Future social changes in Artificial Intelligence Technology

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1. Introduction

Artificial intelligence technology has risen rapidly in recent years. As technologies are rapidly being integrated and distributed in various fields, including media, transportation, logistics, safety and environment, from personal secretarial areas such as Google's Naoo and Apple's Siri to the recognition/decision system of self-driving cars, the new source of value-added creation that will lead the value-added industry and knowledge-based society.
However, not only are there expectations for these economic and social effects, but there are also growing concerns about the negative effects of automation such as job replacement and out of control.

In particular, many experts, including Ellen Musk, Stephen Hawking, Bill Gates, and Steve Wozniak, expressed anxiety about the dangers of artificial intelligence and the future of mankind. Meanwhile, given the rate of development and expansion of technology, these expectations or concerns are likely to become reality in the near future.
Therefore, in order to prevent the negative effects of artificial intelligence technology in advance and to maximise the positive effects, it is necessary to pre-emptively present a discourse to predict and technologically and institutionally prepare for the effects of technology on society as a whole.

Thus, the 2015 Technology Impact Assessment, which focused on MSIP and KISTEP, was designed to look at the current state of artificial intelligence technology and to prepare countermeasures by predicting the impact on the overall social economy in the future.
The manuscript is based on opinions and data presented by experts and ordinary citizens in the process of conducting the AI technology impact assessment, and additional research by KISTEP researchers to present the rationale.

The Technical Assessment has been responsible for the development of undesirable technologies since World War II. The need for democratic control of change and development first began in the United States in 1972 with a reversal of the socio-economic role and responsibility of science and technology.
In Korea, the need began to be raised to secure the accountability of government spending after the

1990s, when spending on research and development increased significantly.
The Framework Act on Science and Technology enacted in 2001 stipulated the obligation to carry out a technical impact assessment, which was first implemented in 2003 and was conducted nine times by 2015.
According to Article 14 of the Framework Act on Science and Technology, the country's technological impact assessment aims to induce desirable direction of change from the beginning of policy establishment by drawing policy considerations to maximize positive impact and minimize negative impact in evaluating the impact of new developments on economy, society, culture, ethics and environment in advance and reflecting the results in policies.
To this end, the new technology provides a response measure through the participation of the members of society, and the function of enhancing social acceptability by improving the people's understanding of the science and technology policies, and thereby enhancing the social responsibility of scientists and engineers.

2. AI Technology Trends

Artificial intelligence technology is a technology that can solve problems by implementing human perceptions, reasoning, learning ability, etc. using computer technology, it is already widely applied in various industries including intelligent financial services, medical diagnosis, legal service support, game, article writing, intelligent robot, intelligent secretary, intelligent monitoring system, recommended system, spam classification, etc. According to last year's Gartner announcement, many of the emerging technologies include brain-computer interface, natural language processing, intelligent robots, and machine running are AI-related body language technologies (Figure 2).

The field of artificial intelligence, which first began in the 1950s with Dartmouth meetings centering on John McCarthy and Marvin Minsky, has experienced several ups and downs ([Table 1]. However, recent advances in cloud computing and big data, improvements in computing power, activation of networks, and deep learning have led to rapid growth in technology and re-emerged attention. In particular, IBM's Deep Blue and Watson computer win over human champions in a "brain" game and a "Jeopardy" quiz show served as an opportunity to show the public the possibility that artificial intelligence computers could prevail in the "intelligence" field, which was considered a natural domain of human beings.

With the remarkable development of artificial intelligence technology, the application area of technology is rapidly expanding and the social and industrial needs are also gradually becoming concrete. First of all, artificial intelligence technology has emerged as a value industry that values human convenience and safety due to the rise of income levels and the advent of an aging society. In particular, it is proposed as an alternative to reducing the social cost of reducing the production population due to low birthrate and aging population, and the possibility of using intelligent robots and unmanned aerial vehicles is expanding in dangerous areas where human access is difficult. Artificial intelligence technology is also drawing attention as a new source of value added that will lead the knowledge and information society of the future. Efficiency is increasing through the use of data management, analysis, and business decision making. In the manufacturing sector, robots that only perform certain risks/precise tasks in accordance with programs given in separate spaces from humans are developed in the same space with artificial intelligence. Meanwhile, in the service sector of finance, education and distribution, artificial intelligence becomes a kind of question-and-answer and consulting agent, providing customized information and services depending on

situations, and promoting service intelligence. Moreover, as the scope and diversity of problem solving is expanded due to the development of artificial intelligence, the expansion of human intelligence is expected to have a significant impact on the development of computer science and so on, and by linking artificial intelligence programs with the cloud, the effectiveness of big data and the Internet can be dramatically increased.

These artificial intelligence technologies are currently actively being studied in advanced countries such as the U.S. and the EU, which provide billions of dollars in investment in government-level artificial intelligence R&D policies. In Korea, the Ministry of Science, ICP and Future Planning (MSIP) is pushing for artificial intelligence development projects such as Exobrain, Deepview, etc. with KAIST, ETRI, and Saltrux as its focus ([Figure 3]).

In the industry, Google, Facebook, Microsoft and IBM, which have recognized the new possibilities of artificial intelligence technology, are actively investing in technology development as well as recruiting talented people. For example, Google recruited Deep Learning's master professor Jeffrey Hinton, acquired word lenses with deep learning company DeepMind and photo-recognition translation technology, and IBM is focusing on strengthening its Watson system to provide B2B corporate consulting and intelligence services. Facebook is also carrying out many studies such as face recognition program Deep Face through Deep Learning, and Microsoft has introduced simultaneous interpretation technology that can be used in voice recognition, Cortana, an intelligent assistant. On the other hand, many of these companies have seen their value soar in recent years, especially as of last year, the companies that rank 1 to 4 in the world's ranking in corporate brand values are those with artificial intelligence technology ([Table 2].

IDC, Tractica, McKinsey and Siemens predict that the global artificial intelligence market will rapidly grow as artificial intelligence becomes a promising technology for the future, with intensive investment and research and development taking place. Tractica predicted an average annual growth of 56.1% from $200 million in 2015 to $11.1 billion in 2024, while Siemens predicted that the global market for artificial intelligence-related smart machines will reach $41.2 billion in 2024, based on BCC research data.

It would be significant for the advancement of technology to look into the effects of artificial intelligence in advance and come up with social and institutional countermeasures. Among the various evaluation issues presented in the technical impact assessment, this manuscript focused on productivity growth and job changes, quality of life and new social and ethical issues with high social interest. On the other hand, since there are various perspectives on the technical feasibility and timing of implementation of strong artificial intelligence, the assessment was conducted focusing on weak artificial intelligence.

3. Future Social Changes and Countermeasures Due to Artificial Intelligence Development

(1) Improving productivity

If artificial intelligence technology is developed, it is expected that automation and intelligence will be promoted in manufacturing and service industries and that productivity and quality will be improved. For example, Industry 4.0, a manufacturing innovation strategy pursued in Germany,

wanted to increase productivity and efficiency by expanding the use of artificial intelligence in manufacturing through the CyberPhysical System (CPS) ([Figure 6]) so that it could be manufactured and produced through the cloud or network in an automated physical space that exists. Labor productivity is also expected to increase significantly as artificial intelligence replaces simple repetitive tasks in humans.

In Amazon, for example, there is a case of introducing a warehouse cleanup automation system called Kiva, greatly increasing the efficiency of the logistics system and reducing the overall cost.

The quality of service offered by humans and artificial intelligence will be greatly improved if they can concentrate on tasks that require judgment, creativity, emotion and cooperation.

For example, if artificial intelligence is entrusted with the existing routine chores of nurses or the prior investigation of lawyers, the relatively large number of tasks can be quickly handled in a short period of time, more time will be devoted to communicating with patients and clients actively.

In addition, artificial intelligence automated production systems can solve the labor cost problem in developed countries, which have traditionally implemented off-shoring policies due to high labor costs, and in some developed countries, manufacturing regressions can be found.
May occur.

Already in the United States, re-shoring policies have begun to be implemented in recent years as part of a manufacturing reinforcement strategy, which is expected to derive positive effects on related industries, even if they do not directly contribute to creating jobs in their own countries. On the other hand, if manufacturing competitiveness of advanced countries is strengthened and global competition intensifies, there is a possibility that the economy will become unstable if excessive production occurs.

It is urgent for Korea to foster an artificial intelligence industry ecosystem and support R&D in order to keep abreast of global industrial competition that will be intensified with this growing productivity and the policy of re-shooting of developed countries. especially the start-up department.
Government-level strategies and investments will be needed, including the establishment of joint platforms and technical systems to foster small and medium-sized enterprises.

Already, leading countries such as the United States, Britain and Germany are building an ecosystem through large-scale government R&D investment and spin-off. Also, artificial intelligence technology is very fast to develop, and since it is a technology field that is difficult to pursue once the ecosystem is in control, it will require consistent, long-term investment and support rather than temporary intensive investment.
Meanwhile, in order for the increased labor productivity to lead to a substantial improvement in the quality of life, it will also be necessary to come up with improvement measures such as work-related laws and welfare systems in line with the growing trend of expanding multi-job groups through timeharing and productivity.

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(2) Job Change

It is expected that many job changes will occur if artificial intelligence automates replace work.

According to Tech Pro Research's recognition report on 'artificial intelligence and IT,' 63 percent of respondents said they expect artificial intelligence to help the business, but also have a 34 percent high level of concern that related technologies will result in job losses.

Amid mounting concerns over artificial intelligence and job replacement, renowned foreign institutions have released different research results on job changes due to the development of artificial intelligence.

According to a 2013 study of 702 detailed job trends at Oxford, 47 percent of U.S. jobs are at risk of being eliminated by computerization.

Also, according to the BCG report, Indonesia, Thailand, Taiwan and South Korea are the most active manufacturers in accepting robot automation. For example, South Korea is expected to replace 20 percent of its overall work with automated robots by 2020 and 45 percent by 2025.On the other hand, McKinsey's analysis of jobs and technology in the U.S. found that after analyzing 2,000 major tasks in 800 jobs surveyed, 45% were automated, but only 5% of them could completely replace people due to automation.

In other words, replacing the robot's labor force should be evaluated in terms of 'work that can't be 'worked'', and even if some of the work is replaced by automation, it still needs a human role, and the machine and the person will work together to increase efficiency.

It is predicted that machines will be in charge of repetitive or physical tasks, while humans will be able to improve industrial productivity or the quality of products and services if they focus on more creative tasks or tasks that require emotional and collaborative work. Different agencies and individuals produce different predictive results, so there is no clear conclusion, but there is a common prediction from most research institutes or experts. The development of artificial intelligence will result in the replacement of human intellectual/physical tasks, and much of the tasks based on simple repetitive tasks or manuals will be replaced. In particular, high-risk jobs such as telemarketers and call center counselors based on manuals, transportation workers and labor production positions were recognized as high-risk groups. In addition, some professional services such as medical, legal counseling, and reporters were also expected to be replaced by artificial intelligence. This is because robot prices continue to fall more than 10 percent a year on average compared to the rising wages of workers, increasing attempts to replace human labor with artificial intelligence.

In particular, it is expected that range of ripple effects will be extensive in the sense that replacement of professional services due to artificial intelligence replaces high-level mental labor unlike previous industrialization and automation. On the other hand, AI will not be able to replace jobs that focus on helping and caring for people, persuading and negotiating others, jobs that have strong artistic and emotional characteristics, or jobs that require a combination of ideas or a comprehensive and creative way of thinking in a novel way that is different from conventional methods. In addition, a new group of professions that are directly and indirectly related to artificial intelligence will be created. The creation of knowledge-intensive new jobs such as development personnel or skilled operators, such as

data science, robot research and development and software development, operation, repair and maintenance jobs, is expected to increase employment as related businesses or new services become active.

For example, market research firm Metra Martech expects employment in robot research and manufacturing, parts and software development, operation, repair and maintenance to increase by more than 30% each year, according to a 2011 forecast survey of Brazil, Germany, the United States, South Korea, Japan and China.

Moreover, the initial industrialization of artificial intelligence technology is also increasing market demand for math, statistics and software engineering.
With the U.S., the popularity of these classes has already reached near the highest level, and the average salary after graduation is also at the top of the list. As artificial intelligence technology spreads to various fields, the status of software engineers will grow even bigger, and the demand for AI experts with new concepts such as data Scientist and white hacker will also expand.

In order to cope with changes in jobs caused by the development of artificial intelligence technology, job research that suits the situation in Korea is needed first. Most of the published work results on artificial intelligence have been conducted in the U.S. and Europe, and it is too difficult to apply them to Korea, as there are many differences in the domestic industrial environment and the composition of jobs. Only when research is underpinned for our environment will policy directions such as the relocation of more effective personnel and the training of new employees. The social environment and possible issues to be changed due to technological development, the change of characteristics of the people and the study of the changes in the employment structure and the industrial ecology of our country according to technological development will be necessary.

There is also a need to improve job policies and systems to reduce friction. Improving labor laws to protect jobs at an appropriate level or recognizing multiple job groups in order to prevent the occurrence of job losses caused by artificial
We need to come up with flexible measures to cope with changes by preparing improvement measures.

The educational system must also be improved. First of all, there should be ways to train specialized IT personnel related to artificial intelligence that are expected to increase demand along with technological advances. Reform measures should be made to improve the education system so that people working in the relevant fields can play a suitable role with professionalism, and to create a lifelong retraining/training system so that they can adapt to shifts or changes in work depending on the rate of job replacement. It is also necessary to expand programming-related education to existing curriculum.

Meanwhile, it is also necessary to nurture talent in areas where artificial intelligence is difficult to replace. Education or programs for promoting creative and comprehensive thinking and enhancing the sensitivity of social skills and empathy will also need to be activated. In addition, it will also be necessary to train educators who can conduct education in a direction that can improve judgment and ethical sophistication rather than simply conveying knowledge.
According to the Washington Post's report, the ability to look at problems from a new perspective and offer useful solutions to future careers where many changes will occur due to artificial intelligence, the ability to use tools to model or prototype ideas with constant

curiosity, the ability to achieve tasks with a clear conscience, an open mind, and a challenge to many people. Of course, in order to cultivate these talents, a change in social perception that encourages new ideas or challenges and values communication among people should be given priority.

(3) Improving the quality of life

The development of artificial intelligence technology is expected to provide new opportunities by improving the quality of life through intelligent service provision and improving access to new knowledge. First of all, it is expected that welfare services will be improved further due to the development of artificial intelligence aid, robot technology, etc. This will solve the problem of human resources in charge of welfare work in the upcoming super-aged society, and will replace or supplement the tasks that are difficult for human beings to perform. They will also receive higher quality service through real-time monitoring or personalised service. For example, if artificial intelligence technology is linked to IoT and learns people's behavior or monitors living conditions, it is expected to improve the quality of life by improving the environment to a more pleasant and convenient environment.

Also, as natural language processing techniques develop that allow machines to understand human language, they will be able to find the knowledge they need more easily and accurately. In particular, for knowledge search services, technologies such as ordering the results according to the intention or situation of searching or recommending the most appropriate person to answer the question are being developed. Multimedia search technology such as unstructured photos and songs, which are hard to express in language, is also being developed. It is expected that these advances provide people with a variety of access to knowledge, and will be developed into more sophisticated and personalised knowledge services in the future, thereby improving their efficiency. On the other hand, if search technology makes access to and management of specialised knowledge easier, the overall quality of life can be improved by further expanding the knowledge system through one's own experience or learning to provide higher service.

Automatic handling of existing simple, repetitive physical and mental tasks on behalf of artificial intelligence robots or algorithms is expected to improve the convenience of life. For example, Quest Visual's Word Lens service, which was acquired by Google in 2014, will remove language barriers for travelers and provide travel convenience through a service that translates text to the desired language in real time when the camera reflects the text it wants to translate. It is expected that AI, which is used for self-driving cars, will provide safety and convenience for drivers in the future as it is becoming more practical as technologies are gradually developed. The replacement of artificial intelligence machines for complex and cumbersome tasks also reduces work stress, increases leisure time, and is expected to allow humans to focus on tasks that require more advanced intelligence or creative ability.

It will take a national level of access and investment to ensure that the benefits derived from such advances in artificial intelligence are not limited to only a small number of people, but also lead to improved quality of life and increased convenience across the nation. It is necessary to promote and guide those who do not know about the benefits of artificial intelligence, to provide educational opportunities for those who do not use technology to access them, and to promote government-level welfare services so that anyone can enjoy the benefits of artificial intelligence without discrimination. The government should establish a professional management system to improve the utilization of services and prevent damages

caused by malfunctions.

Search systems based on artificial intelligence technology and knowledge system utilization systems should be combined with efforts to secure the right information in order to improve the utilization and reliability of information and to prevent false information from spreading. In particular, the government should prepare a special verification and security management system for expert knowledge with high ripple effects, and take care not to violate privacy or leak personal information by strengthening information security for AI devices that learn personal information.

(4) Social and ethical issues

Although the quality or productivity of life can be improved due to the development of artificial intelligence, if technology is gradually enhanced and automation level increases, serious social and ethical problems can arise if the technology becomes out of control or is abused by groups with specific purposes. First of all, giving artificial intelligence devices the ability to make autonomous decisions can create uncontrollable or unexpected problems in the face of conditions or situations that were not previously considered in the design, and can result in loss of life or property that could result in no one being held liable. For example, a sudden, unprogrammed situation in a self-driving car can cause casualties, and an automated investment system using artificial intelligence technology can learn the wrong information, leading to huge economic losses. The ripple effect is expected to be even greater, especially if the LOWS (Local Autonomic Weapons Systems), which was created for use in war, killed innocent citizens due to malfunction in the program. Interest in this is also growing in the international community, with prominent IT professionals issuing a joint letter to control development of the LAWS and holding anti-campaigns in the UK, already moving around the world. In particular, the U.N. Human Rights Council recommended a moratorium on testing, production, acquisition and technology transfer of LAWS until relevant international norms were formed. The reason why LAWS is particularly controversial is that many human rights groups and producers agree on the possibility that machines can violate the basic principles of human dignity by letting them decide what to kill, and that LAWS technology can reach out to police functions in peacetime.

On the other hand, people who misuse artificial intelligence even when it is controllable can cause serious social problems. If misused by political and religious groups or especially extreme forces, there can be large-scale acts of terrorism, such as the indiscriminate killing of bombs using artificial intelligence drones, and the possibility of hacking into artificial intelligence devices designed to improve their own performance through personal information learning can also possible. In particular, if the data obtained by the artificial intelligence community is shared by the entire artificial intelligence system through the cloud, problems such as information leakage or invasion of privacy can become serious if the personal information shared by the artificial intelligence community is not strictly managed. Moreover, there is a possibility that the second round of hacking infringement will become more deadly as the vast amount of information is collected and shared, for example, the safety problems of self-driving passengers or the risk of physical encroachment on their living space. On the other hand, if these artificial intelligence devices combine with various devices to enable the analysis and prediction of individual daily lives, and if such information is abused by public or private subjects, there could be monitoring and control problems, which could adversely affect the basic human rights, such as diversity and freedom.

In order to solve problems caused by malfunctions, misuse and abuse of artificial intelligence, it is necessary to clarify the authority of artificial intelligence and the subject of

responsibility for the consequences. Granting artificial intelligence as another member of human society, or even the power to directly violate human rights, such as a self-destructing weapons system or an artificial intelligence police robot, can cause confusion in society, and in the event of a malfunction of the device, the subject of responsibility will also become unclear. In fact, basically, artificial intelligence should not be the main body of ethical judgment without human intervention, and under these standards, the human body, which is judged to be possible in the event of damage caused by artificial intelligence, should it occur. It will also require careful design from the development stage to ensure that artificial intelligence is not the sole agent of ethical judgment but the functional role to support it.

In fact, artificial intelligence technology is under the control of the person who designed it to a certain extent because it is impossible to give the level of autonomy that people think. However, as technological development increases complexity and autonomy, as the scope of use increases, the level of human control of artificial intelligence will gradually decrease, and the threat to social safety can increase, such as artificial intelligence-interested decision-making harms humans. To prevent this, not only is the issue of the authorization of artificial intelligence, but also the study of the legal basis of the subject of responsibility. In particular, it would be one way to give the developer some responsibility for a more detailed design through a clear definition and distinction of design developers in the process of artificial intelligence becoming a product. It will also be necessary to prepare ethical guidelines for R&D to provide clear standards for developers and to prepare legal and institutional frameworks for the approval and certification process of ethical modules of machinery. And for these standards to be achieved through a certain amount of social consensus, it is necessary to establish committees to enable a wide range of opinions and policy proposals from ordinary citizens and experts.

In order to prevent the misuse and misuse of artificial intelligence technology, social discussions and agreements on strict legal devices and punishments when they fail to comply with them, and research on laws and institutions should be made. It is necessary to preemptively develop a technology to detect and respond to misuse and malfunction, and to try to develop stable and reliable AI devices. Institutional devices will need to protect users of AI devices by adjusting the scope of use of artificial intelligence to protect privacy and to incorporate technologies that prevent public control into artificial intelligence, or to give corporate management responsibilities and obligations, such as the Sarbanes Oxley Act of the United States.

On the other hand, an ethical feasibility study is needed on the development of LAWS, where artificial intelligence can determine and execute the killing of human beings by autonomous judgment. It is also necessary to consider the possibility of infringement of human dignity and national security, from identifying international discussion trends and preparing countermeasures. Furthermore, because LAWS can harm humanity like nuclear issues, international discussions can set regulations, and it can also resolve to ban international use like chemical weapons and cluster bombs.

5. Conclusion

According to the government's announcement, the commercialization of self-driving cars will take place even at a low level by 2020. This means that there is not much time left for various situations that may sound like a science-fiction story to be touched by the skin. In fact, many of the examples presented here are based on actual cases that have already occurred in reality. In the near future society, artificial intelligence technology will replace human-impaired or cumbersome tasks with artificial intelligence, making life more convenient, improving quality of life and speeding up industrial development due to productivity increase in productivity. On the other hand, social and ethical problems can also arise, both large and small, if proper countermeasures are not provided for misuse or malfunction. On the other hand, if there is a growing sense of concern or anxiety about the future in a situation where artificial intelligence technology has not been properly communicated to our society, there is a possibility that technology development will be hampered. In order to fully enjoy the benefits that rapid technological development will bring to us and prevent side effects in advance, a field of discussion such as technical impact assessment needs to be set up steadily. In order to minimize the negative impact of technology, maximize the positive impact, and compete internationally, proper institutional readjustment and promotion of technology must be made at a national level.