

(Unofficial translation)

2016 White Paper on Information and
Communications in Japan
(Outline)

July 2016

Ministry of Internal Affairs and Communications

Special Theme "IoT, Big Data, and AI: New Values Created by Networks and Data"

Chapter 1 ICT-based Innovation and Economic Growth

Section 1 ICT Potential for Solving Issues Facing Japan, Such as the Declining Birth Rate and Aging Population

Section 2 ICT Contribution to Economic Growth: Concrete Channels and Case Example Analysis

Section 3 ICT Contribution to Economic Growth: Quantitative and Comprehensive Verification

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Chapter 2 Analysis of ICT Industrial Trends in the IoT Era

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Chapter 3 New Products and Services in the IoT Era

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Chapter 4 ICT Progress and Future Work Styles

Section 1 ICT Progress and Employment

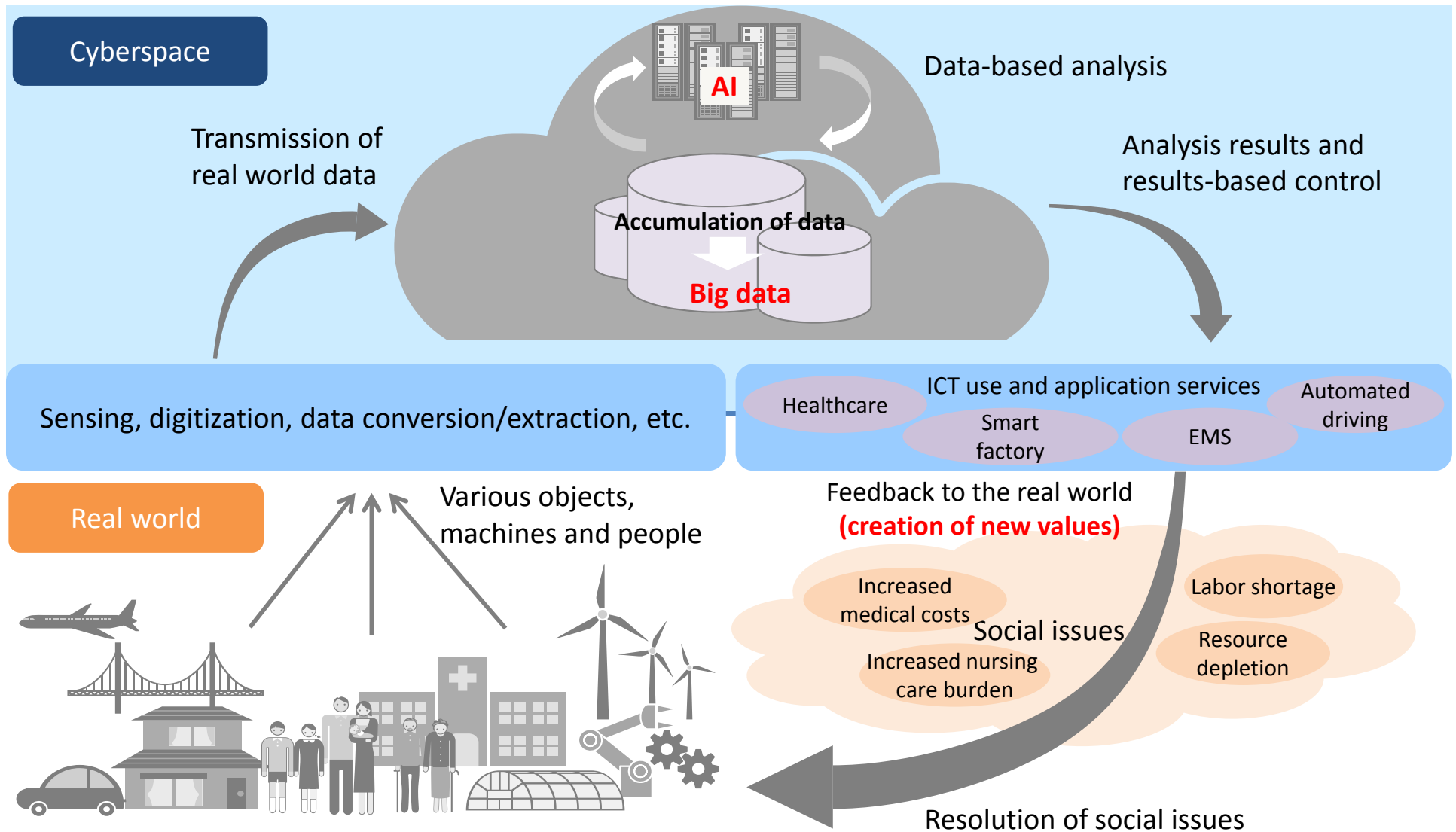
Section 2 Present and Future of Artificial Intelligence (AI)

Section 3 Influence of AI Progress on Employment, etc.

Section 4 Changes in the Required Skills and the Types of Human Resources and Education Sought

* In addition, the basic data on the ICT field (market trends, etc.) and the ICT policy of the Ministry of Internal Affairs and Communications (latest trends) are introduced in Chapters 5 and 6.

- The declining birth rate and aging population as well as the resulting population decline are likely to have negative influences on both the supply side and the demand side of the Japanese economy, thereby inhibiting medium- to long-term economic growth.
- New ICT, including the Internet of Things (IoT), are expected to play an ever-important role by such means as improving corporate productivity and creating new products and services.
- In order to create values and resolve issues through distribution of data, cybersecurity must be ensured as an essential premise.

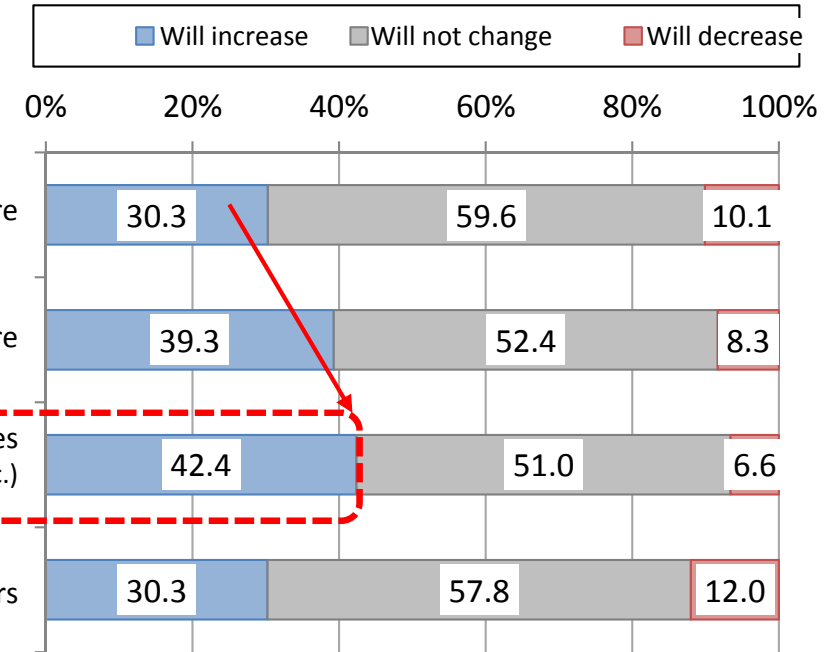
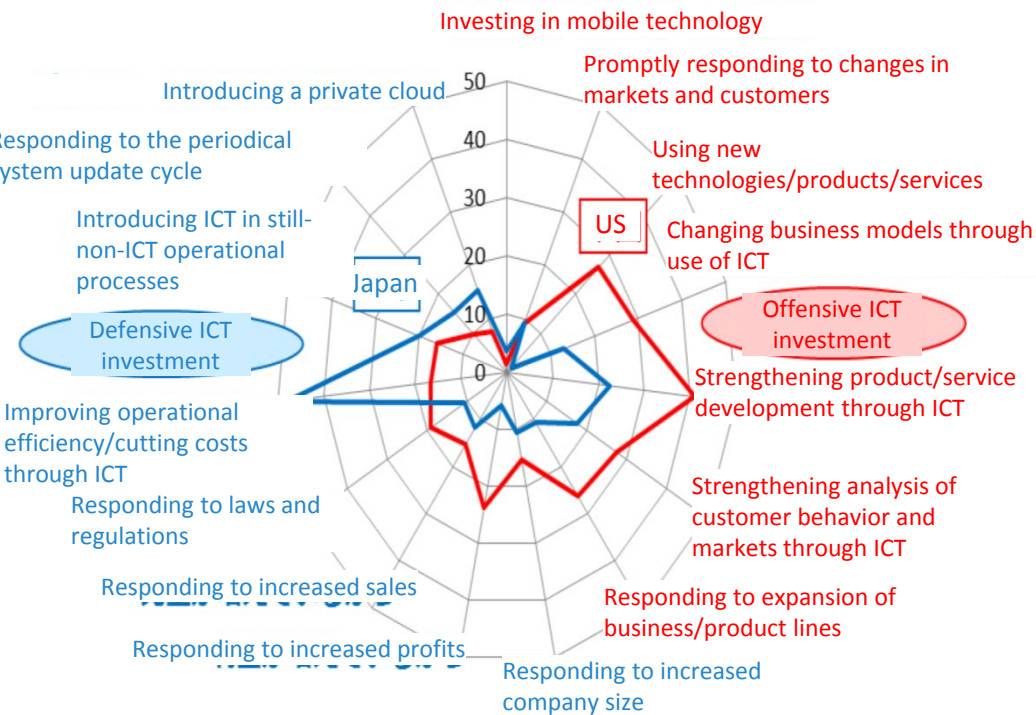


- In order to address the labor shortage caused by the declining birth rate and aging population, which is one of the major issues facing Japan, it is important to make active ICT investments to improve productivity, etc.
- Japanese companies' conventional ICT investments have mostly been defensive ICT investment aimed at improving operational efficiency and cutting costs. In contrast, US companies have taken a lead in ICT products and services by making offensive ICT investment aimed at strengthening product and service development through ICT and changing business models through the use of ICT.
- Japanese companies' future ICT investments are expected to shift from hardware to software and services. Introduction of ICT that contributes to productivity improvement, such as cloud services, is likely to progress.

Usage of the increased budget by companies increasing their conventional IT budget (Japan-US comparison)



Prospect of Japanese companies' future ICT investment (breakdown)



* Source: "Analysis on Differences Between Japanese and US Companies Regarding Business Management Using IT" survey results, Japan Electronics and Information Technology Industries Association (JEITA) and IDC Japan (October 2013)

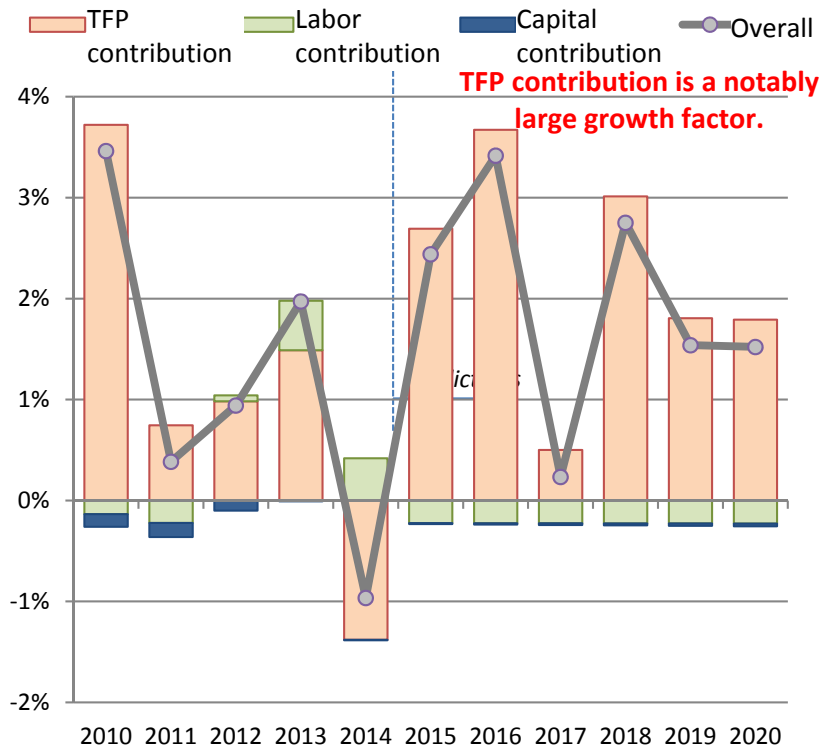
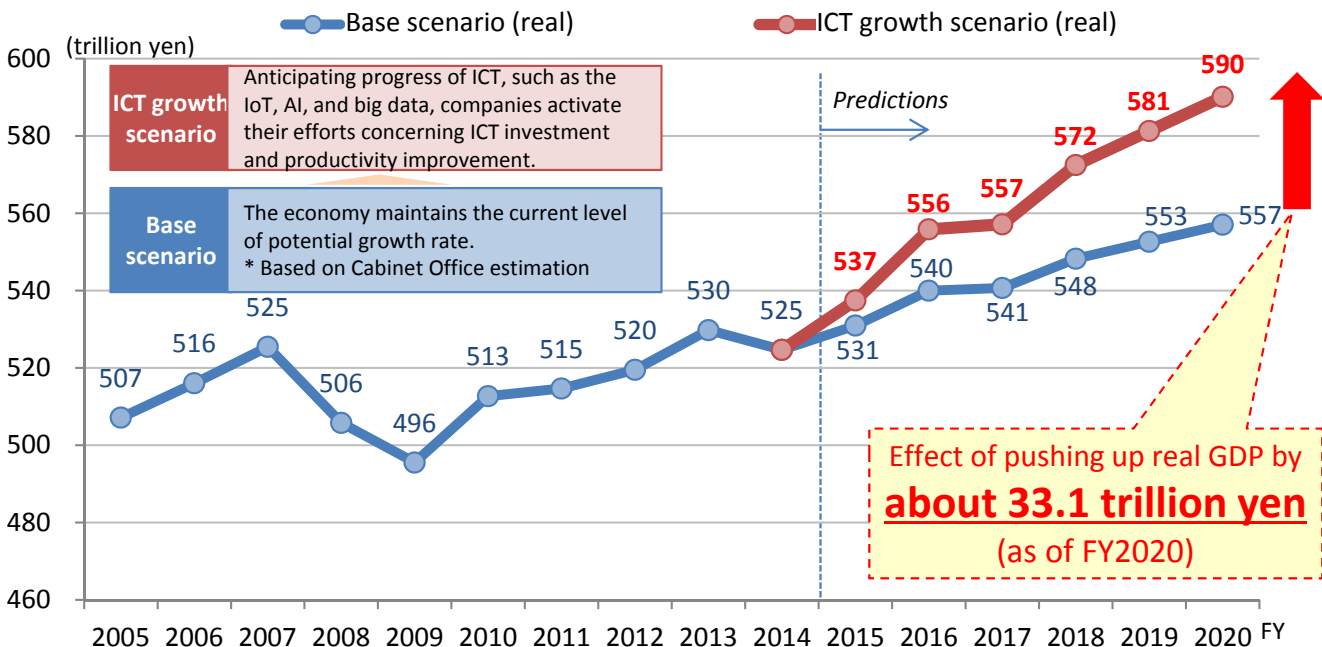
- Progress in ICT investment in the IoT, big data, AI, etc. is expected to accelerate Japan's economic growth and **have an effect of pushing up real GDP by about 33.1 trillion yen** as of FY2020.

- By growth factor, contribution by the total factor productivity (TFP)* is large. ICT is expected to have an effect of further increasing the TFP contribution.

* Total Factor Productivity (TFP): Factors other than production factors (labor, capital) that contribute to increasing added value. Specifically, it includes technology progress, improvement of workers' skills, and improvement in business management efficiency or organizational management efficiency.

Impact of ICT growth on real GDP

Breakdown of growth factors (ICT growth scenario)



<ICT growth scenario>

- The results of a questionnaire survey for companies (all industries excluding the public services) are adopted. The survey concretely indicated the economic contribution made by ICT, and investigated the extent to which the company's ICT investment, number of workers and labor productivity would change by FY2020 through the advancement of ICT.
- The results were estimated by applying the change rates obtained through the questionnaire survey to the number of workers, real capital investment and TFP value for FY2020 used in the base scenario below.

<Base scenario>

- The baseline case used in "Economic and Fiscal Projections for Medium to Long Term Analysis," Cabinet Office (January 21, 2016) is adopted. In the Projections, the consumption tax rate hike in FY2017 (8% → 10%) is taken into consideration.
- The real GDP growth rates from FY2015 onward are broken down into labor contribution, capital contribution and TFP contribution by industry. For the number of workers, the increase in the number of workers by industry is set based on the predicted values (progressive labor participation case) of the Labor Supply and Demand Estimates released by the Japan Institute for Labour Policy and Training (JILPT). The labor share is calculated based on System of National Accounts (SNA) Input-Output Tables (FY2013).
- The real capital stock is calculated by referring to the "real net capital stock by sector" in the Japan Industrial Productivity (JIP) Database, and by using the average values for FY2010 onward for the real capital investment growth rate and the capital stock removal rate by sector.
- The TFP contribution is calculated as the residual value.

Note: The fluctuation in 2017 takes into account the influence of the consumption tax hike.

Non-monetary Values Brought About by ICT (Results of a Consumer Questionnaire Survey)

- ICT brings about values to the company side and the consumer side. While the values brought to the company side can ultimately be identified as GDP growth, etc. through existing statistics, a part of the values brought to the consumer side cannot be identified through existing statistics (non-monetary values).

- Non-monetary values brought about by ICT to the consumer side were analyzed with focus on (i) consumer surplus, (ii) time saving, and (iii) information assets (user reviews, etc.), and the following results were obtained.

- (i) When analyzing consumer surplus (the difference between the price a consumer is willing to pay and the price he/she actually pays) by taking the example of music/video distribution services, users gained a monthly surplus of about 150 yen to 200 yen.
- (ii) When analyzing time saving by taking the example of Internet shopping, users saved about 40 minutes to one hour per set of purchases.
- (iii) When analyzing information assets (user reviews) by taking the example of Internet shopping, more than 80% of users had the experience of deciding on which product to purchase by reading user reviews.

(i) Consumer surplus (music/video distribution services, annual)

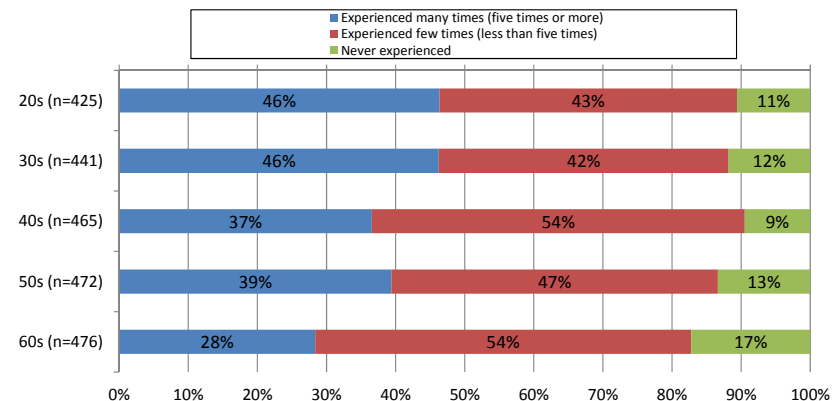
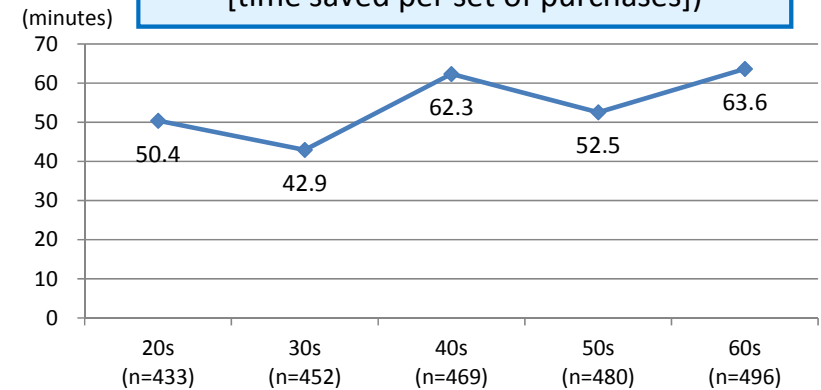
- The amount of consumer surplus per person was the highest for users in their 20s and low for those in their 30s and 40s, while gradually increasing again thereafter as users grew older.
- By also taking into account the rate of using the services, the total annual amount of consumer surplus is estimated at about **109.7 billion yen**.

	Number of Internet users (persons)	Rate of using music/video distribution services	Amount of consumer surplus per person (monthly, yen)	Amount of consumer surplus (annual, 100 million yen)
20s	12,583,190	86.1%	204.2	265.4
30s	15,165,910	77.6%	158.4	223.8
40s	17,986,280	71.2%	156.9	241.2
50s	14,196,520	70.0%	168.1	200.5
60s	13,773,720	58.2%	172.6	166.2
Total				1097.1

(iii) Information assets (Internet shopping [experience of deciding on which product to purchase by reading user reviews])

- More than 80% of users had the experience of deciding on which product to purchase by reading user reviews. The percentage of those who had such experience was slightly higher for younger users.

(ii) Time saving (Internet shopping [time saved per set of purchases])



- Among new ICT, the status of introduction of the IoT in Japan, US, UK, Germany, China, and South Korea were compared based on results of a questionnaire survey of companies in these countries.
- In Japan, the IoT progress index, which comprehensively represents the status of operational efficiency improvement, etc. achieved by using the IoT, is low compared to the status of infrastructure development.

IoT progress index

(Index which comprehensively represents the status of operational efficiency improvement (process) and development/provision of new goods/services that stimulate latent demand (product) achieved by using the IoT)

IoT progress index (based on a questionnaire survey of companies)

Process

Rate of introducing IoT solutions

Amount of IoT-related capital investment by companies that have introduced IoT solutions (percentage of total sales)

Product

Rate of providing IoT goods/services

Amount of sales of IoT goods/services by companies that provide IoT goods/services (percentage of total sales)

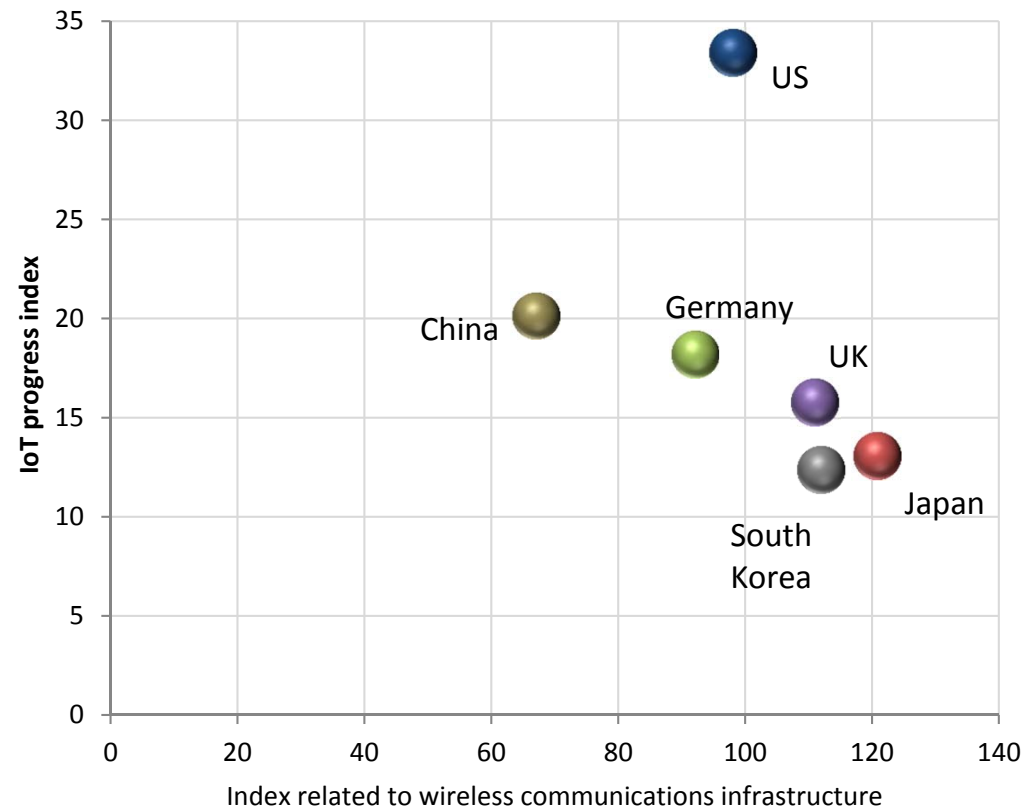
Status of development of infrastructure for wireless communications

Index related to wireless communications infrastructure (ITU*)

Mobile-cellular telephone subscriptions per 100 inhabitants

Active mobile-broadband subscriptions per 100 inhabitants

Relationship between the IoT progress index and the index related to wireless communications infrastructure

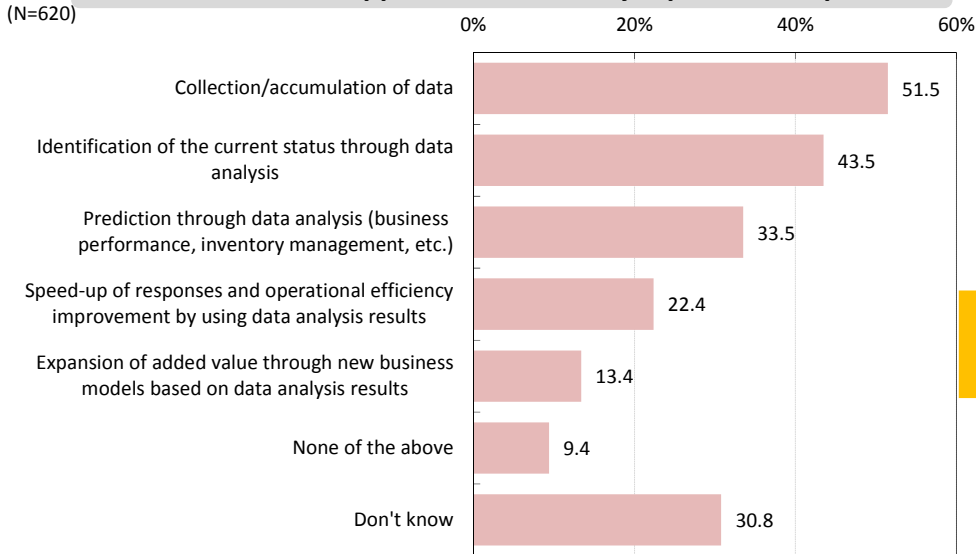


* Source: "ICT Development Index," ITU.

- Use and application of data by Japanese companies have not gone beyond the collection/accumulation phase. Also, their prediction on IoT-driven market expansion is relatively low compared to other countries.

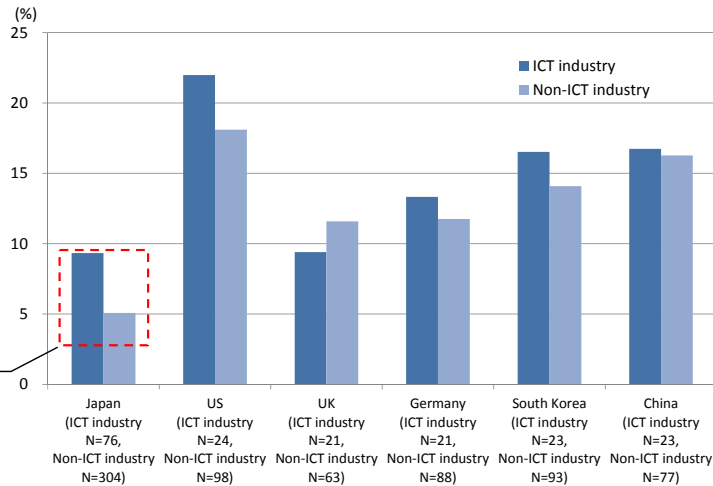
- Therefore, while the overall IoT introduction rate is expected to double or triple over the period from 2015 to 2020, with IoT introduction progressing both in process and product in all the countries, Japan may fall far behind the other countries in the future due to the relatively low intention among Japanese companies to introduce the IoT.

Status of use and application of data by Japanese companies



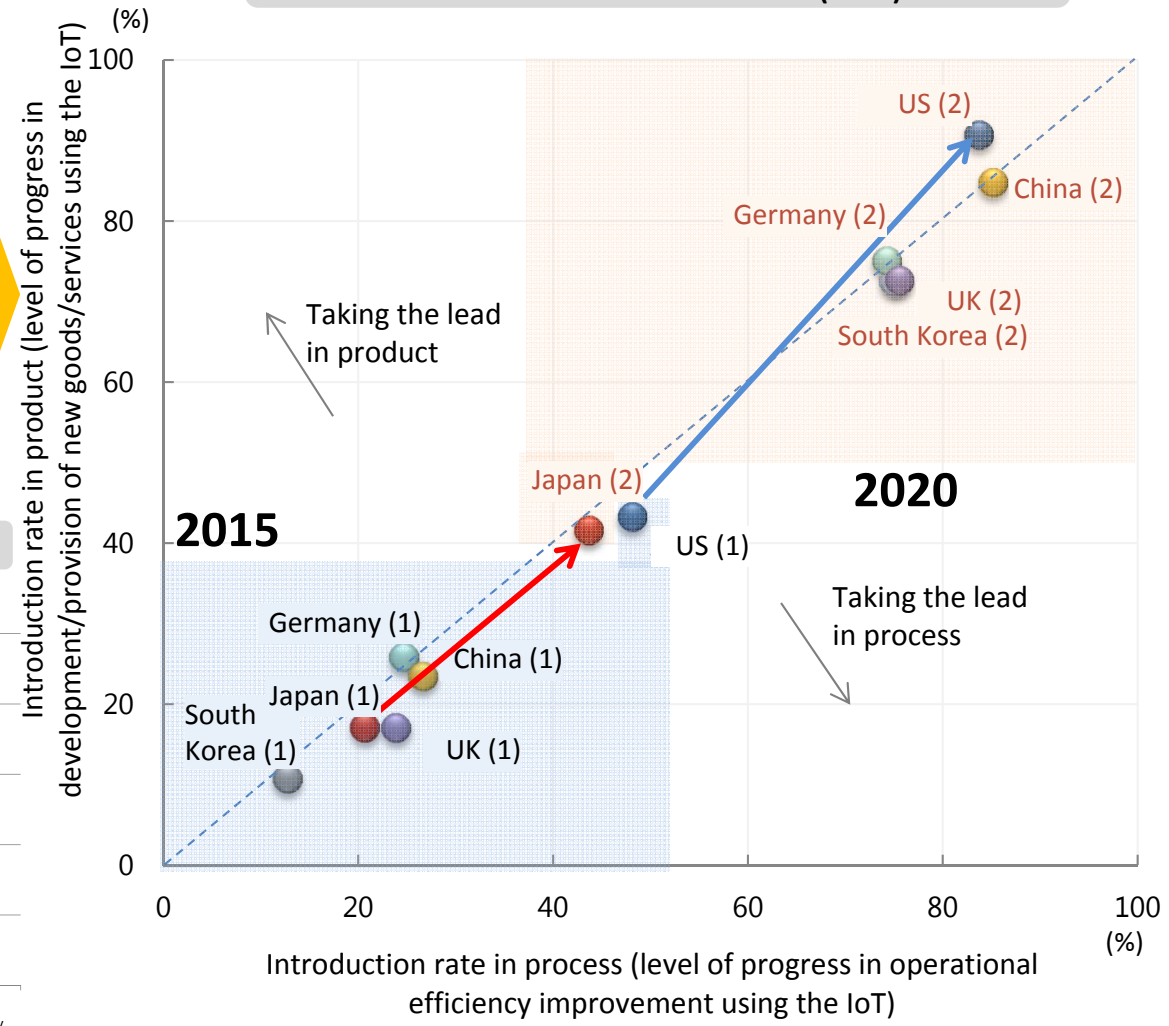
Prediction on IoT-driven market expansion by 2020

Prepared based on responses to the question "To what extent do you think the market size of the overall domestic industry to which your company belongs will expand through the progress and penetration of the IoT over the next five years (by around 2020)?"



- The market expansion rate predicted by non-ICT companies was only about half the rate predicted by ICT companies.

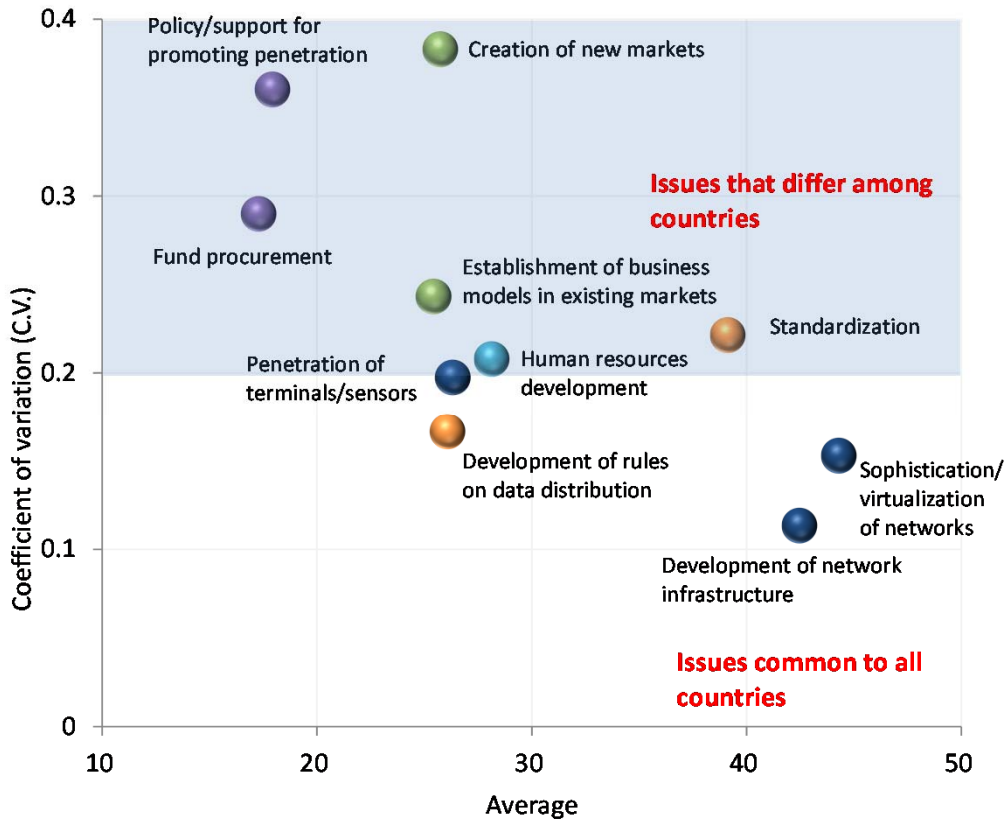
(1) Status of IoT introduction (2015) and (2) intention to introduce the IoT in the future (2020)



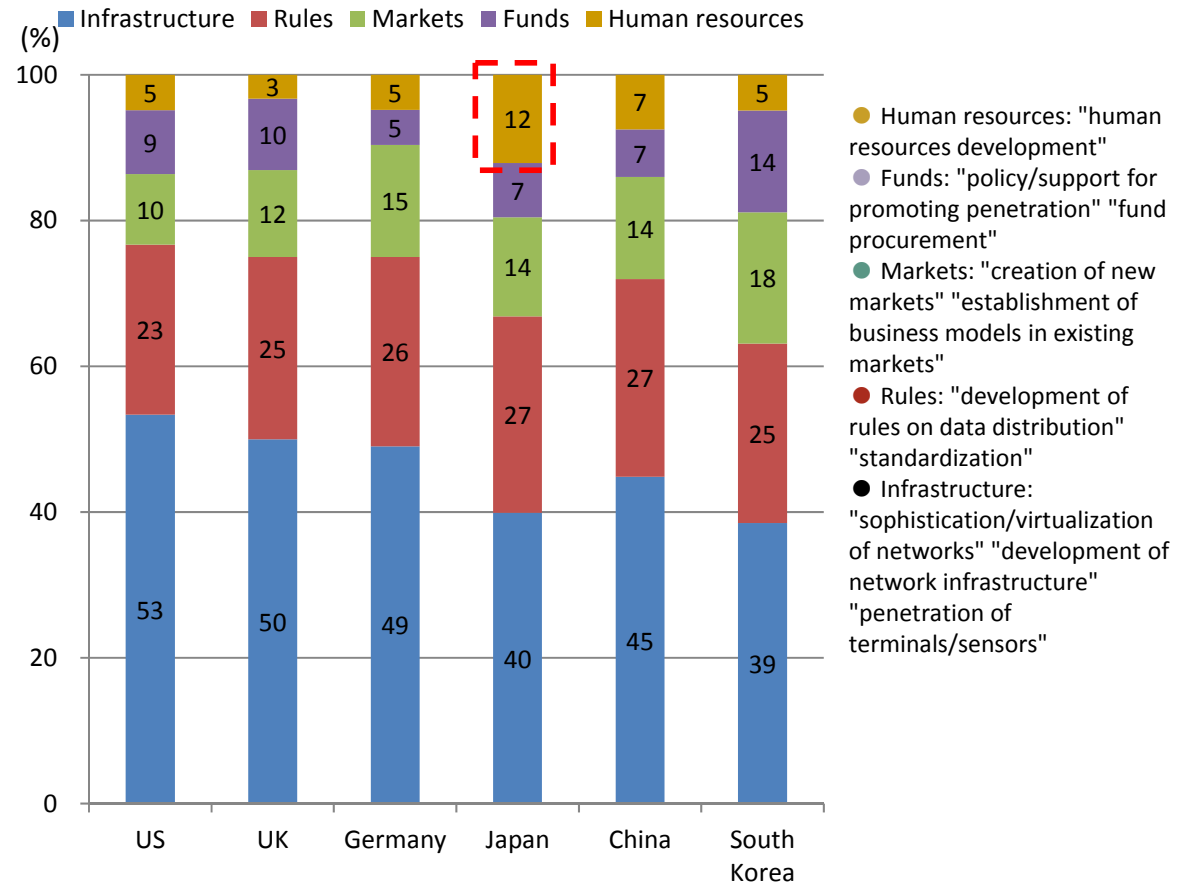
- While all countries are facing the issue of infrastructure development, there are differences among countries as to whether they are facing the issue of market creation or funds. Thus, these factors are considered to be influencing the degree of IoT progress in the respective countries.

- Fewer Japanese companies find infrastructure development to be an issue compared to companies in other countries. On the other hand, Japanese companies find human resources development to be a graver issue compared to companies in other countries. It is necessary to promote IoT use and application by such means as developing human resources and introducing cases of IoT use to user companies.

Average and coefficient of variation of issues concerning IoT progress



Gravest issue among issues concerning IoT progress

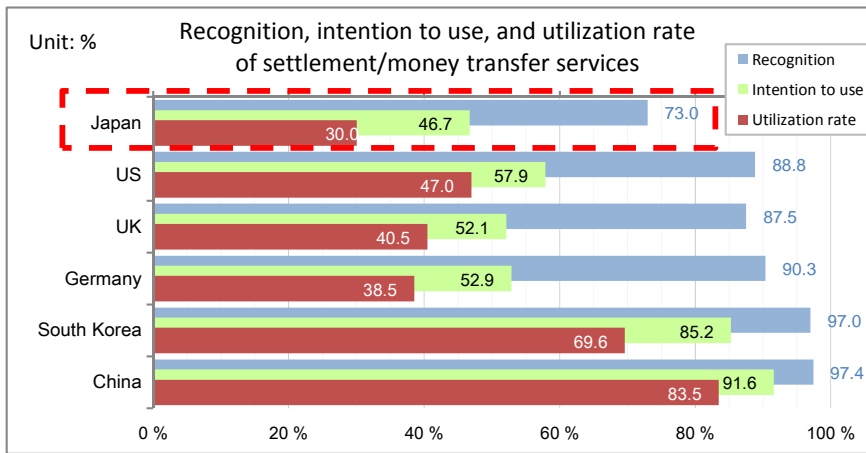


* Deviation value divided by the average. When the coefficient of variation is small, the factor is commonly recognized by all countries as an issue, and when the coefficient of variation is large, there are differences among countries as to whether they recognize the factor as an issue.

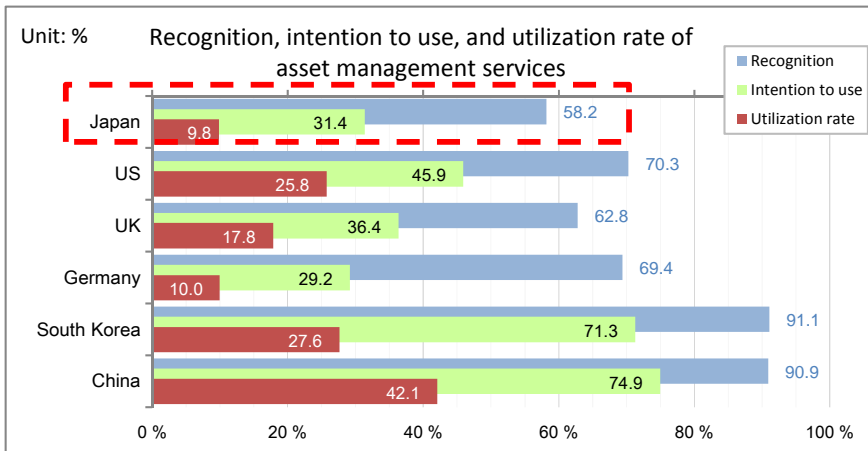
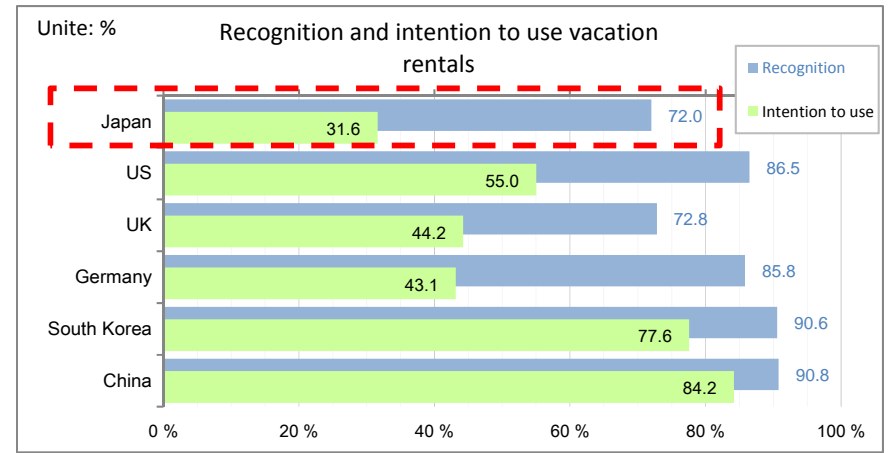
Chapter 2 summary: Japanese companies' intention to introduce the IoT is relatively low. It is necessary to resolve issues such as human resources development in order to achieve the new potentials of ICT.

- New products and services brought about by ICT such as FinTech contribute to economic growth in the aspect of creating demand.
- However, according to the results of a questionnaire survey of consumers in Japan, the US, UK, etc., the recognition and intention to use new services tended to be low among Japanese consumers compared to consumers in other countries.
- Japanese consumers who have the intention to use vacation rentals was 26.0% in the 2015 survey and 31.6% in the 2016 survey.

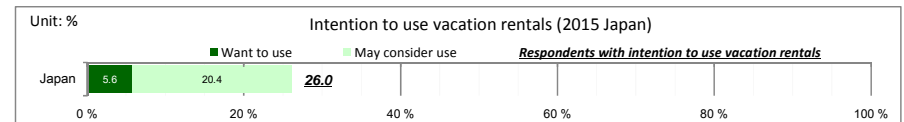
Typical FinTech services



Typical sharing economy services (vacation rentals)



Reference: Survey on the intention to use vacation rentals (2015)



* The 2015 survey and the 2016 survey differ in some respects, such as the questioning styles (while the options in the 2015 survey were "want to use," "may consider use," "prefer not to use," and "do not want to use," the options in the 2016 survey were "want to use even for a charge," "want to use if free of charge," and "do not want to use").

* Responses may be biased for some countries or attributes (sex, age group, etc.). For example, in China where Internet penetration is in the developing stage, there may be a larger proportion of respondents who actively use ICT devices or respondents who are early to use new technology, called "early adopters," than in other countries, and this may have influenced the survey results.

- In Japan, a particularly frequently cited factor as a disadvantage and a reason for not wanting to use sharing economy (vacation rentals) was "there are concerns about response at the time of an accident or trouble."
- Looking at the results of comparison by whether or not respondents have the intention to use vacation rentals in each country, there is a possibility that the disadvantages and reasons for not wanting to use vacation rentals will change along with the progress of use and the increase of recognition and understanding among users. As recognition and understanding increase and concrete successful cases are presented to users, their anxiety is likely to gradually diminish, and their use would be promoted.

Disadvantages, and reasons for not wanting to use vacation rentals (international comparison)

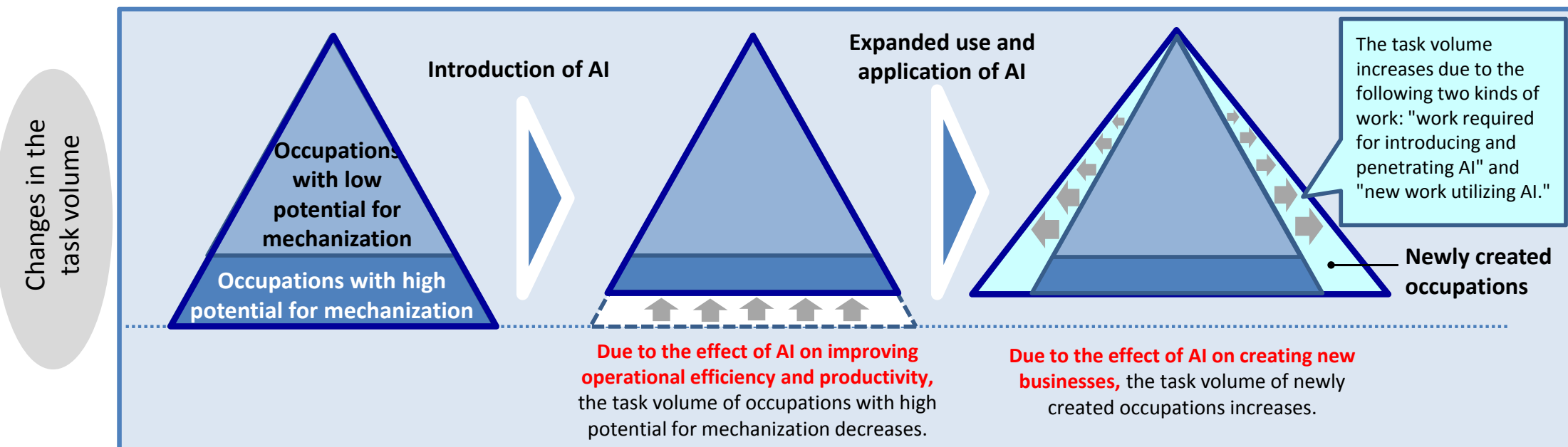
	Unit: %	Services responsibly provided by companies are more trustworthy.	There would be limits to service evaluation through user reviews.	There are concerns about response at the time of an accident or trouble.	Service details and how to use the services seem to be difficult to understand.	Procedures such as registering personal information in advance are bothersome.	Others	n
Japan	Do not have intention to use	31.5%	6.1%	53.6%	11.6%	19.0%	22.7%	680
	Have intention to use	25.7%	15.4%	44.1%	11.1%	18.3%	16.2%	320
US	Do not have intention to use	33.8%	9.6%	32.5%	7.0%	5.4%	45.1%	461
	Have intention to use	54.0%	21.5%	28.7%	10.2%	7.5%	10.6%	539
UK	Do not have intention to use	31.2%	12.3%	33.6%	5.7%	8.2%	40.3%	567
	Have intention to use	38.7%	31.1%	28.6%	8.4%	5.1%	10.7%	433
Germany	Do not have intention to use	21.0%	5.8%	31.7%	4.7%	9.0%	40.7%	567
	Have intention to use	21.3%	19.2%	30.0%	7.2%	7.0%	26.2%	433
South Korea	Do not have intention to use	27.9%	22.8%	55.9%	15.2%	21.6%	12.4%	225
	Have intention to use	36.7%	30.7%	36.2%	16.5%	12.8%	7.0%	775
China	Do not have intention to use	12.2%	24.2%	45.0%	12.7%	20.7%	22.9%	164
	Have intention to use	41.8%	20.1%	26.2%	14.0%	14.7%	10.8%	836

- In Japan, recognition of new goods and services, such as FinTech, is considered to be related to the utilization rate of smartphones. The smartphone utilization rate in Japan is lower than that in other countries at present.
- The smartphone utilization rate is about 60% for survey samples in Japan, about 80% for those in the US, UK, and Germany, and in the upper half of 90% in South Korea and China.
- In Japan, the utilization rate of smartphones is high for those in their 20s and 30s, similar to the US, UK, and Germany, while the utilization rate of feature phones is high for those in their 50s and 60s.

Unit: %	Smartphones	Feature phones	Tablets
[Japan]			
Overall (weighted average)	60.2%	41.9%	19.5%
20s (N=200)	87.0%		19.5%
30s (N=200)	73.0%	31.0%	25.0%
40s (N=200)	60.0%	42.5%	21.0%
50s (N=200)	54.0%	47.5%	18.5%
60s (N=200)	35.0%	62.0%	14.0%
[US]			
Overall (weighted average)	78.6%	18.4%	57.2%
20s (N=200)	92.5%	8.5%	67.0%
30s (N=200)	94.1%	11.5%	76.5%
40s (N=200)	83.0%	17.0%	57.0%
50s (N=200)	61.5%	23.0%	45.5%
60s (N=200)	58.5%	35.0%	37.0%
[UK]			
Overall (weighted average)	82.3%	13.9%	55.6%
20s (N=200)	95.3%	4.5%	61.5%
30s (N=200)	92.5%	7.5%	66.0%
40s (N=200)	85.0%	12.0%	52.5%
50s (N=200)	71.0%	21.5%	46.0%
60s (N=200)	64.5%	26.0%	51.5%
[Germany]			
Overall (weighted average)	82.3%	20.2%	45.8%
20s (N=200)	97.5%	9.5%	52.0%
30s (N=200)	94.0%	9.0%	56.5%
40s (N=200)	85.5%	15.5%	46.0%
50s (N=200)	74.0%	30.0%	44.5%
60s (N=200)	62.0%	35.5%	29.5%
[South Korea]			
Overall (weighted average)	96.6%	7.8%	34.1%
20s (N=200)	100.0%	3.5%	31.0%
30s (N=200)	97.0%	7.5%	43.5%
40s (N=200)	96.0%	9.5%	37.5%
50s (N=200)	97.0%	7.0%	30.0%
60s (N=200)	91.5%	12.5%	24.5%
[China]			
Overall (weighted average)	98.3%	5.0%	47.3%
20s (N=200)	98.5%	3.0%	49.5%
30s (N=200)	100.0%	2.5%	57.5%
40s (N=200)	98.0%	6.0%	46.0%
50s (N=213)	97.7%	5.6%	44.1%
60s (N=187)	96.8%	9.6%	34.8%

Chapter 3 summary: New goods and services using or applying ICT are expected to contribute to economic growth through creating demand, but because recognition is currently low among Japanese consumers, it is necessary to provide relevant information and reduce consumer's worries.

Introduction and expanded use and application of artificial intelligence (AI)*

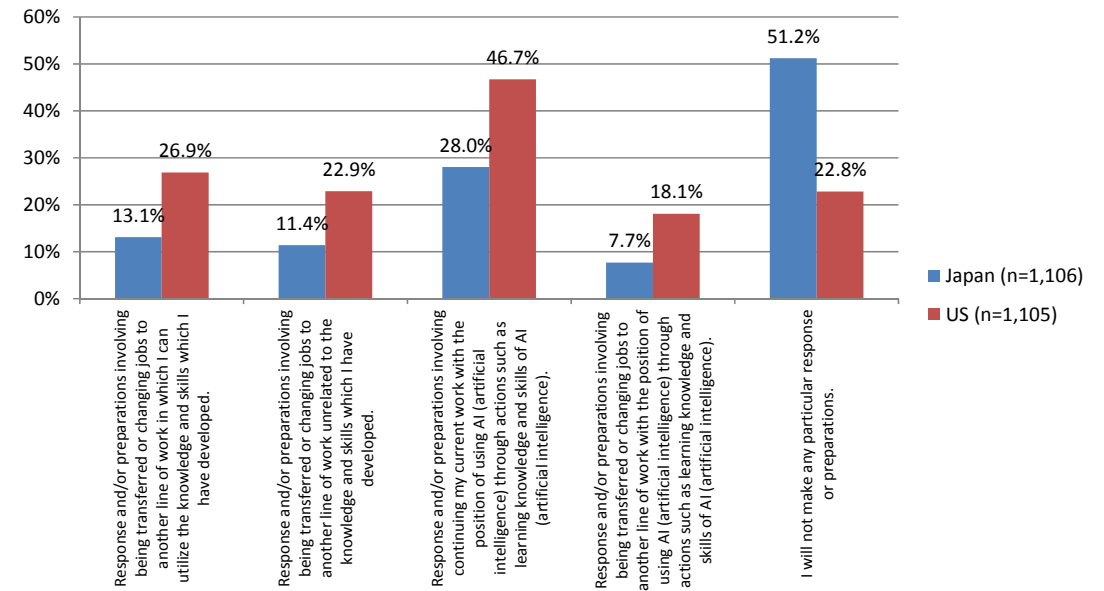


- Changes in the task volume**
- 1 Partial substitution of employment**
AI will not take over all work, in other words, it will not deprive workers of their employment. Instead, it will only take over some tasks for which use of ordinary workers would be costlier for achieving the same level of productivity.
 - 2 Complementation of employment**
The labor supply shortage caused by progress of the declining birth rate and aging population will be complemented by AI, people working with AI, and people whose task volume has decreased due to AI.
 - 3 Maintenance and expansion of employment by directly linking to industrial competitiveness**
Employment will be maintained and expanded as a result that companies which were early in using and applying AI increase their industrial competitiveness.
(However, for Japanese companies, a delay in response to digitization or operational process optimization tends to become an obstacle to the introduction, use and application of AI.)
 - 4 Improvement of the working environment of women and the elderly, etc.**
By shifting to highly productive work that efficiently uses AI, people will be able to work flexibly without always being required to work long hours, which will expand working opportunities for women and the elderly, etc.
- Influence on employment**

* "Science and technology for creating intelligent machines, particularly intelligent computer programs" (website of the Japanese Society for Artificial Intelligence (JSIAI))

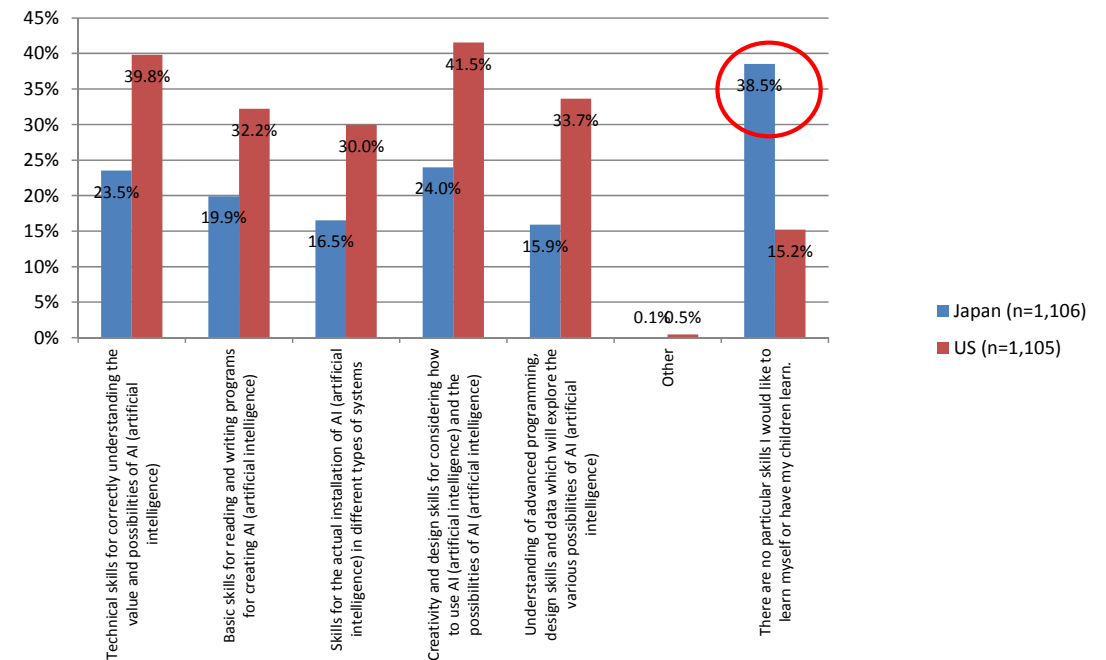
Future response and/or preparations for penetration of AI

In Japan, many respondents answered **"I will not make any particular response or preparations."** On the other hand, many US respondents answered that they will make a **"response and/or preparations involving continuing my current work with the position of using AI (artificial intelligence) through actions such as learning knowledge and skills of AI."**



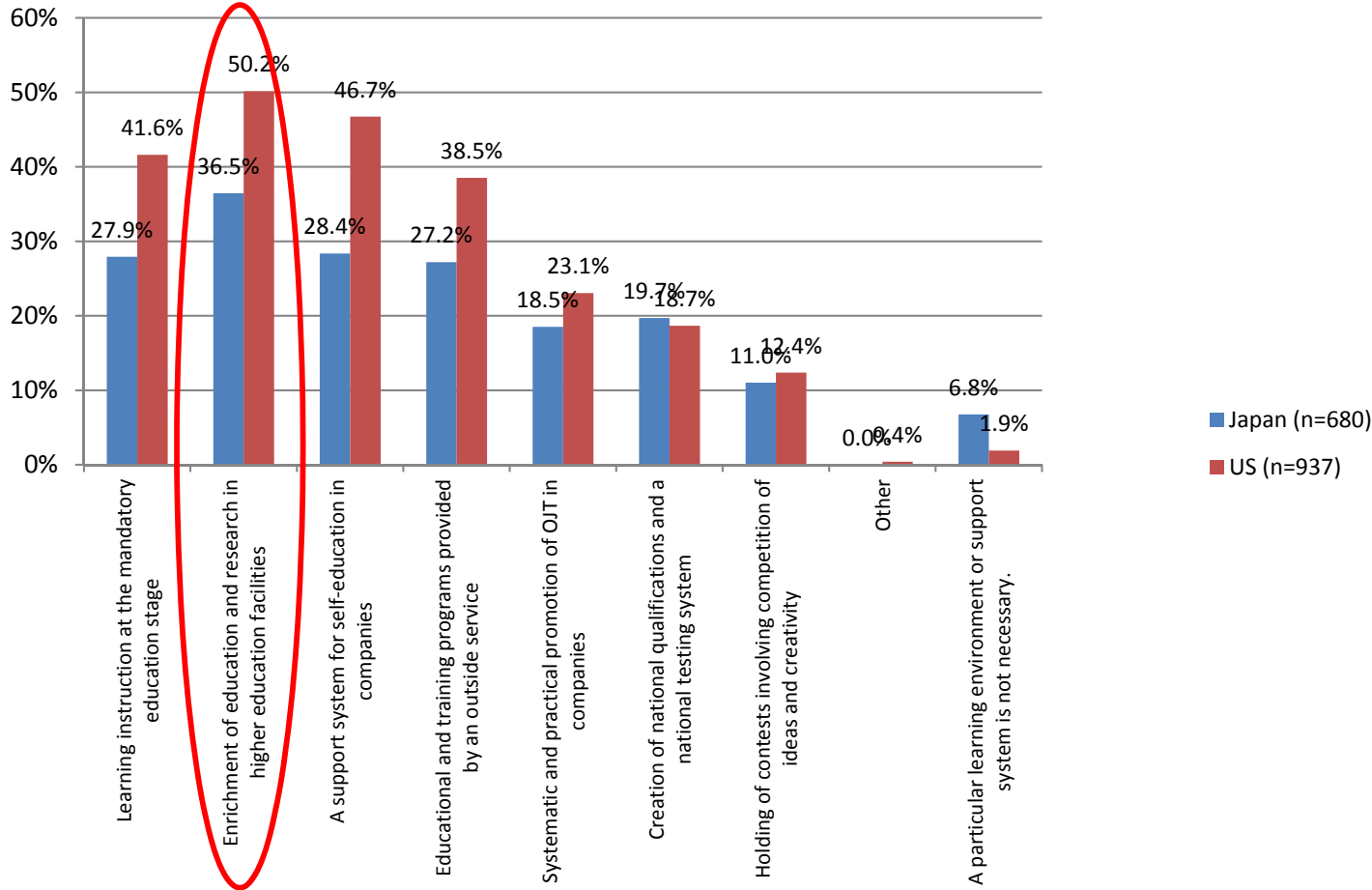
Skills for using AI which the respondent would like to learn him/herself and/or have his/her children learn

When comparing the skills that the respondents would like to learn in Japan and the US, **Japanese respondents showed less motivation to learn AI skills than the US respondents for all types of AI skills.**



With regard to the learning environment and support systems for learning skills for using AI, many Japanese and US respondents indicated the need for "enrichment of education and research in higher education facilities." In addition, many US respondents mentioned the need for "a support system for self-education in companies."

Need for a learning environment and support systems for learning skills for using AI



Chapter 4 summary: Japanese workers are notably lagging behind US workers in making response/preparations for the penetration of AI. Toward the coming IoT Era, it is important to instill in workers a mindset and stance toward using AI and to eliminate their worries of AI-related difficulties, with companies enhancing re-education of workers by providing a support system for self-education.

- Active use and application of ICT will accelerate economic growth. The core of such use and application will be the IoT using AI, and collection/use of data (big data) will be the key.
- New ICT, including the IoT, big data, and AI, are expected to make significant contribution to economic growth through improving corporate productivity and creating new demand.
- However, questionnaire surveys of companies and consumers revealed that Japanese companies' intention to invest in new ICT is relatively low and Japanese consumers' recognition, etc. of new goods and services using ICT is also relatively low, compared to other countries such as the US and the UK.
- Moreover, Japanese workers were found to be notably behind US workers in making response/preparations for AI that is expected to penetrate workplaces in the future.
- Toward the coming IoT Era, it is important that companies and workers securely address such issues as human resources development, so that Japan will not fall behind in using the IoT, which will serve as the core of economic growth.