JFE Steel is proactively implementing various measures to transform existing businesses, make innovative improvements in productivity, and create new businesses, to establish a competitive advantage that maximizes the wealth of data we have collected over many years.

In April 2024, we launched the DX Strategy Headquarters, which integrates the information technology (IT) and operational technology (OT) fields to accelerate DX across the entire digital field.

We plan to complete mission-critical system upgrades at all steelworks and manufacturing centers by the end of fiscal 2025. We are building a cyber-physical systems (CPS) platform to efficiently promote CPS for manufacturing processes and develop applications for its use. Steady progress is also being made at the solutions business, including moving to the verification testing stage for blast furnace CPS.

Under the Seventh Medium-term Business Plan, we have invested 115 billion yen in DX, aiming for a 30 billion yen improvement in earnings. Investment approval is on track relative to the plan, and we expect to achieve this improvement in earnings.

Akira Nitta
Senior Vice President
(General Manager of DX Strategy, in charge of cybersecurity department)

DX Strategy ▷▷▷

The main pillars of JFE Steel's DX are the introduction of technologies like the Internet of things (IoT), artificial intelligence (AI), and data science (DS) for gaining a competitive advantage by proactively utilizing data (= data-driven). Our accumulated expertise in high-grade steel manufacturing, responses to aging equipment, and data related to predictive management are the sources of our competitiveness, as we make advanced use of data—one of JFE Steel's important strategies. We are pursuing DX with three main areas of emphasis—"raise our level of data use" mentioned above, "execute IT structural reforms," and "reinforce our IT risk management."

JFE Steel's major initiatives under the Seventh Medium-term Business Plan

Use "digital" technologies to strengthen the manufacturing base and execute new growth strategies

JFE Steel's vision for DX promotion

Gain competitive advantage through the proactive utilization of data (= data-driven)

With a long history of manufacturing, JFE is a storehouse of data. Our accumulated expertise in high-grade steel manufacturing, responses to aging equipment, and data related to predictive management are the sources of our competitiveness. Advanced use of data is JFE Steel's strategic theme.

Maximize value

Synergistic effects

Three pillars of DX promotion

1 Execute IT structural reforms
Upgrade systems at steelworks

Realize a flexible, change-tolerant IT structure

2 Raise our level of data use
Promote business reforms and the latest advancements in IT

Actively utilize data science and AI

3 Reinforce our IT risk management
Enhance security and standardized controls

Enhance the security environment for IT

Operational and R&D data assets

⟫⟫ Establishment of DX Strategy Headquarters

In April 2024, we established the DX Strategy Headquarters, comprising the Digital Transformation Planning Department, Digitalization Leading Department, Intelligent Technology Development Department, and Smart Factory Leading Department, to integrate the IT and OT fields and formulate a medium- to long-term strategy for the entire digital field, as a way to take an integrated approach to promoting technological development, Companywide development, construction, maintenance, and human resource development.

DX Strategy Headquarters	Digital Transformation Planning Dept.	■ DX strategy planning and formulation ■ DX budget acquisition, allocation, management ■ DX-related product development and support for external sales
	Digitalization Leading Dept.	■ Planning and promotion of Companywide operational reforms ■ Efficient implementation of core DX strategy ■ Standardization of IT-related technologies
	Intelligent Technology Development Dept. (in cooperation with the CPS R&D Dept.)	■ Companywide development of cutting-edge intelligent technologies ■ Agile development and improvement of models ■ Standardization of intelligent technologies
	Smart Factory Leading Dept. Automation Engineering Sec., Iron & Steelmaking Sec., Rolling Sec.	■ Planning and promotion of Companywide conversion to smart factories ■ Packaging of technologies and efficient implementation ■ Standardization of smart factory technologies

A DX achievements presentation is held (semiannually) and a (quarterly) Strategy Headquarters report and (monthly) DX NEWS LETTER are issued to share information within JFE Steel. We also offer DX literacy training and training for data scientists and "citizen developers."

⟫⟫ Introducing CPS for all processes and making operations remote

Technological development roadmap and current status
(forecast at the end of FY2024)

▶ **CPS introduced for all processes:** Operation of the J-astquad® integrated quality analysis system
▶ **Remote and automated operations:** Using robots for testing, cleaning, and grinding

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CPS introduction rate	20%	35%	60%	80%	Higher level, rollout					

CPS for all processes
Introduction — Full operation

CPS for main processes
Blast furnaces (introduction completed in 2020) — Full operation
▽Steelmaking   ▽**CPS for converters**   New processes
▽Electric arc furnaces
▽Hot rolling/plate rolling — Full operation
▽Temper rolling   ▽Cold rolling/CGL

Construction of integrated CPS at steelworks and an entire company

Autonomous operation

Data-driven AI
(e.g., machine learning)
+
Logic and knowledge-based AI
(e.g., AI that integrates knowledge)

Quality control integrated CPS
▽Steel sheets for automobiles/other steel sheets
▽Steel materials, tubes, bars, wire rods, etc.

* 2021: Autonomous Ultrasonic Testing Robots (UT-Robots) for steel plates operational
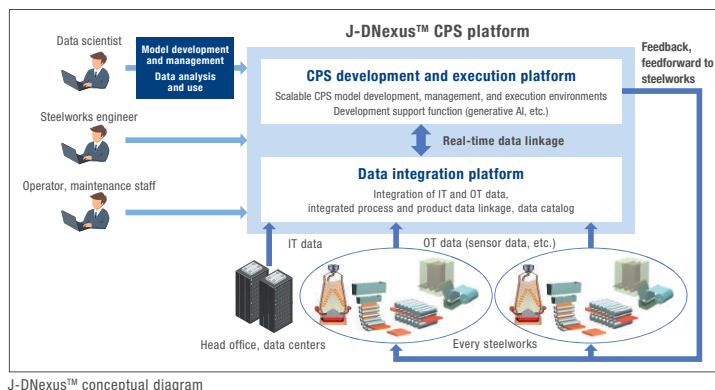* Integrated quality analysis system operation since 2024 (see page 9)

Remote and automated operations
▽Testing of special heavy-duty vehicles — Full operation
▽Remote operations, use of robots for complicated/dangerous operations

Safety and disaster mitigation DX
▽Enhanced safety and disaster mitigation using ICT — Full operation

Remote and automated operations

Further promotion of remote and automated operations

J-DNexus™ CPS platform

Together with JFE Systems, JFE Steel has built and begun operating the J-DNexus™ platform, which integrates production results, product quality data, and other information from the IT field with sensor and other operational data from the OT field, allowing for centralized, cloud-based CPS development and execution. The platform makes it possible to introduce CPS for manufacturing processes that have greater accuracy and speed. Verification testing to date has confirmed that this will allow a reduction in the time required to build a CPS system roughly 30% compared with the previous method.

This data integration is the global steel industry's first use of the Cognite Data Fusion® platform of Norwegian company Cognite, which allows integration of IT data with OT data. Development support functions that include generative AI are also being prepared in the CPS development and execution platform.


J-DNexus™ conceptual diagram

J-astquad® multiprocess integrated quality data analysis system

JFE Steel's DX strategy aims to use CPS to achieve intelligent steelworks at all its steelworks. One of the main achievements of this fiscal year has been the creation and implementation of the J-astquad® multiprocess integrated quality data analysis system as a framework for analyzing the effects of operations on the quality of automotive-use thin steel sheets by using operational data and quality data collected from manufacturing processes. This is a DX core technology for quality control operations in thin steel sheet manufacturing, with the aim of stable manufacturing of automotive-use thin steel sheets.

J-astquad® automatically collects a considerable amount of sensor data including operational data and quality data that fluctuates along the long side of steel sheets during multiple processes such as steelmaking, hot rolling, cold rolling, and surface treatment procedures. Factors including changes in the length of the sheet from rolling, reversals of the long side of the sheet during each process, and the treatment of the end where the sheet is cut off are taken into account. That data is then combined with data from the subdivided position of the long side of the steel sheet to create linked data from multiple processes, making it possible to analyze the cause of quality defects.

In the data analysis, the use of models based on AI technologies allows identification of potential operational conditions that may cause a quality defect. J-astquad® quickly carries out tasks ranging from collecting, linking, and analyzing large amounts of data to identifying possible causes of quality defects and improving operations, leading to a reduction in the rate at which quality defects occur.
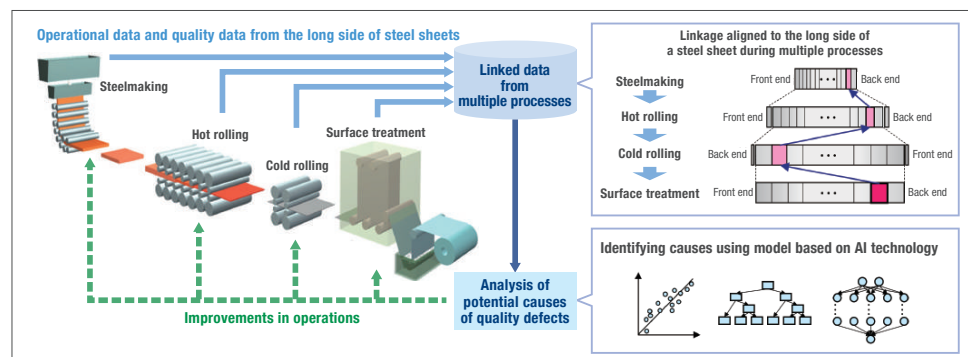
J-astquad® multiprocess integrated quality data analysis system
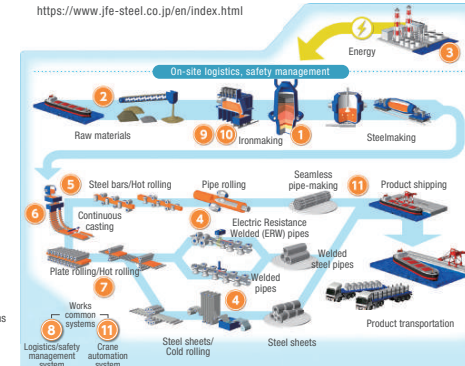
Developing a solutions business

As part of our DX promotion, JFE Steel is developing the JFE Resolus™ business, which uses technologies developed in-house and our expertise in operational improvement to provide solutions to customers, with the aim of achieving innovative, highly productive, and stable operations.

We will look beyond the steel industry and proactively offer the product to customers in a wide range of manufacturing industries. By also proposing specially selected technologies developed by JFE Group companies, the Group as a whole is working closely together to provide customers optimal solution packages.

Data science areas: Technology map
https://www.jfe-steel.co.jp/en/index.html

1 Intelligent Blast Furnace Operation Support System
2 Raw Material Related Technology
3 Energy Optimization Guidance System
4 Deep Learning for Automatic Shape Control System
5 Breakout (BO) Prediction System
6 Breakout (BO) Detection System
7 Autonomous Ultrasonic Testing Robot (UT-Robot) for Inspecting Steel Plates
8 Safety Monitoring System
9 Self-Propelled Cleaning Robot for Harsh Conditions
10 Coke Particle Size Distribution Measurement System
11 Crane Automation System

Start of demonstration testing of blast furnace CPS at JSW steelworks in India

JSW Steel Limited ("JSW") and JFE Steel have begun installing, testing, and operating a blast furnace cyber-physical system ("blast furnace CPS"), a cloud-based data science technology for blast furnaces, at the No. 4 blast furnace in the JSW Vijayanagar Works. This is a groundbreaking project that will use data science technologies in a cloud environment at a JSW steelworks, with issues like data security being resolved cooperatively by the two companies.

A blast furnace CPS makes it possible to visualize the inside of a blast furnace and make estimations, detect anomalies, control the hot metal temperature, and make gas-channeling predictions. In addition to preventing major problems inside the blast furnace, CPS achieves highly efficient, stable operation and contributes to reducing CO$_2$ emissions. Using the successes we have achieved applying blast furnace CPS at our own steelworks, we are building this system for JSW, a leader in the proactive introduction and construction of cutting-edge technologies, as the first model to be provided overseas.
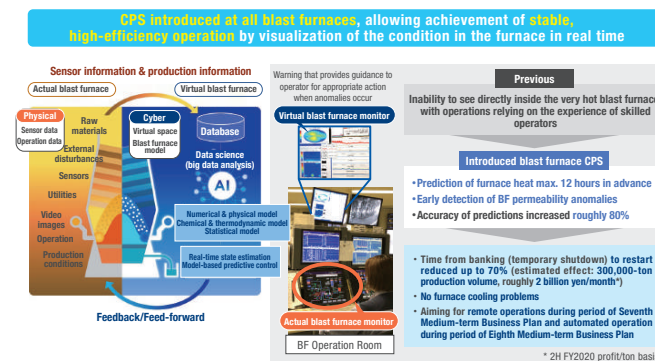
Innovative increases in productivity using generative AI

JFE Steel is applying generative AI in operations to increase innovative productivity.

We have been building our proprietary Chat JFE generative AI service, based on Microsoft's Azure OpenAI service since fiscal 2023, together with security measures and user guidelines, and have achieved an environment in which all employees are able to use the service.

More than 2,000 employees currently use this service. We are developing measures, including through the introduction of other tools, to help employees become more familiar with generative AI. Going forward, we will use Chat JFE's generative AI as a foundation to build an internal document search system to effectively use the data and expertise that we have accumulated through our businesses to date.