Part 1

Chapter 4

ICT Progress and Future Work Styles

Much recent research around the world often speaks of artificial intelligence (AI) in negative terms, as something with the potential to replace human workers. In this chapter, we present the findings of surveys on this issue of AI and employment given to workers in the United States and Japan and on the sentiments of experts in Japan. We also map out the evolution of AI and suggest measures that will be required in the future to deal with AI.

Section 1 ICT Progress and Employment

1. Overview of ICT's impact on employment

ICT progress has 2 opposite effects: an employment replacement effect, in which ICT replaces operations previously done by humans, and an employment creation effect, in which increased added value and the creation of new business domains, brought on by ICT application and use, will increase employment (Figure 4-1-1-1).

The displacement of employment by ICT tends to be viewed negatively. But it can be viewed positively as well, since the application and use of ICT can improve labor productivity at enterprises and create considerable added values. And in Japan, where the declining birthrate and aging population is forecast to reduce the working population, the application and use of ICT will likely be effective in addressing labor supply limitations.

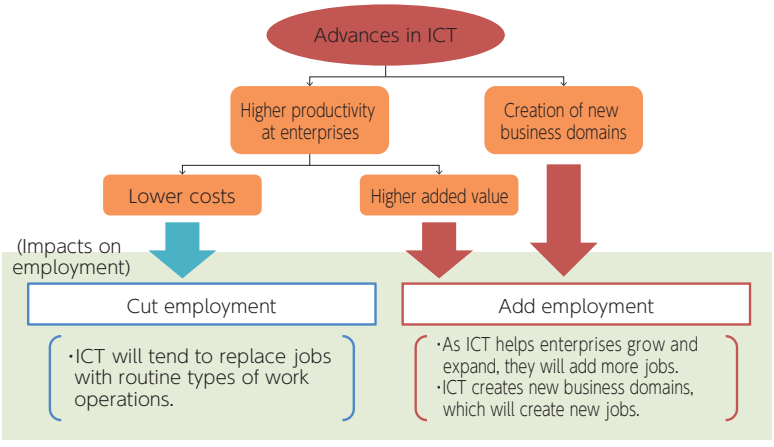
2. Changes in the forms of employment replaced by ICT

Prior research on employment replacement by ICT has clarified that ICT progress to date has replaced humans in routine types of work operations (for example, accounting operations and production processes) but not in non-routine types of work operations (for example, research positions and sales positions) or manual operations (for example, sales promotion operations). There is growing consensus, however, that the rapid advance of AI technology and robotics in recent years will, in the future, replace humans with machines in non-routine types of knowledge operations and complex manual operations too.

3. ICT and new work styles

ICT progress is bringing enormous changes to how people work. For example, telework is making it possible for people to work independent of location. And the proliferation of the sharing economy and digital fabrication are creating more opportunities for individuals to work on demand without belonging to an organization. Such new work styles will allow people to choose more diverse and flexible working arrangements, which is ex-

Figure 4-1-1-1 Impact of ICT on employment



Prepared from the "Study Report on Issues and Solutions to Regional Employment Creation with ICT" (2015), MIC

pected to improve their work-life balance.

(1) Telework

a. State of telework adoption by Japanese enterprises

According to the MIC's 2015 Communications Usage Trend Survey, only 16.2 percent of enterprises answered they had "implemented" telework[5] in Japan, a rate that increased to just around 20 percent when adding in enterprises that answered "have not implemented but have specific plans to do so."

b. Japan-U.S. comparison of worker perceptions of telework

What do workers think of telework? We surveyed worker monitors in Japan and the United States about their intentions to make use of telework.

The gap in telework intentions between the 2 countries was significant, with over 60 percent of U.S. workers answering "I would like to try telework," versus 30 percent of Japanese workers. The intention to make use of telework in Japan was only half that in the United States (Figure 4-1-3-1).

(2) Sharing economy

Consumers in many countries are starting to accept new forms of sharing economy services powered by ICT.

We surveyed worker monitors in Japan and the United States about their intentions to work in sharing-economy style services (i.e., sharing economy work styles). Over 40 percent of workers in the United States answered "I would like to try a sharing economy work style." This was more than twice the rate in Japan, where just over 20 percent of workers gave the same answer (Figure 4-1-3-2).

(3) Digital fabrication

Digital fabrication technology produces physical objects based on digital data. 3D scanners, 3D CAD systems, and other measurement machines convert people's ideas or a person's physical dimensions into digital data. The digital data are loaded into 3D printers, laser cutters, and other digital fabrication machines to produce the final object.

We surveyed worker monitors in Japan and the United States about their intentions to make use of digital fabrication. More than half of U.S. workers answered "I would like to try" digital fabrication, which was more than double the response rate in Japan, where around 20 percent of workers gave the same answer (Figure 4-1-3-3).

(4) New work styles (summary)

ICT advancements are set to enable many new work styles, such as telework, the sharing economy, and digital fabrication. We asked workers in Japan and the United States which of these new work styles they found attractive. For all work styles, more U.S. workers found them attractive than Japanese workers. This suggests Japanese workers are not looking for change in their work styles. This reluctance is likely one factor for the low intention to take advantage of telework, the sharing economy, and digital fabrication (Figure 4-1-3-4).

Figure 4-1-3-1 Workers' intention to make use of telework (Japan / United States)

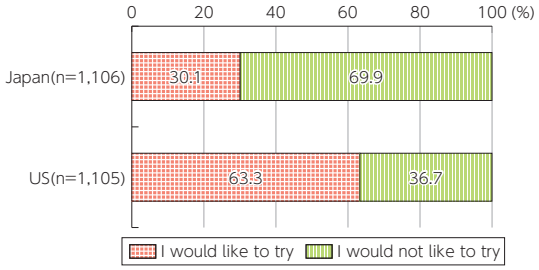


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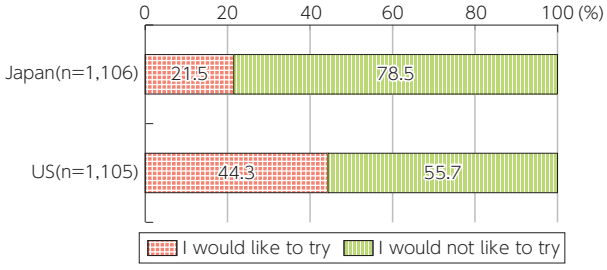
Figure 4-1-3-2 Workers' intention to make use of sharing economy work styles (Japan / United States)



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[5] Telework includes working from home, working at satellite offices, and mobile work.

Figure 4-1-3-3 Workers' intention to make use of digital fabrication (Japan / United States)

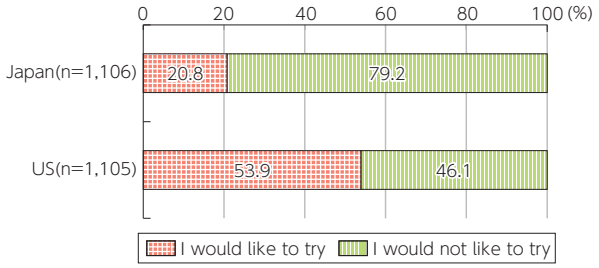

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Figure 4-1-3-4 Work styles viewed as attractive (Japan / United States)

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Section 2 Present and Future of Artificial Intelligence (AI)

1. Progress in artificial intelligence research

(1) What is artificial intelligence?

AlphaGo shocked the world when it defeated the 9-dan rank professional Go player, Lee Sedol, 4 games to 1 in a five-match competition in March 2016. Compared to chess or shogi, Go has a bigger board and infinitely more board combinations. So many believed it would take years before artificial intelligence (AI) could surpass human abilities in Go, but AlphaGo's victory showed the world that AI progress had reached another level.

a. What really is artificial intelligence?

The term AI is quite well recognized now, but the world first learned of it relatively recently at the Dartmouth Conferences in 1956. In broad terms, AI can be described as "the science and engineering of making intelligent machines, especially intelligent computer programs," but researchers are divided on the definition of AI. The reason for this, it has been pointed out, is that there is no proper definition of "intelligence" to begin with, so defining "artificial" intelligence is rather impossible.

For our purposes, we have not chosen a particular definition for AI and simply describe AI as "the science and engineering of making intelligent machines, especially intelligent computer programs."

(2) History of artificial intelligence research

AI research has been ongoing since the 1950s, undergoing several booms and winters in the process. AI is now in the limelight again, in its third boom.

a. Looking back on the first 2 artificial intelligence booms

In the previous 2 AI booms, society's expectations for AI exceeded the technical limits AI could achieve at the time, and the booms fizzled out when this discrepancy became clear. Given this history, it has been said, regarding the present third boom, that people need to recognize there will be a gap in the latent potential that AI technical development and implementation, at its most successful, can achieve and what is forecast to be realistic.

2. Expanding artificial intelligence applications

(1) Examples of using and applying artificial intelligence

Expectations for AI, particularly deep learning, are that application fields will grow, as identification and forecasting accuracies improve, and that the integration of multiple technologies will fulfill functions people have long wanted. AI will certainly develop along multiple paths, but the table below lists the assumptions of experts in the field (Figure 4-2-2-1).

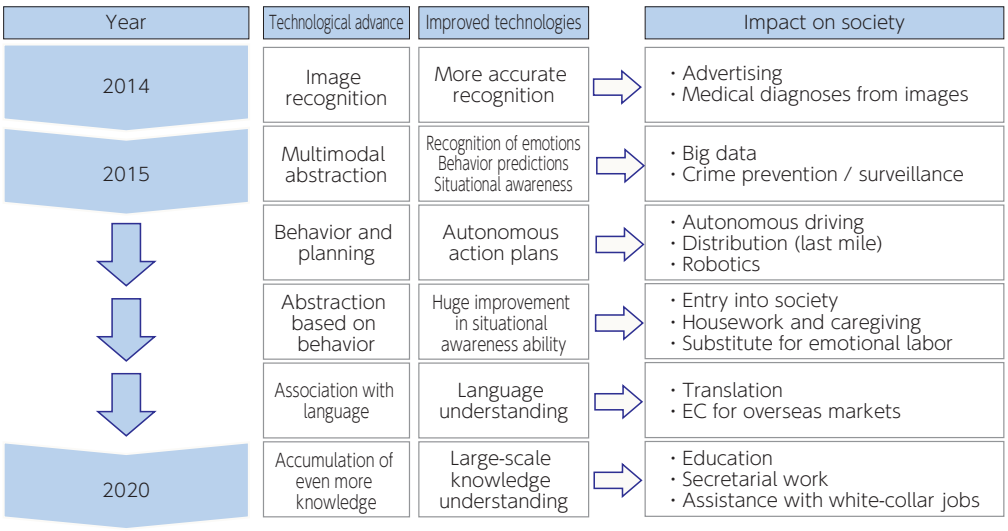
At the same time, it is up to humans to decide how AI will be used, and in which fields, as well as how AI will not be used. Efforts are underway to form a consensus on preventing the use of AI in ways that will harm society — ELSI (ethical, legal, and social issues).

(2) Applications of artificial intelligence

a. Promising fields for artificial intelligence applications

We surveyed experts in the field on promising fields for AI applications. The results indicated there are quite strong needs for AI applications in fields where social issues are expected to be solved. These include more advanced health examinations, autonomous operation of public transportation, route selection for emergency vehicles and ambulances, and easing of traffic congestion and crowding.

Figure 4-2-2-1 Development of AI and evolution of AI applications



(Source) "Study Report on the Impact of ICT Progress on Employment and Work Styles" (2016), MIC

Section 3 Influence of AI Progress on Employment, etc.

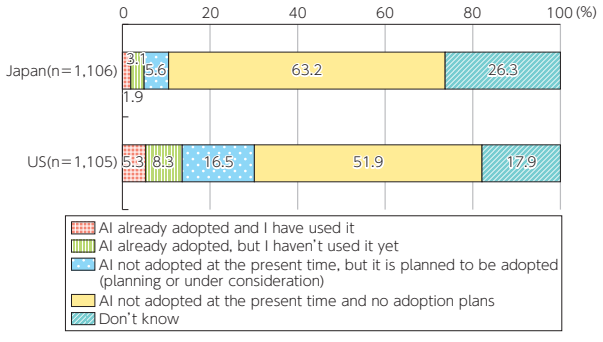
1. Artificial intelligence and employment

(1) State of artificial intelligence adoption in workplaces

We asked workers in Japan and the United States about the state of AI adoption in their present workplaces. The results indicated AI workplace adoption at the present time is more advanced in the United States than in Japan (Figure 4-3-1-1).

Next, we asked workers who answered "AI has already been adopted in my workplace" or "AI is planned to be adopted in my workplace" what role or function AI plays (or will play) in the workplace. The most common answer among Japanese workers was "role or function is to reduce current labor levels," at 41.0 percent, followed

Figure 4-3-1-1 State of current and planned AI workplace adoption



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by "role or function is to supplement labor shortages" and "role or function is to raise efficiency and productivity of existing operations," both at 35.0 percent (Figure 4-3-1-2).

(2) Perceptions on artificial intelligence adoption

We asked workers in Japan and the United States about the possibility of AI becoming their work partner (either as supervisor, colleague, or subordinate) and how much they oppose such a possibility. In the United States, many workers "strongly oppose" or "somewhat oppose" AI becoming their colleague or subordinate, whereas many Japanese workers opposed AI becoming their supervisor (Figure 4-3-1-3).

(3) Envisioned impact of artificial intelligence adoption on employment

There is broad public consensus that AI will engender 2 effects — higher operational efficiencies and productivity and the creation of new operations and businesses — and that these 2 effects will transform the volume of tasks that constitute employment.

The AI effect of higher operational efficiencies and productivity will reduce the amount of tasks in jobs where AI is adopted. On the other hand, the AI effect of creating new operations and businesses is expected to increase the amount of tasks in newly created jobs. Specifically, AI will create jobs needed to introduce and expand AI and new jobs that make use of AI. The ideal for society is that the newly created task amounts exceed the reduced task amounts, resulting in a net gain in task volumes. Therefore, the creation of new operations and businesses through AI has a significant and large role to play.

There are 4 envisioned impacts on employment that will be brought about by such task volume transformations: (1) partial substitution of employment; (2) complementation of employment; (3) maintenance and expansion of employment by directly linking to industrial competitiveness; and (4) improvement of the working environment of women and the elderly, etc. (Figure 4-3-1-4).

a. Impact of growth in artificial intelligence on employment in Japan

We asked experts in the field about what impact AI adoption and growth will have on employment in Japan. Twenty-three of 27 experts said "AI can make up shortages in the labor supply caused by the continuation of low birthrates and aging population" (Figure 4-3-1-5).

b. Impact of artificial intelligence workplace adoption on operations

We asked workers in Japan and the United States

Figure 4-3-1-2 Role or function of AI

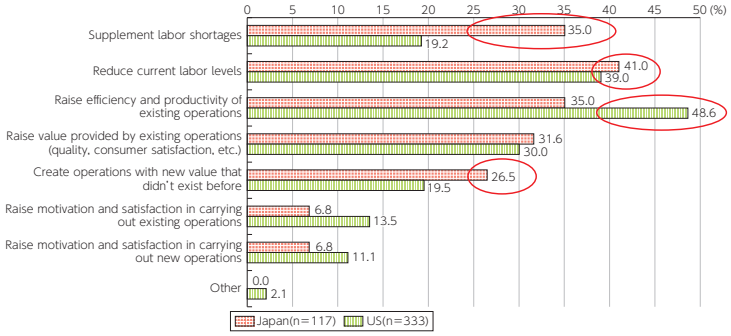

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Figure 4-3-1-3 Possibility and opposition to AI as a work partner

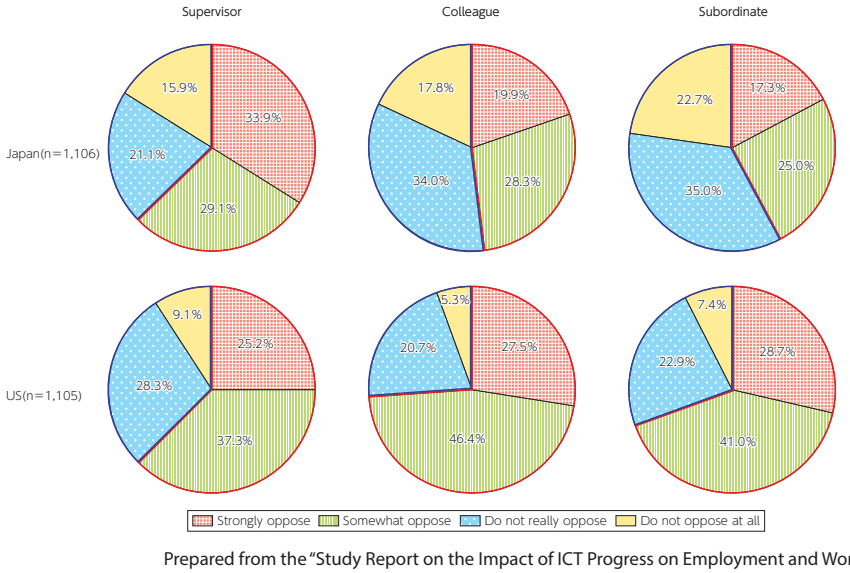

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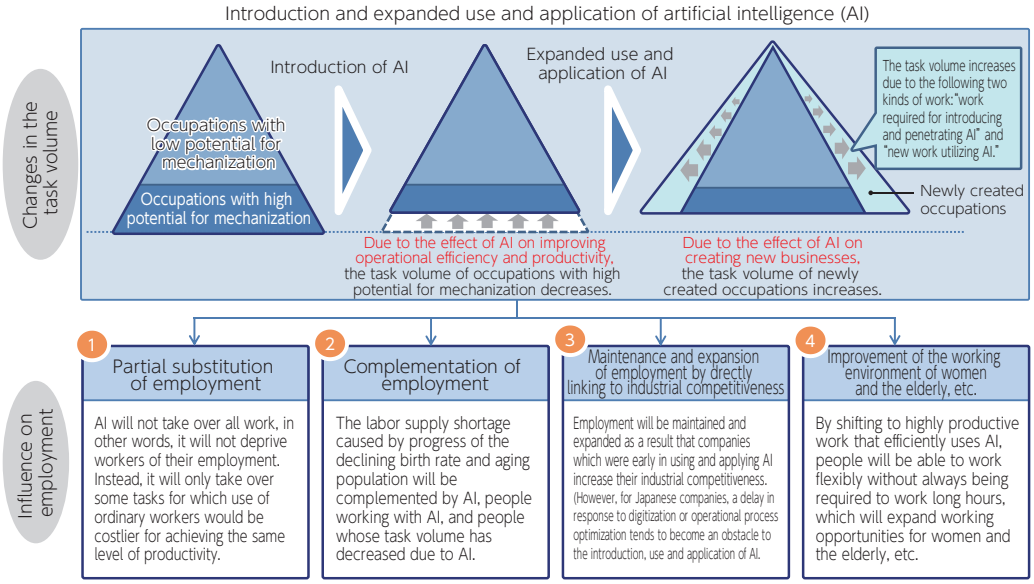
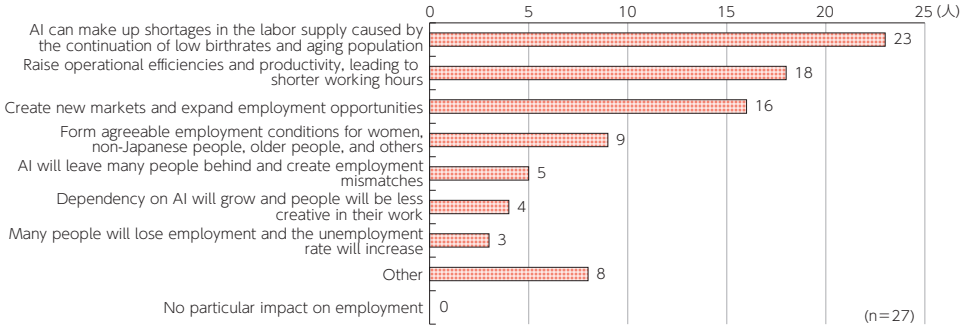
Figure 4-3-1-4 Envisioned impact of AI adoption on employment



(Source) "Study Report on the Impact of ICT Progress on Employment and Work Styles" (2016), MIC

Figure 4-3-1-5 Impact of AI adoption and penetration on employment in Japan



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about the impact AI adoption in their current workplace has had on operations. More U.S. workers answered "has had a very large impact" or "has had some impact" than Japanese workers (Figure 4-3-1-6).

We next asked about the impact AI workplace adoption has had on the range of operations. More U.S. workers answered that operations had increased — total of "increased significantly," "increased somewhat," and "increased slightly" — than answered that operations had decreased — total of "decreased significantly," "decreased somewhat," and "decreased slightly." Thus, U.S. workers are inclined to view AI adoption as expanding operations. The opposite tendency was seen among Japanese workers, with those answering that operations had decreased exceeding those answering that operations had increased by 5.9 percentage points. Thus, compared to their U.S. counterparts, Japanese workers are inclined to view AI adoption as narrowing operations (Figure 4-3-1-7).

Figure 4-3-1-6 Impact of AI workplace adoption on operations

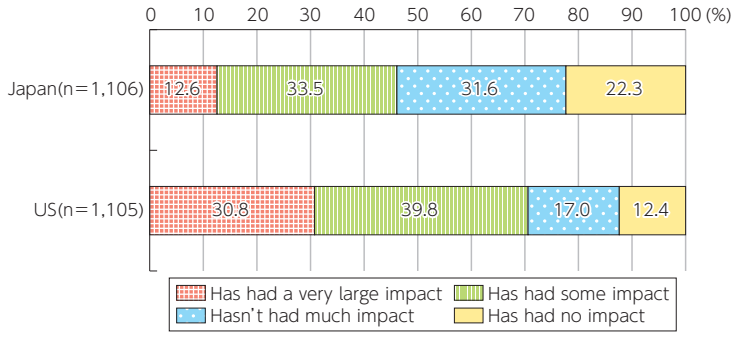

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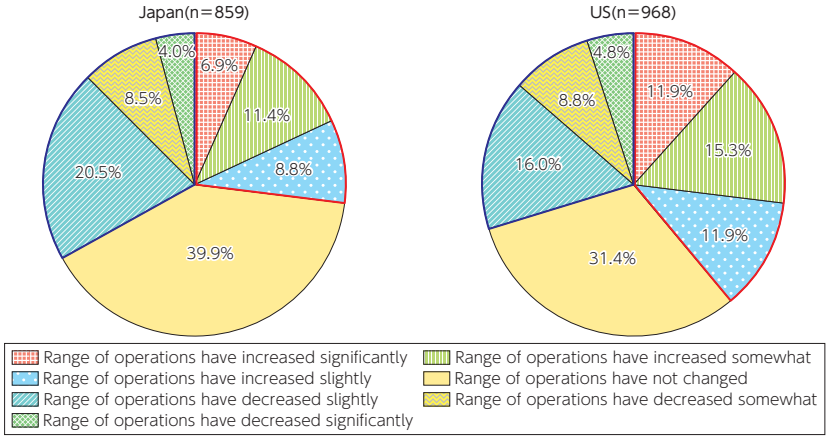
Figure 4-3-1-7 Impact of AI workplace adoption on range of operations



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

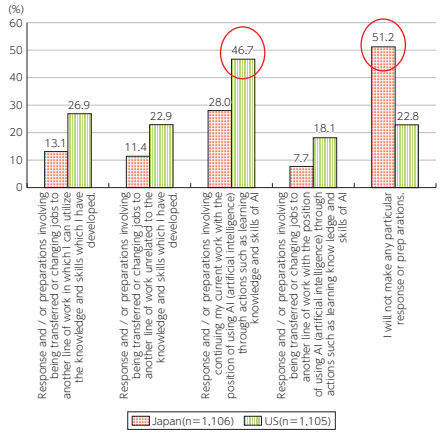
1. Facing further artificial intelligence expansion and growth

(1) Supporting artificial intelligence

What do workers in Japan and the United States think of preparing for and dealing with future AI growth?

Many U.S. workers said "I'm preparing for AI from the standpoint of using AI so I can continue my current job and duties, such as acquiring AI knowledge and skills." This suggests an attitude that puts importance on preparing for and dealing with AI growth so that workers can master AI and apply it to their current jobs and duties. Conversely, in Japan, more than half of workers said "I'm not doing anything specific to prepare for or deal with AI." This attitude prompts concerns that people will be left behind as AI expands and grows (Figure 4-4-1-1).

Figure 4-4-1-1 Preparations to handle future AI growth



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2. Future education and human resources development

(1) Needs in study environments and support structures

In both Japan and the United States, there were strong needs for "enriched education and research at institutes of higher learning" and for "support structures for self-development at enterprises" in the area of study environments and support structures, so that workers can acquire the skills they need to make use of AI (Figure 4-4-2-1).

At the same time, support for individual self-development alone is, naturally, insufficient to establish the conditions for AI adoption and usage. For example, Recruit Holdings has successfully laid the groundwork for all employees to make use of AI in 3 stages: (1) hiring AI experts who take work from all workplaces across the organization; (2) increasing the number of AI experts and assigning AI experts to workplaces who work alongside people in the workplace; and (3) creating conditions for all employees to use AI through systemization.

As this example shows, when it comes to acquiring the necessary attributes and skills to use AI, it is more important that the enterprise lower the barriers to AI usage, while employees study to use AI in the workplace, than to establish usage conditions where people can learn AI skills through experience in the workplace (Figure 4-4-2-2).

Figure 4-4-2-1 Needs for a learning environment and support systems for learning skills for using AI

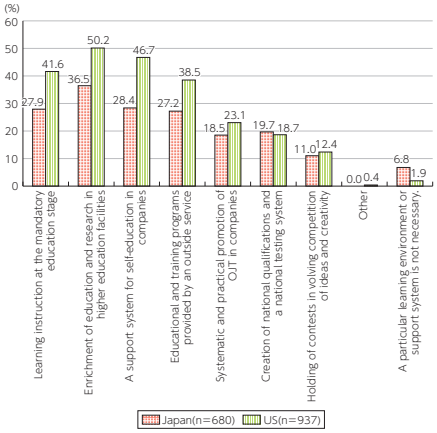

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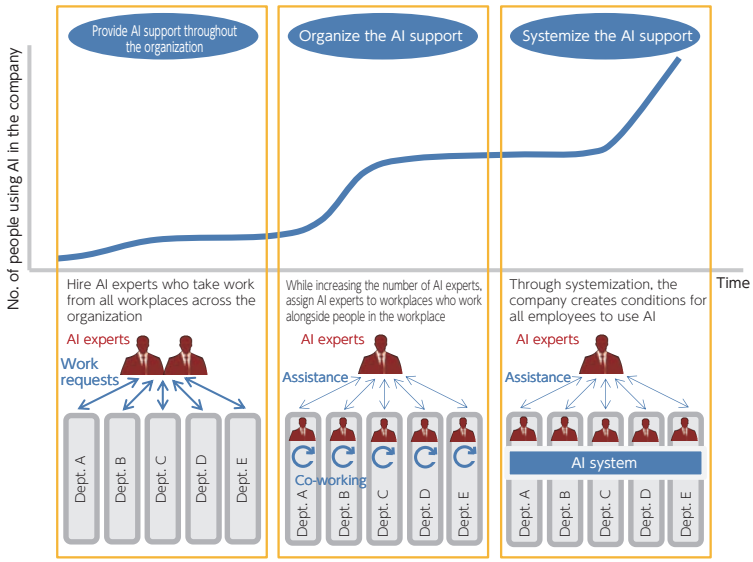
Figure 4-4-2-2 Example of an enterprise setting up conditions for AI usage

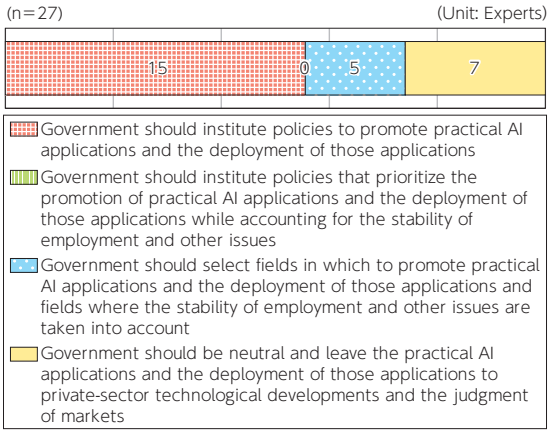


(Source) "Study Report on the Impact of ICT Progress on Employment and Work Styles" (2016), MIC

3. Roles expected of government in spreading artificial intelligence

We asked experts about the roles expected of government in promoting AI research and development and spreading AI in society. Partly because the survey included many experts in the ICT field, including AI, a majority of the experts indicated that the government should institute policies to promote practical AI applications and the deployment of those applications (Figure 4-4-3-1).

Figure 4-4-3-1 Role expected of government in promoting AI research and development and spreading AI in society



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