



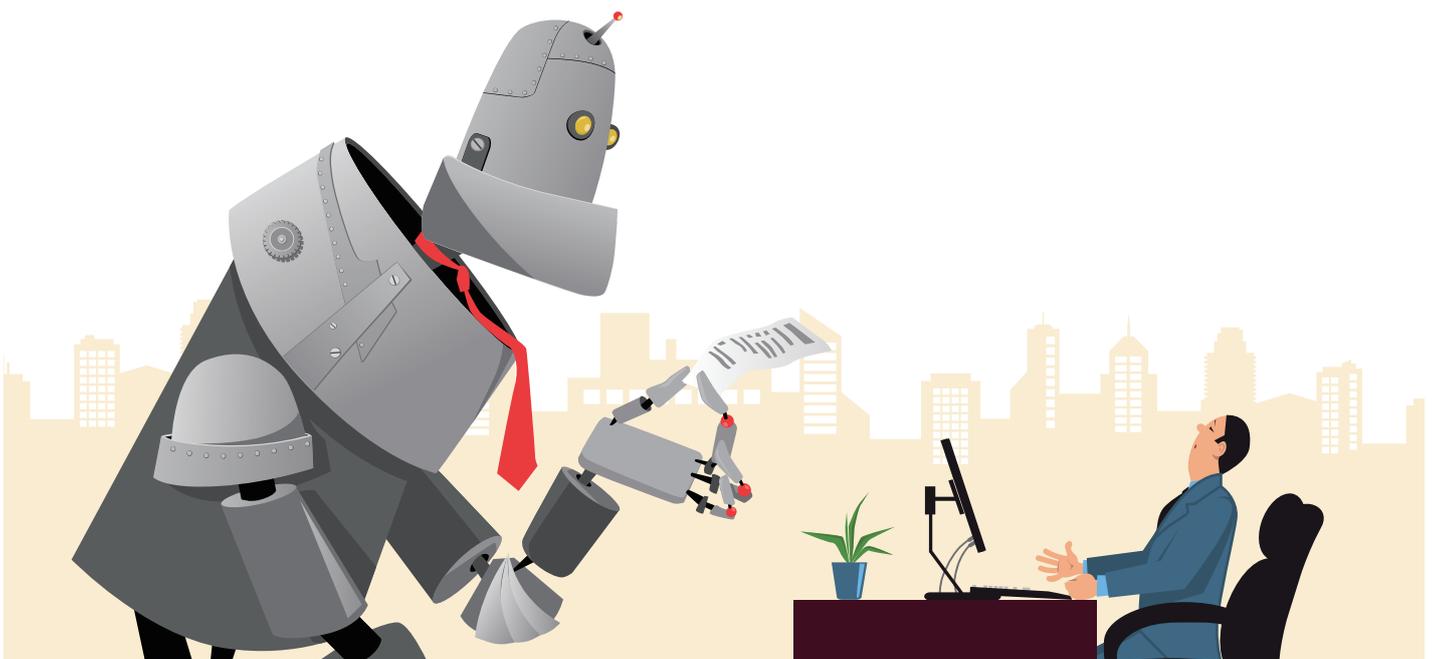
Ministry of Science, ICT
and Future Planning

Committee of Future Preparation
KISTEP, KAIST

Finding a Path to Future Jobs

Future Trends, Human Competencies
and Innovation of System
For Jobs in the 4th Industrial Revolution

2017. 2



I.

Introduction

The report titled *The Future of Jobs* by the World Economic Forum (WEF), held in January 2016 at Davos, Switzerland, predicted the impact of technological advancements, referred to as the Fourth Industrial Revolution, on human jobs. Two months later, Google's AlphaGo defeated Lee Se-dol in a Baduk match in South Korea, clearly showing that technology has entered the realm of human intelligence.

Job-related issues are important and relevant to the future of Korean society. In the same context, job insecurity was addressed as one of the main issues concerning the future of South Korea in the report titled *Future Issues of Korea* that was released by the Future Preparatory Committee of the Ministry of Science, ICT and Future Planning in 2015. The report showed that job insecurity has extensive links to other important economic and social issues (See Figure 1), such as low growth and shift in growth strategy, instability of life for future generations, and inequality, indicating that job insecurity is an issue with wide-ranging implications for Korean society in the future.

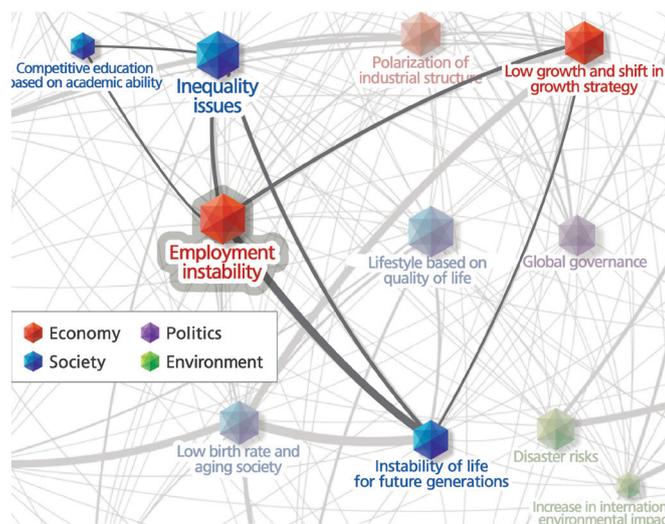


Figure 1 Correlations between job insecurity and other issues

Therefore, this report examines the approach Korean society must pursue to preemptively address future occupational transformations with the aim of proposing a future strategy at the national level based on this. First, factors affecting future changes in occupations, along with their trends, were analyzed to identify opportunities that would help determine a future strategic direction. The key points of this new initiative were defined as humans and innovation; as for humans, in particular, this report offers strategies for systemic transformation that enables humans to identify, cultivate, and maximize future capabilities that will be required for them to live in a future world.

II.

Drivers of Change in Future Jobs

■ Technological Advancements

Recent technological advancements are acting as primary drivers of job transformation in novel and different ways, based on their characteristics (See Figure 2). Remarkable advances in the so-called new DNA of technology, data (D), network (N), architecture (A), and algorithm (A) are expected to increase the value of data as a medium to connect with their contents, thus dismantling the various conventional boundaries. New links will be created in various ways as part of this process, thereby greatly expanding the role of machines and transforming the employment landscape. Humans will also be required to assume new roles amidst this upheaval.

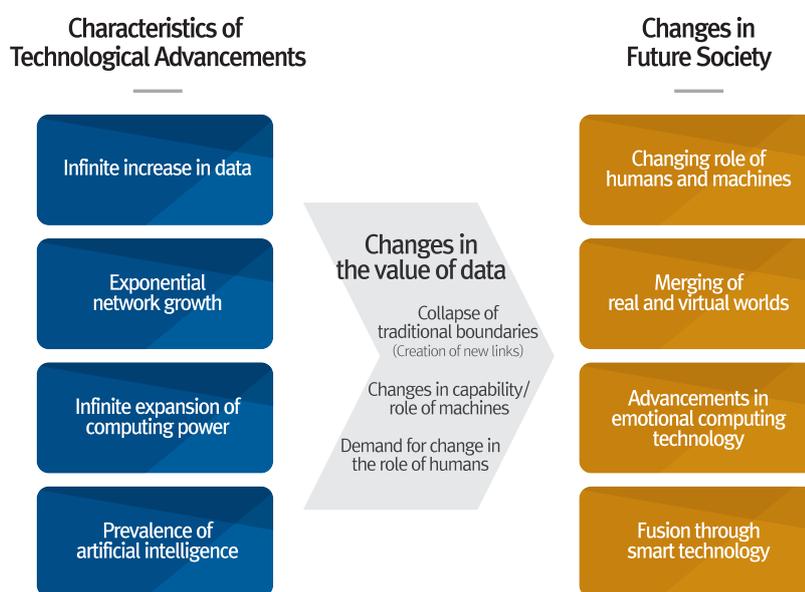


Figure 2 Technological advancements and changes in future society

■ Changes in the Socioeconomic Environment

Socioeconomic changes will also continue to influence job transformation in the future. The changes affecting employment will continue to occur in various areas, such as demographic structure, social values, industrial environment, international relations, and the natural environment.

- Regarding demographic structure, with an aging society and women's greater involvement in social activities, both senior citizens and women would emerge as one of the key labor resources, leading to changes in the structure of the labor force and accelerating the development of related industries.
- Regarding social values, a climate that emphasizes the quality of life will prevail. As a result, the balance between economic activities and leisure is expected to shift, accompanied by changes in the attitude toward labor and career choice. New jobs will be created in fields such as healthcare and the silver industry for maintaining healthy lifestyles.

- Regarding the industrial environment, the development of high value-added knowledge-based services will allow for further industrial growth. The softening of the economy, the so-called softnomics, will intensify the shift toward services, IT, and cultures. The growing tendency for individuals to place high value on the quality of life will influence smart technologies, thereby accelerating the development of high value-added knowledge-based industries.
- Regarding international relations, the expansion of cross-border migration and multiculturalism will continue, and this trend will lead to the diversification of the labor force, which in turn affects the job market and workplace diversity.
- Regarding the natural environment, climate change and energy crises are expected to persist. These threats will lead to increased investment flows toward preventing natural resource abuse and ecosystem destruction, thus creating future jobs in the relevant sectors.

III . Future Job Trends

■ Trends in the Future Job Situation

Technological advancements and socioeconomic changes are expected to significantly alter the future job landscape, such trends becoming predominant in the social environment, corporate culture, industrial structure, employment environment, and work environment (See Figure 3).

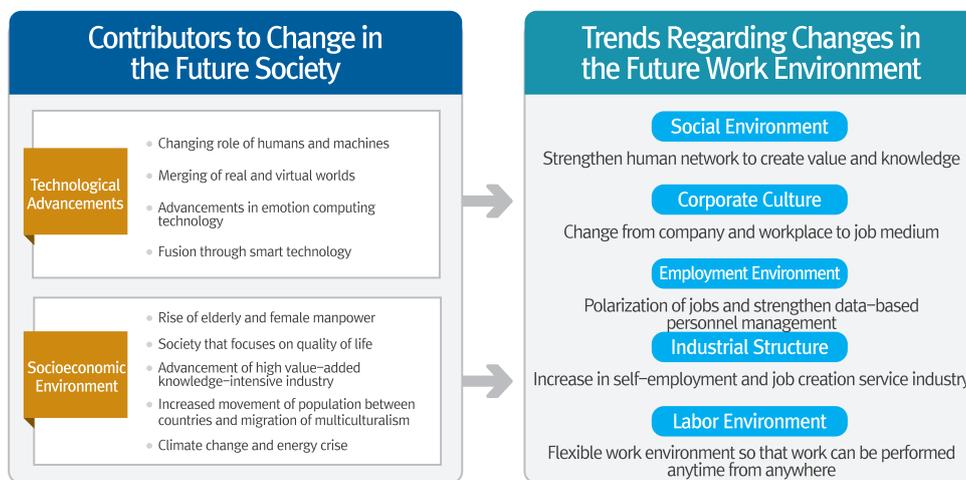


Figure 3 Drivers of change in the future society and future job trends

- Regarding the social environment, the human network will be strengthened as to create value and knowledge. Individuals and businesses will be linked in a network creating a new type of job market, where job openings are posted and filled as needed.
- Regarding corporate culture, the meaning of corporation will change from workplace to conduit for career development. The traditional concept of lifetime employment will become that of lifelong career, along with a shift from organization- to individual-centered corporate culture, further increasing the importance of open communication. There will be a growing demand for companies that place people first, and where work is happiness.

- Regarding industrial structure, self-employment will become more common and the creative service industry will likely grow. The widespread adoption of new production systems that reflect consumer needs will increase self-employment, such as a sole proprietorship, which in turn alters the dichotomous corporate structure of large-sized conglomerates or small- and medium-sized entrepreneurs. Additionally, the advancements in smart technologies, combined with the increased value of imagination, will drive growth in the creative service market.
- Regarding the employment environment, job polarization and data-based human resource (HR) management will continue to intensify. Even currently, employment is becoming increasingly polarized, leading to a stronger reliance on data-driven HR management for recruiting and managing competent employees.
- Regarding the work environment, flexibility will become the key word. A uniform computing environment will be provided for users to work anywhere, any time. As a result, telecommuting and remote work are expected to become more prevalent.

■ Future Trends in Job Transformation

Changes in the employment landscape will also result in significant job transformation. Particularly, four key trends (see Figure 4) are expected to lead the job transformation, where a new occupation is created or occupational characteristics are altered by transforming the role of humans, as well as enabling the development, compartmentalization, and interlinking of conventional jobs.

- Human labor input will become more advanced and complex as machines partially replace human work, thereby creating higher added value for existing jobs.
- Social development and enhanced quality of life will expand the market for customized goods, numerous jobs becoming specialized and compartmentalized.
- As the digital economy thrives, along with the emergence of a hyper-connected society, integrated occupations will be created in the process of linking the knowledge and tasks of diverse jobs.
- The development, application, and delivery of new technologies in space, artificial organs, and other cutting-edge fields will generate numerous spin-off jobs based on science and technology.

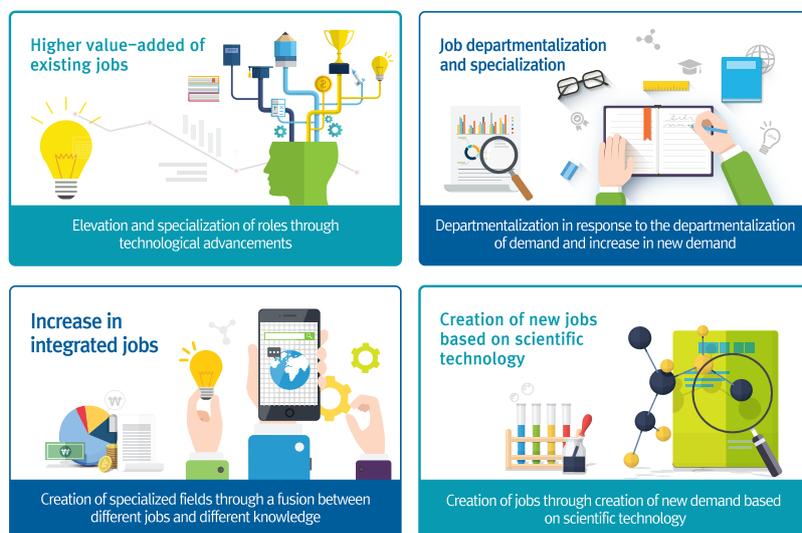


Figure 4 Future trends in job transformation

■ Current State of South Korean Society

The unique features of Korean society, in relation to jobs, can be summarized as follows: 1) rapid demographic changes due to the low birthrate and aging population; 2) high youth unemployment rate and lack of adequate jobs; 3) generational gap in human competence; 4) a service industry characterized by relatively low value-added ratio and productivity; 5) occupational structure with the potential for employment fluctuations; and 6) high job-generating potential in the fields of science and technology.

■ Perception and Prospects

The distinguishing features of Korean society are evident in the perceptions and prospects its members conceive for future jobs. In August 2016, the Future Preparatory Committee conducted a survey of 475 experts, including university career advisors, employment policy experts, and corporate HR managers to examine the perceptions and outlook on future jobs in South Korea.

Key results of the survey showed that South Korean experts consider technological factors to exert as much influence on future job transformation as the socio-economic and demographic changes that have previously driven such job transformations. Additionally, technological advancement is expected to have a positive impact on social changes, productivity, and work environment. During the survey, approximately 300 corporate experts were asked about task-related changes due to technological advances over the past three years. They consider that considerable changes had occurred for machines, while changes in the roles of humans were relatively minor.

Different perceptions on task transformation due to technological advancement were observed among survey respondents. As such, academic and policy experts forecast technological development to transform work tasks, whereas corporate experts provided more neutral responses. The rate of job replacement by machines is expected to be 30 to 40%, the respondents remaining neutral in their view on whether jobs will be able to maintain the same level of specialization in the future. Most experts agree that a better understanding of technology-driven job transformation, alongside the strengthening of necessary capabilities, will help respond to future changes in jobs. However, corporate experts were less supportive compared to the other expert groups.

Finally, South Korean experts perceive the country's future capabilities and related skills to lag behind those of technologically advanced nations leading the 4th industry evolution such as United States, Germany, and Japan. Key human capabilities whose importance will increase in South Korea over the next five years, the so-called future capabilities, were identified as follows: complex problem solving, system and technology capabilities, and social networking skills. On the other hand, the respondents affirm that the task-related capability, once important, would decrease in importance. Moreover, respondents generally perceive South Korea to lack such future capabilities compared to advanced economies (the United States, Germany, and Japan), and rank "aging population" as the leading socioeconomic driver affecting future job transformation.

■ Strategies for Future Jobs

By examining South Korea's perceptions and prospects of future change, as well as its job-related social characteristics, this report identifies threats and opportunities. Positive challenges to future change (see Figure 5) should take so that threats serve as a springboard toward rapid change and opportunities are leveraged to their maximum potential. The key to determining positive challenges is fostering talented individuals, who are capable of responding to future changes, and creating a social environment, where they can thrive by fully employing their core capabilities. Building on these tenets, ensuring continuous human-centric innovation emerges as the primary framework in building a response strategy for future job transformations.

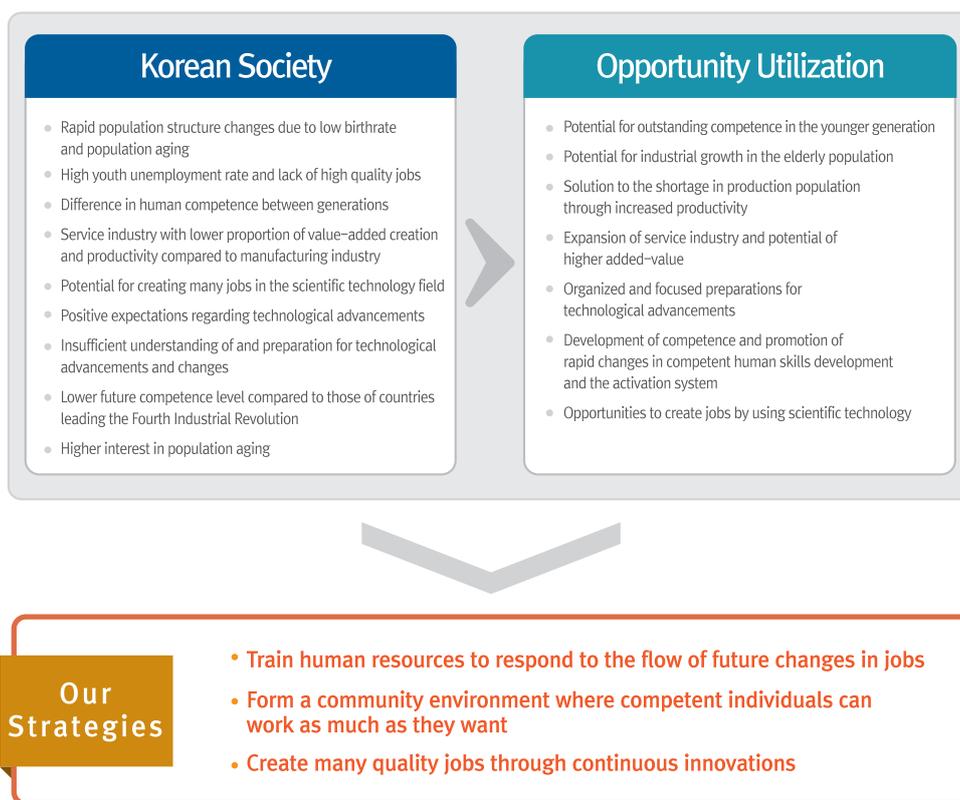


Figure 5 Current state of Korean society and Our strategies toward future changes

V. Necessary Future Capabilities

Three major future capabilities and 11 specific skills required by future jobs were identified by conducting a literature review (80 studies), surveying experts (475 subjects*), performing network analysis, holding expert focus group interviews, and engaging in deductive reasoning (Figure 6).

* 64 university career development specialists, 92 employment policy experts, and 319 corporate HR department managers.

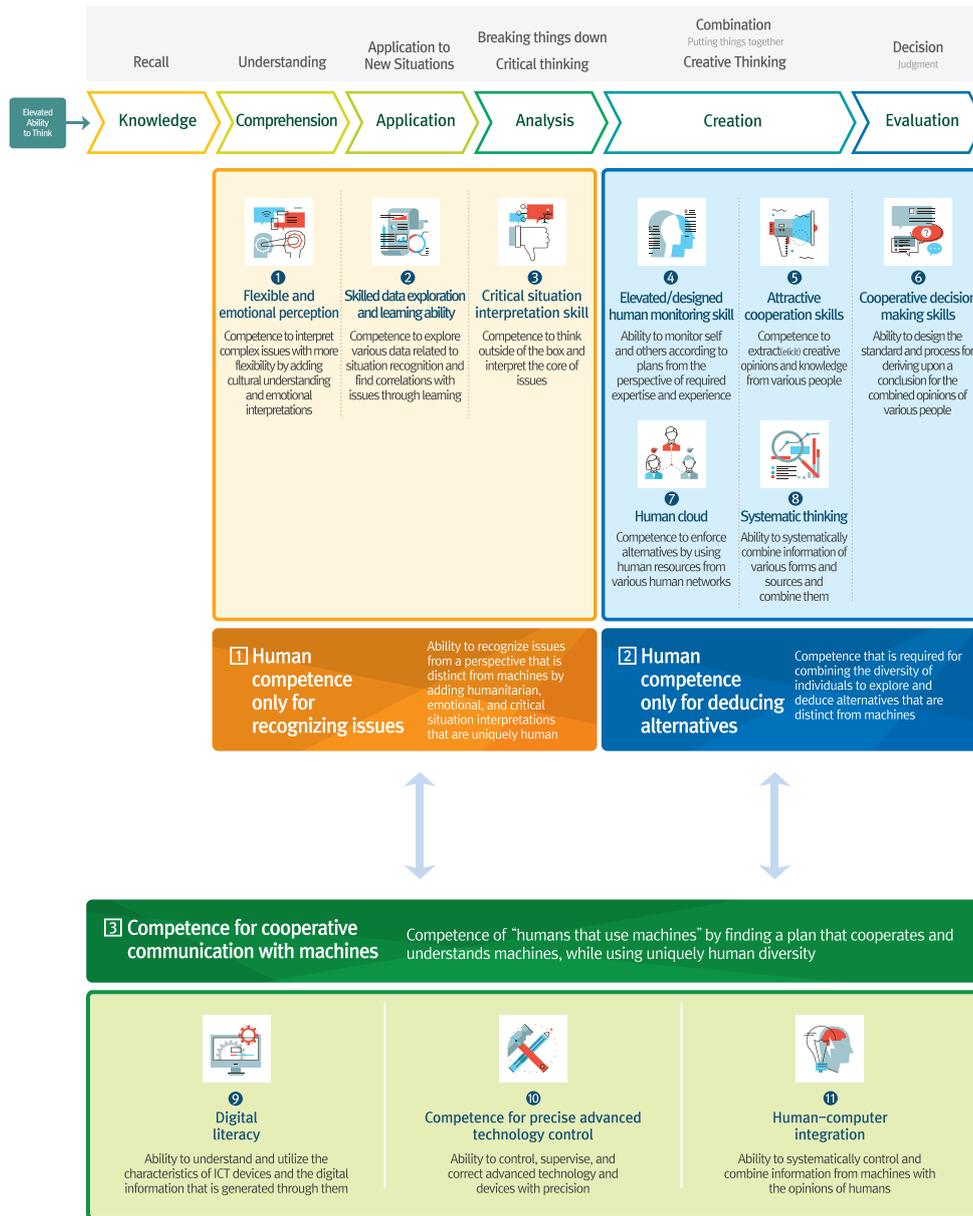


Figure 6 Three major necessary capabilities and 11 specific skill sets

Future generations will be required to possess the following three capabilities: 1) the innate human ability to recognize a problem, which is different from machines; 2) the innate human ability to explore alternatives; and 3) the ability to collaborate and communicate with machines. The uniquely human ability to recognize problems will help differentiate humans from machines regarding interpretation, application, and analysis; and the ability to provide solutions will enable humans to distinguish themselves from machines in creating and evaluating alternatives. Collaborative communication with machines will allow humans to leverage the capabilities of the latter throughout the entire cognitive process and further strengthen overall human cognition. Humans will be able to coexist with machines by utilizing future capabilities to solve complex problems using their creativity and imagination.

VI.

System Innovations for Future Job Transformation

Four key perspectives, based on future core human capabilities, represent the roadmap for change in our social system in preparation for future job transformation (see Figure 7). As such, society-wide changes will be required for humans to utilize new capabilities and fulfill new roles, to leverage machines with more advanced capabilities while retaining leadership over these future tools.



Figure 7 Innovation of Systems that Respond to Changes in Future Jobs

■ Innovation in Customized Education Systems

Innovation in the educational system is critical to the nurturing of a talented labor force with unique capabilities, differentiating them from machines. To achieve this, specific strategies must be established from the following three perspectives.

- **Schooling System Innovations** The future workforce will be required to possess increasingly flexible and creative thinking abilities. Consequently, the education focusing on the abilities to think and solve problems should be strengthened. Nurturing talented individuals capable of collaborating and communicating with others, in an attempt to keep abreast of technological advancements, will require social and emotional education, along with coding and digital education. More active entrepreneurship training must be provided to effectively respond to the increase in self-employment, startup, and job creation, one of the key future trends in job transformation. Concurrent with the training for new capabilities, curriculums and learning methods should also be considered in maximizing the utilization such novel abilities.

- **Lifelong Education** In addition to school education, workers must continue to receive training for technical advancements at their current jobs. The ability to adapt to rapid changes in the workplace must be cultivated, such as industrial restructuring due to technological innovations, shifts in the competitive landscape, or changes in the task processing methods for various jobs. Workers must be continuously provided with training opportunities so that they can increase expertise, and there must be differentiated training on entrepreneurship competence for those with field experience. Guaranteed training hours for workers and a demand-oriented lifelong education system will thus be required for better lifetime learning.

- **Strengthening of Technical Foundation for Education** For the new generation of digital natives, which is more familiar with a smartphone than a pencil, technology-based innovation needs to take place across the educational landscape. Edutech or education technology, which combines these two fields, will provide efficient and customized education via the data-based analysis of student progress and achievements. Massive open online courses (MOOC), a leading edutech service, can be an example of how technology can transcend the boundaries of time and space to provide better educational opportunities and environments.

■ Diversification of Jobs and Innovation in Corporate Culture

The future employment environment must be conducive to the creation of new jobs fueled by rapid changes in our society, allow individuals to fully utilize their expertise, and enable innovation in corporate culture. To this end, specific strategies will be required from the following four perspectives.

- **Startup Promotion and Support** Startups should be promoted so that individuals can explore new jobs and enter the labor market using creative ideas and activities to effectively deal with the automation-driven job transformation. To boost these entrepreneurial efforts, intellectual property rights and institutional support for initial startup investments should be strengthened, and the maker movement, which involves looking for and sharing creative avenues in daily life, should be developed and promoted. Institutional improvements are also required to promote this creation of new jobs, allowing technological development to seamlessly transition to novel high-quality jobs.

- **Integrated Future Job Information Infrastructure** Providing job-related information in the future will no longer revolve around quantitative and standardized information, but will instead emphasize quality. The integrated information system for future jobs should be strengthened, creating a trust-based and systematic job-matching platform. Because job creation and depletion are expected to occur at a faster pace in the future job environment, the job information system would need to include strong forecasting features.

- **Activation of Hybrid Job Experience Support** Hybrid job experience refers to workers with multiple specializations concurrently engaged in a variety of jobs. As it will become easier to match jobs with people, future hybrid job experience will become more commonplace. Therefore, policies that recognize hybrid job experience and activities must be established, and an attitude that acknowledges the value of hybrid job experience must also be fostered across society.

- **Innovation in Corporate Culture and Human Resources Environment** For individual competence to be properly exhibited, human-centric corporate culture must be created. This will first require changes in business management methods. As such, in-company training should be provided for forward-looking capacity building, allowing every employee to strengthen their expertise toward matching their respective capacities. The workplace must be digitized and provided with the support needed to imbue each employee with new capabilities that match the new environment. Reduced working hours and flexible terms of employment could be considered to improve work environment quality.

■ Improvements in the Social Safety Net System

Embracing alienated classes in technological advancements is an important determinant of future job strategy. Responding to this challenge will require specific strategies from the following two perspectives.

- **Organizing a Social System that Responds to New Employment Formats** The rise of the shared economy will lead to an increase in the number of individuals who work independently rather than as part of an organization. As such, new policies must be formulated to protect and support the revenues and rights of these new types of employment.

- **Protecting Vulnerable and Victimized Social Classes** A social safety net must be created to protect groups unable to promptly adapt to job market changes. The government must make a concerted effort to strengthen social security for vulnerable groups, as well as unstable workers not covered by traditional social safety measures. Moreover, job replacement fueled by an increase in the use of machines and automation will exacerbate wage inequality, which calls for further discussions on income redistribution, as well as the development of new tax bases such as a robot tax.

■ Consolidating the Foundations for Creating Quality Jobs

The ultimate goal of the strategies for developing new capabilities that differentiate humans from machines is to provide people with adequate jobs. To this end, human activities must be able to produce highly valuable commodities in an extant industrial system. Innovation strategies will be required from the following three perspectives.

- **Innovation in Manufacturing Industry** New conceptual design capability and an innovative environment, in which this new capability can be exerted, should be created in preparation for society and industry paradigm shifts. It should be noted that the salient aspects of manufacturing innovation via production automation, as represented by smart factories in the United States and Industry 4.0 in Germany, are not merely the cost cutting or productivity boost they deliver, but the potential for changing the method and process of innovation. In other words, the human-centric innovation in the production system and the refining of its role must be based on human experience. With the increasing trend toward demand-customized production, manufacturing must thus converge with services, and the roles of workers be remapped accordingly.

- **High Value-Added Service Industry** To improve productivity in the service industry, the foundations of innovation must first be strengthened. The development of service science will be required to achieve this goal. National R&D capabilities for developing high value-added services and the development of cultural industries

(creative content industry), which combine scientific technology with cultural aspects, will also need to be promoted. New ways to develop a high-quality workforce for the knowledge-based service industry must be explored, because this industry is capable of generating a relatively greater number of new jobs through increased productivity.

- **Creating an Environment that Promotes Innovation** Resources whose benefits can be shared by all companies, which are individually engaged in innovation activities, are called innovation commons. The accumulation of conceptual design capabilities, the development of a platform on which data can be collected and shared throughout society, and the establishment of trust among all parts of society will enable such innovation commons to be built. Additionally, regulations governing domestic industries could become negative as a preemptively respond to the job transformation driven by technological innovation.

VII. Conclusion

The ideal future involves a society in which uniquely human abilities are integrated with the capabilities of machines, leading to an expansion in the overall scope of innovation (see Figure 8). This progress will enable machines to conduct simple and repetitive tasks, while humans focus on unique, emotive, and human tasks, accelerating innovation and expanding total wealth by boosting productivity and reducing the need for human labor to create a prosperous, happier, and leisure-filled society. In pursuit of this vision, the uniquely human capabilities that differentiate individuals from machines, should be developed and leveraged to build a system that enables humans to maintain their leadership over machines and drive innovation. The choices humans make will determine whether technological advancement leads to a machine-dominated productivity expansion that further highlights the polarization and redistribution of income or, instead, results in human-led innovation that creates ample returns in the form of new, high-quality jobs. In the wake of all new industrial revolutions throughout history, humans chose the path toward better roles for humans and positive changes for the social system. Today, our choices remain clear for this newest revolution: people and innovation.

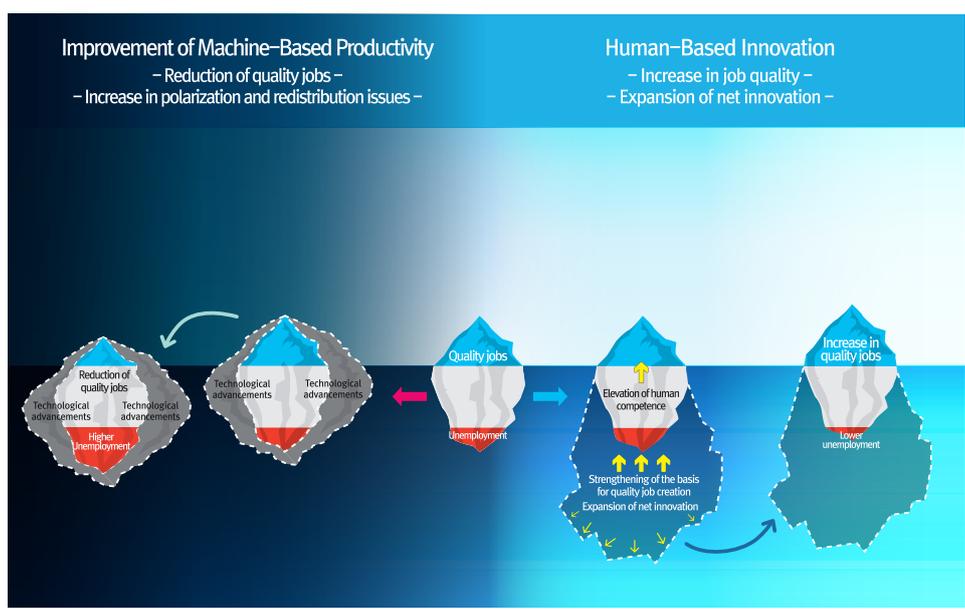


Figure 8 Two directions of future job transformation through technological advancements