# Development of Utilization of Digital Data in JFE Steel
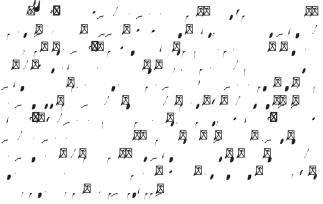
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*Abstract:*

## 1. I

After the Second World War, the Japanese steel industry recovered its prewar level of crude steel pro-

tion with the application of these innovative technologies in JFE Steel.

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### 2.1 D ɼ '、. I 、、 / 、 、 、. / 、、 G 、

The spread of administrative-type business computers and plant operation-type computers started in the 1950s, and with the introduction of OA, application to automation of production planning using acquired data also began. On the other hand, because speed is required in process control computers, implementation dates from the mid-20th century. According to a reference from 1973[1], in 1969 Japan's five integrated steel makers of the time had introduced a total of 137 process computers[1]. Since the country's annual crude steel production was about 90 million tons, which is almost

In the conventional steel manufacturing process, sensor signals are transmitted to higher levels after being aggregated to lower level computers such as sequencers, as illustrated on the left side of

states of the process (health monitoring, anomaly detection and prediction)

ii) Automatic operation and advanced remote operation (identical operation of the actual process and the virtual process: operator can operate the process via the internet)

iii) Simultaneous optimization of stable operation, improved productivity, reduced energy consumption, etc.

iv) Virtual experiments (substantial improvement in process development efficiency by highly accurate simulations of new operating parameters, new equipment, etc.)

**Fig. 2** shows an example of the concept of CPS. The total cyber process is made to function organically by incorporating multiple elemental models and linking the data from the physical process to the respective models. It can also be said that the model side is a real-time version of coupled numerical analysis, and high performance, advanced HPC (High Performance Computing) is increasingly required as the system becomes more complex. JFE Steel has constructed and begun operation of CPS systems for blast furnace operational guidance, prediction of energy supply-and-demand in the steel works and reproduction of the state of ferro-coke furnace. (Articles on these three topics can be found in this Special Issue of JFE Technical Report.) Because CPS is extremely large-scale and complex in comparison with the systems of 50 years ago, which were limited to offline control models, many CPS systems are still in the local CPS stage shown in the center of Fig.

Additionally actuators are also indispensable elements in feedback/feed-forward of the physical process in CPS. By integrating robotics technologies such as material handling and transportation, we aim to realize a comprehensive CPS for advanced plant integration in steelworks..

### 3.3 D

JFE Steel is also expanding the scope of DS utilization to various problems outside of the manufacturing process. In particular, the practicality of the new generation of AI in applications in fields that had been difficult to model by mathematical expressions is steadily increasing as a result of inputting appropriate data and laborious learning. For example, in electrical maintenance, JFE Steel introduced a system in which records of past trouble and action were learned by AI and guidance on appropriate action is given when new trouble occurs throughout the company (also discussed in an article in this Special Issue). In support for safety, a system in which AI automatically recognizes video images and stops the production line when a worker enters a hazardous zone in a plant has reached partially practical application.

Regarding the purpose utilizing DS, it is steadily becoming a general methodology for various types of innovation in society, spanning a diverse range from individual equipment to human systems. Of course, DS is not omnipotent, but there are actually many situations where DS techniques can discover some type of solution for problems that had reached an impasse with the conventional methods. Recognizing this potential, JFE Steel has adopted a policy of expanding the fields of DS application and actively introducing DS in the

future as well.

### 3.4 C░░░░░ ░ D░░░░░

Japan's 5<sup>th</sup> Science and Technology Basic Plan, which was adopted by the Cabinet Office in January of 2016, proposed "Society 5.0" as a vision for the future of Japanese society, and also mentioned CPS as a method for solving social problems and supporting economic growth. Active use of DS, AI, ICT and

point, today, where we are unable to reform our own situation.

Thus, it appears that the greatest challenge may be a reform of our own consciousness of the intrinsic purpose of utilizing DS, AI and CPS, which is to achieve complete automation, truly change how we work, and improve labor productivity without creating unnecessary work. Since FY 2018, JFE Steel has adopted a policy of promoting the development of data scientists and education in AI literacy divided by organizational levels, and enlightenment not only in the technical aspects of these technologies, but also in light of their intrinsic purpose.

### 4. G░░░░

This paper has described the utilization of DS, AI and other ICT and digital data in JFE Steel Corporation. However, compared to the enormous number of processes and equipment in the steel works and plants, application of these technologies is still small, and there remains much manual work and data handling in paper form at the job sites. Although introduction of DS utilization on a company-wide basis is predicted to be time-consuming and costly, we believe that continuing to introduce DS will gradually create a positive spiral that will generate synergistic effects.