

Requirements for Achieving the Full Benefits of Society 5.0

Section 1 What are the Characteristics of the Digital Economy?

1. First Characteristic of the Digital Economy: Data is the Source of Value Creation

(1) How Does Data Create Value?

Traditionally it was thought that what gave value to goods and services was land, physical labor, and the operation of mechanical equipment. What sets the digital economy apart has been the rapid increase in the power of data to generate value, as so-called big data and AI have advanced.

5G and Quasi-Zenith Satellite Systems Will Push Forward the Mechanisms by Which Data Creates Value

Two processes are expected to play an important role in the creation of value by data in the coming years: Fifth-generation mobile communication systems (5G), the full-scale rollout of which is expected to begin in Japan in 2020, and quasi-zenith satellite systems.

Compared to previous mobile communication systems, 5G is characterized by: (i) ultra-fast speeds, (ii) huge numbers of simultaneous connections, and (iii) ultra-low latency. It is necessary to have simultaneous communications by numerous vehicles and sensors and to exchange data in real time through communications, particularly when considering accident avoidance by vehicles. 5G is the ideal platform that supports such communications. As such, 5G is expected to expand the possibilities of the Internet of Things (IoT) immensely.

A quasi-zenith satellite system is a type of satellite navigation system that identifies locations and times on the ground by receiving signals from satellites. GPS, operated by the U.S. Department of Defense, is a satellite navigation system widely used in Japan. The quasi-zenith satellite system constructed by Japan complements GPS to identify surface locations and times even more precisely. The quasi-zenith satellite system has been a four-satellite system since November 2018, which has further improved its accuracy. In this way, quasi-zenith

satellite systems are expected to serve, both in Japan and the Asian-Oceania region, as a platform letting autonomous driving, IoT devices, and other applications access more precise location data.

(2) Examples of Data Creating Value

Non-ICT Companies Also Apply Data to Create Value

Companies using data to create value are not limited to the giant ICT players often referred to as digital platform operators. Japanese manufacturer Komatsu Ltd., for example, is working on smart construction, which optimizes entire construction and production processes using large varied data sets from construction sites. Similarly, there are examples of small retailers in local areas achieving huge gains in sales and profits after introducing customer-prediction and other business-forecasting solutions. Ebiya Ltd., established in 1912, is long-standing small business in Ise, Mie Prefecture that runs a souvenir shop and a Japanese restaurant. Ebiya developed a system for predicting, with an average hit ratio of in the 90-percentile range, the number of customers on the following day. The system analyzes sales data, meteorology (weather forecasts), the day of the week, and the number of guests staying overnight in nearby hotels and other accommodations. Having accurate predictions avoids bringing in excess stock and significantly reduced the hours when meals are served. In the four years since 2012, Ebiya's sales have increased by four times and profit ratios by 10 times.

As these examples show, non-ICT companies, and even local businesses, are generating value through the application of data. This phenomenon is an indication of the progress of the digital transformation, which is described below.

2. Second Characteristic of the Digital Economy: Enabling Activities that Overcome Time, Location, and Scale Constraints

The second characteristic of the digital economy is enabling activities that overcome time, location, and scale constraints. This characteristic is both expanding markets and making markets more granular, two directions that are seemingly contradictory.

3. Third Characteristic of the Digital Economy: Inevitable Rebuilding of Relationships among Many Entities

The third characteristic of the digital economy is the inevitable rebuilding of relationships among many different entities. This characteristic of the digital economy

is driving transformations in company-to-company relationships, in individual-to-company relationships, and in the structures of societies and communities.

4. The Digital Transformation: ICT Integration is Coming to All Industries

The three characteristics of the digital economy described above appear in tangible form in the ICT integration coming to all industries. This phenomenon is called the “digital transformation”.

The Digital Transformation: Making Survival Hard for Business Models Predicated on Conventional Cost Structures

There is a long line of examples of where the entry of ICT companies has forced traditional companies out of a market. This is known as digital disruption.

Digital disruption refers to situations where competi-

tion with business models that use ICT to adapt to new cost structures makes it hard for traditional industries to survive since their business models are predicated on conventional cost structures in.

Recognition of the impact of digitalization has been climbing in Japan, with companies reporting the advancement of digitalization is “already having an impact” or “may have a disruptive impact” on the predominance or continuation of their existing businesses.

Section 2 What Type of Society Will the Evolution of the Digital Economy Bring?

1. Will the Evolution of the Digital Economy Make Society More Abundant?

(1) The Digital Economy and the GDP

Countries around the world suffered a dramatic downturn in GDP due to the 2008 global financial crisis. After the crisis, the GDP in most countries generally recovered, but a sluggish GDP has been a consistent theme for advanced countries.

(2) Discussion over the Digital Economy and Economic Disparities Shock of the Elephant Graph

The economist Branko Milanovic created the “Elephant Graph” in 2012 as a symbol of the current state of economic disparity in the world. The Elephant Graph created a huge sensation.

The Elephant Graph illustrated that for the 20-year period from 1988 to 2008, incomes shot up in the top-income brackets of advanced countries and in the middle class of developing and emerging countries. Paradoxically, incomes in the middle-income brackets of advanced countries declined over this period.

Limiting the data to just advanced countries shows a widening economic gap between the top-income bracket and the middle class. Some observers believe this widening gap is indicative of large movements in the present international situation.

Is ICT Producing Economic Disparities?

A group of IMF economists published a working paper in 2017.²⁸ According to the paper, the labor share²⁹ of global income is on a downward trend for middle-skilled and lower-skilled workers, while increasing only for high-skilled workers. Looking at just middle-skilled workers in advanced countries, the paper finds that technology, combined with global value chain participation, are the two largest explanatory causes for the decline in middle-skilled workers’ labor share. Regarding technology, the paper focuses on the increasing automation of routine tasks, caused by ICT driving down prices for all goods including machinery.³⁰

The authors conclude that ICT has an integral connection to the current economic disparities seen in labor share.

Routine Tasks are Still Relatively Common in Japan

An analysis³¹ was conducted on differences among OECD countries in the relative balance of ICT adoption³² and routine tasks.³³ According to the analysis, the United States, Finland, Denmark, and other countries with higher rates of ICT adoption simultaneously had declining rates of routine tasks. Japan, however, where ICT usage has not advanced very much, had relatively high

²⁸ Mai Chi Dao, Mitali Das, Zsoka Koczan, and Weicheng Lian (2017). “Why Is Labor Receiving a Smaller Share of Global Income? Theory and Empirical Evidence.” IMF Working Paper WP/17/169.

²⁹ Labor share indicates the share of generated added value that is returned to workers in the form of wages and benefits.

³⁰ In other words, considering that capital and labor are production elements, ICT has lowered the cost of capital to the point where it is cheaper than labor costs and, thus, labor is being replaced by capital.

³¹ Sara De la Rica and Lucas Gortazar (2016). “Differences in Job De-Routinization in OECD Countries: Evidence from PIAAC.”

³² ICT adoption was calculated using data from the Programme for the International Assessment of Adult Competencies (PIAAC) in OECD countries collected between 2011 and 2012. The use of the Internet for tasks, the use of spreadsheets (Excel), the use of programming languages, and similar job tasks were counted as ICT adoption.

³³ Calculated as routine task intensity (RTI) using PIAAC data and other sources.

rates of routine tasks. This finding suggests that routine tasks in Japan may have been replaced by temporary employment rather than by automation.

Discussion has emerged on the need for solutions to

redress economic disparities, based on the growing economic gaps in advanced countries. Many new ideas are surfacing and being discussed on concrete policies in this area, such as a basic income and robot taxes.

2. How Will the Evolution of the Digital Economy Realize Society 5.0?

(1) Rapid Change after a Period of Gradual Change

One distinction of ICT could be its exponential growth. Moore's Law is one of the best-known examples of exponential growth. Some concrete examples of recent so-called exponential technologies are biotechnology, AI, robotics, and nanotechnologies.

A characteristic of exponential change, aside from its eventual huge numbers, is that the change remains very gradual for a period until a certain point of time. Once that point in time is passed, the change is very sudden and massive. The effects of ICT have yet to fully materialize at the present moment. But this may be the inflection point of exponential change and the full impact of ICT may be just around the corner.

(2) What are the Lessons from Previous General-Purpose Technologies?

Effects of General-Purpose Technologies Take Time to Appear

Computers and the Internet are examples of general-purpose technologies (GPTs). Some observers believe new technologies currently in the spotlight like AI and blockchain may also become GPTs in the future.

There is one consistent rule regarding the emergence of economic effects from past GPTs. And that is that there has always been a time lag from the arrival of the technology until its proliferation and the emergence of its economic effects. For example, the steam engine, which appeared in the late 18th century and early 19th century, needed some 80 years from the establishment of the technology until its economic effects appeared.³⁴

Why does it take so long for the effects of these GPTs to appear? Analyses tell us that it is because innovations complementing the GPT were necessary.

GPTs develop through three stages. In the first stage, the core foundations of the previous methodology are maintained while being partially replaced by the new technology. In the second stage, production or operational processes are changed to allow the new technology to demonstrate its potential, which generates new added value. And in the third stage, the new technology becomes entrenched in society, leading to transformations in society and industry.

New Technologies Proliferate through Bubbles and Crises

Another view is that new technologies proliferate through bubbles and crises.³⁵ Taking ICT for example, the IT bubble (or the dot com bubble) persisted from the 1990s through to 2000. Following this, the collapse

of the IT bubble (or the dot com crash) lasted from 2000 to 2002. From this point of view, it is now possible to say that ICT has finally entered its proliferation phase.

As the descriptions above illustrate, it is important to take a long-term view from a technology's arrival to its dissemination.

(3) Shape of Society in Which the True Value of Society 5.0 Will Emerge

Society 5.0 Lies at the Endpoint of the Digital Economy's Evolution

What kind of society will the evolution of the digital economy create? One concept, which Japan is advocating for, is "Society 5.0".

Society 5.0 is a human-centered society that achieves both economic development and solutions to social challenges by means of systems that fuse cyber space with physical space in a highly integrated manner. Society 5.0 also means the society that follows the hunter-gatherer society (Society 1.0), agrarian society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0). The term originally appeared as a catchphrase in working out the 5th Science and Technology Basic Plan. Now Society 5.0 is more than just an R&D goal and has become a social goal of the government.³⁶

Society 5.0's true value can be said to lie in its total social optimization by melding together ICT and physical space and making use of ICT connectivity, instead of partial optimizations in which ICT fuels advances in various things separately in physical space. Through total optimization, Society 5.0 is an attempt to resolve social challenges and not purely to seek economic development. On another level, Society 5.0 can be seen as an endeavor to counter technology pessimism, by aiming for innovations in total optimization through integration with physical spaces. When the era comes when Society 5.0's true value has been manifested, the digital economy will be *the* economy.

Realization of Society 5.0 through Digitalization Will Also Contribute to the SDGs

Solving social challenges through the realization of Society 5.0 is expected to contribute to achieving the UN's Sustainable Development Goals (SDGs).³⁷

What Transformations are Necessary for Society 5.0's True Value to Emerge?

Based on the lessons given above from past GPTs, the effects of ICT will not be fully realized without innovative transformations that complement ICT. The lack of these transformations also complicates eliciting the true

³⁴ Paul A. David (1990). "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox." *American Economic Review*, Vol. 80, No. 2, pp. 355-361.

³⁵ Carlota Perez (2003). "Technological Revolutions and Financial Capital."

³⁶ The Fourth Industrial Revolution, which focuses on industry, is another concept oriented toward the same goals.

³⁷ The SDGs are positioned as the successors to the Millennium Development Goals (MDGs) adopted in 2001.

value of Society 5.0.

This prompts the question: What kind of transforma-

tions are needed in Japan?

Section 3 What Kind of Transformations are Necessary for Society 5.0 to Display Its True Value?

1. First Necessary Transformation: Redefining the Position of ICT

(1) Moving ICT to Profit Centers and Front Offices

ICT is used in process innovation, but at the present time it is underutilized in product innovation. Moreover, 80 percent of ICT investment in Japan is allocated to maintaining and operating existing businesses.

At a finer level, the information systems departments that promote ICT deployment in companies are regarded in Japan as cost centers that do not generate profit. An additional problem is the operations of information systems departments are relegated to back office operations, which provide value only to other departments in the company, such as business departments involved in developing and supplying products. Furthermore, ICT deployment is not positioned as a core operation of companies; information systems departments very often outsource ICT deployment to ICT companies known as system integrators.

ICT in the future will transform companies' product innovation and business models, with data as a source of value creation. And ICT deployment operations will become front office operations, providing value directly to customers and not to internal company departments.

ICT deployment as front office operations requires companies to switch to an organizational structure in which information systems departments, and business departments that receive support from system integrators, play a more important role and are collectively considered as profit centers.

In addition to transforming the very business models of a company, ICT will change companies' boundaries

between inner and outer. Precisely for this reason, decisions at top management levels are needed.

(2) Redeploying ICT Personnel

ICT personnel are the key to transform ICT's positioning. Japan is unusual in that ICT personnel are concentrated at ICT companies and not at user companies. According to a survey by the Information-technology Promotion Agency, Japan, the percentage of ICT personnel in Japan affiliated with ICT companies as of 2015 was 72.0 percent. This is in stark contrast to the 34.6 percent in the United States, 46.1 percent in the United Kingdom, and 38.6 percent in Germany.

The current allocation of ICT personnel is thought to have limited the benefits of ICT deployment in Japan so far. It is also believed to be an obstacle in implementing ICT in the future as profit centers and front office operations. Thus, more promotion is needed to increase the ranks of ICT personnel at user companies.

The ICT Personnel Shortage Problem

On the flipside, Japan faces a quantitative shortfall in ICT personnel, and the problem will only get more challenging in the coming years.

Some observers feel there are deficiencies both quantitatively and in terms of quality. It may not be possible to immediately retrain personnel who have learned skills primarily in systems of record (SoR), a defensive ICT application, at ICT companies, into personnel who can support ICT's new position centered on systems of engagement (SoE), an offensive ICT application.

2. Second Necessary Transformation: M&A Initiatives as Open Innovation

(1) Why Open Innovation Requires Breaking Away from the Self-Sufficiency Mindset

A common distinction among Japanese companies is their self-sufficiency mindset. Today, however, it is necessary to develop new products rapidly, and this includes transforming business models as well. This brings to the fore what Clayton Christensen calls "The Innovator's Dilemma",³⁸ which illustrates the limits of trying to address today's demands with a self-sufficiency mindset.

In this context, open innovation has become increasingly important.³⁹

(2) Importance of M&As to Open Innovation

GAFA's Growth through M&As

GAFA, the acronym of the four largest U.S. digital platform operators, have created growth through aggressive M&As. Open innovation has been the subject of lively discussion in Japan, but much the discussion has focused on open innovation as a method of industry-academic collaboration.⁴⁰ Companies must change their core operations to take advantage of data as a source of value and transform their business models, given changing cost structures. During this transition, open innovation becomes important as a method for transforming organizational structures in the form of M&As. In this way, open innovation goes beyond mere business partnerships and joint research.

³⁸ Clayton M. Christensen (2011). "The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business."

³⁹ Henry W. Chesbrough (2003). "Open Innovation: The New Imperative for Creating and Profiting from Technology."

⁴⁰ Some observers have also indicated that Japan's open innovation policies place disproportionate emphasis on industry-academic collaboration.

M&As are Particularly Vital for Large Companies

As ICT integration comes to all industries, even companies that have not been ICT companies in the past must develop and supply services that take advantage of ICT. Start-ups, which are smaller in scale than large companies, are generally thought to have a special advantage in generating innovation using ICT because of their faster decision-making ability.

Given these two facts, it is important for large companies in particular to not fixate on generating innovation through their own R&D and other initiatives, but instead to partner with these quicker start-ups and take advantage of their capabilities.

Another important perspective is regarding M&As as an alternate method to R&D — i.e., acquisition and development (A&D) as opposed to research and development (R&D). The advantages of A&D are absorbing excellent outside resources and lowering risks associated when conducting in-house R&D.⁴¹

The Option of Using CVC

There is a movement of companies focusing on setting up corporate venture capital (CVC) to invest in start-ups in addition to traditional M&As.

CVC investments are becoming more active on the global stage, and the percentage of CVC investments among all investments is on the upswing. CVC investments are different from venture capital in that the aver-

age investment amount per investment is larger.

Comparing Japan, the United States, and China on the number and amounts of CVC investments, the United States dominates in both categories. Japan and China have roughly the same number of CVC investments, but China's investment amounts are much larger. Consequently, Japan's CVC investments tend to be relatively small in scale.

(3) Improving the Business Landscape for Start-Ups through More Active M&As by Large Companies and Other Groups

Entrepreneurship in Japan is sluggish. The latest annual Global Entrepreneurship Monitor (GEM) report⁴² listed Japan as 45th of 49 countries on our total entrepreneurship activity (TEA) rate.⁴³

One of the reasons of the low rate of entrepreneurship in Japan is the limited exits for entrepreneurs. Capital funds called venture capital (VC) ordinarily fund start-up ventures.

Although VC allows entrepreneurs to sell off shares (or exit) for a certain amount of time, the methods of exiting are broadly taking the start-up public — namely, IPOs — and stock acquisitions by large companies or other businesses — namely, M&As.

Japan is unique in that start-up exits are heavily weighted toward IPOs.

3. Third Necessary Transformation: Work-Style Reforms

The government is moving ahead with efforts to work-style reforms based on an action plan formulated in March 2017. Work-style reforms are expected to lead to higher productivity as well as make people's lives better. At the same time, these reforms can be part of the rebuilding of relationships between companies and people — something that is essential with the evolution of the digital economy. Pushing ahead work-style reforms is anticipated to bring greater richness to people's lives in the digital economy and be a driving force in the generation of innovation. The efforts are also necessary for

Society 5.0 to manifest its true value.

One of the work-style reforms the government is pursuing is telework, which is part of establishing conditions to make flexible working arrangements easier.

The other of the government's working arrangement reforms is to promote the widespread acceptance of taking on side businesses or side jobs. Side businesses and side jobs are expected to aid companies in terms of the development of new technologies and open innovation and to aid individuals in terms of a means of starting a business and preparing for a second life.

4. Opportunities for Local Regions During the Evolution of the Digital Economy

What will happen to local regions during the evolution of the digital economy?

The digital disruption described in Section 1 is a predicament for local regions. As ICT transforms cost structures, it is possible that conventional business models

cannot persist in either small cities or local regional settings. Another way of thinking suggests that ICT will inflate the advantages of consolidation. In fact, in terms of population, consolidation into Tokyo and other major metropolitan areas has been underway in recent years.⁴⁴

⁴¹ Henry Chesbrough (2006), "Open Business Models: How to Thrive in the New Information Landscape" refers to these advantages. Furthermore, Masahiko Aoki (2001), "Toward a Comparative Institutional Analysis" also mentions — as an advantage of A&D over R&D — the flexibility A&D provides in maintaining other options until the uncertainty associated with a system design has been reduced.

⁴² Niels Bosma and Donna Kelley (2019). "Global Entrepreneurship Monitor 2018/2019 Global Report."

⁴³ TEA indicates the percentage of 100 adults between the ages of 18 and 64 engaged in entrepreneurship activities (the time from preparing to start a business to being an entrepreneur for less than 3.5 years after starting a business).

⁴⁴ According to the MIC's 2018 Report on Internal Migration in Japan, eight prefectures saw a net inflow of residents — namely Tokyo, Saitama, Kanagawa, Chiba, Aichi, Fukuoka, Osaka, and Shiga. Thirty-nine prefectures, including Ibaraki, Fukushima, Niigata, and Nagasaki, had a net outflow of residents. At the municipal level, 27.9 percent of all municipalities saw a net inflow of residents, while 72.1 percent had a net outflow of residents. Furthermore, the Metro Tokyo region has had a net inflow of residents for 23 straight years.

The evolution of the digital economy is thought to drive more consolidation into specific areas.

(1) First Priority Action: Establish ICT Infrastructure

Pursuing digital transformations is necessary for local regions to seize opportunities in the digital economy. Moving ahead with the establishment of ICT infrastructure is a key prerequisite for digital transformations.

5G is expected to become an important ICT infrastructure. Unlike other infrastructure in the past that assumed communications by people, 5G is infrastructure for things — namely, the IoT. Thus, 5G is critical from the point of generating many different types of value. Based on this and the frequency allocation in May 2019, a requirement on 5G infrastructure is that it be extended broadly and reliably nationwide, and not be limited to just residential areas. This requirement is expected to allow 5G to be utilized in many fields, such as living, industry, healthcare, and disaster responses and for 5G to solve challenges faced by local regions. Furthermore, Local 5G will let many entities utilize 5G for regional and individual needs, including smart cities. System arrangements for Local 5G will be completed in 2019 and applications for Local 5G licenses will be accepted.

(2) Second Priority Action: Make Use of Data

The next priority is making use of data, which is the source of value creation. The Regional Economy and Society Analyzing System (RESAS) is one entry point for

local regions to make use of data. RESAS was designed to assist various regional revitalization initiatives from the information side. The system gathers public and private big data and presents it in a visual format. The big data include industrial structures, changes in population demographics, and the flow of people in regional areas. The Headquarters for the Creation of Communities, People, and Jobs began providing RESAS in April 2015. The system is used widely by local government personnel, as well as by people in many different fields with an interest in revitalizing local regions, for the efficient planning, implementation, and verification of strategies.

MIC began providing the Statistics Dashboard⁴⁵ in May 2017. The dashboard creates and displays graphs of key statistics created by various government ministries and agencies. The system allows users to use and apply simple data in an easy-to-view format.⁴⁶

(3) Third Priority Action: Cultivate New Cooperation Partners

An additional priority is to cultivate new cooperation partners, instead of relying on existing relationships, by considering various individuals, companies, and organizations as prospective partners. This is necessary because one of the qualities of the digital economy is the rebuilding of relationships among various entities. Furthermore, although data is the source of value, it generally holds true that the amount of data determines the value generated. Therefore, working in cooperation with others is expected to shore up the amount of data available to generate value.

Section 4 New Relationships between People and ICT

1. ICT Acceptance by People

Looking back on the history of technologies used widely throughout economies and societies, we can see in the rise and fall of whole countries and whole regions whether or not these societies took in the new general-purpose technologies.

Neither rail transport nor automobiles existed in Japan when they first became practical. Nevertheless, business models emerged for rail transport in combination with real-estate development, such as Hankyu and Tokyu, and Japan ended up producing the world-renowned Shinkansen bullet train. Automobiles, too, have a history of causing massive changes in Japan's economy and society as a core industry. Therefore, when it comes to new general-purpose technologies and the much-heralded artificial intelligence (AI), acceptance and understanding by people are thought to be necessary prior to the technologies being truly adopted throughout the economy and society.

A relatively high percentage of Japan's population has a positive image of humanoid robots compared to the United States and Germany. One contributing factor that

has been suggested is the influence of *Astro Boy*, *Doraemon*, and other anime that featured friendly robot characters.

On average, people in Japan have serious concerns about their jobs being replaced by AI or robots. This anxiety is especially pronounced among people in their 20s and 30s. However, as of 2019, AI and robots on a macro level have not caused substantial increases in productivity nor replaced many jobs.

Only a limited number of companies have introduced the IoT or AI into their workplaces and obtained real results. At the same time, Japan faces a shortage of skilled workers in the workplace due to a falling and aging population and a decreasing birthrate. Thus, some observers have pointed out that workplaces may well welcome the integration of new technologies, as a means to make up for workforce shortages with automation as well as to empower people, as increases in small-lot production of diverse products place more pressure on human workers.

⁴⁵ <https://dashboard.e-stat.go.jp/en/>

⁴⁶ The system compiles around 5,000 types of statistical data grouped into 17 categories and provides 55 types of graphs.

2. New Workstyles that Make Use of ICT

(1) Results of a Survey on Telework Introduction and Its Effects

a. State of Telework Introduction

Telework is a flexible way of working that can effectively utilize time and locations through the use of ICT. Three types of telework are working from home, working at satellite offices, and mobile work. Telework is considered the secret advantage in implementing workstyle reforms. It is expected to help maintain work-life balances, ensure a sufficient workforce in a period of depopulation, contribute to regional revitalization, and, for companies, have a positive effect on efficiencies and worker outputs.

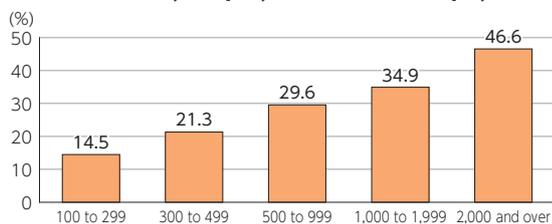
An estimated 13.9 percent of companies had introduced telework as of 2018, based on MIC (2019),⁴⁷ and this percentage has risen to 19.1 percent in 2019. Larger companies are likely to have higher adoption rates.

b. Advantages and Significance of Telework

(i) Encourages Labor Participation

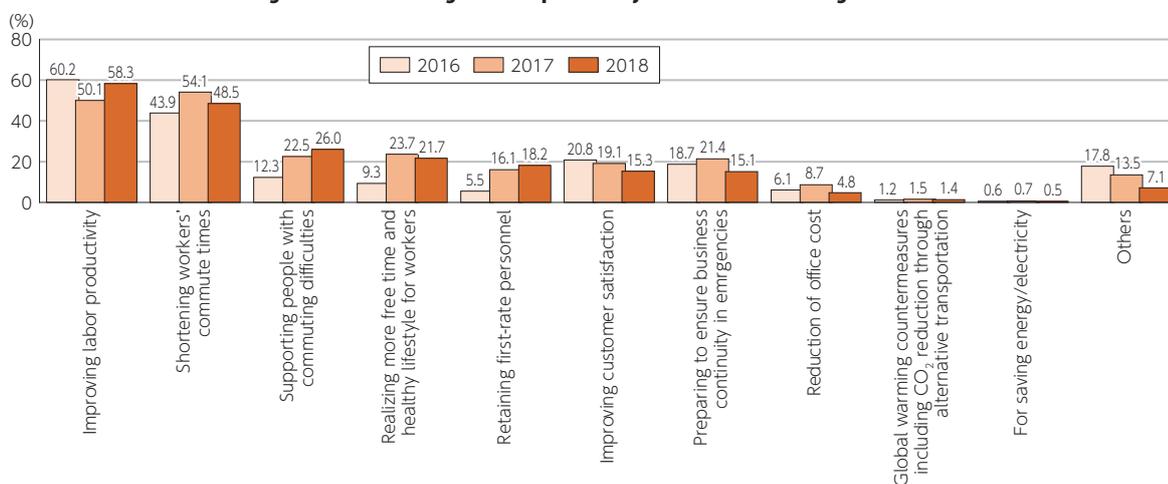
The transitions in companies' objectives for introducing telework were surveyed in MIC (2019). "Shortening workers' commute times" was a common objective, second overall. The percentages for other objectives — such as "Supporting people with commuting difficulties" and "Retaining first-rate personnel" — are on an upward trajectory over the last few years. This suggests a move-

Figure 2-4-2-1 Rate of telework introduction at companies (by company size (number of employees))



(Source) MIC (2019), "2018 Communications Usage Trend Survey"

Figure 2-4-2-2 Changes in companies' objectives for introducing telework



(Source) Created from the "Communications Usage Trend Survey", MIC, for each respective year

ment among companies to adopt telework to make it easier for employees to work and for the objectives of employment continuity and personnel retention amid labor shortage.

(ii) Shortening Commuting Times and Easing Traffic Congestion

Research results have shown that, as result of the advance of the service economy, the more densely populated an area, the higher the productivity. It has been pointed out that the concentration of economic activities in major metropolitan areas has the potential to help boost the productivity of the service industry, but conversely such concentration has side effects of making commuting time longer and discouraging female employment. Telework is hoped to mitigate these side effects.

Prior to the 2012 London Olympic and Paralympic Games, it was projected that traffic congestion would interfere with people's movement within London. Based on these estimates, around 80 percent of companies in the city introduced telework, thereby avoiding congestion during the Games. In Japan, the government, in cooperation with the Tokyo Metropolitan Government and related organizations, designated July 24 — the day on which the 2020 Tokyo Olympic Games' opening ceremony will be held — as "Telework Day" to spur on a national movement toward working arrangement reforms.

c. Quantitative Analysis of the Relationship between Telework and Productivity

Cabinet Office (2018)⁴⁸ made analytic estimates that controlled for reverse causal relationships, which suggested that the promotion of flexible working arrangements could raise productivity levels. Specifically, the analysis showed that compared to companies that did not introduce telework or other flexible working arrangements, companies that did grow their labor pro-

⁴⁷ MIC (2019). "2018 Communications Usage Trend Survey (Company Edition)."

⁴⁸ Cabinet Office (2018). "Annual Report on the Japanese Economy and Public Finance 2018."

ductivity between 2012 and 2016 by over 10 percentage points, with an average annual growth of three to four percentage points.⁴⁹

(2) Combination of ICT Introduction and Other Initiatives Necessary for Work-style Reforms

As mentioned above, 19.1 percent of Japanese companies have introduced telework, but only 8.7 percent of workers have tried telework.

This figure indicates the number of people who actually telework is quite limited, even at companies that allow telework. It also suggests a strong likelihood of factors obstructing employees' use of telework at the average Japanese company, including those that have introduced telework.

a. Implementation of Work-style Reform

Figure 2-4-2-3 gives an overall view of the implementation status of policies on work-style reform. The most frequently implemented policy is "Encouraging employees to take days off". This is followed by "Setting reduction targets for working hours to reduce long working hours", "Sending messages from top management on work-style reform", and "Making working hours more visible".

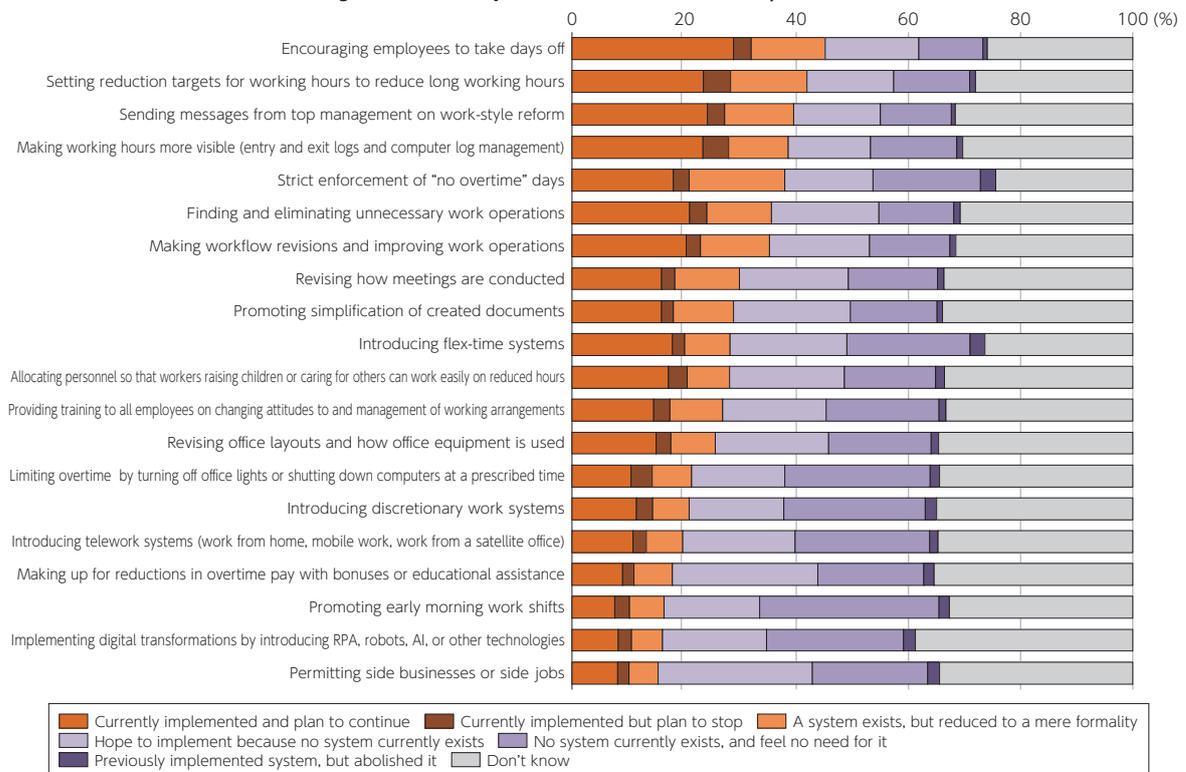
Conversely, very few companies are implementing such policies as "Permitting side businesses or side jobs", "Implementing digital transformations by intro-

ducing RPA, robots, AI, or other technologies", and "Making up for reductions in overtime pay with bonuses or educational assistance".

To get an idea of which policies were taken in combination with telework introduction,⁵⁰ telework introduction rates were calculated for companies that took the corresponding policy and for companies that did not. Companies that replied they were "Implementing digital transformations by introducing RPA, robots, AI, or other technologies" had the highest telework system introduction rate. Telework system introduction rates were also high among companies that made up for reductions in overtime pay, introduced systems for side businesses or side jobs, and introduced discretionary work hours. On the whole, a correlation was seen between the group making larger revisions to systematic organizational structures and high telework system introduction rates. (Figure 2-4-2-4)

What positive changes did work-style reform policies bring about were also studied. Replies for "Working hours have fallen" and "Easier to take time off" were relatively high, at about 20 percentage points higher than the overall averages. The reply rates were higher the larger the company size. Reply rates were relatively low for other positive results or changes that contributed to satisfaction. Furthermore, the rate for "No positive changes" was around 20 percent.

Figure 2-4-2-3 Implementation state of work-style reform

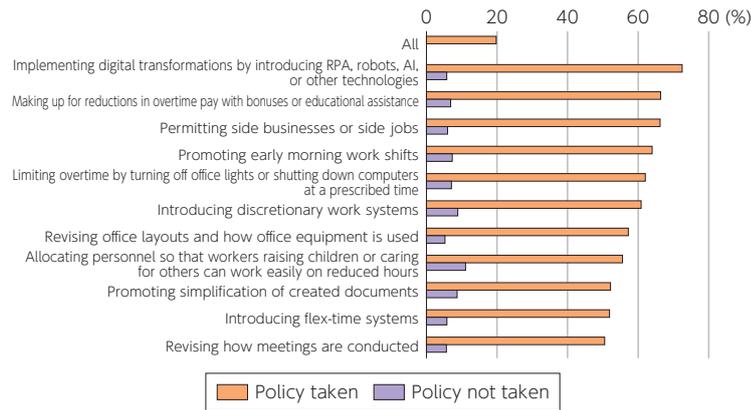


(Source) MIC (2019), "Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements"

⁴⁹ This analysis, however, used a propensity score method instead of a panel data analysis. Thus, when matching the group with organizations that gave workers the flexibility to choose where to work, such as telework, with the group with organizations that did not, it is possible factors other than the variables used for matching may have influenced the results.

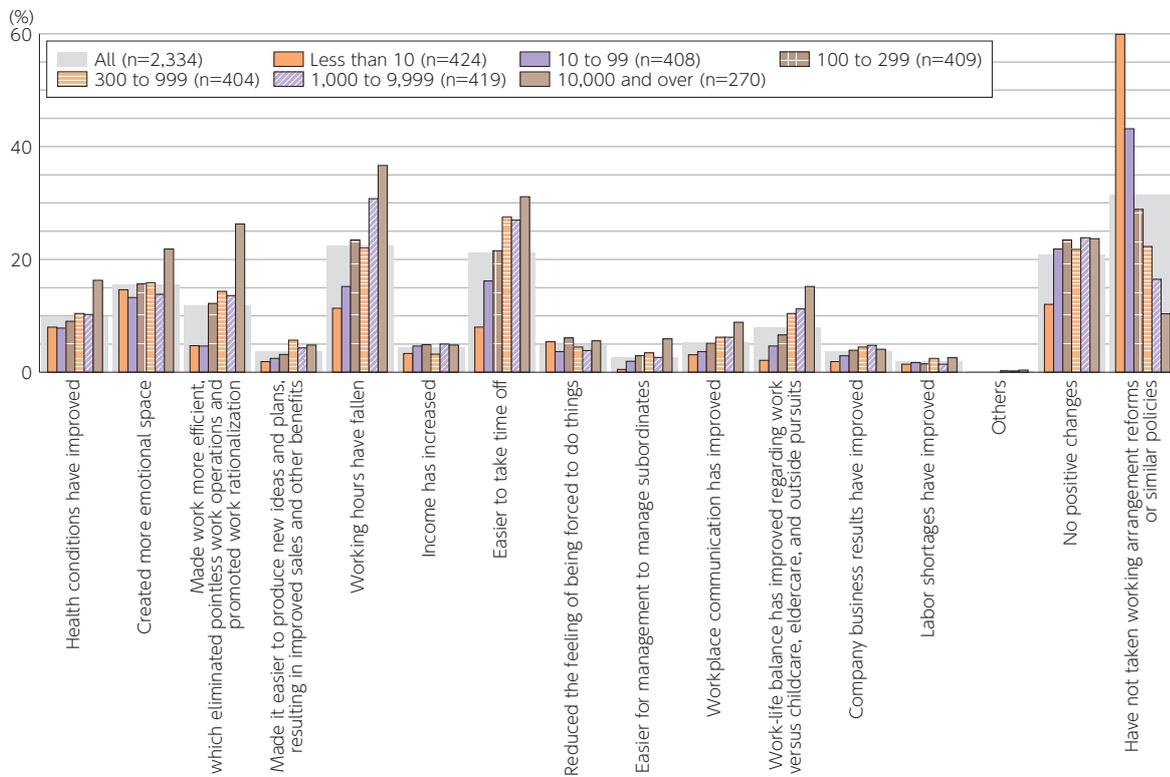
⁵⁰ As mentioned above, the telework introduction rate among companies was 19.1 percent in the latest Communications Usage Trend Survey. The Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements (2019) gives a different telework introduction rate because it is based on a different study sample.

Figure 2-4-2-4 State of telework system introduction versus whether or not the corresponding policy has been taken



(Source) MIC (2019), "Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements"

Figure 2-4-2-5 Positive changes caused by the implementation of work-style reform policies (all companies / by company size)



(Source) MIC (2019), "Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements"

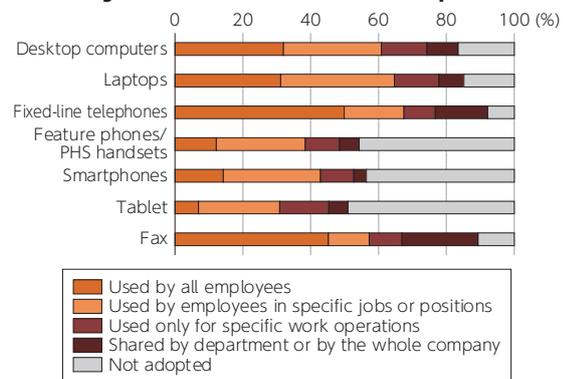
b. Adoption of ICT Business Tools

ICT business tools are expected to aid labor participation of a wider range of personnel and underpin diverse workstyle that provide location and time flexibility. In this analysis, ICT business tools are split into tools for information sharing and communications and tools for labor and general-affairs management.

Over 80 percent of companies replied they have adopted ICT devices, which includes desktop computers and laptops, including computers with usage restrictions. Around half of the companies have adopted mobile devices, including feature phones, smartphones, and tablets (Figure 2-4-2-6).

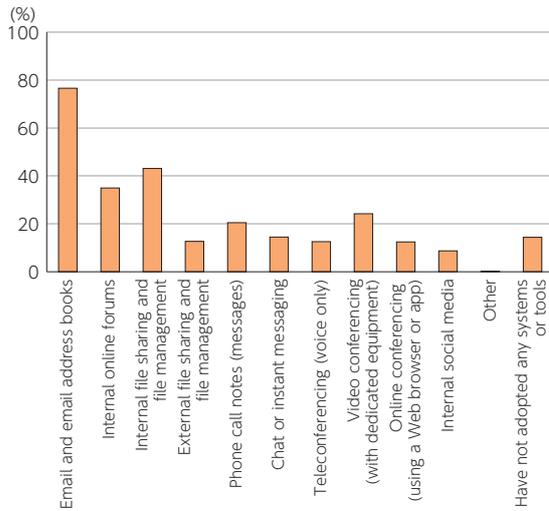
In regards to systems and tools for information sharing and communications, close to 80 percent of companies said they have adopted email and email address books. At the same, more than 10 percent said they have

Figure 2-4-2-6 State of ICT device adoption



(Source) MIC (2019), "Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements"

Figure 2-4-2-7 State of system and tool adoption for information sharing and communications



(Source) MIC (2019), "Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements"

not introduced any information sharing or communications systems or tools.

Around 40 percent of companies have introduced online forums and file sharing/management internally, but adoption of file sharing/management with external entities has not progressed significantly. The same lack of

3. Major Disasters and ICT

(1) Frequent Disasters and ICT

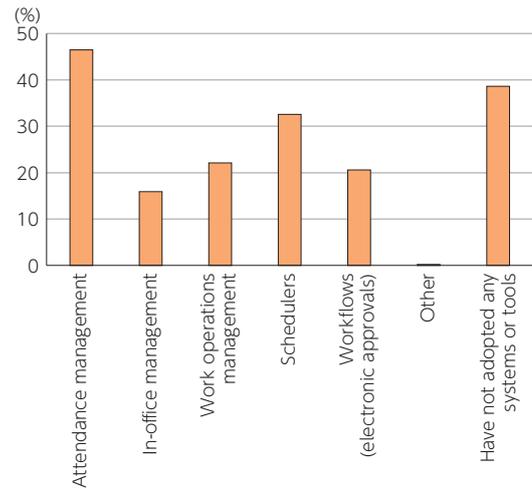
a. Frequent Major Disasters and ICT

Over three decades of the Heisei Era, Japan saw frequent major earthquakes, torrential rains, and other disasters. The list of just those disasters named by the Meteorological Agency comes to 27.

As we have seen so far, the 30 years of the Heisei Era are also distinctive for the growth and proliferation of ICT, in particular the Internet and mobile phones. The turning point for ICT growth and proliferation is in some important ways related to major disasters.

The 1995 HanShin-Awaji Earthquake severed fixed-line telephone networks or rendered them highly congested. The fact that mobile phones and networks were still functioning, even though they were in their early growth stage at the time, drew attention. Furthermore, conditions in areas struck by the earthquake were communicated via the Internet, which was also just being rolled out. By the time the 2011 Great East Japan Earthquake occurred, mobile phones were in far greater use than at the time of the HanShin-Awaji Earthquake, and social media was also frequently used as a communication tool. Nevertheless, ICT was still affected, primarily in the Tohoku and Kanto regions, due to broken communication links, power outages, and other damage that prevented ICT device use. It is well known that LINE

Figure 2-4-2-8 State of system and tool adoption for labor and general-affairs management



(Source) MIC (2019), "Study Report on the Impact of Digitalization on Lifestyles and Working Arrangements"

proliferation exists with business chat, instant messaging, online conferencing, and similar tools. (Figure 2-4-2-7)

Regarding the adoption of systems and tools for labor and general-affairs management, the highest adoption rates were for attendance management and schedulers (Figure 2-4-2-8).

was developed based on lessons from the Great East Japan Earthquake.

(2) State of Communications During the July 2018 Torrential Rain Disaster

a. Overview of the July 2018 Torrential Rain Disaster

The torrential rains of July 2018 (Western Japan Torrential Rain Disaster) triggered river inundations, flash-flooding damage, and landslides in many areas of Western Japan. More than 200 people died, making it the deadliest flood-related disaster during the Heisei Era.

From June 28, 2018 on, a persistent weather front and Typhoon No. 7 interacted to produce extremely hot and humid air near Japan, which spread over a wide area bringing heavy rains. A wide swath of Western Japan was hit by record-breaking torrential rains especially between July 6 and July 8. The Meteorological Agency held an emergency press conference on July 5, where the agency forecasted heavy rains over a large portion of the country until around July 8 and the possibility of record-setting torrential rains. The agency said severe warnings were necessary for landslides, flooding in low-lying areas, and sudden rises in river levels and overflows. On July 6, the agency issued emergency heavy rain warnings⁵¹ for 11 prefectures. In total, the extreme rainfalls and the resulting flooding and landslides caused

⁵¹ Operation of the emergency warning system started in August 2013. Emergency warnings are issued when extreme heavy rains or tsunamis are predicted that greatly exceed the warning threshold and there is an elevated likelihood of serious damage occurring. Emergency warnings are issued for regions where abnormal conditions are predicted involving serious and imminent danger that is either unprecedented or with the potential of being the worst in a decade or longer. In the case of heavy rains, emergency warnings are issued for typhoons or localized rainfalls expected to cause extreme precipitation levels with the potential of being the worst in a decade or longer.

major devastation over a wide area, resulting in 237 deaths, eight missing, 22,000 houses either completely or partially destroyed, and over 28,000 houses affected by flooding.

b. State of Damages to Communication Equipment during the July 2018

Torrential Rain Disaster

Communication equipment was also damaged by the July 2018 torrential rains. In some cases, landslides severed communication links and snapped electric power cables causing power outages. In other places, floodwaters swamped communication equipment. In both cases, prompt restoration of services was nearly impossible. It was also difficult to traverse roads and reach communication equipment due to road washouts and other damages. Therefore, some equipment took a long time to be restored. Damage to mobile-phone services, however, was limited. Emergency repairs quickly restored mobile-phone communications in many cases, although some areas were without services for considerable periods of time.

(i) Fixed-Line Telephones and the Internet

On July 7, around 100,000 NTT West Flet's optical cables were not functioning throughout Kochi Prefecture, affecting a maximum of 115,680 communication lines. The affected communication lines fell to around 21,000 on July 8, after which the numbers slowly declined to just over 8,000 lines after July 12 and finally down to zero on August 6. Examples of where the restoration took a long time were relay transmission lines severed by landslides and central stations being flooded. The former cases were gradually restored with emergency measures, such as temporary installations of re-routed lines.

(ii) Mobile Phones

Mobile-phone base stations stopped transmitting for a number of reasons: 56 percent because transmission lines were cut, 36 percent because of power outages, five percent because of flooding, and three percent because of equipment damage. These percentages are similar to those of the 2017 Northern Kyushu Torrential Rain — 50 percent because transmission lines were cut and 41 percent because of power outages. In the Kumamoto Earthquake, about 75 percent of mobile-phone base stations stopped transmitting because of commercial power supply outages. In torrential rain disasters, in comparison, landslides cutting transmission lines has a larger effect on mobile-phone base stations.

(3) Information Behavior During the July 2018 Torrential Rain Disaster

MIC conducted a survey to analyze information behavior by residents in the regions hit by the July 2018 Torrential Rain Disaster. MIC also interviewed municipal personnel, company officials, and people involved in volunteer operations.

What was notable about the usage of common ICT devices by age group was that a large percentage of people under 60 used smartphones, whereas a significantly

smaller percentage of people 60 and older used smartphones. As for Internet usage, around 90 percent of people in their 20s and 30s said they frequently used the Internet and around 80 percent said they frequently used LINE. But only 20-odd percent in their 60s said the same.

The means residents used to collect information was surveyed at five points: at the time of the official warning, at the time the disaster struck, during the first week after the disaster, and after one week following the disaster. Voice calls using a mobile phone was the widest used method, followed by terrestrial TV broadcasts, mobile-phone email, and LINE. In general, people made use of the communication means they normally use. The use of terrestrial TV broadcasts varied considerably over the five time frames, while use of cable TV broadcasts, word-of-mouth with neighbors, and government websites change slightly over time. The use of other means of collecting information was more or less constant.

The change in usage of terrestrial TV broadcasts is interesting. Where its usage rate was 40 percent at the time of the official warning, this fell to around 30 percent at the time the disaster struck, and then rose to about 50 percent after one week following the disaster. The reason is believed to be the drastic change in local conditions from just before flooding or landslides to when flooding or landslides occurred. For a time, people sought more detailed information by means other than broadcasts, but later used broadcasts to collect information during the restoration period. (Figure 2-4-3-1)

The changes over time in the means considered useful for collecting information were compared with similar studies after the Great East Japan Earthquake and the Kumamoto Earthquake. After the Great East Japan Earthquake, the perceived usefulness of many types of communication media rose over time (except for radio, whose usefulness fell over time). Conversely, the perceptual changes over time were small after the Kumamoto Earthquake — a similar finding to the survey results for the July 2018 Torrential Rain Disaster. One explanation is that in both the Kumamoto Earthquake and the July 2018 Torrential Rain Disaster, damage to communication and broadcasting infrastructure was relatively limited.

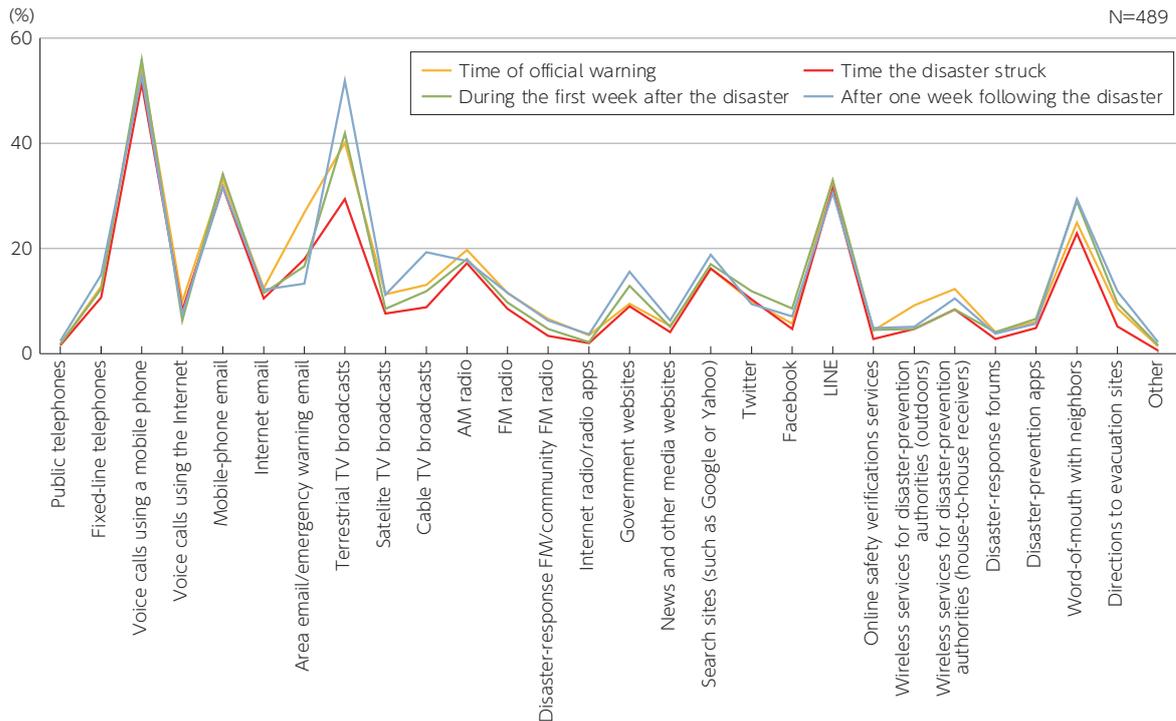
(4) Lessons from the July 2018 Torrential Rain Disaster and ICT

a. Realizing Safety and Security by Making Communication Infrastructure More Robust

(i) Efforts by Telecom Carriers on Disaster-Resilient ICT Infrastructure

Telecom carriers have enhanced their measures to handle power outages and transmission line breaks as well as their strategies to cover areas when a mobile-phone base station goes down. The enhanced measures have been taken based on the fact that during the Great East Japan Earthquake, many mobile-phone base stations stopped transmitting due to power outages and severed transmission lines. In terms of training and preparedness during normal times, telecom carriers have created and revised manuals on disaster responses and engaged in training exercises and coordination with re-

Figure 2-4-3-1 Means used to collect information (changes over time)



(Source) MIC (2019), "Survey on the State of ICT Use and Utilization during Torrential Rain Disasters"

lated organizations. Moreover, they have revised and updated manuals and training after each major disaster. Power outage measures include increasing the number of portable generators and vehicles carrying mobile generators on standby as well as ensuring more battery reserves at base stations. Measures to deal with transmission line breaks include adding multiple routes for transmission lines and enhancing emergency restoration measures with satellite feed-in links and microwave-frequency feed-in links. Area coverage strategies include increasing the number of portable base stations and vehicles carrying base stations on standby as well as installing more large-zone base stations.

During the July 2018 torrential rains, some telecommunication lines were severed by landslides. In general, however, the infrastructure and preparedness steps taken by telecom carriers based on their experiences with large disasters since the Great East Japan Earthquake have kept mobile communication infrastructure damage localized during disasters. Telecom carriers, thus, have applied lessons from past disasters.

b. Smartphone Use Widespread among People Up to 60: Use the Technology You Can Use

(i) Residents

The survey found that around 80 percent of people between 20 and 49, and around 70 percent of people in their 50s, used smartphones.

However, given the lower usage rates of ICT devices and services among people 60 and older, the best sce-

nario in a disaster is that relatively younger people in the community will convey necessary information to those 60 and older.

The interview survey collected comments from many organizations involved in supporting victims of disasters. The comments indicated that the use of LINE groups and the sharing photos of disaster scenes were effective in getting people to take subsequent actions, such as calling out to others.

(ii) Municipalities and Other Organizations

Local governments and lifeline businesses used L-Alert to forward and communicate information to broadcasters and other media companies. For example, between July 4 and July 9, 2018 — the peak period of the July 2018 torrential rains — 549 organizations nationwide communicated information via L-Alert (542 local governments, five lifeline businesses, and two MLIT organizations). In total, 15,227 communications were sent via L-Alert (3,004 evacuation advisories and instructions, 7,855 communications about the opening of evacuation shelters, and 1,549 notifications). In later interviews about L-Alert, municipalities commented that, "L-Alert allowed for very prompt notifications and it simplified communications"⁵² and broadcasters commented that, "Gathering information has required significantly less work since the introduction of L-Alert".

⁵² The systems and operations to issue disaster-related information via L-Alert are dependent on the disaster-response information systems set up independently at the prefectural level. As a result, usability gaps currently exist caused by differences in disaster-response information systems. There have been cases where information on city-level disaster-response information sharing systems had to be manually entered sequentially into the prefectural system. Operational usability is expected to be improved in the future.

c. Why are Evacuations Slow, Leading to the Loss of Lives? Moving from “Communicating” to “Being Communicated” and On to Action

The fact is that during and immediately after disasters residents are slow to evacuate and lives have been lost as a result, despite evacuation advisories and orders and despite predictions of damages on hazard maps. This point has been repeatedly raised in the news, at government commissions and study groups, and other venues.

Based on a survey, we tabulated the decision factors that people consider about evacuating by whether the respondents evacuated or not and by the location they evacuated to (Figure 2-4-3-2). Frequent reasons for evacuating — at around 40 percent — given by people who evacuated from their homes were “The surrounding conditions had gotten worse”, “The place I was in got flooded or had a landslide”, and “I was urged by my neighbors to evacuate”. This indicates the potential for intuitive and immediately comprehensible events to spur people to evacuate. A relatively high percentage of people who didn’t evacuate or who moved to the second or higher floors of their homes said “I hadn’t experienced a disaster on this scale before” and “I believed going outside was more dangerous due to the heavy rains and flooding”.

a. Moving from “Communicating” to “Being Communicated” and On to Action: Example of an Initiative that Provides Detailed Information to Residents

Efforts led by district residents are believed to be very effective.

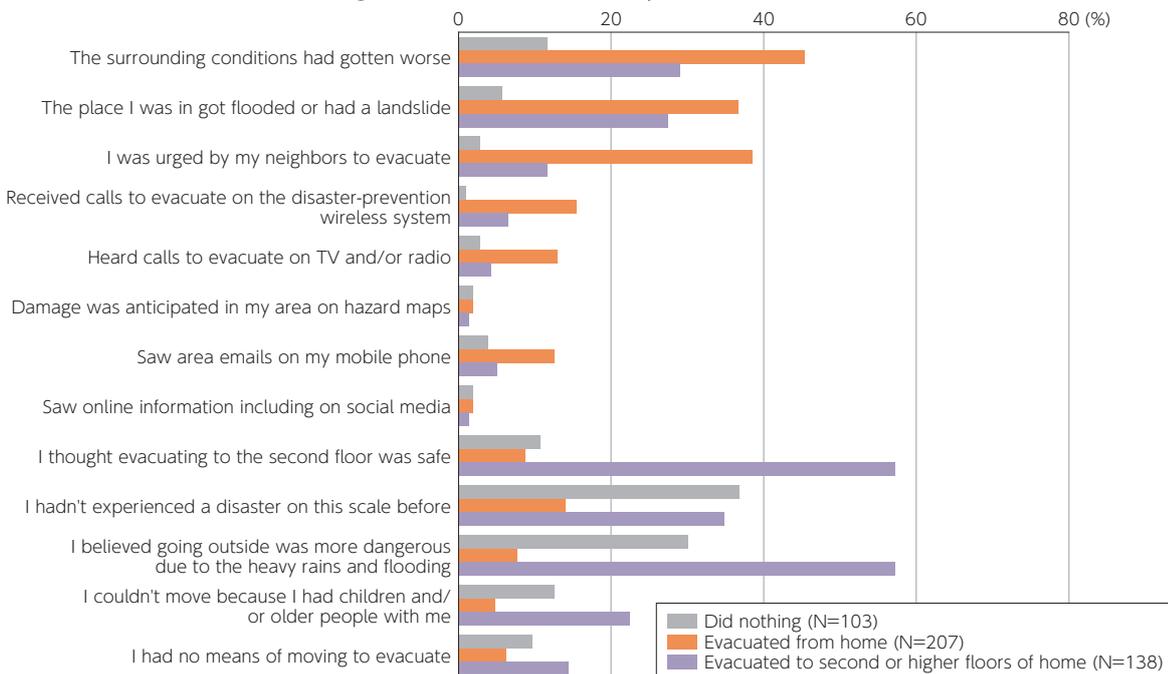
The surveys introduced here, and past surveys too, indicate that an immediately comprehensible impetus is the key to whether people actually evacuate when evacuations are necessary. Disaster response administrations have pointed out in recent years the limits of search and

rescue operations by public agencies and the necessity of self-help and cooperative-help by residents themselves. ICT is believed to be able to play a big role in residents helping themselves and others. Falling prices for sensors and cameras, due to the growth of smart-phones, are helping drive IoT advances and expand the potential for ICT applications in the disaster response and mitigation fields. There are examples in various districts of initiatives that allow residents to see for themselves the state of water levels, for example, by installing live cameras along rivers. However, the initiative by the Miiri District in Asakita-ku, Hiroshima is an illustrative example of how district residents can work together in this area with a university.

The Miiri District suffered landslides that claimed two lives in an August 2014 torrential rain disaster. Mr. Atarashiki Nobuhiro, chairman of the district’s volunteer disaster prevention organization, teamed up with Professor Nishi Masahiro from the Faculty of Information Sciences at the Hiroshima City University, who is researching methods to transmit disaster-monitoring information. Together they worked to install monitoring cameras along the Nenotani River, which flows through the district, and set up gas-detector sensors on the district’s mountainsides. These installations let residents check the river’s level on their computers or phones from a safe location. They also ran trials with the gas detectors to predict precursors to landslides.

This type of initiative has the potential to help residents decide on whether it is necessary to evacuate and take evacuation actions when evacuations are necessary. In fact, during the July 2018 torrential rain disaster, younger people in the Miiri District evacuated on their own relatively quickly because they saw live video from the monitoring cameras on their smartphones. The dis-

Figure 2-4-3-2 Decision factors by evacuation location



(Source) MIC (2019), “Survey on the State of ICT Use and Utilization during Torrential Rain Disasters”

trict was fortunately spared from any major damage, but the incident showed the initiative does spur people into action.⁵³ One remaining issue, however, is that although younger people could check the monitoring camera im-

ages on smartphones and other devices, older people could not. Future efforts are expected on workarounds, such as attempts to broadcast camera images to televisions in each household.

⁵³ No people evacuated during the August 2014 torrential rain disaster. It is important to remember, however, that the conditions were different, as the August 2014 torrential rains started late at night.