

## Introduction

Society holds high expectations for the benefits of artificial intelligence (AI). In Japan, under the instructions of the Prime Minister during the “Public-Private Dialogue towards Investment for the Future” held in April 2016, the “Strategic Council for AI Technology” was established. Under the leadership of the council, research and development and social implementation on AI were facilitated in cooperation and in coordination with the relevant ministries and agencies, including the Ministry of Internal Affairs and Communications (MIC), Ministry of Education, Culture, Sports, Science and Technology (MEXT), Ministry of Economy, Trade and Industry (METI), Cabinet Office, Ministry of Health, Labour and Welfare (MHLW), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and Ministry of Agriculture, Forestry and Fisheries (MAFF) of Japan.<sup>1</sup>

Expectations are placed on AI technology as an important foundational technology of “Society 5.0,” for which the Japanese government is aiming; however, there is also concern over the impact of technology on human society. For example, both the “Report on Artificial Intelligence and Human Society” released in 2017 by the Cabinet Office and the “2017 Report of the Conference toward AI Network Society” by the Institute for Information and Communications Policy, under MIC addresses ethical, legal, and social implications concerning technology and put forth arguments about its influence on employment and work styles as economic implications.<sup>2</sup> The “New Industrial Structure Vision” by the New Industrial Structure Committee of the Industrial Structure Council of the METI has also considered changes in the industrial structure and employment structure, as well as the development of human resources, to be future issues.<sup>3</sup>

This report discusses how AI and robotics influence employment and labor. It will introduce how AI and robot technologies are used today, how they influence people’s values, social systems, and laws under the perception that technology is just one of the methods for addressing social problems, and how technology and society interact with each other.

Many countries, including Japan, view AI and robotics as a pillar of their economic development and industrial policies. However, the social and political backgrounds and contexts in which AI and robotics are discussed regarding the issue of employment and labor vary by country. In Japan, for example, AI and robotics are positioned strongly as a solution to the aging population and the decreasing birthrate, as well as the associated decline of the labor force population.<sup>4</sup> On the other

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<sup>1</sup> Strategic Council for AI Technology, “Artificial Intelligence Technology Strategy (Report of Strategic Council for AI Technology),” 2017.3.31, p.2. < <http://www.nedo.go.jp/content/100865202.pdf> >

<sup>2</sup> Advisory Board on Artificial Intelligence and Human Society, Cabinet Office, “Report on Artificial Intelligence and Human Society Unofficial translation,” 2017.3.24, pp.1-2. < [http://www8.cao.go.jp/cstp/tyousakai/ai/summary/aisociety\\_en.pdf](http://www8.cao.go.jp/cstp/tyousakai/ai/summary/aisociety_en.pdf) >, Conference toward AI Network Society, Institute for Information and Communications Policy, Ministry of Internal Affairs and Communications, “Report 2017 - Toward Promotion of International Discussions on AI Networking,” 2017.7.28, pp.1-2. Ministry of Internal Affairs and Communications Website < [http://www.soumu.go.jp/main\\_sosiki/joho\\_tsin/eng/Releases/Telecommunications/170728\\_05.html](http://www.soumu.go.jp/main_sosiki/joho_tsin/eng/Releases/Telecommunications/170728_05.html) >

<sup>3</sup> New Industrial Structure Committee, Industrial Structure Council, Ministry of Economy, Trade and Industry, “New Industrial Structure Vision (Summary of Vision for New Industrial Structure),” 2017.5.30, Ministry of Economy, Trade and Industry Website < [http://www.meti.go.jp/english/press/2017/0530\\_003.html](http://www.meti.go.jp/english/press/2017/0530_003.html) >

<sup>4</sup> Strategic Council for AI Technology, “Artificial Intelligence Technology Strategy (Report of Strategic Council for AI

hand, in the United States and Europe, the growing disparity caused by the spread of AI and robotics has drawn particular attention.

Three topics will be introduced by cross-sectional perspectives that has been revealed in this report. In addition to this three topics, it is necessary to have further discussions on the jobs of “experts” (occupations) in each domain, as well as the significance of labor itself and its treatment when discussing the implications of AI and robotics on employment and labor in the future.

### 1. Will machines take away all our jobs? AI and robotics replacing humans beings’ tasks

In 2013, associate professor of Oxford University Michael A. Osborne published a report with colleagues<sup>5</sup> estimating that 47% of the jobs in the United States are at risk of being replaced by machines within the next 10 to 20 years, which became a hot topic across the globe. A survey was also conducted in Japan using similar methods, and the results published in 2015 suggest that 49% of jobs are at risk of being replaced by machines.<sup>6</sup> A report published by the World Economic Forum in 2016 anticipates that based on questionnaire surveys conducted with 371 human resources officers of companies around the world, a total of 7.1 million jobs will be lost worldwide between 2015 and 2020, but there will be a total gain of 2 million new jobs.<sup>7</sup> Some say that “technological unemployment,” which means that skill acquirement and worker migration cannot keep pace with the speed of technological innovation and that human jobs will be replaced by machines, has already become a reality.<sup>8</sup>

However, despite the concern that “human jobs will be replaced by machines,” many now consider that not the entire jobs of domain experts but some of the “tasks” of such jobs will be replaced by AI and robotics, at least in the short term.<sup>9</sup>

Some note that instead of competing with machines, productivity would increase when humans, who have intuitions and creativity, collaborate with machines that are good at processing vast volumes of data and computing. For example, collaboration between AI and humans has created new pieces of artwork and strategies in the domain of art and design as well as in the world of *shōgi*

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Technology),” 2017.3.31, <<http://www.nedo.go.jp/content/100865202.pdf>>; Cabinet Office, “Annual Report on the Japanese Economy and Public Finance 2017,” 2017.7, chapter 3. <<http://www5.cao.go.jp/keizai3/2017/0721wp-keizai/summary.html>>

<sup>5</sup> Carl Benedikt Frey and Michael A. Osborne, *The Future of Employment: How susceptible are jobs to computerisation?* Oxford Martin Programme on Technology and Employment, 2013.

<[https://www.oxfordmartin.ox.ac.uk/downloads/academic/The\\_Future\\_of\\_Employment.pdf](https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf)>

<sup>6</sup> Nomura Research Institute et al., “Computerization and the Future of Jobs in Japan,” 2015.

<<https://www.nri.com/~media/PDF/jp/journal/2017/05/01J.pdf>> (in Japanese).

<sup>7</sup> World Economic Forum, “The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution,” 2016.1, p.13. <[http://www3.weforum.org/docs/WEF\\_Future\\_of\\_Jobs.pdf](http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf)>

<sup>8</sup> Erik Brynjolfsson and Andrew McAfee, *Race Against the Machine*, Lightning Source Inc, 2011.

<sup>9</sup> Documents pointing out the changes in “tasks” caused by AI include the following: World Economic Forum, *op.cit.*(4), p.19; James Manyika et al., *A future that works: automation, employment, and productivity*, McKinsey Global Institute, 2017, p.7.

<[https://www.mckinsey.com/~media/McKinsey/Global%20Themes/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works\\_Full-report.ashx](https://www.mckinsey.com/~media/McKinsey/Global%20Themes/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works_Full-report.ashx)>; Noriyuki Yanagawa et al., “Advantages of humans and management in the era of AI,” *NIRA Opinion Paper*, No.25, 2016.11. <<http://www.nira.or.jp/pdf/opinion25.pdf>> (in Japanese).

(Japanese chess).<sup>10</sup> There are tasks at which AI and robotics are better than humans, such as presenting possible outcomes by reading an enormous amount of data and academic papers or detecting diseases in agricultural crops and abnormal behaviors in humans.<sup>11</sup> Tasks that can be replaced by AI and robotics include tasks that we rather “want to be taken away”<sup>12</sup> owing to the high risk and heavy physical burden. However, there are tasks that can be technically replaced by machines but that require humans to handle and take ultimate responsibility from the perspective of human values, social systems, and laws, as in hospitality and diagnostic imaging in the domain of healthcare.<sup>13</sup> When introducing AI and robotics, it is necessary not only to consider the technological potentials but also to think of the elements of the tasks in experts’ jobs in each domain and the manner in which they should be divided and assigned, in light of human values, social systems, and laws. Therefore, it is also a priority not just to cultivate human resources that develop AI and robot technologies but also to develop human resources that can utilize AI and robots in society or in business.<sup>14</sup>

## 2. Organizational culture and human values

In terms of labor, many routine tasks remain in Japan compared with other countries.<sup>15</sup> Some consider that “Japanese employment practices,” which are characterized by lifetime employment, seniority-based pay systems, and an enterprise labor union system, would significantly change from the introduction and dissemination of AI and robotics.<sup>16</sup> For example, many more companies have introduced new forms of employment, such as telework, in recent years.<sup>17</sup> Some note that because AI and robotics facilitate autonomy and automation, they can cause frictions in an organizational culture such as military, which considers top-down command and control or hierarchy to be important.<sup>18</sup> Therefore, organizations must think about their culture, employment forms, and work styles when introducing technology, and they must try to establish an incentive framework by honoring people who are successfully using technology<sup>19</sup> or forming a community where people can share case examples.<sup>20</sup>

AI may increase job performance by compensating for a lack of experience; for example, knowledge, skills, and knowhow are stored in databases and visualized and shared in real time along

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<sup>10</sup> See Part 2 “III Art and Design” and “Column 2 Japanese Chess (Shōgi)” of this report.

<sup>11</sup> See Part 2 “I Healthcare,” “VII Agriculture,” and “VIII Public order and Security” of this report.

<sup>12</sup> Dangerous tasks, such as pesticide spraying and mowing on slopes, are actively being replaced by machines. See Part 2 “VII Agriculture” of this report.

<sup>13</sup> See Part 2 “I Healthcare” and “V Hospitality” of this report.

<sup>14</sup> See Part 3 “VII Development and Recruitment of AI-related Human Resources” of this report.

<sup>15</sup> Sara De La Rica and Lucas Gortazar, “Differences in Job De-Routinization in OECD Countries: Evidence from PIAAC,” *IZA Discussion Paper*, No.9736, 2016.2. <<http://ftp.iza.org/dp9736.pdf>> Japan is ranked fourth in terms of intensity of routine tasks among 22 countries surveyed.

<sup>16</sup> Conference toward AI Network Society, Institute for Information and Communications Policy, Ministry of Internal Affairs and Communications, “Report 2017 - Toward Promotion of International Discussions on AI Networking,” 2017.7.28. Ministry of Internal Affairs and Communications Website <[http://www.soumu.go.jp/main\\_sosiki/joho\\_tsusin/eng/Releases/Telecommunications/170728\\_05.html](http://www.soumu.go.jp/main_sosiki/joho_tsusin/eng/Releases/Telecommunications/170728_05.html)>

<sup>17</sup> See Part 3 “V Technological Innovation and Employment” of this report.

<sup>18</sup> See Part 2 “Column 1 AI applications for Defense and National Security Overseas ” of this report.

<sup>19</sup> See Part 2 “About the Introduction and Use of ‘Predictive Crime Defense System’ in the Kyoto Prefectural Police Department” of this report.

<sup>20</sup> See Part 2 “VII Agriculture” of this report.

with the introduction and dissemination of AI, which may allow newcomers to grasp the statuses of animals and plants grown and raised in agriculture or may promote awareness in areas in which security measures must be implemented to prevent crimes.<sup>21</sup> With the expansion of the “democratization of AI,”<sup>22</sup> which means everyone can utilize AI technology, non-experts are now beginning to indirectly use the knowledge and skills of experts. For example, people can design logos or compose music by using AI in a short period of time inexpensively, even without knowledge and skills.<sup>23</sup> However, such changes may significantly affect not only the market but also social systems, laws, and human values. Therefore, social systems and laws must be established, while social, economic, and cultural values provided by the jobs of experts must be restructured.<sup>24</sup>

### 3. Infrastructure for utilizing AI and robotics: Data and human resources

To disseminate technology in society, it is important not just to develop technology itself but also to establish infrastructure to support it. To develop or use AI technology, vast volumes of data are necessary for learning. Therefore, standardization of data formats owned and used by organizations are necessary. In addition, data management methods to facilitate the cross-sectional use of data beyond institutions and organizations are required.<sup>25</sup> On the other hand, some note the necessity to address the protection of personal information and privacy, since anyone can be among those being controlled as an employee, client, or consumer through monitoring with the use of information and communication technology (ICT).<sup>26</sup> In addition, avoiding not to have any biases in AI learning data is essential.<sup>27</sup>

In addition to data, hardware for operating AI and robots, communication networks indispensable for data transmission, and general-purpose terminal devices, such as smartphones, which function as user interfaces, are also positioned as infrastructure. It is important for these elements to be provided at a reasonable price and for there to be ease of maintenance.<sup>28</sup> When establishing communication networks,<sup>29</sup> it is probably necessary to promote research on health risks

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<sup>21</sup> See Part 2 “VII Agriculture” and “VII Public order and Security” of this report.

<sup>22</sup> “Google makes the use of AI easy, US IT businesses accelerate “democratization of IT, there are issues like data monopolies,” *Nihon Keizai Shimbun*, 2018.1.18, p.13. (in Japanese)

<sup>23</sup> See Part 2 “III Art and Design” of this report.

<sup>24</sup> For example, Part 2 “III Art and Design” of this report explains that discussions on how to handle copyrights are being held. “V Hospitality” notes that if robots provide hospitality, workers will be free of “emotional labor,” but they may have less opportunities to come into contact with the “gratitude” or “smiles” of customers.

<sup>25</sup> To make predictions and conduct a performance analysis, a certain volume of data must be accumulated. Part 2 “VII Agriculture” of this report notes that data can be obtained only in certain seasons in agriculture, and it takes time to accumulate data. “VIII Public Order and Security” also explains that the system cannot be used in areas in which the number of crimes is low, in terms of the “Predictive Crime Defense System” introduced by the Kyoto Prefectural Police Department.

<sup>26</sup> Part 3 “VI Human Resources and Labor Management by IT and its Regulation: Japan and Overseas” of this report describes what level of employee monitoring is permitted for the purpose of labor control. Part 2 “II Elderly Care” of this report explains the difficulty of determining where to draw the line between “elderly watching” and “monitoring” of those in need of care.

<sup>27</sup> For example, there are disputes over the credibility of data used in “crime prediction systems” being introduced in the domain of security. See Part 2 “VIII Public Order and Security” of this report.

<sup>28</sup> For example, there is seasonality in agriculture, and equipment must function without fail even if they are not used for several months. See Part 2 “VII Agriculture” of this report.

<sup>29</sup> Part 2 “VII Agriculture” of this report notes that it is necessary to secure a certain level of communication speed so that people can use systems in the cloud even in rural areas. “VIII Public Order and Security” explains that the presence of a secure network that extends to the Police station (Koban) level was a prerequisite for the introduction of

and similar issues posed by electromagnetic waves.<sup>30</sup>

When introducing AI and robotics, economic rationality and efficiency are emphasized, and therefore, the environments of the facilities, such as the structures and layouts, as well as people's work styles, are sometimes forced to adapt to AI and robots.<sup>31</sup> However, we must be careful not to steer or restrict behaviors and values of worker, customers, and consumers to achieve economic efficiency.

It is also important to cultivate human resources that can develop or utilize AI and robotics and to provide literacy education to employees.<sup>32</sup> To promote the use of AI and robotics in society and in business, it is also necessary to think about ethical, legal, and social implications (ELSI), including the issue of privacy and security measurement, as well as to cultivate experts who can serve as an intermediary between technology and society.<sup>33</sup>

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the "Predictive Crime Defense System" in the Kyoto Prefectural Police Department. In terms of autonomous driving, 5G (the fifth-generation mobile communication system) must be used so that vast volumes of data can be transmitted at high speed. "(Nickki's big question) What is next-generation communication "5G"?" 5G resolves delays of data and can be used for autonomous driving," Nihon Keizai Shimbun, 2017.9.25, Evening paper, p.2. (in Japanese).

<sup>30</sup> The World Health Organization (WHO) and International Agency for Research on Cancer (IARC) are debating the influence of electromagnetic waves coming from base stations and mobile devices on health. In Japan, the Ministry of Internal Affairs and Communications has a program for evaluating the safety of electrical waves. "Survey of the safety of electrical waves and evaluation technology," Ministry of Internal Affairs and Communications, Usage of electrical wave website. <<http://www.tele.soumu.go.jp/j/sys/ele/index.htm>> (in Japanese).

<sup>31</sup> Part 2 "V Hospitality" of this report describes how steps were eliminated and turned into slopes within a hotel such that robots can move around easily upon the introduction of robots. Part 2 "VII Agriculture" also introduces a study for making tree forms straight so that robots can easily harvest fruit.

<sup>32</sup> See Part 3 "VII Development and Recruitment of AI-related Human Resources" of this report. Part 3 "III AI and Employment Issues in France" and "IV AI, Robotics, and Labor in the Chinese Workplace" describe how governments provide support to ventures by using AI and note how they are committed to the cultivation of AI and IT human resources.

<sup>33</sup> Part 2 "II Elderly Care," "IV Education," "VI Transportation / Mobility," and "VIII Public Order and Security" of this report highlight issues of privacy and security as well as the need to set rules.