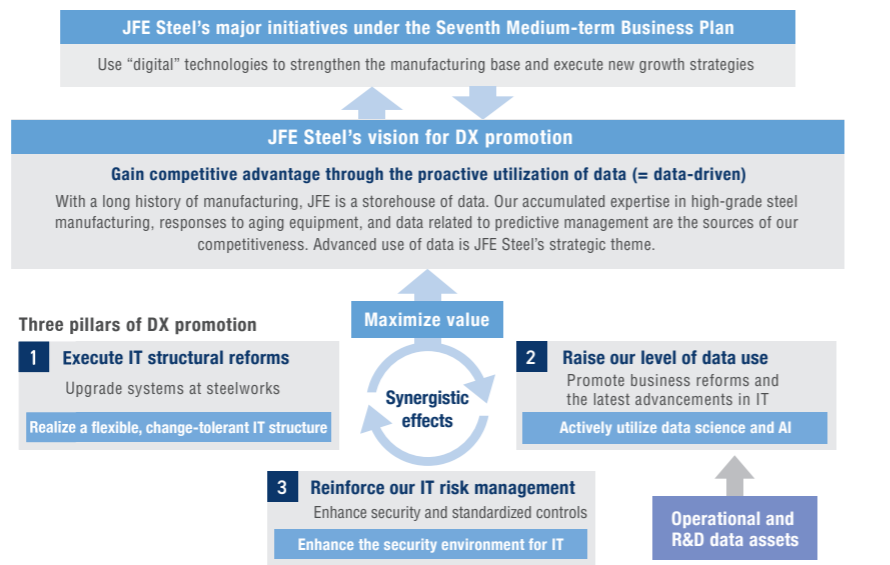# Steel Business

(JFE Steel Corporation)

JFE Steel's DX strategy is to accelerate the building of a foundation for transformation of existing businesses, innovation of groundbreaking improvements in productivity, and creation of new businesses, to establish a competitive position that makes maximum use of the abundant data it has accumulated over the years.

The company is integrating its IT platforms beginning with steelworks' system upgrades, to build a platform that is able to make full use of its accumulated expertise and data together with image and sensor data obtained using the latest technologies. In addition, increased productivity, improved labor productivity, and higher yields are also being achieved through initiatives including the introduction of cyber-physical systems (CPS), remote operations, and automation in all steelmaking processes.

The company is also strengthening initiatives that will lead to the creation of a culture that will be a foundation for retraining and DX to train key people who will use data assets and information and communications technology (ICT), to cultivate the human resources who will be the driving force behind DX.

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 the advanced use of data—one of JFE Steel's important strategies.

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.

Three pillars of DX promotion

Maximize value

Synergistic effects

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

■ Decisive IT restructuring

JFE Steel is pursuing "IT restructuring" to build an open platform that achieves an "IT structure that is highly flexible in response to change" and integrate and switch from antiquated legacy systems as one of the pillars supporting its DX promotion.

The company is making progress in its IT restructuring with the completion in 2022 of making its **head office mission-critical system ❶** and **Sendai system ❷** as the first manufacturing center with an open platform. Along with introducing open platforms at other steelworks and manufacturing centers to have companywide open platforms during the period covered by the Eighth Medium-term Business Plan, it is pursuing DX in new platforms at the head office and Sendai district, which are already open platform, with the aim of increasing corporate value.

Head office	Steelworks					
	Kurashiki	Fukuyama	Chiba	Keihin	Sendai	Chita
Open platform project Sales, manufacturing, logistics	System updates at steelworks Manufacturing management, operational management					
Marketing / **Logistics**						
Upgrade completed in FY2021	Upgrades scheduled for completion during period covered by 8th Medium-term Business Plan					
Open platform project Business management	Open platform project General administration				Upgrade completed in 2022	
Upgrade completed in FY2021	Upgrades scheduled for completion during period covered by 8th Medium-term Business Plan					

Open structure process | : Restructuring and migration | : ERP installation

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❶ Migration of head office mission-critical systems to open platform completed

The migration of all head office mission-critical systems to an open platform was completed in November 2021. Going forward, we will pursue a project to transform business processes in mission-critical operational areas. In the area of human resources, we are working to strengthen our human resource management capabilities by upgrading systems in the pursuit of D&I* and enhanced employee engagement, centralizing management of human resource data to achieve optimal allocation and training of human resources, and expanding the sharing of human resource information. In materials purchasing, we aim to upgrade operations to shift to value creation operations, use category management to reduce costs and automate small projects to increase operational efficiency, and strengthen supply chain management using external solutions that have become accessible with an open platform.

■ News release (in Japanese only)
Migration of head office mission-critical systems to open platform completed
—Transforming structure of IT platform as foundation for DX promotion—
https://www.jfe-steel.co.jp/release/2022/03/220315.html

*D&I: Diversity and inclusion

❷ Migration of first manufacturing center mission-critical system to open platform completed

The migration of the mission-critical system at the Sendai Works to an open platform, as the first manufacturing center to migrate, was completed in October 2022. With this migration, we will promote DX in a cutting-edge system environment, strengthen our manufacturing foundation, and work to reduce CO_2 emissions by at least 30% by fiscal 2030.

■ News release (in Japanese only)
Migration of first manufacturing center mission-critical system to open platform completed
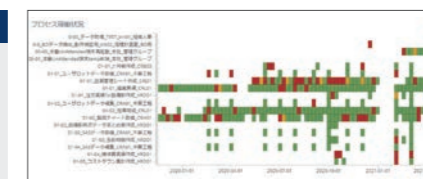—DX promotion at Sendai Works—
https://www.jfe-steel.co.jp/release/2022/11/221107.html

■ DX human resource development

Strengthening low-code development structure

JFE Steel is working to increase developer motivation and share ideas companywide through a variety of initiatives including the commencement of citizen development for robotic process automation (RPA) from fiscal 2020 and citizen development using Power Platform from fiscal 2022. The emphasis in processes for improvement is on visualizing operations and reviewing unnecessary operations, which will lead to the elimination of operational black boxes and improve operational efficiency in a real way. By monitoring logs after operations are completed, the administrative department will conduct surveys and interviews for programs that do not work or have many errors, and follow the situation for continuous improvement.

Low-code development process, follow-up structure and tools

Concept creation
• In addition to operational improvement, confirm meaning and vision for citizen development as a cornerstone of DX promotion
• Top message: Using DX to improve labor productivity

Process	Orientation	Business improvement	Coding	Release	Operation
Content	• Citizen development fundamentals • Explanation of rules • Basic training in tools	• Organize and review own business processes • Consider ideas to improve own business processes • Select development tools	• Coding • User testing and improvement (repeated)	• Check for compliance with rules • Involve supervisor • Share developed product	• Operational monitoring (remove programs that do not work, follow programs with many errors) • Continuous improvement
Support structure and tools	• Academy • Training held by the administrative department	• Business counseling • Development tool proposals • Community of citizen developers	• Q&A support • Website for idea discovery and sharing	• Pre-deployment inspection • Presentations of smart work styles	• Monitoring of operational logs

Enhance motivation
• Encourage heads of departments with few citizen developers
• Create system of giving badges to citizen developers by level

Automated collection and monitoring of program operational status

Level 1 / Level 2 / Level 3 / Level 4

Badges according to certification level

Citizen development: Application development by operational division staff rather than IT specialist staff
Low-code development: Method and support tools for swift application development without writing sophisticated code

■ Results

No. of employees who have completed the UiPath Academy	No. of operations with RPA introduced (citizen development) (Creation time: 1,801 hours/month)	No. of employees who have attended low-code development briefing (of whom, 222 are in trials)	No. of applications in full-scale operation using Power Platform
292	**238**	**280**	**104**

Achieved FY2022 target at end-September!

JFE VOICE !

Case study

App to manage progress in addressing quality non-conformity

Application that automatically sends confirmation email to related people on designated day after quality non-conformity form is received

When the Sendai Products Design & Quality Control Sec. receives a quality non-conformity form from a plant, I create a list, request the persons involved to address non-conformity, and consolidate it. I used to manage this process by sending emails and talking directly to the related people to ensure that there were no delays in addressing the issues. Recently, I heard that with low-code development, we can automate the current management operations, so I decided to give it a try. Using Power Automate, I created an automatic transmission email app in a short period of time. For the base portion, I used one that had been created by an IT department employee, and was able to develop the app relatively smoothly.

I enjoyed putting together the pieces that were available, and felt a sense of accomplishment when the app worked. I hope that people will give it a try, even if they do not have any experience. I believe you will be able to realize great results.

Shizuka Sakurada
Sendai Products Design & Quality Control Sec.
Products Design & Quality Control Dept.

Initiatives to develop DX human resources ─DS tools and apps─

All employees can upgrade and enhance the latest DS tools on their own personal computers at any time. Instructors are invited from vendors and manufacturers to conduct on-the-job training (OJT) based on themes from the participants' workplace, and the number of cases of successful implementation is steadily increasing.

dotData (NEC)	DS analytical and modeling tools for intermediate to advanced users No. of users: 600, No. of projects implemented: 30, No. in preparation: 70
SPSS (IBM)	DS analytical and modeling tools for intermediate users No. of users: 1,000, No. of projects implemented: 430, No. in preparation: 60
Visual Inspection (IBM)	Image recognition AI tools for beginning to intermediate users No. of users: 270, No. of projects implemented: 2, No. in preparation: 8
AnyLogic (AnyLogic)	Simulation modeling tools for intermediate to advanced users (logistics, etc.) No. of users: 30, No. of projects implemented: 10

## Raising our level of data use

Using cyber-physical systems (CPS) to automate blast furnace operations

In the past, blast furnace operations have relied on the experience and intuition of skilled operators, but in recent years a declining birthrate and work style reforms have created a need for high efficiency to raise productivity, while at the same time reducing CO_2 emissions requires stable operations with low percentage of reducing agent. We have therefore built a system that uses process models in a virtual space to predict the temperature of hot metal eight to 12 hours into the future with high accuracy and automatically takes the most appropriate action to achieve highly efficient, stable operations through process automation. In addition, gas channeling prediction technology using information from several thousand sensors, a new furnace heat index to predict furnace cooling problems, estimates of slag liquid surface levels, and other features are used to detect abnormalities quickly for automated blast furnace operations in a normal state.

This has made it possible to digitalize the sophisticated expertise that had previously been in the form of "craftsmanship," and is a revolutionary way to pass on operations technologies indefinitely and use stable operations to contribute to work style reforms.

By rolling out this system companywide, we will increase labor productivity and reduce CO_2 emissions through stable operations with low percentage of reducing agent.

We will also work to incorporate these initiatives in all processes, as a further step toward the achievement of JFE Steel's aim of intelligent steelworks that learns by itself to autonomously carry out optimal automated operations.
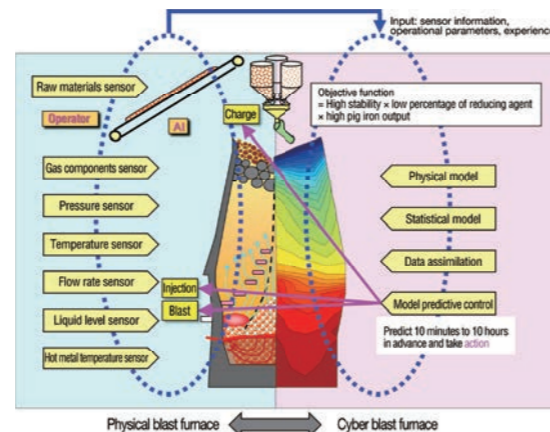

Introducing fuel and electricity use guidance system at steelworks

To conserve energy, reduce CO_2 emissions, and minimize costs in the use of fuel and electricity at steelworks in Japan, JFE Steel has developed and begun using a guidance system to support operators in their work.

This guidance system is based on the CPS concept, and uses huge amounts of measured data (1) and detailed production plans at each plant to calculate supply and demand forecasts, to predict the supply and demand situation from the present into the future with a high degree of precision (2). Then, taking into consideration the operational constraints, special features, and contract information of things like the power generation facilities within the steelworks (3), the optimal operational conditions for the minimal purchasing amount are determined through a fuel and electricity simulation (4), and that result is used as guidance (5).

Introducing this system makes it possible to optimize the amount of city gas and electricity purchased. We can operate much more efficiently than in the past and achieve reductions in energy use, CO_2 emissions, and fuel and electricity costs.
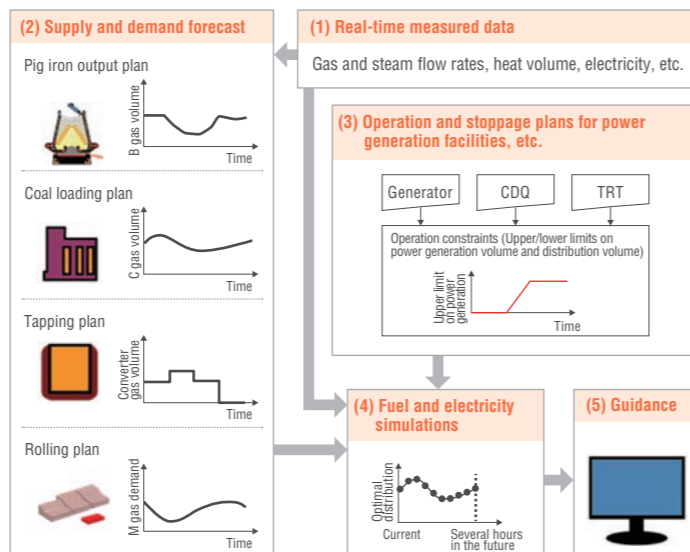
Start of verification testing for automated truck transport system

In February 2023, JFE Steel and IHI Corporation began verification testing of an automated transport system using a retrofitted existing vehicle for transport within a facility at the East Japan Works (Keihin district).

JFE Steel has been jointly developing automation technologies for transport vehicles within plant premises with IHI since fiscal 2019, to address a shortage of truck drivers and improve the work environment, and has completed development for basic automation functions related to driving, turning, and stopping. To verify their development results in a real-world environment, the two companies began transport testing in February 2023 using a tractor-trailer loaded with 100 tons of actual cargo along part of a transport route (roughly three kilometers) within the East Japan Works' Keihin district.

Various signs have been set up at intersections and pedestrian crossings, and the testing is to verify appropriate traffic control methods using these signs and signal controls to inform nearby vehicles and pedestrians of the approach of the automated transport vehicle. This is intended to achieve safer transport, and also to increase acceptance of automated vehicles driving on roads within the premises. The configuration of the sensors to detect objects around the vehicle, including the number and positioning, is also being studied, and we aim to complete verification testing along the entire route during fiscal 2023.

Self-driving transport vehicle

Using robots to increase labor productivity
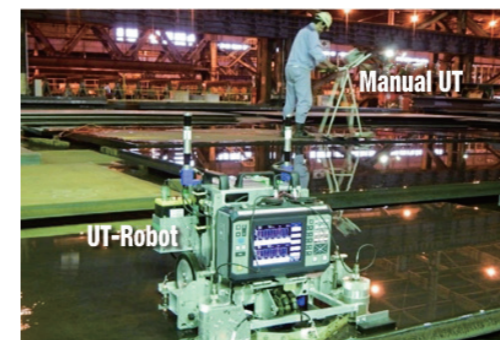
JFE Steel is emphasizing the use of remote operations and automation robots to achieve the increase in labor productivity of at least 20% called for in the Medium-term Business Plan.

We are introducing robots in various locations to automate manual operations including the processing and transport of steel products at steelworks. This automation is being carried out through a combination of using cameras for object recognition, automation control algorithms, and off-the-shelf robots.

The aim is to promote the introduction of robots for tasks that can be automated, for further increases in labor productivity.

Autonomous Ultrasonic Testing Robots (UT-Robots) have been introduced at the steel plate plant in the East Japan Works' Keihin district. Going forward we plan to roll them out to the Kurashiki and Fukuyama districts as well.

External service sales platform to support development of solutions business

We are developing a platform to serve as a foundation supporting the solutions business being pursued by the Global Business Development Division. The platform will use JFE's accumulated data to provide solutions to customers who conclude subscription contracts for the service. The service is built around a "service portal" that takes into account customer convenience, with a secure connection to customers' systems allowing it to be used as a cloud-based service anywhere in the world. We are currently building the platform to provide various solutions services to customers in Japan and overseas.