CHAPTER 9

Impact of Disruptive Technologies on Employment and the Role of Universities

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INTRODUCTION

Various different concepts have been used to express disruptive technology. For example, it has been referred to as the Fourth Industrial Revolution (Schwab, 2017), and there have been government initiatives such as Industry 4.0 in Germany and Society 5.0, which the Japanese government recently proposed in order to keep up with the developments in Europe. As such, this new stage of technological development within society has been called by various names, and the interest given to the topic has varied slightly in scope, but the common focal point is the rapid pace in which technological innovation is transforming our society.

It is also apparent that the issues concerning employment are regarded as one of the most important aspects of the impact of disruptive technologies. This is not surprising at all because employment is considered a derived demand from production, and production basically depends on technology. On the other hand, employment is also decisively influenced by demography, which is its supply source. Especially in such countries as Japan, labour supply is significantly decreasing because of declining birth rates and population aging.

This paper aims to examine the impact of disruptive technologies on employment and possible measures to cope with it. It will also discuss the significance of disruptive technologies to cope with issues in a rapidly aging society such as Japan. And, based on these considerations, it will explore the role universities can play in responding to disruptive technologies.

HOW DISRUPTIVE TECHNOLOGIES AFFECT EMPLOYMENT

Disruptive technologies, such as AI and robotics, have the potential to make a huge impact on employment, both in terms of the amount of jobs and the quality and content of jobs. It is important to differentiate between these two aspects in terms of the measures that need to be taken.

Employment is a derived demand from production, so the amount of employment is determined by the amount of production. All other things being equal, companies increase the number of employees if production increases, and decrease the number of employees if production decreases, and if all else, including production amount, being equal, labour-saving technology will lead to a decrease in the amount of employment.

But if productivity improves because of technological progress, allowing for the prices of products to drop, the demand for the products will also become greater. If production increases due to increased demand of products, then employment, which is a derived demand from production, will also increase. Therefore, it is not clear whether disruptive technologies will lead to an increase or decrease in employment, as this depends on which factors described above dominate.

However, what modern industrial history tells us is that the long-term instead of the short-term consequences of technological advancement have always spurred economic growth and brought net employment growth. The Luddite movement in the 1810s is one such incident that occurred in early industrial Britain (Ashton & Hudson, 1997). A group of English textile workers and weavers protested against the use of machinery by destroying them, fearing that their jobs would be replaced by machines. However, despite their concern, the textile industry boomed during the Industrial Revolution — improved productivity resulted in lower prices and a significant increase in production capacity as well as the number of employees.

Better productivity meant higher wages, which expanded the purchasing power of workers, stimulated demand and led to more jobs. This kind of virtuous cycle has been observed repeatedly throughout history. For instance, Henry Ford, whose car company was responsible for advancing mass manufacturing technologies through the creation of the moving assembly line, increased his workers' wages twofold. Of course, this was partly a business decision to cope with the unionization of his workers, but he also stated that he doubled wages so that the workers could afford to buy the cars they made (Nevins & Hill, 1954). Japan's postwar economic growth was also characterized by a virtuous cycle — the gains from improved productivity were shared with the workers in the form of higher wages, which led to the expansion of the middle class, stimulating domestic demand and increasing employment.

These historical facts tell us that the key to creating a virtuous cycle of technological progress and employment is through increased demand of products

driven by technological advancements, and translating this to higher wages for workers. In other words, the kind of impact technological innovation will have on employment is determined not by the technology itself, but whether the gains from increased productivity are shared among the workers.

The same thing can be said for disruptive technologies. The acceptance of the technologies by the people, especially workers, will depend on whether improved productivity can provide higher wages and increased employment.

However, the way technological progress will impact the quality and content of jobs is quite clear. Workers will no longer be required to do work that can be automated through AI and robots; they will be required to do what only humans can do. This outcome is unavoidable even if the amount of employment increases. The way we work has also changed from artisans taking on the entire process of manufacturing to the division of labour in which workers are responsible for only part of the manufacturing process. Therefore, factory work has become more about monitoring the process instead of physically doing the work.

Generally speaking, technological innovation has raised the quality and content of jobs and, as a result, the workforce structure has become more white-collar than blue-collar oriented. Over the long term, jobs have become more intellectual, as well as more comfortable, through technological innovation. As with history, there is no doubt that disruptive technologies will change the quality and content of jobs. But the fact that the impact of these technologies will spread widely to white-collar professions is markedly different to how the impact of technological innovation until now has been restricted mainly to the quality and content of blue-collar jobs.

WORK THAT ONLY HUMANS CAN DO

Disruptive technologies, and in particular AI, will create huge disruptions to white-collar professions. It is currently predicted that these technologies will replace white-collar jobs including the most highly skilled professions — and there is already evidence of this happening. Advances in information technology during the so-called Third Industrial Revolution replaced many tasks typically carried out in an office, such as filing or creating documents, but AI's influence will extend to more specialized high-paying jobs such as those in the legal, accounting and medical fields.

A well-known survey conducted by a team of researchers at the University of Oxford evaluated at-risk jobs against the probability of computerization within the coming decade or two among 702 occupations in the US in 2010 by distinguishing low-, middle- and high-risk groups. According to their analysis, 47% of the 702 occupations are in the high-risk category, and this will be the case especially for jobs in the "Office and Administrative Support", "Sales and Related" and "Service" fields. On the other hand, new technologies will

not have a major effect on jobs in the "Education, Legal, Community Service, Arts and Media", "Healthcare Practitioners and Technical", "Management, Business, and Financial" and "Computer, Engineering and Science" fields (Frey & Osborne, 2013).

So what are jobs that only humans can do in a society with advanced AI? Before disruptive technologies gained so much attention, Robert Reich predicted in his book *The Future of Success* that two types of people will be in great demand in the new era: geeks and shrinks (Reich, 2000). Geeks are people who have the ability to create completely new things such as game-changing software, products, services and know-how, or come up with new ideas.

Reich explains that geeks find ultimate joy when their creations are recognized as being cool. This suggests that geeks are creators on the one hand, but are not so interested in the economic value of their creations. What motivates them is curiosity. They get pleasure out of inventing something new and are ecstatic when their creations are called "cool".

With geeks, you need shrinks. Shrinks are the type of people who can intuit what people want, especially those deepest yearnings and needs that even they themselves are not aware of. The relationship of a shrink to a geek is that shrinks have the insight into knowing which products or services created by geeks will sell, or what kind of products or services geeks should create in order for them to sell. Geeks are the creative people and shrinks are the imaginative people.

Geeks and shrinks do jobs that only humans can do, but this demands a certain talent that a lot of people do not have. In terms of high volume, other types of work that can only be performed by humans are those of a craftsperson in the broadest sense, and those that provide sophisticated services. Typically, a craftsperson would engage in make-to-order production such as building custom-made machines. This entails making a completely new piece of machinery, so quite often the client may not fully understand what kind of machinery they need. Jobs that provide sophisticated services are those that provide services that "hit the spot". These services cannot be manualized because they respond to the individual needs and desires of the client in different and sometimes unexpected situations. People in this profession must have the ability to produce added value by raising the level of services in medical care, long-term care, education and tourism, among other fields.

And another type of job that humans have to do is organizational jobs, most typically management jobs. Organizing a well-balanced team to achieve high level of performance, motivating people within the organization and adequately fostering people on the job are indispensable contributions that humans can make. Good organizational persons, geeks, shrinks, craftspersons and sophisticated service providers are capable of achieving high performance.

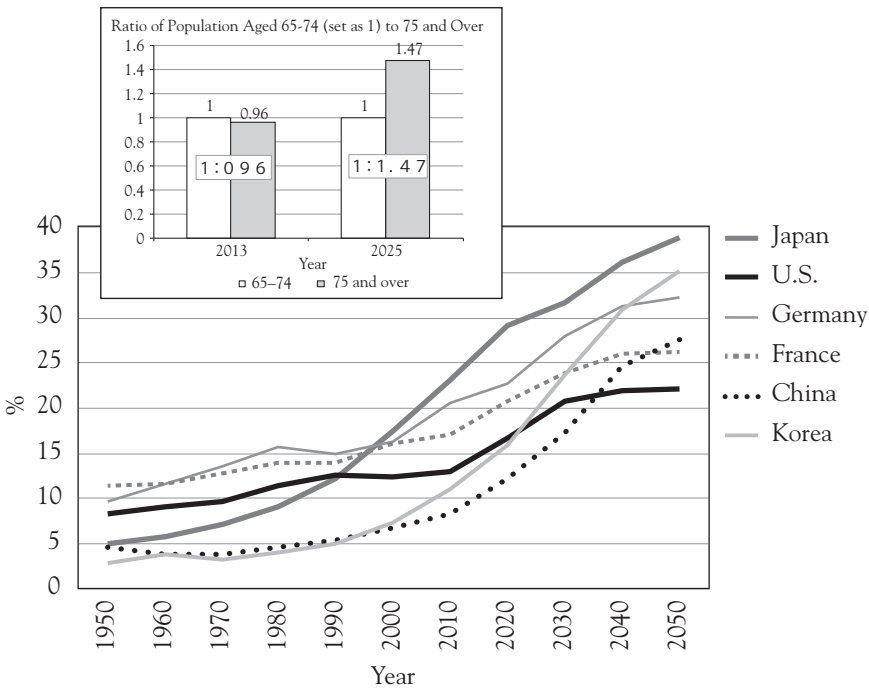
The work of a craftsperson is materializing the needs of the client into products. Sophisticated services that hit the spot are about perceiving the

needs and desires of the customers or clients and providing services according to each specific situation. And organizational persons must have wide-ranging and deep insights. In all these cases, they must be resourceful, imaginative and empathetic, which is something that AI is not.

BIG HOPE IN DISRUPTIVE TECHNOLOGIES TO COPE WITH POPULATION AGING

Similar to the potential of disruptive technologies such as AI and robotics to significantly impact employment, we are already seeing evidence of drastic changes affecting the structure of labour supply, which basically determines employment. In this respect, in developed countries, particularly in Japan, the low birthrate and population aging are the most significant structural changes.

Figure 1 – Proportion of older population aged 65 and over in major developed countries



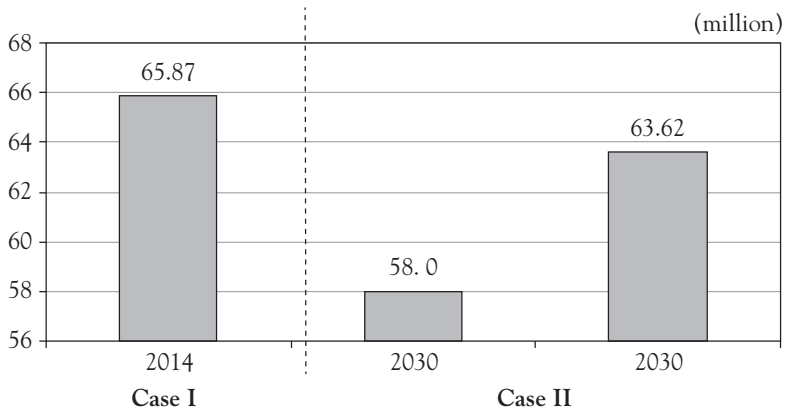
Source: Based on data from the World Population Prospects: The 2015 Revision, UN.

As seen in Figure 1, Japan's population aging is globally unprecedented in its level, speed and depth. The proportion of people aged 65 years old and over has now reached 27% of the total population of Japan, making it already the largest

proportion in the world. The speed at which population aging is progressing in Japan is two to four times faster than that of European countries. For example, in France it took 114 years for the older population to increase from 7% to 14% of the total population, while in Japan it took only 24 years. Furthermore, as the baby boomers who were born between 1947 and 1949 reach the age of 75 by 2025, within the older population itself, the proportion of people aged 75 years and over is expected to increase rapidly. Now the ratio of people aged 65 to 74 and people aged 75 and over is 1 to 1, but it is projected to be 1 to 1.5 in 2025.

One significant impact of population aging is the shrinking of the labour force. Figure 2 shows how much Japan's labour force is predicted to shrink by comparing the actual figures in 2014 and the projection for 2030. If no measures are taken, the labour force is set to decrease from the present 66 million to 58 million in 2030. All other conditions being equal, a smaller labour force will lead to lower productivity, which means that economic growth will weaken in the supply side of the economy. Furthermore, lower wages will result in lower consumption, thus economic growth will weaken also in the demand side of the economy. If we consider that it is mainly the working population that pays tax and social security, this would naturally mean that a smaller labour force will challenge the sustainability of the social security system.

Figure 2 – Projection of the Labour Force in Japan



Case I: Labour force participation rates remain constant
Case II: Labour force participation rates of women and older people will increase
(The necessary increase of the labour force participation rate for Case II)

Males	60-64	77.6%	→	89.3%
	65-69	52.5%	→	67.9%
Females	30-34	71.0%	→	84.6%
	35-39	70.8%	→	83.8%

Source: The Study Group Report on Employment Policies (2015), Ministry of Health, Labour and Welfare.

However, population decline does not necessarily mean a reduction in the labour force. The size of the labour force is calculated by multiplying the population by the labour force participation rate, so if we are to increase the number of people who are willing to work, in other words the labour force participation rate, then we would be able to sustain the current numbers of the labour force, or at least minimize its reduction. Already, the labour force participation rate of prime-age male workers is close to 100%, so one of the ways that has the greatest potential to expand the size of the working population is the promotion of the labour force participation of women and older people (Seike, 2016b).

As can be seen in the lower rows of Figure 2, if the labour force participation rate for women in their 30s and men in their 60s can be increased by 10 to 15 percentage points, the size of the labour force could be maintained at a stable level of 64 million by 2030. And, needless to say, increasing the labour force participation rate of older people largely depends on to what extent they are healthy (Seike, 2001). In this respect, the major progress of disruptive technologies in the field of life sciences may play a major role in the prevention of lifestyle-related diseases and help maintain good health into old age and cognitive abilities among older people. This is highly expected to happen.

Also enhancing child care support is one of the most important conditions to raise the labour force participation rate of women, because without substantial improvement, they would have to leave their jobs to care for their children. In addition to improving childcare services, we also need to provide more opportunities for women to work from home, and improve conditions that allow women to look after their children while they work. In this aspect, major advances in information technology may help expand the possibilities of working from home.

Furthermore, we are now facing a more serious phenomenon in which middle-aged to older people and women are reluctantly leaving their jobs to care for their parents or spouse. Losing experienced workers at the prime of their working lives, as well as women who are wives or daughters of older people who need long-term care, from the work force is a huge loss of human resources. Even now, there are not enough care services available because of the shortage of care workers, and with the rapidly increasing number of older people needing long-term care, this problem will only become more acute.

Another pressing problem is the dramatic increase in the number of older people with cognitive decline. The number is expected to grow from 5 million to 7 million within the next decade (Ninomiya *et al.*, 2014). Older people with cognitive decline essentially need person-to-person care, so this may bring a sharp increase in the demand for care workers. Therefore, the shortage of care workers may worsen at a faster pace, which means that more people will have to quit their jobs to take care of older family members with cognitive decline.

Again in this respect, disruptive technologies, namely remarkable advances in the life sciences, may provide solutions for preventing older people from developing physical and cognitive decline; enable the deferment of its onset through advances in the medical sciences; or even accelerate the development of assistive technology or equipment that can support people suffering from physical and cognitive decline. The introduction of care-giving robots may replace care workers, eliminate the problem of shortage of care workers, and reduce the number of middle- to older-aged workers and women unwillingly leaving their jobs to care for their family members (Ushiba & Soekadar, 2016; Inamura *et al.*, 2016).

Because of the literal interpretation, disruptive technologies are often thought to have a destructive impact on the economy and society, and this is particularly believed to be the case for employment. However, there are also high hopes, especially in a country such as Japan with a rapidly aging population, that new technologies will be a powerful tool for tackling problems related to population aging. In other words, disruptive technologies and aging may create a win-win relationship — we can be constructive with disruptive technologies. Japanese society should capitalize on this possibility and build a model for an aging society which can cope with problems caused by population aging through technological solutions for other countries that will soon face the same phenomena.

THE ROLE OF UNIVERSITIES

In any case, in order to ensure sustainable socioeconomic development amidst falling fertility rates and an aging population, it is essential to improve productivity. The advancement of technologies, such as IT, AI, IoT and robotics, is welcome news. These new technologies can replace some of the work that workers are now performing, while workers can specialize in work that can only be done by humans, producing added value that can only be created through human skills and ingenuity, and thus raising the value of labour productivity.

The important thing here is to ensure that the gains from raising value added productivity are distributed properly to the people who contributed to it. History has demonstrated that increased productivity through technological innovation has resulted in more demand for products, and therefore more employment, and raised the level of living standards. A virtuous cycle was created in which the fruits of improved productivity were shared among the workers in various forms, such as higher wages, and this in turn increased domestic demand. If the gains are not properly distributed, this could lead to the widening of disparities and shrinking of the economy.

The recent rise of populism, most notably in the UK, US and some European countries, is quite often attributed to the resentment people are

feeling after losing their jobs through economic globalization and technological innovation or having their income reduced, or it is triggered from the fear that these things may occur. However, we cannot deny that globalization and technology advancements are real, and we should not stop these processes, because these advancements could either have detrimental consequences or they could bring enormous economic benefits. Instead, we need to focus on sharing the benefits with as many people as possible and push ahead with economic globalization and technological innovation.

Universities can play a major role in this aspect. This role can be divided into two areas.

Firstly, universities can contribute to the sound development of new technologies and innovation by carrying out cutting-edge research that directly promotes technological innovation in the fields of natural sciences, life sciences and technological sciences. At the same time, it is important to promote research in the social sciences and humanities in order to understand the conditions under which these technologies are accepted by society. Discussions of the ethical, legal, economic and even psychological aspects surrounding the emergence of new technologies have become increasingly more important (Kokuryo & Kaya, 2017).

Another role universities are expected to play is, of course, education. To make new technological innovation available to a wider public, there needs to be some kind of system of redistributing the benefits thereof. Broadly speaking, there are two ways this can be done.

The first is to redistribute the gains from increased productivity in the form of monetary redistribution. Recently the idea of Basic Income, proposed by several economists, has garnered attention, and the referendum on a universal basic income plan in Switzerland in 2016 is still fresh in many people's minds. However, income distribution is one of the most important incentives for working, and there is a possibility that a plan which guarantees a uniform income for all may have an adverse effect on work ethics. This may also impact labour productivity and even pose various kinds of moral hazards.

The second way is involving as many people as possible in improving productivity through technological innovation, so that they can directly have a share in the benefits. To achieve this, these people must be equipped with the work ability to adapt to new technologies. Universities can play a major role in helping them cultivate the necessary abilities that will allow them to develop the capacity to adapt to the technologies themselves, or through training received on the job. One way to achieve this is to strengthen lifelong education, which is a recurrent education program that allows students to catch up with the newest technology. Graduate schools and professional graduate schools, in particular, will play a huge role in this area.

On the other hand, another necessary ability is being able to adapt to changes associated with the emergence of new technologies and markets. A defining characteristic of disruptive technologies is the pace at which these changes will occur, so it is not always realistic to learn new skills at university each time there is technological change. Instead, it is generally more efficient to learn new work skills through on-the-job training.

Therefore, it is important for universities to help students develop the basic ability that allows them to adapt to changes and re-skill when new technologies emerge (Seike, 2016a). This is the ability to understand for themselves market and technology changes and respond appropriately based on this understanding. The ability to think for yourself is not about thinking aimlessly but systematically; it is the ability to identify a problem, form a theory that logically explains the problem, verify whether the theory is true or false, and, if proven true, take appropriate action. This is, needless to say, the learning methodology of taking an unsolved problem as a research topic, constructing a hypothesis to explain the problem and testing the hypothesis to reach a conclusion.

In other words, what university students must do to respond to disruptive technologies is to engage themselves properly in this learning process. They need to understand the meaning of learning through a liberal arts education, as well as by implementing the learning methodology of selecting a topic and researching it in depth. Among work that can only be performed by humans, honing the ability of thinking for yourself is particularly helpful for people who are engaged in work that requires the imagination. This can be effectively developed through the learning methodology described above.

CONCLUSION

New technologies will continue to make significant advances and the pace at which this is currently taking place is likely to get faster. It is important not to stop this process, but to adapt these technologies to improve the public welfare of society, which will allow more people to support technological innovation. To do so, we need to build a framework of distributing the benefits of new technologies to the people.

Firstly, a framework which prevents the negative side effects of disruptive technologies is needed, and moreover, which distributes the fruits of the technology to as many people as possible. Here, it is especially important that as many people as possible are involved in the realization and success of the technological innovation, and as explained above, universities have an important role to play in making this a reality.

On the contrary, if we consider that new technological innovations have great potential to help us tackle issues brought on by declining fertility rates and population aging, these new technologies are not destructive but rather

are constructive. Since it is possible to forge a win-win relationship between aging and technological innovation, disruptive technologies can become constructive technologies in the long run. Allowing technologies to take their course in areas where they can replace humans, and humans to engage in work that only humans can do, is demonstrative of the kind of progress human society has made throughout history. Most people will engage in typically "human" work that involves creating new value, discerning its potential application, and responding flexibly to other people's needs.

With the appropriate response, the so-called disruptive technologies have a huge potential to help improve the wellbeing of humanity in the long run. Universities, too, can play a definitive role in assisting in the building of this win-win relationship between technological innovation and society.

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