

Using diverse businesses to provide new added value

Having diverse businesses organized around a steel business is one of the JFE Group's unique features.

The Group's strength lies in having these diverse businesses, and being able to create synergies through cooperation across these businesses to provide new added value. Here we will introduce some examples that lead to providing new added value.

Group collaboration × Synergy

Offshore wind power generation

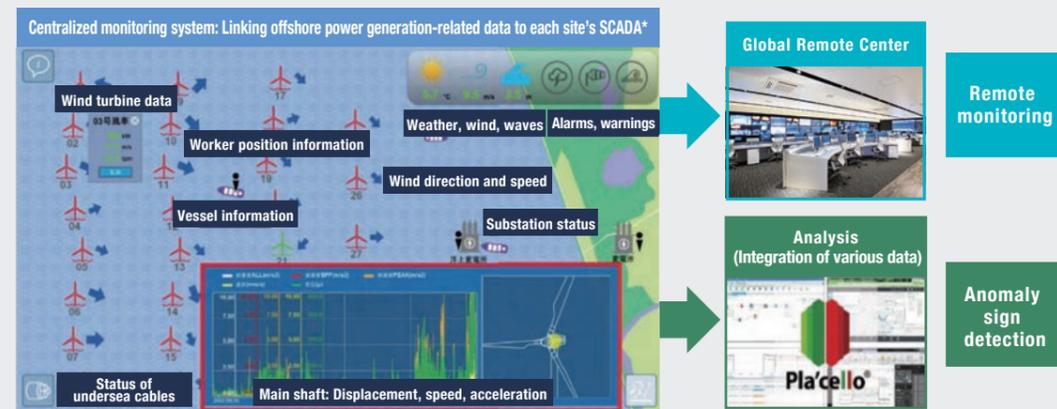
The JFE Group aims to enter the field of offshore wind power generation operation and management (O&M).

For more than 25 years, since 1996, JFE Engineering has been engaged in engineering, procurement, and construction (EPC) for onshore wind farms with businesses ranging from providing equipment to maintenance. Because offshore wind power generation facilities are difficult to access unlike onshore facilities, it is more important for the stable operation using our extensive experience and knowledge to constantly monitor the status of equipment and to respond quickly and appropriately when signs of problems are detected.

JFE Engineering has the experience gained through remote monitoring of 87 (as of November 2022) waste incineration and other facilities in Japan and overseas using big data analysis technologies to detect signs of abnormalities. JFE Steel also has the technologies and knowledge acquired through the operation and maintenance of steelworks that operate uninterrupted 24 hours a day using big data analysis. With the aim of applying these experiences and the Group's data analysis technologies to the field of offshore wind power generation, we are conducting analysis and verification tests for abnormality detection using data related to things like vibration, strain and corrosion at the Horonobe wind power station in Hokkaido operated by JFE Engineering.

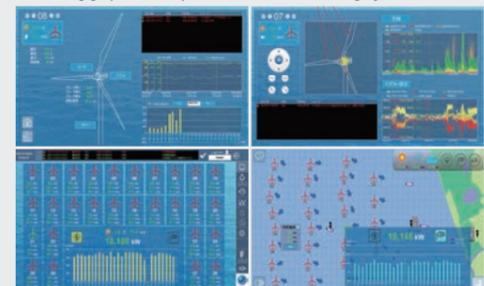
In addition to wind turbines, we are developing the ASUNAG centralized monitoring system that enables flexible, centralized management of various information related to things including cables, substations, weather, and ships.

Conceptual image of the ASUNAG centralized monitoring system



*SCADA: Supervisory Control And Data Acquisition

Monitoring graphics example of Centralized Monitoring System "ASUNAG"



<https://www.jfe-eng.co.jp/products/life/owp03.html>
(in Japanese only)



Exhibition booth at "Global Offshore Wind Summit - Japan 2022" held in Akita City in November 2022

Trading business × Business transformation and creation

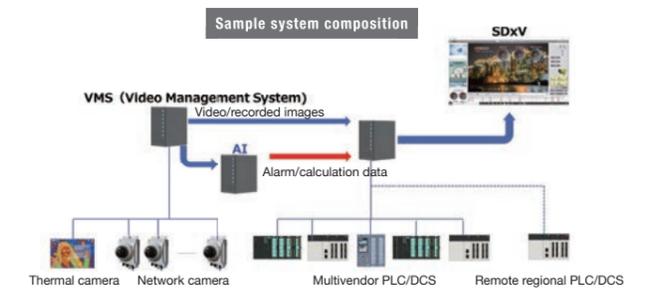
Centralized management system for plant information and video images

JFE Shoji Electronics' DX products and services

With the aim of "transforming businesses and creating new value," JFE Shoji Electronics Corporation has begun offering the SDxV remote monitoring system that enables the centralized management of plant information (temperature, pressure, etc.) and images from surveillance cameras in steelworks. This system makes it possible not only to visualize equipment and plant sites from a monitoring room, but also to use artificial intelligence (AI) for the effective collection of information to detect abnormalities and for predictive maintenance.

System overview

- Integrates optic, thermal camera images with SCADA (supervisory control and data acquisition) which is able to manage and monitor various data (such as control status, operating info) comprehensively, in order to display all those images and data on a single screen for centralized management
- Realized integrated visualization, centralized monitoring and remote control of events that occur in the plant



System features

- View various plant information, live images, and recorded images from surveillance cameras simultaneously
- Display current and past sensor data, AI analysis information, and recorded simultaneously for comparison and inspection
- Operate remotely while confirming onsite images from remote locations
- Design customized monitoring screen based on customers' request

Example of usage in steelworks

Order received: JFE Steel West Japan Works Kurashiki district and East Japan Works Chiba district

- Locations of cameras and sensors: Materials yard, continuous casting, hot rolling, coke, sintering, steelmaking, product quay, etc.

Easy comparison between "current" and "past" situation of manufacturing site. AI analysis based on live, recorded video footage and collected sensor data to detect abnormalities and predictive maintenance



Operation screen display of SDxV at the time of abnormality

Immediately after the occurrence of abnormality

Video image upon the occurrence of alarm

Another video image from separate camera upon the occurrence of alarm

異常情報	センサー状態	異常情報	異常コード	発報日時
XXX	ON	GGG	XXX	YYYY/MM/DD HH:mm
YYY	OFF	PPP	XXX	YYYY/MM/DD HH:mm
ZZZ	ON	KKK	XXX	YYYY/MM/DD HH:mm

Alarm for abnormal signs detected by AI

Alarm for abnormal signs detected by PLC sensors

Detail information at the time of abnormality

Alarm detected by AI

AI compares images of normal operation with ones of most recent operation

AI calculates and visualizes the status of equipment load

Historical data calculated by AI

PLC sensors' historical data

Detail data is displayed on the screen after clicking on "abnormality information" item

Initiatives to secure and train human resources for DX promotion

Securing and training human resources is the key to our initiatives to promote DX.

The JFE Group is working to secure and train human resources who understand various businesses and are able to promote DX across the Group and at a wide range of levels. Here, we will introduce the main initiatives at each operating company.

Steel Business

JFE Steel is introducing various training programs based on the fact that training human resources and cultivating a corporate culture are important as the driving force behind DX promotion.

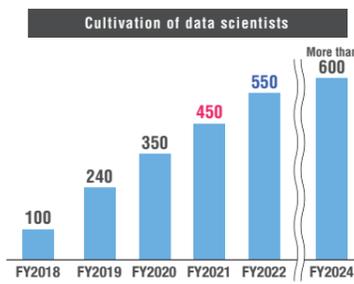
"Advanced use of data," a pillar of JFE's DX, requires the training of internal human resources with a thorough knowledge of actual operations and manufacturing processes, and we are therefore retraining at various levels of proficiency to cultivate internal data scientists. In addition to training specialist human resources, through activities including low-code citizen development in operational departments we are working to cultivate a corporate culture that proactively uses digital technologies to improve operations and create new value. Going forward, we will expand DX fundamental training with the aim of instilling our DX vision and raising the level of DX literacy companywide.

Training data scientists

For DX promotion, we are building easier-to-use environments and frameworks for utilizing data science to cultivate data scientists internally and encourage their activities, allowing many employees to take part in our DX promotion.

Level	Target	Training method
1 DS pioneer	<ul style="list-style-type: none"> Research laboratories, researchers Manufacturing engineers 	<ul style="list-style-type: none"> Dispatched to academic institutions for training Training at research laboratories, JDXC*
2 DS evangelist	<ul style="list-style-type: none"> Electrical maintenance engineers Manufacturing engineers 	<ul style="list-style-type: none"> Training in use of advanced DS tools Primarily OJT General DS training
3 DS applier	All technology-related employees	Training on introduction of DS tools
4 DS user	Employees including administrative staff	Literacy training (e-learning)

• Launched level-specific training programs companywide in FY2018
 • More than 80% of data scientists working on DS operational issues



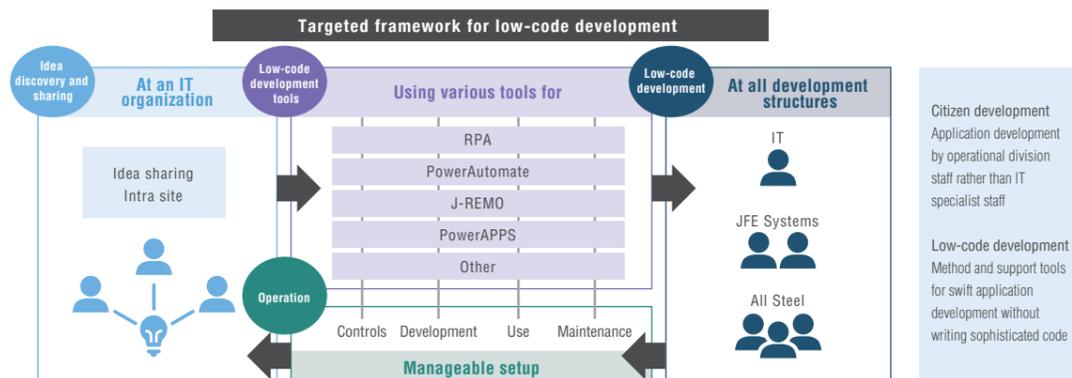
Training completed for 450 persons as of end-FY2021, and will increase to more than 600 by end-FY2024.

Strengthening low-code development structure

Low-code development, including citizen development, to strengthen problem-solving approach and achieve and jointly (competitively) create business value

JFE Steel is building a structure for low-code development that includes citizen development. This is being organized primarily by the IT Innovation Leading Department, which shares ideas for operational labor savings with operational departments and works to achieve those ideas with various tools and an optimal development structure. All successful results are managed by the administrative department and ideas that are achieved are shared across the organization, leading to further innovation.

In particular, we believe that citizen development, with a problem-solving approach using digital technologies and the experience of repeated agile and quick PDCA cycles, cultivates a mindset and raises the level of DX literacy that are needed to promote DX companywide. Broadening participation beyond IT departments to include operating department staff deepens the level of DX promotion across the company. (Further details are included under the Steel Business on page 8.)



Training for highly-skilled engineers and raising overall IT literacy

JFE Engineering established a DX Headquarters in April 2022 to consolidate its DX related human resource, which it defines as: (1) DX promotion staff who are able to transform existing businesses and create new businesses; (2) IT engineers who develop and operate digital platforms (cloud platforms, data analysis, systems and application development, etc.); and (3) control engineers who implement control systems and collect data from construction sites and plants.

DX promotion staff, who have a high level of interest in digital technology and are familiar with business operations, use things like open innovation to enhance technological strengths and business sense. The company is actively hiring mid-career IT engineers as core DX resource who are skillful at cutting-edge digital technologies and data analysis, and roughly 80% of those engineers are mid-career hires.

DX promotion also includes proactive activities to raise the overall IT literacy. The number of users of the Pla'cello® data analytics platform has surpassed 1,800, and more than 1,000 people on a cumulative basis have taken classes from the Data Scientist Training program (an educational program comprising 17 classes over 120 hours).

The company also has an internal AI/IoT Technical Group, with 265 members, to raise the overall level of information and communications technology (ICT) capabilities and train experts. In addition to raising the skill levels of both beginners and mid-level staff, they are striving to strengthen the company's OT-related* ICT. (Further details on transforming the corporate culture and Pla'cello® initiatives are included under the Engineering Business on page 12.)

* OT: Operational Technology

Data Scientist Training Program

- Training in individual tools (self-study and hands-on): 13 courses
- Implementation training using multiple tools in near-real cases (hands-on): 4 courses

	Data preparation	Analysis/Visualization	Machine learning	Application development
Practical training (hands-on)		Practice of image processing application development		
		Mid-level data scientist training		
		Introductory data scientist training		
		Practice of data processing /visualization application development		
Specialist training (hands-on)	H/O	H/O (applied) H/O (basic)	H/O (chronological) H/O (image)	H/O H/O: Hands-on
Specialist training (self-study)	e-L (applied) e-L (basic)	e-L (applied) e-L (basic)	e-L (chronological) e-L (image)	e-L e-L: e-learning

AI/IoT Technical Group

- Data Utilization Working Group
 - AI in general
- OT-Related Working Group
 - DCS* linkage, IoT data collection, cloud utilization, application development
- Smart Workplace Working Group
 - Robotics, drones, AR/VR
- Smart Operations Working Group
 - Teams, Sharepoint, Power Automate, Excel
- Case Study Working Group
 - Internal and external case studies using AI and ICT

*DCS: Distributed Control System

Trading Business

Raising level of DX-related knowledge and motivation for transformation

As part of DX promotion activities, JFE Shoji is conducting training including basic DX training (e-learning) and position-specific training by using outside specialists to raise the level of companywide DX-related knowledge and motivation for transformation.

Going forward, the company intends to continue training while expanding its scope and increasing the number of programs.

- DX e-learning** (Nov–Dec 2021)
 - Purpose: Basic DX training
 - Participants: Career position – General managers (approx. 1,100 people)
 - Content: Explanation of the basics of DX, approx. 2 hours
- DX survey** (Nov–Dec 2021)
 - Purpose: Identify operational departments' DX needs
 - Participants: Career position – General managers (approx. 1,100 people)
 - Content: Survey of DX needs by business category
DX workshops consider materialization, based on survey results
- DX seminar for officers** (August 2022)
 - Purpose: Cultivation of DX mindset for officers
 - Participants: Executive officers – President (29 people)
 - Content: Explanation of the basics of DX, approx. 1.5 hours
- DX training for new managers** (August 2022)
 - Purpose: Cultivation of DX mindset
 - Participants: Newly appointed managers (mid-30s; 45 people)
 - Content: Explanation of the basics of DX (main points of ③ above; approx. 45 minutes)

