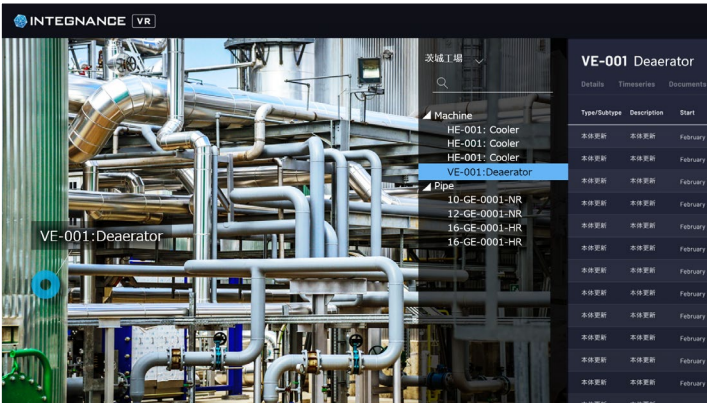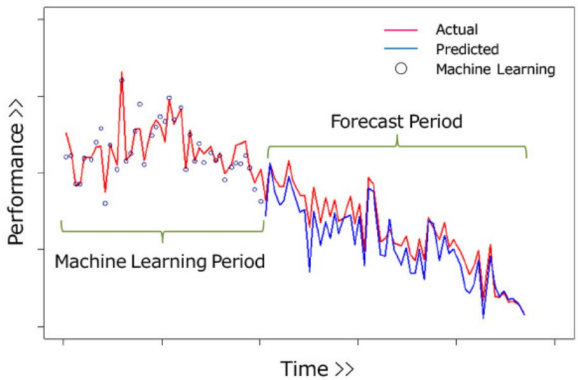# Smart O&M Solutions

JGC has developed digital solutions utilizing its extensive knowledge and experience from long-term O&M support to achieve work efficiency, sustainable technical transitions, and less manned operations. Additionally, cutting-edge digital twin technologies accelerate the transition of your conventional operation and maintenance to the next stage.
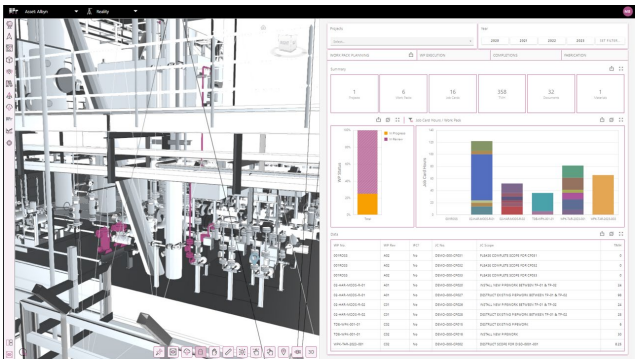
Service Menu

◆ **Maintenance Digital Twins Program**

INTEGNANCE VR
(Fast Digital Twin Maintenance Viewer)

◆ **Smart Turnaround Management Program**

MODS - Connect

◆ **Plant Smartification Program**

INTEGNANCE TR
(Predicting Failure of Rotating Machinery)

Plant Smartification with AI Technology

Remote Monitoring and Assistance

Fast Digital Twin Maintenance Viewer

**Plant Smartification
AI Analysis for Catalyst Deterioration**
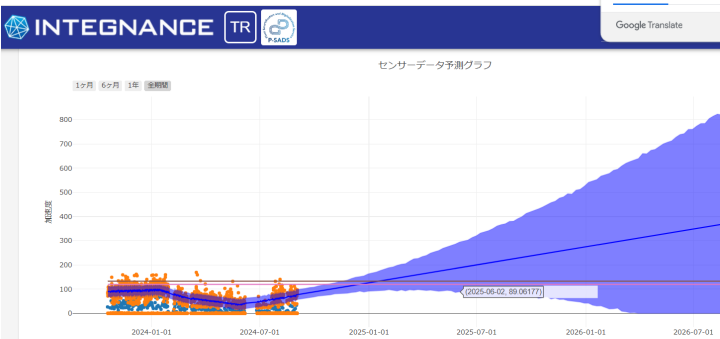
Predicting Failure of Rotating Machinery

MODS Connect

JGC **Operational** Excellence Services

Smart O&M Solutions

INTEGNANCE VR

Fast Digital Twin Maintenance Viewer

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Operation

Decarbonization

HSE

Reliability & Maintenance

Technical Assistance & Training

Smart O&M Solutions

Operational Excellence Services

INTEGNANCE VR-Fast Digital Twin Maintenance Viewer

Do you have any of these issues?

☹ **Struggling with promoting DX to aging plant which doesn't have 3D model**

☹ **Wasting time on Site Visit for repair work planning, inspection planning, and daily maintenance work planning**

☹ **Outdated or missing blueprints**

Our Solutions

- Our "Fast Digital Twin" replicates your plant as 3D model within 3 days at the earliest
- Without going to the site, maintenance planning can be developed via web
- Direct recording into a 3D model with tablets on-site is an efficient way to share site data without the need for blueprints

(*)INTEGNANCE VR is developed by Brownreverse which is one of JGC group companies.

Brownreverse

3D Viewer development/provision (INTEGNANCE VR)(*)

INTEGNANCE VR

8B-PD-1002-A1

360 panorama

3D point cloud model

3D scanning

Wearable 3D Imaging Scanner

Drone
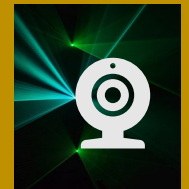
Imaging Laser Scanner

Enhancing **planetary health**

INTEGNANCE VR-Fast Digital Twin Maintenance Viewer

Key Features
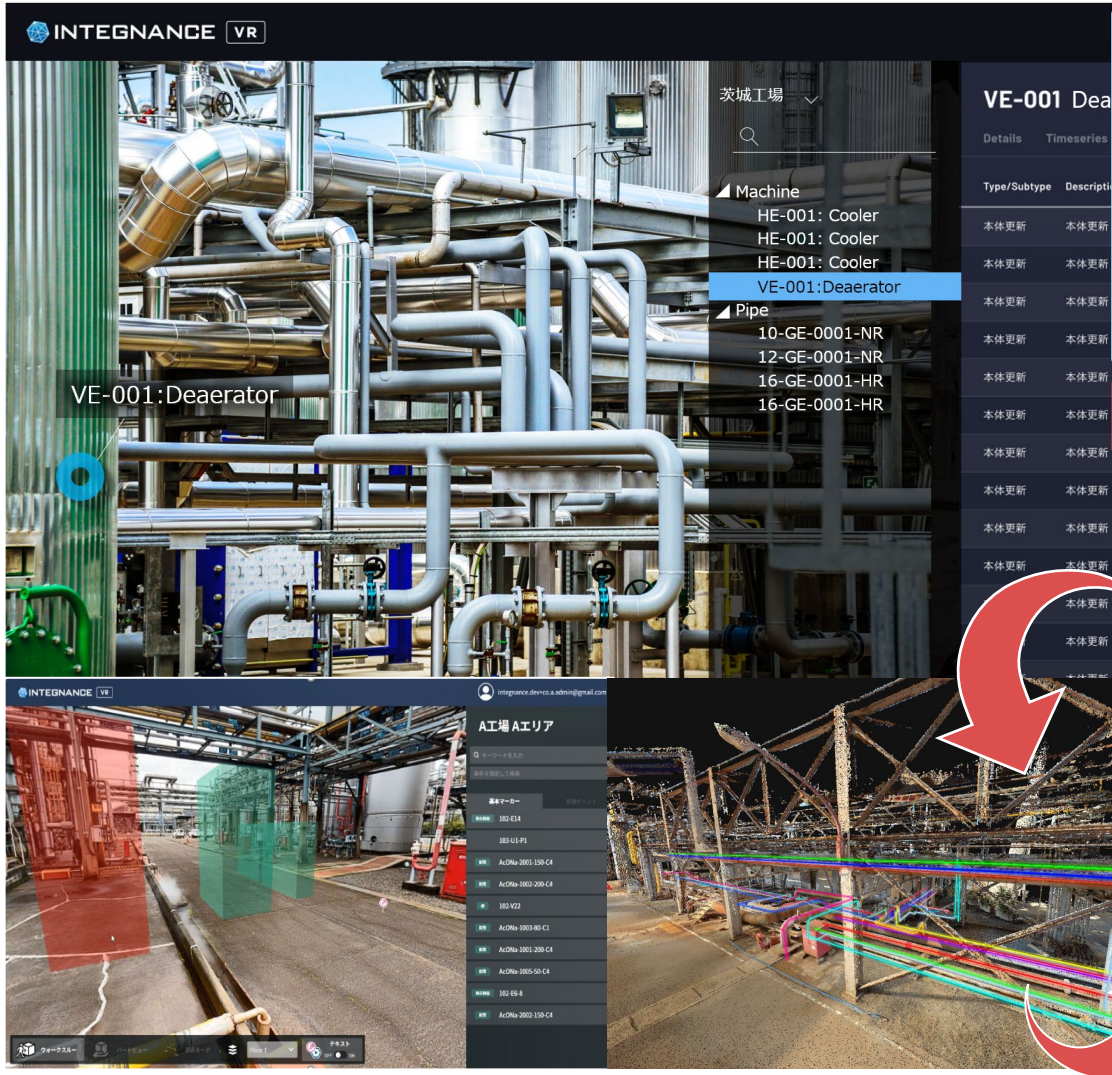
3D Simulation

Planning of scaffolding area, Checking of material delivery routes, complicated construction, etc.

Desktop Survey

Measure the length between two points on the display without reading the drawing or measuring the actual length in the site.

Anytime Anywhere Access

No special hardware required.
Easy sharing thru URL.
collaborative editing by multiple users.

Apps for Windows/iOS
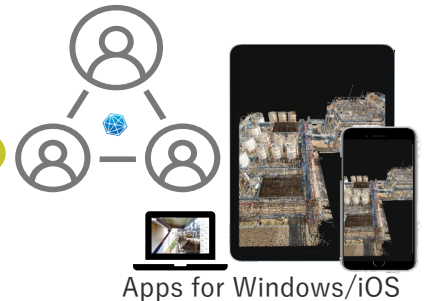
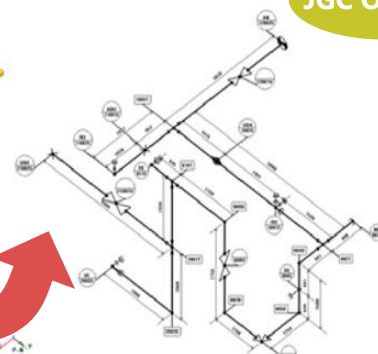### Automatic Piping Recognition

JGC Original

Mapping of corrosive loops and corrosion /damage focus areas on 360 panorama image

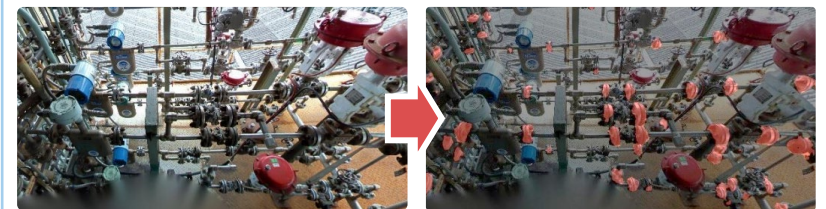### Automatic Isometric Output

JGC Original

Automatic Flange/Valve Detection

JGC Original

Auto detection of flanges/valves positions form 360 panorama image by utilizing AI machine learning technology
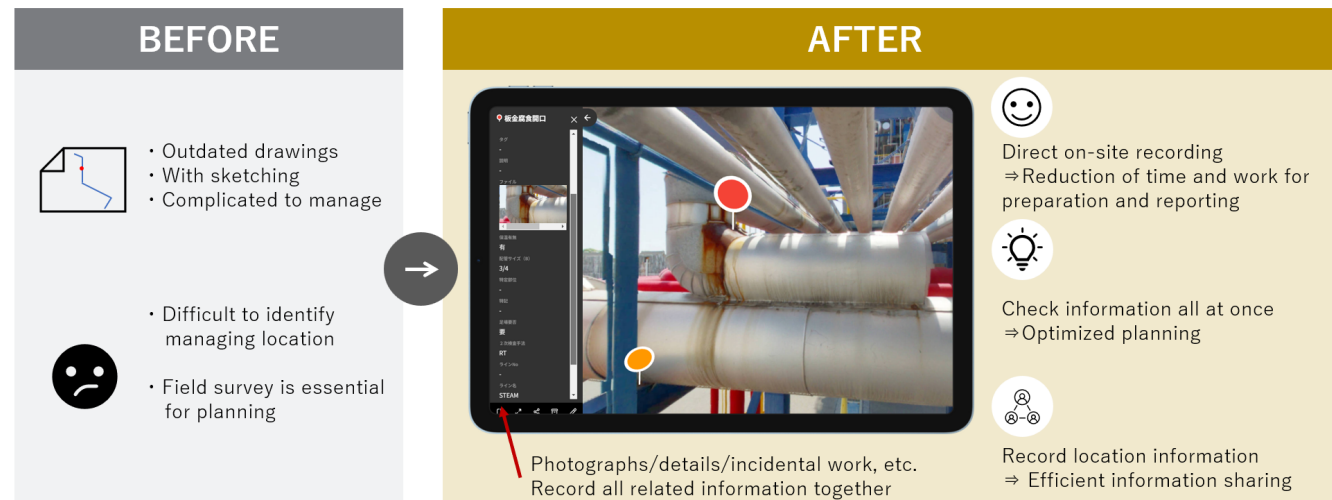
Enhancing **planetary health**

INTEGNANCE VR-Fast Digital Twin Maintenance Viewer

Use Case

Direct recording of 3D model into tablets on-site saves 22,500hr from 50,000hr annually. (45% reduction*)

BEFORE

- Outdated drawings
- With sketching
- Complicated to manage

- Difficult to identify managing location
- Field survey is essential for planning

AFTER

Direct on-site recording
⇒Reduction of time and work for preparation and reporting

Check information all at once
⇒Optimized planning

Record location information
⇒ Efficient information sharing

Photographs/details/incidental work, etc. Record all related information together

*5,000 cases annually

System Integration

Integrating data infrastructures* with WEB API makes it easier to reference and update related information on INTEGNANCE VR.

Providers under consideration

API Linkage

DataOps — COGNITE 【CDF】 — AVEVA 【AIM】 — HEXAGON 【SDx】

Facility/operation management — FUJITSU 【PLANTIA】 — YOKOGAWA 【PI-System】 — IBM 【Meridium】

construction/ inspection management — JGC 【A-MIS】 — VALQUA 【SPM】 — CoreSafety

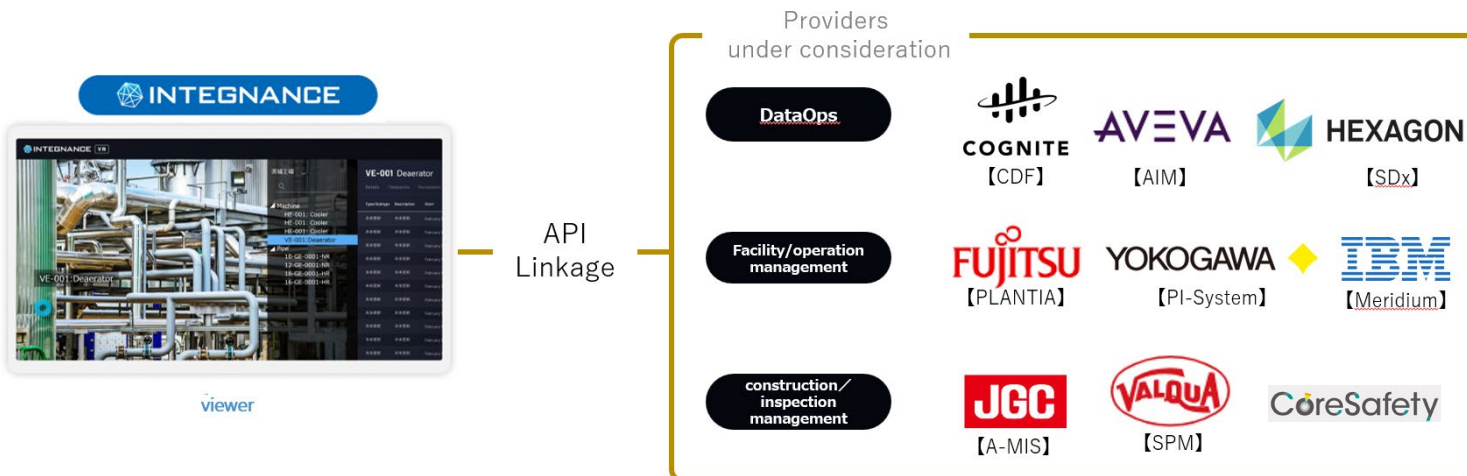*PoC with various providers is being implemented and discussed based on requests from clients.

Our Experiences

Over 50 Sites

INTEGNANCE VR has been adopted to over 50 sites.

Recent news:
INTEGNANCE VR was adopted for an ammonia production base in Indonesia for a joint study on reducing GHG emissions.(Sep 2024)

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Smart O&M Solutions

MODS Connect

Smart Turnaround Management

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Access to MODS Connect

Industrial Construction Management Software | MODS Connect | MODS

MODS Connect-Smart Turnaround Management

Do you have any of these issues?

- **Desire efficient information sharing and status update with digital tools during turnaround**
- **Struggling with transitioning to paperless work management**
- **Need to optimize the turnaround plan effectively**

Concept of MODS Connect for Turnaround

- A cloud-based solution that digitalizes, visualizes and automates Turnaround Project workflows, MODS Connect simplifies processes, improves safety, optimizes cost and time efficiencies.
- It enables remote collaboration and information sharing to help users make best decisions every day from turnaround planning to execution.

As flexible as comprehensive MODS Connect ecosystem includes 5 intelligent modules that connect in any combination.
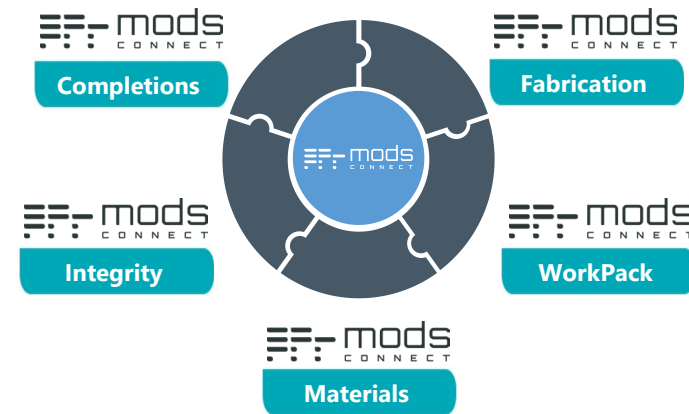
> Completions

Facilitate a controlled, staged transfer of responsibility under each discipline via an intelligent centralized database.

> Integrity

Provide the digital intelligence to ensure leak-free startup, process safety and major hazard avoidance.

> Materials

Intelligent inventory control of materials, equipment and components to ensure delivery on time, in sequence and to the correct location.

> Fabrication

Intelligently track components throughout the upstream fabrication process to provide transparency, traceability and reliable supply-chain control.
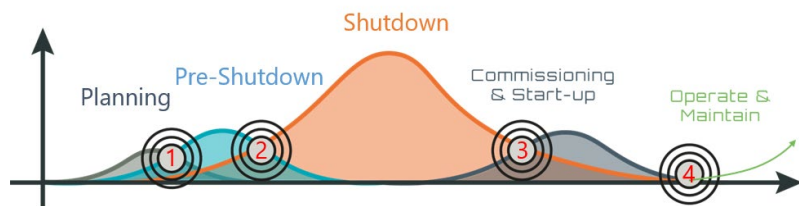
> WorkPack

Go paperless with digital work packs for more intelligent, transparent and accountable project execution

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MODS Connect-Smart Turnaround Management

Seamless Turnaround Management

MODS Connect achieves seamless interface management during turnaround activities

> ### 1.Planning to Pre-Shutdown

Manage the pre-shutdown work by assessing risks, scheduling tasks, and preparing resources based on the accumulate past experiences and knowledge in the database.

> ### 2.Pre-Shutdown to Shutdown

Assign successors and predecessors to define the path of shutdown work, identify execution requirements to allow constraint management

> ### 3.Shutdown to Start-up

Monitor shutdown work progress utilizing mobile devices, complete installation and quality records on mobile technology to provide real time tracking.

Visualize shutdown to commissioning handover.

> ### 4.Handover

Provide Realtime handover acceptance for operational hand over and stable operations
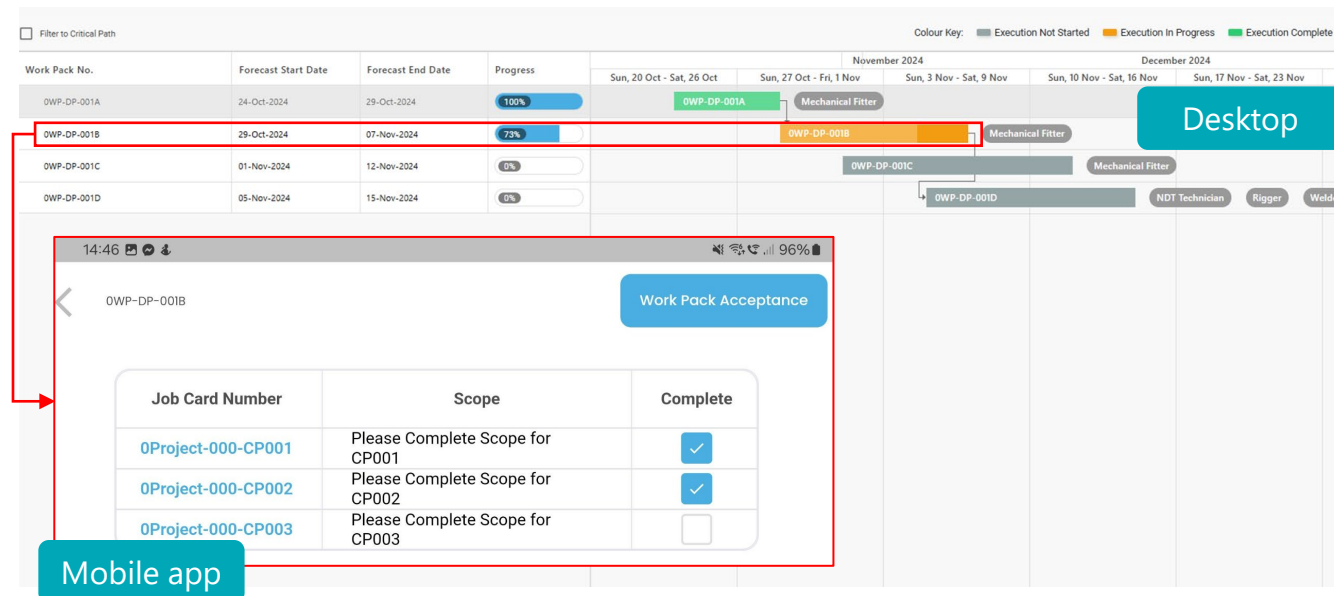
Gant chart monitoring and managing of activities on desktop and mobile app

Client's Benefits

- Reduces costs, for example, by reducing time spent searching for data by ~50%.
- Improves safety through transparent, streamlined workflows to minimize risk and increase the awareness of teams.
- Streamlines complex processes and maximizes resource utilization and efficiency.

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JGC Operational Excellence Services

Smart O&M Solutions

INTEGNANCE TR

Predicting Failure of Rotating Machinery

Smart O&M Solutions

Operation

Decarbonization

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Reliability & Maintenance

Technical Assistance & Training

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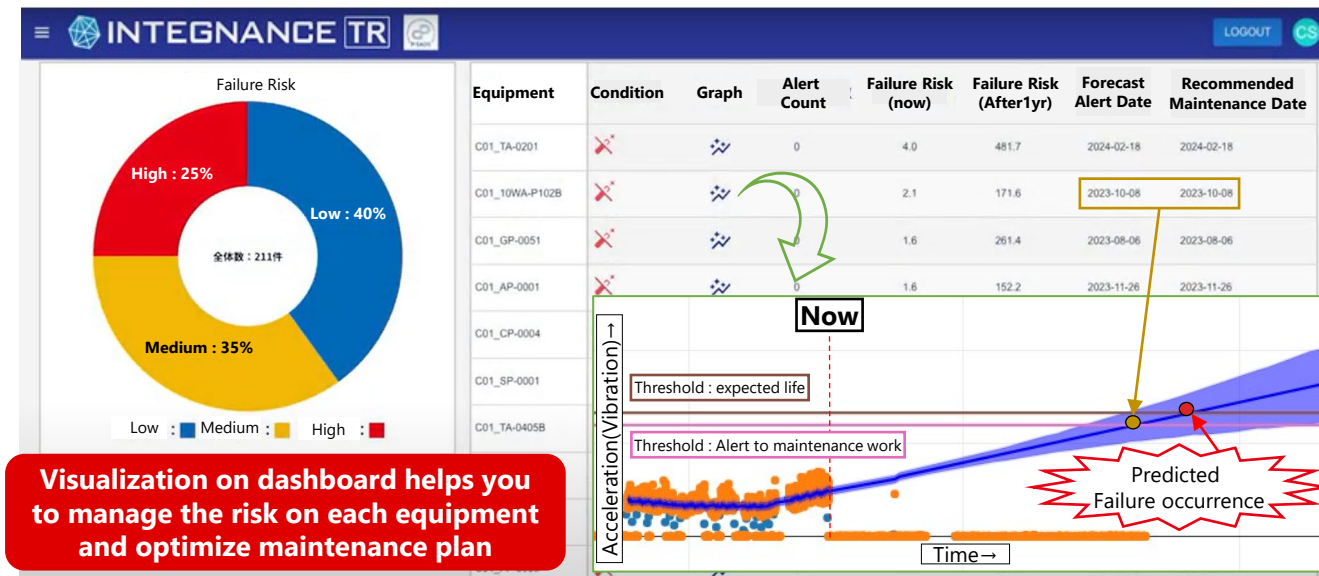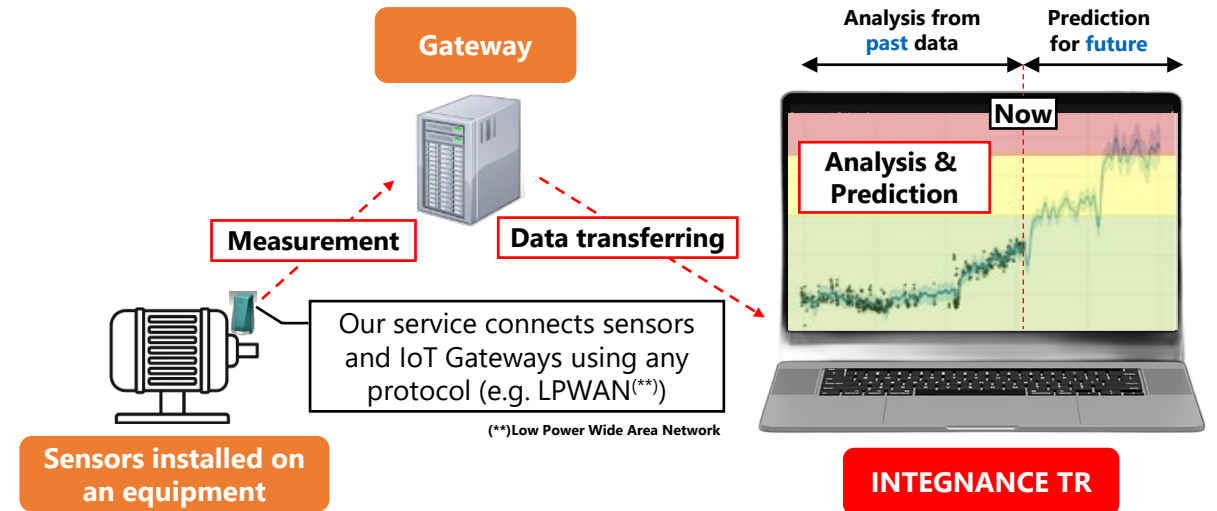# INTEGNANCE TR-Predicting Failure of Rotating Machinery

Do you have any of these issues?

- **Need to predict failure event to minimize production loss**
- **Need to optimize maintenance plan and cost for rotating machinery with/without existing sensors**
- **Struggling to accumulate maintenance knowledge**

What is INTEGNANCE TR(*)

- **Web-Based Analysis Tool:**
  INTEGNANCE TR, one of JGC in-house software, analyzes and visualizes the predicted condition of rotating machines by modeling time series data from sensors (e.g., vibration, temperature).
- **One-Stop Service:**
  Provides comprehensive services, including the installation of sensors and gateway devices to connect equipment to the cloud, AI modeling, and cloud-based visualization, all with secure data transfer protocols.
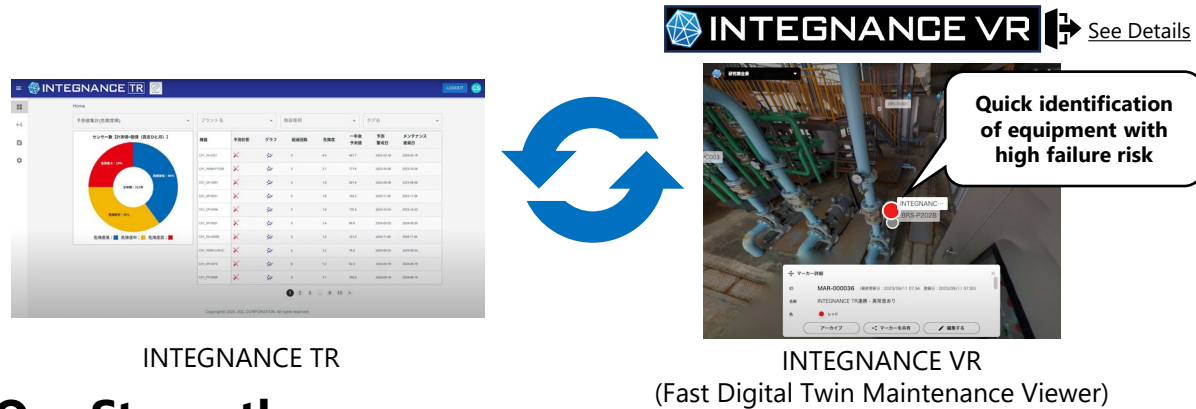
(*)**T**ime series regression forecast for **R**otating machinery

Gateway

Measurement

Data transferring

Our service connects sensors and IoT Gateways using any protocol (e.g. LPWAN(**))

(**)Low Power Wide Area Network

Sensors installed on an equipment

Analysis from **past** data — Prediction for **future**

Now

Analysis & Prediction

INTEGNANCE TR

Failure Risk

High : 25%
Low : 40%
全体数 : 211件
Medium : 35%

Low : ■ Medium : ■ High : ■

Equipment	Condition	Graph	Alert Count	Failure Risk (now)	Failure Risk (After1yr)	Forecast Alert Date	Recommended Maintenance Date
C01_TA-0201			0	4.0	481.7	2024-02-18	2024-02-18
C01_10WA-P102B			0	2.1	171.6	2023-10-08	2023-10-08
C01_GP-0051				1.6	261.4	2023-08-06	2023-08-06
C01_AP-0001				1.6	152.2	2023-11-26	2023-11-26
C01_CP-0004							
C01_SP-0001							
C01_TA-0405B							

Now

Threshold : expected life

Threshold : Alert to maintenance work

Predicted Failure occurrence

Acceleration(Vibration)→

Time→

Visualization on dashboard helps you to manage the risk on each equipment and optimize maintenance plan

Enhancing **planetary health**

INTEGNANCE TR-Predicting Failure of Rotating Machinery

Linkage to Virtual Reality

- **VR-Linked Monitoring**
  Track equipment failure risks with INTEGNANCE VR.
- **Quick Anomaly Response**
  Technical staff can quickly act on alarms and share equipment status and location.

See Details

Quick identification of equipment with high failure risk

INTEGNANCE TR

INTEGNANCE VR
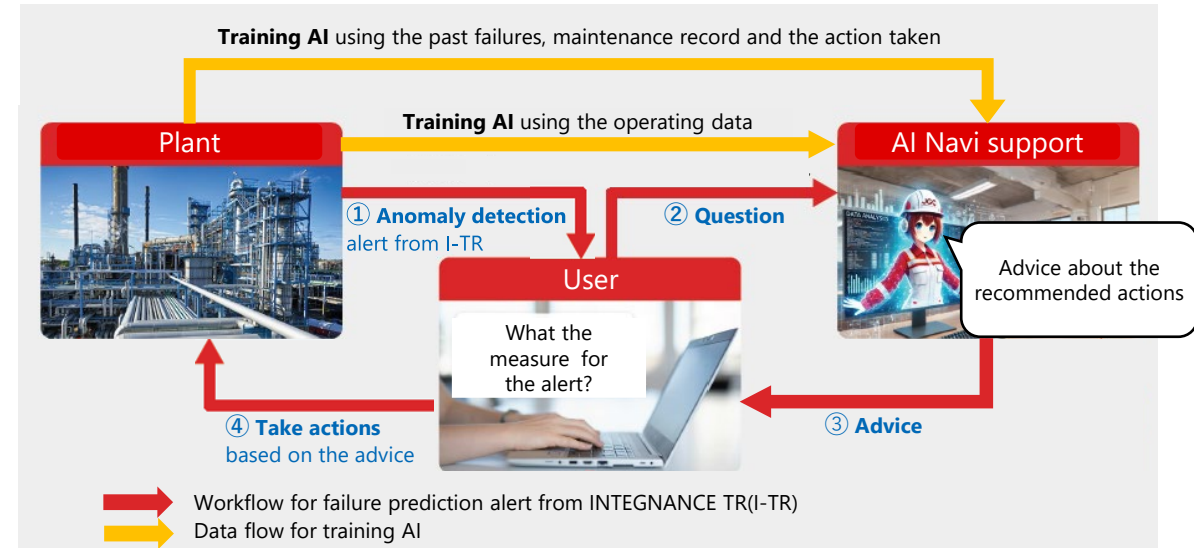(Fast Digital Twin Maintenance Viewer)

Our Strengths

- **Customized AI Algorithms:**
  Leveraging extensive plant engineering expertise, we develop tailored AI algorithms for specific equipment and situations.
- **Flexible Integration:**
  Our system seamlessly connects with sensors from any vendor.
- **Cost-Effective:**
  We offer low implementation and licensing costs.

Future Features of INTEGNANCE TR

- **AI Navi** (*) **Integration:**
  Get advice based on past failures, actions taken, and operating data.
- **Prescriptive Maintenance:**
  Combining INTEGNANCE TR and AI Navi for proactive solutions.
- **Knowledge Standardization:**
  AI Navi captures and standardizes expert knowledge for sustainable transitions.

(*)AI Navi is under development by JGC

Training AI using the past failures, maintenance record and the action taken

Training AI using the operating data

Plant

AI Navi support

① Anomaly detection alert from I-TR

② Question

User

What the measure for the alert?

Advice about the recommended actions

④ Take actions based on the advice

③ Advice

Workflow for failure prediction alert from INTEGNANCE TR(I-TR)
Data flow for training AI

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INTEGNANCE TR-Predicting Failure of Rotating Machinery

Use Case : Failure Prediction in Oil Refineries

Client: Japanese oil refinery

- Predictive maintenance for the rotating machinery in offsite area
- Approximately 300 rotating machinery (e.g., pump, mixer) without sensors monitoring its condition

Client benefit

- **Prevent Unexpected Shutdowns:**
  Timely maintenance prevents unexpected equipment failures.
- **Remote Monitoring:**
  Expanded from 300 to 800 rotating machines monitored remotely.
- **Reduced Maintenance Costs:**
  Optimize maintenance schedules to reduce costs.

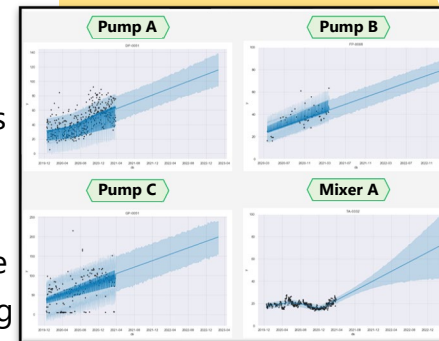## Pilot Implementation

Full-scale Operation

Initial Setup

- **Vibration Monitoring:**
  Connected sensors to monitor vibration acceleration.
- **AI Model Development:**
  Developed and trained an AI model using past operating data.
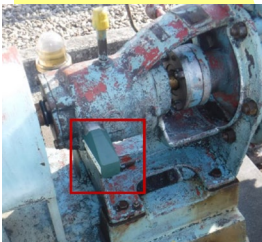
Validation of AI model

- **Trend Detection:**
  Identified increasing vibration acceleration trends in various types of rotating machineries
- **Condition Check:**
  Client inspections confirmed failure symptoms actually in these rotating machineries which trended to increase vibration
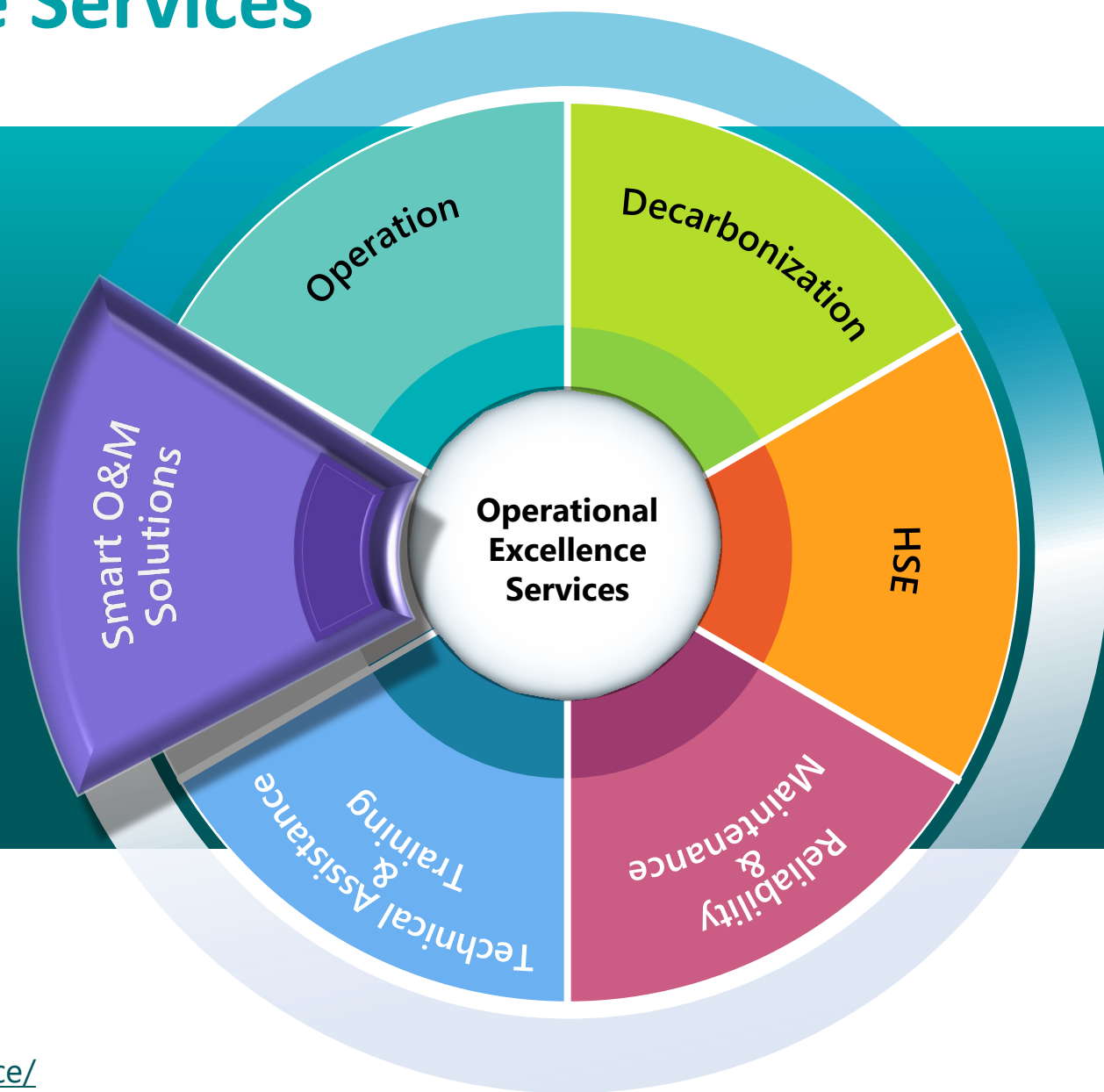

Go Live and Roll Over

- **Go Live:**
  Full-scale operation of INTEGNANCE TR has been commenced.
- **Roll Over:**
  Expansion of INTEGNANCE TR in the Client's other 2 plant as well and monitored approximately 800 rotating machinery totally.

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Smart O&M Solutions

Plant Smartification with AI Technology

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Diagram labels:
- Operation
- Decarbonization
- HSE
- Reliability & Maintenance
- Technical Assistance & Training
- Smart O&M Solutions
- Operational Excellence Services

Plant Smartification with AI Technology

Do you have any of these issues?

🙁 Lack of specific expertise for O&M improvement

🙁 Decline in productivity due to plant aging

🙁 Accumulated large amount of data but not being used

🙁 Knowledge gained through the experience of senior O&M personnel is not shared well with other members of the team.

Why choose an AI Solution with JGC

Know your Process Design	Extensive achievement in process engineering for various types of EPC project
Longstanding O&M Service	Our team has wide knowledge and experience in O&M service
Multi-field Engineers	Our engineers can propose AI solution with multiple fields including process, pressure vessels, rotating equipment, static equipment, electrical, instrumentation, HSE, etc.

Excellent AI experts	Extensive successful experience in providing AI solutions and well-developed implementation methodology.
30+ Cases	Prediction of catalyst degradation, Digital systemization of O&M, Equipment Failure Prediction System...etc.
Various Types of Facilities	Oil Producing, Power Plant, LNG Plant, Chemical plant, Space station, Waste treatment plant...etc.

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Plant Smartification with AI Technology

Our Solution

Operation Visualization
Visualize plant operation data to intuitively determine operating conditions

Anomaly Detection
**Quickly detect abnormalities and analyze causes** to prevent any unforeseen events and trouble

Prediction of age-related deterioration.
Predicts age-related deterioration of catalysts, solvents, etc., and suggests optimal replacement times.
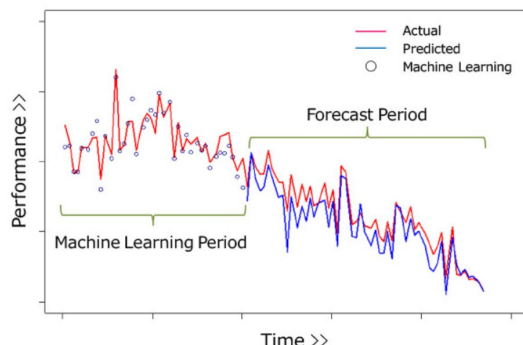
Productivity Improvement
Incorporating external factor such as climate data into operational data analysis to improve productivity
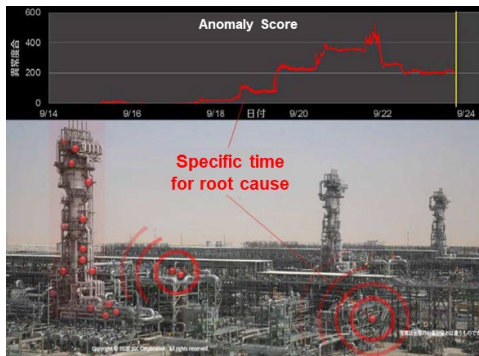
Trace the process determine the cause

Time-dependent catalyst deterioration

Our Approach

Workshop

Proposal

Contract

Discussions between client and JGC data analysis engineers (1.5-2 hours/workshop x 1 or more times as required).
- Identification of customer recognized and potential issues
- Planning of problem-solving measures
- Confirmation of quantity and quality of data required for data analysis

Mobilize Team and Engineer

Offer the best methods such as:
- Report on cause investigation, etc.
- AI software (GUI of customer's choice)
- Automation system
- Image identification equipment
- Consultant for customer's AI construction and use

AI Digital Solution

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Case Study: Analysis equipment clogging factors in Chemical plant

(1) Issue

- 🙁 **Equipment clogging occurs frequently**
- 🙁 To clean the clogging, the plant had to be shutdown and resulting in a **significant loss of production.**
- 🙁 Difficult to analyze **the large number of operating conditions** under which clogging occurs.

(2) Our Solution

Step-1 To develop AI model based on algorithms for LightGBM Classifier model to investigate operating conditions during clogging for the past 10 years

Step-2 The model calculates clogging in real time during operation and extracts operational factors (e.g., sensor values) related to blockages sequentially.

Step-3 Approximately 20 factors representing operating conditions that contribute to blockage were found. The top three factors were visualized as a three-dimensional plot. **(Fig. 1)**

Step-4 The result allows engineers to properly analyze the elements causing the clogging and develop an efficient solution.
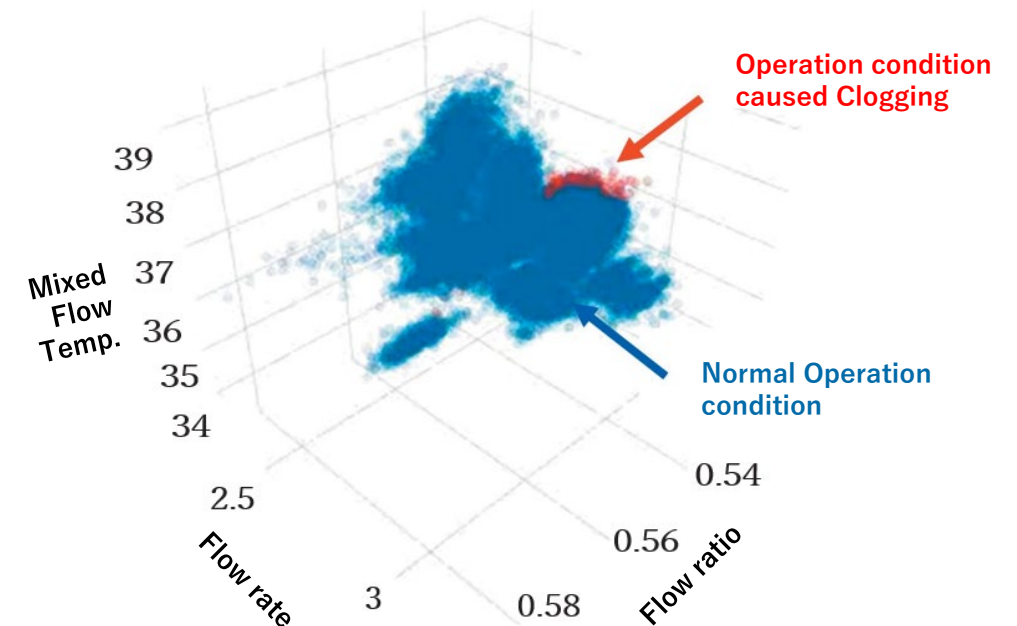

Operation condition caused Clogging

Normal Operation condition

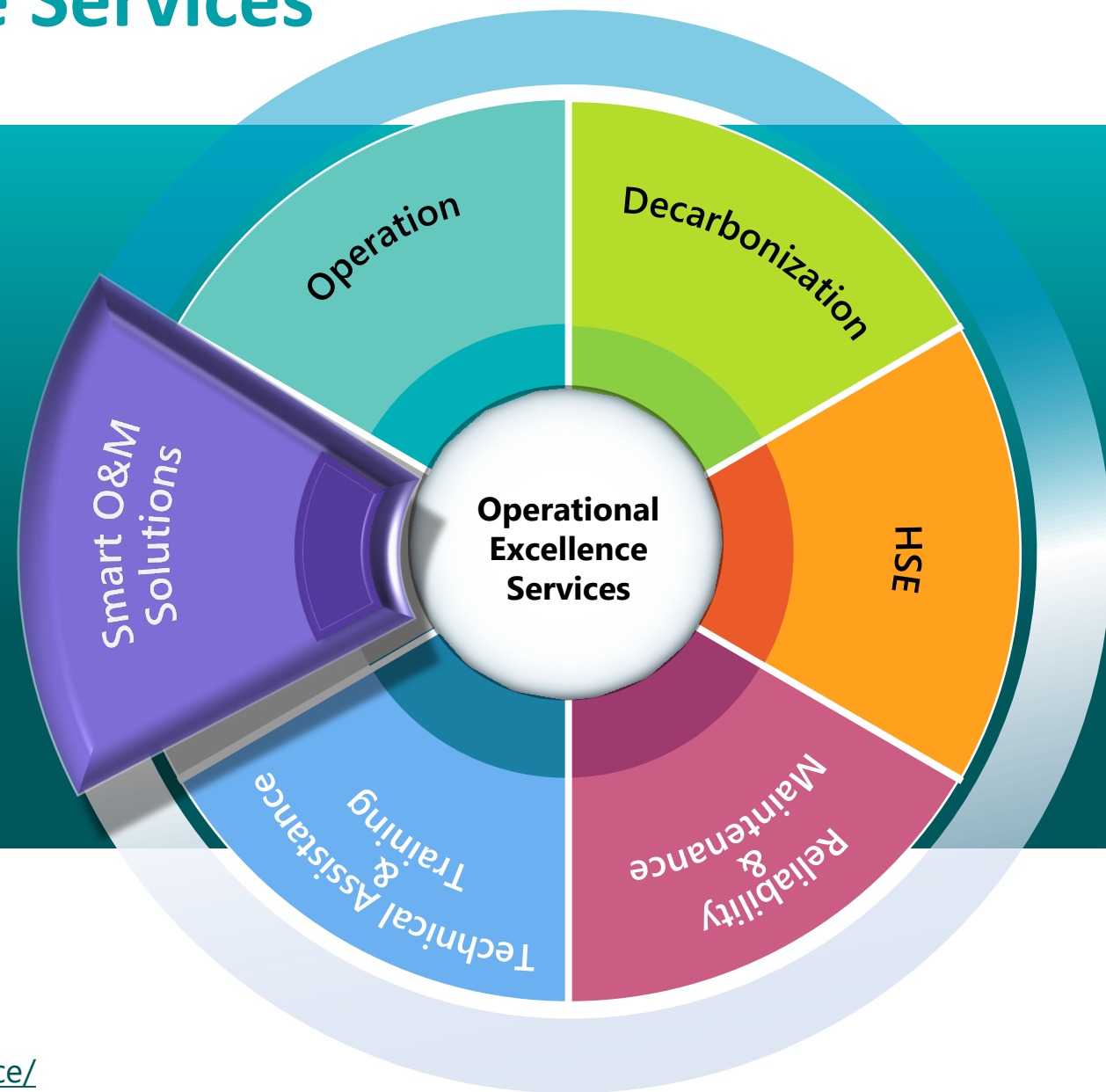**Fig.1 3D visualization of elements causing clogging**

(3) Client's Benefit

Improved productivity was achieved by operating to prevent clogging

![JGC] **Operational Excellence Services**

Smart O&M Solutions

Remote Monitoring and Assistance

Diagram labels: Operation · Decarbonization · HSE · Reliability & Maintenance · Technical Assistance & Training · Smart O&M Solutions · Operational Excellence Services

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Remote Monitoring and Assistance

Do you have any of these issues?

☹ **Restricted number of persons for site access**
☹ **Understanding operational status of remotely located plants**
☹ **Identify improvement opportunities in operations**
☹ **Problem-solving teams on technical troubles**
☹ **Lack of experienced engineers & technicians**

Our Solutions

- Remotely visualize the operations data or share the operations information with the remotely located plant site and our Global Operating Center and solve the problem with clients as "one team".

- Without dispatching experts to the site, our expert team at Global Operating Center will support clients with troubleshooting.

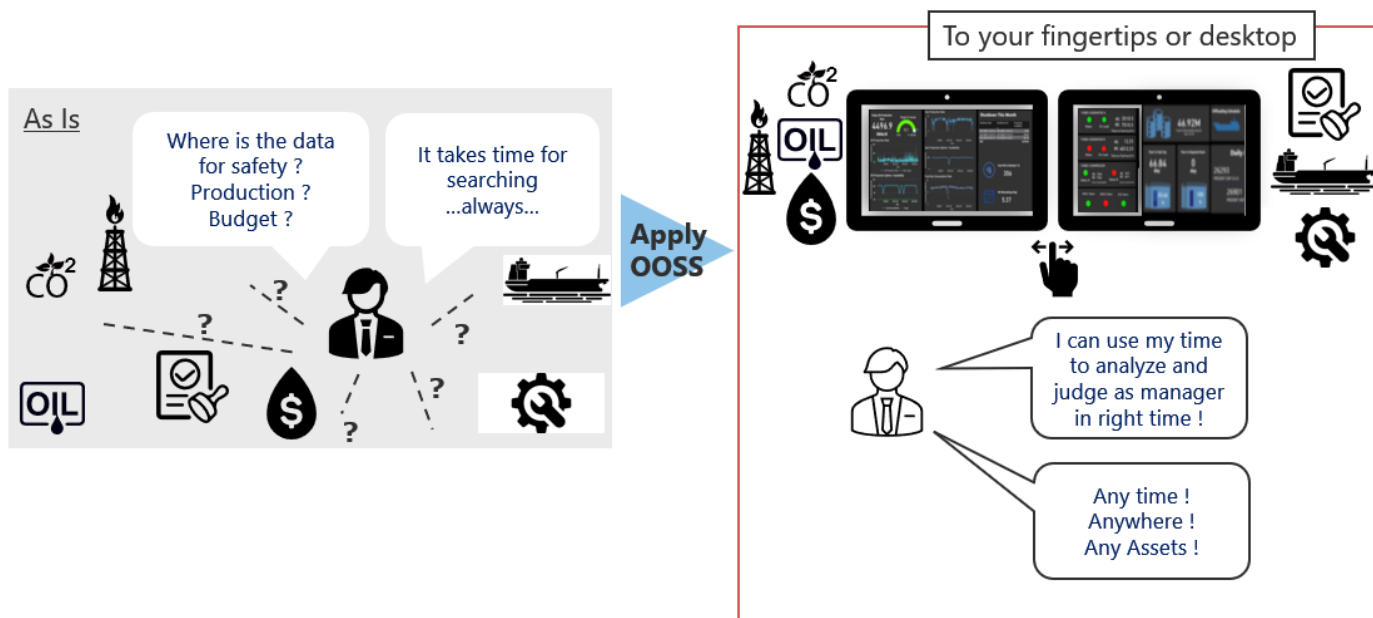**Example of KPI Dashboards for remote operations monitoring**

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Remote Monitoring and Assistance

Use Case — Bringing scattered information to your fingertips

Significantly reduced time to spend for searching necessary information for managers for the right decision at the right time

Our Strengths

- Data Visualization System to enable monitoring and analyzing the trouble with clients
- Specialized teams at Global Operating Center with expertise from various EPC and Operational Excellence services
- Availability of various experts who can solve problems quickly

Our Experiences

30+

Years in Global Market

Middle East, North Africa Southeast Asia...etc

Various Type of Facilities

Gas Processing
Oil Producing
FPSO
Integrated Water, Steam, Power Plant, etc.

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