

The “sophistication of data use” is the essence of JFE Steel’s digital transformation (DX).

The IT Innovation Leading Department and the Business Process Innovation Team are integrating IT platforms, including systems upgrades at steelworks. By linking expertise and data accumulated to date (the Integrated DB) with images and sensor data obtained with the latest technologies, we are building a platform that can fully use this data to further increase customer value.

At the same time, we are implementing swift and exhaustive countermeasures in response to the risks of increasingly sophisticated cyberattacks and information leaks. Led by the JFE-Security Integration and Response Team (JFE-SIRT), set up in fiscal 2016, we will continue to improve the level of information security management.

Our DX aims to strategically use the huge wealth of data on a secure IT platform to achieve a preeminent strategic position.



Akira Nitta

Vice President

We are working to improve profitability by developing infrastructure that enables the systematic use of our abundant operational data assets, including the JFE Digital Transformation Center (JDXC™), which began operating at the head office last summer, while at the same time accelerating the incorporation of major processes into cyber-physical systems, thereby making process operations more advanced, automated, and efficient. We also aim to significantly improve worker productivity by using AI for human knowledge and know-how and robotics to automate field work. To achieve DX propulsion, we are creating systems to facilitate the use of data science (DS), implementing training for in-house data scientists, and creating structures that further strengthen their activities for DX.

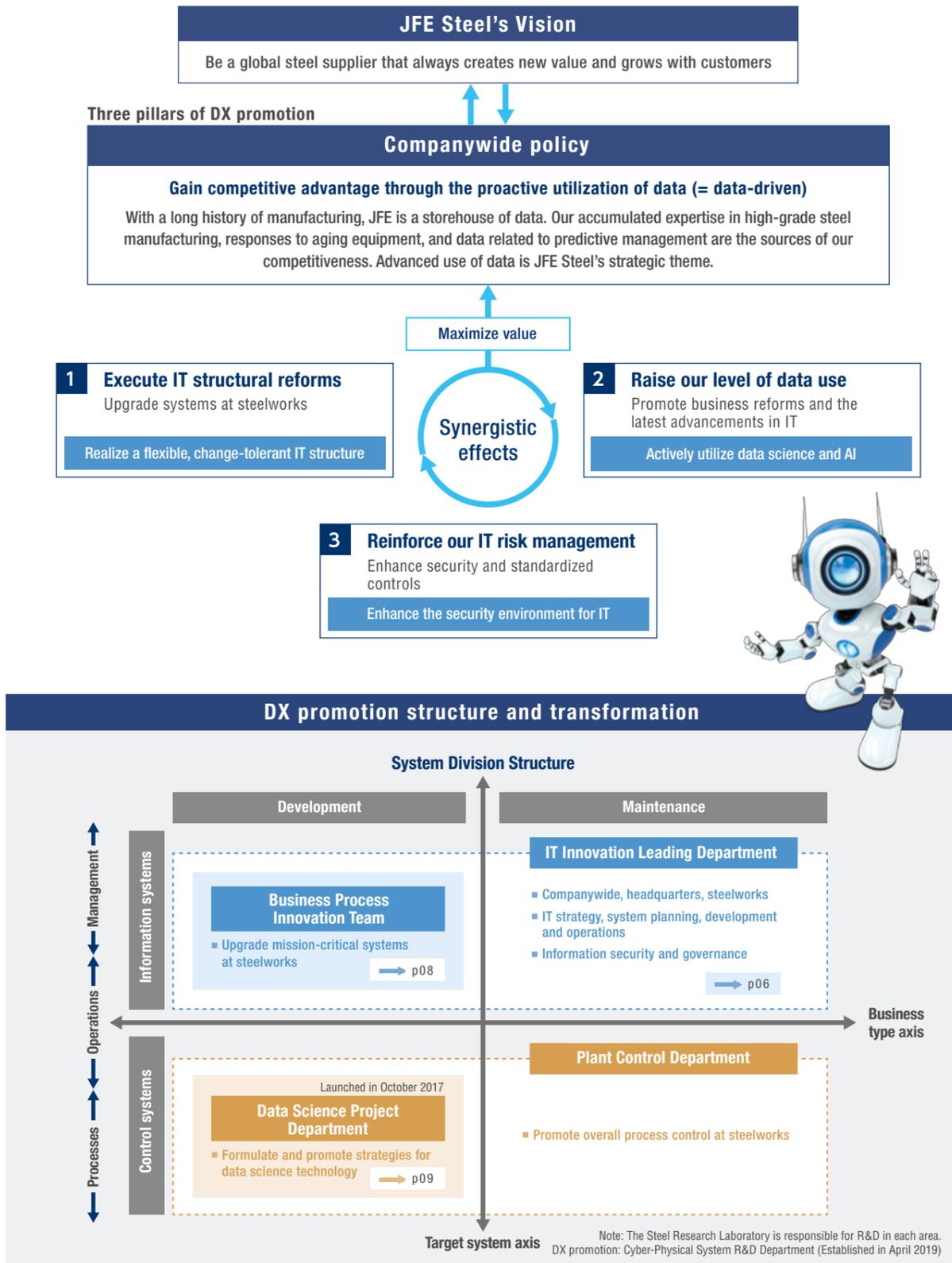


Akira Kazama

Vice President

Vision for DX promotion

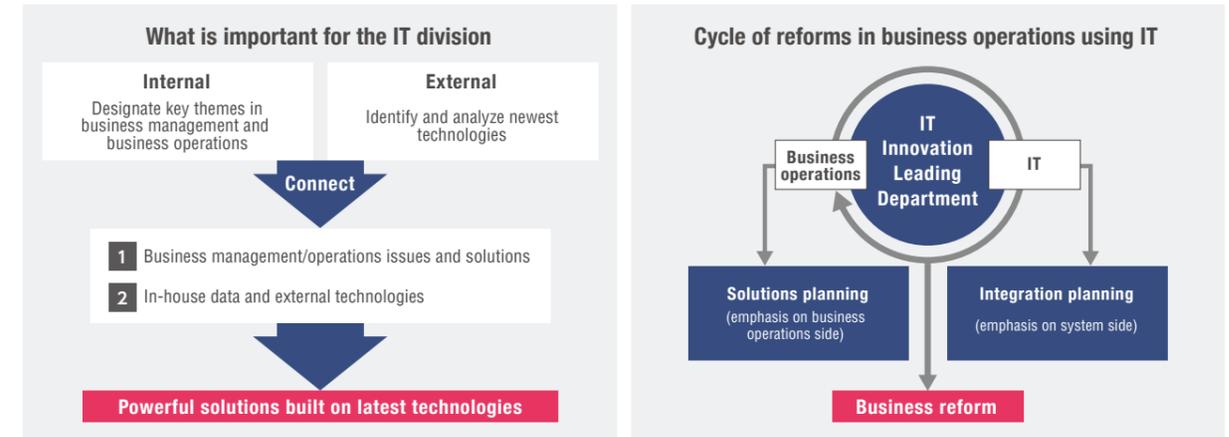
The main pillars of JFE Steel's digital transformation (DX) are technological innovation and the use of data assets through proactive incorporation of elements like the internet of things (IoT), artificial intelligence (AI), and data science (DS). We have accumulated a large reserve of expertise and data over many years, even compared with those of steel mills in various countries overseas. This wealth of data assets is a source of value creation. The use of this latest DS and AI across the company will innovatively increase productivity and quality, achieve stable operations, and enhance competitiveness.



IT Innovation Leading Department

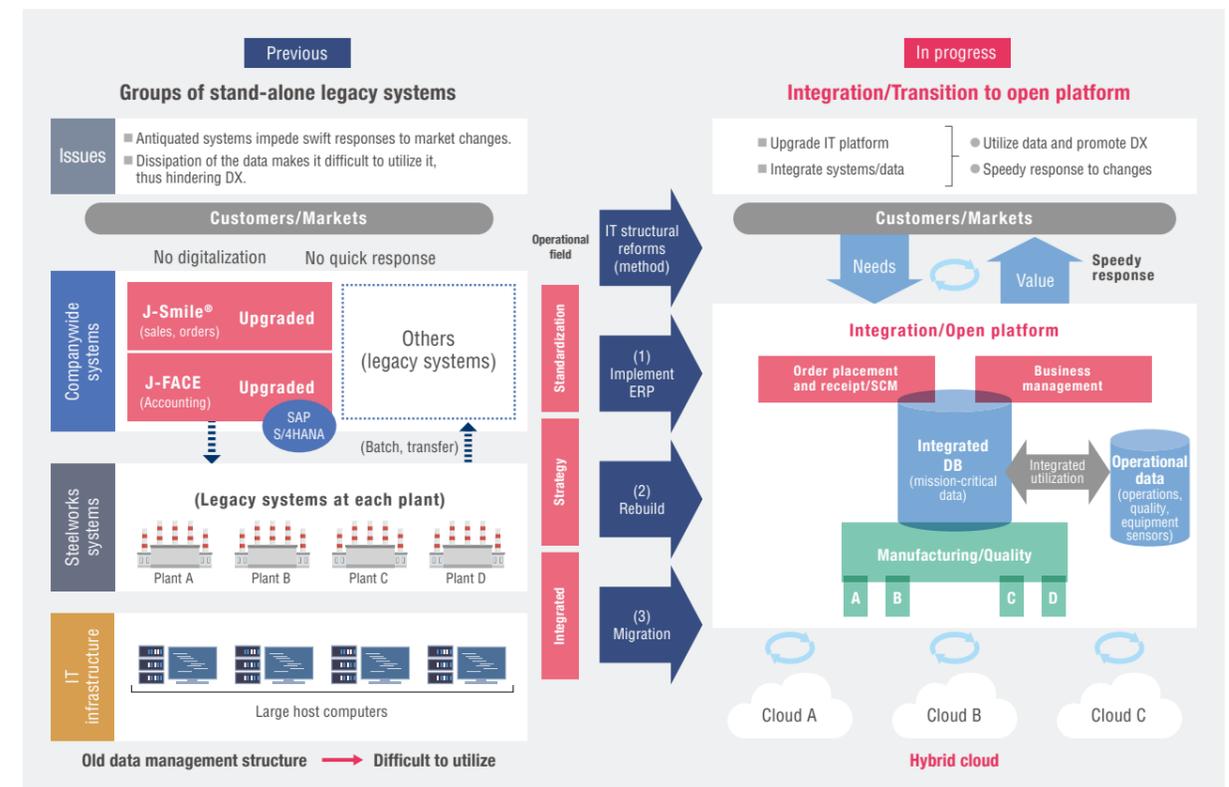
Our mission is to work as one with the administrative and operational divisions to proactively use cloud computing as we create a secure IT platform optimized for the entire company, use the latest technologies to promote business process innovation, transform businesses, and create new value. For important topics in our DX strategy, basic policies are confirmed at the IT Steering Committee, and decisions are made by the management team.

Promoting reforms in business operations with IT, transforming businesses, and creating new value



Enhancing an information system platform for DX promotion

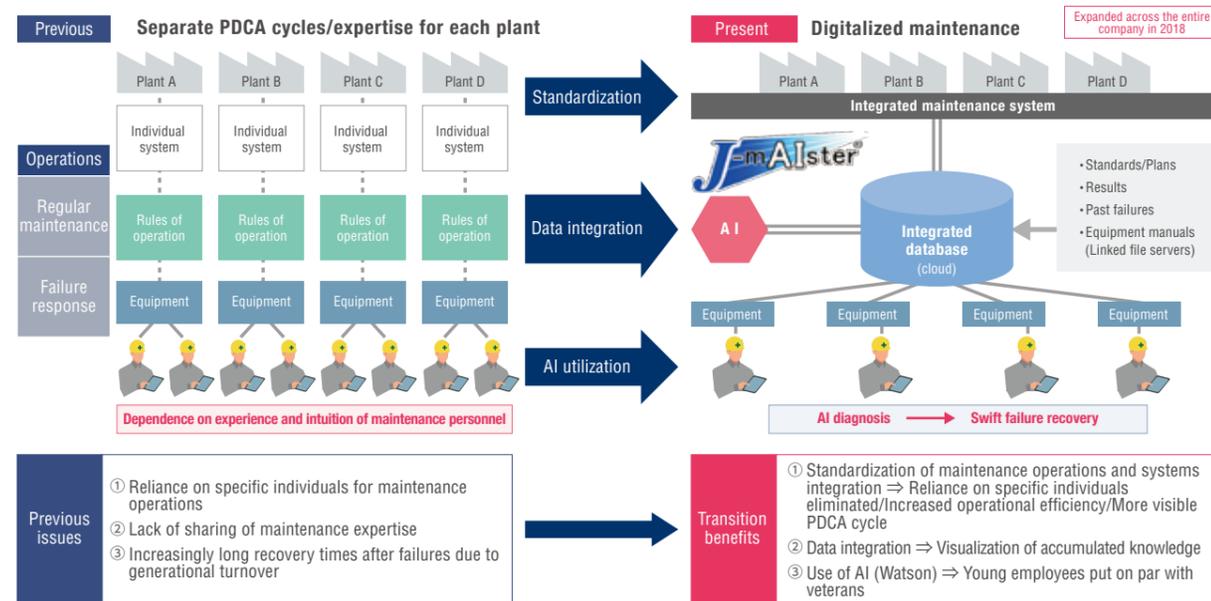
We are engaged in structural reforms of our IT platform to facilitate the use of our wealth of data assets, the core of our DX strategy. By consolidating groups of legacy systems and creating open platforms, we are designing a structure that responds swiftly and flexibly to changes in our operating environment.



System to support recovery from control failures (J-mAlster®)

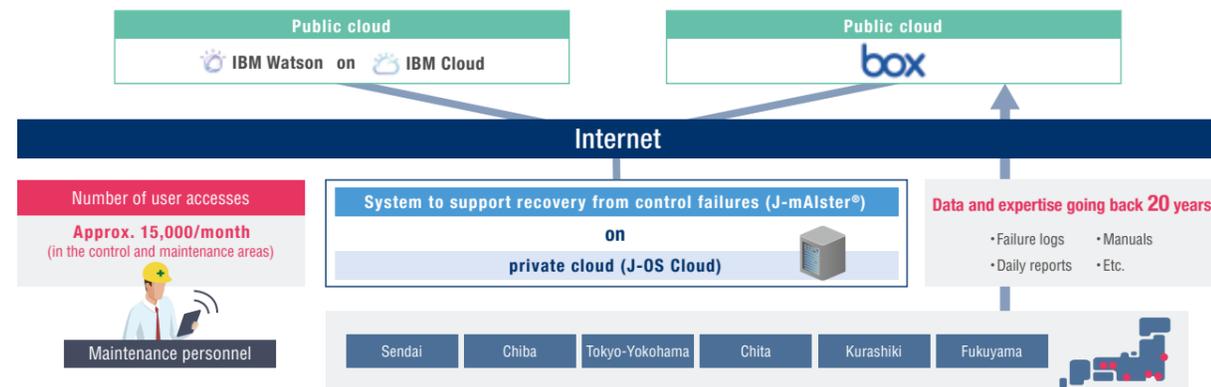
We are integrating our platforms, including the companywide integrated maintenance system that went into operation in 2015 and the installation in all manufacturing lines in fiscal 2018 of the J-mAlster® system to support recovery from control failures. J-mAlster® draws on IBM Watson to make advanced use of the huge amount of failure data from the past 20 years stored in the maintenance system. With J-mAlster® installed, we have confirmed that recovery times are significantly reduced, and we are rolling out the system for full-scale use including linking it to other internal systems.

*J-mAlster®: JFE Maintenance AI of Smart TPM for Electric Repairs



Building a system that maintains information security while using the latest ICT

By constructing a hybrid cloud environment that links our dedicated J-OS Cloud private cloud with the public IBM Cloud, J-mAlster® has the flexibility to use the latest technologies like IBM Watson while also maintaining the conditions required for information security. In addition, reports, manuals, and other information stored on each regional file server have been consolidated on the companywide box cloud-based shared file server and are centrally managed. Security on this file server is enhanced with encryption functions, while at the same time the sharing of information across regions supports smooth maintenance operations.



JFE VOICE !

Since the installation of J-mAlster®, recovery times have been reduced at many workplaces!

The J-mAlster® system allows efficient searching for examples of problems that have occurred at all manufacturing lines of all steelworks and for information needed for recovery. When I have trouble determining the cause of a problem at my workplace, I use J-mAlster®. I input key words describing the situation into a mobile terminal by voice or keyboard, and artificial intelligence searches huge amounts of data and selects reports on similar problems that other people have experienced, simple procedure manuals, and other information, showing me the next step in determining the cause. In the future, I hope to use J-mAlster® to pass on the knowledge of my predecessors to the employees who will come after me.

Since J-mAlster® was installed, recovery times have been reduced at many workplaces. Going forward, by continuing to accumulate data and learn, I expect the system itself to become able to analyze failures and propose responses.

Masaki Matsushita, Leader, Plant Maintenance & Control Section, Planning Department, Chita Works



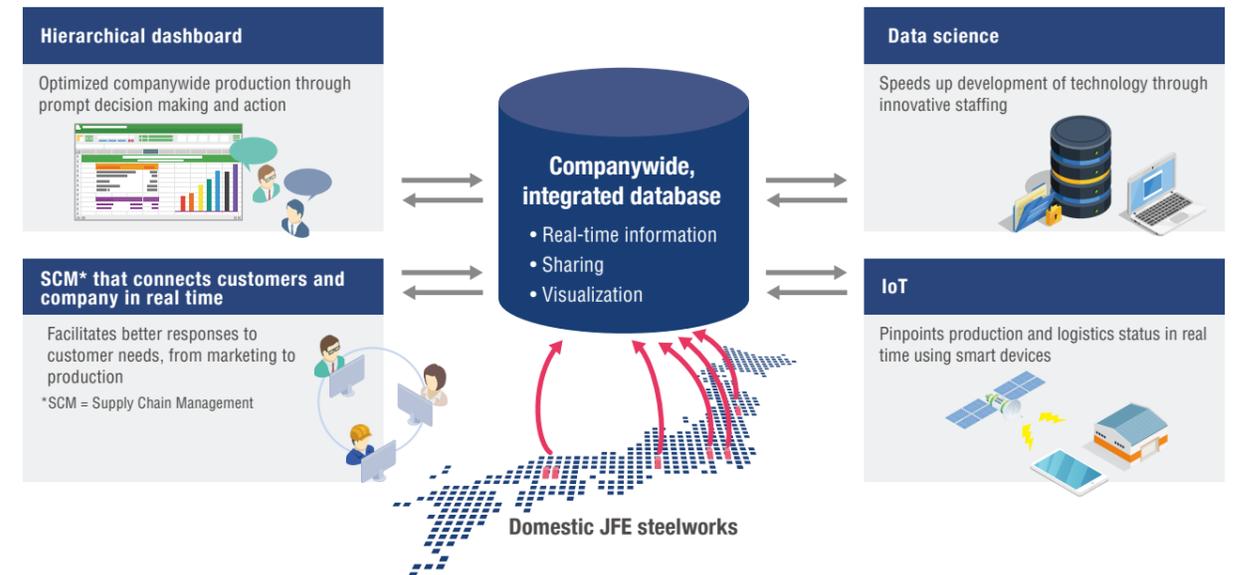
Business Process Innovation Team

Reform mission-critical systems at steelworks using the latest ICT Create new value through reforms in business operations

We are reforming mission-critical systems at steelworks under the following policy: (1) Rebuilt a system platform using the latest ICT; (2) Redefine operational processes to pass on manufacturing expertise and introduce standardized operations; and (3) Create an integrated database with a standardized data structure.

Through this system upgrade, we aim to create an operating platform that shares and uses all companies' data with all employees, and to transform work styles to create new value.

New work styles realized through system upgrades

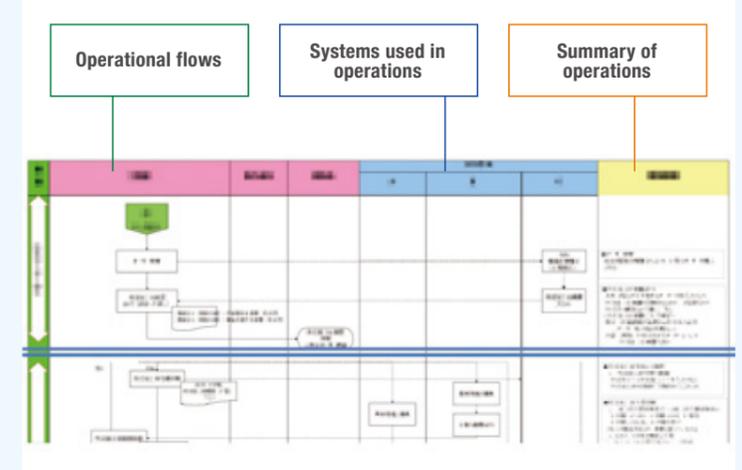


JFE VOICE !

Organizational knowledge by visualizing operation and data flow

We are working on the project of reforming mission-critical systems at steelworks. As part of the project's task, we produced "manufacturing operation- and data-related flow diagrams" (shown in the illustration), which visualize all the systems' work flow. The diagrams make it possible to broadly share a common understanding of the relation between operation and data, which had been known to a few specific people. With this task, we contribute to business process reengineering.

Haruka Nakamura, Takahiro Omori, Business Process Innovation Team



Contribute to developing a new system platform for the future

After joining JFE, we were responsible for manufacturing and operating technology at steelworks. Now we are working on a project to reform mission-critical systems, which are aimed at designing manufacturing recipes. The new systems steadily have been going live in stages. We will proceed to implement a new system platform that will create new value in the future.

Yoshiki Watanabe, Yu Hashimoto, Narihiko Ai, Business Process Innovation Team



Data Science Project Department

To maintain a competitive advantage using our wealth of operational data assets, we are aiming to strengthen our infrastructure for collecting process data from all steelworks and use data-science technologies to “integratedly and comprehensively automate” every process.

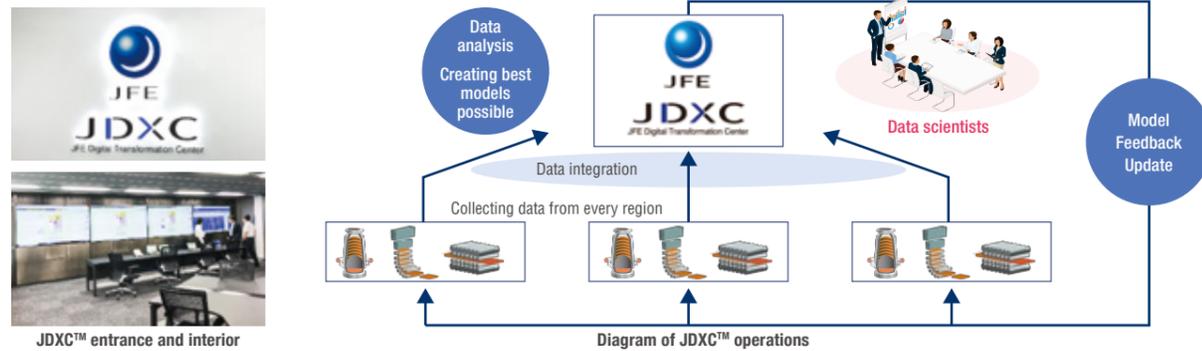
Establishing the JFE Digital Transformation Center, a base for DX promotion

We have established the JFE Digital Transformation Center (JDXC™) at the head office as a base for companywide DX promotion using data science and the latest information and communication technology. JDXC™ represents the Japanese steel industry's first environment that can comprehensively use operational data accumulated at all steelworks and manufacturing sites, further raising our global competitiveness.

JDXC™ functions and objectives

- 1 Promote higher productivity and cost reductions through the comprehensive use of data by linking data from upstream processes to downstream processes, sharing data across regions, and other measures.
- 2 Raise the overall level of operational technology by pursuing cohesion and standardization of the cyber-physical system (CPS)* for manufacturing processes.
- 3 Raise the individual skill level and expand the number of data scientists by sharing knowledge, experience, and the resolution of issues among data scientists companywide.

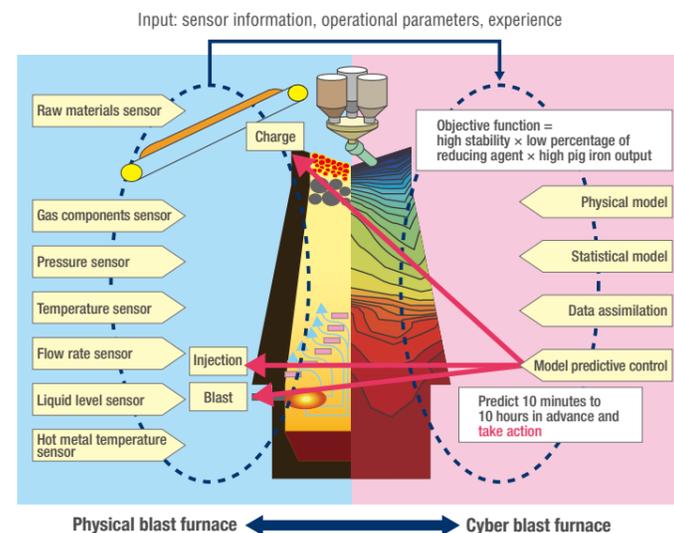
* Cyber-physical system: A system that creates value by collecting information from physical space (actual equipment and products) with huge sensors (big data), consolidating this information in cyberspace and applying various analytical methods to make feedback to physical space in real time.



Introducing data science technologies at all blast furnaces—raising productivity with “blast furnace CPS”

JFE Steel is promoting technological innovation by proactively introducing the internet of things, artificial intelligence, and data science. CPS is being introduced at all our operating blast furnaces in Japan. This has made it possible to address the difficult issue of detecting anomalies in the airflow inside a furnace, which can cause major problems, and make important predictions about the temperature inside an operating furnace, contributing to both higher blast furnace productivity and stable operations.

- Objectives**
- Stable and highly efficient operations
 - Uniform level of operations in all regions
 - System standardization
- Predictive model**
- Detect anomalies in airflow in the furnace from pressure sensors (several dozen minutes in advance) ⇒ Avoid gas channeling trouble⁽¹⁾
 - Predict the furnace temperature up to 10 hours in advance⁽²⁾ ⇒ Take appropriate action to maintain the target temperature
- (1) Gas channeling: Occurs when hot air being injected through the tuyere flows in separate channels when viewed from the circumference of the furnace interior. This causes the furnace temperature to fall and the layers of raw fuel inside the furnace become uneven, leading to poor airflow.
- (2) Importance of predicting furnace temperature: If the furnace temperature falls, items being smelted can harden and become difficult to extract, in some cases halting production for an extended time. Maintaining a high temperature means that fuel (reduced material) is wasted.
- Going forward, we will introduce CPS in manufacturing processes other than those used in blast furnaces. Our objectives are as follows:
- Feed results of anomaly prediction back into actual processes as operational action ⇒ Achieve stable operations
 - Visualize process bottlenecks ⇒ Raise productivity
 - Innovate processes through virtual testing. Pass on technologies and reform work styles by AI for knowledge and expertise



Introduction of training simulator using MR technology—passing on technical skills to young employees

JFE Steel has installed a training simulator that uses the latest mixed reality (MR) technology* at its West Japan Works. This is the Japanese steel industry's first system that uses the latest virtual technology to conduct training identical to actual operations at steelworks.

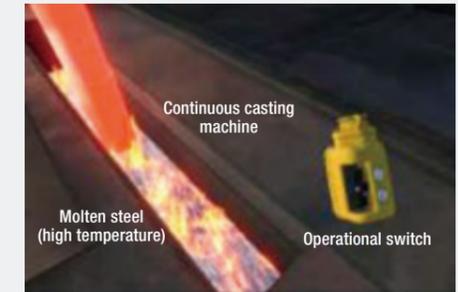
Some on-site operations at JFE Steel, including the handling of materials melted at high temperatures, involve high degrees of operational or safety risk. These technical skills need to be developed, however, and we have had no choice but to use on-the-job training to pass on those skills, which created issues in terms of doing so safely and reliably. To resolve these issues, we are using MR technology in the belief that a virtual environment is effective for training. With MR technology, we can create a training environment that integrates a virtual plant realistically recreated on a computer with human actions in the real world, making it possible to recreate both stable operational status and abnormal situations.

* Mixed reality (MR) and related technologies
 • Virtual reality (VR): Technology that uses a computer to create a virtual space
 • Augmented reality (AR): Technology that expands the actual world by adding information to actual space
 • Mixed reality (MR): Technology that creates a new space combining real space and virtual space that coexist in real time

Actual training allows staff to move equipment, operate switches, and experience the real status of equipment operations in a 3D virtual space. Training on this system before on-the-job training reduces operational and safety risks, allowing decisions and responses to be made quickly in abnormal situations. Going forward, we will roll out this training simulator to all steelworks and other works to pass on technical skills to young employees.



Scene of actual training



Trainee's field of vision

JFE VOICE!

Opening the JFE Digital Transformation Center as a base for DX promotion

As the person in charge of investment, research and development, and infrastructure development, I established the JFE Digital Transformation Center (JDXC™) and am currently working on utilizing it. JDXC™ is a base for data collaboration and utilization, as well as a base for training data scientists. Going forward, we will continue to build and expand an environment where we make proactive and broad-based use of accumulated data and expertise for stronger and faster DX, with the aims of contributing to operational efficiency and cost reduction.

Go Yokokura, Data Science Project Department



Introducing data science technology at all blast furnaces—increasing productivity with CPS for blast furnaces

Since joining JFE Steel, I have been involved in developing models to introduce cyber-physical systems (CPS) for ironmaking and steelmaking processes. Given the difficulty of grasping the overall process in a high-temperature environment, I am using data science technology to visualize these processes. I frequently visit plants as part of my model development and actual equipment installation, and I always try to raise my level by learning new things from the experience and expertise of the operators. I plan to continue these activities, with the aim of creating an automated control system.

Ryosuke Masuda, Cyber-Physical System R&D Department, Steel Research Laboratory

