

## 海外との連携について

第5回懇談会での検討資料を基に英文化したものを各国大使館や関係者に 2017 年 1 月上旬に送付した。

内容：

- 懇談会のアプローチ
- 人工知能と人間社会に関して検討すべき論点（論点整理）
- 論点の絞り込み
- 事例の抜粋
- 共通する論点の抽出の表（参考資料 2 - 2）



Cabinet Office  
Government of Japan

Dear Sir / Madam,

4<sup>th</sup> January 2017

Artificial Intelligence (AI) is expected to contribute to our society with regard to supporting and enhancing human's activities and decisions. It has a crucial role to realize "Society 5.0", that can be expected to facilitate human prosperity by providing the necessary goods and services to the people who need them at the required time and in just the right amount, responding precisely to a wide variety of social needs, and providing solutions for social problems such as aging society and low birthrate. All kinds of people can readily obtain high quality services, overcome differences of age, gender, region, and language, and live vigorous and comfortable lives in Society 5.0. However, one may have concerns on the quick advancement of AI and its implementation in our society.

That was why Advisory Board on Artificial Intelligence and Human Society ("Advisory Board," hereafter) was set up under the initiative of Minister of State for Science and Technology Policy with the aim to assess different societal issues which would possibly be raised by the development of AI and to discuss its implication on the society (May 30, 2016). Board members have various backgrounds such as engineering, philosophy, law, economics and social sciences. The advisory board is preparing a report, which will be published in March. I would like to share ideas and pieces of its preliminary version with you for communications and a potential cooperation in the future.

In what follows, this file contains the board members, our approach for considering AI and a human society, the summary of issues to be addressed, and case examples and particular scenarios that we considered to identify the issues. Another file shows the matrix consisting of the cases and our viewpoints such as ethics and laws, from which we identified common issues shared by the various cases.

Any comments are welcome. The issues should be discussed continuously as AI is advancing, hopefully with international cooperation.

Sincerely yours,

Yuko Harayama, PhD

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## Approach

We attempted a realistic and concrete discussion rather than discussions on improbable concerns and unforeseeable future. Therefore, we adopted a case-based approach where we examined artificial intelligence (AI) technologies that exist or will be available in a near future, in order to consider their impacts on a human society. It is worth noting that we examined not only typical AI technologies exploiting machine learning but also digital technologies related in some way or other to AI, since the latter can also have huge impacts on a human society.

First, we delineated a picture of the near future for some fields such as mobility and manufacturing and made a list of a variety of particular cases from the viewpoints of ethics, law, economics, society, education, and R&D. We made the list based on the opinions and advices from the board members, experts in various fields, and business managers. To collect a wide spectrum of opinions on AI and cases to be considered, we invited public opinions via Internet and held a brainstorming workshop with people who were interested in AI and a human society. “Case analysis” is the result of our case-based consideration from the viewpoints of ethics, law, economics, society, education, and R&D. “Supposed cases” show examples of cases (or scenarios) that we supposed in order for our consideration to be realistic and concrete.

Then, we summarized issues through identifying common issues shared by some or all of the cases. In doing so, we paid specific attention to the balance between the opportunities and challenges from AI technologies. “Matrix for deriving common issues across cases” illustrates how we identified the common issues from the case analysis.

“Summary of the issues to be addressed on Artificial Intelligence and Society” is the result of our consideration.

This approach has the advantage of enabling a multidisciplinary and holistic consideration. For example, we considered employment issues from the viewpoints of economy, education, and R&D with this approach.

# Summary of the Issues to be Addressed on Artificial Intelligence and Society

Artificial Intelligence (AI)<sup>1</sup> will greatly benefit and empower our human society and contribute to ensure its sustainability, while AI may generate social and ethical challenges. With a view to realizing the sustainable society supported by AI, the Advisory Board has attempted to identify key issues to be addressed on the relationship between the current and near-future AI and human society,<sup>2</sup> as summarized below.

## **Ethical issues**

### **Changing relationship between humans and AI, and the emerging new sense of ethics**

Humans have utilized various tools and machines to make choices and decisions depending on circumstances. The advancement of AI is increasing the cases in which AI, using big data, can make accurate and quick decisions, semi-automatic operations, and statistically appropriate choices. When AI supports human choices and decisions, there are many benefits, such as improvement in accuracy and speed, and independence from human cognitive bias and prejudice.<sup>3</sup> We should, however, consider the balance between human decisions and AI-based decisions. Relationships between humans and AI/machines will change gradually as AI advances, likely accompanied by the emergence of a new sense of ethics based on the evolving relationships.

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<sup>1</sup> We consider AI as technologies that can perform intelligent activities (perception, cognition, inference, learning, thinking, and actions based on those) like a human. We focus on AI and AI-related digitalization in this paper.

<sup>2</sup> Since it is impossible to list all of the global cases and issues, we must be aware that some may have been omitted.

<sup>3</sup> For example, the confirmation bias (human's cognitive tendency to overestimate favorable information matching one's own reasoning or faith, which are thereby confirmed, while alternative facts are neglected), the fundamental attribution error (humans tend to think that others' behavior and its results are caused by her/his personal characteristics or ability, rather than by the external situation), and individual prejudices influenced by circumstance and culture.

### **Concerns about modulating emotion, faith, and behavior, and ranking or selecting by AI: Revisiting the concept of humanity**

AI is becoming able to support and make decisions and actions that only humans have previously been able to perform. People may have concerns and anxieties about AI's potential modulation or operation of our mind and behavior, evaluation or ranking of people by AI, and AI influencing people's emotion, affection, and faith. Ethical discussions might especially be needed if these are conducted without people's awareness. In the future, our senses of space, time, and the body will be augmented by AI, and changing concepts of human ability and emotion may interact with such augmented senses. Accordingly, the concept of humanity may be revisited taking account of these AI's potential.

### **Considering the value of products and actions relating to AI: Sustaining the diversity in values and future prospects**

It can be predicted that AI will enhance productivity quantitatively and qualitatively, and be able to produce objects that otherwise either could not be made or would require high costs and/or a long time to make. Thus, everyone will have access to such high-quality items. It might be necessary to discuss how to evaluate the values (e.g., originality, utility, and virtue) of products made and actions performed by humans, AI, and human cooperating with AI, together with how those values are accepted in society. Cooperation between humans and AI can lead to augmentation of human ability, and will be a basis of a new sense of values. We should consider individuals' differences in values and future prospects, and sustain various choices and the diversity of values.

## **Legal issues**

### **Clarifying the locus of responsibility for accidents and other problems caused by AI: Considering the risks of using and not using AI**

It is anticipated that users and businesses could benefit from AI more easily by clearly determining the locus of responsibility for risks, accidents, and rights infringement – in addition to the benefits and achievements – caused by AI. For human society to accept and benefit from AI technologies, it could be useful to clarify the locus of responsibility

according to the levels of technological advancement (e.g., the levels 0 to 4 for the automated driving technology)<sup>4</sup> and to deal with uncertain, probabilistic risks through insurance. Clarifying the locus of responsibility is also important for preventing businesses from becoming intimidated by or overreacting to reputation risks. It is important to consider not only the risks from using AI but also the risks of losing opportunities and credibility by not using AI.

### **Balancing the benefits from AI exploiting big data with privacy information protection**

The ability to exploit big data would make AI more useful. However, there would be a trade-off relationship between its usefulness and personal information protection (privacy issues). It is necessary to consider appropriate institutional frameworks (laws, guidelines, and contracts) to avoid the chilling effects of fearing privacy invasion and balancing the usefulness with privacy issues. We might need to clarify Japan's positions on access to personal information, data portability, rights to be forgotten, and related security issues. It is anticipated that the government considers the utilization of AI for government services to embody the above positions.

### **Considering the rights and incentives for the creation by AI**

It is necessary to consider who retains the property rights to the creation and calculation results produced by AI or the collaboration between AI and humans (i.e., shares of contributions), given that the exploitation of AI will easily create high-value products.<sup>5</sup> Furthermore, to facilitate the development and utilization of AI, it is expected that people will find an appropriate method of assignment of rights (incentives) to AI developers, users, and data owners by means of appropriate contracts and guidelines on a case-by-case basis.

### **Possible necessity of rethinking the concept of law itself**

We need to continuously discuss whether the existing laws (on

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<sup>4</sup> It is said that drivers are responsible for the accidents caused by automated driving at the levels of 0 to 2.

<sup>5</sup> Industrial robots that can work either at the level of or better than human experts, and AI technologies that can create pieces of work by modeling the style of famous human artists, are already being put to practical use.

transportation, business, pharmacy, labor, etc.) can deal with the change in jobs and employment caused by AI, whether we need to revise existing laws or introduce new legislation, or whether we need to fundamentally reconsider the concept of law itself.

## **Economic issues**

It is possible that the comparative advantage of AI will drastically change the power relationships in business, just as the small number of companies that successfully exploited big data on the Internet gained extensive power in the information society. It is also anticipated that many companies can reduce business costs and improve their business impetus, since AI requires less labor power to run companies.

### **Changes in the ways people work caused by AI: For individual workers**

It is expected that employees will be freed from tedious tasks and required to focus on more creative tasks, since AI will be able to do the current jobs and tasks that humans do. To perform such creative tasks, workers will have to acquire abilities to move to other jobs to fully use their talents, to do creative things, and to exploit AI. It is also expected that the number of new businesses will increase and more people will work on their own account.

### **Change in employment systems and companies due to the utilization of AI: For companies**

It is anticipated that the utilization of AI will reduce tedious, prolonged, and exhausting jobs and increase high-value jobs and the freedom of people to work without belonging to companies. These transformations will require companies to reconsider their way of decision-making and staff (re)assignment, taking advantage of the flexibility of working that are unconstrained by time and space, e.g., teleworking.

### **Policy for facilitating the utilization of AI: For the government**

At government level, it is necessary to formulate policies that provide opportunities for people to learn abilities for labor moving,<sup>6</sup> in order

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<sup>6</sup> “Labor moving” refers to individual workers changing jobs across companies,

to facilitate economic growth by AI and ensure a variety of ways of working that are suitable for individuals. In addition, it might be important to consider the necessity of implementing appropriate macroeconomic policies and safety nets. It is necessary to consider how to fairly distribute the profits and benefits of productivity improvements, economic revitalization, and predictability attributable to AI.

## **Social issues**

### **Freedom to use (or not use) AI: Right to be forgotten**

The social benefits from AI are huge, as the realization of social security and safety and improvement of productivity counters labor shortages, a decreasing birthrate, and an aging population. However, like many other tools and technologies, AI's utilization cannot be socially enforced, even if it has social benefits. It may be necessary to take into consideration ensuring freedom to use AI, based on individuals' faith, and avoiding social conflict between users and non-users of AI. For these purposes, it is necessary to provide forums where persons with different visions and ideas, including experts, can establish dialogues continuously. Furthermore, for persons who submit personal data to benefit from AI to be able to delete all of that data once they decide to stop using a service, it might be necessary to consider establishing opt-in / opt-out methods and institutions.

### **AI divide: Unbalanced burden of social costs relative to AI**

To maximize benefits from AI, in addition to appropriate knowledge on AI itself, users need digital goods and services literacy and knowledge of data privacy. However, if some people cannot acquire or maintain this knowledge and literacy, it might be a factor to cause the so-called "AI divide".

For example, "ride share" backed by AI could offer a new means of transport at low cost comparative to taxi, therefore supportive of socially weak people. However access to these services require a minimum familiarity with digital devices, so that these people without this literacy may be excluded from benefit of ride share services. Therefore, it is necessary to take into consideration and make policies to avoid generating

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industries, and job categories in the labor market.



an imbalanced social cost burden and a new differential caused by literacy, knowledge, and assets.

### **New social pathology, conflict, and dependence on AI**

With increasing opportunities to use AI in social contexts, there is a possibility of generating social pathology and new social problems, such as excessive rejection, overconfidence, and dependence on AI. It is, therefore, assumed necessary to provide accurate information and the opportunity for dialogue, and for training.

## **Educational issues**

### **Cultivating individuals' ability to utilize AI**

When new tools and technologies appear, humans first train on how to use them, and then, ultimately, benefit. For AI, we should learn how to identify responsibilities and acquire literacy and skills to know how and in what ways AI makes choices or judgments and operates. In summary, it is necessary to cultivate users' ability to utilize AI by themselves and to perform creative activities collaborating with AI.

### **Cultivating human abilities that AI cannot perform**

We should investigate what can be performed efficiently by AI and what cannot, then discuss the reform of education curricula based on this evidence to cultivate human abilities that AI cannot perform. Education for children is especially urgent because it takes time and AI development is so fast. It is important to consider what abilities should be still learned by humans even though the activities enabled by those abilities can be performed instead by AI.

### **Policy actions against educational inequity**

Policy making is needed to improve AI literacy and skills through school education, academic training and educational environments for self-learning. To minimize disparity on AI, policy actions against educational inequity are required.

## **Research and developmental issues**

### **Ethics, accountability, security, and privacy protection**

It may be required for researchers and engineers to engage in R&D in AI related areas with a high level of professional ethics,<sup>7</sup> while observing the ethical codes and guidelines of their academic societies and organizations,<sup>8</sup> and with accountability for them. It is also necessary for scientists and engineers to establish environments to use AI with robust cyber-security and safety. It is especially essential to develop technology that enables us to choose how much individual privacy should be protected and what kind of information can be used publicly.

### **Controllability and transparency**

It is assumed that we need to develop the technologies that enable people to control AI for its safe use, the interfaces to enable smooth transitions of controls from AI to human especially in an emergency, the technologies to explain the processes and logics of AI calculations inside AI, and the technology to embed how much AI is used in decisions or actions.

### **Appropriate disclosure of information and responsible use**

When spreading new technologies, we might have to invest efforts in explaining their benefits and risks fairly, and people might ultimately be required to themselves judge whether to use or not to use the technologies.

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<sup>7</sup> “Principles in AI R&D Guideline” have been proposed by Japan’s Ministry of Internal Affairs and Communications (MIC): (1) Transparency, (2) User assistance, (3) Controllability, (4) Security, (5) Safety, (6) Privacy, (7) Ethics, and (8) Accountability (Interim report published in April 2016; Annual report published in June 2016).

<sup>8</sup> The Japanese Society of Artificial Intelligence proposed “Ethical codes for AI researchers” in June 2016. The Institutional Review Board (IRB) on AI will be established in research institutes, universities, and companies in the near future.

# Case Analysis

## Mobility

### **[Social implementations in the near future]**

Mobility-A (autonomous vehicle):

Autonomous vehicles will execute accelerating, braking, and steering instead of a human driver, using vehicles' sensors such as cameras, radars, and GPSs with traffic information from external networks, enabling them to drive on highways or jammed roads reducing the driver's workload.

Autonomous vehicles will reduce the psychological load and physical workload of elderly people who have concerns regarding dynamic vision and quick action through AI support. Even when a driver becomes unable to control a car due to an accident, the autonomous vehicle can safely control and park the car.

Mobility-B (ride share):

Ride-share taxis and buses will optimize routes based on several passengers' destinations, removing the need for passengers to wait a long time for a bus or taxi or seek a complex transit route of public buses or subways themselves. The ride share system will be useful for people living in a depopulated area and/or elderly people.

Mobility-C (autonomous logistics):

Delivery of customers' orders will be optimized for each customer, ensuring they can receive ordered objects at a desired time and place by autonomous vehicles and drones. Autonomous vehicles will reduce the driving load of delivery drivers in specific areas where this technology is available.

## **Ethical issues**

### **Mobility-A (autonomous vehicle):**

Who should decide, and how, the priority of accident avoidance? (Should humans decide behaviors to avoid accidents except for stopping?)

### **Mobility-B (ride share):**

Should passengers' features (e.g., disability, social disadvantage, or gender) or personal urgency be considered in addition to service fees when their ride-share's route is optimized? If so, how should their priority and route optimization be decided?

### **Mobility-C (autonomous logistics):**

N/A

## **Legal issues**

### **Mobility-A (autonomous vehicle):**

Who is responsible for the accidents that occur during automated driving? Is it necessary to reinterpret/revise the Road Traffic Act to deal with drivers who remotely control vehicles? How can we guarantee privacy when we try to improve security by using surveillance cameras, etc.? How can we assure the options for protecting our privacy rights (i.e., the options on how much personal information we must disclose, which could vary between individuals)?

### **Mobility-B (ride share):**

How can we protect the personal information of fellow passengers? Is it necessary to reinterpret/revise road transport laws?

### **Mobility-C (autonomous logistics):**

How can we protect personal information, such as when the receiver is absent, whether they live alone, and whether they are elderly?

## **Economic issues**

### **Mobility-A (autonomous vehicle):**

Is it necessary for manufacturers to manage the product liability risks and possibilities of accidents? Can the current insurance system, which determines premiums based on drivers' attributes and experience, be viable if the vehicle software is more responsible for accidents than human drivers?

### **Mobility-B (ride share):**

What insurance will be available and who should pay for it? Will taxi drivers, as skilled workers, lose their jobs or suffer an income-cut?

### **Mobility-C (autonomous logistics):**

Is autonomous logistics unprofitable if it costs too much due to serving few

customers in underpopulated areas? Will autonomous logistics steal truck drivers' jobs or their income? Will it automate delivery planning (which requires skills, though autonomous logistics solves the problem of redelivery due to the receivers' absence, which increases logistics costs)?

## **Social issues**

### **Mobility-A (autonomous vehicle):**

Should the elderly be forced to use autonomous vehicles by reason of efficiency and safety? Can the freedom of choice on how to move be preserved? Should the variety of options, with some people wanting to use autonomous vehicle while others want to drive themselves, be guaranteed?

### **Mobility-B (ride share):**

There might be a possibility of a digital (or AI) divide, for example, as socially weak people in traffic, such as the elderly, come to live in a society where a smartphone or the internet is a prerequisite for using services. Will conventional taxis become relatively expensive as the number of their users decreases, and will the imbalance of the movement cost between people who can use ride share and those who cannot increase? It might be hard to use for the socially weak people, who should primarily benefit from AI.

### **Mobility-C (autonomous logistics):**

N/A

## **Educational issues**

### **Mobility-A (autonomous vehicle):**

Human drivers should acquire ability to shape appropriate decision making on choosing human control and AI control accordingly, and cooperating with an autonomous control system. It may be necessary to cultivate literacy for appropriate reliance on AI (preventing over-reliance or unfounded rejection).

### **Mobility-B (ride share):**

N/A

### **Mobility-C (autonomous logistics):**

N/A

## **Research and developmental issues**

### **Mobility-A (autonomous vehicle):**

The method to deal with security risks is necessary (e.g., periodic patrol or scan AI systems, applying virus pattern file, detaching the contaminated devices from

networks, or stopping automatic control promptly). The algorithm for the priority and the way to show its results are necessary to be developed. The interfaces to switch the level of control, that is, showing the reliability of AI appropriately and promoting to switch the AI control level, are also to be developed.

**Mobility-B (ride share):**

Security mechanism to protect the passenger's privacy is necessary.

**Mobility-C (autonomous logistics):**

Security mechanism to protect the user's privacy is necessary.

# Manufacturing

## **[Social implementations in the near future]**

Manufacturing-A (automated factory):

Robot arms with AI will be able to handle any objects, regardless of their shapes and orientations, without complicated programming. Accordingly, manufacturing of a wide variety of products in small quantities and for various needs will be realized with low costs. Factory robots will learn specialist skills, enabling them to perform specialist skills and contribute to other workers learning specialists' implicit skills. Power-assisting robotic suits (exoskeleton) will reduce the physical workloads of workers.

Manufacturing-B (creations):

AI will produce extensive literary writings, music, and arts semi-autonomously. AI will be able to re-produce the touch of famous artists with high accuracy.

## **Ethical issues**

Manufacturing-A (automated factory):

Does the value of humans' learned skills change when AI can perform the same skills? Are there any differences in value between a robot's skills learned from specialists and specialist humans' skills, and how are they evaluated?

Manufacturing-B (creations):

How are the originality of AI creations evaluated? Should it be stated whether a product was made using AI? Does one become uncertain of or doubt one's first impression of a creation when later discovering the creation was made by AI? Is it acceptable for AI to make a large quantity of arts or creations affecting humans' impressions and emotions?

## **Legal issues**

Manufacturing-A (automated factory):

Should we place responsibility on the user of a myoelectric-controlled powered exoskeleton for the accidents caused by its malfunction, based on the idea that the myoelectric signal reflects the user's will? Who is responsible for the accidents caused by autonomous robots?

### Manufacturing-B (creations):

How should we treat copyright and other intellectual property rights in AI creations (e.g., granting rights depending on how much AI is exploited for the creation, and claiming rights or incentives for AI developers)? Is it necessary to review labor and tax laws, which assume a laborer belongs to a company, if more people work as sole proprietors? How can we guarantee the intellectual property rights of original creations by humans if AI can fully replicate the creations?

## Economic issues

### Manufacturing-A (automated factory):

Business decision-making might be redesigned to enable the utilization of new AI algorithms (including the adaptation of AI to business decisions) and high-mix, low-volume production. Do we have to consider the social system (e.g., basic income) that distributes AI wealth fairly and broadly (since an automated factory would reduce labor hours and workers, though it can solve staffing shortages as it improves productivity due to the need for fewer labor hours and workers)?

### Manufacturing-B (creations):

AI may facilitate creation of small-scale businesses by individuals because AI supports human creations with low costs. If there are barriers to prevent such economic opportunities (e.g. social institutions and cultural framework), the government should take appropriate actions to remove them. More people might be unconstrained by time and location when they work (e.g., teleworking).

## Social issues

### Manufacturing-A (automated factory):

There are concerns about the market being monopolized by a few large companies, depending on the disparity between companies that can and those that cannot utilize big data and/or AI.

### Manufacturing-B (creations):

Excessive confidence in AI, praise for AI creation, rejection / aversion, and its possible social confrontation.

## Educational issues

### Manufacturing-A (automated factory):

It might be required for factory workers to acquire literacy to collaborate with autonomous machines or AI. It is necessary to cultivate human resources who have advanced skills or creative abilities that robots cannot perform? While the production and tradition of advanced skills and traditional crafts will be easy by AI



and robots, it might lead to decreased demand for human workers in these fields. Is it necessary to provide industry protection and educational environments to preserve cultures and maintain diversity?

**Manufacturing-B (creations):**

It is necessary to cultivate abilities for creative production utilizing AI.

### **Research and developmental issues**

**Manufacturing-A (automated factory):**

It is necessary to implement security to prevent robots from being directed to wrong or unintended work and being hacked from outside. Technical functions that enable us to trace the status, calculations, and outputs of AI when certain accidents occur is also to be developed.

**Manufacturing-B (creations):**

Technical mechanisms to embed information on how much AI is used in the creation, and to assure the originality of the creation by AI should be developed.

## Personal services (including medical care and finance)

### [Social implementations in the near future]

Services-A (medical care, diagnosis):

Predicting health status and doctors' diagnoses will be supported by AI using daily-life data and/or DNA sequences. Based on these, how to change one's lifestyle, how to prevent diseases, and medical care can be proposed optimally for individuals.

Services-B (credit examination, financing):

AI will improve the reliability and speed of credit examinations using various personal data, and reduce the costs and complications of financing. It will benefit both lenders and borrowers.

Services-C (recommender system):

Recommendations on various activities, issues, and events (e.g., shopping, political issues, behaviors, careers, and communications), optimized for each individual, will be provided based on AI inferences, using big data and individual data on behaviors, shopping, and affiliations.

### Ethical issues

Services-A (medical care, diagnosis):

Prediction of health status or diseases will be accurate even before symptoms appear. Should we reconsider patients' right to (not) know a diagnosis and doctors' duty to tell? Might predictive diagnosis increase politically incorrect discrimination between healthy people and others?

Services-B (credit examination, financing):

Do humans accept their credit scores being ranked or evaluated by AI?

Services-C (recommender system):

What are optimal conditions or goals of AI recommender systems (how to balance the different goals of individuals, companies, governments, and humankind)? Is it acceptable that customer profiling is conducted without users' awareness, and users are classified or ranked without their awareness? Though users are convinced that they behave according to their own free will, AI recommender systems would actually influence their behaviors. It should

be discussed ethically.

## **Legal issues**

### **Services-A (medical care, diagnosis):**

Who is responsible for erroneous diagnoses? Is it necessary to review whether the diagnosis by AI should be regarded as medical practice, and to review the relationship between disease naming and treatment actions (e.g., prescribing drugs)?

### **Services-B (credit examination, financing):**

Do we need any special restrictions on the information used for AI credit examinations?

### **Services-C (recommender system):**

We need to protect personal data that is used for profiling personal information and the resulting profiles.

## **Economic issues**

### **Services-A (medical care, diagnosis):**

Will the advancement of personal profiling that exploits information on life patterns, genes, family members, and other matters change the industrial structure as it sophisticates the prediction of possible diseases, thus diminishing the need for insurance?

### **Services-B (credit examination, financing):**

AI-based credit and finance-related personal services will accelerate complicated credit examinations. However, those services may reduce the number of workers for credit examination, leading to the conversion of work positions. Thus, the credit and finance-related workers might be urged to acquire new skills.

### **Services-C (recommender system):**

It is anticipated that recommender systems will affect some job categories, though the systems are expected to be exploited in many fields and facilitate economic growth, which will increase employment. Will the adaptation of recommender systems to office administration, for the purpose of suggesting the best action, reduce the need for secretaries except for service and communication-related tasks, though also lowering business costs?

## **Social issues**

### **Services-A (medical care, diagnosis):**

Consensus could be necessary to determine how far we can estimate health

status and future disease in detail. Is it necessary to establish a system for allowing individuals to determine? Is there any possibility of discrimination due to disease susceptibility or health conditions? While young people with literacy and assets will be able to utilize AI, and highly educated and rich people can become healthier by utilizing disease prevention, socially weak people who cannot use AI are expected to become less healthy. This may mean that economic disparity will increase social disparity through AI.

**Services-B (credit examination, financing):**

Will a person who does not want to provide personal information be denied access to credit screening or face a fall in their credit rating? How and what extent to assign decisions of the credit examination to humans and AI?

**Services-C (recommender system):**

Will opportunities to encounter new information be reduced as surrounded by convenient services such as the personal optimization based on AI? Care should be taken to avoid the possibility of discrimination based on profile results.

## **Educational issues**

**Services-A (medical care, diagnosis):**

It is important to cultivate (potential) patients' abilities to understand diagnoses and predicted diseases, and actively use them to enhance their own quality of life.

**Services-B (credit examination, financing):**

It is important to cultivate lenders' abilities to judge financing utilizing AI credit examinations, considering the circumstances, type of business, and risks by themselves.

**Services-C (recommender system):**

Ability to choose information might be diminished by the personalized recommender system. It is important to cultivate abilities to seek and obtain novel information, rather than being limited to recommended information.

## **Research and developmental issues**

**Services-A (medical care, diagnosis):**

It is necessary to develop methods to anonymize each person's data to avoid identification from the collected data, together with techniques to protect privacy such that each person can access their own data.

**Services-B (credit examination, financing):**

It is necessary to develop techniques to protect privacy information included

in the collected data or credit examinations based thereon.

**Services-C (recommender system):**

It is necessary to develop the technical mechanism for everyone to personally set their own parameters on how much individual data can be used publicly and how much individual profiles can be estimated. Ethical attitudes may be required from researchers and engineers.

# Conversation/Communication

## **[Social implementations in the near future]**

Conversation-A (conversation agent):

Conversation agents speaking and understanding users' native language will be useful for all people, including the elderly and children, and will be partners in our everyday lives. Machine translations will make our communication across languages and cultures easy and smooth.

## **Ethical issues**

Conversation-A (conversation agent):

Does it violate human dignity that an AI agent pretending to be and indistinguishable from a human being interacts with human users? Is it always required for AI agents to identify themselves as AI? How much can we accept AI affecting and modulating our emotion, affection, and faith?

## **Legal issues**

Conversation-A (conversation agent):

Who is responsible for the accidents and damage caused by misinterpretation by conversation agents and machine translation systems? How can we protect personal information when collecting all the data of conversations and user logs to improve systems using machine learning? How can we protect copyright and other rights in the creation resulting from conversations and interaction between conversation agents and humans?

## **Economic issues**

Conversation-A (conversation agent):

For jobs in which workers talk and communicate based on rules and case examples (e.g., customer support, question answering, and legal advice), human workers might be replaced by AI and the number of required workers decreases, even in the fields where sophisticated skills have been required.

## **Social issues**

Conversation-A (conversation agent):

How extensively can AI be involved in human communication? Will conflict occur

where, in a conversation between two (or more people), one person wishes to communicate using a conversation agent and the other does not? There is a possibility of excessive empathy with and dependence on the conversation agent (addiction).

### **Educational issues**

Conversation-A (conversation agent):

Abilities to communicate and lead conversations with others may be diminished. Individual differences in communication ability might be enlarged. Is it necessary for users to acquire literacies specific to cyber communications, such as handling flames, privacy matters, and cyber security? It is necessary to educate ability to assess the level of a conversation agent or a machine translation, and use them adequately in critical situations.

### **Research and developmental issues**

Conversation-A (conversation agent):

Technical methods to advance AI algorithms by collecting big data while simultaneously protecting individual privacy might be necessary. Methods to monitor users' emotional and mental impacts and prevent addiction or excessive influences might also be essential.

## Supposed Cases (extract)

- ◆ You are driving a car that assists drivers in avoiding accidents. The car suddenly brakes because its image recognition module wrongly recognizes a brand-new snack's package on the road as a child. Who is responsible for the accidents caused by the sudden braking; AI developers, data suppliers, or you (the driver)? Note that AI's behavior is hard to predict for situations that are not in previous data since AI depends on statistical machine learning that learns from the previous data and AI developers cannot always conceive such unexpected risks.
- ◆ You are working wearing a myoelectric-controlled powered exoskeleton in a factory. You accidentally kill a worker working next to you because of an unintentional movement of your exoskeleton. The exoskeleton behaves accurately according to the observed myoelectric potential, though you have no intention of moving that way. Is it possible that we regard myoelectric signals as our intention and blame you for the accident? If not, who should be responsible for it?
- ◆ You have recently received direct-mail messages from dating agencies and marriage consultancies frequently. This is because AI systems in the agencies inferred from your age, occupation, the history of your family, your purchase history, and your pattern of living that you want a partner. Although you have never imagined that you want one, you become wonder whether you actually want a partner deep down inside.
- ◆ Conversational agents have potential to alleviate the depression of patients through counseling. On the other hand, they might have excessive influence on their emotions.
- ◆ Most of traffic accidents are due to driver's human errors, and partly caused by dementia and aging. Autonomous cars equipped with an accident-avoidance function can decrease the accidents due to human errors. Is it allowed to force people with dementia or the elderly to use such autonomous cars or to limit their driver's licenses to ones effective only for the autonomous cars?
- ◆ A sixty-something person is driving a driver-assistance-system-equipped vehicle in a city. A ten-something boy suddenly runs out into the road from a telegraph pole. It is too sudden for the driver to avoid an accident and too close for the vehicle to do so by itself too. There is no choice but either to crash into the boy or to crash into the telegraph pole and harm the driver. How should a driver assistance system be designed to deal with such a situation? Who should be responsible for the design?