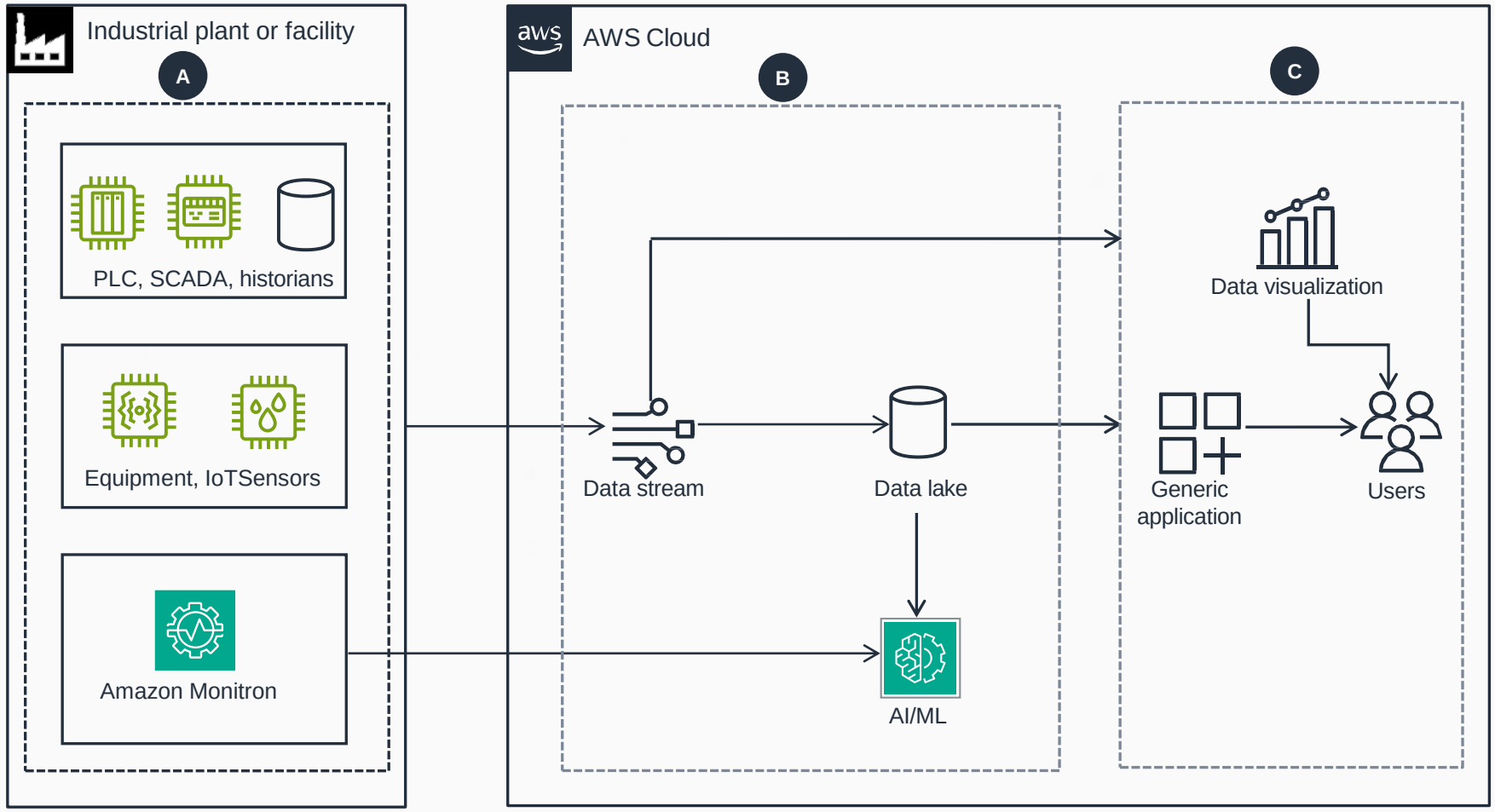
Guidance for Equipment Analytics on AWS

Overview

The architecture diagrams for this Guidance are comprised of a suite of three modules: A) Data ingestion, B) Data streaming, processing & machine learning, and C) Data visualization and notifications. This diagram provides a conceptual overview of each module and its interdependencies.



AWS Reference Architecture

Overview

This architecture diagram consists of three integrated modules that address key stages of equipment connectivity, analytics, and data visualization.

A The customer facility represents the operational site where data is collected from various sources, such as Programmable Logic Controllers (PLCs), SCADA, and Internet of Things (IoT) sensors. This location also provides connectors for various industrial protocols and edge computing capabilities, including machine learning models for predictive maintenance and asset optimization.

B The data stream module ingests real-time data from industrial equipment and sensors.

The data lake establishes a centralized, secure time-series data repository for storing and curating all sensors, machines, production lines, and other industrial equipment. By consolidating diverse data sources into a single repository, organizations can gain deeper insights into their operations, improve decision-making processes, optimize efficiency, and enable advanced analytics, machine learning, and predictive maintenance.

The artificial intelligence and machine learning (AI/ML) module utilizes advanced algorithms and models to predict equipment failures, optimize production schedules, and improve overall efficiency. Through anomaly detection, predictive maintenance, and process optimization, machine learning algorithms can identify patterns and trends that may not be apparent through traditional analysis methods.

C The data visualization module presents real-time visibility into key performance indicators, equipment status, and production trends. This enables informed decision-making, proactive maintenance strategies, and optimization of resource utilization.

End users interact with this solution through a visualization dashboard. They also receive notifications and alerts across various devices.

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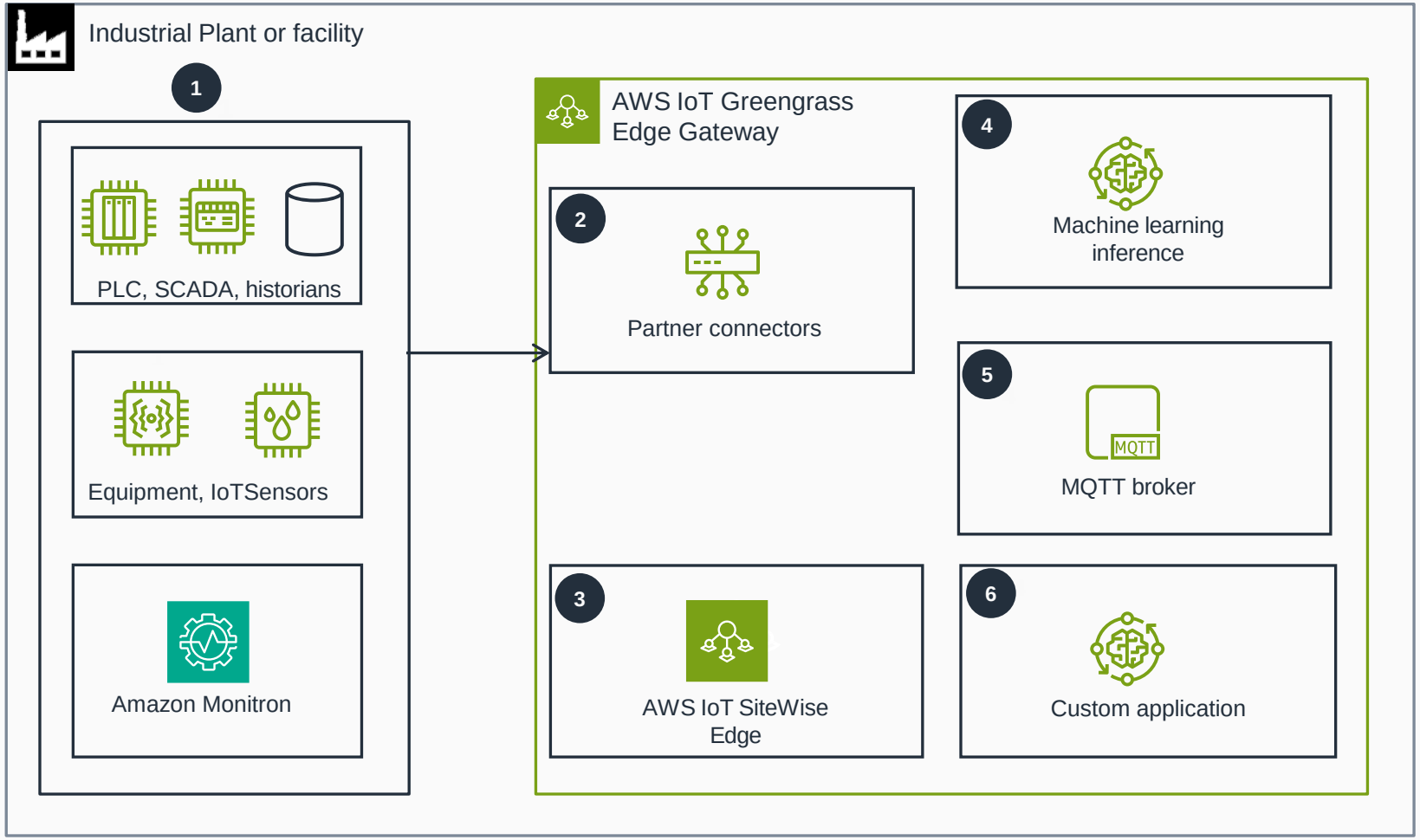
Module A: Data ingestion

This architecture diagram displays an edge location component that enables on-site data ingestion from IoT sensors, PLCs, SCADA, and historians.



Data ingestion

The edge location component enables on-site data ingestion from PLCs, historians, industrial equipment, and IoT sensors installed on equipment. This allows the capture of data on critical parameters such as temperature, vibration, and pressure.

1. At the edge location, various telemetry data are produced from the PLCs, SCADA, historians, IoT sensors, and industrial equipment.
2. Partner connector software solutions act as translation layers, converting data packets from the legacy protocol into a format compatible with a modern standard, such as MQTT or an OPC Unified Architecture (OPC UA).
3. **AWS IoT SiteWise Edge** enables the collection, organization, processing, and monitoring of equipment data on-premises. Local applications that use data from **AWS IoT SiteWise Edge** will continue to function even during intermittent cloud connectivity.
4. The **AWS IoT Greengrass** machine learning component facilitates inferences locally on devices using models that are created, trained, and optimized in the cloud. This enables the prediction of equipment failure and the avoidance of breakdowns.
5. The MQTT broker coordinates the messages between clients, receiving and filtering the messages.
6. Custom applications can be created by using **IoT Greengrass** V2 components to create modular application software.

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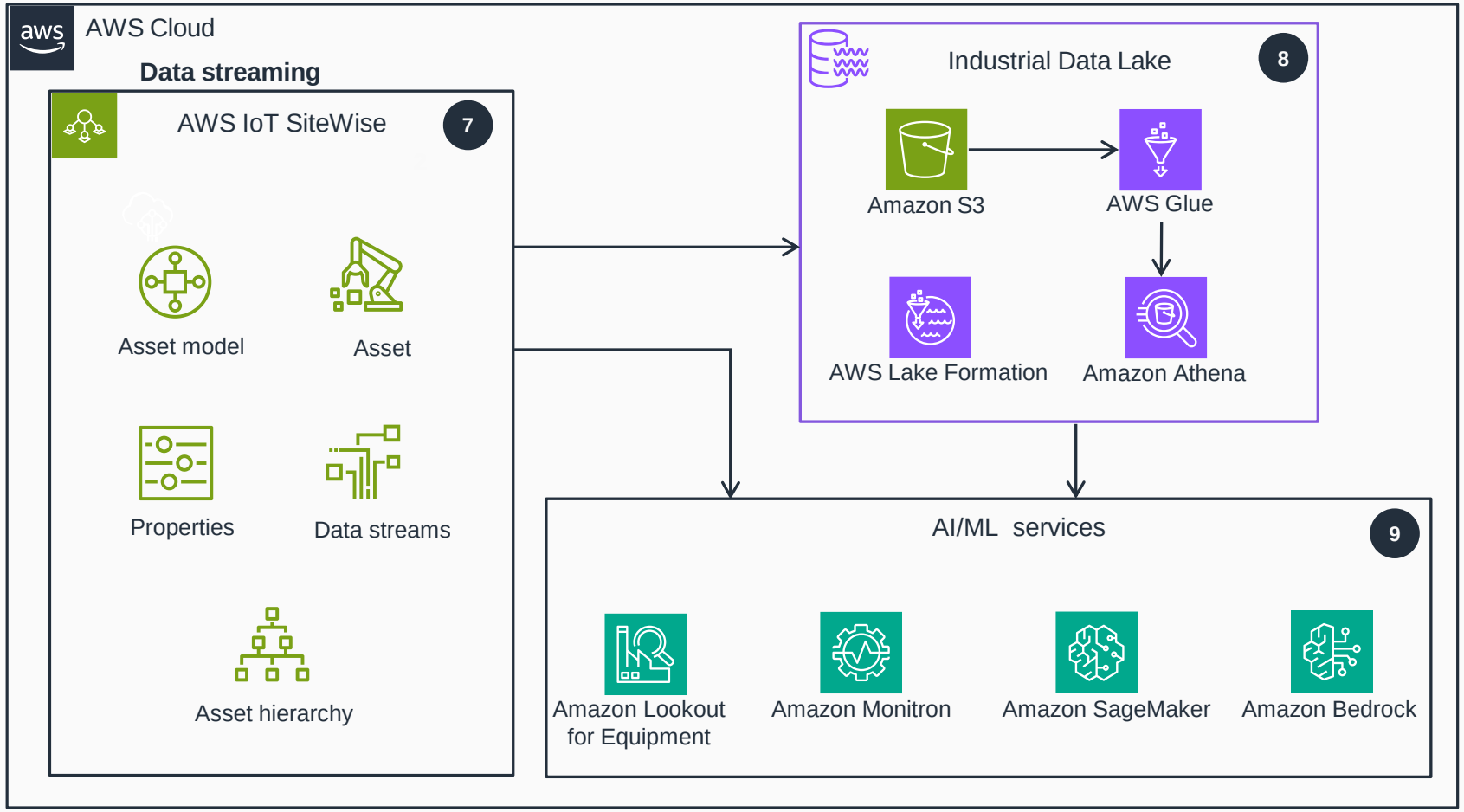
Module B: Data streaming, processing, and machine learning

This architecture diagram shows how data from the edge location is processed and ingested into a data lake, along with AI/ML services.



Data Streaming, processing, and machine learning
This module ingests and processes real-time data from industrial equipment and IoT devices at the edge, preparing and streaming it to the centralized data lake. The AI/ML services then use this data to detect abnormal equipment behavior, enabling the prediction of potential machine failures and the avoidance of unplanned downtime.

7 Use **AWS IoT SiteWise** to unlock real-time data streaming from industrial equipment, delivering an organized view of live and historical data.

8 An industrial data lake using the contextual data provided by **AWS IoT SiteWise**. Govern, secure, and share data using **AWS Lake Formation** for advanced analytics. Catalog the data using **AWS Glue** and analyze the data using **Amazon Athena** queries.

Use the built-in integration of **AWS IoT SiteWise** and **Amazon Lookout for Equipment** for anomaly detection.

9 **Amazon Monitron** is used to detect abnormal equipment behavior so that potential machine failures are detected before failures occur and unplanned downtime is avoided.

Custom ML models can be developed with **Amazon SageMaker.**

Amazon Bedrock is used to build and scale generative AI applications with foundation models.

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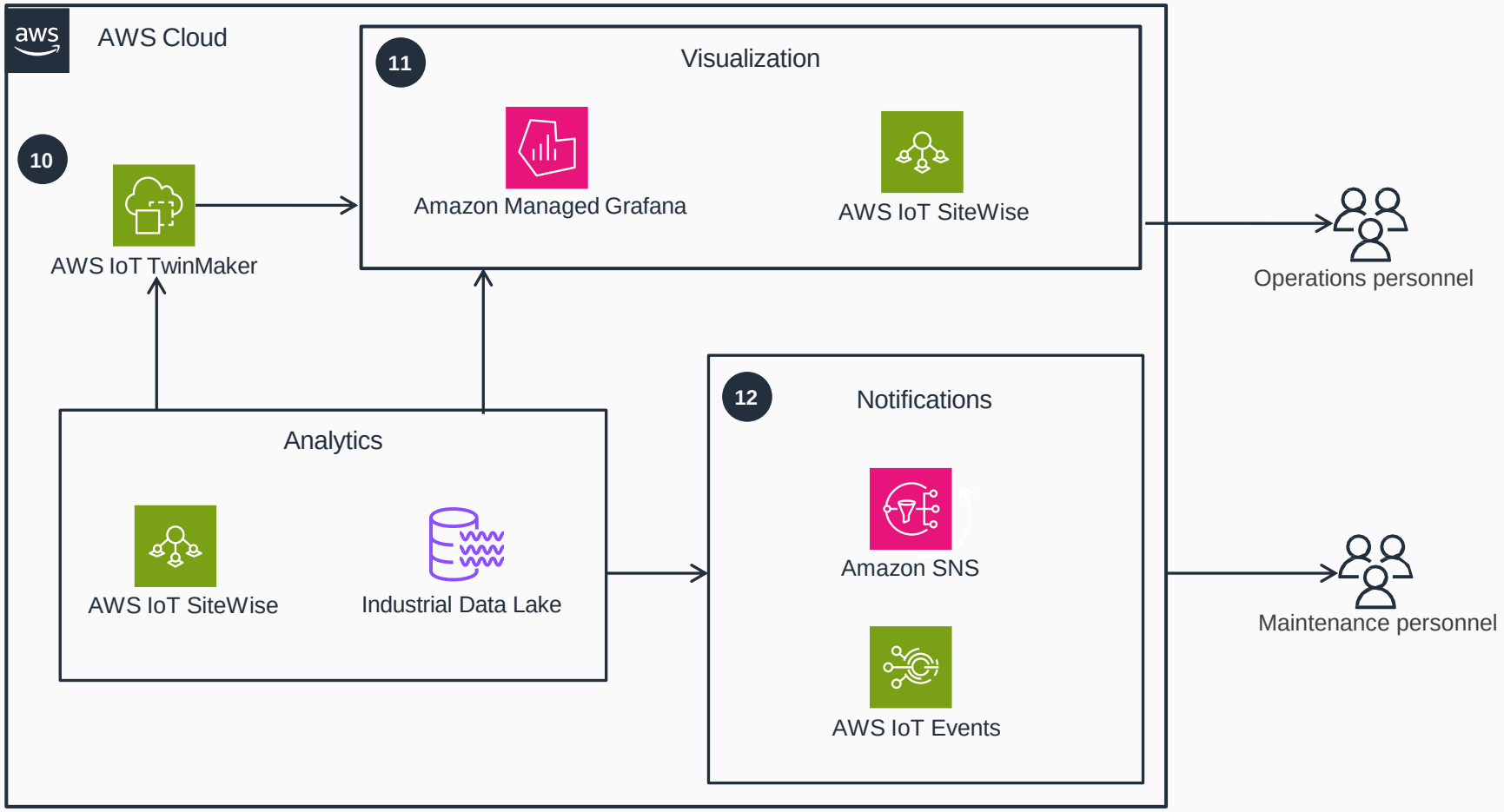
Module C: Data visualization & notifications

This architecture diagram shows how data is ingested and used for dashboards and 3D visualizations.



Data visualization & notifications

The data visualization module ingests data from **AWS IoT SiteWise** and the data lake to provide dashboards and 3D visualizations, as well as enable direct data exploration and analysis from the curated datasets.

10 Use **AWS IoT TwinMaker** to create digital twins, which are virtual representations of the physical operational environment. This enables plant operators to quickly identify and address equipment and process anomalies on the plant floor to improve worker productivity and efficiency.

11 Use **Amazon Managed Grafana, AWS IoT SiteWise** Monitor**, AWS IoT App Kit,** or an AWS Partner to create a dashboard for the visualization of the digital twin and remotely monitor your equipment in near real-time. The fully-managed service, **Managed Grafana,** provides rich, contextual dashboards for this purpose.

12 Use **AWS IoT Events** and **Amazon Simple Notification Service (Amazon SNS)** to monitor the health of industrial equipment for failures or changes in operation and notify the right personnel to take action.

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