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ICT-Enabled Business Model Innovation by B2B Manufacturers

—Pursuing the Creation of Process Value—

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Business-to-business (B2B) manufacturers that develop products and sell them to other businesses now face the need for going beyond merely selling their products and creating "process value" for customer companies. Process value can be classified into three types of value. They are "work process value," "business process value" and "knowledge process value." By creating these types of value, B2B manufacturers should aim to offer higher levels of added value than those that can be offered by simply producing and selling products.

Information and communications technology (ICT) plays a significant role in offering process value. For example, business process value can be offered by employing machine-to-machine (M2M) technology, which is expected to make major contributions mainly in the area of operation and maintenance (O&M). It becomes possible to offer knowledge process value by making the best use of data that have not yet been fully utilized such as machine data and social network data in combination with external data. Amassing and analyzing these data enables the development of new businesses and new products. In such a way, ICT is the key to creating higher levels of process value.

The groundbreaking cases of ICT-enabled process value creation include KOMTRAX (Komatsu Machine Tracking System), a remote monitoring system developed by Komatsu. Another example is one in which Company A, a machinery manufacturer, integrated its ICT capabilities that had been developed for each product separately within the company by gathering its ICT engineers together in one department.

The important measures for ICT-empowered process value creation include: (1) systematizing the knowledge of a company's engineers and using such systematized data through an ICT system, (2) building a mechanism to visualize and utilize the knowledge and skills of control engineers and ICT engineers who are apt to simply support product development, (3) developing a structure to identify customer problems, define requirements and develop ICT-enabled solutions and (4) establishing an organization that drives business model innovation.

I Approaching an Era where Manufacturers Must Offer Process Value

Business-to-business (B2B) manufacturers that develop products and sell them to other businesses have been finding it increasingly difficult to achieve product-based differentiation. This trend is particularly pronounced in areas of products that are widespread in developed countries such as photocopiers, construction equipment and machine tools. For example, along with increasing digitization, computer printer manufacturers have been entering the copier market that had previously been dominated by traditional copier manufacturers, in particular, Japanese companies having overwhelming competitive strengths. Given this situation, it has become difficult for B2B manufacturers to differentiate their products only by drawing on extensions of technologies that were developed and accumulated in the era of analog technology. In order to retain and increase market share, they are facing a growing need for becoming involved in customers' work processes.

Another example is the construction equipment industry. Buoyed by rapidly increasing demand in emerging markets, construction equipment manufacturers operating in these regions such as South Korea's Hyundai Heavy Industries and China's Sany Heavy Industry, which have grown with their price competitiveness, have been improving their performance and quality. In the face of such rising competitive advantages in terms of both price and quality, it has become difficult for Japanese manufacturers to achieve differentiation simply by enhancing product quality in this sector as well.

Such being the case, besides offering high-quality products, it has become increasingly important for B2B manufacturers to get involved in customers' business processes to identify the issues facing their customers. To this end, these manufacturers must offer "process value" to act on behalf of their customers to solve relevant issues. Offering process value means that in addition to selling products, B2B manufacturers act on behalf of their customers in terms of their work process and business process, as well as in terms of "knowledge process" for which high levels of pertinent knowledge are required such as creating a business model (Figure 1).

Process value can be classified into the following three types of value.

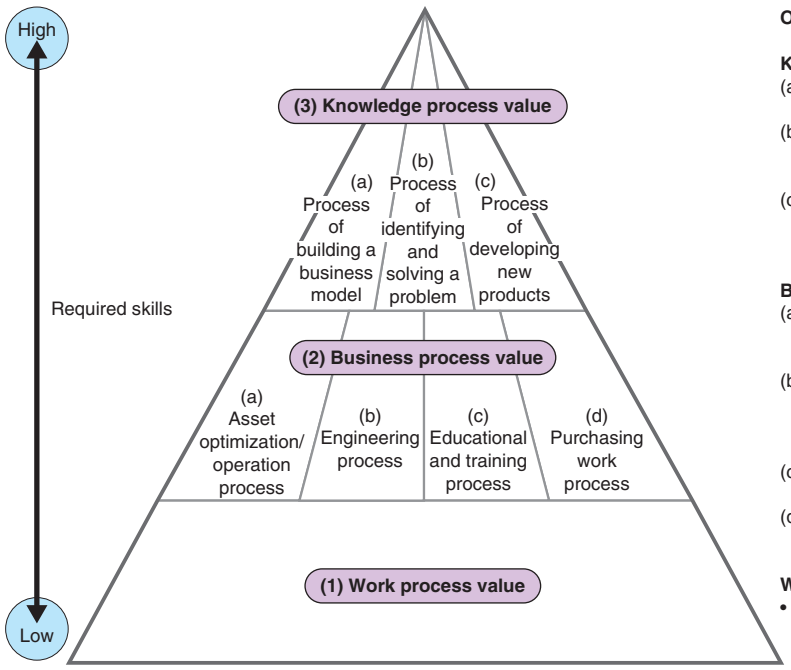
①Work process value
②Business process value
③Knowledge process value

The use of rapidly advancing information and communications technology (ICT) is essential to provide high levels of process value. How best to utilize ICT is described in detail in Chapters II, III and IV.

1 Work process value

Work process value refers to value offered by performing a customer's work on behalf of the customer and is considered as added value provided to the customer. Examples of offering work process value include the case

Figure 1. Structure of "process value" provided by B2B manufacturers



Outline of each "process value" and example companies

Knowledge process value
(a) Proposing a business model to increase value offered by customers (Examples include Xerox and HP)
(b) Fully understanding a customer's development and production processes and making proposals to improve the efficiency of each process (Examples include Keyence)
(c) Entering into a partnership with a customer and jointly working to plan and develop new products (Examples include Toray)

Business process value
(a) Making proposals to optimize asset operations and performing a customer's work on behalf of the customer (Examples include HP and Xerox)
(b) Performing engineering work on behalf of a customer in which its own products and those of other manufacturers are combined to develop an optimal product that conforms to certain specifications (Examples include Konica Minolta)
(c) Providing educational and training process (Examples include Olympus)
(d) Conducting purchasing work on behalf of a customer (Examples include ASKUL and Dell)

Work process value
• Performing a customer's work (Examples include copier manufacturers)

in which a photocopier manufacturer sends its employees to the customer's copy center to provide the service of operating its copier at the center.

2 Business process value

Business process value refers to value offered to a customer by designing and optimizing the customer's business processes. Conceivable business processes for which value is offered include: (a) asset optimization/operation process, (b) engineering process, (c) educational and training process and (d) purchasing work process.

Examples of "(a) asset optimization/operation process" include "managed print services (MPS)" globally offered by Hewlett-Packard and Xerox. These companies are the two dominant MPS providers, which optimize operation of a customer's assets such as copiers and printers by analyzing the flow of data and documents in the course of their customer's business activities. In addition, Xerox sends its employees to the customer's workplaces to implement business activities on behalf of the customer.

In most cases, value provided for "(b) engineering process" is value offered by the suppliers of parts, components and/or raw materials to manufacturers of finished products. In some other cases, it is value provided for the management of projects that affect society at large and thus require the highest level of safety such as the development of traffic systems and nuclear power plants.

Other cases include the case in which the plant engineering department of a heavy electric machinery manufacturer combines its compressor with pipes made by another manufacturer, which were separately procured by a customer, in such a way as to ensure optimization of the entire plant. In some cases, through such synchronization-type engineering process, a manufacturer, which had previously only provided products, draws up a plan for an entire project and manages its progress on behalf of a customer, and guarantees the operation of a plant according to the specifications of the contract.

A typical example of "(c) educational and training process" is the education of a customer company's operators. Let's look at the case of Olympus. Olympus now holds more than a 70 percent share of the global market in flexible endoscopes. The company's efforts that led to this success date back to 1950 when Olympus developed a prototype gastrocamera at the request of doctors at the University of Tokyo Branch Hospital. Subsequently, the company established a training center where the company continues to provide "educational and training process" to help doctors acquire skills to operate endoscopic equipment. Even now, when Olympus has an overwhelming market share in flexible endoscopes, the company actively supports the dissemination of endoscopic examination technology among doctors and the improvement of their skill levels by setting up training centers in regions where endoscopic treatment has not yet become common.

Value offered through "(d) purchasing work process" is, as its name suggests, value offered by conducting purchasing work on behalf of a customer. For example, ASKUL, a wholly owned subsidiary of PLUS Corporation, which manufactures and sells stationery products, acts as an agent for purchasing work and provides direct delivery services of office supplies and commodities including those of other manufacturers. In the case of Dell, in addition to simply selling personal computers to businesses, Dell provides an online purchase mechanism (purchase portal) for a wide range of its product line to substantially reduce the time and labor required for customers to make purchases.

3 Knowledge process value

Knowledge process value is value offered in such a way as to provide a customer company with ideas and/or by identifying the issues facing the company. Specific processes for which value is created include: (a) process of building a business model, (b) process of identifying and solving a problem and (c) process of developing new products.

The value provided for "(a) process of building a business model" relates to supporting increases in added value of a customer's business by offering ideas for developing a new business model. An example of offering such value is seen in the case of Xerox's digital printing business. Xerox provides a means of one-to-one marketing (variable data printing by digital printing equipment according to customer attributes and anticipated profits) to its customers (consumer goods manufacturers). In so doing, Xerox encourages its customers to shift to a business model involving small-lot production of many models, which offers higher added value that could not be achieved by traditional mass-production printing using offset presses.

An example for "(b) process of identifying and solving a problem" is seen in the proposals made by Keyence, a manufacturer of sensors, measurement systems, microscopes and related products. Keyence thoroughly examines the methods of development and production adopted by its customers, and conducts research on "ways to improve the efficiency of customers' production processes." By converting the research results into numerical data and making proposals based on such data, Keyence offers knowledge process value to its customers.

The case of Toray Industries can be cited as an example of offering value for "(c) process of developing new products." By entering into a strategic partnership with Fast Retailing for UNIQLO business, Toray and Fast Retailing have been jointly planning and

developing new products. Based on this partnership, an integrated system ranging from the introduction of new raw materials to the sales of finished products was established. Toray, together with its customer (Fast Retailing), has been continuing to offer new value such as Heattech (thermal underwear) to consumers.

II Importance of ICT Use in Offering Process Value

In this chapter, based on the cases of ICT use in offering process value, consideration is given to specific ICT applications for each type of process value.

1 Cases of achieving a shift from work process value to business process value

Looking at cases in which a B2B manufacturer achieved a "shift from work process value to business process value" with respect to value offered to customers, either (1) a means of using M2M [Note 1] or (2) a means of using a combination of electronic commerce (EC) and BI [Note 2] has often been adopted.

(1) Use of M2M

Among the four types of business process value, M2M is often used to achieve the value for "(a) asset optimization/operation process," which is expected to lead to improved operation and maintenance (O&M) efficiency.

For example, Fuji Xerox has developed a quality management system, called "TQMS-Uni (trace quality management system)," to collect data on operating conditions of its copiers online. These data are used to improve the efficiency of maintenance work. Most copiers are equipped with several hundred sensors, which detect faults, potential faults and alerts that occur during daily operation. Fuji Xerox has devised work procedures that contribute to improved maintenance efficiency without negatively affecting the degree of customer satisfaction. These procedures consist of collecting such data through TQMS-Uni online and analyzing them according to an algorithm defined for each customer. In addition, physical problems such as paper jams are different from electrical faults in terms of causes and seriousness. Therefore, the company has been working to develop a theory that enables the separation of physical faults from electrical ones by using the data collected from the sensors in the copiers.

DMG Mori Seiki, a machine tools manufacturer, uses "MORI-NET" to enhance maintenance efficiency. This system monitors their machine performance and provides remote maintenance service. In the same way as is done by Fuji Xerox, based on the data collected from sensors attached to their machine tools, the company leverages ICT to monitor machine performance and provides remote support. By setting up a company-wide policy of "providing top-quality service" in 2002, the company enhanced its call center services that same year. After two years, the company launched MORI-NET as part of its commitment to offering its customers maximum value from the service perspective.

(2) Use of EC and BI

In the category of business process value, the method of combining EC and BI is primarily used to achieve value for "(d) purchasing work process."

For example, ASKUL uses its SOLOEL system to comprehensively manage all services from purchases on behalf of a customer to the customer's business process reengineering. An "electronic procurement system" underlies SOLOEL. The use of the electronic procurement system facilitates the integration of purchasing procedures and purchase data of indirect materials as well as product procurement standards in conformity with the customer's in-house rules. Such integration enables "visualization" of the customer's purchases of indirect materials, which reveals the issues facing the customer from the perspective of achieving company-wide optimization. This information can be used to support the customer in reengineering various processes for procurement. Examples include leveraging economies of scale for price negotiation, obtaining favorable terms and conditions for purchases and planning joint purchases, all based on the information collected through SOLOEL.

Furthermore, ASKUL collects and analyzes information on customer needs through its e-commerce websites. If products that satisfy customer needs are not available, the company develops and sells its own private brand products. In addition to customer feedback received daily at call centers, ASKUL uses two methods to collect information on customer needs. They are a "community site" and "customer log analysis."

The community site is a bulletin board system that is provided within an e-commerce website for companies where visitors can exchange views and opinions on product ideas and problems. Rather than "one-to-one" communication between ASKUL and a customer company, this site enables "many-to-many" communication, making it possible for ASKUL to nurture a feeling of satisfaction among customers in the sense that "they participate in product development," in addition to gathering information on customer needs.

Customer log analysis refers to a method in which log data stored on an e-commerce website for individual consumers are collected and analyzed to identify consumer needs. In addition to purchase history and conversion rate (percentage of site visitors who make purchases and/or register as members), log data also include a list of "products for which searches were made, but no successful hits were obtained."

In addition to improving a customer's "(d) purchasing work process" efficiency, a set of these ASKUL activities

offers high levels of value to customers by going so far as to develop and sell products that are necessary but were not available for purchase.

2 Cases of achieving a shift from work process value/business process value to knowledge process value

The use of ICT in the field of big data is often seen in cases in which the value offered is shifted from "work process value/business process value" to "knowledge process value."

Among the three types of knowledge process value, big data is used particularly for "(a) process of building a business model." Leveraging big data enables a B2B manufacturer and its customer companies to continuously optimize their marketing activities.

For example, Hewlett Packard places an importance on data analysis (marketing intelligence) when proposing its Indigo digital printing press to customers (printing companies). For printing companies, Indigo press is anything but cheap, often raising concerns about whether the introduction of this press is truly effective. To address such concerns, HP analyzes the sales data of a customer company of a printing company to identify the needs of end-users (consumers). Then, HP proposes how best to use its printing press based on the identified needs. In this way, HP creates new value that supports marketing activities of a printing company (its customer) by amassing and analyzing data through ICT.

Fuji Xerox offers "Direct2One" direct marketing service to its customer companies based on advanced analysis of consumer data. Fuji Xerox, which produces and sells digital printing presses represented by Xerox iGen, offers "work process value" to its customer companies in the form of selling its products. On top of this value, Fuji Xerox has come to offer Direct2One to support sales and marketing activities because these activities are usually the primary purposes of printing press use. Specifically, by analyzing consumer data that a customer company has, Fuji Xerox examines consumer lifestyles and behaviors. Based on the results, the company helps customers conduct consumer segmentation as well as plan and produce promotional materials.

Direct2One creates new knowledge process value in that it supports customers' promotional activities based on the data analyzed through the use of ICT without relying on a rule of thumb or some sort of intuition.

3 Offering process value by adopting a traditional approach unique to each individual B2B manufacturer

Sections 1 and 2 above introduced the cases in which ICT is used to create process value. There are, of course, B2B manufacturers that create process value without using ICT or without relying on M2M or big data.

As described in Chapter I, Toray and Fast Retailing have been jointly planning and developing new products. However, it is hard to say that ICT has played an extremely important role in achieving value for "(c) process of developing new products," which is one of the three types of knowledge process value.

Similarly, Keyence considers that the key factor for success (KFS) for "(b) process of identifying and solving a problem," which is again one of the three types of knowledge process value, is to thoroughly utilize classical information-sharing tools and databases. Keyence has traditionally compiled information-sharing tools such as "technical handbooks," which indicate conditions that must be followed in using a product as well as precautions in use, and "application case studies," which introduce the best practices achieved by customer companies. Keyence also uses a "needs card," which is a mechanism to give feedback to the development department about customer demand. However, none of these mechanisms uses M2M or big data. It is fair to assume that most manufacturers are equipped with such mechanisms to a greater or lesser extent. Keyence excels in identifying and solving problems and is able to enjoy higher profit margins. Such success is the result of its efforts to fully utilize information and technologies that it has developed and accumulated, rather than the result of ICT use.

It is true that some B2B manufacturers have been achieving success by conducting such unique activities. Nevertheless, in recent years, there have been increasing expectations of M2M and big data. Actually, some companies have been successful in offering process value using these new technologies. In the same way as they do, it is considered essential that B2B manufacturers offer process value by skillfully leveraging ICT in the future.

III Cases of Japanese B2B Manufacturers Using ICT to Offer Process Value

In Chapter II, the authors pointed out the importance of the use of ICT including M2M and big data in offering process value. This chapter looks at three Japanese manufacturers offering process value and explains in detail how they are using ICT in offering process value. They are Komatsu, Company A (machinery manufacturer) and Hitachi.

1 Komatsu

Without limiting its business to simply selling its construction equipment, Komatsu has developed a remote management system, KOMTRAX (Komatsu Machine Tracking System), to improve customer loyalty and

maintenance efficiency. The system monitors the location and operating conditions of its construction equipment.

At the end of the 1990s, car navigation systems emerged in the vehicle-mounted equipment industry. With the appearance of such systems, advances in global positioning system (GPS) technology have made rapid strides. By riding on such evolutionary trends, the then Construction Equipment Research Center, Development Division came up with an idea of KOMTRAX. Because initially, development efforts mostly relied on "seeds" (technologies, capabilities and human resources owned by the company), the developed prototypes did not match actual "needs," leading to a situation where the system introduction project was about to collapse. However, subsequently, the president of then BigRental (now Komatsu Rental after integration) discovered potential value in KOMTRAX and utilized such value, initiating KOMTRAX services.

Because the benefits of KOMTRAX at that time were unclear to customers, the system was nothing but an additional cost for them. Under the instructions of then President and CEO Masahiro Sakane, the Corporate Planning Department played a central role in conducting research and studies on KOMTRAX. These research and study results caused then President Sakane to make a decision that "even simply being able to track the locations of the company's construction equipment and to know their travel distance can constitute value for Komatsu." Since then, KOMTRAX became a regional standard in the Japanese market.

At first, partially due to the small number of models equipped with KOMTRAX, the system was not well received within the company, causing negative feelings as represented by "there is a greater number of machines from which data cannot be collected and the way we do work remains unchanged." As such, little progress was made in the use of the collected data.

However, in 2004 when KOMTRAX was launched as standard in China, its value increased significantly. At that time, Komatsu had just laid the groundwork for a dealer system in the Chinese market, and an information system was far from being ready. Under this situation, additional thoughts were given to the value of KOMTRAX that is capable of automatically collecting and managing data on the operating conditions of construction equipment, marking the start of full-scale use of KOMTRAX. Subsequently, new methods of use that are particularly effective in the Chinese market were added such as remotely suspending operation of construction equipment as a means of urging a delinquent customer to pay, and monitoring the operating conditions of construction equipment so as to use the collected data as credit information.

In 2005, with an eye to globally deploying KOMTRAX, the KOMTRAX Promotion Office was established within Komatsu. Starting in 2006, global deployment of KOMTRAX swung into high gear. Initially, the KOMTRAX Promotion Office was part of Komatsu's Marketing Division. In 2012, the office was separated from the Marketing Division and became the ICT Business Division, assuming greater responsibility. While its main task was to promote the deployment of KOMTRAX, after it was upgraded to the ICT Business Division, this division came to cover a much wider range of activities for designing and developing an entire business model of KOMTRAX. These activities include collecting not only data on sales and services but also needs related to the use of KOMTRAX, examining the seeds (resources owned by the company) from the perspective of identified user needs, and providing feedback to the System Development Department in the form of development requirements based on examination results.

KOMTRAX constantly monitors the operating conditions of construction equipment. The data collected through this system not only lead to remarkable improvements in Komatsu's maintenance service for customers but also enable customers to use the system as a "tool that supports the visualization of their own businesses." With such ability, KOMTRAX contributes to greater customer satisfaction and, eventually, to an increase in the value of the Komatsu brand.

For mining equipment, Komatsu released KOMTRAX Plus that collects detailed status information on large equipment. In addition, Komatsu developed Autonomous Haulage System (AHS) for super-large driverless dump trucks. Using this system, Komatsu shares key performance indicators (KPIs) with mining companies and plays a part in their mining operations. In this way, Komatsu has been very active in using ICT. By going beyond simply selling its products, Komatsu provides high levels of support for customers' businesses by taking part in their operations.

In addition to President Sakane's strong leadership, Komatsu's organizational culture has greatly contributed to the development and deployment of KOMTRAX. Since its inception in 1921, Komatsu has placed a particular emphasis on "quality control (QC)." This historical characteristic has created a corporate climate in which information collected through KOMTRAX on the locations and operating conditions of equipment has been regarded as "facts" of the market, and business and management decisions have been made based on these facts.

In January 2014, Komatsu and GE Mining, a subsidiary of General Electric (GE), announced the establishment of a joint venture, Komatsu GE Mining Systems, LLC., to develop next-generation mining equipment. Komatsu and GE Mining intend to combine their expertise in mining equipment and propulsion systems with the aim of increasing customer productivity and safety for underground mines. Specifically, the new company plans to combine Komatsu's mining

equipment, vehicle and ICT technologies with GE's electric power expertise, electric drive systems and battery technologies to offer innovative levels of process value to global mining customers. Without limiting options to what it can achieve on its own, Komatsu always adopts a "customer-focused" approach to increase process value and actively enters into alliances (partnerships) with other companies in the areas in which the company is not strong.

In addition, the "Komatsu Way" plays a significant role. These guiding principles define Komatsu's brand management initiative. As an overriding concept for its sales and marketing activities, Komatsu set an important goal of "letting customers feel that Komatsu is invaluable" (Table 1). To work together with customers based on this brand management initiative, Komatsu has provided KOMTRAX as a strategic tool and has achieved success in further increasing the value offered by KOMTRAX.

That is, Komatsu has been continuing to enhance its organizational culture of being sensitive to market trends by "visualizing (finding facts such as)" the operating conditions of equipment on site through KOMTRAX. For dealers, KOMTRAX contributes to the improvement of business efficiency and service quality. For customers, in addition to "visualizing (finding facts such as)" the operating conditions of equipment, KOMTRAX enables them to increase their equipment utilization rate and reduce operating cost. Through the use of ICT, all Komatsu Group organizations are committed to constantly offering process value to customers and further enhancing customer relationships.

2 Company A, machinery manufacturer

Company A, machinery manufacturer, is a conglomerate developing and selling infrastructure equipment and similar products. The company has a large number of ICT engineers. However, because most of them are control engineers working in the company's Product Development Department, they have simply assisted product developers and have not taken on a central role in product development. To enable them to fully use their capabilities, Company A separated these control engineers and ICT engineers from the Product Development Department and incorporated them into a single new department. Using their capabilities, Company A intends to offer solutions to customer companies by integrating a variety of hardware through ICT. In so doing, Company A aims to move beyond simply selling hardware and build a business model covering a much wider array of business areas including O&M (operation and maintenance).

In other words, Company A enhanced its ICT development functions in the form of a platform covering all products and services. This platform was created by gathering ICT engineers (ICT human resources), who were engaged only in product development in the past, together in one department and making them available for all business operations. Through these efforts, the company intends to strengthen the entire value chain ranging from hardware to O&M.

3 Hitachi

Hitachi intends to enhance its strengths in the area of ICT to an extent that its global competitors such as GE and Siemens have not yet reached. As part of its in-house company system, the Information & Telecommunication Systems Company of Hitachi plays a central part in developing related technologies and businesses.

In a similar way as Company A (machinery manufacturer) does, Hitachi has long been offering process value in the form of "optimizing the operation of infrastructure equipment." Specifically, for remote monitoring of its gas turbines operating worldwide, 200 to 300 sensors are attached per unit. Data collected through these sensors are analyzed to control machines, monitor daily,

Table 1. Komatsu's brand management initiative

	Seven-stage model for customer relationships	Value of Komatsu to customers
7	• Komatsu is indispensable to our business • We want to grow together with Komatsu	Komatsu is indispensable to our business
6	• We want to do something for Komatsu • We want to create something together with Komatsu	Komatsu enables us to enjoy maximum benefits
5	• We want to continue to buy Komatsu products • We want to continue to have a relationship with Komatsu	Lack of Komatsu availability hinders our operations
4	• We were glad that we bought a Komatsu product • The product we bought was as expected	Komatsu products are preferred over other companies' products
3	• Komatsu is on a par with other manufacturers • We may buy a single unit from Komatsu	Komatsu is one of our suppliers
2	• We may simply listen to a Komatsu salesperson	None (we don't buy)
1	No access is allowed	None (we don't buy)

weekly and monthly operating conditions and predict abnormalities.

However, even within Hitachi, these advanced ICT-based operations are still limited to specific projects and are not yet widespread throughout the company. In order to promote the implementation of similar operations throughout Hitachi, the company is promoting four initiatives: (1) sharing the business concept, (2) creating business with the resolution of problems as the starting point, (3) vesting the ICT department with authority and (4) systematizing engineers' knowledge.

(1) Sharing the business concept

Hitachi has been leveraging the above-mentioned data utilization technology, which the company calls "Field to Future Technology," for product development. Hitachi considers: "Data collected from business scenes and daily life contain 'facts' that can only be discovered in the field. Future value can be created by correctly identifying these facts and by ensuring the improvement of customers' business processes based on identified facts." The company also considers the primary purpose of data utilization to be "support for the creation of value by people."

As seen in the case of Hitachi, widely disseminating clear concepts on the company's policy as well as on added value the company intends to offer inside and outside the company and sharing such concepts among all employees, customers and markets represent an effective means of adopting a top-down approach in business.

(2) Creating business with the resolution of problems as the starting point

To identify problems, discover the most effective solutions to such problems and incorporate such solutions in an ICT system, an extremely large number of processes is involved including a process of making a decision on whether a relevant problem can be solved. Any attempts to accomplish all of these processes alone would entail large amounts of time before reaching the stage of starting business. To address this issue, with the goal of "creating innovation through collaboration with customers," Hitachi places emphasis on the process where problems are identified through discussions with customers and solutions to identified problems are developed through collaboration with customers.

This process was also adopted in the case of gas turbines, which was described at the beginning of Section 3 above. In the past, maintenance for gas turbines was performed by regularly conducting inspections and replacing parts and components. Being unable to predict a failure led to the need for unexpected repair work as well as for always having replacement parts and components in stock. To address this situation, the company has accumulated alert data and data on operating conditions and amassed expertise and knowledge of experts on various analytical techniques and mathematical analysis to find appropriate analytical methods to resolve problems.

(3) Vesting the ICT department with authority

An organizational structure in which business operation departments play a central part and the ICT department simply supports these business operations as one of backup functions tends to make business operation departments too demanding, causing concerns over failure to achieve the goal of "sharing the business concept," which was described in Item (1) above. To avoid such concerns, Hitachi defines its ICT department as a "department that is responsible for identifying company-wide needs for the use of ICT and for driving ICT use."

In April 2012, Hitachi established the "Smart Business Innovation Laboratory" under the umbrella of Hitachi's Information and Telecommunication Company. While this laboratory is composed of data analytics "meisters" and focuses on providing data analytics service, its mission is not limited to providing such analytical service. The laboratory is also responsible for supervising business deployment and strategies. Consisting of 200 employees, the laboratory is working toward the development of new technologies and new businesses.

The action that symbolizes Hitachi's firm commitment to enhancing the use of ICT is that Hitachi appointed Mr. Yutaka Saito as president of the Information and Telecommunication Company in 2012. Up until then, Mr. Saito was president of the Infrastructure Systems Company and played a major role in driving infrastructure business, which is a core business of the Hitachi Group. This appointment rapidly boosted the presence of the Information and Telecommunication Company inside and outside Hitachi.

(4) Systematizing engineers' knowledge

In addition to organizations, Hitachi also systematized the knowledge of its engineers, and defined necessary human resources.

As explained in Item (3) above, the Smart Business Innovation Laboratory consists of 200 employees including researchers who are well versed in data analytics for data collected from the entire Hitachi Group, BI consultants and system integrators. Through collaboration with Hitachi's research and development (R&D) arms, the laboratory aims to create new value by combining technological elements.

Specifically, the laboratory has a large number of templates in which abundant analytical technologies and cases are classified. Each template contains the names of researchers who are familiar with a specific field and have full knowledge of the technological trends in relevant academic circles. Because these researchers have highly specialized knowledge, they generally tend

to overemphasize technology. To strike a balance between technology and business, personnel who are capable of providing coordination between technology and business are assigned to the Smart Business Innovation Laboratory so that researchers and these personnel can jointly consider potential business ideas.

IV Four Measures for Creating Process Value through ICT Use

As suggested by the successful cases described in Chapter III, the important measures for ICT-empowered process value creation include: (1) systematizing the knowledge of a company's engineers and using such systematized data through an ICT system, (2) building a mechanism to visualize and utilize the knowledge and skills of control engineers and ICT engineers who are apt to simply support product development, (3) developing a structure to identify customer problems, define requirements and develop ICT-enabled solutions and (4) establishing an organization that drives business model innovation.

1 Systematizing the knowledge of a company's engineers and using such systematized data through an ICT system

The ultimate objective of the use of ICT is business model innovation. To achieve this goal, it is generally considered that special talent such as data scientists [Note 3] is necessary. However, it is often the case that a company already has a vast hidden storehouse of valuable expertise. In this case, such tacit knowledge must be codified and converted into explicit data, which are then incorporated into an ICT system.

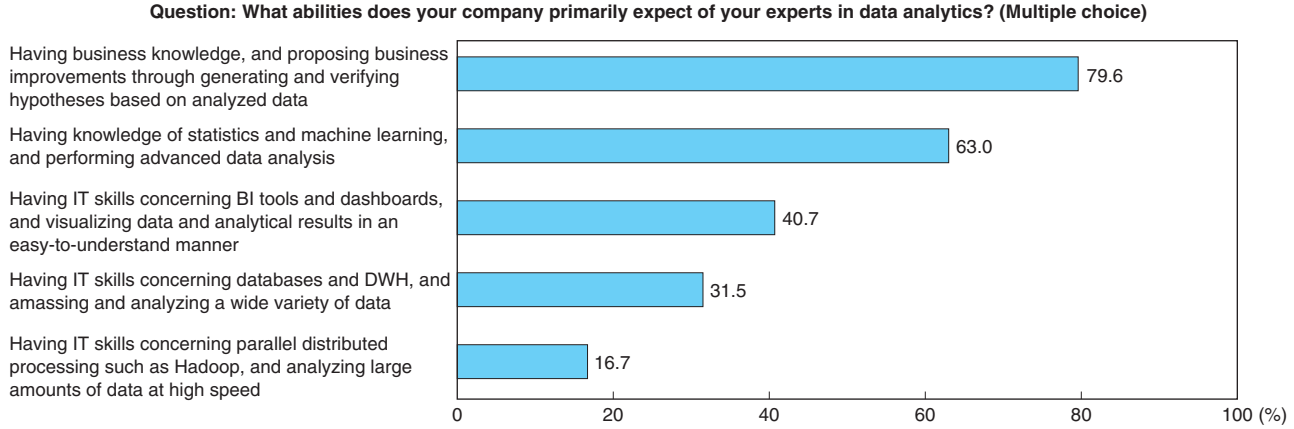
In September 2013, Nomura Research Institute (NRI) conducted the "Survey on Corporate Information Systems and IT Key Words." The survey results revealed that experts in data analytics are expected to "have business knowledge and have the ability to propose business improvements through generating and verifying hypotheses based on analyzed data," rather than having knowledge concerning statistics and machine learning (Figure 2).

Actually, for its remote maintenance service, "Air Net II Service System," Daikin Industries took inventory of the maintenance knowledge of its engineers and systematized such knowledge, which is now used through its information system. By creating patterns by grouping phenomena, the system detects the signs of a fault, which only experienced engineers could detect in the past, and makes it easy to use empirical knowledge in the form of an "expert engine."

2 Building a mechanism to visualize and utilize the knowledge and skills of control engineers and ICT engineers

There has been a growing demand for ICT engineers in the manufacturing sector. However, because most of these engineers are associated with product development, their presence tends to be invisible within a company. One effective method to address this situation is for top executives to ensure that all employees throughout the company have a clear understanding of the importance of process value created through ICT. At the same time, efforts should be made to "visualize" the presence of ICT engineers and develop a common ICT-empowered operation and maintenance (O&M) platform.

Figure 2. Abilities expected of a company's experts in data analytics



Notes: BI: Business Intelligence (representing the tools and systems used to analyze and process in-house accounting and business data so as to enable top management and on-site employees to use the results for decision making), IT: Information Technology, DWH: data warehouse, Hadoop: a framework for distributed processing of big data, Dashboard: measurement and management tool.
Source: "Survey on Corporate Information Systems and IT Key Words" conducted by Nomura Research Institute in September 2013.

3 Developing a structure to identify customer problems, define requirements and develop ICT-enabled solutions

To offer process value to customer companies, it is necessary to clearly understand the problems a customer faces in its business operations. For this purpose, an organization or a structure that enables a company to better understand a customer's business processes and discover problems in each relevant process is essential. To develop such an organization or structure, the company must have personnel who are able to define requirements by understanding customer problems and to propose specific solutions by indicating how to transform business operations and how to use ICT for such transformation. These personnel should be developed and trained specifically for this purpose, or they should be acquired by recruiting people who have experience with system development in large projects.

4 Establishing an organization that drives business model innovation

To create process value with the aim of achieving the ultimate goal of business model innovation, a picture of a business model that a company intends to create with ICT must first be articulated. In specific terms, the company must clearly define the following matters: target customers, solutions provided to each customer problem, how to generate profits, how to achieve differentiation from competitors, how best to use ICT to achieve these goals and important technologies for such achievement.

Business model innovation does not merely represent a new method of selling products. It is an approach to making clear what process value could be offered with ICT in addition to products in order to achieve differentiation from competitors. Upon determining the path towards innovation, a company should examine whether necessary technologies are already in place. If the company finds that it lacks some technologies, it should consider various options for acquiring such technologies such as developing them on its own or acquiring them externally. After developing a clear vision of business model innovation and after ensuring the availability of all necessary technologies, the company should establish an organization that can drive ICT-enabled business model innovation.

Notes:

1 M2M, or machine-to-machine, refers to technology that enables communications between things (devices and machines), or refers to such a communications format.

2 BI stands for business intelligence. BI represents the tools and systems that are used to analyze and process in-house accounting and business data so as to enable top management and on-site employees to use the results for making decisions.

3 Data scientists refer to personnel who collect and analyze data from inside and outside a company to utilize such data for business. In recent years, with growing interest in big data, data scientists have been drawing increased attention as personnel necessary for promoting the utilization of big data.

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