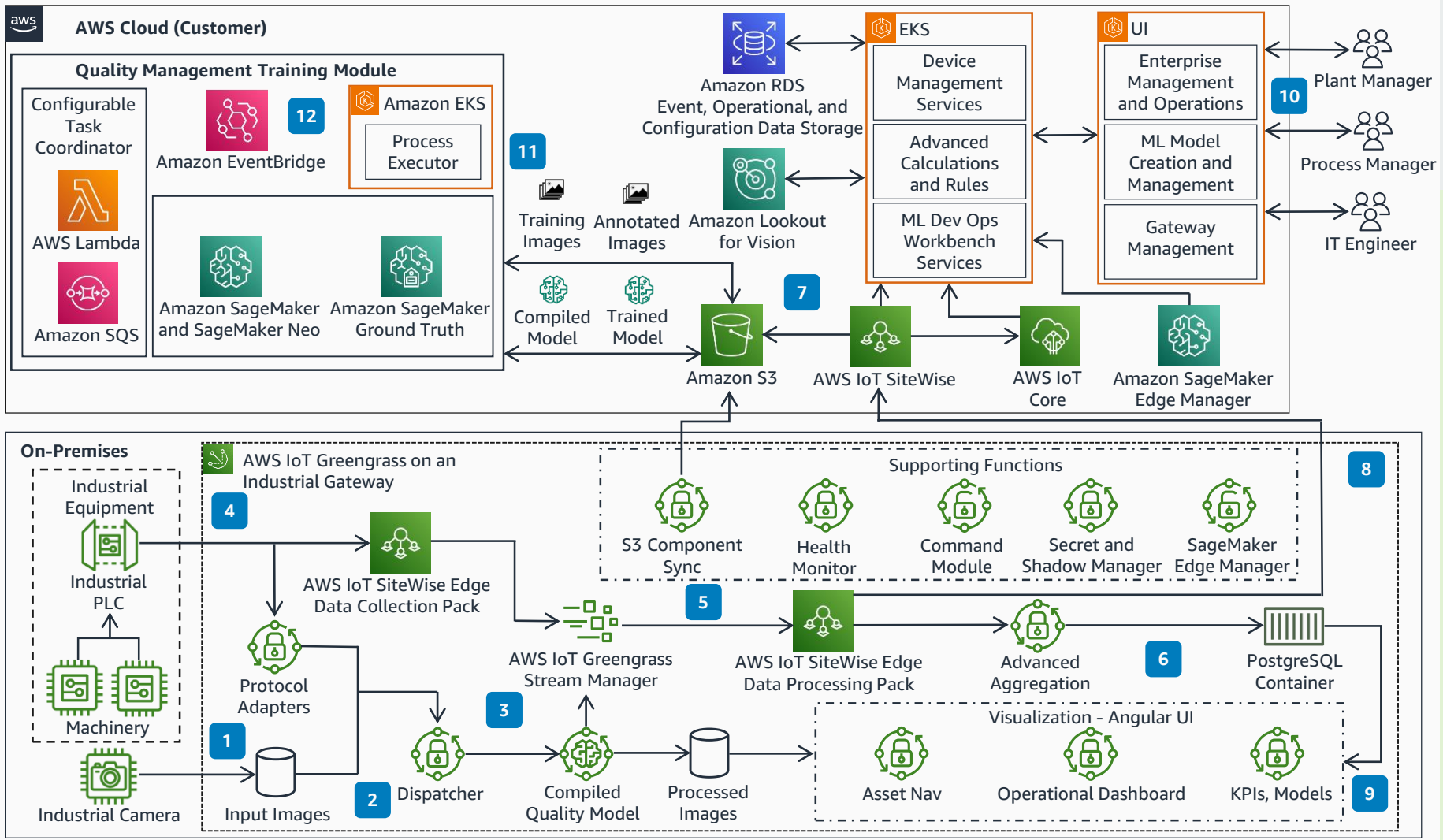


Guidance for Cognizant's APEx Quality Management through Computer Vision on AWS

This architecture shows an edge-based quality management system with enterprise functionality.



CV at the Edge

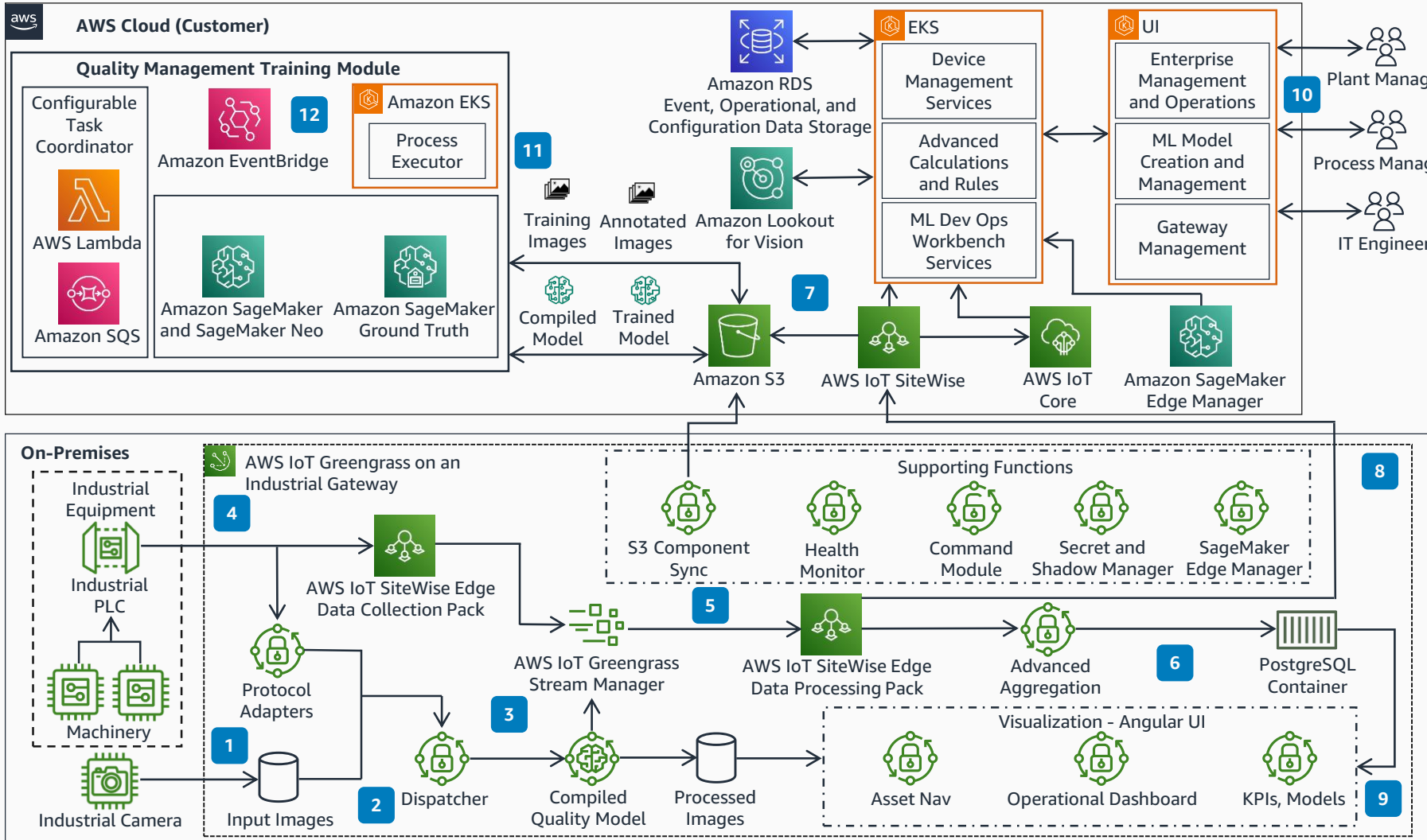
- 1 An industrial camera is used to capture product images which are stored on the edge device for the CV use case.
- 2 The captured images are routed through the Dispatcher to the appropriate Compiled Quality Model for inference.
- 3 The result of the inference is stored on the gateway with **AWS IoT Greengrass Stream Manager** and combined with other near real-time data and calculations to generate overall equipment effectiveness (OEE) and other operational metrics and identify quality issues. This is available to view in the factory through the Visualization layer.

Operations at the Edge

- 4 Near real-time data is collected from the machinery, typically from an Industrial Programmable Logic Controller (PLC), using built-in connectors, like **AWS IoT SiteWise Edge Data Collection Pack**, or custom Protocol Adapters, and stored on the gateway.
- 5 Operational metrics, as configured in the cloud interface, are calculated based on near real-time data, inferences, and results from the Advanced Aggregation function in the **AWS IoT SiteWise Edge Data Processing Pack**.
- 6 Additional Advanced Aggregations are calculated based on Operational Technology (OT) system configurations and shift schedules and stored on the edge device. The PostgreSQL Container will manage this data on the edge.
- 7 Data and aggregations, as configured, are transferred from the edge device to **AWS IoT SiteWise** for enterprise-level views and additional data analysis. **AWS IoT Core** handles data requiring immediate actions. Advanced calculations, advanced alarming, and other backend services are deployed as containers in **Amazon Elastic Kubernetes Services (Amazon EKS)**. **Amazon Relational Database Service (Amazon RDS)** stores event, operational, and configuration data.

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- Operations at the Edge (cont.)**
- 8** The container-based business logic and configuration data can be replicated to the edge environment and orchestrated through **AWS IoT Greengrass** to provide the same functionality while reducing undifferentiated heavy lifting in maintaining multiple code bases. Supporting features include: a) S3 Component Sync to synchronize data between the edge device and cloud, including stored images when model re-training is requested, b) Health Monitor to surface issues on the gateway, such as connectivity and downloaded modules, c) Command Module to orchestrate actions between the cloud and edge device, such as requests to send stored images to the cloud, and d) Secret and Shadow Manager and **Amazon SageMaker Edge Manager**, which are AWS-provided components.
 - 9** Even if cloud connectivity is lost, users can view the operational data, quality results, and custom dashboard on the edge through features such as Asset Nav, an Operational Dashboard, and KPIs and Models.
 - 10** The simplified user interface (UI) helps train ML models, manage gateway deployments and enterprise operational performance, and reduce the complexity and personas required to provision a gateway in the factory. Plant managers can use the UI to monitor KPIs in their own plants or enable an organization-wide view of metrics. Process managers can explore quality KPIs and issues on a per-line basis and examine the results of a particular part. IT engineers can train models and associate the models to particular manufacturing lines or gateways. Amazon SageMaker Edge Manager facilitates the model deployment to the specific gateway.
- Enterprise Management**
- 11** Process or quality engineers train new models by requesting images from the edge device through the S3 Component Sync (custom **AWS IoT Greengrass** component), and storing the images in **Amazon Simple Storage Service (Amazon S3)**. An intuitive interface, powered by **Amazon SageMaker Ground Truth**, is used to identify good or bad part images and annotate defects.
 - 12** **Amazon EventBridge**, **AWS Lambda**, and **Amazon Simple Queue Service (Amazon SQS)** orchestrate a series of processes executed in **Amazon EKS** to automatically train the CV model with **Amazon SageMaker** and compile and package the model for the edge with **Amazon SageMaker Neo**. The model is version-controlled and available for deployment to the gateway. Based on the customer use case, **Amazon Lookout for Vision** can be used for model training.