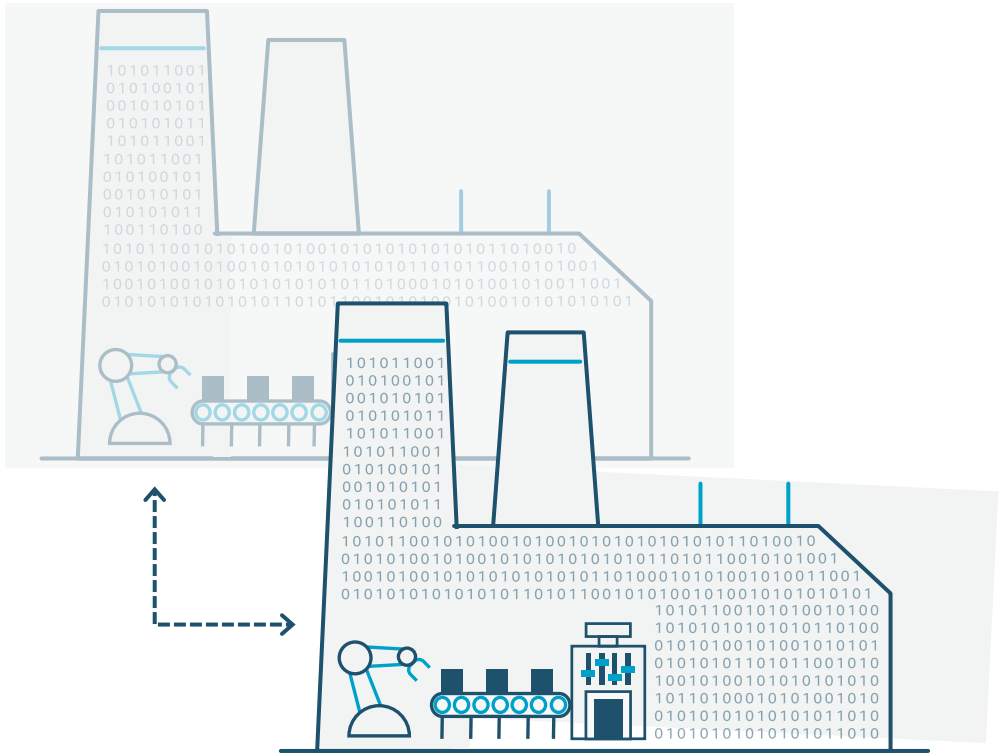
IoT virtuous cycle



How can I liberate data that was once locked in industrial facilities?

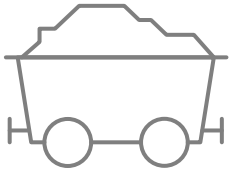


Focus on making things (smartly)

Connected Factory

Agriculture

Oil and Gas



Mining

Healthcare

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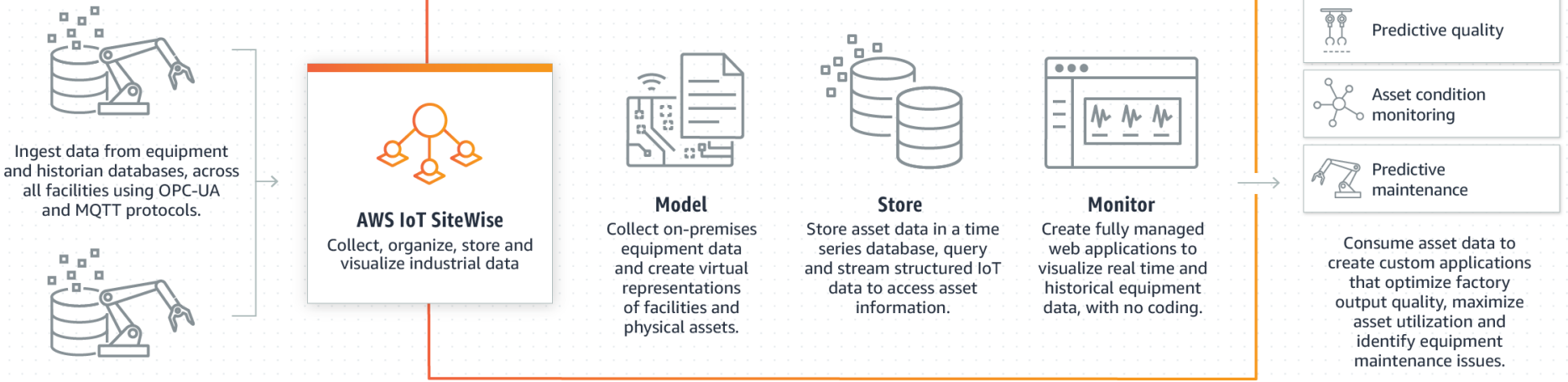
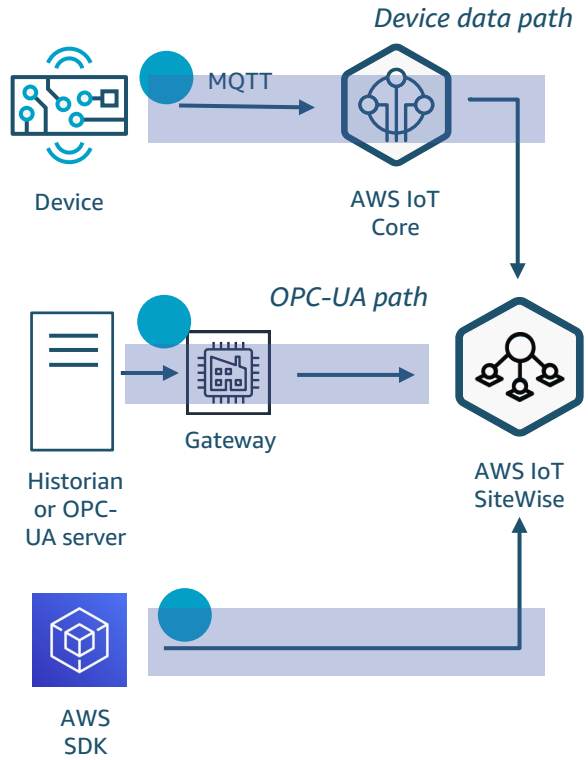
AWS IoT SiteWise



Analytics Services

Ingest data

- Collect data from devices and historians across all sites
- Send data to AWS IoT SiteWise from AWS IoT Core and through PUT APIs
- Supports MQTT and OPC-UA protocols
- Remotely manage edge gateways



Analytics Services

Model assets

Static descriptions

Raw data, time/quality/value

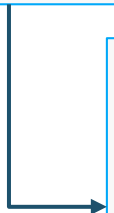
Translate measurements

Compute metrics

```
Model name: Wind Turbine
Property {
 Attribute { Make: string,
             Model: integer,
             Location: string }
 Measurement { RPM: double,
               TorqueKNM: double,
               Wind Direction: double,
               Wind Speed: double }
 Transform {{ Torque: double;
               value = KNM * 1000 }
             { RPS: double;
               value = RPM / 60 }
             { Overdrive State: double;
               value = gte(Torque, 3) }}
 Metric {{ Overdrive : double;
           value = statetime (Overdrive State) }
         { Average Power: double;
           value = avg(Torque)*avg(RPS)*2*3.14 }
         { Average Wind Speed: double;
           value = avg (Wind Speed) }}
```

Add model hierarchy

```
Model name: Wind Farm
Name: string
Property {
  Metric: {
     Total Average Power = sum(turbine avg power);
     Total Overdrive Statetime = sum(turbine overdrive statetime) }
```



```
Model name: Wind Turbine
Name: string
Property {
  Metric:
     Avg Power = avg(Torque)*avg(RPS)*2*3.14;
     Overdrive Statetime = statetime(overdrive state) }
```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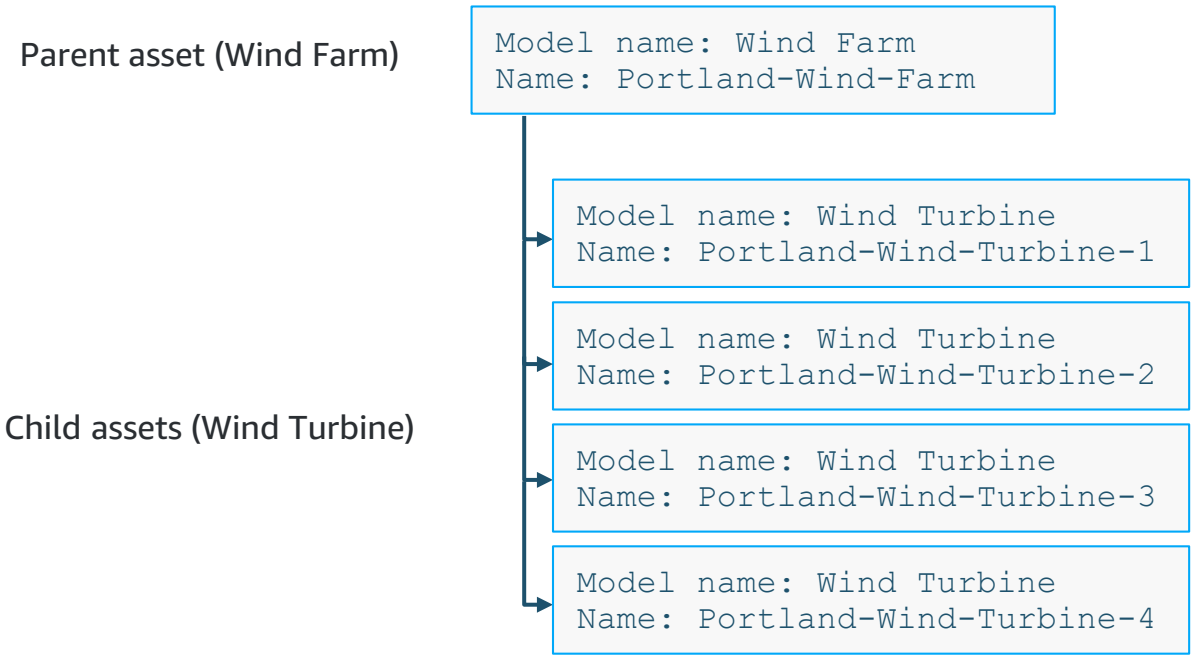
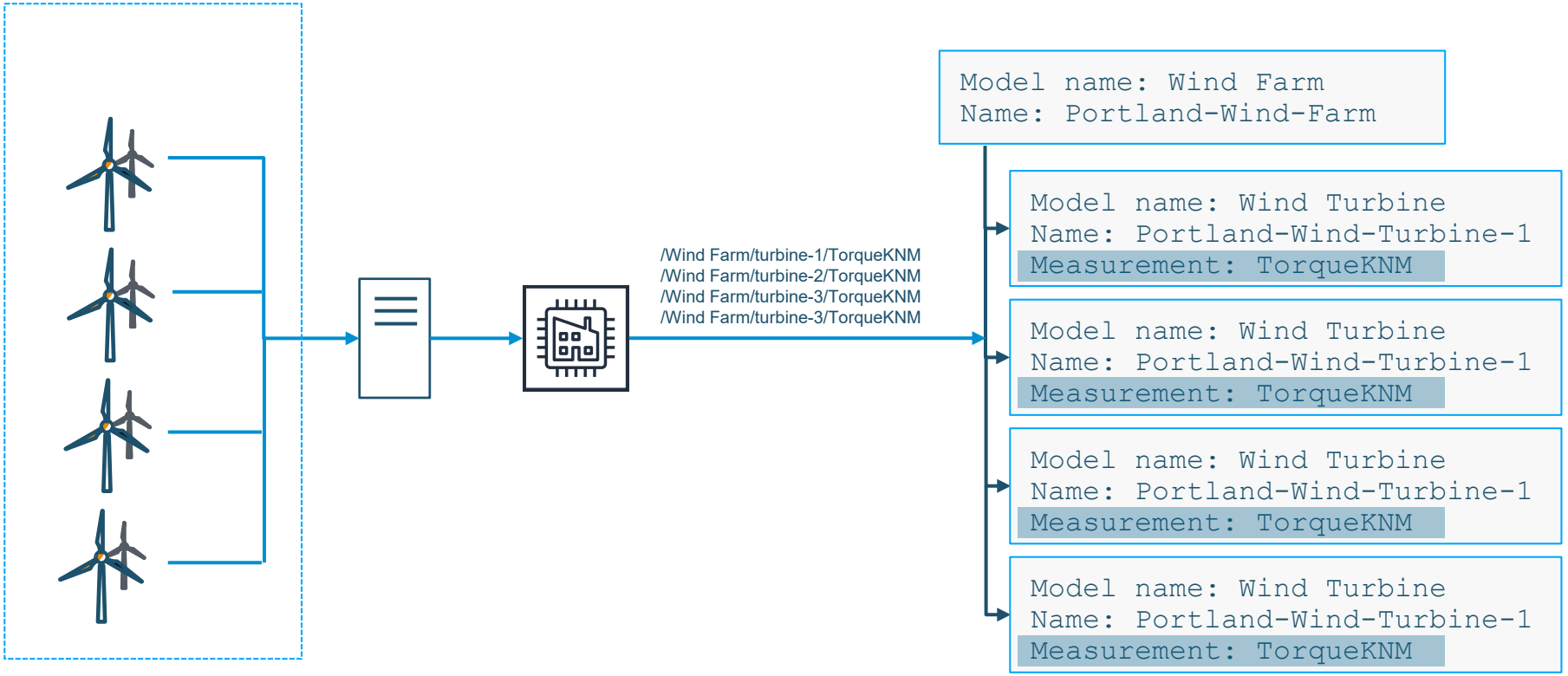
Create instances from model



Link measurements to assets



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Store time series data

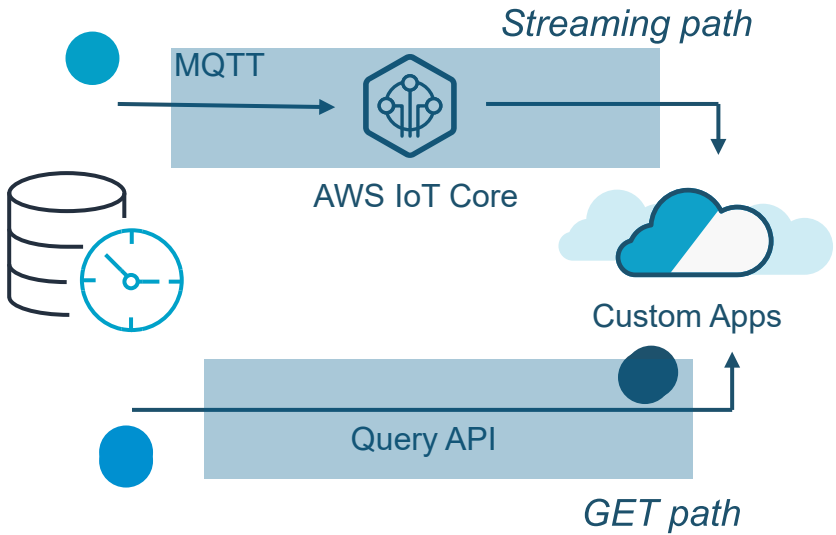
- Scalable, performant, and managed time-series data store
- No capacity planning or provisioning needed
- Low latency access to equipment data and computed metrics

Analytics Services

aws

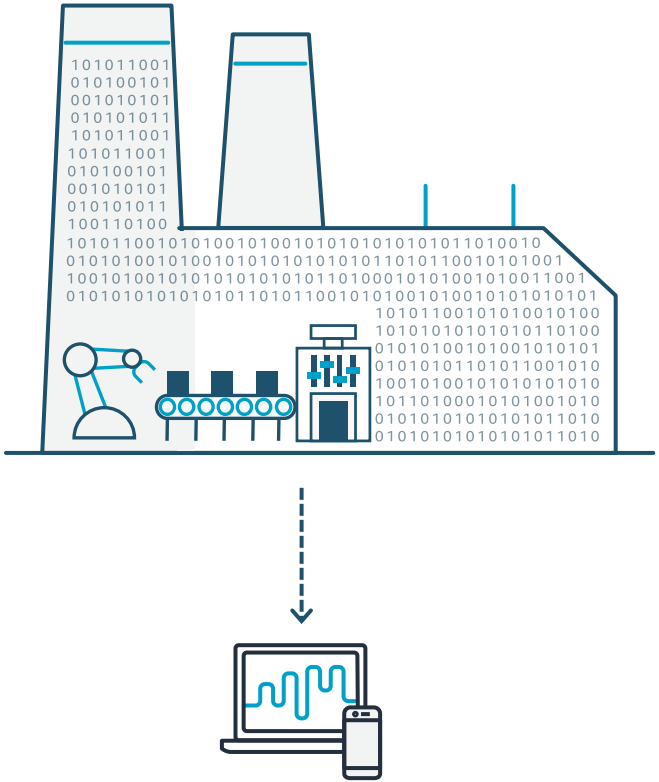
Retrieve data

- Publish-subscribe interface streams updates to asset properties to an MQTT topic
- GET APIs to query historical values of properties and metrics



Analytics Services

How can visualize, interact with, and share machine data?

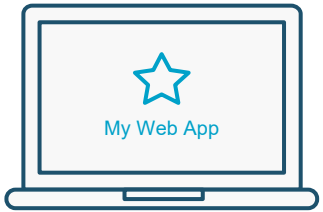


Analytics Services

aws Internet of things

SiteWise Monitor for AWS IoT SiteWise

Create a fully managed web application for visualizing and interacting with operational data from devices and equipment connected to AWS IoT.



Set up and deploy web applications for visibility into industrial machine data in minutes, without writing any code.

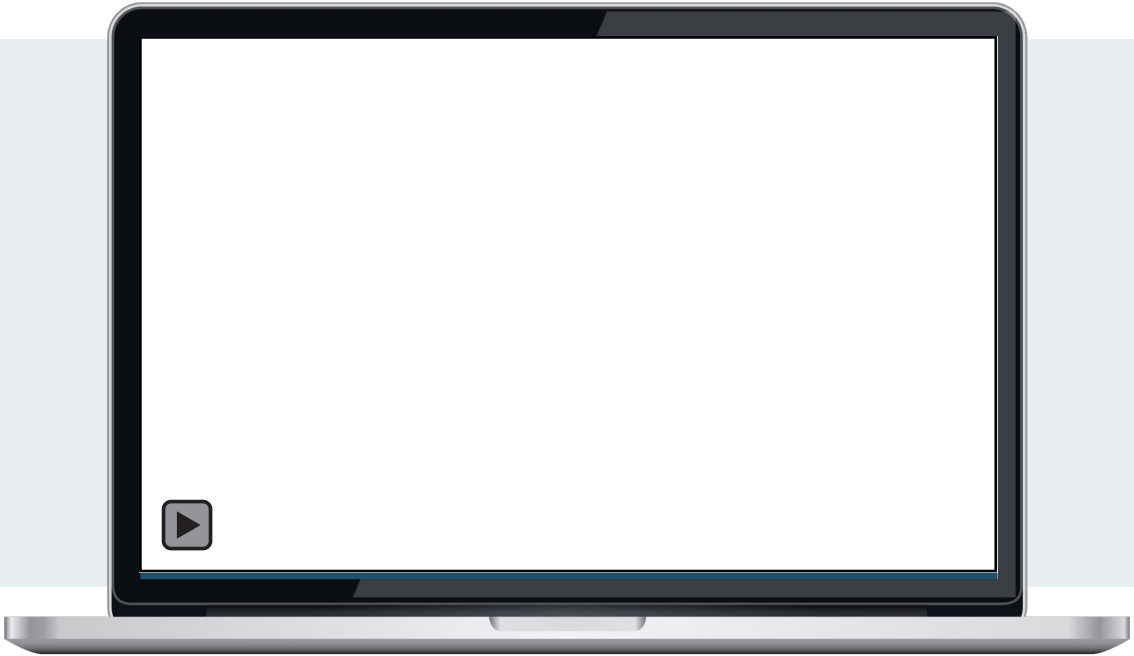
Automatically discover and visualize data from industrial assets that have already been ingested and modeled with AWS IoT SiteWise.

Easily share access to industrial data with any team in your organization to accelerate insights.

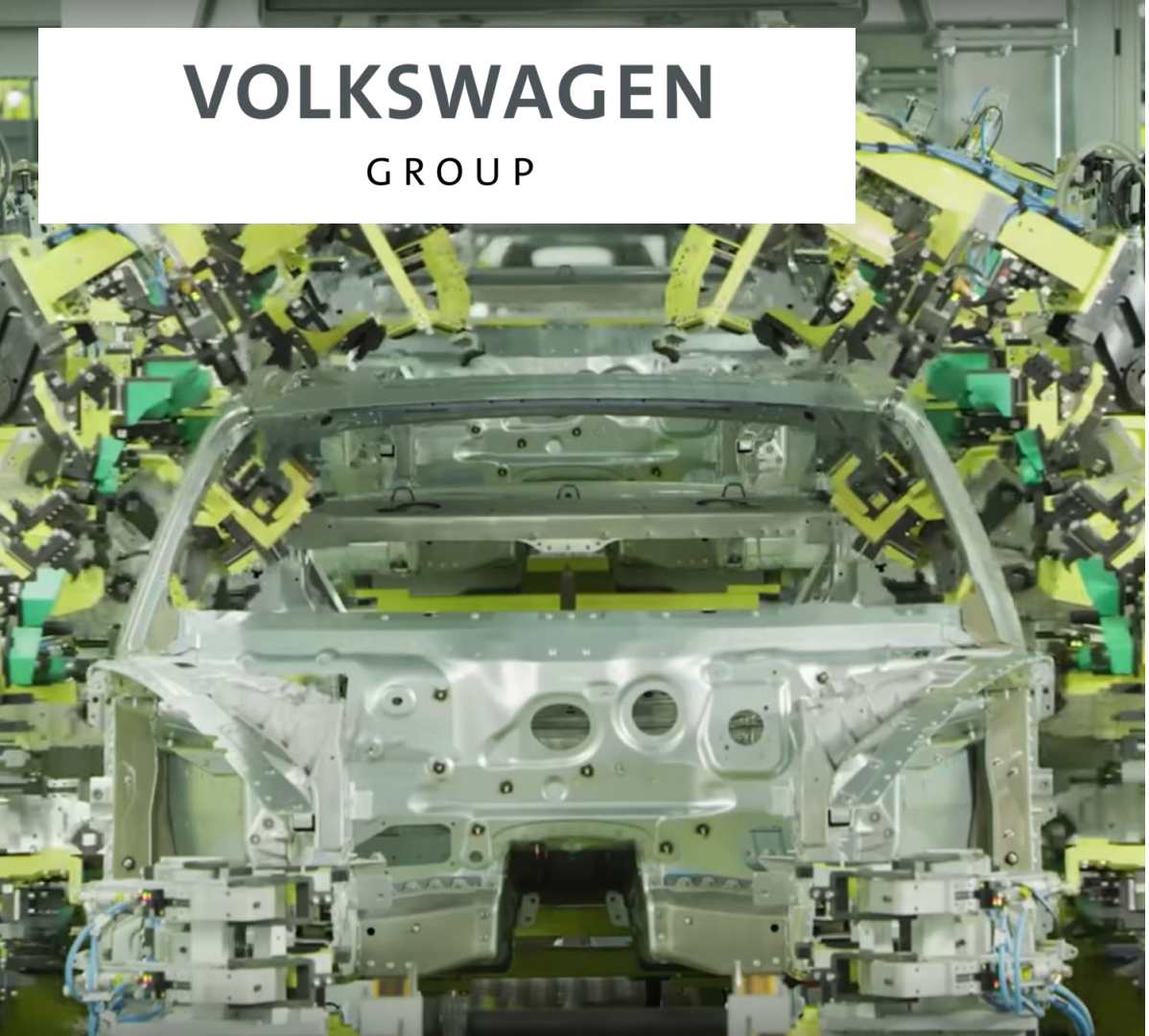
Analytics Services

aws

SiteWise Monitor



Analytics Services



Mission

Volkswagen Group, one of the world's leading automobile manufacturers is transforming its business to become the global leading provider of sustainable mobility and to improve production efficiency by 30%. To achieve that, VW Group needs a flexible, comprehensive and standardized industrial IoT platform that can ingest and combine data from all of its machines, plants and legacy applications.

Solution

Volkswagen and AWS are developing the Volkswagen Industrial Cloud, which includes foundational platform services, spanning the edge to the cloud that can be swiftly adopted by VW business communities to enable various use cases. With the Digital Shop Floor Management solution, manufacturing shop floor data is ingested through AWS IoT SiteWise, stored in a data lake, and used by a custom web application to monitor near real time status of machines and calculate overall equipment effectiveness (OEE) for the cylinder production line.

Impact

For their component production processes, Volkswagen can reduce administrative efforts through automated data retrieval and reporting, achieve sustainable improvement of machine availability through transparent activity tracking and knowledge sharing across plants, and increase productivity by having full visibility into production losses and their influence factors.

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Customer: Bayer Crop Science

Peri Subrahmanya, Principal Engineer, (former IoT Product Group Lead), Bayer Crop Science

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What is OEE?

Overall **E**quipment **E**ffectives is a measure of manufacturing productivity. It is key to not only understand how operations are running overall but provides some valuable insights into how we can reduce COGS (Cost of Goods Sold) by optimizing throughput across lines/assets. At Bayer CS, we aim to achieve roughly 80% OEE and it all begins with having visibility across different areas in our manufacturing process.

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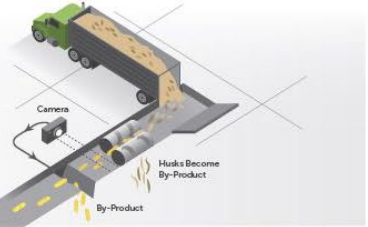
Seed Harvest Operations - Corn

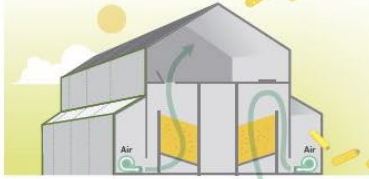
1 Field Operations (Planting, Detasseling & Harvest)

Corn is planted in late spring. By mid-summer, the tassels from the female plants are removed. Most tassels are removed mechanically, but some remain and are removed by hand. Tassels on male plants then pollinate the female plants to create hybrid seed. In early fall the seed is harvested using machines designed to minimize damage.

2 Receiving, Husking & Sorting

Trucks transport the hybrid corn to the production facility, where it is weighed and unloaded onto a receiving line. Ears pass over a series of machines, where rollers remove the husks. Unhusked ears are automatically recycled. In addition, all ears are inspected to assure only quality ears move to the drying step.



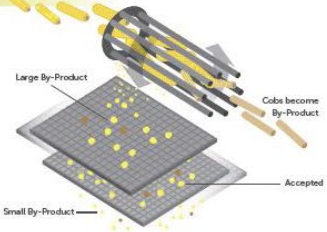


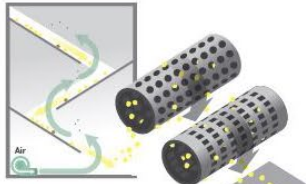
3 Drying

Ears are then placed in drying bins and heated air is used to reduce moisture. Each bin has individualized air and temperature controls. The process is computer-monitored to assure drying parameters are achieved. The average cycle time per bin is 72 hours, bringing the corn to a 13% moisture rate, optimal for seed quality.

4 Shelling & Bulk Storage

The shelling process separates the seed and the cob. A custom designed machine gently removes the seed. After shelling, the seeds are pre-cleaned to remove large and small particles from the bulk seed. After pre-cleaning, the seeds are stored in ventilated bins, each equipped with sensors to monitor temperature.



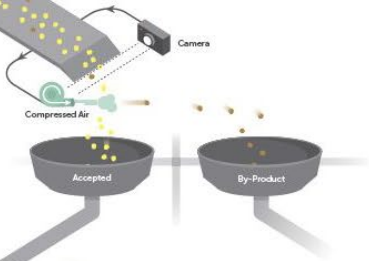


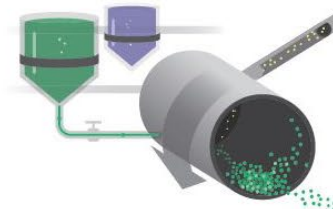
5 Cleaning & Sizing

The cleaning and sizing process further removes all unwanted seeds by separating by dimension (length and width) and shape (flat and round). Sizing is necessary to assure optimum application of treatment in the facility and uniformity when planting in the field. Lastly, if required, seeds pass through density-separating machines to remove lighter seeds that do not meet quality standards. After sizing, the seeds are stored awaiting treatment.

6 Color Sorting

An additional step in the cleaning process is color sorting. In this step, the seeds move over sensors that use high resolution cameras to detect materials of different colors. If sensors detect an off-color, an ejector releases a small burst of compressed air to reject the defective seed.





7 Treating

Next, the seed is coated with a treatment to protect it and enhance its ability to germinate when planted. The seed treatment contains fungicide, insecticide, micronutrients and other potential chemistries. Additives and equipment are used to assure uniform treatment application to each seed. Different treatment colors are used to identify seed traits and treatment types.

8 Packaging, Warehousing & Logistics

Finally, the treated seed is packaged for sale. Package types can include paper bags and bulk containers. Each package is labeled with details of the contents and a tag is added with required legal information. Finished packages are then moved to a warehouse, where cool temperatures and low humidity levels help maintain germination quality. Then, based on orders, the corn is transported to customers to plant the following spring.

Why: Business Drivers

Driving smart business decisions via a single/standard platform

- Performance optimization & monitoring (OEE, KPIs etc.)
- End-to-End operational visibility
- Logistics & Supply chain optimization
- Digital Twins (Simulation models)
- Quick Insights/Dashboards
- Canned reports
- Augmented Reality to help with remote assistance/visibility

Integration of IoT devices where lack of infrastructure (inexpensive)

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AWS IoT SiteWise

Why AWS IoT SiteWise?

- Plug-&-Play with OPC UA
- Ability to configure tags for data collection at the Gateway level
- Cloud Modeler for Asset Template creation, Measurement and Metrics definitions
- Variable cost of utilizing the service i.e pay-per-use; giving the flexibility for smaller sites to incur less cost than larger sites
- Flexibility in Reporting and Dashboards by:
  - Facility (Corn, Cotton)
  - Area (Receiving, Shelling, Treating, etc.)
  - Lines/Assets within Area (Line 1, 2, etc.)

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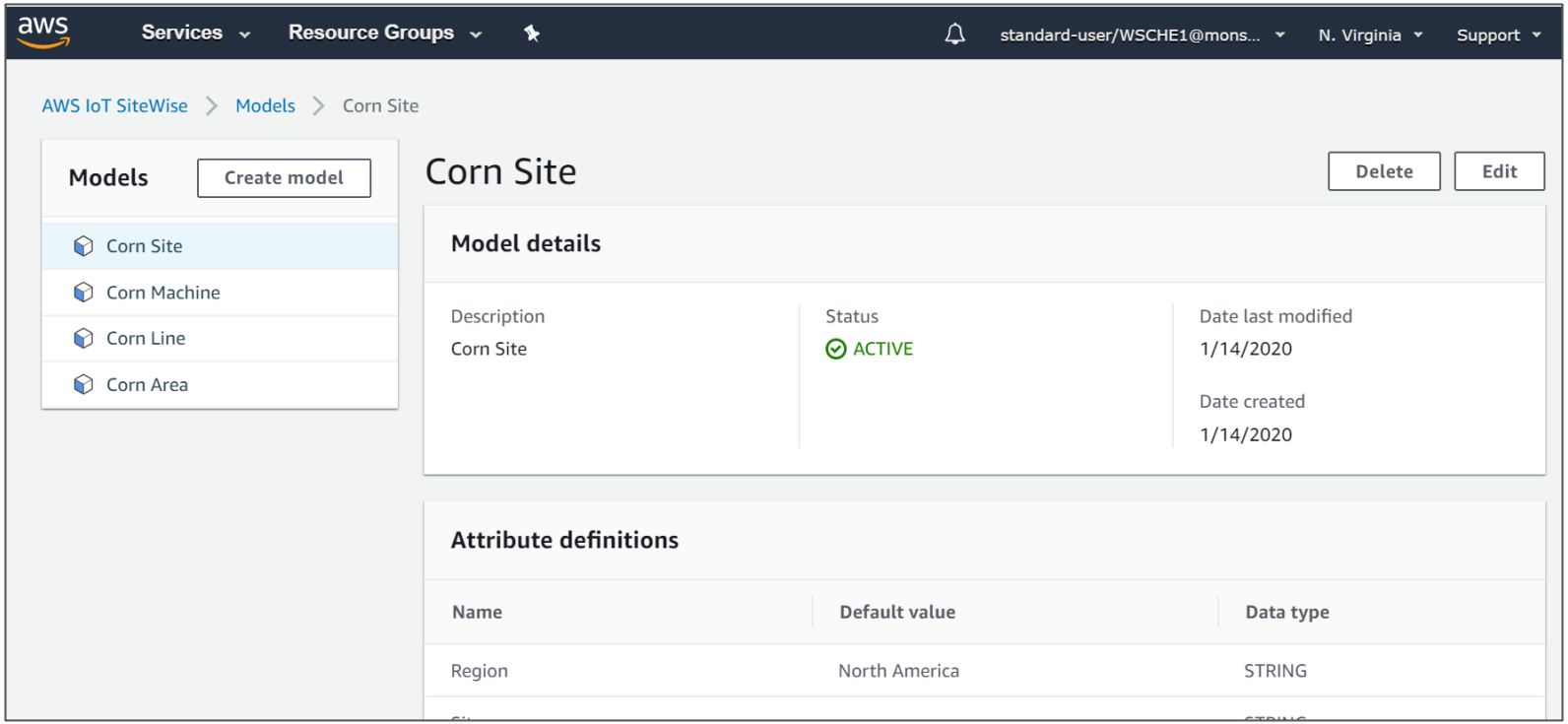
AWS IoT SiteWise

Asset models



AWS IoT SiteWise

Measurements – Data directly brought from PLC data through OPC UA connector

Measurements

Name	Alias
equipment_state	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/Equipment_State
good_counter	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/GoodCounter
bad_counter	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/BadCounter
design_speed	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/DesignSpeed
target_speed	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/TargetSpeed
seed_variety	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/Variety/Variety
seed_size	–
bulk_batch	/FactoryTalkLinxGateway/Tower/Online/KRY_OEE_Trt_L2/Bulk_Batch/Bulk_Batch

AWS IoT SiteWise

Transforms – Down time codes

Transforms

Name	Formula
running	eq(equipment_state,1001)
equipment_configuration	eq(equipment_state,1400)
equipment_setup	eq(equipment_state,1401)
sizing_setup	eq(equipment_state,1402)
formulation	eq(equipment_state,1403)
calibration	eq(equipment_state,1404)
paper_bag_size_change	eq(equipment_state,1405)
variety	eq(equipment_state,1501)
color_change_treater	eq(equipment_state,1504)
refuge_change_drain_down	eq(equipment_state,1505)

AWS IoT SiteWise

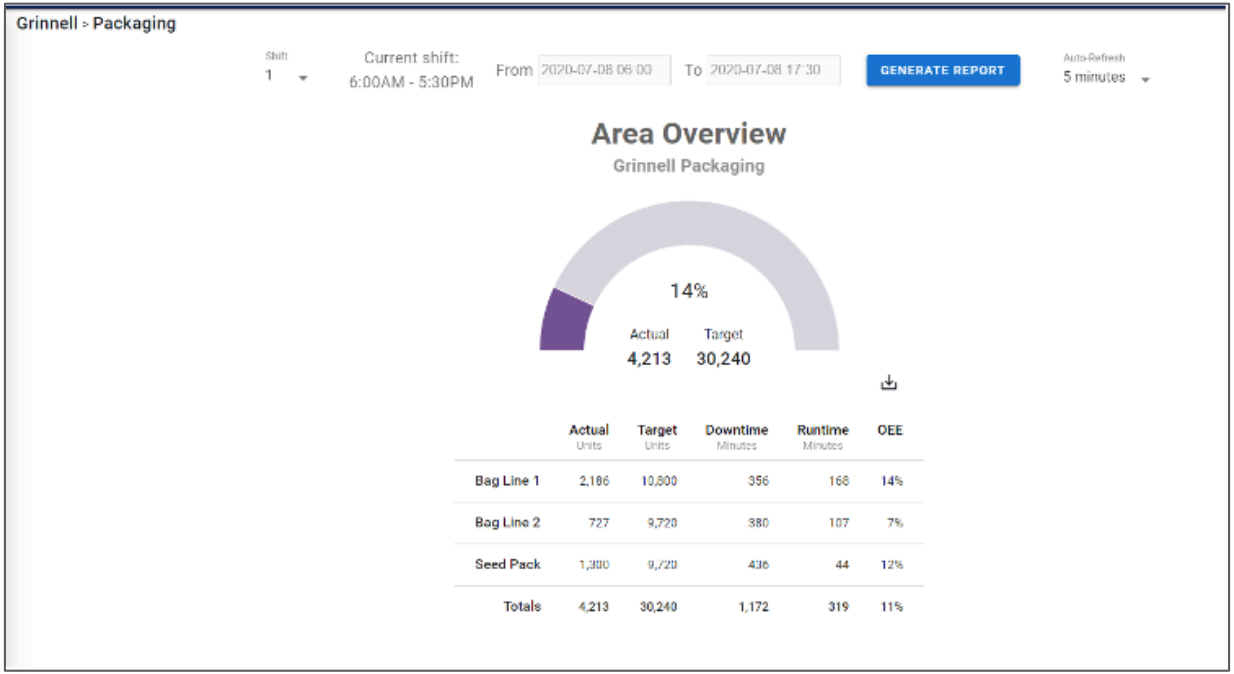
Metrics – Formulas

Metrics

Name	Formula
state_planned_downtime	statetime(generic)+ statetime(safety)+ statetime(training)+ statetime(general)+ statetime(m
state_full_production_time	statetime(running)
unplanned_downtime_1	statetime(emergency_stop)+statetime(down)+statetime(breakdown)+statetime(receiving_co
unplanned_downtime_2	statetime(tagger)+statetime(sewing)+statetime(printer)+statetime(palletizer)+statetime(wra
io_downtime_1	statetime(missing_input)+statetime(process_order)+statetime(no_trucks)+statetime(no_drye
io_downtime_2	statetime(missing_output)+statetime(no_dryer_bins_to_fill)+statetime(silage_issue_no_trucl
state_change_over	statetime(equipment_configuration)+statetime(equipment_setup)+statetime(sizing_setup)+s
state_un_scheduled	statetime(no_scheduled_order)+statetime(direct_harvest)
planned_downtime_hour	statetime(generic)+ statetime(safety)+ statetime(training)+ statetime(general)+ statetime(m

InSite Dashboard

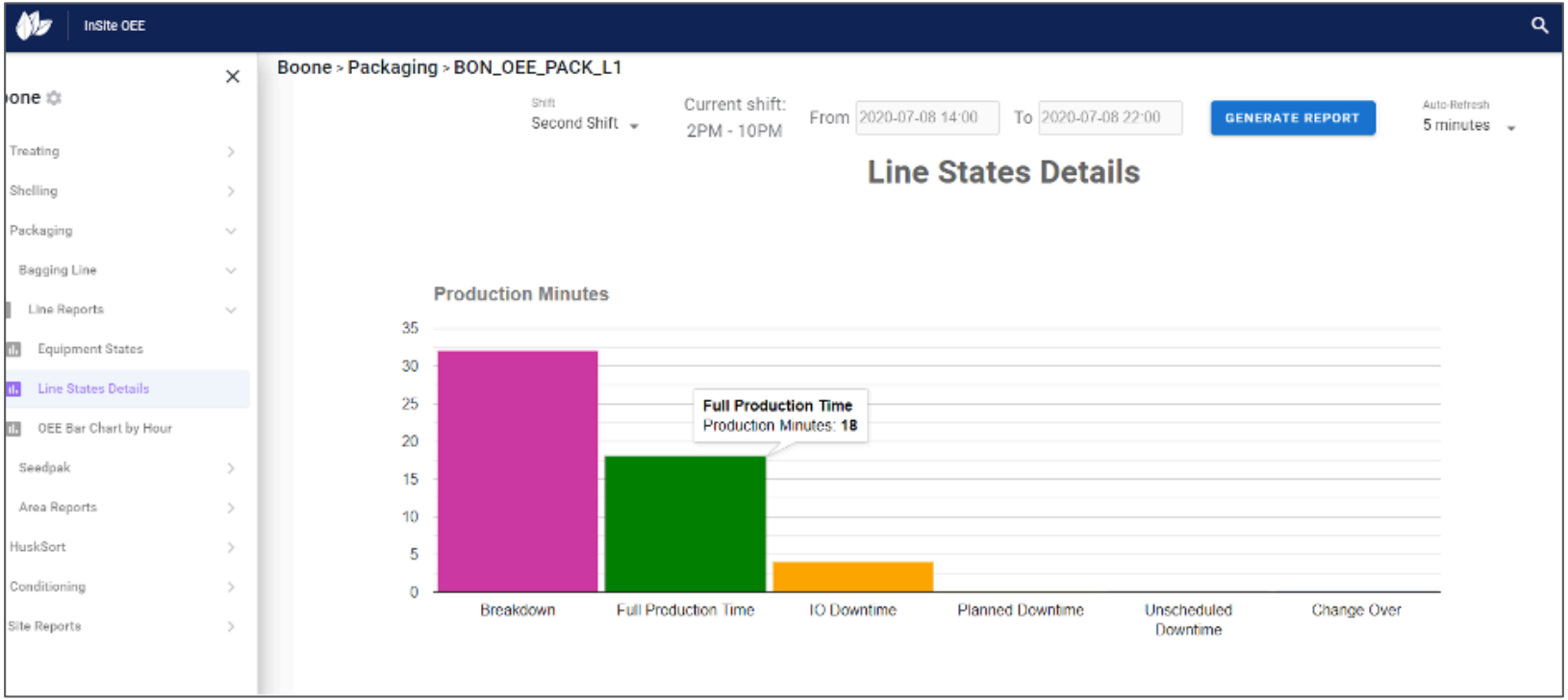
Overview



	Actual Units	Target Units	Downtime Minutes	Runtime Minutes	OEE
Bag Line 1	2,186	10,800	356	168	14%
Bag Line 2	727	9,720	380	107	7%
Seed Pack	1,300	9,720	436	44	12%
Totals	4,213	30,240	1,172	319	11%

InSite Dashboard

Line State Details



InSite Dashboard

Area Line States

Demo

What's Next?

1. Use AWS SiteWise to collect real-time asset/line information

2. Model assets in AWS cloud to setup a testing scenario of a production area

3. Develop AR program
   a) Detect Asset on the shop floor
   b) Fetch data for the asset/line from AWS Sitewise
   c) Visual display for the Connected Worker

Reduce Overall COGS

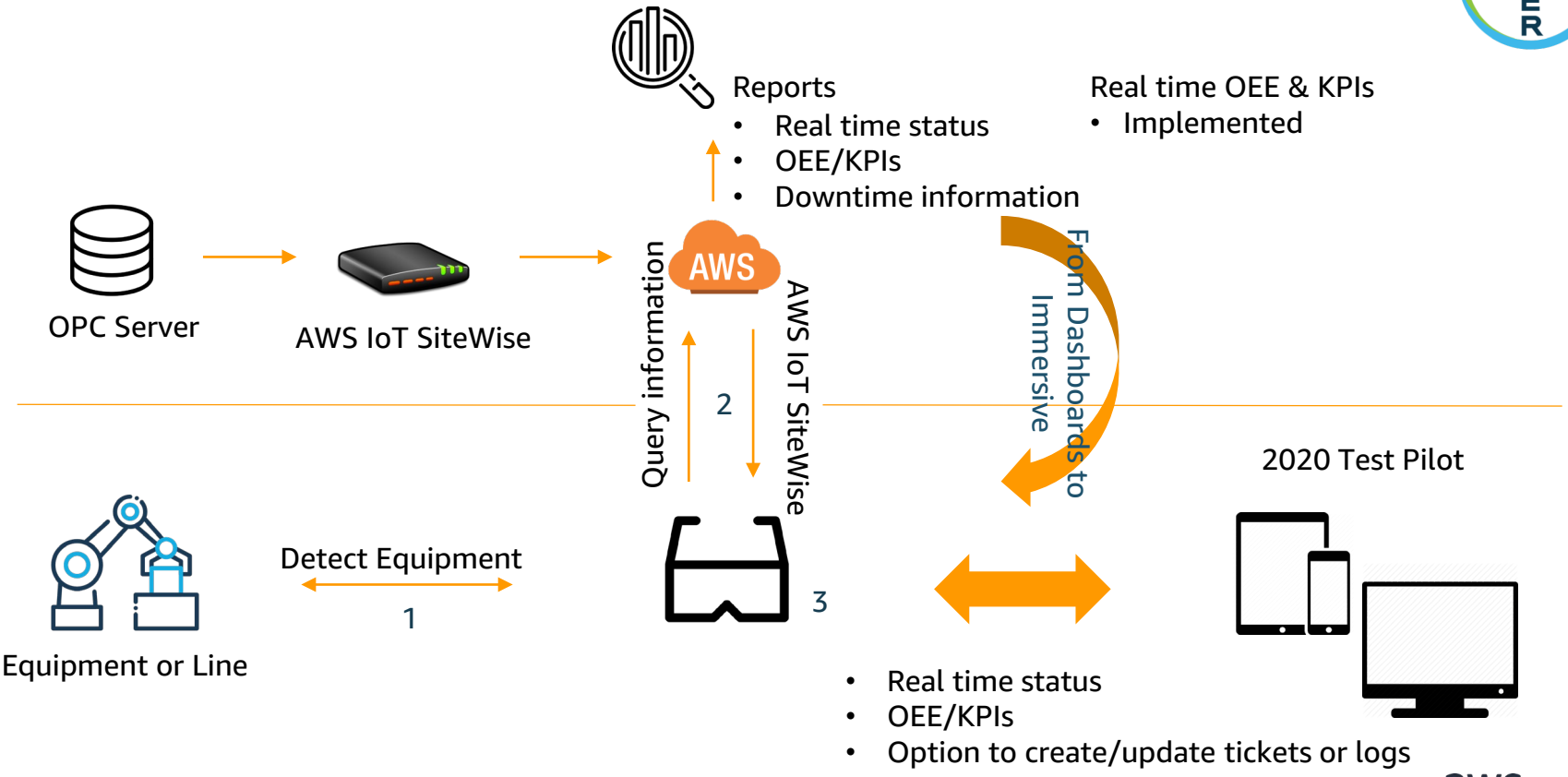
Connected *Worker*

Empower the worker to:

- ✓ Access real time equipment data
- ✓ Accelerate maintenance
- ✓ Reduce downtime

Industry 4.0

Proposed Workflow



Thank You!

Learn more:

AWS IoT SiteWise

Webpage
(https://aws.amazon.com/iot-sitewise/)

Getting Started
(https://docs.aws.amazon.com/iot-sitewise/latest/userguide/getting-started.html#requirements)

Connected Factory Solution
(https://aws.amazon.com/iot/solutions/ConnectedFactoryOffering/)

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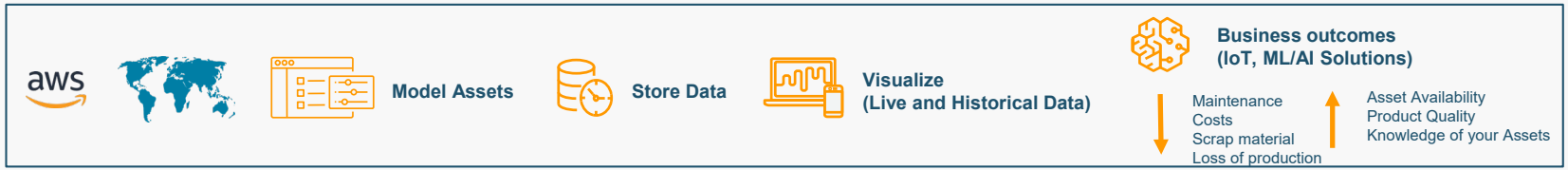
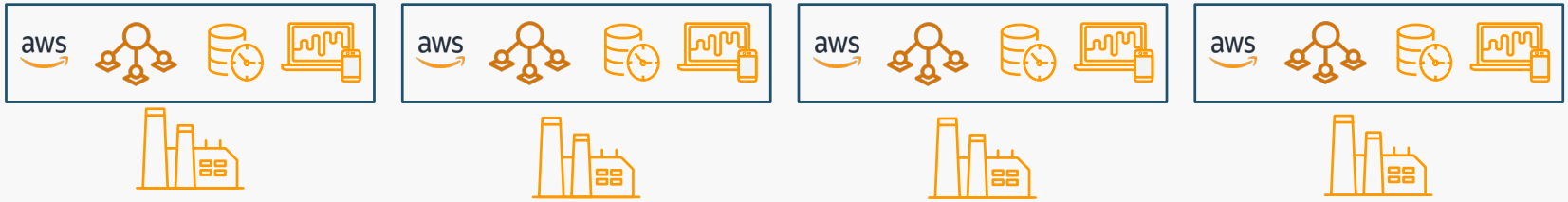
Appendix

Connected Factory Solution (I4.0 QuickStart kit)

Enterprise level visibility



Division and Plant level visibility



- **Ingest data** to AWS (machine data, quality data)
- **Store data** in a time series optimized data store
- **Model assets** specify performance metrics for your equipment and processes
- **Visualize** live and historical equipment data
- **Deploy ML/AI applications** that optimize factory output, product quality, maximize asset utilization and identify equipment maintenance issues

https://aws.amazon.com/iot/solutions/ConnectedFactoryOffering/