Chapter 5

ICT and the Future of Industry

Part 2

Section 1 ICT and Future Issues for Japan's Economy

In this section, we sort through prevailing views on future issues for Japan's economy and the role ICT can play.

1. Future issues for Japan's economy

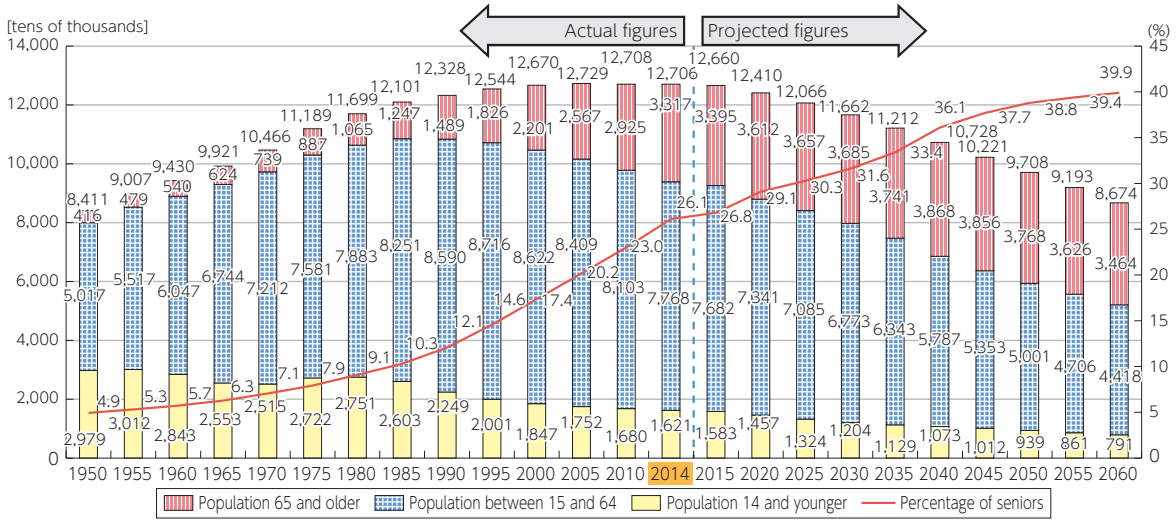
(1) Continuation of the low birth rate and aging population and the arrival of a society with a declining population

Due to the ongoing low birth rate and aging population, Japan's working-age population has been in decline since its peak in 1995, and the total population started declining since its highest point in 2008. According to the national census, the country's total population in 2010 was 127.08 million and the working-age population was 81.03 million. And according to population projections (medium fertility assumption) by the National Institute of Population and Social Security Research, the total population will fall to 116.62 million in 2030 and to 86.74 million in 2060 (a 31.74 percent decline from the 2010 population). The working-age population is forecast to shrink to 67.73 million in 2030 and to 44.18 million in 2060 (a 45.47 percent decline from 2010) (Figure 5-1-1-1).

(2) Course of action toward mid-to-long-term economic growth

As the birth rate remains low and the population continues to age and decline, we must move ahead with supply-side measures and demand-side measures, as two halves of the same whole, in order to realize mid-to-long-term economic growth. On the demand side, the first priority is to focus on the shrinking labor input and to boost the productivity of enterprises. Additionally, we must expand the labor participation rate through the promotion of employment for women and seniors as well as improve labor quality through enhancements to education and HR development. On the supply side, it is important to advance efforts to capture expanding overseas demand through proactive global expansion by enterprises and to strive to generate sustained demand through the creation of new products and services (product innovation).

Figure 5-1-1-1 Transitions in and future projections of Japan's population



(Source) Figures to 2010 taken from the "National Census," MIC; figures for 2014 taken from "Population Statistics," MIC (figures established on December 1); and figures for 2015 and beyond taken from "Population Projections for Japan (January 2012)," (medium fertility and medium mortality assumption) National Institute of Population and Social Security Research

2. The role of ICT in economic growth

(1) Boosting the productivity of enterprises with ICT (supply side (1))

ICT can be used to make enterprises' production activities and distribution activities more efficient, thereby boosting productivity. In the past, enterprises in all industries have largely focused their efforts to boost productivity with ICT on making business operations more efficient. For example, beginning with the construction of business operation systems with mainframes, then moving through the widespread adoption of client-server systems to today, when cloud computing is utilized. As this shows, ICT is the most common tool for raising efficiencies in business activities (process innovation) and it is the driving force behind economic growth as seen from the supply side. Further efficiency improvements are expected in production and distribution processes through, for example, the analysis of big data.

(2) Expanding labor participation and improving labor quality with ICT (supply side (2))

Telework and other working arrangements made possible with ICT are expected to give diverse, flexible work options to women raising children, seniors, people with disabilities, and others and, thereby, increase labor participation rates. At the same time, ICT progress has greatly changed the skills required for employment and the in-demand skills are anticipated to change even more in the future. Therefore, it is imperative, in the interest of improving labor quality, to foster a labor force that can cope with these future skill changes through early ICT education and other measures.

(3) Creating new markets with ICT (demand side (1))

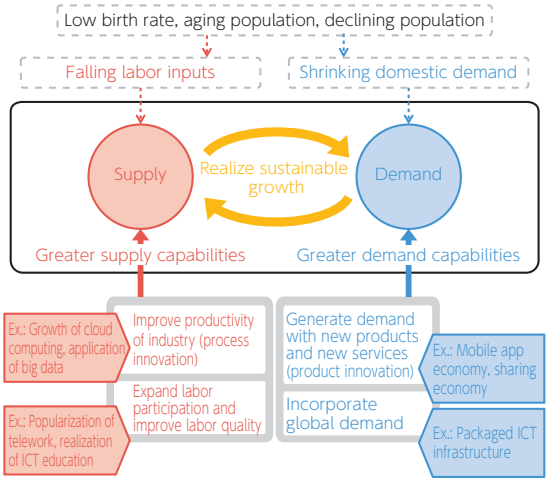
ICT is the source of new market creation. In the ICT field, innovative products—such as mobile phones, computers, flat-panel televisions, smartphones, and tablets—and innovative services—such as online shopping, content delivery, online games, social media, and smartphone apps—have been developed and marketed one after another, creating new markets. During Japan's period of rapid economic growth, economic growth was sustained on the demand side by the popularization of three essential status symbols (B&W televisions, washing machines, and refrigerators) and later by three new essential status symbols (color televisions, air-conditioner units, and cars). But since the 1990s, Japan's economic growth has been sustained on the demand side by ICT-related products and services.

Like other products and services, ICT products and services, viewed individually, start with an early-adaptor stage, pass through a growth stage, and finally reach a stage of demand saturation. ICT products and services, however, are distinguished by the creation of new derivative products and services, after an original product or service spreads extensively through the market for a time, that use the original product or service as a platform. Repeating this process forms new markets at multiple tiers. Repeating this process forms new markets at multiple tiers. For example, the rapid growth of the smartphone has led to the development and popularization of all kinds of apps, and the dissemination of these apps has led to the growth of content markets within apps (for example, the stamp market for the Line app). Another example is the emergence of a new transaction arrangement called the sharing economy, in which individuals share goods and services backed by social media's proliferation that makes trust relations visible. The continuation of such product innovation in the ICT field may be able to sustain our economic growth from the demand side.

(4) Global expansion of the ICT industry (demand side (2))

In contrast to Japan, where there are fears the declining population will trigger a contraction in domestic demand, rapid increases in demand are forecast for emerging countries, fueled by population growth and rising incomes. It is essential to aggressively tap into this overseas demand for our mid-to-long-term economic growth. Consequently, global expansion of the ICT industry, one of Japan's leading industries, is thought to hold major significance from this viewpoint. Figure 5-1-2-1 below summarizes the points made above about ICT's contribution to sustained economic growth.

Figure 5-1-2-1 ICT's contribution to sustained economic growth



3. Objective verifications

Based on the categorization of ICT economic contributions in the previous paragraphs, in the following paragraphs we verify ICT's contributions to our macro economy to this point using objective data. Note, however, because of constraints on data availability, the following verifications do not completely cover the ICT economic contributions categorized above. Refining these verifications is a future topic.

(1) ICT investment's contribution to growth in labor productivity

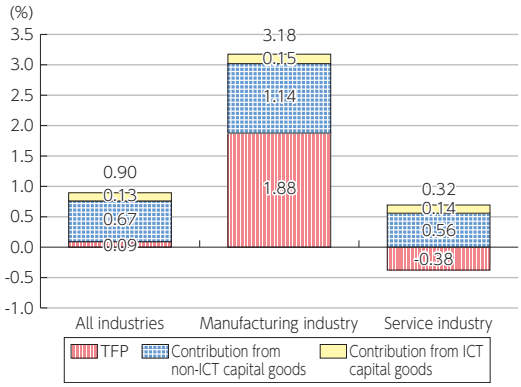
We begin by looking at how much ICT capital goods have contributed to labor productivity growth rates by industry. Figure 5-1-3-1 below provides a breakdown of contributing factors to labor productivity growth rates over the 2000—2013 period for all industries, for the manufacturing industry, and for the service industry. In the manufacturing industry, further ICT capital goods contributed 0.15 percent of the 3.18 percent growth in labor productivity over the period. In the service industry, further ICT capital goods contributed 0.14 percent of the 0.32 percent growth in labor productivity over the period. Thus, ICT capital goods were a positive contributor to labor productivity growth rates in both the manufacturing and service industries (Figure 5-1-3-1). These data indicate that ICT investment lifts labor productivity regardless of the industrial sector.

(2) ICT investment's contribution to economic growth

Next, we looked at how much ICT investment contributes to our country's economic growth. Figure 5-1-3-2 below measures the contributions of production factors to economic growth using a growth accounting method with capital split into "ICT capital" and "general capital" categories. "ICT capital services," which reflect the increase in ICT capital stock through ICT investment, contributed 0.40 percent over the 1990—1995 period and 0.69 percent over the 1995—2000 period to our economic growth rate. These data indicate that ICT investment has been a major contributor to the growth of Japan's economy since the 1990s. ICT capital services contributed 0.27 percent over the 2000—2005 period and 0.34 percent over the 2005—2010 period, remaining a positive, although somewhat smaller, contributor. For the 2010—2013 period, ICT capital services contributed 0.19 percent of the 0.97 percent total economic growth rate (Figure 5-1-3-2).

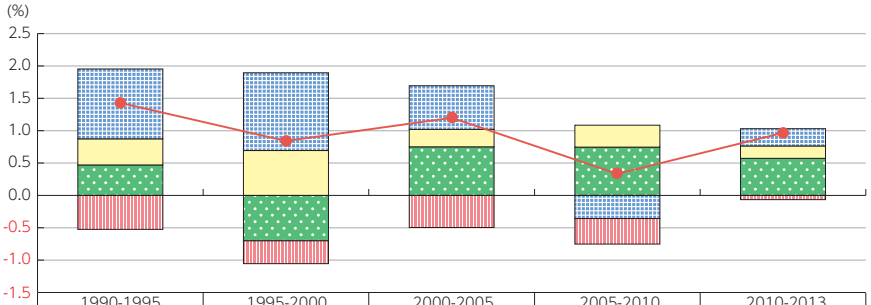
Because of declines in the labor force population, labor services have been a negative contributor to economic growth since 1990 onward. ICT capital services, conversely, have consistently been a positive contributor to economic growth since 1990. This suggests that ICT investment plays a role in supporting economic growth in a society with a declining population.

Figure 5-1-3-1 Contribution of ICT capital goods to labor productivity growth rates by industry



(Source) "Study on Economic Analysis of ICT," MIC (2015)

Figure 5-1-3-2 ICT capital services' contribution to economic growth



	1990-1995	1995-2000	2000-2005	2005-2010	2010-2013
Labor services	-0.52	-0.35	-0.50	-0.40	-0.06
General capital services	1.08	1.20	0.67	-0.36	0.27
ICT capital services	0.40	0.69	0.27	0.34	0.19
Other (TFP)	0.47	-0.70	0.75	0.75	0.57
Economic growth rate	1.43	0.84	1.20	0.33	0.97

(Source) "Study on Economic Analysis of ICT," MIC (2015)

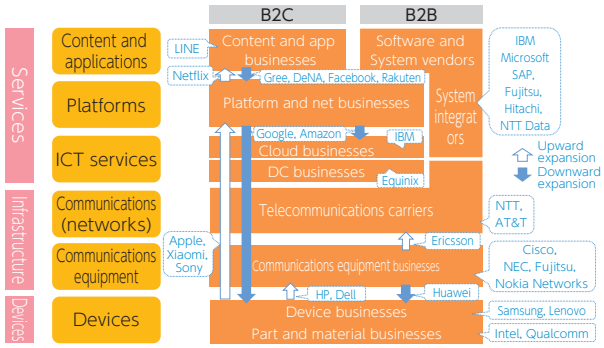
Section 2 Global Trends in the ICT Industry

In this section, we categorize trends in the ICT industry's global markets and verify the position of Japan's ICT industry in those markets.

1. Overall trends

As discussed in Section 3 of Chapter 1, the current structure (an era of co-creation and competition through mobile and cloud) of the ICT industry supports a mixture of business models, with enterprises in each layer expanding into higher and lower layers and collaborating with enterprises in other layers aiming to generate new added value, as the market's diversification and globalization accelerates and as vertical separation and horizontal integration between layers progresses (Figure 5-2-1-1).

Figure 5-2-1-1 Current structure of the ICT industry



(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

2. Application layer: Trends in Japan's ICT industry

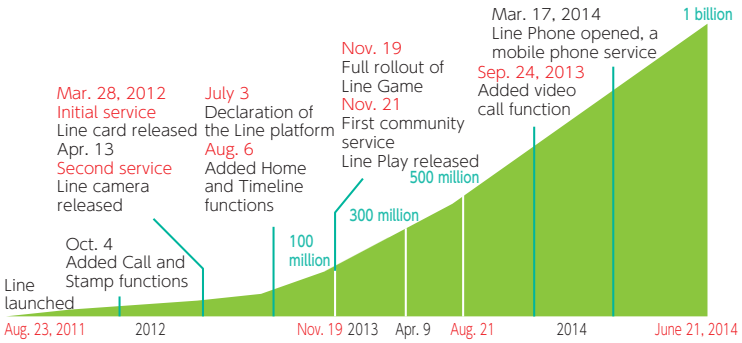
The content market for smartphones, particularly mobile games, has been growing in Japan. At the same time, efforts seeking to make overseas content and app markets into future growth centers have been observed, exemplified by the overseas expansion of domestic game platform enterprises. Below, we look at two examples of such efforts by Line and GungHo Online Entertainment.

a. Line

Messenger apps for sending and receiving messages on smartphones are rapidly growing in reach and usage along with the popularity of social media. Messenger apps are expanding in order to further their growth and to battle with other leading apps for users. Line, a messenger app that became hugely popular nearly overnight in Japan, has been aggressive in pushing its overseas expansion, reaching 560 million registered users worldwide in October 2014. In surpassing 500 million users in just over three years since its launch, Line is growing at a pace faster than Facebook, the world's largest social network.

Although Line has many users in Europe and the Americas, currently its growth continues to be predominantly in Asia. The company has also continued to add new features and services since its launch, and the apps, including games, supplied by Line have been downloaded more than 1 billion times to date. And Line's business as an advertising media platform has been expanding, especially in Asian countries where it is used heavily (Figure 5-2-2-1).

Figure 5-2-2-1 Line's trajectory since launch



(Source) Prepared from news stories on Line

b. GungHo Online Entertainment

GungHo Online Entertainment, which has used its mobile game business to expand in Japan and abroad, maintains subsidiaries in the United States and South Korea and opened a subsidiary in Singapore in September 2014 to strengthen its business in the Asia-Pacific region. The company's leading game, Puzzle & Dragons, has been released in 33 countries and regions. GungHo announced in October 2014 that it had purchased a controlling interest in the U.S. company PlayPhone, a leading global billing service that is focused on emerging markets where online games have long been popular and where there are signs of growth in the smartphone game market driven by smartphone proliferation. PlayPhone provides global billing services for smartphone games to major telecom carriers around the world. It has expanded its services to 11 carriers in 10 countries, including emerging markets in Southeast Asia, the Middle East, and Latin America. It also provides free software development kits to game developers. By acquiring PlayPhone, GungHo is attempting to capture the growth performance of emerging markets and expand into the billing platform business.

3. ICT service layer: Trends in Japan's ICT industry

Firm domestic demand is projected for Japan's domestic ICT service market for the present time, driven by My Number-related investment and system investments by large financial institutions. Over the longer term, however, growth in the domestic market is expected to slow down appreciably, so enterprises are currently expanding into overseas high-growth markets through M&As and establishing local subsidiaries (Figure 5-2-3-1). Below, we list some recent efforts in the ICT service market by leading players.

a. NTT Group

NTT Group is engaged in strengthening cloud services and accelerating global expansion as the Group aims to move to a new stage. In its Mid-term Management Strategy, announced in the fall of 2012, the Group placed global cloud services at the heart of its overseas business and set out mid-term financial targets of 2 trillion yen for overseas sales in FY 2016 and raising the overseas ratio of corporate sales to over 50 percent. As for specific initiatives, NTT Group is continuing to acquire overseas enterprises in the ICT services field and the acquired enterprises are used as the main entities in accelerating the Group's global expansion. Two reasons for the Group's decision to expand acquisitions are immediately strengthening its business, in terms of capturing customers, for example, in each region, and boosting its competitiveness by incorporating expertise from the acquired enterprises. The acquisitions are also positioned to shore up weaknesses in Group companies, and there are hopes to benefit from synergies by governing affiliated companies and collaborating between companies.

Figure 5-2-3-1 Examples of Recent M&As by Japanese enterprises in the ICT service market

Company	Announcement Period	Company Acquired (country)	Acquired Company's Business Field
NTT Corporation	June 2013	Solutionary, Inc. (U.S.)	Security services
NTT Data	December 2012	IFI Solution (Vietnam)	Offshore development for Europe
	December 2012	Innogence (Australia)	SAP-related services
	October 2013	everis Group (Spain)	IT services
	November 2013	Aster Group (U.S.)	SAP BI-related products and services
	November 2013	EBS Romania (Romania)	Near-shoring development inside Europe
	November 2013	Optimal Solution Integration (U.S.)	Provision of expert SAP services
	January 2014	4C Management Consulting (Denmark)	Corporate performance management
NTT Communications	June 2013	Digital Port Asia (Thailand)	Data center operations
	August 2013	Arkadin International (France)	Cloud-based conferencing systems
	October 2013	Virtela Technology Service (U.S.)	International data communications services
	October 2013	Raging Wire Data Centers (U.S.)	Data center operations
Fujitsu	February 2012	Technology Management Corporation (Canada)	IT consulting
	April 2013	Run My Process (France)	Cloud services
Hitachi Group	February 2014	Micro Clinic India (India)	IT services
	April 2014	Customer Effective (U.S.)	CRM solutions
	November 2014	I-Net Solutions (Singapore)	IT services
	February 2015	Cosmic Blue Team (Italy)	IT services

(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

b. KDDI Group

KDDI is committed to its Telehouse business, which is involved in data centers, primarily overseas. Having expanded into 13 overseas countries and regions, 24 cities, and more than 46 operational sites (including data centers in Japan), KDDI is furthering area expansion through partnerships with local enterprises. Telehouse is a global brand used by both Japanese enterprises and many local enterprises. In July 2014, the Group announced Telehouse Europe, its local affiliate in Europe, would invest approximately 135 million pounds (roughly 24 billion yen) to construct a new large-scale data center in London, England.

Through similar efforts like this, KDDI is capturing more customers and improving profits with its data center business in China and North America and, thereby, expanding its overseas earnings. Its consolidated overseas business for the year ending in March 2015 increased substantially, with operating revenues of 320.6 billion yen (up 21.6 percent year on year) and an operating profit of 16.8 billion yen (up 47.3 percent year on year).

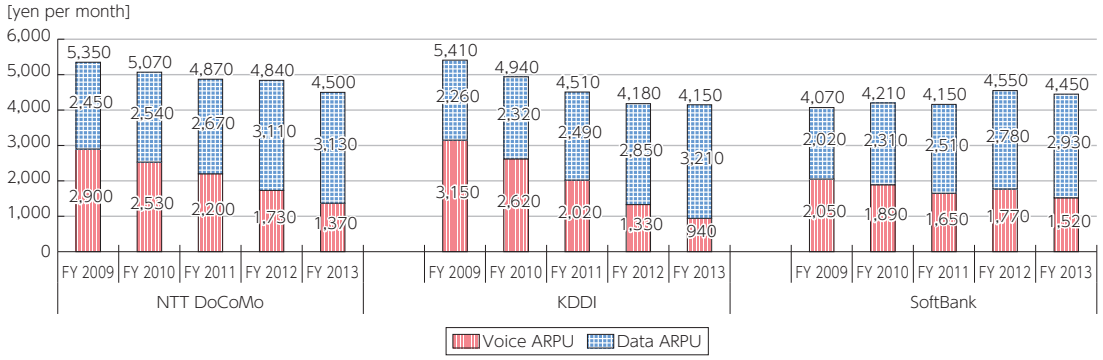
c. Fujitsu

Fujitsu provides IT system consulting, solutions and system integration for construction, and infrastructure services, particularly outsourcing. The company's global expansion has focused on outsourcing, deploying data centers in 16 countries and about 100 locations, mostly in Japan and Europe, and rolling out global standardized cloud service platforms (such as IaaS, PaaS, and SaaS) in Japan, Australia, Singapore, the United States, the United Kingdom, and Germany. Given the rising demand to link local U.S. subsidiaries with head offices in Japan, driven by the globalization of Japanese enterprises, Fujitsu opened two new data centers on the east and west coasts of the United States in May 2014 and launched the provision of outsourcing services and private cloud (hosted) services. In this way, the company continues to strengthen its global service hubs and systems.

4. Communications layer: Trends in Japan's ICT industry

Japan extended high-quality mobile communications infrastructure services early on, even on a global level, under a system of three groups—NTT Group, KDDI Group, and SoftBank Group. As the voice service market shrinks, these groups have been striving to expand the high-added-value data communications service market. Looking at the groups' actual average revenue per user (ARPU) shows that while voice ARPU has plummeted, this drop is being compensated by strong increases in data ARPU (Figure 5-2-4-1).

Figure 5-2-4-1 Transitions in mobile ARPU (voice and data) over the last five years for the three domestic mobile carriers



(Source) Prepared from "Competition Evaluation 2013," MIC

5. Communications equipment layer: Trends in Japan's ICT industry

"Data communications equipment" accounts for the largest percentage of Japan's exports of communications equipment by value. It is followed by "base stations." The "data communications equipment" category consists of digital transmission equipment and fixed-line communications equipment (including fixed-line wireless and satellite systems). Although export values had been on a downward trend until around 2012, all product categories rebounded in 2014 (Figure 5-2-5-1).

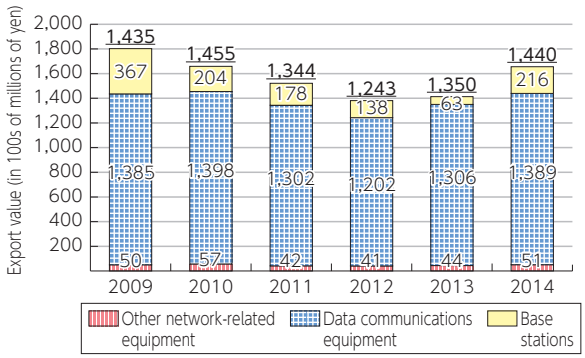
Demand is anticipated for the build-out of backhaul networks in conjunction with the increasing sophistication and resilience of mobile communications networks through the establishment of base stations. A typical example of a backhaul network is a transmission network that joins core network nodes, such as mobile base stations with control stations or exchanges. Ordinarily, backhaul networks use fiber-optic lines or other fixed wired connections or fixed wireless connections. An example of a backhaul product in Japan is Pasolink, a fixed network wireless transmitter from NEC that relies on the company's stock of microwave transmission technology and miniaturization technology. Pasolink enjoys a large share of the global market.

Territories that have not built optical fiber lines or other large-capacity line infrastructure and territories too expansive to lay fixed lines have selected Pasolink equipment to drastically slash installation costs. In fact about two-thirds of the almost 150 countries where Paso-

link has been deployed are developing countries in the Asia-Pacific region, Middle East, and Africa. The products in demand by the backhaul market fall into the "data communications equipment" category mentioned above in the transitions of communications equipment export value, and further growth is expected.

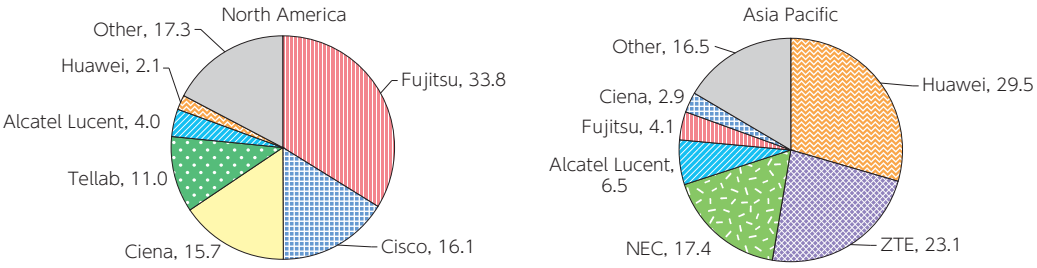
Competition continues worldwide in the development of ultra-high-speed, large-capacity optical communications technologies in order to meet soaring traffic volumes and the expansion in cloud computing that processes the traffic. Above all, the optical transmission field is where Japanese telecommunications carriers and manufacturers have exerted leadership in global standards. One typical network example is the market for metropolitan area networks (urban communications networks around 10 kilometers in length), where Fujitsu and NEC are the leading players in North America and the Asia-Pacific region (Figure 5-2-5-2). In 2014, NTT, NEC, Fujitsu, and Mitsubishi Electric worked on a joint R&D project on technology that processes optical transmission signals at speeds up to 100 Gbit/sec and were the first in the world to successfully implement the technology in a chipset (LSI). The four companies have adopted the technology to networks of optical submarine communications cables connecting 22 countries across the Pacific and Atlantic oceans. As this example shows, Japanese enterprises in the optical transmission field are expected to leverage their technological superiority to expand overseas.

Figure 5-2-5-1 Transitions in export value of Japanese communications equipment



(Source) "Communications Equipment Production, Exports, and Imports," Communications and Information Network Association of Japan

Figure 5-2-5-2 Metropolitan area network (WDN) market shares (2013)



(Source) IHS Technology

6. Device layer: Trends in Japan's ICT industry

(1) Device product market

Japanese manufacturers have lost ground and presence in the competitive smartphone market. In the midst of the heated market conditions, the future moves of Japanese phonemakers are under scrutiny: Sony, who continues to challenge the major global manufacturers by selling on brand power and functionality, and Fujitsu and Kyocera, which have some presence in niche markets where emphasis is placed on particular functions (Figure 5-2-6-1).

(2) Developments in the parts and materials market

Mobile devices, for example, consist of a multitude of parts and materials: touch panels, LCD panels, high-performance processors, large-capacity DRAM, flash memory, wireless LAN modules, GPS modules, accelerometers, electronic compasses, gyroscopes, and many more.

Although the competitiveness of Japan's end product manufacturing industry—smartphones, mobile phones, TV receivers, and the like—is on the wane, exports of Japanese parts and materials supplied for these end products (in the global market) have remained solid. Japanese enterprises have high technological competencies in many areas of the parts and materials market. Therefore, as domestic device manufacturers struggle, attention is focusing on domestic parts and materials manufacturers that provide device parts. Despite their sales being small compared with those of communications device and electronic equipment manufacturers, many parts and materials manufacturers derive a large percentage of their sales overseas and maintain high operating profit rates (Figure 5-2-6-2).

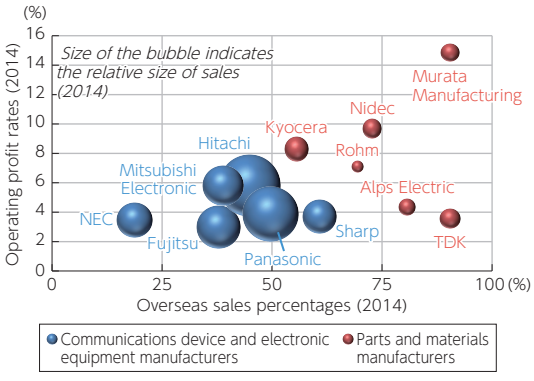
The competitiveness of our enterprises in the parts

Figure 5-2-6-1 State of overseas expansion efforts by Japanese manufacturers

Manufacturer	Leading products for overseas markets	Summary of overseas expansion efforts
Sony	 Xperia M4 Aqua	・Developing global business around the Xperia brand. ・The strategy is to develop the business in the new super midrange category with models that offer superior cost performance with modest specifications. Sony presented the Xperia M4 Aqua, a super midrange device, at the Mobile World Congress 2015. The Xperia M4 Aqua is positioned to challenge the rising dominance of new Chinese manufacturers in emerging and developing countries throughout Asia. ・The plan is to focus as much as possible on global markets with a limited number of core models.
Fujitsu	 Stylistic S01	・As other domestic manufacturers pull out of the handset business, Fujitsu is aggressively pursuing its handset business within and outside Japan because it considers the positioning of devices of paramount importance in providing consistently high value. ・Fujitsu introduced the Raku-Raku Phone for seniors in Japan in 2001 and followed this with the Raku-Raku Smartphone. The Stylistic S01 Android smartphone for seniors, which is based on the Raku-Raku Smartphone, is being sold in cooperation with Orange, the leading French carrier.
Kyocera	 Torque	・Kyocera is working to open up world markets with smartphones specialized for specific needs. The company announced in February 2015 that it would be marketing the Torque, an extra-durable smartphone that has gained popularity in Japan and the United States, in Europe. It expects to sell the Torque primarily to enterprises. Kyocera has made use of its technologies to tailor Torque's strengths to address the extensive latent needs in enterprise applications. ・Kyocera has been working to expand its business; for example, exhibiting a prototype of the smartphone running Windows Phone 8.1 at the Mobile World Congress 2015. ・Kyocera has captured a certain share of the U.S. market by providing extra-durable smartphones that are water and shock resistant and low-cost smartphones for the prepaid market. The rugged design that can withstand drops, vibrations, and extreme temperature fluctuations is compliant with the U.S. Department of Defense procurement standards.

(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

Figure 5-2-6-2 Overseas sales percentages and operating profit rates of communications device and electronic equipment manufacturers and parts and materials manufacturers



(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

and materials market is expected to manifest itself when it comes to building the next mainstay products after smartphones in the IoT age. For example, domestic manufacturers own the top market shares worldwide in sensor devices, which are a crucial component underpinning the IoT. According to a JEITA study, Japanese manufacturers shipped 883.9 billion yen worth of sensors in 2011, more than half of the global demand of 1.8290 trillion yen. Many Japanese enterprises, such as Rohm and Murata Manufacturing, are highly skilled in sensor technology and are positioned to lead the sensor market both in terms of manufacturing and application. As the smartphone market matures and IoT continues to develop, these companies are expected to bolster their supplies for wearables, connected vehicles, and other new markets.

7. Infrastructure exports

The government has positioned the overseas expansion of infrastructure systems as one of its growth strategy tenets and is putting tremendous energy into advancing various overseas expansion measures in this area, particularly in high-level public-private joint trade promotions led by the Prime Minister himself. Promising fields for overseas expansion of infrastructure systems that have been cited include high-speed rail links, expressways, bridges, ports, airports, industrial parks, nuclear power plants, electric power, disaster-preparedness and disaster-relief management using satellites and satellite data, environment management and recycling (waste processing), medicine, water and sewer services, e-government, disaster-preparedness measures (against flooding, earthquakes and tsunami, landslides, and other disasters), early warning systems, climate change measures (satellites), and financial systems. To be successful, Japan must take the lead in international standardization activities and similar endeavors in the many infrastructure-related fields and systems and, from this foundation, strive to consolidate and bolster the competitiveness of Japanese technology while promoting strategic collaborations between enterprises. Overseas expansion of infrastructure systems also requires us to take aggressive approaches through public-private partnerships (Figure 5-2-7-1).

Attention is focusing on efforts by ICT enterprises to expand in ways tied to the global expansion of the infrastructure mentioned above. It is desirable that ICT enterprises package ICT-utilizing infrastructure installations to include not only constructing the systems but also providing operational support and after-sales service. The table below provides some examples of recent infrastructure export projects by Japanese ICT enterprises (Figure 5-2-7-2).

Figure 5-2-7-1 Examples of infrastructure-related fields where Japan is leading standardization

Field	Specific examples
Energy	High-efficiency coal-fired power generation systems, geothermal power generation systems, combined-cycle gas thermal power generation systems, electric power system stabilization/automated power distribution systems, etc.
Transportation	High-speed rail systems (bullet trains, SCMaglev), urban rail systems (subways, monorails, etc.), IC cards for public transportation systems, fast chargers for electric vehicles (CHAdeMO charging method), vehicle safety and environmental performance, intelligent transport systems (ITS), earthquake-resistant bridge technologies, rapid construction technologies for breakwaters and wharfs, air traffic control systems, port Electronic Data Interchange (EDI) systems, Nippon Automated Cargo And Port Consolidated System (NACCS), etc.
Information and communications systems	Terrestrial digital broadcasting systems, ICT for disaster preparedness, sensor networks (for the environment, disaster preparedness, etc.), detection systems for unlawful radio stations, optical communications access systems, 4K and 8K (ultra-high-definition television), postal infrastructure systems, central bank core systems, etc.
Living environments	Measures for non-revenue water (leakage), water and sewer systems, desalination systems, industrial waste water recycling technology, water purification tanks, etc.
Medicine	Medical systems (hospital operation and management systems), particle-beam cancer treatment equipment, catheter insertion methods, Japanese models of dialysis systems, etc.
Agriculture	Plant variety protection systems and methods of evaluating traits of genetic resources, agriculture infrastructure systems, value-chain construction for agricultural produce
Space, marine, disaster preparedness, and other fields	Quasi-zenith satellites, energy-efficient marine vessels, offshore structures (megafloats, etc.), fire, safety, and disaster preparedness infrastructure systems, etc.

(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

Figure 5-2-7-2 Infrastructure projects by ICT enterprises (including M&As)

Enterprise	Examples of infrastructure projects
Hitachi	Hitachi announced in February 2015 that it had acquired a signal business and rolling stock business from Finmeccanica, a leading Italian defense and aviation corporation. Finmeccanica is a large heavy machinery firm involved in automobile production, shipbuilding, railroads, electronics, and other fields. It was also involved in the manufacture of the ETR 500 and other rolling stock for Italy's national ETR high-speed railway. Since Finmeccanica was planning to specialize in the aerospace and defense divisions, Hitachi was able to acquire the signal and rolling stock businesses. The total value of the acquisition is believed to be Hitachi's largest ever corporate acquisition. Hitachi's goal with the acquisition is to strengthen and expand its public innovation business unit that combines IT with public infrastructure.
NEC, NTT Communications, and Sumitomo Corporation	The three companies formed a consortium and won an infrastructure construction contract from Myanmar in May 2013. The contract includes installation of facilities to construct communications infrastructure, upgrading the Internet access environment, and assisting the operations of the communications infrastructure. The consortium will construct the country's main communication infrastructure, including a 30 Gbps large-capacity optical backbone communications network linking the cities of Yangon, Mandalay, and Naypyidaw, optical communications networks in each of the cities that provide 10 Gbps LTE communications, fixed-line telephone, and Internet communications, and 50 LTE base stations combined for the three cities.
Toshiba	Toshiba took over Landis+Gyr, headquartered in Switzerland, in May 2011. Landis+Gyr is a multinational corporation involved in the design, manufacture, and sales of energy meters, communications equipment, and software that collects and manages data from meters. By integrating Landis+Gyr's smart meter solutions with Toshiba's infrastructure, business, and home electronic products, Toshiba is aiming to construct smart communities that produce and consume energy efficiently and sustainably. Through Landis+Gyr, Toshiba acquired PowerSense, a Danish optical sensor manufacturing technology company, in May 2014 and GRIDiant, a U.S. technology company that makes control and analytic software for power distribution systems, in June 2014. As a result of the Landis+Gyr takeover, Toshiba has been expanding its business in the energy sector, including winning an order for smart meters from British Gas, the largest power and gas utility in the U.K.

(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

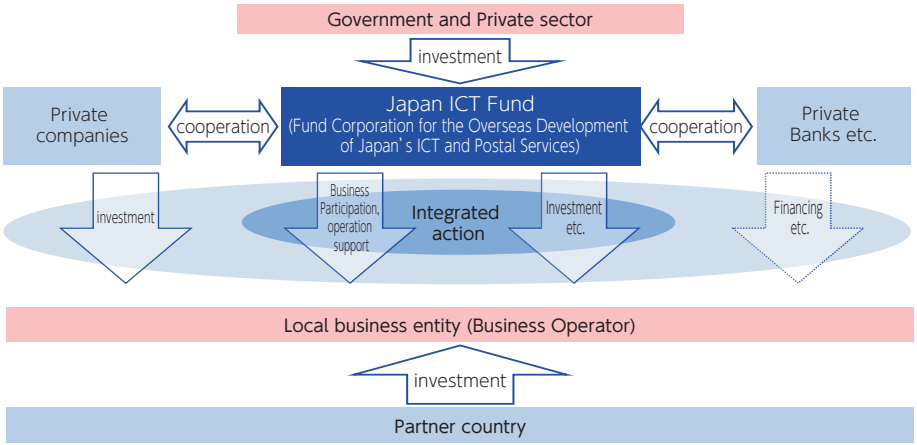
Policy Focus: Fund Corporation for the Overseas Development of Japan's ICT and Postal Services

Our economic growth requires us to aggressively capture ASEAN and other overseas demand for communications, broadcasting, and postal services ahead of other countries. An effective means of accomplishing this is to expand overseas by providing ICT services and broadcast content as packages; i.e., providing operational, maintenance, and management services together with constructing infrastructure in the partner country. The personal connections made when deploying Japan's terrestrial digital television broadcasting standard overseas, a project tackled by MIC together with the government, can help expand the market for all of Japan's ICT fields. Active overseas expansion making use of these personal connections is expected.

At the same time, overseas communications, broadcasting, and postal businesses are regulated sectors, and, as such, are subject to government risks and resulting demand risks. This situation makes it difficult for private companies to enter these markets on their own. It is believed that providing assistance to companies in these businesses, in the form of long-term risk management, will be effective to offset the risks.

Given these circumstances, MIC submitted in March 2015 the Fund Corporation for the Overseas Development of Japan's ICT and Postal Services bill to the 189th session of the National Diet. The bill was passed in May 2015. The Act on the Fund Corporation for the Overseas Development of Japan's ICT and Postal Services stipulates the establishment and operational scope of the Fund Corporation to Aid Overseas Communications, Broadcasting, and Postal Services. The Fund Corporation leads the disbursement of the FY 2015 budget of 20 billion yen in industry investments and 7 billion yen in government guarantees, which is earmarked to provide funds, deploy experts, and provide other forms of assistance to companies engaged in overseas telecommunications businesses, broadcasting businesses, or postal services, or related businesses (Figure).

Figure Overview of the Fund Corporation for the Overseas Development of Japan's ICT and Postal Services



• Establishment of the Fund Corporation

-The Fund Corporation is established with the approval of the Minister for Internal Affairs and Communications.
-The government shall always hold at least 50 percent of the Fund Corporation's total shares.

• Main operations of the Fund Corporation

-Provide the following forms of assistance to companies engaged in communications, broadcasting, or postal services overseas:
-Financing (joint investment with the private sector)
-Business planning and operational support
(negotiations with partner country's government, deploy experts in the communications, broadcasting, or postal field, etc.)

• Management of the Fund Corporation

-Corporate governance regulations under the Companies Act apply, as it is an incorporated company.
-Supervised* by the Minister for Internal Affairs and Communications.
*Decisions on assistance criteria, approval of assistance decisions, supervision orders, etc.

Policy Focus: Overseas expansion of ICT infrastructure systems centered on terrestrial digital television

In keeping with the Japanese government's overall efforts to deploy infrastructure systems overseas, MIC has positioned international expansion in the ICT field as a priority policy and is aggressively pursuing initiatives in this area, such as high-level public-private joint trade promotions.

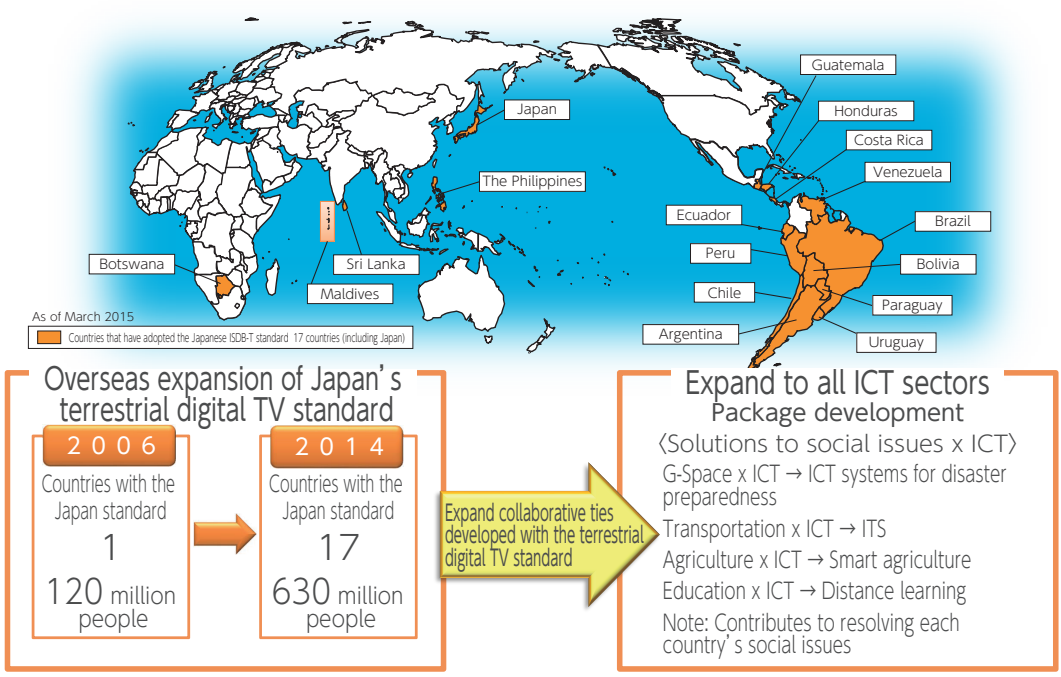
As part of the government's strategy to export infrastructure systems, MIC is actively working to incorporate Japan's terrestrial digital TV standard, disaster-preparedness ICT and other cutting-edge ICT systems, and Japan's superlative postal systems into the public infrastructure systems of partner countries. It aims to do this by being involved from the proposal formation stage onward through inter-governmental dialogs and other representations.

As more countries adopt Japan's terrestrial digital TV standard, a certain amount of results are being seen from the overseas expansion, such as an increase in overseas orders for digital broadcast transmitters from Japanese manufacturers.

In 2016, taking advantage of the tenth anniversary since Japan's terrestrial digital TV standard was first adopted overseas, MIC, in cooperation with private enterprises and other organizations, will put priority on activities to raise awareness and build cooperation on the international proliferation of fiber optics and other ICT technologies and services that Japan has accumulated, centered on terrestrial digital TV.

A major premise of fully manifesting the strengths of Japan's ICT technologies and services in international markets is ensuring the freedom to distribute information on the Internet. Therefore, MIC will work in partnership with developed countries in the West to continue to ensure freedom on the Internet (Figure).

Figure Overseas expansion to all ICT sectors centered on terrestrial digital television



Section 3 Perceptions and Predictions by ICT Enterprise Executives in Six Countries

In this section, we perform an international comparison of the state and perceptions of ICT global development using the results of a survey of ICT industry enterprises in six countries: Japan, the United States, Germany, China, South Korea, and India.

1. Perceptions of the competitiveness of own country's ICT industry

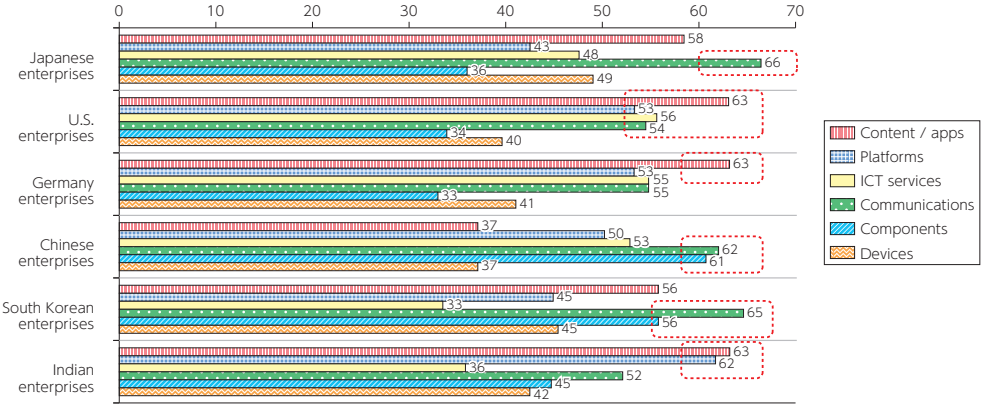
ICT-related enterprises in the six countries were asked how they rate the international competitiveness of their own country's ICT industry by layer. The results show that, in general, enterprises in the three Asian countries—Japan, China, and South Korea—gave higher competitiveness scores for the lower layers: communications layer, device layer, and component layer. On the other hand, enterprises in the U.S., Germany, and India gave higher competitiveness scores for the higher layers: IT services, platforms, and content and applications.

By country, Japanese enterprises rated the competitiveness of Japan's ICT industry highest in the communications layer, followed by the content and application

layer, and the component layer. This indicates a strong perception that the ICT industry's competitiveness is driven by the communications layer.

Among U.S. enterprises, the difference in scores for the device and component layer and the communications and higher layers was enormous. Above all, U.S. enterprises feel that the U.S. industry is strongly competitive in the content and application layer. The same tendency appears in Germany, apart from the platform layer. On the opposite side of the U.S. and Germany is China, whose enterprises rate China's competitiveness highly in the communications layer and device layer. This reflects their recognition of China's huge domestic communications market and China's increasing presence in the global device market in recent years (Figure 5-3-1-1).

Figure 5-3-1-1 Perceptions of the competitiveness of own country's ICT industry

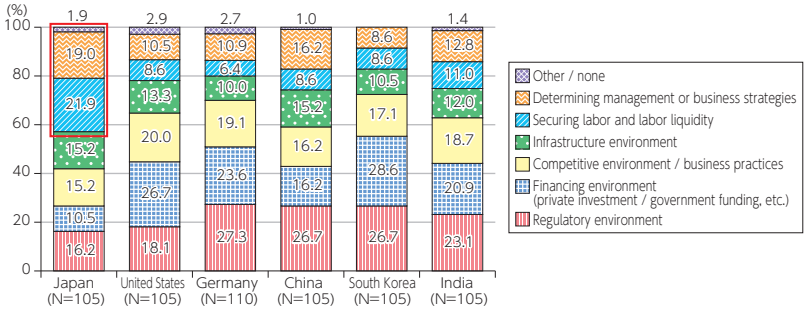


(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

2. Most important overseas expansion issue

The surveyed ICT enterprises in the six countries were asked what was the most important issue they faced with respect to overseas expansion. Overall, enterprises tended to pick external factors such as "regulatory environment" or "financing environment" most frequently. Japanese enterprises, however, had strong issue recognition with internal factors such as "securing labor and labor liquidity" and "determining management or business strategies." Compared to enterprises in other countries, Japanese enterprises were far more likely to view labor issues as a problem. This underscores that labor is an urgent issue for Japan's industry (Figure 5-3-2-1).

Figure 5-3-2-1 Overseas expansion issues (most important issue)



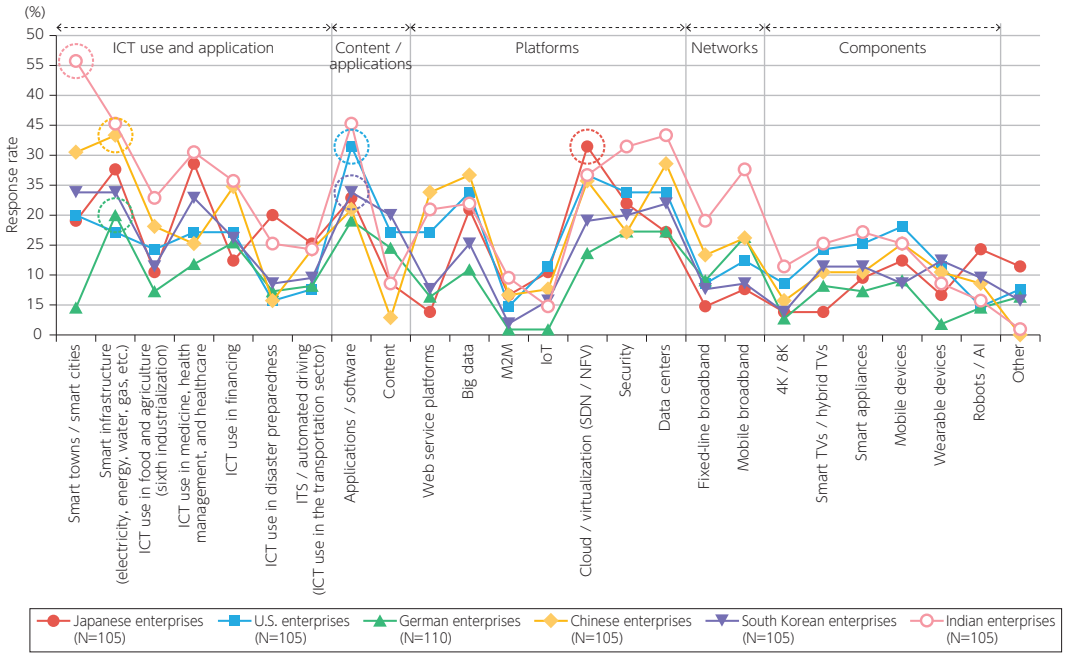
(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

3. Promising fields as seen by enterprises in different countries

The surveyed ICT enterprises in the six countries were asked what fields they saw as promising. The most frequent responses in all the countries except Japan were concentrated in the ICT use and application layer or the content and application layer. Enterprises in China, India, and Germany had the greatest interest in "smart towns/smart cities" and "smart infrastructure (electricity, energy, water, gas, etc.)." U.S. and South Korean enterprises were most interested in "applications/software." Japanese enterprises, on the other hand, showed the most interest in "cloud/virtualization (SDN/NFV)"—elements of the platform layer that have been in the limelight in recent years (Figure 5-3-3-1).

After averaging and adjusting for variances between countries, the interest in the platform layer and the ICT use and application layer markets, with some exceptions, was relatively higher among enterprises in all six countries. At the same time, all enterprises tended to be least interested in the component layer.

Figure 5-3-3-1 Perceptions of promising fields



(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

Section 4 Structural Changes in the Economy Caused by ICT Advancement

In this section, we analyze three noteworthy structural changes in the economy brought about by ICT advancement. The first is the changes caused by the Internet of Things (IoT), which has gained a lot of attention recently; the second is the changes that ICT is starting to bring to bear on the entrepreneurial process; and the third is the changes that are occurring as a result of advances in the use and application of big data.

1. IoT's impact on industry

This paragraph provides a general overview, interspersed with examples from multiple perspectives, of the impact of the Internet of Things (IoT), which has gained a lot of attention recently, will have on industry.

(1) From ubiquitous networks to the IoT

The ubiquitous-networked society, in which everything and everyone is connected to networks everywhere and all the time, was conceived in the first part of the 2000s. Its actualization has rapidly taken off in recent years primarily due to advances in component technologies that will be mentioned below. The ubiquitous networks that are finally coming into being are now expressed by the term Internet of Things (IoT). IoT means that a multitude of things—not just conventional ICT devices like computers, smartphones, and tablets—will form part of the Internet by virtue of sensors and wireless communications.

The IoT concept refers to a state where vehicles, white appliances, robots, facilities, and nearly all other things connect to the Internet and exchange information with each other. According to the concept, as things are converted into data and automation based on these data progresses, new added value will be generated. The IoT will also contribute to transforming things into services, where not only are products sold; products are used to provide services.

An unmistakable indicator of the advent of the IoT era is claimed to be the explosive growth in the numbers of things connected to the Internet. According to IHS, the number of things connected to the Internet (i.e., IoT devices) in 2013 was approximately 15.8 billion. The company estimates this figure will soar to about 53.0 billion by 2020 (Figure 5-4-1-1).

IoT is being closely watched in the automotive and industry sectors because of its growth rate (Figure 5-4-1-2). On the other side, according to Cisco, of the 1.5 trillion things existing today in the world, 99.4 percent of them are not connected to the Internet. Assuming in the future many more of these things will be connected to the Internet, it is possible to glimpse the scale of the latent value the IoT concept holds.

(2) Specific impacts of the implementation of the IoT

What specific ramifications will the realization of the IoT have? Here, we give a general overview of real applications divided into three areas: the manufacturing industry, public infrastructure, and personal services.

a. Impacts on industry (manufacturing and other industries)

The IoT can improve production lines in manufacturing plants, by making it possible to collect and analyze

Figure 5-4-1-1 Number of things connected to the Internet (IoT Devices)

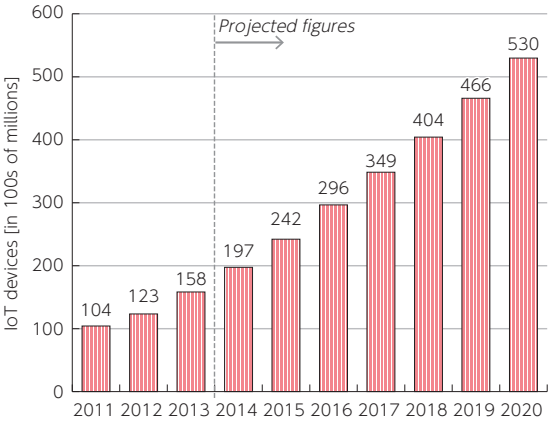
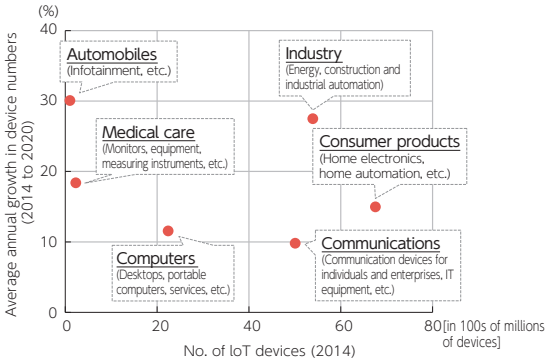


Figure 5-4-1-2 IoT devices by sector/application and their growth rates



(Source) IHS Technology

Figure 5-4-1-3 Examples of IoT products and efforts for industry

Application	Enterprise	Summary
Product quality management	Kyocera Communication Systems	The company has developed a platform called Shuzo that modularizes system integration, which previously was done on a sensor-by-sensor basis, and collects M2M and IoT data from multiple sensors regardless of the sensor type. This results in improved product quality on the manufacturing floor and higher availability factors for production.
Demand forecasting	Komatsu	Komatsu has developed the KOMTRAX system, which uses communication modules installed on its construction equipment sold around the world to collect data on the construction equipment and determine its operational status. From these operational status data, it is possible to measure CO_2 consumption volumes and predict business conditions.
Fault predictions	Omron and Kewpie	Kewpie has used Omron platforms in its manufacturing plant to detect tiny, instantaneous changes in electric current values. Detecting signs of abnormalities like these throughout the production process has led to increased production efficiencies.

(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

data that were previously unusable such as separate manufacturing conditions or log data from production equipment. From examples around the world in applying the IoT to industry, it is clear that enterprises have various aims when applying the IoT, such as ascertaining and improving the availability factors of manufacturing facilities or making business processes more efficient by tracking the operational statuses of products for customers (Figure 5-4-1-3).

b. Impacts on public infrastructure (energy, transportation, etc.)

Energy, transportation, logistics, and other public infrastructure have been tapped as promising application fields for the IoT. The aim is to collect and analyze data from sensors placed at various installations and facilities and use the data to improve the safety and efficiency of public infrastructure. Serious deterioration of infrastructure in Japan is creating facility investment and maintenance issues. It is hoped that the IoT will mitigate these issues.

c. Impacts on personal services

As the IoT expands, primarily targeting the business-to-business (B2B) sector, it will also precipitate significant transformations in people's lives.

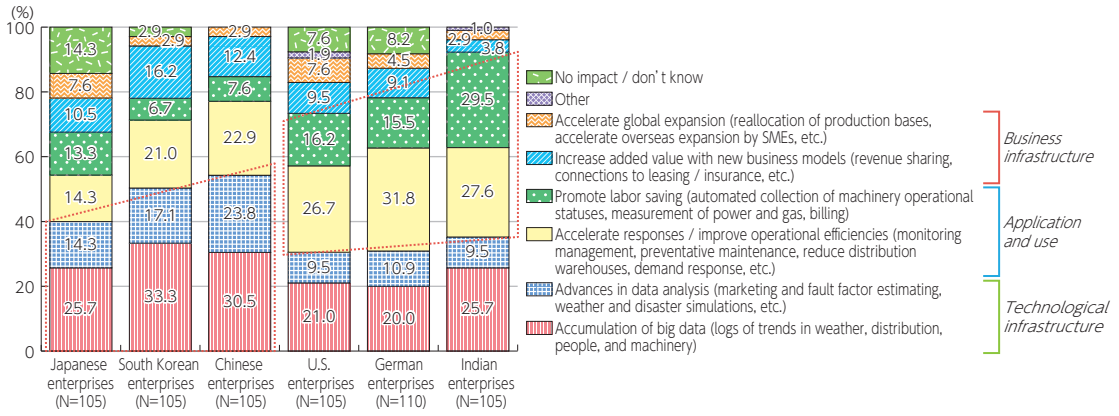
As presented in Chapter 4, three types of new ICT devices—wearables, connected vehicles, and partner robots—are anticipated to form the nucleus of personal IoT services. Besides these, however, many other IoT devices and services are expected to emerge. Albeit IoT products and services are still in their nascent stage, they share a common underlying architecture: data collected from sensors is analyzed via the cloud and utilized to provide new value to users.

(3) Directions for Japan's ICT industry

While the struggle for supremacy in the IoT world intensifies, Japan's ICT industry is expected to spot domains that can broaden business opportunities. To discover such opportunities, it is important to have a keen perception of the essence of the IoT and sufficient competitiveness in the target domains to take a leading role and function in related businesses.

For Section 3 of this chapter, we conducted an international survey (Japan, United States, Germany, China, South Korea, and India) on perceptions about the business impact of the IoT, which ICT enterprises in many countries have been following with close interest. East Asian enterprises in Japan, China, and South Korea tend to focus on the technological infrastructure of the IoT, such as "accumulation of big data" and "advances in data analysis," whereas enterprises in the United States, Germany, and India, which have a head start in the IoT, tend to focus more on the application and use of the IoT, such as "promote labor saving" and "accelerate responses/improve operational efficiencies" (Figure 5-4-1-4). These results indicate a strong interest by ICT enterprises in many countries in business domains that collect and ac-

Figure 5-4-1-4 The IoT's impact on business



(Source) "Study Report on Structural Changes and Future Prospects for the Global ICT Industry," MIC (2015)

cumulate data, as well as analyze, apply, or respond to the data, all of which is engendered by the IoT.

With respect to the sensor technology that enables the collection of data, Japan holds a relatively large portion of the sensor market. And while Japan is thought to be highly competitive in this market, it is very likely Japanese enterprises will have to compete with Chinese and South Korean enterprises that are very attracted to the sensor domain. Therefore, it is vital to construct an IoT ecosystem as early as possible that includes the data analysis, response, and application domains, through the aggressive pursuit of cross-industry collaborations and tie-ups with overseas enterprises.

2. Advancement of big data application

It has been several years since the application of big data became a watched trend in the ICT industry. Solutions using big data have now advanced past the experimental phase and are being developed into businesses. Nevertheless, it is difficult to grasp the state of big data use and application by just following individual case studies. In this paragraph, therefore, we analyze the current state of big data application from two sides—a macro study (estimating the volume of big data traffic in Japan) and a micro study (a survey of the current state of big data application by enterprises and other organizations)—based on past surveys up to last year.

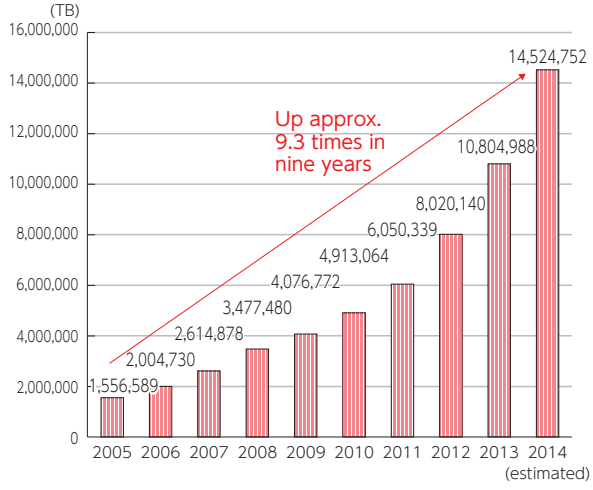
(1) Estimations of the volume of big data distribution in Japan

The data distribution volume in 2014 was estimated to be approximately 14.5 exabytes for the total of nine industries (service industry, information and communications industry, transportation industry, real estate industry, finance and insurance industry, wholesale and retail industry, electricity, gas, and water industry, construction industry, and manufacturing industry). Over time, the data distribution volume has risen from approximately 1.6 exabytes in 2005 to an estimated 14.5 exabytes in 2014, a jump of about 9.3 times in nine years (an average annual growth rate of 28.2 percent) (Figure 5-4-2-1).

(2) Current state of big data application by enterprises

Below, we analyze, based on survey data, what types of data enterprises use in what domains and how they

Figure 5-4-2-1 Transitions in domestic data distribution volumes



(Source) "Study Report on Big Data Distribution Volume Estimates and the State of Big Data Application," MIC (2015)

analyze the data and what extent of benefits have they attained.

a. Benefit attainment ratio through the application of data

We calculated the attainment ratio of benefits from the percentage of enterprises that use data in each given domain and the percentage that obtained benefits through the application of data. The highest attainment ratio was for "logistics and inventory management," at 67 percent. Contrarily, "general management" had the highest data application percentage but the lowest benefit attainment ratio. We can read from these results that it is relatively easy to obtain benefits through the use and application of data in the "logistics and inventory management" domain (Figure 5-4-2-2).

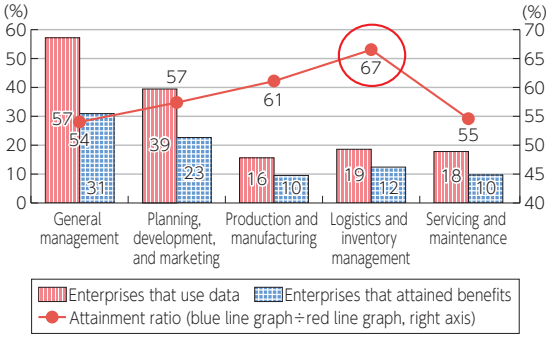
b. Comparison of enterprises that have attained benefits through the application of data versus enterprises that have not

We conjectured there might be some differences in the analytic methods and data used in analyses between enterprises that have attained benefits through the application of data those that have not. To test our conjecture, we compared enterprises that have attained benefits versus enterprises that have not, targeting enterprises that use data analyses for "planning, development, and marketing," an area that had a relatively high rate of data application across all industries.

We first compared enterprises on their data analysis frequency. A majority of enterprises that have attained benefits analyze data at intervals shorter than one month, whereas a majority of enterprises that have not attained benefits analyze data at intervals of one month or longer (Figure 5-4-2-3). This finding suggests that, in order to attain benefits through the application of data, data should be analyzed at relatively short intervals.

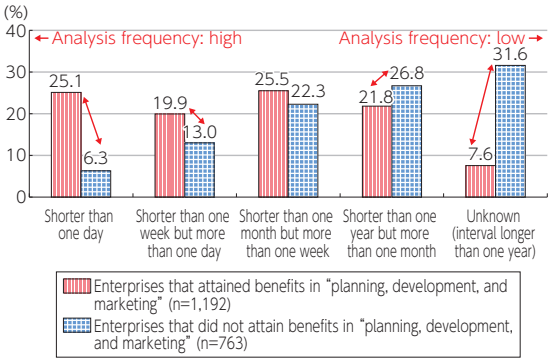
We next compared enterprises on the number of data types used in analyses. Among enterprises that have attained benefits, the most common response was for five or more data types used in analyses. Conversely, a majority of enterprises that have not attained benefits answered they used two or less data types in analyses (Figure 5-4-2-4).

Figure 5-4-2-2 Benefit attainment ratios through the application of data



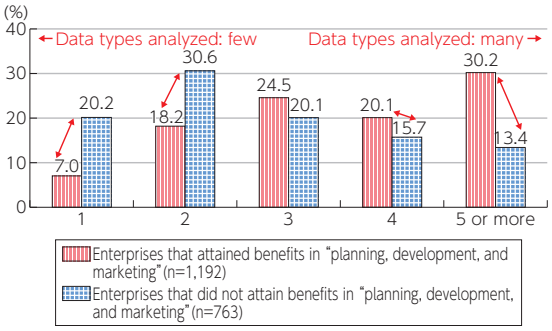
(Source) "Study Report on Big Data Distribution Volume Estimates and the State of Big Data Application," MIC (2015)

Figure 5-4-2-3 Comparison of benefit attainment (analysis frequency)



(Source) "Study Report on Big Data Distribution Volume Estimates and the State of Big Data Application," MIC (2015)

Figure 5-4-2-4 Comparison of benefit attainment (no. of data types used in analyses)



(Source) "Study Report on Big Data Distribution Volume Estimates and the State of Big Data Application," MIC (2015)