Chapter 3

Productivity Improvement and Organizational Reform through ICT

According to the Annual Report on the Aging Society 2017, Japan's production-age population (15-64) will decrease from about 77 million in 2016 to about 45 million in 2065, which is from about 60% to 51% of the country's total population. Decline of total population has a negative impact on GDP. If we can maintain GDP per capita, wealth felt by citizens will remain unchanged. However, because not only total population but the ratio of production-age population is expected to decline, it is difficult to maintain the current GDP per capita as it stands. In order to maintain GDP per capita and ensure sustained growth, it is essential to improve labor force participation and productivity. In this context, this chapter will discuss productivity improvement through ICT utilization.

Section 1 Productivity Improvement by ICT

1. ICT and Improvement of Production Efficiency

(1) Contribution of the ICT Industry to Productivity

Figure 3-1-1-1 shows real labor productivity (real GDP/ number of employees; prices in 2011) of the ICT and other industries in Japan as index (100 in 2000) for the period from 2000 to 2016.

Due to the bankruptcy of Lehman Brothers the index of the ICT industry dropped 2.1 points from 153.2 in 2008 to 151.1 in 2009 but sharply increased to 161.3 in 2010. Since then, after rising and falling, the index increased by 0.6 points from 2015 to 2016, reaching 178.4.

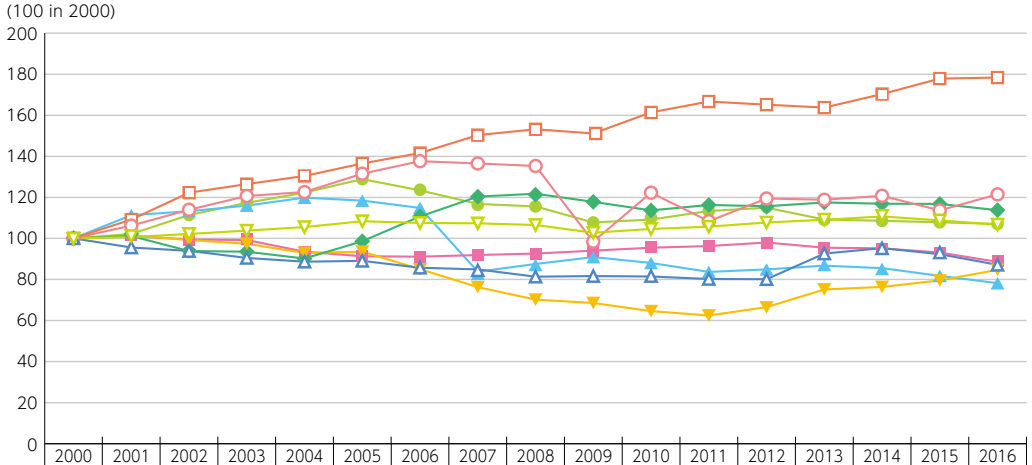
Since 2000, productivity of the industry has maintained an upward trend in comparison with other industries such as commerce, real estate and personal services where the productivity index has remained almost flat between 80 and 100.

Figure 3-1-1-2 shows contribution of the ICT industry and other industries to labor productivity in four-year periods. Contribution of the ICT industry to the improvement of labor productivity of the entire industries has been positive in all periods.

(2) Contribution of ICT Solutions to Productivity

We will look at the relationship between specific ICT solutions and labor productivity[11], here. We take up cloud services and telework as typical examples. According to the Communications Usage Trend Survey of

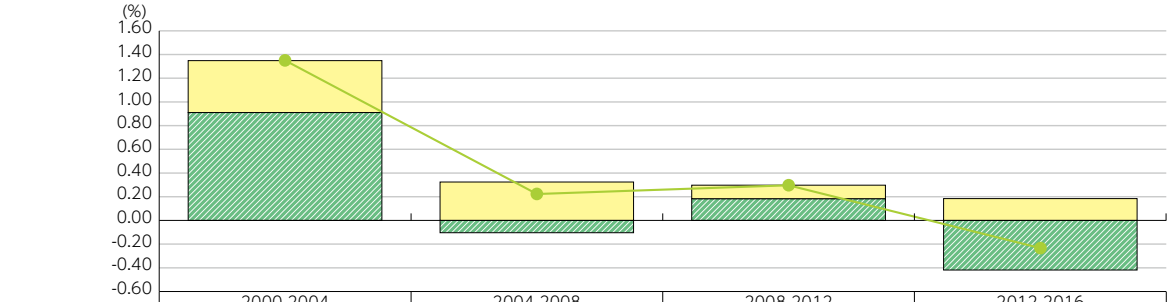
Figure 3-1-1-1 Changes in labor productivity index of the ICT and other industries



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Commerce	100.0	102.2	111.4	117.3	122.3	128.9	123.4	116.8	115.6	107.8	109.2	113.4	115.0	109.2	108.6	107.9	107.0
Real estate	100.0	111.3	113.2	116.0	119.8	118.4	114.9	83.8	87.6	90.9	88.1	83.7	84.9	86.7	85.5	81.8	78.2
Medical care / welfare	100.0	101.2	99.4	99.2	93.5	91.3	91.1	91.9	92.6	94.1	95.4	96.3	98.1	95.5	95.2	93.1	88.6
Construction	100.0	101.4	99.2	97.5	93.0	93.5	85.0	76.2	70.2	68.6	64.6	62.5	66.6	75.2	76.4	79.5	84.7
Business-oriented services	100.0	101.2	93.9	93.5	90.2	98.6	110.7	120.4	121.7	117.8	113.7	116.3	115.7	117.5	116.9	116.8	113.8
Transportation machines	100.0	106.2	114.0	120.7	122.6	131.6	137.6	136.5	135.3	98.4	122.3	108.4	119.5	118.8	120.8	113.7	121.4
Personal services	100.0	95.5	93.9	90.5	88.7	89.1	85.7	84.9	81.4	81.7	81.5	80.2	80.1	92.6	95.3	92.3	87.2
ICT	100.0	109.2	122.3	126.5	130.4	136.5	141.5	150.3	153.2	151.1	161.3	166.6	165.2	163.7	170.4	177.8	178.4
All industries	100.0	100.6	102.2	103.8	105.6	108.3	107.5	107.3	106.5	102.8	104.6	105.8	107.8	109.1	110.7	108.8	106.8

(Source) Study on Economic Analysis of ICT, MIC (2018)

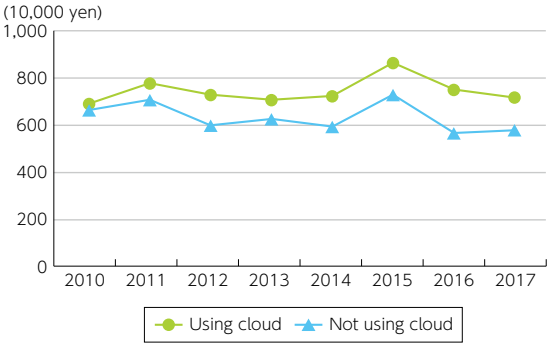
Figure 3-1-1-2 Changes in contribution of the ICT industry and other industries to labor productivity



	2000-2004 (Year average)	2004-2008 (Year average)	2008-2012 (Year average)	2012-2016 (Year average)
ICT industry	0.44	0.32	0.11	0.18
Other industries	0.91	-0.10	0.18	-0.42
All industries	1.35	0.22	0.30	-0.23

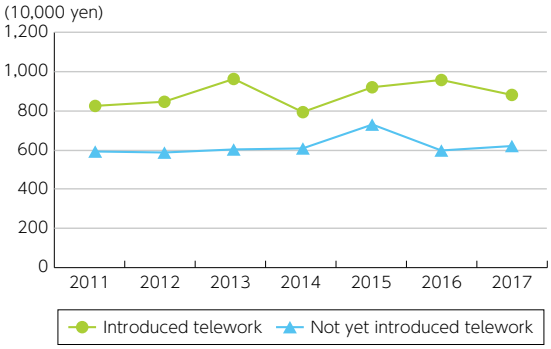
(Source) Study on Economic Analysis of ICT, MIC (2018)

Figure 3-1-1-3 Relationship between use of cloud services and labor productivity (changes)



(Source) "Communications Usage Trend Survey" MIC (each year)

Figure 3-1-1-4 Relationship between introduction of telework and labor productivity (changes)



(Source) "Communications Usage Trend Survey" MIC (each year)

MIC, companies using cloud service consistently from 2010 to 2017 show higher labor productivity compared with other companies (Figure 3-1-1-3). Similarly, companies introducing telework consistently from 2011 to 2017 show higher labor productivity compared with other companies (Figure 3-1-1-4).

Section 2 Measures for Productivity Improvement through ICT and their Effects

In this section, the productivity improvement through ICT discussed above is summarized mainly from the corporate point of view, using the result of an international questionnaire survey of companies.

1. State of ICT Introduction by Companies

First, let us confirm the current state of ICT introduction and utilization by companies toward productivity improvement based on the results of the survey.

(1) State of ICT Introduction

First, we compare the state of ICT introduction by companies in countries. The comparison covers basic ICT technologies including ICT networks, internal systems, communication terminals and the information transmission environment.

70.2% of Japanese companies answered they have already introduced ICT. The introduction rate is 10 to 25% lower than companies in other countries (Figure 3-2-1-1). The introduction rate of European companies is especially high at 90% or higher. It is hoped that ICT introduction rate of Japanese companies will rise to the level of European countries and the United States.

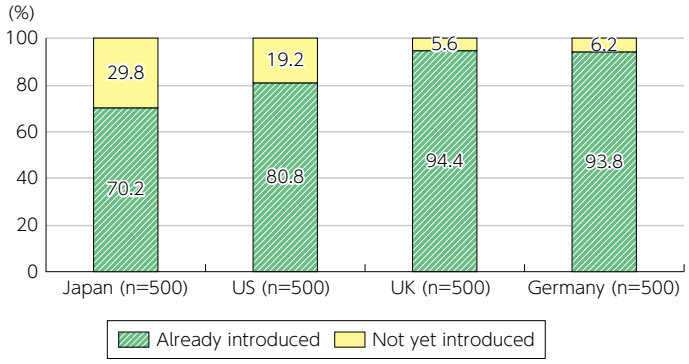
(2) State of Improvement of the Environment for ICT Utilization

For companies to introduce ICT and increase their investment efficiency, it is important to create an environment for productivity improvement. About half of the Japanese companies answered that they are creating the environment, but the rate is low compared with other counties (Figure 3-2-1-2).

Companies improving the environment for taking advantage of ICT were asked about specific efforts to enhance utilization of ICT. "Review of the company organization" was cited by the largest number of the respondents in all countries, which shows that they have

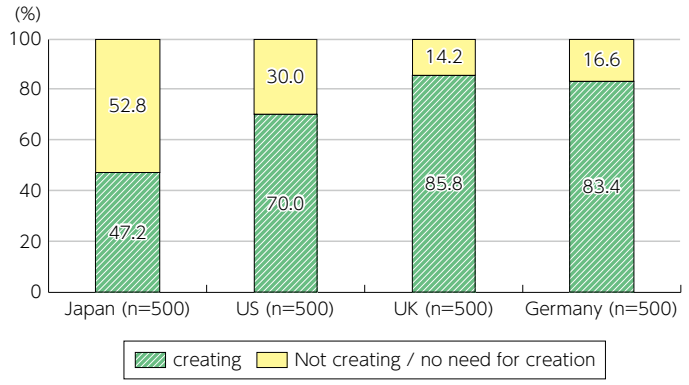
[11] Calculated as follows here, labor productivity = (operating profits + labor costs + depreciation) / number of employees

Figure 3-2-1-1 State of ICT introduction by companies in countries



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-2-1-2 State of environmental improvement for taking advantage of ICT



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

a strong awareness of the importance of reviewing the organization.

2. State of and Plans for Introduction of AI and IoT

(1) Introduction State of AI and IoT

Here the state and intention of AI/IoT introduction by companies is examined from the viewpoints of "processes" and "products"[12]. Looking at the current state of introduction, IoT is introduced ahead of AI by companies in all countries. The rate of introduction of AI and IoT by Japanese companies is not much different from the rate of European and US companies. Based on the answers concerning future plan for introduction, however, there is a risk that Japanese companies will lag behind companies in other countries in and after 2020 and that the difference will widen (Figure 3-2-2-1).

(2) Challenges for Introducing AI and IoT

What are challenges and barriers for introduction of AI and IoT? Overall, challenges concerning security rank high. The rate of citing "shortage in organization/human resources to lead introduction of IoT" is higher among Japanese companies compared with companies in other countries (Figure 3-2-2-2).

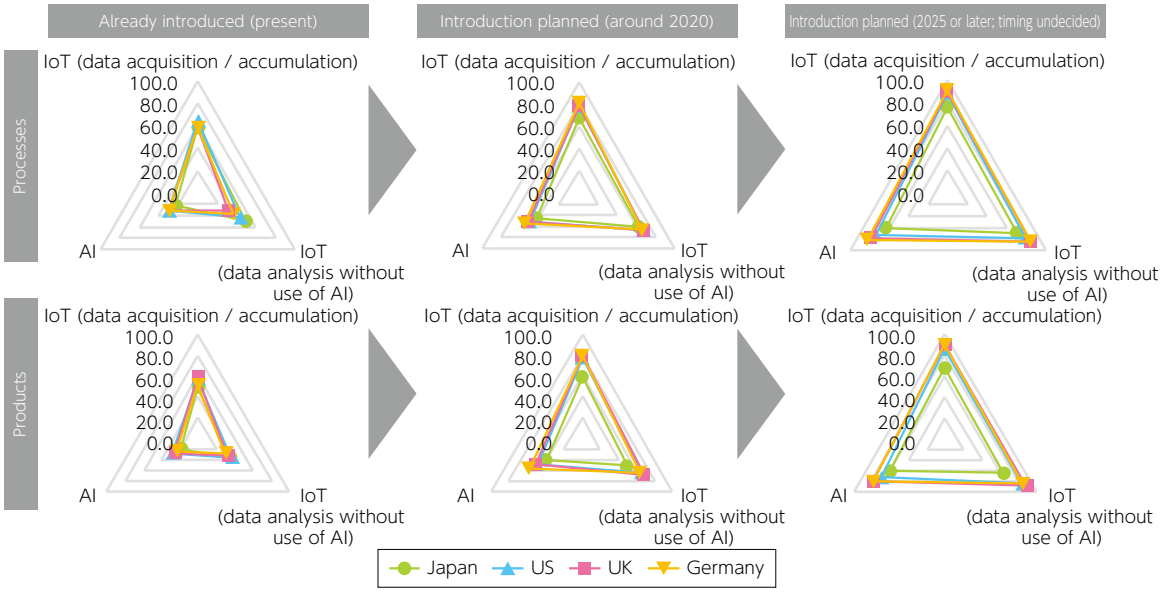
Looking at the challenges they feel in introducing AI, a high percentage of respondents cited unclear effects of AI introduction, which include "there is no guarantee the quality of processing results of AI" and "it is not clear whether we can obtain useful results." This may be attributed to the fact that AI just started to spread to the overall market. As in the case with IoT discussed above, the rate of citing "shortage in organization/human resources to lead introduction of AI" is high among Japanese companies compared with companies in other countries (Figure 3-2-2-3).

(3) Challenges Associated with Utilization of AI and IoT

What challenges will companies face in utilization of AI and IoT in the future? According to the result of the international questionnaire survey of companies, the rate of citing "communication line quality and speed," "external connectivity" and other challenges concerning ICT infrastructure is low among Japanese companies compared with companies in other countries. On the other hand, Japanese companies showed a higher rate of citing challenges concerning business restructuring including "solutions, products and services meeting the needs of own company," "business model development";

[12] Here, "process" is defined as processes in a company that are necessary to create goods and services in corporate activities. "Product" is defined as goods and services created as a result of corporate activities.

Figure 3-2-2-1 State of and plans for introduction of AI and IoT in companies in various countries (by processes and products)



*Excluding "don't know"

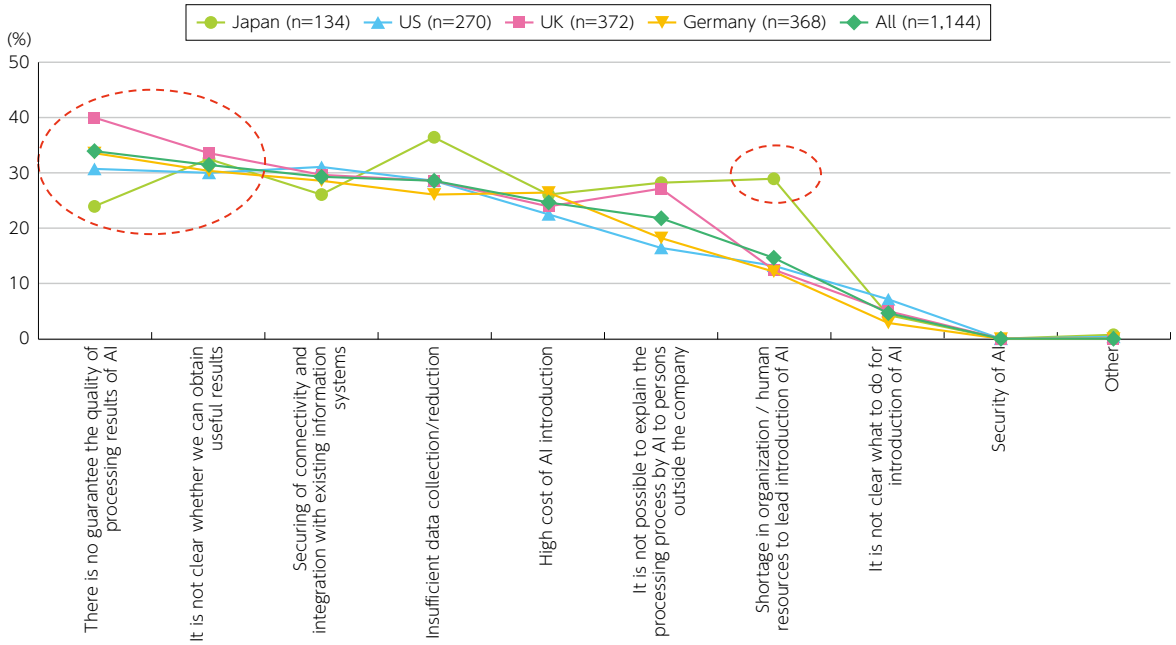
(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-2-2-2 Challenges in introducing IoT

(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

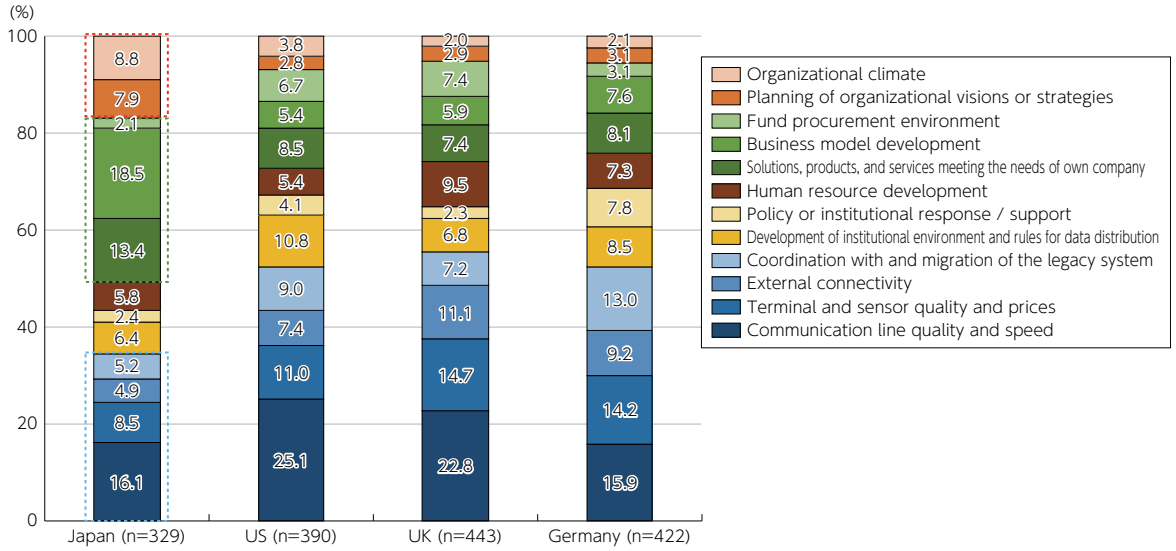
organizational reform including "planning of organizational visions or strategies" and "organizational climate." The latter suggests, as in the case with the challenges associated with introduction described above, a possibility that Japanese companies are unable to gain a concrete view of the effects that can be brought about through utilization of AI and IoT and measures for maximizing those effects. In other countries, overall, the rate of citing challenges concerning ICT infrastructure is high. Rate of "development of institutional environment and rules for data distribution" among American companies, the rate of "human resource development" among

Figure 3-2-2-3 Challenges in introducing AI



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-2-2-4 Challenges facing companies in utilization of AI and IoT



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

UK companies and the rate of "coordination with and migration of the legacy system" among German companies are higher compared with other countries (Figure 3-2-2-4).

3. Strategies for Productivity Improvement through ICT

(1) Approaches to Productivity Improvement

"Labor productivity" is one of the quantitative indices of productivity. Because labor productivity is an economic result (value added) produced by a certain labor input (total amount expressed by number of workers and working hours), basic approaches to productivity improvement can be divided broadly into (i) increasing the efficiency of the labor input and (ii) increasing the value added. Let's look at these approaches from the aspect of concrete measures taken by companies. The approach of (i) may include measures for efficient utilization of labor by saving labor needed for operations or improving the efficiency of operational processes. If there is much room for labor-saving or efficiency improvement, results can be delivered easier in a relatively short period of time. The approach of (ii) may include measures to increase corporate earnings by enhancing the value added of existing products and services or developing new products and services. Delivering results in this approach may take longer time and increase uncertainty

depending on the business environment.

This way, companies adopt different approaches and orientations for productivity improvement based on the nature and results of their efforts. Japanese companies have a strong sense for process innovation aimed at operational efficiency and cost reduction but are less enthusiastic about product innovation including change of business models compared with American companies. Namely, Japanese companies emphasize the approach of (i), but the approach of (ii) has not taken root among them.

For this reason, when trying to improve productivity through introduction and utilization of ICT in an effort to solve business challenges, they tend to position ICT as an implementation tool for operational efficiency and cost reduction (so called "defensive" ICT). They are less interested in ICT as an implementation tool for increasing value added based on change of business models, etc. (so-called "aggressive" ICT) compared with companies in other countries including the United States.

In fact, looking at the business challenges solved by Japanese companies through introduction/utilization of ICT based on the result of the questionnaire survey, process innovations including "efficiency improvement of operational processes" (48.3%) rank higher than product innovations such as "change of business models" (Figure 3-2-3-1). The result also suggests that Japanese companies tend to position ICT as a means of process innovation.

For Japan's further productivity improvement, it is essential to promote introduction and utilization of ICT while identifying various ways including product innovation. Against the backdrop of price reduction of ICT equipment and terminals, progress of cloud services to be discussed in Section 3 and other developments, barriers to introduction and utilization of ICT by companies have become lower and new ICTs including AI and IoT have become applicable to actual businesses. As a result, chances of saving labor and increasing value added of products through ICT are widened also for services and products heavily dependent on manpower and those for which differentiation is becoming difficult.

(2) Example cases of Productivity Improvement through ICT

What is productivity improvement through ICT in concrete terms? Here, "high-cost structure," "personnel shortage" and "product and services" are chosen as examples of business challenges faced by companies. Categories of measures for resolving them through ICT are organized in Figure 3-2-4-1 below. In addition to measures for direct productivity improvement, promotion of labor force participation to increase the labor input is also included in the categories of solutions using ICT. Below we will explain the background of business challenges of specific industries and examples of solution strategies through AI, IoT and other advanced ICTs that are expected to develop in the future.

a. High-cost structure

If the industry or operation is labor intensive (e.g. high dependency on manpower) due to its nature, or involves a large-scale development, labor cost and adjustment costs may run up, which leads to a high-cost structure of the operation. An example of the latter is the increase in development cost per product in the pharmaceutical industry. Examples of solutions of this type of business challenge through ICT are saving labor for operations and improving the efficiency of operational processes.

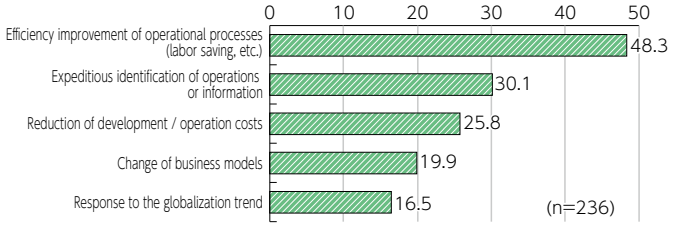
b. Personnel shortages

Decline of the working population will accelerate personnel shortage in many companies. This has already become a business challenge in labor intensive agriculture/fisheries, construction, transportation/distribution and service industries that are significantly affected by the decline. Companies may not be able to maintain sales scale or profitability due to personnel shortage and could lose corporate continuity. Examples of solutions of this business challenge through ICT may include "saving labor for operations" and "improving the efficiency of operational processes." Solutions by increasing labor input may include "promotion of labor force participation."

c. Commoditization of products and services

Circulation of a great deal of products and services that are not significantly different in functions/quality causes loss of differentiating characteristics (e.g. function, quality and brand power) of competing goods. In such case consumer choice is made only based on their price and ease of purchase. This is the so-called "commoditization" that is a business challenge in the retail and wholesale industries where entry is relatively easy, the energy and infrastructure industries that are experiencing cost and price competition against the backdrop of deregulation, and other industries. Examples of solutions of the business challenge through ICT may include enhancing the value added of existing products and ser-

Figure 3-2-3-1 Categories of business challenges solved by domestic companies by using ICT



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

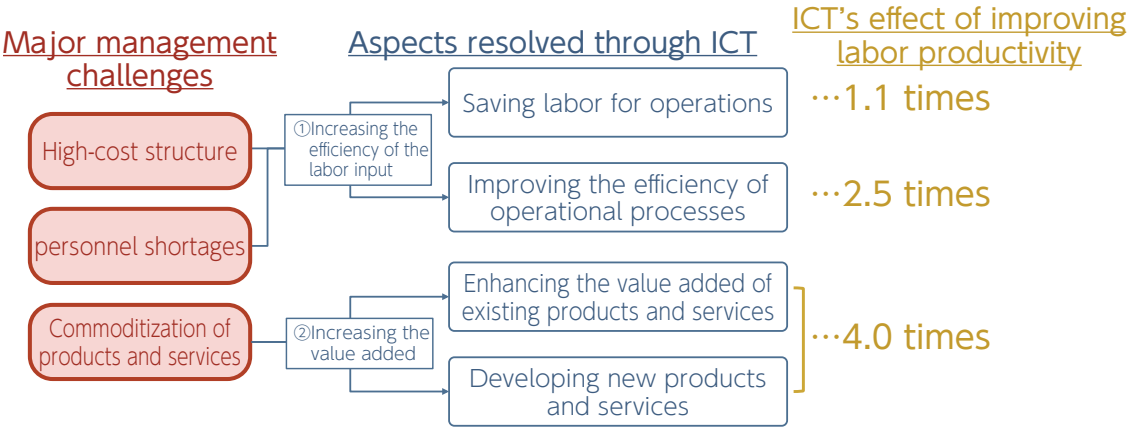
vices or developing new products and services through utilization of ICT to earn new business income.

4. Effects of Productivity Improvement through ICT

Here, effects of productivity improvement measures through ICT are quantitatively examined. Specifically, results of productivity improvements through ICT achieved to date are empirically evaluated based on the questionnaire survey of domestic companies. The result shows that all the measures had an effect to increase labor productivity and that introduction and utilization of ICT positively contributed to solving business challenges faced by companies. In comparison of categories of measures, it is found that "aggressive" ICT, meaning enhancement of value added based on change of business models, etc. including "enhancing the value added of existing products and services" and "developing new products and services" (4.0 times), is more effective than "saving labor for operations" (1.1 times) and "improving the efficiency of business processes" (2.5 times) (Figure 3-2-4-1)[13]. Given that this is the result of the past three years, possible factors may include the fact that efforts related to processes had started earlier in Japanese companies. This also suggests that we cannot expect uniform effects because preconditions including existing efforts vary depending on the industry, company size and other factors.

However, it is desirable to make continuous efforts for productivity improvement by identifying areas of ICT solutions of various business challenges facing companies from various aspects, while at the same time implementing organizational reform and other initiatives to maximize the effects.

Figure 3-2-4-1 Effects of productivity improvement through ICT



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Section 3 ICT Bringing About Productivity Improvement by "Connecting" Organizations

1. Progress of API Disclosure and Associated Changes, Effects and Challenges

(1) Overview of API Disclosure

API (abbreviation of Application Programming Interface) is an agreement to make functions of a program available also to other programs. Specified functions are made available. In the past, API was used for efficiency improvement of program development within a company. In recent years, APIs are disclosed for external connections to services developed and operated in-house.

According to the results of the international questionnaire survey of companies, both the recognition and disclosure rate of API are low among Japanese companies. Even in comparison with Germany where the API disclosure rate is second lowest following Japan among four countries, there is a big difference in the percentage of the companies planning or considering future disclosure (10.2% in Japan compared with 49.8% in Germany) (Figure 3-3-1-1).

(2) Effects and Challenges of API Disclosure

Through API disclosure, companies can link their services to services of other companies and individuals and thereby enhance the value of their services. As a result, economy zones through API, namely the state of API economy, are forming.

Companies' disclosure of the APIs of their services has effects including promotion of open innovation, ex-

[13] Each category's labor productivity growth rate over a span of three years was as follows:
"Saving labor for operations": applicable (3.32%), not applicable (3.10%)
"Improving efficiency of operational processes": applicable (6.71%), not applicable (2.71%)
"Enhancing the value added of existing products and services," "developing new products and services": applicable (7.78%), not applicable (1.96%)

pansion of existing businesses and efficiency improvement of service development. Especially large benefits are promotion of open innovation through introduction of external knowledge and expansion of business opportunities through expansion of available customer segments and sources of revenue. It is expected that business will shift from the conventional "self-sufficiency".

On the other hand, API disclosure poses challenges in terms of guarantee of security, increased threat of entry of other companies and loads on servers, because data and services of one's own company are disclosed. When disclosing API, it is necessary to appropriately define what parts of the company data and services will be disclosed, and how and to what extent, with consideration of security.

In the international questionnaire survey of companies, respondents who were aware of API were asked about their perception of the effects and challenges of API disclosure. A large majority of companies recognize effects of API disclosure in all the countries. However, the percentage of the companies answering "don't know" and "aware of only challenges" is relatively high in Japan in comparison with other countries. This indicates that companies aware of API do not necessarily have an image of effects of API disclosure (Figure 3-3-1-2).

level of security are also moving toward API disclosure by the revision of the Banking Act. The Act for Partial Revision of the Banking Act ("revised Banking Act") was enacted in May 2017 and promulgated in June of the same year. Banks shall make efforts to establish systems pertaining to open API within two years after the enforcement of the revised Banking Act.

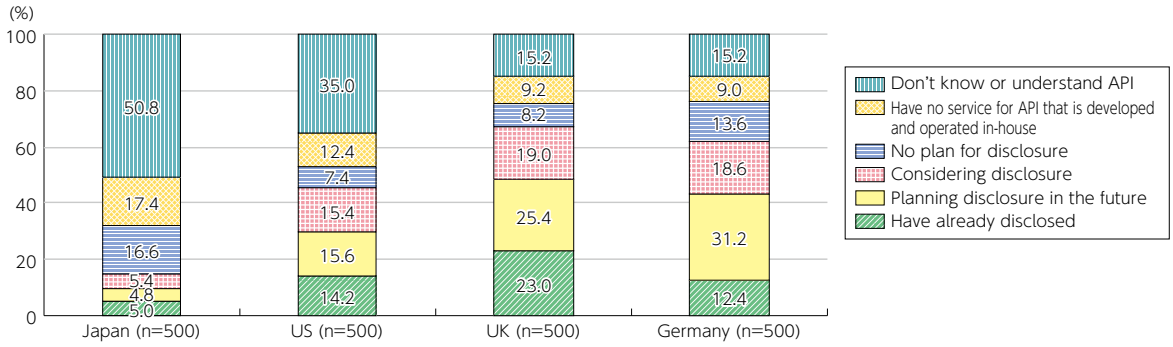
Further API connections between financial institutions and FinTech businesses will enable use of FinTech services without disclosing ID and other user information held by the financial institution to the FinTech service, which will eliminate concerns for user protection. It is also expected that advancement of API disclosure in compliance with the standard specification defined in cooperation with financial institutions and stakeholders will improve the efficiency of cooperation between FinTech companies and financial institutions and thereby will promote open innovation.

Survey results also confirmed the difference in API awareness and disclosure between financial businesses and other businesses in Japan. A difference is not found in awareness of API, but the percentage of businesses disclosing API (or considering disclosure)[14] is 25.5% for financial businesses whereas it is 13.9% for other businesses, which is almost half of the former (Figure 3-3-1-3).

(3) API Disclosure in the Financial Sector

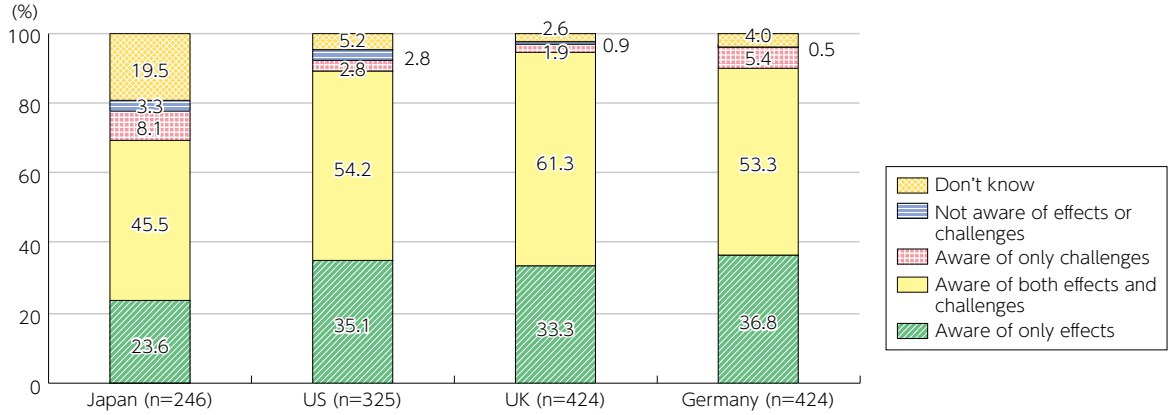
Banks and other financial institutions that need a high

Figure 3-3-1-1 Recognition and Disclosure of API



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

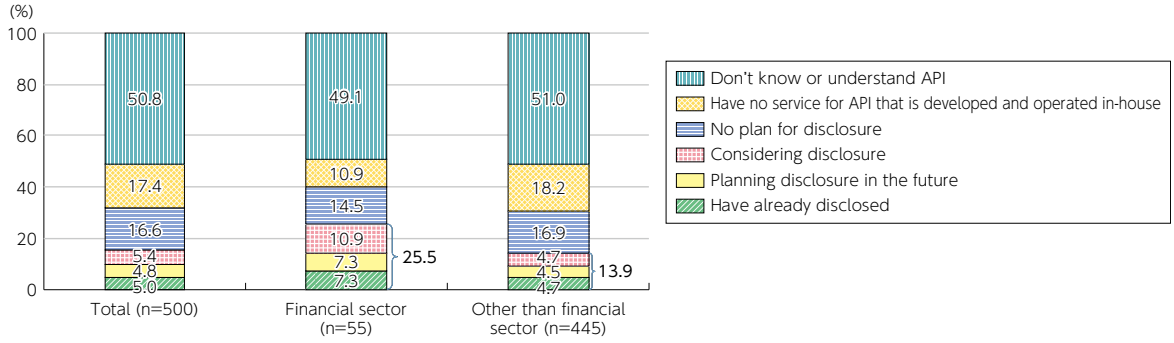
Figure 3-3-1-2 Awareness of effects and challenges of API disclosure



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

[14] Total of the answers "have already disclosed," "considering disclosure in the future" and "thinking about disclosure."

Figure 3-3-1-3 Comparison of API awareness and disclosure between financial businesses and other businesses in Japan



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

2. Cloud Services

(1) Overview of Cloud Services

Cloud is abbreviation of Cloud Computing which is a system to use data, applications and other computer resources via a network. Today it is commonplace to use smartphones or mobile phones to exchange emails and play games. These applications realize services including e-mail and games through connection with servers and storages placed in large-scale facilities called data centers and a variety of software beyond smartphones and mobile phones.

Services provided through cloud are divided broadly into three categories (i) IaaS (Infrastructure as a Service), (ii) PaaS (Platform as a Service) and (iii) SaaS (Software as a Service) based on their components. IaaS refers to services to provide functions of hardware including computers, storage, and network. PaaS refers to services to provide tools and environment for development and execution of application programs. SaaS refers to services to provide functions of application programs.

Cloud is also divided into (i) public cloud, (ii) private cloud and (iii) hybrid cloud based on its usage form. Public cloud is a form where an unspecified number of people jointly use standard cloud services. Private cloud refers to a cloud environment dedicated to a specific user company. Sometimes constructing a dedicated computing environment allows more flexible use at a lower price compared with use of public cloud that is billed based on usage. Private cloud is chosen in such cases. Because public cloud and private cloud have different advantages and disadvantages, there are increasing cases to integrate the two. This is called hybrid cloud. In order to utilize advantages of public and private clouds as hybrid cloud, we need a policy on their appropriate use, a system for integrated management and "portability," that is, migration of program and data from one cloud to the other.

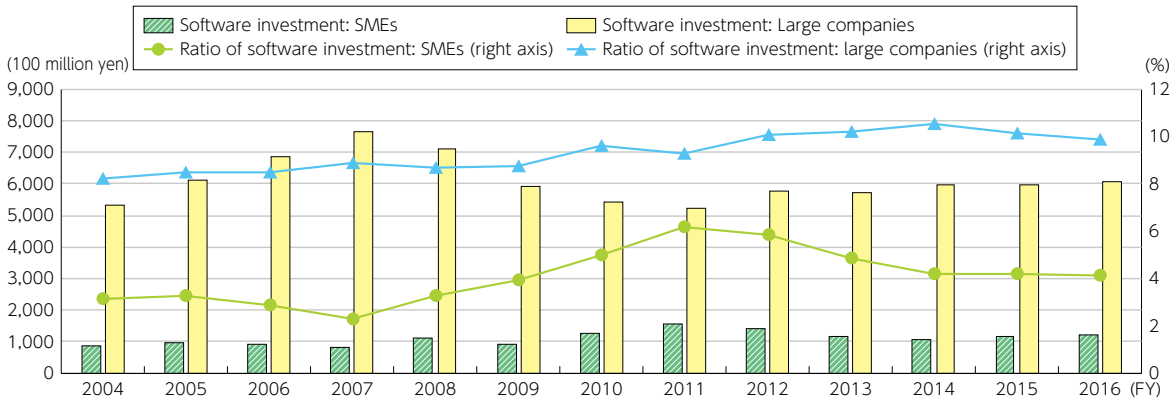
(2) Effects and Challenges of Cloud Services

Examples of effects of using cloud services for companies may include: (i) expeditious system construction and easy extension, (ii) reduced initial and operational costs, (iii) improved availability and (iv) improved convenience.

In the past, companies above a certain size generally developed their own service infrastructure by investing in information systems, but it was difficult for less-resourced companies to utilize an information system for their operation. The ratio of software investment to all capital investment is about 10% for large companies but 4% for SMEs. Large companies have a higher ratio of software investment (Figure 3-3-2-1).

Use of a cloud service has an effect to reduce initial

Figure 3-3-2-1 Changes in ICT investment by companies



*Large companies are defined as companies with capital of 1 billion yen or more. SMEs are defined as companies with capital of 10 million yen or more and less than 100 million.

(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)
(Created based on MOF "Financial Statements Statistics of Corporations")

and operational investments. This has greatly lowered the hurdle for SMEs and start-ups to invest human resources and money in business. For this reason, it is hoped that cloud will encourage introduction of information systems by SMEs and start-ups for whom it was difficult to invest in an information system in terms of cost, and that large companies will also find it easier to start new businesses or develop new products/services.

Use of cloud services by companies involves not only the effects described above but also challenges. Examples are (i) guarantee of security, (ii) increase in repair/communication costs, and (iii) insufficient customization.

Below, awareness of effects and challenges described in this section is confirmed in the results of the international questionnaire survey of companies. To the question about the effects of cloud service introduction, the rate of answering "high system expandability" and "quick system change" is high across all respondents. However, Japanese companies chose answers concerning low cost most frequently while choosing items contributing to products less frequently compared with companies in other countries (Figure 3-3-2-2).

As regards the content of challenges perceived by companies that are not using cloud service, items concerning security are cited at high rate in all countries surveyed. The rate of choosing security concern is higher than other items among Japanese companies, showing that security concern remains strong as in the case with API disclosure (Figure 3-3-2-3).

(3) Example cases of Cloud Service Introduction

Because productivity improvement through ICT will require "aggressive ICT investment" in the future, we focus on examples using cloud services as "aggressive ICT investment". Here we chose three types of use that will benefit from cloud services: (a) introduction by SME, (b) introduction by startups, and (c) Introduction by large companies to start new businesses. Below we will discuss meaning, actual state and effects of these types of using cloud services.

a. Introduction by SMEs

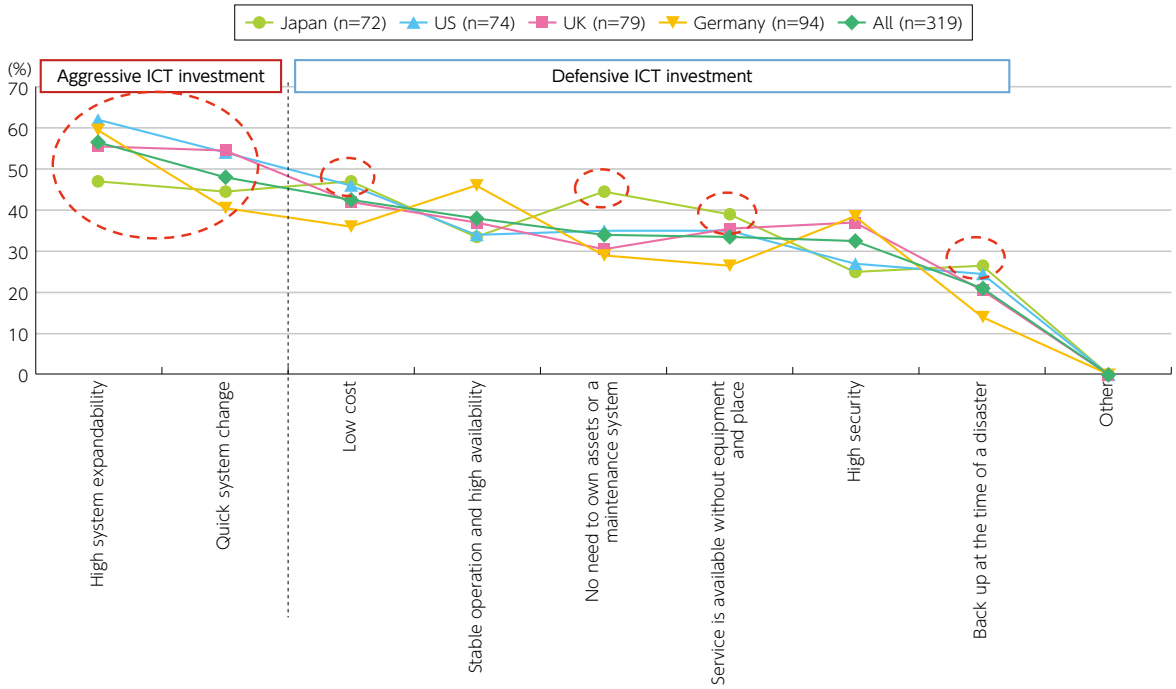
Some cases of cloud service introduction by SMEs leading to "aggressive" ICT investment were made in three stages. The first stage is improvement of efficiency of internal operations. The second stage is internal visualization of the company. When information that was personally managed using paper or spreadsheet software is gathered on a cloud, the company can detect waste in operations which has been missed and further improve efficiency. The third stage is change of business models.

For example, a company can earn revenue by providing solutions constructed on a cloud and develop a new business separately from the core business (Figure 3-3-2-4).

b. Introduction by startups

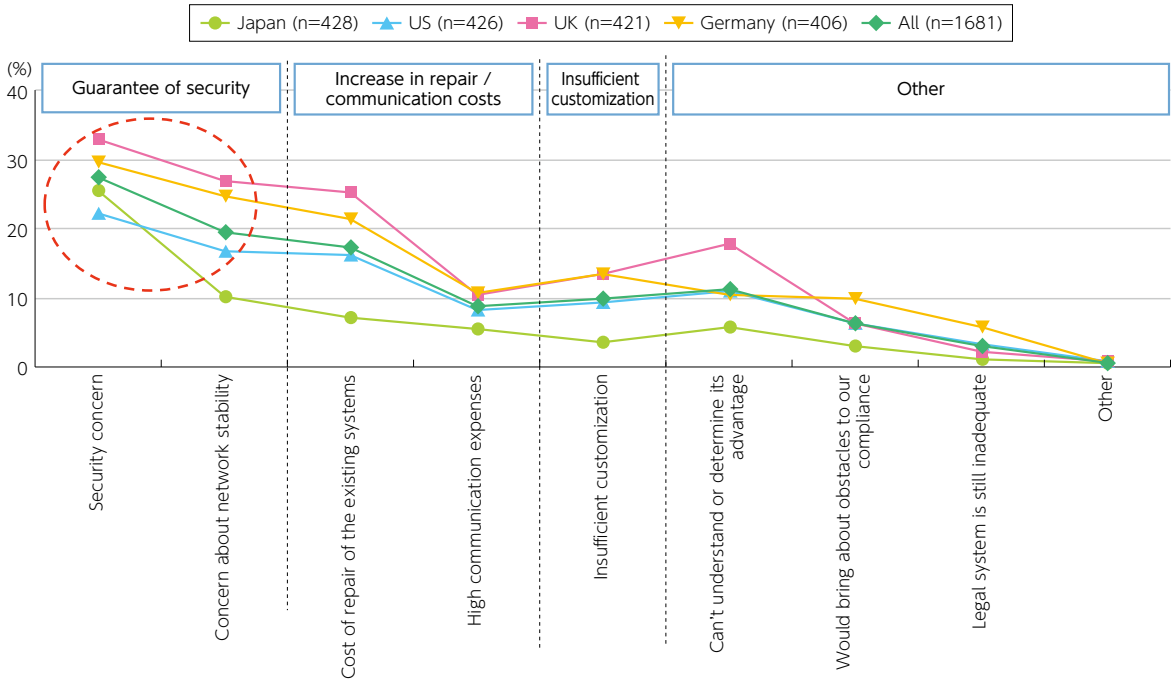
Due to limited resources including funds and employees, it is difficult for startups to construct information infrastructure and ensure availability sufficient for business on their own even if they can create an environment to provide services. In addition, because startups generally target less competitive markets, they need to save time up to the launch of services and expand resources and functions flexibly according to the number of users. In this context some startups use cloud services from the beginning to develop their business.

Figure 3-3-2-2 Effects of introduction of cloud services



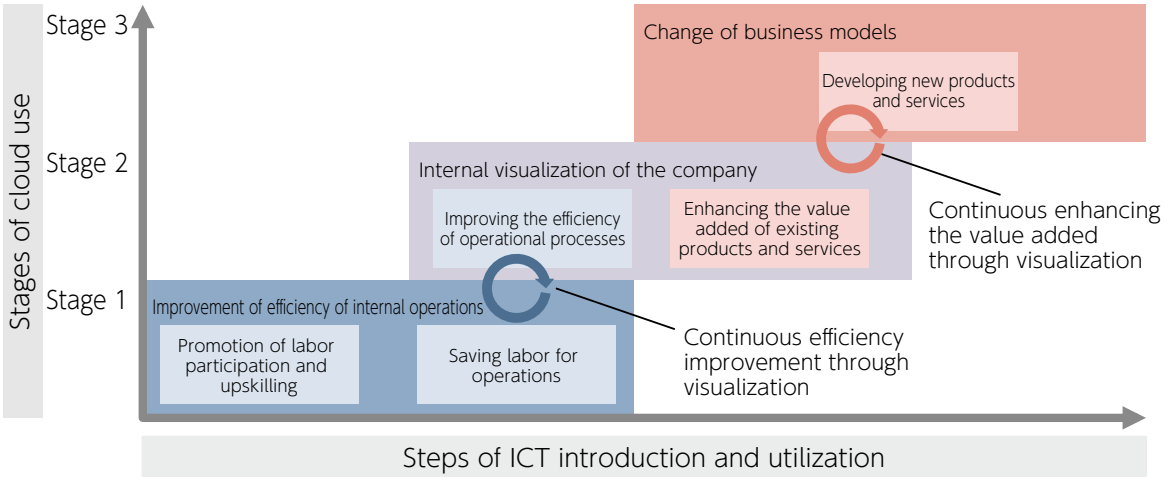
(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-3-2-3 Content of challenges concerning cloud service introduction



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-3-2-4 Stages of cloud service use by SMEs



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

c. Introduction by large companies for new businesses

Most large companies have already introduced their internal systems but cannot necessarily use the systems as they are to establish a new business. There are three major reasons for this. One is repair cost of the existing systems. Establishment of a new business sometimes requires addition of new functions to the existing systems and their linkage. In this case, it is necessary to repair the existing internal systems after assessing the influences on them, which involves money and time. Second is the nature of new businesses. Because it is difficult to determine the required scale of the new business beforehand, you may not be able to ensure enough flexibility by expansion of the existing systems. The third reason is the difference in necessary speed between existing business and new business. Because new businesses tend to target markets with no or little competition as in the case of startups, speedy launch is required.

3. Blockchain

(1) Overview of blockchain

Blockchain technology is a kind of database where terminals on a communication network are directly connected to each other and transactions are processed and recorded using encryption technology in a decentralized manner. This is a generic technology used for bitcoin and other virtual currencies.

(2) Effects and Challenges of Blockchain

Compared with conventional centralized information

management, decentralized management based on blockchain has effects of (i) high availability, (ii) high integrity, and (iii) low transaction cost. However, blockchain has challenges in terms of scalability due to its decentralized nature. The blockchain of bitcoin, a typical large-scale blockchain, has challenges such as increase in the time required for data storage with increase in transactions, and increase in required power with increase in users and mined bitcoins.

(3) Examples of Application of Blockchain

Highly credible information exchange systems can be constructed using blockchain with relatively low cost compared with conventional centralized systems. For this reason, its application is considered in various fields including matching of relief goods at the time of a disaster and real estate transactions. Demonstration experiments and development of services are in progress for some applications.

(4) Blockchain in the Financial Sector

Use of blockchain started in virtual currencies but there is a movement to use blockchain technology in the financial sector other than virtual currency.

The Growth Strategy states "because blockchain technology has a high potential to become a game changer of the financial system itself, we will make proactive efforts toward its practical use in the financial sector in order to ensure competitiveness of our financial businesses." In fact, a broad range of financial institutions from city banks to securities companies formed consortiums, etc. and are jointly working for this purpose.

4. 5G

(1) Overview of 5G

With the progress of IoT that connects everything, telecommunication networks that are its foundation will dramatically increase its importance. Barrage of large-volume information including still and moving images will be communicated and an enormous number of devices will be connected. There will be more scenes that require smooth operation of equipment via network without lag as in the case of telemedicine. Facing the full-fledged IoT era, we need telecommunication systems that can meet the expectations.

Mobile communication systems have been in practical use up to 4G including LTE-Advanced. 5G or the 5th generation mobile communication system is attracting attention as the next generation network following 4G. Countries around the world are working toward realization of 5G by 2020.

(2) Characteristics of 5G

5G has characteristics of "multiple concurrent connections" and "ultra-low latency" as well as high transmission speed. While technologies up to 4G have been developed basically as tools of personal communication, 5G will serve as a new communication tool in the age of IoT where everything and everyone are connected.

"Multiple concurrent connection" means a dramatic increase of terminals that can be concurrently connected to one base station. For example, today several terminals including personal computers and smartphones are connected at home, but 5G will enable concurrent connection of about 100 devices and sensors to the Internet. In March 2018 the National Institute of Information and Communications Technology (NICT) announced that it confirmed concurrent connection of about 20,000 terminals in a demonstration experiment.

"Ultra-low latency" means that delay, i.e., time lag in communication networks can be lowered to an extremely low level. For example, self-driving that requires high security needs real-time communication. Ultra-low latency will make an impact also in remote control of robots and telemedicine.

In this way, 5G will become an important infrastructure in the age of IoT to come. Its realization is expected to change ways of communication and lead to development of new businesses.

5. Importance of Security

This section introduced API disclosure and cloud service as ICTs that connect organizations. However, securing security is a big challenge in introduction of these services. The more companies introduce ICT and the more connections are made between companies, the higher the dependency on ICT becomes in business activities and the wider the area of influence of a threat. As a result, the importance of security will inevitably increase.

In the introduction and utilization of AI and IoT, it is necessary not only to enhance the current information security but also to prepare for new threats. This is because AI and IoT have characteristics different from those of existing ICTs and there will be new security challenges due to their characteristics. For example, IoT involves a large number of devices. Increase in connected devices may make their management inadequate, leading to increase of security risks of the entire network. Increase in the types of devices connected to the internet involves the risk of damages that have never occurred or been anticipated. In fact, new threats accompanying the progress of IoT are reported in multiple categories. It is projected that the importance of security will increase and the security market will continue to expand.

In the questionnaire survey, challenges concerning security, namely the risk of things connected to a network being taken over and the issue of storage of real data and privacy data are ranked as the first and the second challenges in introducing IoT. This indicates that it is important to solve security challenges for introduction of AI and IoT.

Section 4 Organizational Reform that Brings out the Potential of ICT

1. Need for Organizational Reform

(1) Need for Organizational Reform by Appointing CIO / CDO

Reform of processes and products through introduction of ICTs including AI and IoT in companies is difficult without organizing a top-down promotion system with active involvement of the management. Such reform requires development of an organization that can bring out the potential of ICT. The larger the scale of the reform and the wider its scope covering business activities are, the more it requires the management's commitment and leaders responsible for the reform.

An example of top-down organizational reform is the appointment of a CIO (Chief Information Officer) or/and a CDO (Chief Digital Officer) whose mission is introduction and utilization of ICT in business activities. In this case, organizations under their direct control promote introduction and utilization of ICT.

CIOs and CDOs formulate company-wide ICT strategies and define their targets. One of the roles of the CIO/CDO is to obtain stakeholders' understanding of the targets by sending appropriate messages. It is also expected that division of roles between the business operations departments and the system department is also defined based on the company-wide ICT strategy in a top-down manner (Figure 3-4-1-1).

Organizational reform including appointment of a CIO or/and a CDO is expected to advance introduction of RPA in the future. According to the Robotic Process Automation Association Japan, RPA refers to "efforts to take care of operations that were assumed to be possible only by humans and other sophisticated operations by using cognitive technologies including rule engines, AI and machine learning". RPA is attracting increasing attention as a means for productivity improvement through ICT. By leaving routine tasks to RPA, it is expected that human workers can spend more time for creative operations with more value added, which only human workers can do.

While expectations for RPA is rising, labor saving can make substantial progress also in operations where it has not progressed, which will lead to relocation and reduction of existing personnel. In this contest, it is required to promote top-down efforts through organizational reform led by the CIO or/and CDO while at the same time ensuring understanding of both operational and system departments.

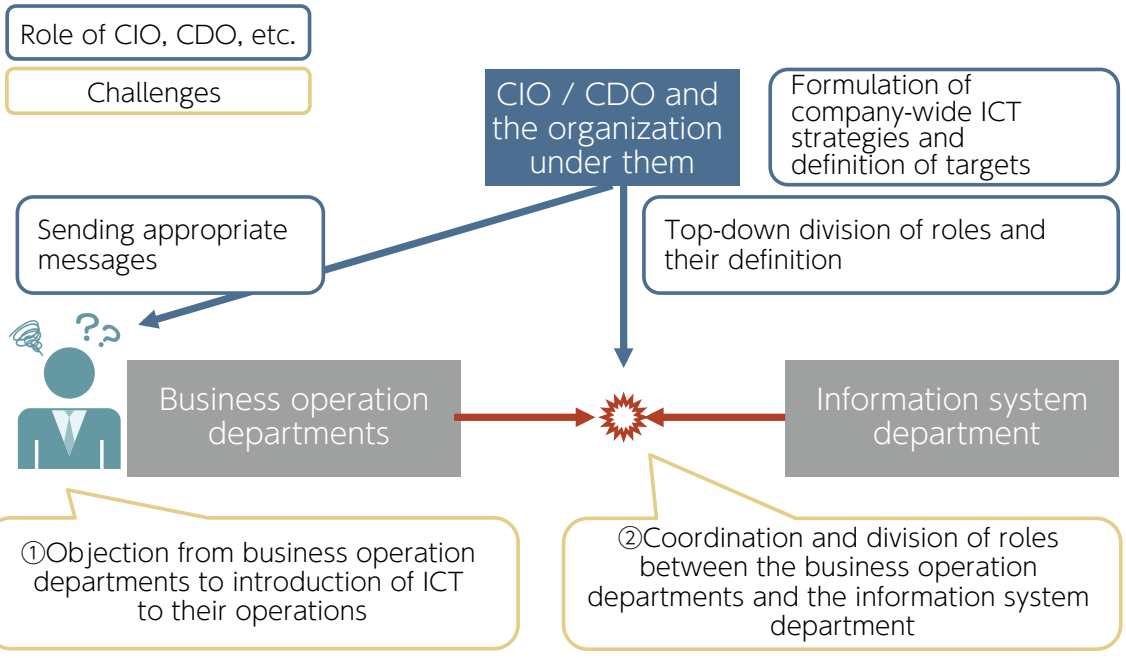
(2) State of the Progress of Organizational Reform by Appointing a CIO, CDO, etc.

According to the international questionnaire survey of companies, the rate of the respondents appointing a CIO or CDO is lower in Japan compared with other countries. The fact that their percentage of "don't know" exceeds 50% for both CIO and CDO indicates low awareness of efforts concerning CIO/CDO in the companies (Figure 3-4-1-2).

The rate of appointment of CIO or CDO for exclusive duty is 56.7% for both CIO and CDO in Germany, while the percentage is over 60% in other countries. The rate of German companies is lower, while the rate of Japanese companies is similar to companies in the US and the UK (Figure 3-4-1-3).

We checked the level of understanding of informatiza-

Figure 3-4-1-1 Roles of organizational reform (appointment of CIO and CDO, etc.) in ICT introduction

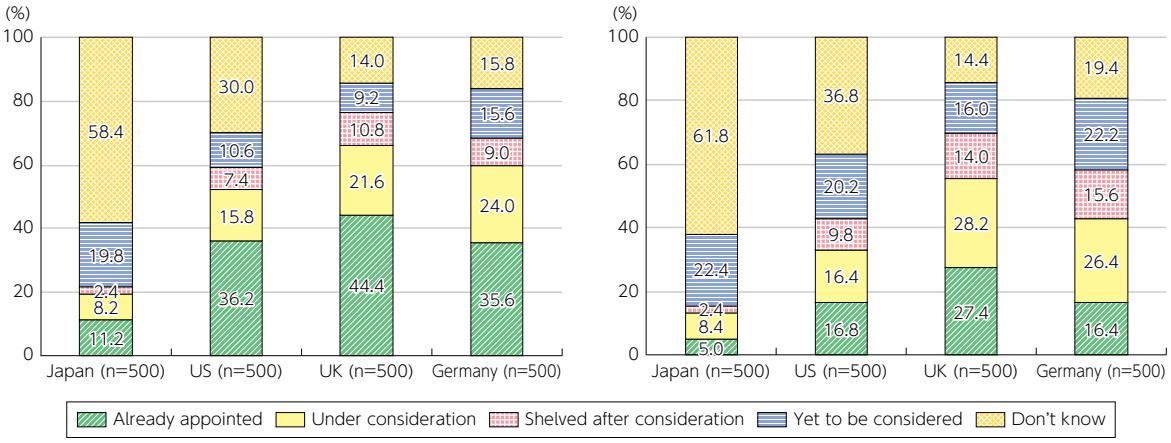


(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

tion/digitalization by employees handling operations by state of CIO/CDO appointment. The rate of answering "understood by most employees" is 29.7% among the companies appointing or considering appointment of CIO/CDO, while the percentage of other companies is 8.5%, lower than one third of the former group. The result indicates that employees handling operations are improving understanding of promotion of informatization /digitization in companies appointing or considering appointment of CIO/CDO (Figure 3-4-1-4).

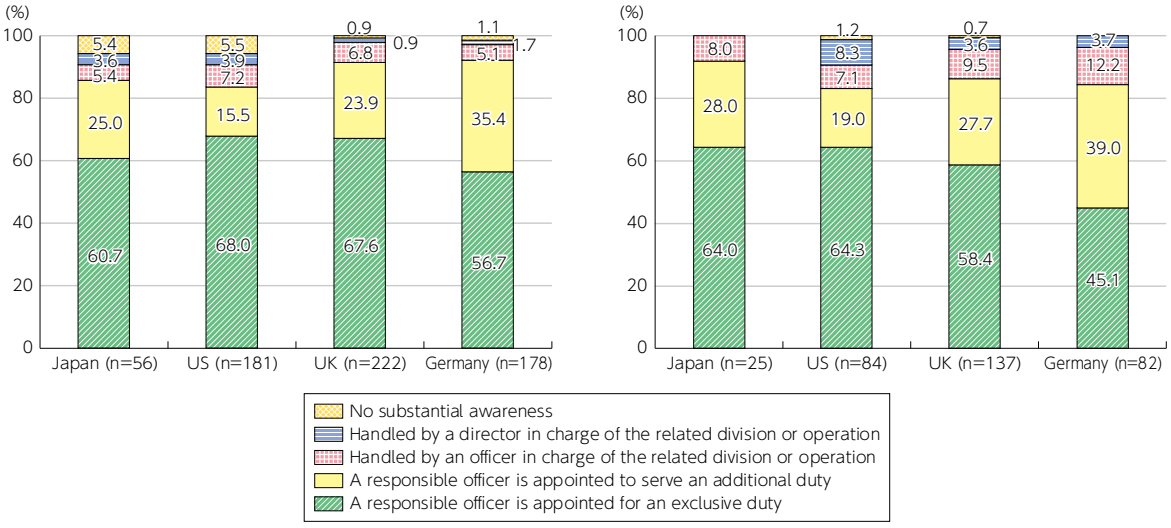
Furthermore, domestic companies that have appointed a CIO or/and a CDO (or considering appointment) show higher rates of ICT introduction and implementation of initiatives for hiring and labor improvement through ICT compared with other companies. Particularly there is a big difference in the latter between them (Figure 3-4-1-5).

Figure 3-4-1-2 State of Appointment of CIO/CDO (left figure: CIO; right figure: CDO)



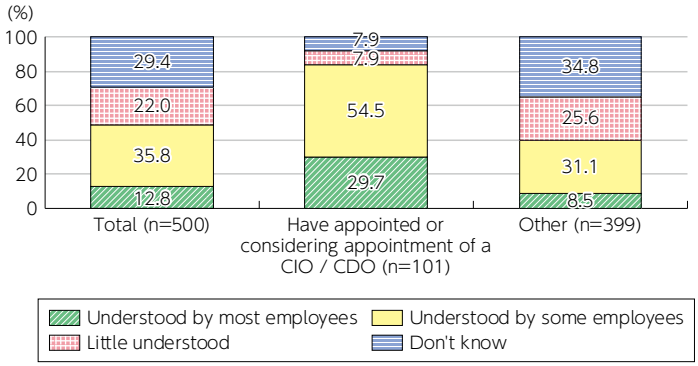
(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-4-1-3 CIO and CDO as an additional post (left figure: CIO; right figure: CDO)



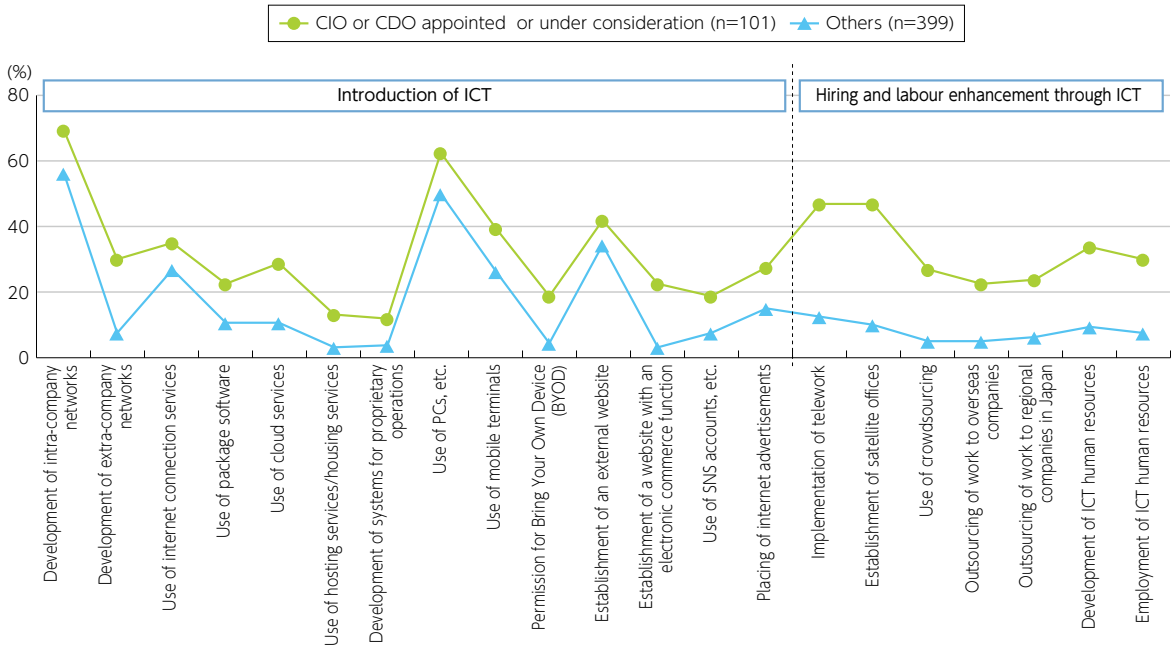
(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-4-1-4 Understanding of promotion of informatization / digitization among employees of domestic companies



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

Figure 3-4-1-5 State of efforts of domestic companies to hiring and labour improvement through use of ICT (by CIO/CDO appointment state)



(Source) Survey Research on Innovation through ICT and Formation of New Economy, MIC (2018)

2. Specific Efforts for Organizational Reform

Efficiency improvement as a condition of ICT introduction requires not only appointment of a CIO or/and a CDO but also organizational reform led by them. In fact, some companies appointing a CIO/CDO set up organizations related to digitization under them at the same time with their appointment. When setting up new departments, many companies promote cooperation with external parties or innovation in and outside the company. Some companies set up an organization called an "innovation lab."

Companies adopting the approach of combination of offices by internal members focus on promotion of company-wide digital strategies based on the grasp of ICT-related internal efforts and needs, which is controlled by a CIO/CDO. Large companies, in particular, are promoting digitization by individual divisions, sometimes resulting in partial optimization.

By gathering dedicated or interlocking members in an organization directly controlled by a CIO/CDO, you can grasp efforts of and needs for digitization in individual divisions and promote digitization with overall optimization.

3. Promotion of Labor Force Participation

In Japan where population is declining, decrease in workers, namely the labor force, will be inevitable in the future. In order to ensure sustainable growth under this condition, it is necessary to increase participants in the labor market to the extent possible and enhance the labor productivity of each participant. Typical ICT tools effective for this challenge include telework and crowdsourcing. Both approaches are major change for conventional organizations and therefore require appropriate response by the companies.