Proposal for "Manufacturing Solutions" through Digital Transformation (DX)

HIDEAKI YAMAMOTO*1

To continue to sustainably help customers and society by providing machine tools, it is necessary for Mitsubishi Heavy Industries Machine Tool Co., Ltd. to transform itself into a company that can continuously change and grow while having the capability of responding to recent technological innovations and rapid changes in the social environment, etc.

In the world of business, the conventional trade of "tangibles" has been gradually taken over by that of "intangibles." With a view to sustainable change and growth, our company promotes digital transformation (DX) and offers, in relation to around machine tools, "manufacturing solutions" that enable us to coexist, live and create together with our customers, thereby shifting the business focus to so-called "intangibles." This report presents the details.

1. Introduction

The environment surrounding us is changing rapidly, as represented by a decrease in the number of skilled engineers in Japan as they age and digital technology innovations such as IoT, AI and 5G. Under such circumstances, in addition to providing products ("tangibles") such as machine tools, demand for the offering of solutions ("intangibles") such as "machining a raw material to produce a product"—which is the purpose of introducing a machine tool in the first place—is rapidly increasing.

Having been engaged in trading "tangibles" by selling machine tools and aftersales services, we consider that we also need to focus more on providing "intangibles." Specifically, it is necessary to offer customers "manufacturing solutions" built around machine tools, which enable us to coexist, live and create together with them.

2. Business shift to delivering "intangibles" through digital transformation

When it comes to how to proceed with providing around machine tool-based "manufacturing solutions" for coexistence, living and creation with customers, one approach is to promote digital transformation (DX).

DX represents the concept of "creating new value through the use of various digital technologies such as IoT, AI and 5G to bring innovations to business," which is the very challenge we need to undertake to shift our business focus to providing "intangibles" (**Figure 1**). DX is the "revolution of data" by which large quantities of data are turned into a valuable asset. This indeed coincides with the change in the direction of our business for offering "manufacturing solutions" as "intangibles" based on various types of data and information.

As described earlier, the environment surrounding us is changing rapidly. Under such circumstances with the rapidly increasing demand for "intangibles," we promote and undertake the challenge for DX and will further grow as a provider of "intangibles" (i.e., "manufacturing solutions") so that customers can benefit from a variety of services at every stage of production

*1 Engineering Manager, Engineering Development Department, Engineering Headquarters, Mitsubishi Heavy Industries Machine Tool Co., Ltd.

activities (**Figure 2**).

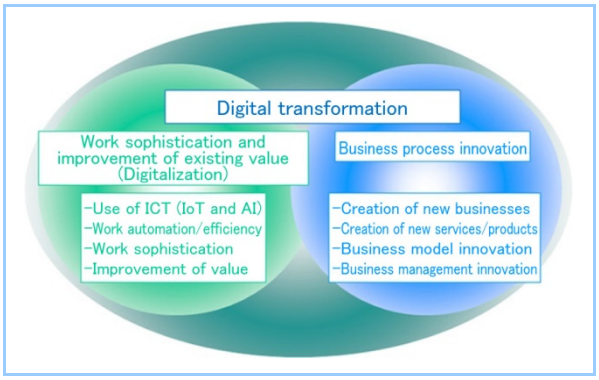

Figure 1 Concept of digital transformation

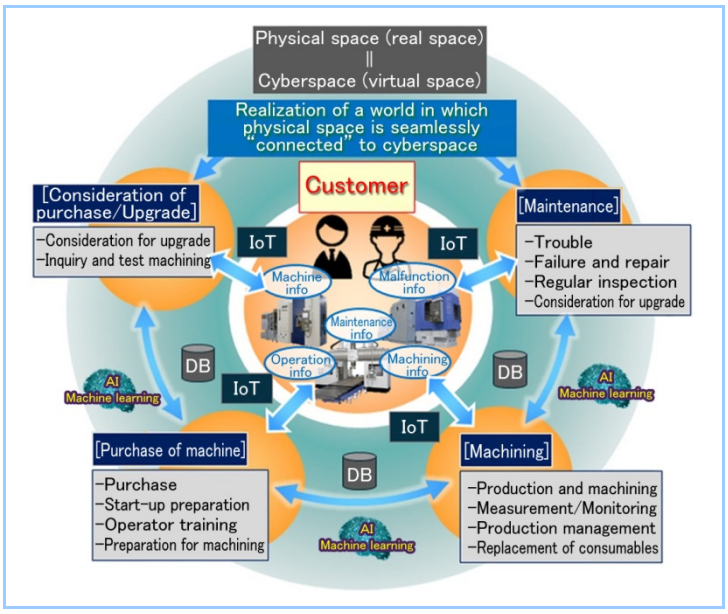

Figure 2 "Manufacturing solutions" for coexistence, living and creation with customers through DX

3. "Manufacturing solutions" for coexistence, living and creation with customers

Figure 3 outlines our "manufacturing solutions" for coexistence, living and creation with customers. Since 2016, we have offered DIASCOPE® – a platform for IoT or AI, through which machine data are stored for use to deliver various services to customers as "manufacturing solutions." We are thus developing our business as a provider of "intangibles."

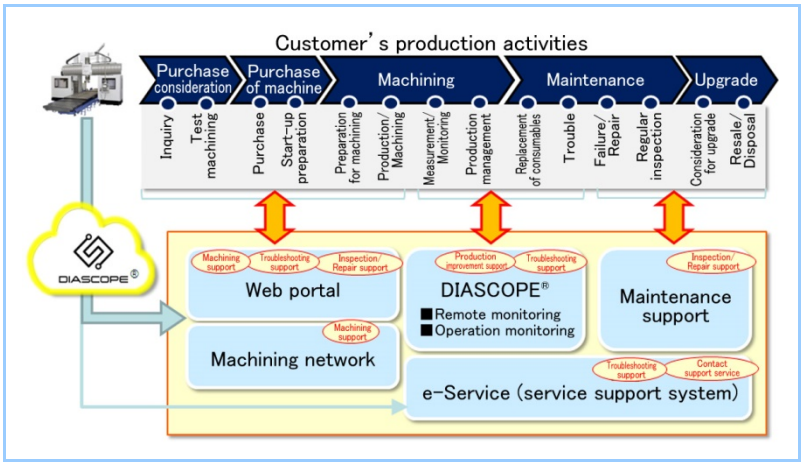

Figure 3 "Manufacturing solutions" for coexistence, living and creation with customers

These "manufacturing solutions" include the following major system services: (1) DIASCOPE® (remote monitoring and operation monitoring), (2) web portal, (3) machining network, (4) e-Service (service support system) and (5) maintenance support. Based on the machine data stored through DIASCOPE®, we help our customers with their production activities at all stages.

4. "Manufacturing solutions" platform

Illustrated in **Figure 4** is the platform used to provide "manufacturing solutions." The major system services such as DIASCOPE® and the web portal are configured in an integrated manner within Microsoft's cloud platform Microsoft Azure.

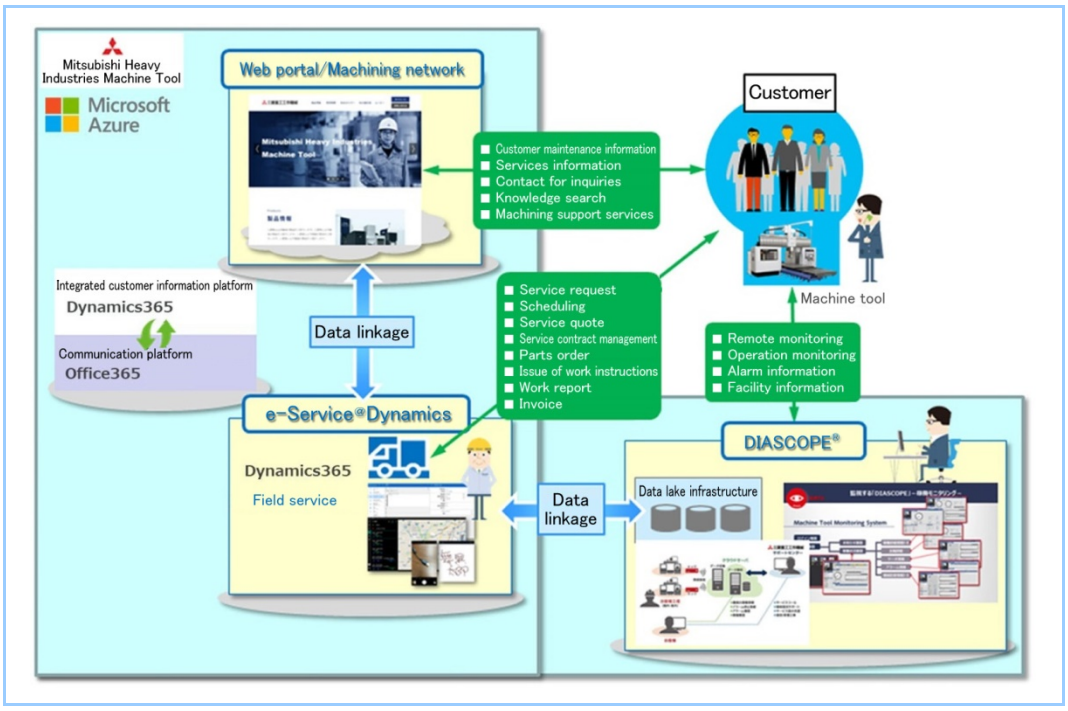

Figure 4 "Manufacturing solutions" platform

All the data about machine tools are stored in the cloud through DIASCOPE® and are linked among the major system services. As shown in Figure 2, digital twinning is realized by seamlessly interrelating physical space and cyberspace. Consequently, it has become possible to use data in cyberspace more efficiently and effectively, allowing us to optimally deliver a variety of services to customers in an integrated manner. In other words, with this platform being built to realize "Connected Industries," we have established a system to help customers with multiple aspects of their production activities. The service details will be given later in Section 6.

5. IoT platform "DIASCOPE®"

The IoT platform required to provide "manufacturing solutions" is described below. DIASCOPE® has been built as an IoT platform to support customers in optimizing their production activities, the five features of which are (1) connecting, (2) monitoring, (3) diagnosis/prediction, (4) controll/Autnomous and (5) linking/optimization. **Figure 5** shows the road map for DIASCOPE®. As the functions associated with (1) connecting and (2) monitoring, "remote monitoring" and "operation monitoring" have been rolled out in the market. These two functions have been included as standard in all shipped large machine tools, gear cutting machines, and micro milling machines since April 2020. We have thus established a system by which "remote monitoring" and "operation monitoring" services can be offered to all customers. Accordingly, the infrastructure to deliver "manufacturing solutions" through DX has been constructed.

In regard to the functions associated with (3) diagnosis/prediction, we are proceeding with the test operation of "facility health monitoring," "tool monitoring" and "machining quality monitoring." These will be made available to customers accordingly.

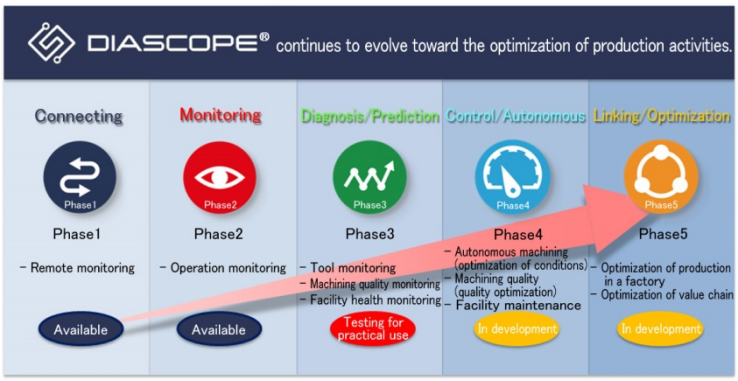

Figure 5 DIASCOPE® road map

6. Details of "manufacturing solutions" services

This section describes the services and functions to be provided as "manufacturing solutions."

6.1 Machining support through the web portal (machining network site)

In addition to conventional machining support, we will actively work on online support through the web portal. To fully support customers in machining, the portal will contain a variety of contents, so that customers can obtain necessary information whenever in need, and eventually a global support system for machining can be constructed.

Specifically, the portal services will include (1) the ability to download manuals and 3D data, (2) Web-NC school, (3) machining technique hotline and (4) a machining conditions database. These features will not only be available through the web browser of a computer, but in due course will also become operable/browsable on the control panel of the latest machine models. Finally, as noted in (5), everything will be offered online through the portal, including NC training course application, to further improve the usability for customers.

6.2 Production improvement support through DIASCOPE®

With the use of DIASCOPE® operation monitoring, machine operation data can be obtained in real time, and the machine status is browsable through the web browser. As the operation monitoring screen is accessible from a smartphone or tablet if an internet connection is available, the operational status of machines in a factory can be checked at any time (**Figure 6**).

The multi-angle analysis of data stored through operation monitoring can be used to improve productivity or optimize facility operation. As an example of problem solving using DIASCOPE®, we have a customer who wanted to shorten the time until the delivery of their products, but had no means to understand the detailed machine operational status or real-time progress in the production process. With DIASCOPE® in use, however, it has become possible to understand the daily operation rates and real-time progress in the construction through Gantt charts, successfully reducing the time until delivery (**Figure 7**).

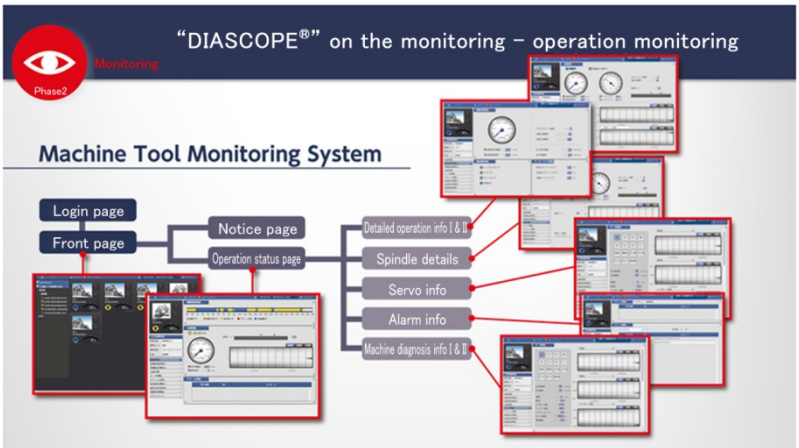

Figure 6 DIASCOPE® operation monitoring

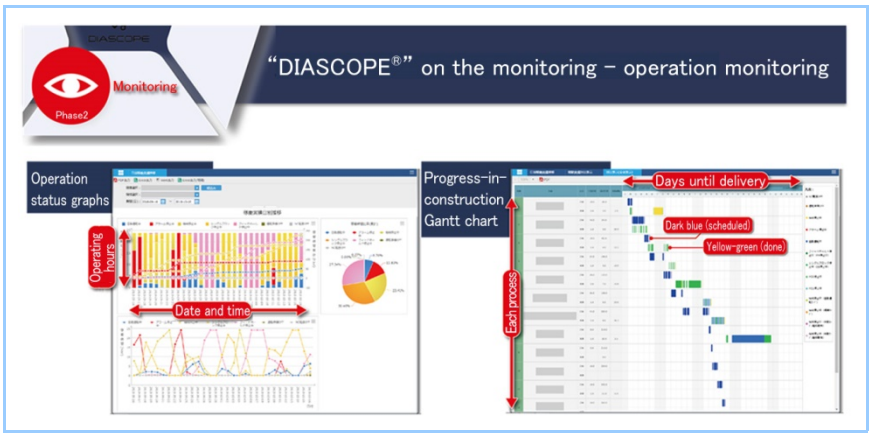

Figure 7 Real-time display of production process

6.3 Troubleshooting support with the use of DIASCOPE® (contact support service)

With DIASCOPE® remote monitoring in use, once notification of the occurrence of a problem is made by the customer, we can remotely access the machine with the problem and precisely advise the customer how to handle the situation based on the actual data of the machine, thereby helping to reduce downtime (**Figure 8**).

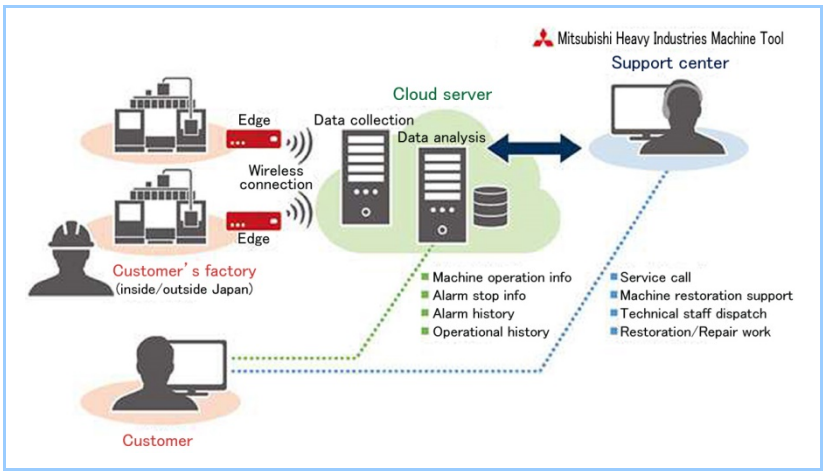

Figure 8 DIASCOPE® remote monitoring

6.4 Troubleshooting support through the web portal

Although we currently receive the customer inquiries for troubleshooting mainly by telephone through our service support system e-Service, we will gradually proceed with automating customer support services including FAQs and chatbots through the web portal. Further improvement of customer satisfaction will be attempted by enhancing service quality during the night and public holidays and improving the global service system. The data for the FAQs and chatbots will be augmented by learning based on the service information stored in e-Service, so that more intelligent advice can be provided.

By presenting the portal contents that make it possible to manage the information of our service history and that of a customer's maintenance history in an integrated manner, our proposal for support in cooperation with the customer will be fine-tuned in terms of quality and will be easy to adopt.

6.5 Inspection/repair support through the web portal

In addition to troubleshooting support, we will also help customers to carry out inspections and repairs on their own. Specifically, the portal contents will include (1) alarm search (search for how to respond at the time of alarm), (2) maintenance videos to search/view and (3) maintenance information for browsing. The contents will not only be available through the web browser of a computer, but will also become operable/browsable on the control panel of machines that will be newly launched.

6.6 Maintenance support inspection and repair support

While IoT and DX are introduced widely, old machine models are often incompatible. As some customers prefer maintenance inspection by experts from the machine's manufacturer, we also offer a maintenance support service that is a machine tool version of a thorough medical check-up. By allowing us to conduct maintenance support work (regular inspection), it will become possible to detect abnormalities at an early stage and prevent the occurrence of machine tool shutdown due to sudden failures, thereby helping customers to operate their facilities in a stable manner. Online registration will be available through the web portal, including requests for the maintenance support service and the purchase of service parts.

7. Conclusion

Since April 2020, DIASCOPE® has been included as a standard feature. Building this system to collect data from machine tools, we now have the infrastructure to deliver "manufacturing solutions" through DX. Our business as a provider of "manufacturing solutions" through DX has just begun.

By continuously providing tailored, more effective "manufacturing solutions" over the whole life cycle such as productivity improvement and machining , trouble support, maintenance support based on the data stored through DIASCOPE®, we help customers to optimize their production activities and work toward our goal to coexist, live and create with them.

The product information available at:
https://www.mhi-machinetool.com/support/diascope.html