

The Initiatives of the Digital Innovation Center to Promote the Digital Transformation

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ABSTRACT In order to develop the digital technology as a “fundamental technology”, we established the Digital Innovation Center in April 2020 and have been promoting the Mono-zukuri (manufacturing) Digital Transformation (DX), Koto-zukuri (value creation) DX and the digital education within the company.

The main initiatives of the Mono-zukuri DX are the automatic production by Artificial Intelligence (AI) and the improvement of the inspection efficiency by AI image inspection. The problems faced at the factory are common to those of the activities of our customers and we are working to develop the solutions for the Mono-zukuri DX that can also be applied to our customers’ Koto-zukuri activities. We are also working on new DX businesses, including the promotion of DX in the primary industries.

To strengthen the foundation for promoting the DX within the company, we are implementing company-wide E-learning, DX courses for managers, and other digital education tailored to the type and level of human resources.

1. INTRODUCTION

Throughout our long history, Furukawa Electric have been supporting Japan’s modernization with copper and electric wires and have been contributing in the infrastructure such as in electricity, telecommunications, and railways. With the material capability of the core activities that we have cultivated over the centuries, we have been working incessantly on technological innovation. Aiming to realize the Furukawa Electric Group Vision 2030, we are working to realize a prosperous and sustainable society and create the businesses of social problem solving, by utilizing the four core technologies of metals, polymers, photonics, and high frequency.

With the adaptation to the new normal, such as avoiding the “3 Cs” (Closed spaces, Crowded places and Cross-contact settings), cyberization has made great progress. Essential workers support a comfortable remote life, including telework, which is further supported by the digital technology. As a manufacturer, it is an important point of view to connect the factories through telework and factories and make them remote, unmanned, and automated. In order to achieve this, it is called a digital twin, but it is necessary to have a solid database of data on people, equipment, and products in the manufacturing so that inspection and control can be performed tightly based on inter-processes.

In addition, the digital technology has an impact of not only on the reform of Mono-zukuri, but also on the cre-

ation of new values and Koto-zukuri. The DX has been attracting a widespread attention as a concept that also can leads to the reform of business processes and organizational culture. With the growing momentum to accelerate the digitization of the Mono-zukuri and the Koto-zukuri, the Digital Innovation Center was established to lead to the creation of businesses in new areas. Although it belongs to the R&D Division, not only the members of the research laboratories but also the Mono-zukuri department, Information and Communication Technology (ICT) department, and sales departments participated so that the organization could be cross-functional within the company. This report focuses on the activities of the Digital Innovation Center and describes our approach to the DX and its initiatives.

2. THE ACTIVITIES OF THE DIGITAL INNOVATION CENTER

2.1 The Activity Concept of the Digital Innovation Center

The four core technologies, metals, polymers, photonics, and high frequency are the group of technologies that directly contribute to the competitive advantage of our products. However, the common technologies that fundamentally support these technologies are also important. At Furukawa Electric, we have been developing advanced analytical technology, simulation technology, production technology, reliability technology as the “fundamental technologies”. By firmly insourcing and taking control of the fundamental technologies, we are able to accumulate

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know-how, ensure confidentiality, customize them to meet internal needs, and respond agilely to the problems of business and research divisions. Figure 1 shows the relationship among business areas, core technologies, and fundamental technologies.

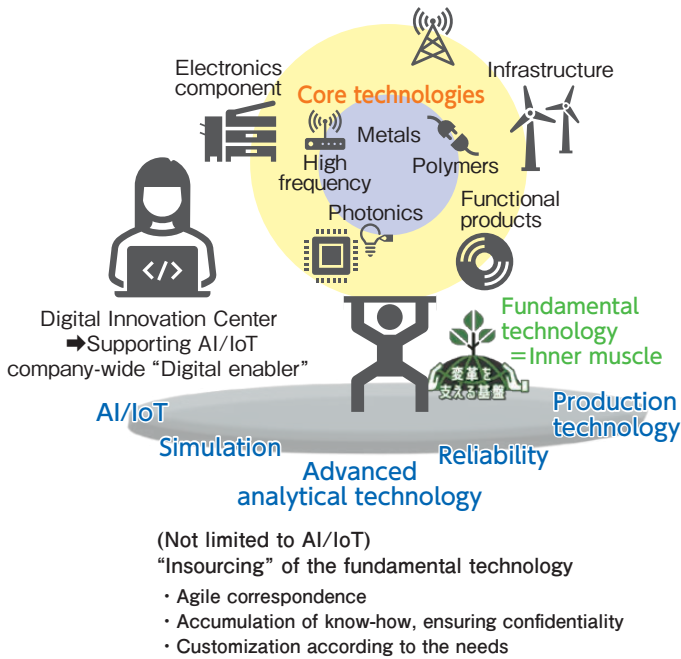


Figure 1 The relationship among business areas, core technologies, and fundamental technologies.

Among them, the reliability-related technologies have been based on the statistical analysis, but in the mid-2010s, driven by the rapid progress of digital technologies, they have been approaching areas such as the data science and the deep learning. Also, at the same time, the data collection by the Internet of Things (IoT) and the automation of image inspection have become important

issues in production technology and the energetic activities have been carried out. In April 2020, the Digital Innovation Center, a cross-functional organization, was established in order to unite these activities and develop the digital technologies such as AI and IoT as the “fundamental technologies”. We are working on the development of a software platform that targets both productivity improvement and skill transfer using the digital technology, and Koto-zukuri and the business creation making full use of AI. We are calling to everyone in the center and within the company, “Let’s firmly develop the inner muscle that supports the core technology and business divisions.”, “Let’s become a digital enabler that makes things possible”

2.2 The Initiatives of the Digital Innovation Center for the Mono-zukuri DX

Figure 2 shows a bird’s-eye view of the activities of the Digital Innovation Center. The horizontal axis represents “exploitation of the technology” and the vertical axis represents “exploration by digital twin”. In the technical axis, data can be acquired and visualized by IoT, factor analysis and prediction can be performed, and eventually automatic control and prevention can be realized. Exploration activities are divided into the “Mono-zukuri DX: Process Innovation”, the “Koto-zukuri DX: Work Innovation”, and the “Koto-zukuri DX: New DX Business”.

One of the main initiatives is the digitization of the Mono-zukuri: process innovation. The shift to cyberspace is progressing cross-functionally across the company’s business divisions and the automatic manufacturing by AI, the improvement of inspection efficiency by AI image, etc. are being carried out. AI-assisted visual inspection has high expectations within the company and we are working on many projects. Some of the projects have already been introduced and operated in the mass production factories. In addition, as an advancement in the product design and the material design, we are also

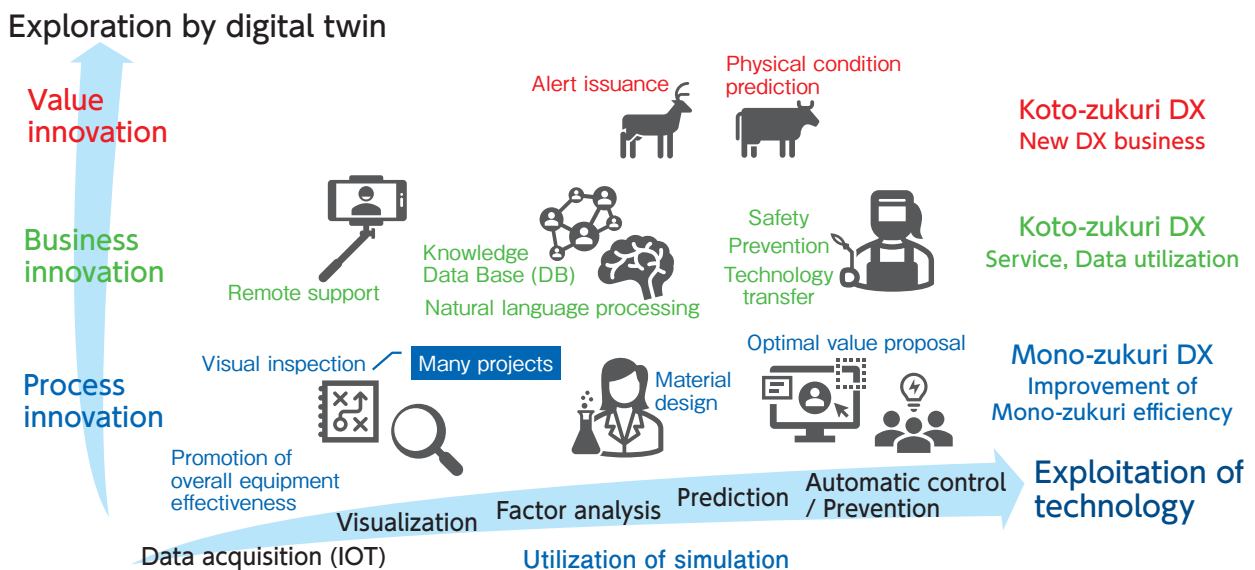


Figure 2 The bird’s eye view of the Digital Innovation Center activities.

working on AI-based material informatics to accelerate the development of new materials for the advancement of product design and material design.

Figure 3 shows an example of the AI image inspection system. One of the challenges in operating the AI system in an overseas factory is the remote operation and the control from the mother factory in Japan, and updating the AI model. In this system, if the AI makes a wrong judgment in the image inspection, the corrected training data is sent to the cloud and the cloud updates AI model. The cloud side sends an approval email stating the accuracy of the judgment, and when the production engineer approves the e-mail, the new model is automatically updated to the on-site machine. Through this process, the control from the mother factories in Japan will become easy. As a side note, this system was jointly

developed with Aidemy Inc., a venture company from the Tokyo University.

The process data analysis, the factor analysis, etc. have been cultivated through the reliability technology, but recently, approaches using machine learning have been increasing as shown in Figure 4. In this example, a machine learning model that predicts the characteristics from the process data is constructed, but it is not limited to predicting characteristics; it can also propose conditions for achieving target values, contributing to the manufacturing of products with targeted characteristics. This technology can also be used to visualize and transfer on the “Takumi no waza (master craftsmanship)”.

2.3 The DX for Solving Social Problems

In this way, we are enhancing our technological capabilities in the area of the process innovation, which is highly

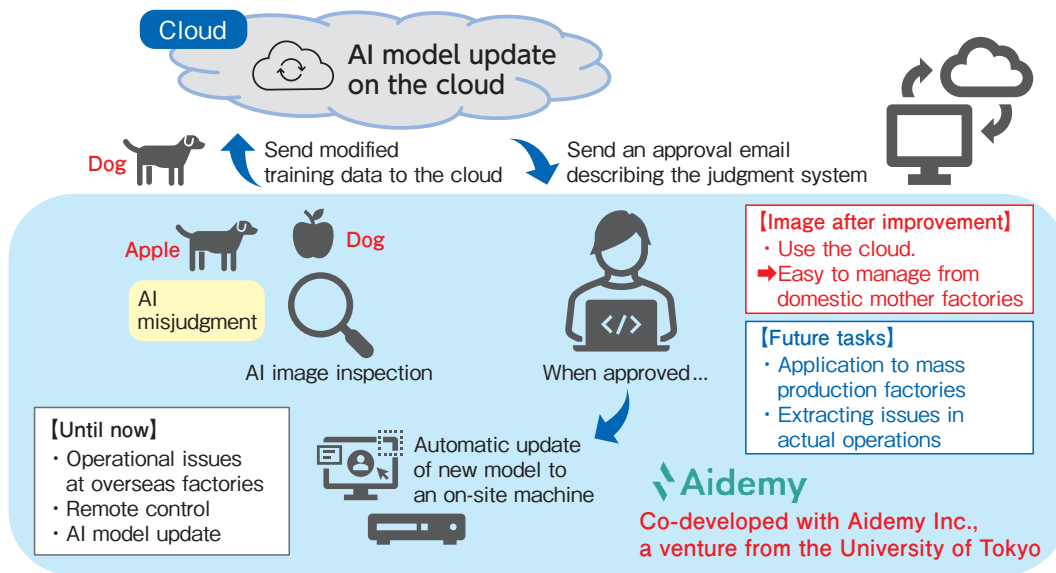


Figure 3 The cloud-based AI image inspection system.

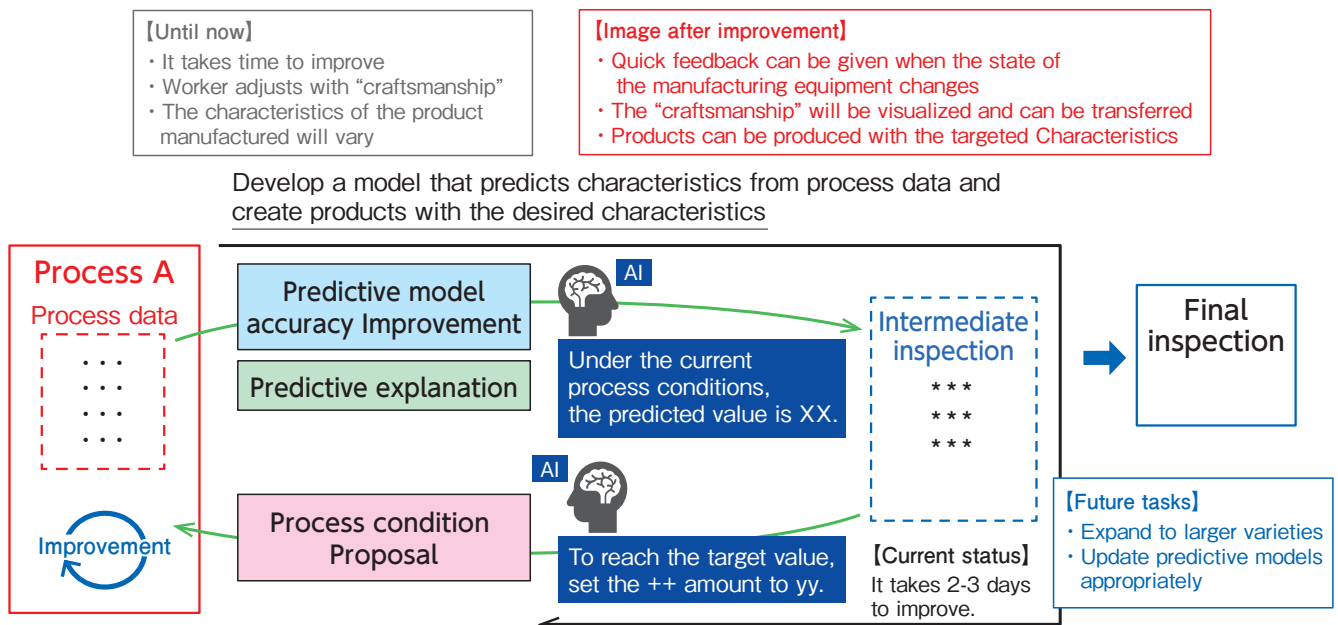


Figure 4 The characteristic prediction and the feedback system using machine learning.

sought after within the company, but the problems that we face at the factory are based on social issues, which are also shared by our customers. In other words, we see our experience in the Mono-zukuri DX as a seed for the Koto-zukuri DX, and we aim to promote the DX in an “ambidextrous” manner, exploitation and exploration. For example, in the situation of corona crisis, the remote operation and the remote start-up of overseas factories have become major issues in the Mono-zukuri DX. In addition to the cloud-based image inspection system described above, we are working on solving the Mono-zukuri jobs, including the use of VR (Virtual Reality) / AR (Augmented Reality) devices, but if applied also to the assistance of the maintenance and the inspection at the customer’s site, it will develop into not only Mono-zukuri DX but also Koto-zukuri. We are working on with a consciousness of expanding the platform cultivated within the company to the customers’ Koto-zukuri.

As for new DX business in the enclaves, we are also

working on the detection of wild animals and the promotion of DX in the primary industries. The scope of digital application is wide and we will be working on full-fledged company-wide deployment in the future. Figure 5 shows an example of a project that we are currently working on, This is the example of research and development to predict the poor physical conditions by using AI while collecting and monitoring data on position, behavior, appearance, and body temperature of cows for the purpose of early detection of poor physical condition of nursing cows in group captivity, As a side note, this research is supported by the “Innovation Creation Enhancement Research Promotion Project” of the Bio-Oriented Technology Research Advancement Center, which is a part of the National Agriculture and Food Research Organization.

Figure 6 shows a bird’s-eye view of the Mono-zukuri DX and the Koto-zukuri DX from a different perspective than Figure 2. The Mono-zukuri DX focuses on digital improve-

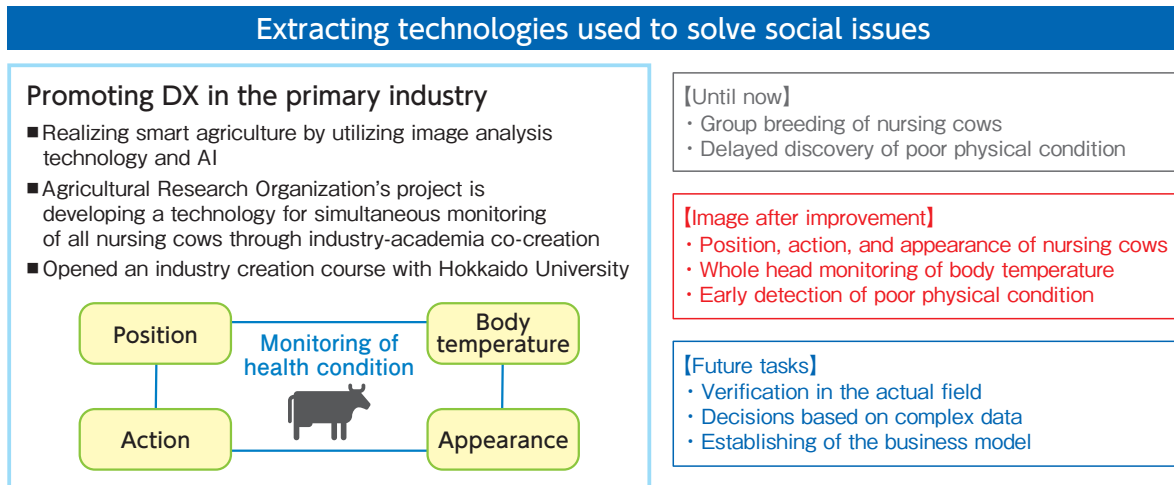


Figure 5 The DX in the primary industries using AI.

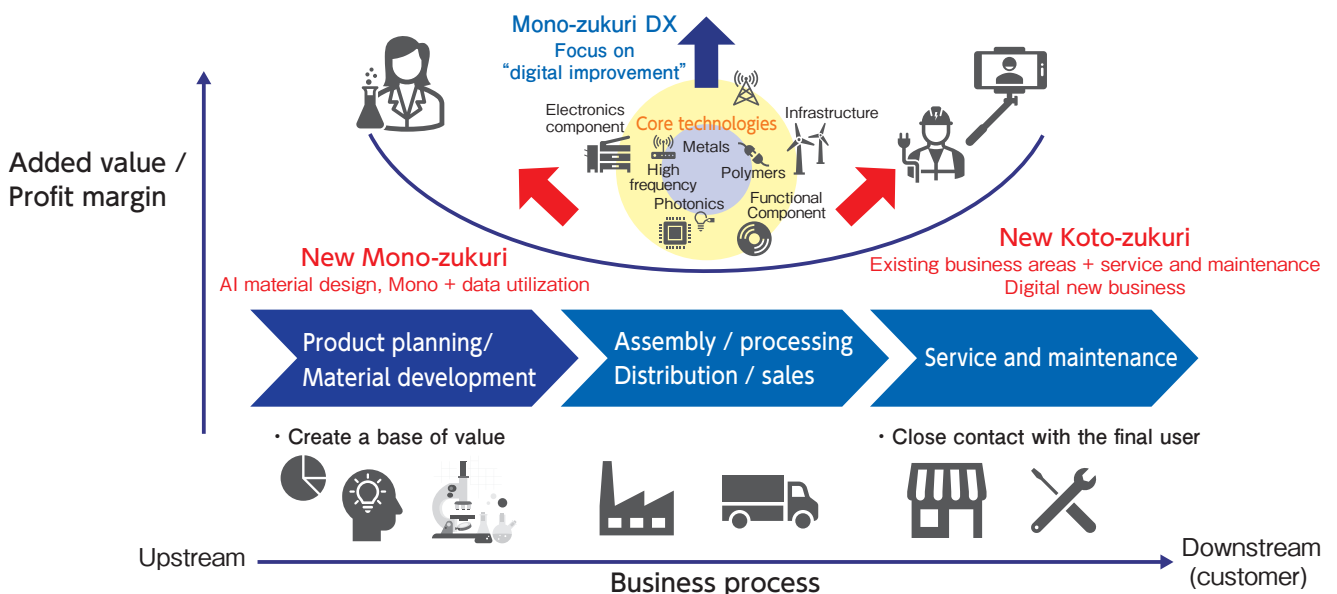


Figure 6 The value chain and the Mono-zukuri, Koto-zukuri DX.

ments in the factory to improve quality, productivity, maintainability, etc., and contribute to raising profit margins. On the other hand, even in the same Mono-zukuri DX, the planning of new products and the development of new materials using AI functions can be seen as a move into the upstream side of the value chain. Furthermore, by advancing into service and maintenance using the digital technology, the company is moving into the downstream side of the value chain. In this way, we will go beyond the “smile curve” phenomenon, in which the profit margins of the upstream and the downstream are high, and promote activities to control the entire value chain.

2.4 Developing and Strengthening the Digital Human Resources Within the Company

As a part of our efforts to strengthen our digital human resources, we are strengthening our recruitment of new recruits and career recruits. In the area of recruiting new employees, we are strengthening our efforts to reach out to information-related departments that we have had little contact with in the past, such as by participating in social collaboration courses at the Tokyo Institute of Technology's School of Information Science and Engineering. In the area of career recruitment, we are actively promoting our DX activities to the outside company.

On the other hand, digital human resources are short supply throughout the industry, and there is a limit to strengthening by appointing external human resources. Therefore, it is essential to strengthen the internal development of digital human resources. Since 2018, we have been using E-learning from Aidemy Inc. in the R&D Division. In addition to the ease of use of E-learning and the technology that covers system development, the vision of Aidemy Inc. (Economic implementation of AI, support for insourcing production within the company) and the activity concept of the Digital Innovation Center

resonated, leading to the capital and business alliance in June 2021.

As digital human resources, we divide them into concept planners (planners, designers) and creators (software engineers, AI engineers). Concept planners are the promoters who plan to improve the structure of a series of business processes. They identify business problems, determine whether the digital technology is effective in solving them, and develop improvement plans. Creators design and create the details under the concept planners. In addition, a small-scale problem-solving exercise is conducted, in which similar improvements have been made in the past. It is the role of embodying, designing, realizing, and utilizing improvement plans according to the work in the field to produce effects. Using AI as an example, Figure 7 illustrates the steps of digital application and the image of the corresponding human resources. The Digital Innovation Center is the main body for building IoT and AI models within the company, but it also works with business divisions to identify issues and operate models. The planner must have domain knowledge of each business, and it is desirable to arm the aces of business units with digital skills.

As detailed DX education according to the type and level of human resources, we hold DX courses for managers, company-wide deployment of E-learning, and exchange meetings within the company. The basic curriculum for the DX course for managers consists of three-month Aidemy online learning content and total of two remote lectures, with an optional workshop for identifying actual issues and creating plans.

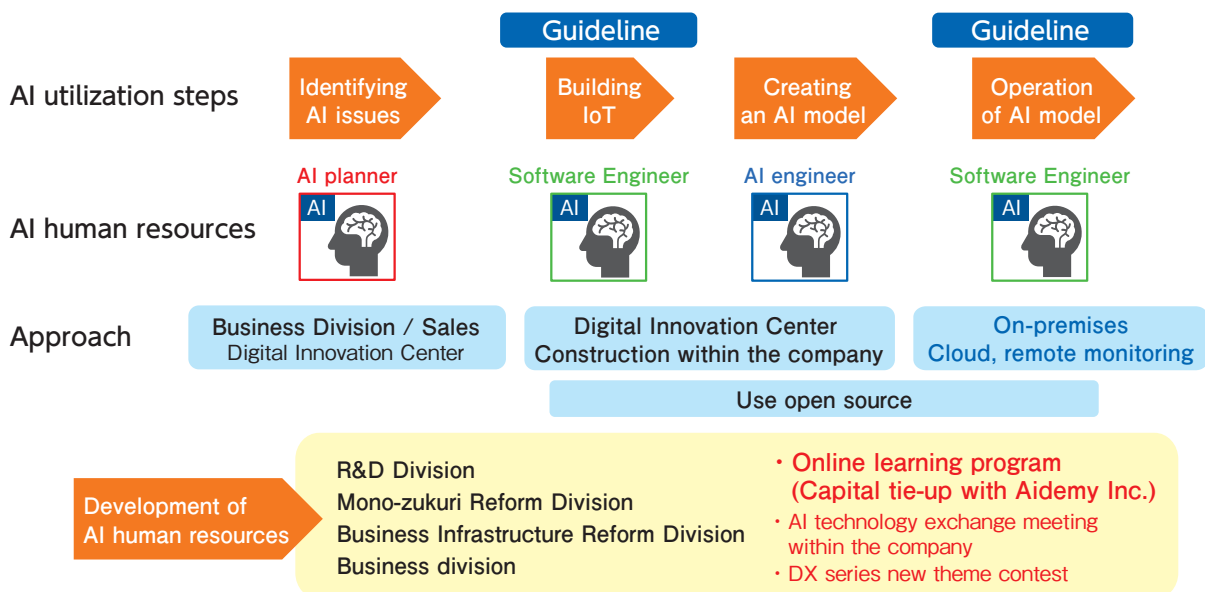


Figure 7 The steps in the use of AI and the corresponding digital human resources.

3. ISSUES / HURDLES AND DIRECTIONS FOR SOLVING

Since the establishment of the Digital Innovation Center, some results have been achieved, mainly in the area of the Mono-zukuri DX, but full-scale company-wide deployment is yet to be achieved. In promoting the DX, we must also gain understanding of cost effectiveness and the placement and training of human resources. In particular, increasing the number of promoters in the department side and solving the shortage of software human resources are major hurdles. In order to overcome this hurdle, it is necessary to have a system in place to pick up measures that make good sense and place emphasis on human resources. We are currently strengthening the training of human resources who will play the role of promoters by using E-learning but in the future, we will create a roadmap for human resource development that includes criteria for each level and the number of people at each level to ensure the company-wide deployment.