YOKOGAWA

Co-innovating tomorrow™

Smart Mining

The Future of Mining Plants Evolving Through Digital Technology

Bulletin 53Y01M01-01EN

Creating a Sustainable Future Together Through the Realization of **Smart Mining**

Worker and Plant Safety

- Introduction of Automation Technology
- Cyber Security Measures

Productivity Improvement

- Improving Efficiency Through Data Utilization
- Integration of IoT, AI, and Digital Twin

Optimal Plant Operation

- Strengthen Reliability with Smart Maintenance
- Minimizing Downtime

Modern society is dependent on mineral resources for automobiles, home appliances, batteries, infrastructure, and construction, and more. In this situation, the mining industry is facing complex issues such as responding to ESG (environment, society, governance) standards, resource depletion, geopolitical risks, labor shortages, and occupational safety. It is difficult to solve those problems with the existing individual optimization approach. Now addressing this challenge requires a perspective of overall optimization and industry-wide transformation.

Yokogawa promotes the transformation of mining plants by utilizing measurement and control technologies cultivated in the oil and gas industry over more than one hundred years, as well as technologies such as IoT, AI, and Digital Twin. We provide prompt support to mining companies and mines around the world through our global support structures, and work with the entire ecosystem to take on the challenge of solving complex issues.

Work together with Yokogawa to achieve sustainable mining that goes beyond conventional approaches

Customer's Challenges AsIs / ToBe

AsIs	ToBe
Hazardous work	Reducing the worker's burden and ensuring safety
The work varies depending on the operators	Autonomous operation by systems
The recovery rate does not improve	Continuous improvement in recovery rate
Insufficient equipment monitoring	All equipment monitoring in real time
Responding after a problem occurs	Problem prevention with predictive maintenance

Worker and Plant Safety

Fieldwork Support

Enable safe operations by real-time sharing and digitizing video and audio

On-Site Challenges

- **Takes time to get to the problem site**
- **Insufficient support leads to equipment failure and worker injury**

Solutions

- Check the on-site situation utilizing clear video and voice calls from remote locations
- Write instructions from remote locations on documents and images displayed on mobile devices in real time
- Record the work details along with video, and share the information and create a manual at a later date

Benefits

- If any problems arise, the on-site situation can be shared early, and support can be provided to the site from remote locations
- Reducing the on-site work time and system recovery time

Minimization of Cyber Attack Risk

Ensure appropriate security management for the customers' situations and effectively protect the plant from cyber attacks

On-Site Challenges

- **No measures in place for dealing with security incidents**
- **Not sure where to start with security measures**

Solutions

- Realization of end-to-end proposal and implementation of security measures, operation monitoring, and incident response based on IEC62443
- Target levels consideration based on cost-effectiveness
- Centralized security management with real-time monitoring
- 24/7 global management through help desk

Benefits

- Minimizing the monetary loss risks from cyber attacks
- Cost reduction by simplifying, standardizing, and further integrating security management
- Strengthen the security by complying with industry and enterprise security standards such as IEC62443

Productivity Improvement

Transformation into Data-Driven Operations

Organize workflows to support optimal on-site data utilization

On-Site Challenges

- **Little use of camera images and process data**
- **Unclear work procedures**

Solutions

- Organize the collected data and the use to create priorities and roadmaps for data utilization
- Hold workshops to clarify work procedures
- Introduce digital standard operating procedures (SOP) to achieve automation through systems

Benefits

- Operational transform tailored to actual work contents and data
- SOP facilitates skill transfer and reduces the burden of operators

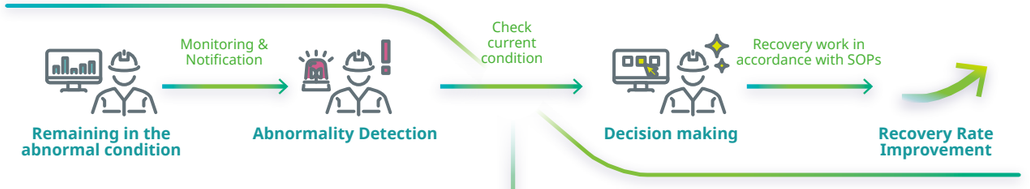
Flotation Use Case

Step 1 : Organize Data Usage and Work Procedures

Propose workflow improvements using unused data

Step 2 : Work Standardization and Automation

Achieve operational stabilization and early recovery by SOP introduction



Before : Frequently remains in the abnormal state

- The froth on the flotation cell surface are captured on camera but are not monitored by the operator. The abnormal froth conditions are left unchecked, adversely affecting mineral recovery rates.

After : Rapid detection and response to abnormal conditions

- Rapid detection and response to abnormal conditions automatically detects abnormal froth conditions by image-recognizing the camera image. Notify the operator and prompts the operator to respond quickly.

Before : The work varies depending on the operators

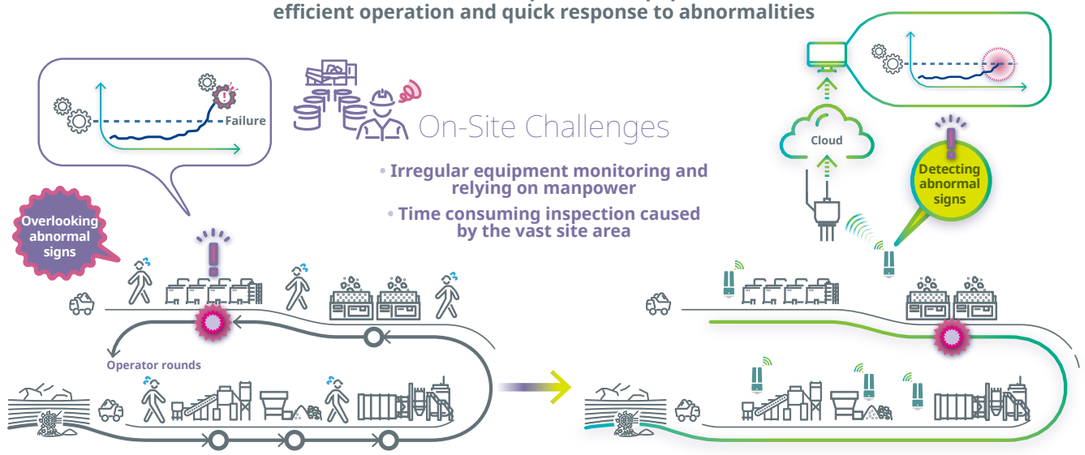
- Operator's work procedures for recovering from abnormal to normal conditions are inconsistent and vary.

After : Work is standardized and partly automated

- Identify and improve the operator's work procedures, and incorporated into the SOP.
- Minimize the person-hours required for recovery by automating works that can be systemized.

Equipment Condition Visualization

Real-time visualization of the entire plant and equipment condition enables efficient operation and quick response to abnormalities



Solutions

- Automatically collect equipment condition data at all times by utilizing the easy-to-install wireless sensors
- Monitor equipment condition on a dashboard and detect abnormal signs with AI

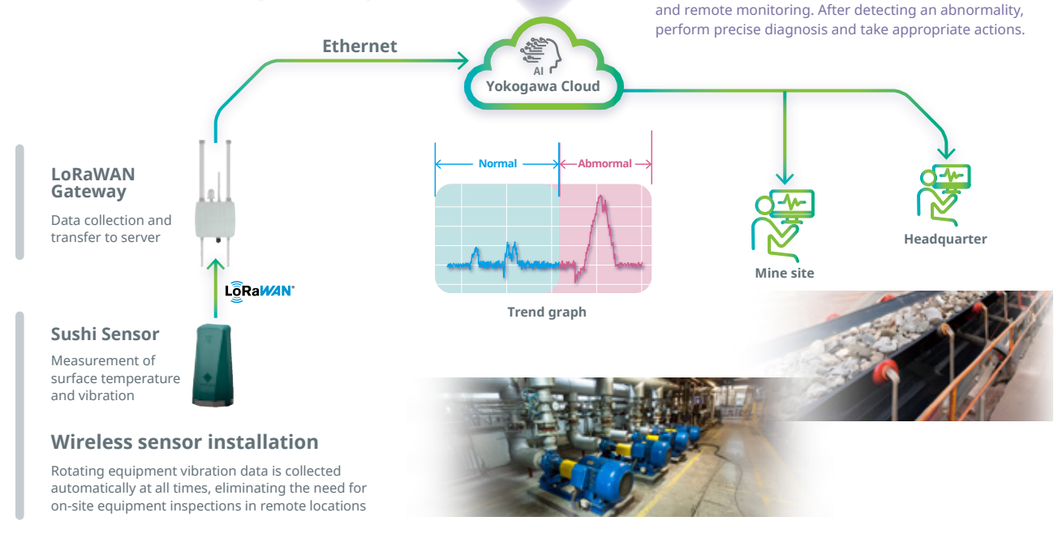
Benefits

- Reduce the person-hours for human inspection
- Stabilize inspection quality through quantifying and visualizing inspection work
- Prevent sudden, unexpected equipment failure

Rotating Equipment Use Case

Monitoring vibration data on the dashboard and detecting abnormal signs utilizing AI

Allow to monitor the equipment conditions using numerical values without relying on professional intuition and experience. Furthermore, by utilizing the cloud environment, realize AI-powered predictive maintenance and remote monitoring. After detecting an abnormality, perform precise diagnosis and take appropriate actions.



Wireless sensor installation

Rotating equipment vibration data is collected automatically at all times, eliminating the need for on-site equipment inspections in remote locations

Plant Operation Optimization Platform

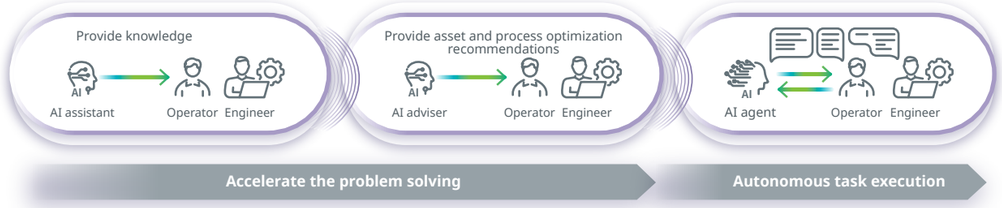
By utilizing Digital Twin for real-time data processing and autonomous problem-solving AI agents, maximize the use of assets such as equipment and support decision-makers in plant operations, thereby optimizing plant operations

Framework Proposed by Yokogawa

AOM (Asset Operations Management) is built on three technology pillars: Composability, AI/ML, and Digital Twin. It unifies operations, maintenance, reliability, and engineering to achieve operational excellence.

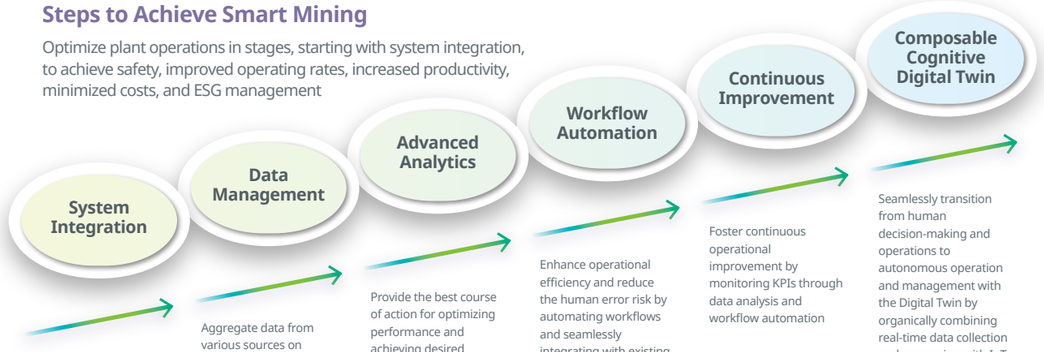
AI Is Evolving from Assisting Humans to Collaborating with Humans

AI agents not only perform specialized tasks to achieve business goals, but also communicate and coordinate with other AI agents to enhance problem-solving capabilities. This means that AI agents behave in the same way as operators and engineers have done until now.



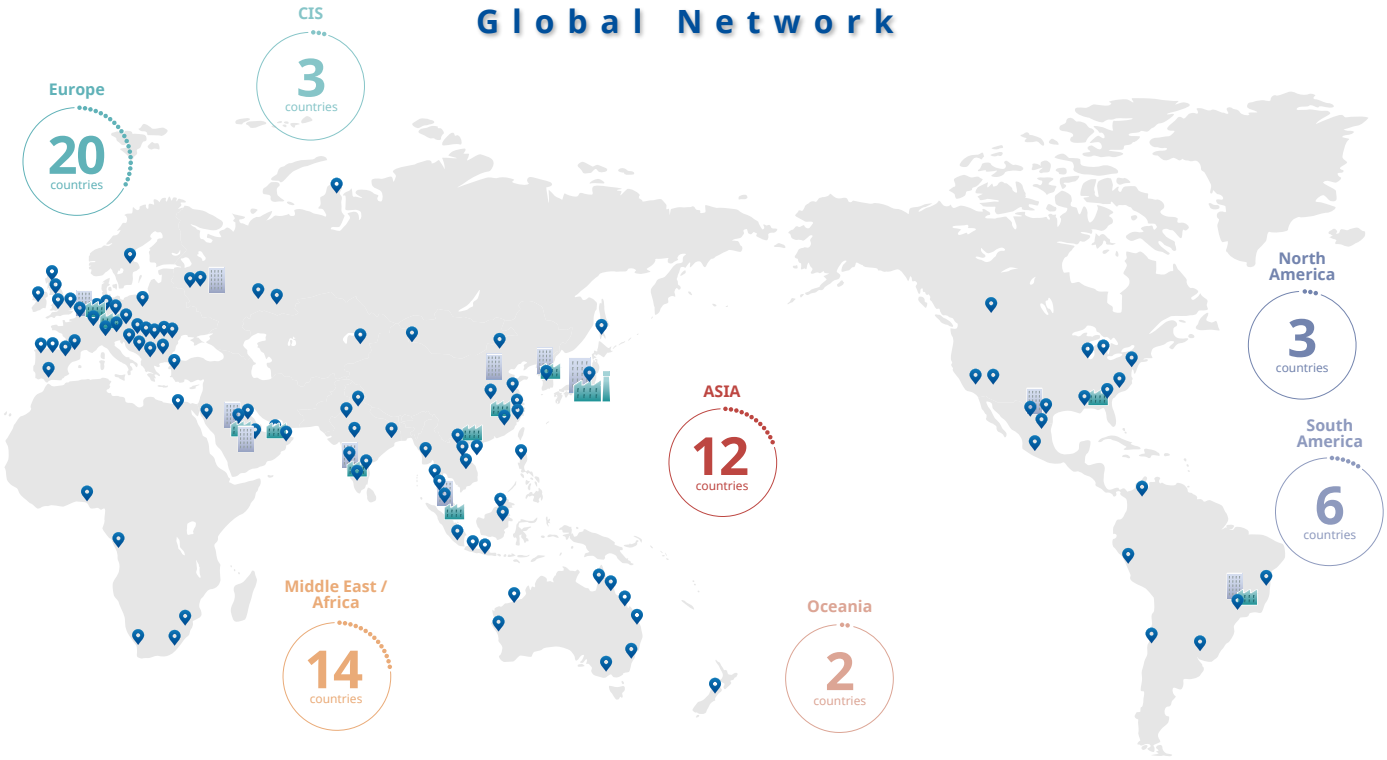
Steps to Achieve Smart Mining

Optimize plant operations in stages, starting with system integration, to achieve safety, improved operating rates, increased productivity, minimized costs, and ESG management



*OT : Operational Technology
IT : Information Technology
ET : Engineering Technology

Global Network



Subsidiaries and affiliates

13 in Japan | **113** outside Japan

*Includes branches and representative offices

Business sites

60 countries

Manufacturing sites

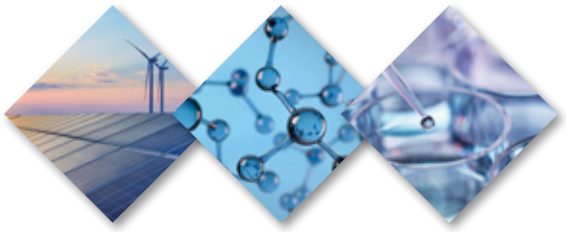
12 countries

Service network

Service sites **180+**

Service engineers **2,500+**

Since our inception in 1915, Yokogawa has been achieving a sustainable society through our business activities leveraging our expertise in measurement, control, and information technologies. Building on trust-based relationships with our worldwide customers, Yokogawa is creating new value across entire supply chains and shaping the future together.



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