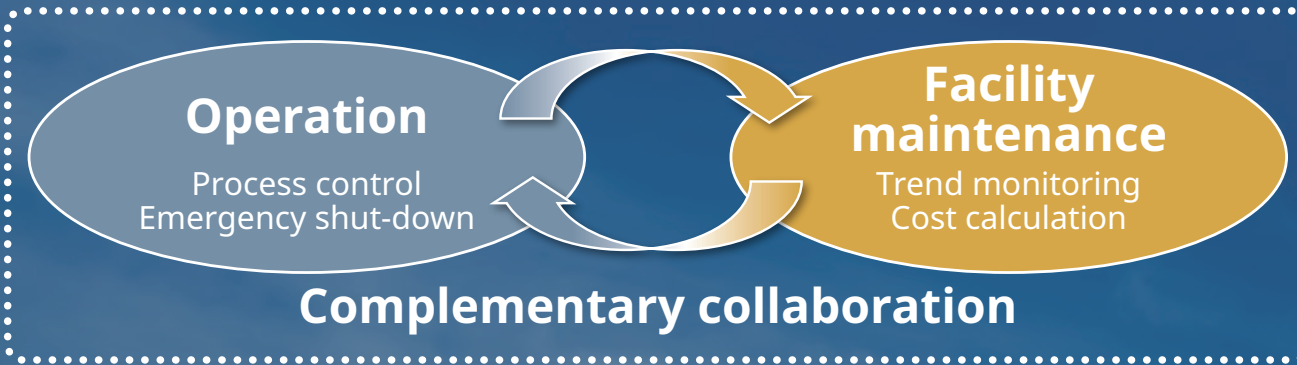OpreX™ Asset Management and Integrity

A Wireless Solution for the Industrial IoT

Sushi Sensor
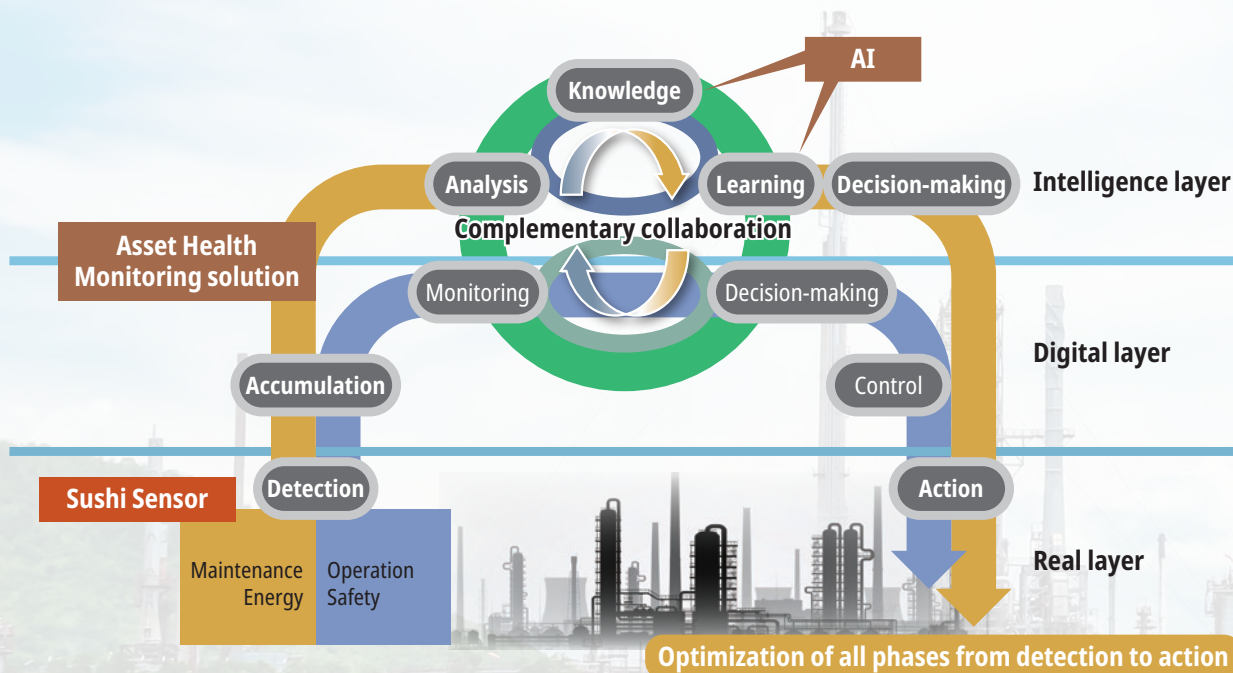
Yokogawa Advocates APM

Operation
Process control
Emergency shut-down

Facility maintenance
Trend monitoring
Cost calculation

Complementary collaboration

Yokogawa enhances the value of customers' facilities through asset performance management (APM).

To maximize the value of facilities, APM focuses on the availability of facilities and evaluates their performance. To maximize performance, APM should be performed not only in maintenance but also in operation and other areas where maintenance and operation must be collaborated to complement each other.

■ Complementary collaboration across departments

Sushi Sensor
A wireless sensor solution to monitor facility conditions. Accurate identification of facility conditions is the first step of APM.
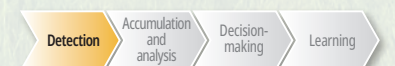
Asset Health Monitoring solution
This solution monitors facilities continuously and helps operators make quick decisions when a sign of abnormality is detected.

AI
Based on accumulated maintenance records, AI can convert tacit knowledge and experience into explicit know-how.

Conventionally, plant operation systems aim to improve production efficiency and product quality while facility maintenance systems aim to both maximize operational efficiency and minimize costs. However, when maximizing production efficiency, maintenance costs are not necessarily optimized. Although operation information and maintenance information must be combined to maximize profits for the whole plant, this is rarely achieved mainly because maintenance is not always quantified.

To solve this problem, Yokogawa has developed Sushi Sensor, which consists of a sensor that collects basic data for facility maintenance and functions that quantify, accumulate, and analyze these data, enabling operators to make objective judgements.

Sushi Sensor strengthens collaboration between operation systems and facility maintenance systems, achieving APM that optimizes all phases from the detection of facility conditions by sensors to decisions on appropriate actions by operators.

Yokogawa's APM not only optimizes facility maintenance but also improves the operation of the whole plant.

Detection → Accumulation and analysis → Decision-making → Learning

Sushi Sensor

Enhancing the value created by facilities

Condition-based maintenance (CBM) is the first step for enhancing the value created by facilities. To achieve CBM, facility conditions must be grasped. Conventional operator rounds are not ideal for this because increasingly complex facilities make it difficult to access all instruments and increase the time required for inspection.

To solve these problems, Yokogawa released Sushi Sensor, an ideal wireless solution for the IIoT.

Features of Sushi Sensor

Detection › Accumulation and analysis › Decision-making › Learning

Sushi Sensor is a wireless solution for the IIoT, monitoring facility conditions continuously.

- **■ Easy installation**
  - The rugged Sushi Sensor can be installed in harsh environments including hazardous areas.
  - The wireless function, battery, and sensor are integrated in a single body.
  - The LoRaWAN standard enables long-distance communication and thus flexible installation.
 - Easy mounting with a screw or magnet.
- **■ Easy setting**
  - Parameters can be set with a smartphone via near-field communication (NFC).
  - A user-friendly application is available for setting.
- **■ Easy data collection and monitoring**
  - Data can be collected over a wide area via long-distance wireless communication.
  - Collected data can be accessed from user applications regardless of the communication protocol.

Various parameters can be set with a smartphone.
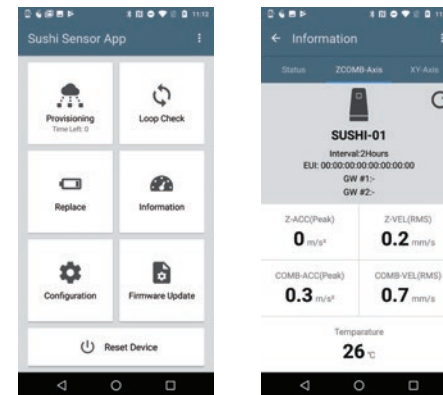
Application screen examples

XS770A Wireless Vibration Sensor

The XS770A is a wireless sensor for measuring the vibration and surface temperature of rotating equipment and other devices.
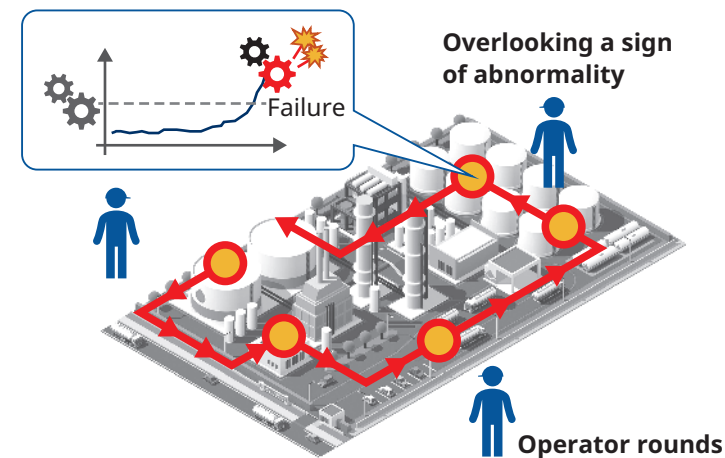
■ Specifications[*1]

Measurement data	Velocity, Acceleration, Surface temperature
Measurement axis	X, Y, Z axes and 3-axis composite
Measurement frequency range	10 Hz to 1 kHz
Measurement range	Velocity: 0 to 20 mm/s Acceleration: 0 to 130 m/s^2 Temperature: -20°C to +85°C
Ambient temperature	-20°C to +80°C
Communication	LoRaWAN™
Data update cycle	1 hour (typ.)
Battery life	4 years (data update cycle: 1 hour), Battery replaceable
Mount	Screw or magnet
Degree of protection	IP66/67
Explosion protected type	Intrinsically safe: ATEX Approval IECEx (approval under pending)

Magnet

Screw thread

XS770A

*1 Specifications may be changed without prior notice.

Benefits of Sushi Sensor

Detection › **Accumulation and analysis** › Decision-making › Learning

■ Before installation

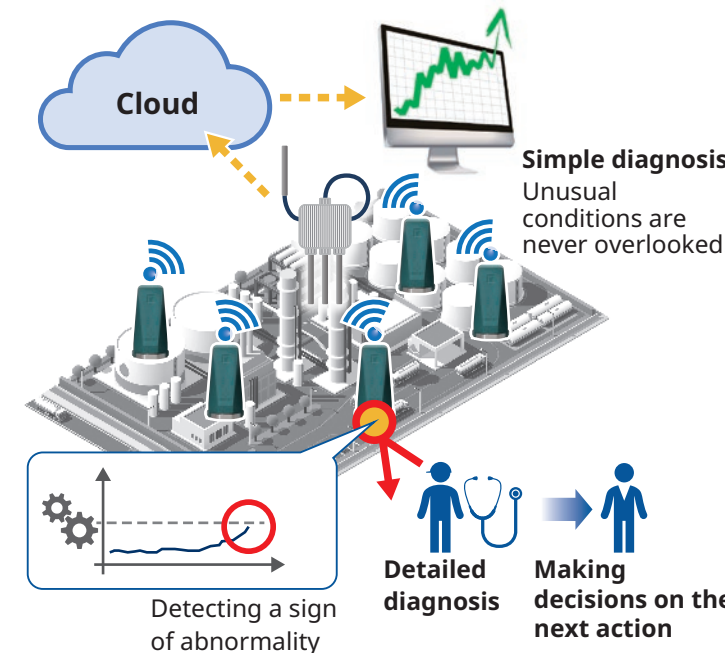Overlooking a sign of abnormality

Failure

Operator rounds

Operator rounds mainly confirm absence of abnormality signs in facilities, but are not ideal because:
- The required man-hours keep increasing as the number of facilities and items to be inspected keeps growing.
- In addition to manpower shortages, insufficient training results in insufficiently skilled field workers.
- Measurement results are not always quantified.

There is an increasing possibility of overlooking signs of abnormality.

■ After installation

Cloud

Simple diagnosis
Unusual conditions are never overlooked.

Detecting a sign of abnormality

Detailed diagnosis

Making decisions on the next action

Sushi Sensor continuously monitors target facilities. Data are quantified, accumulated, and used for simple diagnoses. Signs of abnormality in facilities are never overlooked.

- **■ Detailed diagnosis**
  When a sign of abnormality is detected, operators perform a detailed diagnosis to identify the cause.
- **■ Making a decision on the next action**
  Based on the results of the detailed diagnosis, operators decide an appropriate action and its schedule.

Examples
- Monitoring the vibration of cooling tower fans
- Monitoring the vibration of conveyers
- Monitoring the vibration of bearings in intake and exhaust blowers
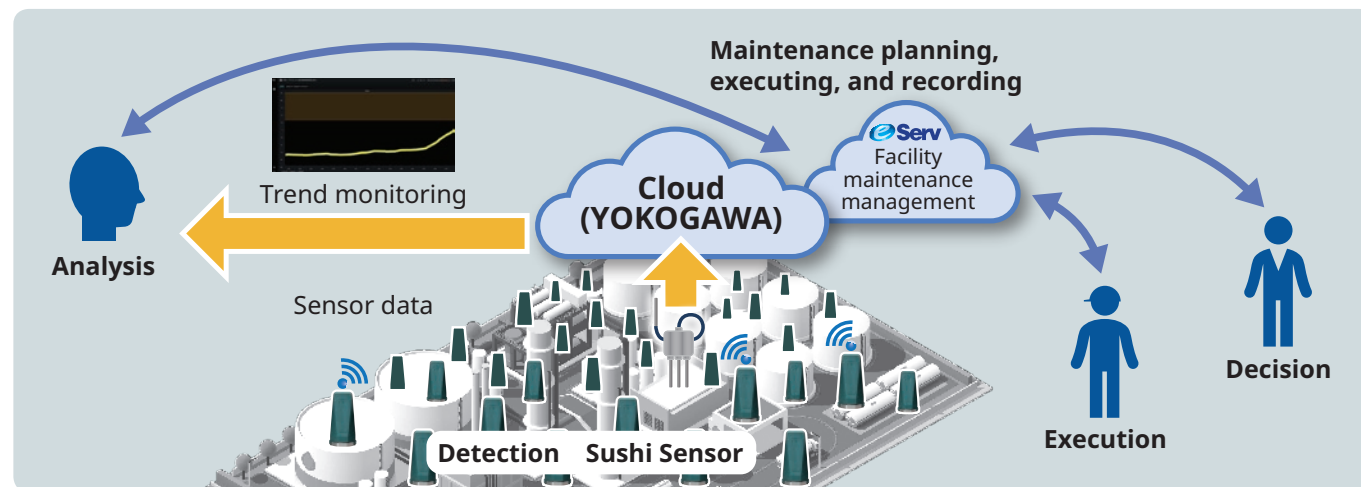
■ Benefits

- The required man-hours do not increase even when the number of facilities grows.
- Manpower shortages are resolved. Skilled workers can spend more time passing on their skills and know-how to other workers.
- Quantified measurement data help identify facility conditions more accurately.

Operators can concentrate on high value-added tasks such as detailed diagnoses and making decisions on the next action. A sign of abnormality is never overlooked and CBM is ensured.

Plant Asset Health Monitoring solution and Sushi Sensor

Plant Asset Health Monitoring solution monitors facilities continuously and helps operators make quick decisions when a sign of abnormality is detected.

Maintenance planning, executing, and recording

Trend monitoring — Cloud (YOKOGAWA) — eServ Facility maintenance management

Analysis — Sensor data — Detection — Sushi Sensor — Execution — Decision

■ Features

- Sushi Sensors are installed on many equipment and monitors their condition continuously.
- Condition data of equipment is accumulated in Cloud (YOKOGAWA).
- Cloud (YOKOGAWA) analyzes such as trend monitoring using accumulated data.

System components of Sushi Sensor

Name or model		Description
Sushi Sensor XS770A		Measures the vibration and surface temperature of facilities. Contains one dedicated battery.
LoRaWAN gateway		Receives measurement data from the XS770A and passes them to the cloud server or a on-premises server.
PoE injector*2		An adapter that superimposes 48 V DC on Ethernet signals
Ethernet switch with a PoE function*2		An Ethernet switch that outputs Ethernet signals on which 48 V DC is superimposed, and supplies power to the gateway
Android device		A device on which Sushi Sensor applications are used to set the XS770A
Cloud (YOKOGAWA)		Cloud service with which applications can access measurement data regardless of the communication protocol of the XS770A
Options		
GA10		Software that graphically displays measurement data and records them
Lithium battery		A battery for replacement. Four-piece and 12-piece sets are available.
Magnetic holder		A magnet for mounting the XS770A (Female screw)
NFC card		A memory device for storing a cryptographic key for LoRaWAN communication

*2 Either a PoE injector or an Ethernet switch with a PoE function is used.
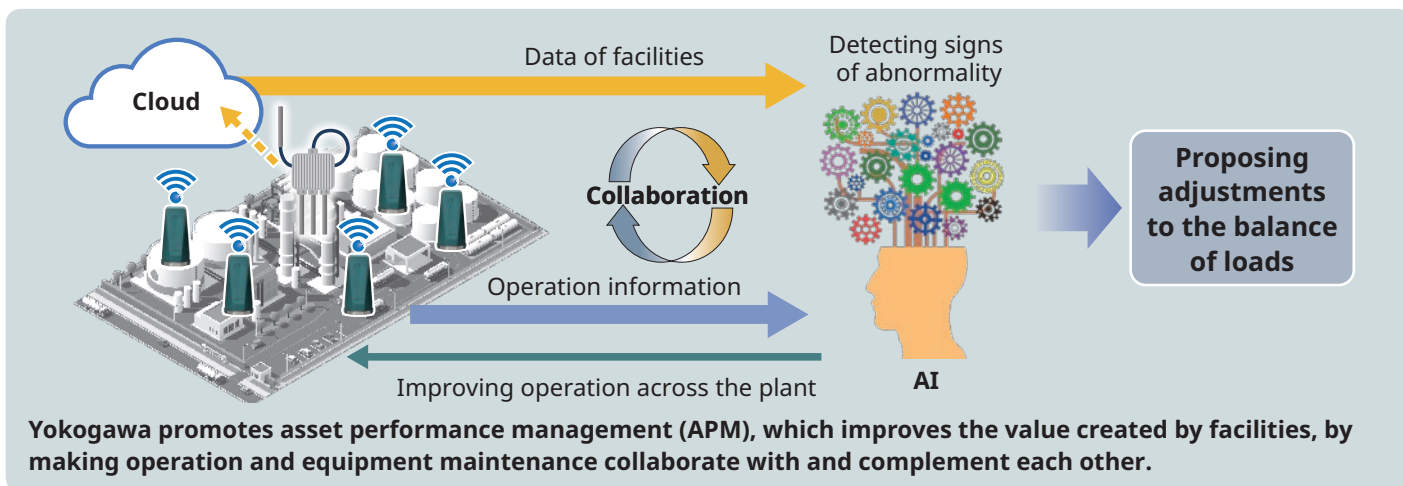
Sushi Sensor Q and A

Question	Answer
Why is it called Sushi Sensor?	Sushi Sensor was named after sushi, a hand-pressed traditional Japanese food which combines rice with various ingredients. (1) Sushi is easy to eat. Sushi Sensor can be easily installed. (2) Professionals prepare sushi. Sushi Sensor is a robust, finely-crafted product. (3) Sushi comes with various toppings. Various kinds of sensors are being developed for Sushi Sensor.
What is Sushi Sensor used for?	Sushi Sensor is expected to replace operator rounds of instruments and facilities by human workers. Sushi Sensor is typically used at a data collection cycle of about once an hour, which is more frequent than operator rounds by human workers (once a day, or once a shift). Customers can promptly detect changes in facility conditions. In addition, Sushi Sensor helps quantify and digitize check operations that depend on visual observation and other senses. By monitoring the trend of instrument and facility conditions, it is possible to detect signs of abnormality in instruments.
Why do you focus on detecting signs of abnormality in facilities?	Because it avoids overlooking unusual conditions and can exactly identify the status of facilities. Currently, operator rounds aim to confirm absence of abnormality signs in facilities. By automating this activity, human workers can concentrate on more complex tasks such as detailed diagnosis.
Are there any case examples?	One company installed the Sushi Sensor XS770A on pumps for six months and collected data on the surface temperature, vibration velocity, and acceleration every hour. When acceleration value increased and changed its slope, the pump was disassembled and it was found that the bearing had broken. An unexpected shutdown of facilities was prevented.
What is the role of AI?	The relation between data and abnormality of facilities is not yet clear. Although we have not yet released AI-enabled products, they are expected to identify this relation by advanced data processing and quickly detect signs of abnormality. Accumulating sufficient data before and after failures in the field will enable much of the detailed diagnosis to be automated in the future.
What is LoRaWAN?	It is one of the communication standards called Low Power Wide Area (LPWA), which are specifically for IoT communication handling small amounts of data such as sensor data. It features low power consumption enabling battery-powered long-distance communication. The LoRaWAN standard enables wireless infrastructure to be built easily and to cover a whole plant; it also enables sensors to be easily installed and operated.
How is it different from ISA100 Wireless?	ISA100 Wireless is a wireless communication system suitable for high-speed, high-reliability instrumentation. LoRaWAN, which is used in Sushi Sensor, features long-distance communication and long battery life but is not suitable for large-volume, frequent communication.

Information technology accelerates the improvement in the value of data

Sushi Sensor helps quantify and accumulate the results of maintenance. By combining with AI and other information technologies, it can accumulate know-how based on maintenance records.

Yokogawa is researching how to use AI for precisely detecting unusual conditions among stored data, and how to simultaneously analyze sensor data, operation information, and maintenance records. This will make it possible to detect signs of deterioration in equipment that cannot be detected only with sensor data. Detected signs will be fed back to operators, who can respond such as by adjusting the balance of operation and loads on facilities.

Cloud — Data of facilities → Detecting signs of abnormality

Collaboration

Operation information →

Improving operation across the plant

AI

Proposing adjustments to the balance of loads

Yokogawa promotes asset performance management (APM), which improves the value created by facilities, by making operation and equipment maintenance collaborate with and complement each other.

Sushi Sensor was named after sushi, a hand-pressed traditional Japanese food which combines rice with various toppings.

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