AI Strategy 2022

（tentative translation）

April 22, 2022

CONTENTS

PART I   BASIC CONCEPT

1. Introduction

In "AI Strategy 2019," which was formulated in June 2019, four strategic objectives were set. To realize these strategic objectives, the government has vigorously promoted various initiatives related to education reform, creation of a foundation for research and development systems, implementation in society, improvement of data-related infrastructure, digital government in the AI era, support for small and medium enterprises and venture companies, ethics, and other areas.

Education reform led to the widespread introduction of AI and data science education in school education and corporate human resource development programs in Japan. A series of AI-related research and implementation in society projects have also started. As a result, Japan's school education and corporate human resources development are undergoing major changes, and their goals are being achieved.

However, although it takes time for the effects to appear, the effects of each measure have not yet been fully realized in areas such as human resources development, industrial competitiveness, a sustainable society with diversity, and research and development.

In addition, in light of the risks of pandemics and large-scale disasters, the Government of Japan has established strategic objectives for dealing with imminent crises in the formulation of the AI Strategy 2021 in June 2021. In light of this, the Government of Japan has also examined specific objectives. AI for National Resilience, which aims to improve resilience in dealing with national crises in Japan, and Planetary Resilience, which aims to improve resilience in dealing with planetary crises, are two major challenges. As the foundation for implementing these challenges (strengthening cybersecurity), we need "Resilient and Responsible AI" to improve resilience against attacks on potential vulnerabilities through the accelerated introduction of digital transformation (DX) and AI and to improve the reliability of AI (establishing Responsible AI).

"AI Strategy 2022" presents a strategic policy extended from the former AI strategy to fit the current situation, reflecting the many risk factors that will become more apparent, such as the pandemic caused by the novel coronavirus and crustal movement. We will further promote the implementation in society of AI.

2. Scope of the Strategy

"Artificial Intelligence (hereinafter referred to as "AI")" in this strategy is supposed to be a system to realize intelligent functions[1].

AI in recent years has mainly been based on machine learning, especially deep learning. However, AI-related technologies are rapidly developing, and "AI" in this strategy is not limited to machine learning-based technologies.

3. Purpose of the Strategy

The purpose of this strategy is to contribute to the resolution of global issues through the realization of Society 5.0, and to present a comprehensive policy package related to AI for overcoming Japan's own social issues and improving industrial competitiveness.

4. Philosophy behind the Strategy

In March 2019, the government finalized the "Human-centered AI Social Principles." The principles indicate the shape of the society that Japan should aim for, the multilateral framework, and the direction that national and local governments should aim for, along with the development of AI. The following three points are defined:

① A society where human dignity is respected (Dignity)
② A society in which people with diverse backgrounds can pursue diverse happiness (Diversity & Inclusion)
③ A sustainable society (Sustainability)

The Strategy respects these basic principles.

5. Basic Approach to Promoting the Strategy

In order to realize the above-mentioned basic principles, namely, toward a "sustainable society with diversity," it is important to introduce new technologies, including AI, and to reform social systems in parallel with the technology introduction. Furthermore, it is essential for each and every citizen to be able to realize concrete benefits through the introduction of AI and for new technologies and social systems to be widely accepted.

In addition, Japan must improve its international presence and drastically

strengthen its industrial competitiveness while promoting the realization of Society 5.0. In doing so, based on the "Human-centered AI Social Principles", it is important to enable diverse human resources to contribute based on a wide range of knowledge, perspectives, ideas, etc., regardless of their diverse backgrounds such as gender, age, political beliefs, and religion.

Bearing the above viewpoints in mind, the national government, as a comprehensive coordinator, needs to steadily promote the various measures described in this Strategy while also paying attention to the following points.

① The greatest mission of a nation is to protect the lives and property of people living there. It is essential to build a system that can quickly respond to emergency situations, including pandemics and large-scale disasters. It is necessary to quickly correct the delay in responding to these needs and to build a sufficient foundation and management system.

② Private companies are the key players of industries. In order for private companies to demonstrate their capabilities, it is essential to develop infrastructure (developing and attracting human resources, promoting R & D, and supporting the development and commercialization of industrial infrastructure), to build systems that accelerate the introduction of new technologies, to eliminate inhibitory factors, and to build a multilateral framework.

③ The implementation of AI systems requires infrastructure, ultra-high-speed communication networks, sensors, robots, etc., which collect and store large-scale data and provide access to it.

④ For social acceptance of AI, it is important to develop and implement technologies that ensure the safety and soundness of systems, including cybersecurity and AI ethics, to improve literacy related to AI, to ensure appropriate communication between developers, operators and users, and to feel the concrete benefits of AI.

⑤ In view of the increasingly complex international situation and changes in socio-economic structures, various initiatives are being considered for important technologies including AI from the perspective of economic security. Therefore, it is necessary to coordinate related measures so that the government as a whole can effectively prioritize them.

⑥ In addition, since AI has a wide range of applications and is technically closely related to many research fields, it is important to pursue synergies with the government's strategic initiatives such as quantum, bio, and material science.

This Strategy establishes the following strategic objectives.

Among these strategic objectives, Strategic Objective 0 is to prepare for the capability to deal with imminent crises. As a country with natural disasters, Japan needs to take full measures. On the other hand, Strategic Objectives 1-4 will lay the foundation for Japan's sustainable industry and society. It will be necessary for Japan to maintain its international competitiveness and to take a sustainable and steady approach for the survival of Japan. We need to turn these two wheels in parallel.

Strategic Objective 0

A system and technological infrastructure that will enable Japan to protect the lives and property of the people living there as much as possible in the face of imminent crises such as pandemics and large-scale disasters, and a mechanism for proper and sustainable operation will be established.

The pandemic caused by the novel coronavirus requires a certain amount of time and a detailed response until it settles down. At the same time, it is necessary to assume that this is not the last pandemic, but that a new pandemic may occur in the future. In addition, it is necessary to assume that emergency situations such as large-scale disasters and even more urgent situations will occur frequently, such as large-scale earthquakes such as Tokyo Metropolitan Inland Earthquake and Nankai Trough Earthquake, as well as increasingly severe and frequent meteorological disasters. What has been revealed in the response to the novel coronavirus is an unbelievable delay in our country's digitization, which can be seen in both the public and private sectors. In addition, it is difficult to say that the organizations and legal systems for responding to such emergency situations are in place. In the part related to this strategy, there are many problems before AI, such as unclear ownership of various data and paper-based information transmission. This problem should be corrected without delay. Reflecting the launch of the Digital Agency and the establishment of a series of legal systems, we aim to advance AI-related research and development that will contribute to the protection of the lives and property of the Japanese people and to quickly put it into practical use.

Strategic Objective 1

Japan should become the world's most capable country in the AI era by developing human resources and attracting human resources from around the world. Furthermore, a mechanism should be established to realize this objective in a sustainable manner.

"Human resources for the AI era" is not a single concept but is categorized as follows:
- Human resources to conduct cutting-edge AI research
- Human resources to apply AI to industry
- Human resources to realize AI applications at small and medium-sized enterprises
- Human resources to conduct new business and creation using AI

It is necessary to have a large number of people in each category.

In order to increase the number of human resources, it is important to develop and attract various types of human resources, including women and the elderly, as well as people seeking to enter Japan from overseas. Therefore, in the future, it will be important to develop advanced education programs, and it will also be necessary to expand these programs to the level that can be offered overseas.

In our daily lives, more effective use of AI will improve the convenience of our lives and enable us to do things that we couldn't do before. In order to do so, we need to increase our AI literacy so that each person can enjoy and utilize the benefits of AI on his or her own will without anxiety.

Strategic Objective 2

Japan should become a top runner in the application of AI in real-world industries and achieve enhanced industrial competitiveness.

The "real world industry[2]" area, where value is created only through interactions with people, nature, hardware, and so on, without being completed in cyberspace, contains vast amounts of information that have not yet been systematically acquired.

In many cases in this area, it is extremely important to promote the shift to high-value-added industries centered on service platforms. Therefore, we aim to improve industrial competitiveness and secure and maintain our position as the world's top runner by promoting AI-related development support, designing systems, and implementation in society. While this is an objective that will be achieved in conjunction with policies other than AI strategy, AI strategy is definitely an important part of it. Labor productivity can be considered as a measure of industrial competitiveness. It is clear that Japan needs an extremely drastic reform of its industrial structure in order to reach the labor productivity level[3] as high as that of the United States, Germany, France and others. At the same time, we will contribute to the achievement of SDGs on a global scale through these fields. For example, as stated in SDG9 on the promotion of sustainable industrialization and innovation, Japan can contribute to the promotion of sustainable industries and the achievement of SDGs through innovation, and AI can play an important role on it.

In addition, it is important to further improve the quality of services, improve the working environment, and ultimately reduce the financial burden by applying AI in the public service sector.

Service industries such as e-commerce and SNS, which are almost complete in cyberspace, will be discussed in the future.

Strategic Objective 3

In Japan, a series of technology systems to realize a "sustainable society with diversity" is established and a mechanism to operate them is realized.

It is vital that diverse people from diverse backgrounds, such as women, foreigners and the elderly, be able to fully participate in society while realizing diverse lifestyles. Japan will promote the establishment of various AI-related technology systems and the creation of social systems and mechanisms to utilize them, with the aim of enabling each individual citizen to receive concrete benefits from AI.

Moreover, this strategic objective is not intended only for Japan, but it is important to formulate a plan for its implementation on the premise of promoting it on a global scale in order to contribute to the achievement of the SDGs.

<u>Strategic Objective 4</u>

Japan should take the leadership to build an international network in the AI field for research, education and social infrastructure and accelerate AI research and development, human resources development, and achievement of SDGs.

Amid rapid economic and social globalization, AI-related human resources development and securement, industrial development and the like are never completed within Japan, and must always have an international perspective. For example, in order to develop and secure human resources, it is necessary to provide many opportunities for overseas researchers and engineers to play active roles in Japan and to increase joint research, development and joint projects between Japan and overseas.

For this reason, in addition to strengthening cooperation with research and educational institutions and companies in North America and Europe, Japan will promote full-scale cooperation with ASEAN, India, the Middle East, and Africa, which are expected to grow in the future, and contribute to the promotion of AI research and practical application in these regions. In order to achieve this, it is necessary for the core centers of the AI R & D Network to clarify how they will conduct world-leading research in each priority area, and how they will attract human resources internationally, including diversity in human resources and themes, in emergent research.

In addition, in areas such as health, medical care, nursing care, agriculture, and smart cities, Japan will aim for international collaboration and cooperation of a scale with mutual merits in terms of human resources, data, and markets.

7. Role sharing between the public and private sectors

Unified efforts by the public and private sectors are indispensable for the realization of this Strategy. Among them, the Government will develop an environment for creating a new society (Society 5.0) in the future and support the private sector's efforts to improve productivity, create diverse values, create start-up companies, and continuously reform the industrial structure through them. by implementing the following initiatives:

- Develop a strategy and a roadmap to achieve it
- Swift removal of institutional and policy obstacles
- Building a network to resolve issues among multi-stakeholders
- Human resources development in Japan and overseas
- Implementation in society for social structural changes and for the survival of the nation
- Fundamental research and development, next-generation basic research
- Development of a common environment to accelerate AI utilization
- Formation of national and international system for ethical issues and governance
- Building a hub for a "global network"

On the other hand, the private sector needs to fully understand the purpose of this Strategy, comply with the AI Social Principles, introduce an internationally competitive compensation system for outstanding human resources, and make further efforts to realize implementation in society of AI technology as a goal. It also needs to promote international cooperation with other countries and regions and cooperation with various stakeholders. In order to co-create the future, the Government need to be conscious of being an entity that will take on major challenges and actively contribute to future economic and social development.

PART II   DEALING WITH IMMINENT CRISES

1. Environment surrounding Japan

Building a foundation for dealing with national crises such as disasters, which is the goal of Strategic Objective 0, is an extremely important issue for Japan, which is a country with many natural disasters. At the same time, we need to achieve sustainability on a planetary scale crises. In order to achieve both, AI and digitization will need to be promoted and the barriers for the building of the foundation will be removed. This section describes in detail the background to the establishment of a strategy based on Strategic Objective 0.

(1) Japan's "Current Crises" -- The Need to Establish National Resilience

While the spread of the novel coronavirus continues, Japan is currently exposed to the risk of large-scale disasters such as large-scale earthquakes such as the Tokyo Metropolitan Inland Earthquake and the Nankai Trough Earthquake, large-scale volcanic eruptions including Mt. Fuji, and heavy rains that are becoming increasingly severe and frequent due to climate change. Since natural disasters are inevitable, it is obvious that efforts should be made to minimize the damage caused by natural disasters, and there is also a major challenge of how to reconstruct Japan after that.

Furthermore, not only the burden on the medical system, which has been transformed by the endemic of the novel coronavirus, but also the risk of new pandemics, such as avian influenza, has not been reduced. It is necessary to assume that pandemic risks will increase further in the future in conjunction with climate change and loss of biodiversity.

At the same time, internal factors such as the rapidly shrinking domestic market and labor population due to population decline and aging, and the extreme deterioration of public finances have deprived the nation of its physical strength. Furthermore, it must be said that the response to major changes has been decisively delayed, as seen in the delay of digitization and AI. There are also concerns about geopolitical risks. This is not a sudden change like a disaster, but in the sense that there is a high probability that it will lead to a critical situation, it is an emergency, and serious and immediate response is necessary. Unfortunately, this is our "present crisis" and our "promised future."

These challenges cannot be overcome by AI alone. However, these are issues to be dealt with by the present all-out efforts of Japan, including AI, and it should be greatly utilized as a catalyst to break the existing blockage. In particular, large-scale disasters are becoming a serious situation at a time when the nation's strength is being eroded, and countermeasures against such disasters are of the utmost importance. At the same time, Japan has a history of overcoming repeated large-scale disasters. In fact, earthquakes along the Nankai Trough repeatedly occurred, and when they occurred during the Ansei era, they caused major disasters, and Japan reached a historic turning point from the end of the Edo Shogunate to the Meiji Restoration. The next cycle was the end of the Pacific War, and Japan entered an era of high economic growth from the end of the war. Based on this historical perspective, it is necessary for us to develop a strategy to firmly respond to the current crustal movement cycle and at the same time to envision the shape of Japan to follow. Efforts to create hope for this "promised future" will not only be realized by the combined efforts of mankind, but will also serve as a trigger that will bring about changes in society in the future. This is also a way in which Japan can contribute to the world in its own way.

(2) Planetary crisis is progressing -- Show leadership in building Planetary Resilience

At the same time, the planetary crisis is progressing and the urgency of responding to it is increasing every day. An irreversible Climate Departure[4] is foreseen, which will lead directly to intensification of wind and flood damage, increased pandemic risk, food crises, and depletion of water resources. Beyond that, there will be further increases in inequality, poverty, hunger, political instability, and frequent regional conflicts.

Sustainability on this planet is a holistic problem that cannot be solved by achieving carbon neutrality alone. As discussed at the Visionary Meeting of the Moonshot Research and Development Program in Japan, a very broad range of issues will need to be resolved[5]. At the same time, an extremely shocking study has been published that even the extremely severe decline in economic activity caused by the global lockdown in the first half of 2020 due to the impact of the novel coronavirus did not lead to sufficient improvements in environmental impact[6]. This indicates the need for fundamental changes in social and industrial structures, rather than simply measures such as reducing economic activity and increasing

efficiency[7].

Many of the solutions to these problems can be achieved through a new and, perhaps radical, transformation of social and industrial structures and a series of technological breakthroughs that make it possible. Japan is also a country that places great value on safety and security as well as on the fertile but harsh natural environment, and places great importance on harmony with nature. Japan should clearly show its determination to achieve a series of technological innovations, including AI, and structural changes in society and industry, and take global leadership in these areas. This is not only a great contribution to solving global problems but also an opportunity to create a great industry, which will greatly contribute to the development of Japan and the improvement of its international standing.

(3) Overcoming Vulnerabilities Associated with AI and Digitalization -- Establishing Responsible AI and Strengthening Cybersecurity as Cybernetic Resilience

The achievement of National Resilience and Planetary Resilience is a challenge that must be addressed with every possible means. It is also true that AI and digitization are essential to its realization and a part of its core. This means that more information will be accumulated and distributed in digital space, and more valuable information will be generated from analysis using AI and other technologies. It is extremely important that the social infrastructure formed by AI and digitization is fair, transparent, operated in a responsible manner, and secure. This is a major premise for the spread of AI and digitalization, and is the basis for achieving reliable cross-border data flows. Such technology will ensure the reliability of Japan's information infrastructure and will also create competitive advantages in terms of high quality, security and safety.

While overcoming these challenges will entail major social and industrial transformation and technological breakthroughs, it is also an opportunity to generate significant business opportunities. In short, the intent of Strategic Objective 0 is to develop and rapidly implement a strategy that transforms the great crisis we are facing into the greatest opportunity. At the same time, it is intended that this strategy will become the very policy that Japan should undertake to support the improvement of our industrial competitiveness.

In order to realize the strategy centered on Strategic Objective 0 of AI Strategy 2022, it is necessary to formulate and implement concrete measures to realize the following action policy.

(1) Establishment of AI for National Resilience

Maximizing resilience against large-scale disasters and formulating recovery plans. AI and its peripheral technology support maximum measures at each stage of disaster prediction, prevention, response and recovery, and realize measures that were impossible before. This will require digitalization and AI at maximum speed, and a shift to an extremely robust social system. It is also necessary to accelerate preparations for reconstruction and a vision of a new Japan. To this end, it is necessary to build a strategic buffer, both physically and information-wise, based on the Fundamental Plan for National Resilience (Cabinet decision in December 2018).

Major goal

Establishment of "AI for National Resilience"

---

① National Resilience through the establishment of Digital Twins

While there are many studies that attempt to utilize AI for disaster prevention and mitigation, it is important to build a Digital Twin as a foundation that can use AI to support a series of integrated flow of disaster prediction, prevention, response, restoration and reconstruction. In Recommendation of the Future Vision Team of the Digital and Disaster Prevention Technology Working Group[8], options for disaster prevention and mitigation using digital technology are presented. Disaster responses should be promoted from peacetime, and one of them is the construction of Digital Twins. This is not only from the viewpoint of disaster prevention but also from the aspect of promoting digitization of public infrastructure in Japan. The basic premise for AI adoption of core infrastructure is thorough digitization. The major premise is to implement the Recommendations of the Future Vision Team of the Digital and Disaster Prevention Technology Working Group[9]. The Digital Twins will not simply be closed to cyberspace, but will be integrated with robotics and sensors to create a

hybrid system with real space.

A Digital Twin is not only a disaster countermeasure but also a foundation for national administration. It can also be a platform for improving the efficiency of private services and creating new services and a flexible lifestyle. Attempts to apply Digital Twins to urban planning, operation and a wide range of businesses are being made in Singapore and other countries[10]. Cooperation with these initiatives is also important.

The realization of the Digital Twins will promote the digitization of central and local governments and other administrative bodies. At the same time, digitization will enable flexible work and life styles. This will give a great degree of freedom in choosing where to live and where to find their office. It opens the way to migration to areas with low earthquake risk, to live in multiple locations, and to form depopulated communities. The purpose of digitalization and AI is not simply to increase the convenience of life and business opportunities. Rather, its essence should be to realize inclusion of diversity and sustainability. We believe that realization of a resilient society against disasters, inclusion of diversity, and improvement of sustainability can be simultaneously realized.

It should also be noted that Digital Twins are expected to be used in efforts similar to disaster response, such as the protection of citizens in armed attack situations.

Specific target

　Building Digital Twins as the foundation for AI utilization

---

② 　Establish National Resilience by strengthening global networks

The importance of establishing a Resilience is not limited to domestic measures. In order to cope with large-scale disasters and rapid contraction of the market and labor force in Japan, BCPs capable of coping with changes in conditions outside Japan and measures against supply chain disruptions are necessary. This means that a system can be efficiently constructed so that supply chains can be maintained and businesses and lives can be continued even in the event of large-scale disasters either inside or outside the country.

At the same time, we will pursue greater potential by strengthening

partnerships with larger markets away from the domestic market, which is likely to shrink due to the low birthrate and aging population, thereby improving corporate resilience and ultimately Japan's resilience. The rapid aging of society also means that opportunities for highly specialized human resources to pass on their knowledge and craft skills are rapidly disappearing. Rapid aging and population decline are not just problems for Japan, but also problems that many countries face sooner or later.

The public sector, including central and local governments, needs to accelerate the building of infrastructure and institutions that support the rapid deployment of private companies in global markets. For example, establishing interoperability of Japan's digital data platform with data platforms such as India Stack[11] can support access to large markets and expansion of business scale.

This means not only that services and products developed in Japan will be deployed overseas, but also that the development and commercialization bases will be dispersed not only in Japan but also overseas and will have a backup function. The government needs to quickly set up infrastructure, institutions and players that can be deployed in global markets and provide efficient support for strengthening resilience. Such policies will also contribute to the global expansion of a wide range of companies. For example, if we take the agricultural sector as an example, the expansion of WAGRI[12], an integrated agricultural data-platform, not only in Japan but also abroad, may lead to the accumulation of a wider range of data and support for Japanese agricultural businesses abroad. It can be expected to develop as a system of high-quality services and products by linking it with a platform to ensure traceability and developing logistics systems such as cold chains. In fact, a smart food chain platform is being developed and will be implemented. It is important to construct the harvest loop on the development which overlooks such world market. At the same time, it is expected that the establishment and operation of such systems will enhance the capability to respond to contingencies both at home and abroad. It is important to start up a group of projects that can be expected to play such leading roles.

At this time, it is important to build a double harvest loop that not only develops services and products, but also creates value from the data accumulated there, leading to the accumulation of data that can create even greater value[13]. It is extremely important to develop a "flywheel" based on such a loop as a process and to implement it quickly[14]

In light of the current international situation, which is becoming increasingly complex, it is necessary to select appropriate countries as partners for cooperation.

<div style="border:1px dashed">

Specific target

Construction of infrastructure to support the global expansion of private companies, including the construction of a "data economic zone" through international collaboration of domestic data infrastructure

</div>

(2) Establishing leadership in AI for Planetary Resilience

We will develop and implement technologies, platforms and action plans that will significantly contribute to addressing global environmental issues and other sustainability issues. For example, the development of methods for reducing the burden on biodiversity in the agricultural sector and achieving both environmental load reduction and economic rationality, as well as a resilient and sustainable food supply through distribution, data accumulation and analysis, have the potential to simultaneously solve global environmental and food problems. In the area of AI, under the banner of AI for Goods, it is necessary to apply AI to areas such as sustainability and to contribute to society[15] Leading companies and universities are actively promoting research and implementation of AI for Good. Applications of AI in the context of sustainability are expected in many areas such as energy, mobility, health care and food.

For example, in the area of food that we have already discussed, the question is how to contribute to the instability of the global food supply. In order to ensure a stable and efficient supply of renewable energy, grid control, forecasting of power generation and demand, and smoothing of demand in conjunction with areas such as mobility will be necessary. Expectations for AI are high in many fields, including telemedicine and AI diagnosis for improved access to medical care and personalized medicine, expansion of access to education and personalized support, prediction of disasters such as floods, including use in developing countries, and technology that enables recycling of resources[16] throughout economic activities.

Changes in working styles and lifestyles accelerated by COVID-19 could serve as a catalyst to redefine the role of cities and what they should be. Rapid urbanization worldwide is projected to result in 60 per cent of the world's population living in

cities in 2030 and 70 per cent in 2050, accounting for 80 per cent of global GDP. It is estimated that 75% of CO2 emissions come from urban areas[17]. The impact of COVID-19 is expected to increase the number of people living outside cities and in two locations, but efficiency and other factors suggest that urbanization is unlikely to reverse. Cities enable the accumulation of economic activities in an extremely efficient manner. At the same time, they also contain many risks including large-scale disasters. In addition, 44 per cent of urban GDP is projected to be severely affected by the loss of biodiversity and the natural environment[18]. Urban structures and operational technologies that are resilient to disasters and pandemics will benefit many regions. At the same time, inclusion of diversity in cities is also important[19] but balancing this with resilience seems to create many possibilities[20]. In February 2021, the United Kingdom published its Dasgupta Review, which focuses on the concepts of Inclusive Wealth and Ecosystem Services with the aim of balancing biodiversity balance and economy[21]. It is worth noting that in January 2022, the World Economic Forum (WEF) published a report advocating the importance of biodiversity in cities[22]. The same problem exists in "depopulated communities," which at first glance are the opposite of cities. There is a common need for resources in the activities of human society, environmental loads including emissions into the air, rivers and sea, and basic social infrastructure. It is necessary not only to reduce environmental impact but also to recycle resources in urban activities[23] and to improve the environment through activities that support our society. In the WEF report, it is described as "Nature-Positive". The concept of Nature-based Solutions (NbS) is presented by regarding cities as a single life form. Although this concept itself is abstract at the present stage, it is certain that our economic and social activities require a paradigm shift that not only harmonizes with nature but also contributes to the increase of biodiversity and the restoration of nature. It is no exaggeration to say that this is development and implementation of the global scale terraformation technology. AI can't do this alone, but AI can be an important core technology to make it happen. Japan should take leadership in this field and pursue a strategy to establish an AI for Nature-Positive Economy. In doing so, Japan should hone its unique strengths and aim for a major catalytic presence that breaks away from the difficult situation of hope in the world.

(3) Establishing leadership in Resilient and Responsible AI

What should be promoted at the same time as thorough digitization and enhanced functionality through AI is a foundation for developing and deploying resilient, high-quality, safe and secure AI. The most important issue is Responsible AI and Resilient AI based on the strengthening of cyber security.

The realization of Responsible AI is a requirement that must be secured in the promotion of digitization. To this end, it will be important to promote further R & D and implementation in society of a series of technologies such as Explainable AI (XAI) and Federated Learning, which can be learned while protecting privacy and confidential information, as well as to build platforms and to exercise leadership in their operation. In addition, security requirements make it a prerequisite for these platforms to be robust with advanced cybersecurity technologies. The high quality, high reliability, and safe and secure nature of AI-related services in Japan are advantageous not only for their widespread use in Japan, but also for their deployment around the world. It is important to establish leadership in this area.

The promotion of R & D and implementation in society of a series of technologies related to Responsible AI and their platformization will not only contribute to the creation of digital twin systems as a measure against large-scale disasters, but also contribute to the creation of new businesses utilizing public segment data and APIs. It will also serve as a platform to globally appeal the high quality, security and safety of AI in Japan and contribute to the realization of Resilient AI. Specifically, as discussed in (1) ②, in order to realize services using AI and machine learning while developing international networks, it is necessary to develop and properly operate technologies such as Federated Learning that respects personal information protection and assumes machine learning from large-scale data

17

sets in multiple countries. It's a resilient AI that addresses issues like Cyber Attack and Privacy. It is also an essential requirement if we take leadership in the field of AI for Planetary Resilience as discussed in (2) above. In order to solve the problems created by cities, thorough digitization and the introduction of AI can be assumed. This means that city functions are more vulnerable to some kind of trouble related to those systems[24]. The basic architecture and resilience design will be even more important. This is also true for non-urban issues. It is essential to achieve Responsible AI that is robust enough to protect and maintain the deployment and operation of global AI systems and that can maintain the reliability of those systems.

In addition to efforts to improve the reliability of AI (Security for AI), it is also important to utilize AI to enhance security measures in cyberspace (AI for Security). In order to cope with increasingly complex and sophisticated attacks and the risk of vulnerability that increases as systems become more complex, active consideration should be given to the use of AI, such as information gathering, analysis, support functions, and AI for automation of defense in order to help cyber security analysts make decisions.

Major goal

Establishing leadership through "Strong and Responsible AI"

Specific target
- Initiatives to realize "Responsible AI" such as "Explainable AI" (Accountable AI)
- Promote technology development in the area of integration of cyber security and AI leading to improved reliability.

3. Alignment of Strategic Objectives and alignment of direction

At the same time as these actions as Strategic Objective 0, it is also important to link them with existing Strategic Objectives. With regard to Strategic Objectives 1 to 4, which have already achieved a certain level of progress, alignment with the intent of Strategic Objective 0 is desirable. For example, as an additional action on Strategic Objectives 1 and 4, it is desirable to develop and implement concrete policies to realize the large number of Japanese students studying abroad and the accepting foreign students to Japan. In particular, in order to realize the National Resilience and Planetary Resilience of Strategic Objective 0, it is essential to form a team with human resources and diversity that not only has a deep understanding of AI and data science but also can come up with ideas that take a panoramic perspective of the earth. In addition, Strategic Objective 2, "Top Runner in AI Applications in Real World Industries" and Strategic Objective 3, "Realization of a Society that Embraces Diversity" can be enhanced to be more effective by accelerating the current plan and simultaneously linking it with the direction presented in Strategic Objective 0.

In this way, AI Strategy 2022 aims to achieve multiple outcomes such as resilience, inclusion of diversity, sustainability and creation of business opportunities on a global scale by setting Strategic Objectives 0 and organically implementing a series of action policies based on it.

The AI Strategy 2022 takes the crises facing Japan and the world head-on and clearly aims for Japan to be a leader in overcoming it. Many of these solutions are on the scale of the grand challenge. But many real innovations come from such challenges. AI Strategy 2022 sees Japan's future in it.

PART III PROMOTION OF IMPLEMENTATION IN SOCIETY

1. Background of implementation in society

In order to promote the implementation of AI, to effectively utilize AI, and to enjoy the benefits of AI in our society, economy, and people's lives, it is necessary to abandon the preconceptions that are now believed widely.

In our country, AI is often recognized as a substitute for human work and used to reduce cost and labor. It is certainly possible to see it that way. However, because many people are preoccupied with such a one-sided perception, even if some companies and research institutes develop technologically superior AI, AI will not be used in our workplaces and daily lives as we might expect.

While other developed countries, such as the United States, are quickly transforming themselves with AI, many of us are unaware of these transformations, or even if they do, are simply bemoaning the inefficiency of our unique social structures and customs, or are ignoring them in the light of baseless optimism that "Japan will soon be able to catch up." However, as long as our society is in such a situation, it will not be easy for Japan to regain its vitality as an economic superpower in the future when AI will become a fundamental technology for society. Perhaps the current social system will not be able to effectively use AI as the foundation of society, and it will fall behind other countries for a long time.

We live in a time when our society should be transformed. In DX, which can be called the process of opening up cyberspace, the United States has grown significantly, while Japan has failed to gain an advantage in global competition. In the future, the main battlefield will shift to the fusion of physical space and cyberspace, and we will enter a situation that can be called the second round of DX. As Japan moves forward with the implementation of AI that takes advantage of its strengths in physical space and transforms its society, it will be able to find the "winning strategy."

Efforts in the next few years will surely create a big difference in Japan's national strength in the "after digital" era that will come after the DX. What we need now is to understand what is the difference between advanced AI countries and Japan, what we need to tackle to promote AI implementation and initiatives to enrich our social economy and people's lives in Japan into the future.

2. Approach to promoting implementation in society

In order to promote the implementation of AI in Japan, it is necessary to abandon the following assumptions about AI, as the digitization of society is a matter of course.

① "AI substitutes for human work" ⇒ "AI cooperates with human"

If AI is more accurate than humans, or if you want to reduce the amount of work done by humans with a certain margin for error, then AI should take the place of humans.

However, many of the tasks we perform on a daily basis require very extensive informed judgment, or even the slightest error is unacceptable (for example, an error that kills a patient in a surgical operation is fatal). Therefore, as long as it is recognized that AI implementation is a complete substitute for human work and without human involvement, there will be very few situations where AI can be effectively used and implementation in society will be slow.

In other words, in order to effectively utilize AI and efficiently process diverse tasks, it is necessary to abandon the belief that AI substitutes for human work. In most cases, AI is helping people. By working with AI, people can minimize their effort and maximize their profits.

② "Only engineers can understand AI deeply" ⇒ "AI can be understood from business cases"

As long as the field of vision remains within Japan, it is unnoticeable, but on a global scale, the search for AI utilization measures is progressing in almost every field. There are many start-ups, and there are unicorns that have built innovative business models using AI in various fields.

When considering how to use AI, it is not appropriate to assume that only engineers can understand AI deeply, and to think that engineers who can build AI systems are necessary.

In practice, even without such engineers, it is possible to understand from many other examples what can be processed and at what level by leveraging AI products and services.

In order to build a new business model using AI, it is not always necessary for

a company to develop AI itself. Acquiring existing AI or incorporating useful elements of an existing business model that includes AI and differentiating itself in other areas is also an effective approach. It is possible to make use of AI even without engineers who have a deep understanding of AI.

③ "All depends on data" ⇒ "It is important to form a loop"

AI learns or processes data by algorithms.

For this reason, as if "all depends on data", there is an assumption that if you don't have a large amount of data, you can't win in AI utilization. Data is certainly important, but in a digital situation, it is also effective that the provision of services enables to acquire data, to strengthen AI, and thus to improve services.

For this reason, while data is important, what is more important is that consideration should be given to forming a continuous cycle (loop) such as collecting data through the service to enhance AI.

3. Initiatives to promote implementation in society of AI

In order to promote implementation in society of AI and lead to the creation of large profits, deep learning, which could be widely and effectively used in image recognition and natural language processing, should be prioritized as an important field. The following efforts should be made while keeping in mind the implementation by private companies.

(1) Break the black box nature of AI and resolve concerns

One of the impediments to the implementation in society of AI is "concern over the reliability of AI."

For example, when AI is expected to function as a substitute for humans, it is not easy to build and acquire such highly reliable AI. This raises concerns about its reliability and discourages the use of AI.

Even in cases where AI is not required to perform such functions and a certain degree of imperfection can be tolerated, AI processing is a so-called black box, and when people cannot understand the basis of AI processing, the validity of the results cannot be verified. For example, if you fear that you may be affected by inappropriate

racial or gender bias, you can't trust AI.

There are also security risks. When AI processes data that needs to be protected, such as personal information, there may be concerns about the reliability of the processing. In recent years, there has also been an awareness of the risk of AI itself becoming an attack target by intentionally inputting illegal data in the AI learning process.

There are several solutions to this. Of course, increasing the accuracy of AI through technical improvements in AI itself is an option. In addition, it is necessary to improve the reliability of AI through initiatives related to Explainable AI (XAI), which breaks the black box nature of AI by enhancing the transparency and accountability of AI processing, and through technological development in the area of integration of cyber security and AI. In addition, efforts to realize "Responsible AI" are also expected through initiatives related to the ELSI of AI, such as designing AI with ethical considerations in the first place and conducting audits in the AI utilization cycle.

Major goal

    Improve AI reliability

Specific target
- Initiatives to realize "Responsible AI" such as "Explainable AI" (repeated list)
- Promotion of technology development in the area of integration of cyber security and AI leading to improved reliability (repeated)

(2) Expansion of AI application areas

In addition to algorithms and computing resources, AI is enabled by data to be learned and processed. Data is not only a prerequisite for AI utilization but also a major factor in differentiating AI-based products and services.

An area where data to be learned or processed by AI exists is considered to be an area where AI can potentially be applied. In particular, given that the use of AI will become more active in the area of integration between real space and cyberspace, it is necessary to quickly expand the application area of AI by incorporating various objects and various indicators in real space as data.

In addition, if the data to be learned has an inappropriate bias, defect, or shortage, the accuracy of the AI will deteriorate and the function will be insufficient. In other words, high quality and wide range of data leads to the creation of good AI products and services. In Japan, there is considerable accumulation of high-quality data in each field. Therefore, efforts should be made to enhance data that supports AI utilization by linking and converting these data in a form suitable for AI.

With regard to the excellent data base, it is expected that a "data economic zone" centering on Japan will be constructed by actively engaging in cooperation with other countries.

Major goal

    Enhancement of data supporting AI utilization

Specific target
- Building Digital Twins as the foundation for AI utilization (reprinted)
- Improving research data infrastructure, clinical data infrastructure, etc. to promote AI utilization
- Promotion of technology development in the area of integration of cyber security and AI leading to effective use of confidential data

(3) Additional initiatives related to AI human resources, technical information, data handling rules, etc.

Compared with other AI-advanced countries such as the United States, Japan has insufficient human resources to support AI utilization. Various measures are already being taken to improve literacy in education reform and other areas. However, additional efforts are still needed to secure high-level human resources for research and development of AI itself.

With regard to the development of highly skilled human resources in the AI field, it is effective to gain access to cutting-edge research and opportunities for friendly competition, especially in an environment where highly competent human resources with enthusiasm from all over the world gather, such as in the United States. In recent years, however, the financial and language skills necessary for studying abroad have become obstacles, and it seems that the inward orientation of

students is becoming stronger in Japan. Therefore, it is desirable that further efforts be made to increase the international brain circulation of human resources in the AI field.

In addition, when engaging in AI-related research and development, it is often difficult to secure particularly excellent and sufficient human resources. On the other hand, since excellent human resources make significant progress in research and development, it is also expected that research funds will be used to invite doctoral students and others to participate. In setting the amount of research assistant expenses to be paid in such cases, it is desirable to set it boldly and flexibly to attract excellent human resources based on the actual conditions of relevant industries, rather than following a uniform salary level regardless of academic field.

On the other hand, in order to encourage implementation by private companies in Japan, it is important to actively provide technical information held by national research institutes, etc., and to accelerate bridging of new technologies through practical human resources development that directly leads to corporate activities such as start-up creation. It is also important to make efforts to actively carry out trial and error in practice.

In addition, as an important element in the AI utilization environment, it is necessary to make constant efforts to improve data handling rules that take into consideration measures against the outflow of sensitive data and technologies overseas.

Major goal

    Additional environmental improvements such as securing human resources

---

Specific target
- Improvement of international brain circulation in advanced technologies such as AI
- Proactive provision of technical information from national research institutes and practical human resources development and etc. to promote AI implementation through activities by private companies
- Review of rules for handling data subject to AI learning and processing

(4) Strong government traction

In Japan, many general-purpose AI products and services are already available. While forward-thinking private companies are aggressively adopting AI to develop new businesses, many are not making such choices and maintaining their traditional business methods.

Which choice is right depends on the circumstances in which each is located. But industry shifts have been frequent, with digital cameras replacing many of the old film cameras, creating new businesses where everyone can instantly share the images they've just taken. Examples include changes in storage media such as floppy disks and CDs, and changes in storing data in the cloud. At such a time, government agencies should not stick to the old methods and act as an obstacle to a society that is trying to change its industrial structure.

In Japan, many government agencies, mainly central government ministries, have not yet fully implemented AI. Overseas, however, there are examples of governments actively promoting the use and application of AI in the public sector to drive the transformation of industrial structures by improving convenience and ensuring safety and security through AI.

In particular, the active use of general-purpose AI products and services on the market will lead to improvements in administrative services and increased convenience, rather than incorporating AI into complex government information systems. Active action by government agencies is also expected to promote the use of AI throughout society.

Based on these, we will work toward the achievement of the following specific targets for the promotion of AI utilization in the government.

Major goal

Promotion of AI utilization in the government

Specific target
· Strengthen the organizations to promote the introduction of AI in government agencies and thereby strengthen and improve administrative functions.
· Formation of sustainable improvement cycles, including data collection through AI applications

(5) Focus on strengths

It is also effective to integrate AI with technologies in which Japan is strong, such as physics, chemistry, and machinery, in order to find a "winning strategy" in AI utilization in which competition is fierce worldwide.

For example, drug discovery and materials science are areas where such effects can be targeted. By combining AI with technologies and data bases that Japan has already developed, the possibility of creating products and services with international superiority will increase. It is important that AI investments are consciously focused on those areas.

In addition to science and technology, Japan is also strong in food, tourism, and cultural fields such as anime and other content. In the future, it is desirable to promote related initiatives with a view to utilizing AI in these fields as well.

On the other hand, it is also necessary to continue to actively utilize AI in dealing with the unique challenges of Japan. In dealing with such problems, it is appropriate to pursue fusion with technologies in which Japan is strong to the extent possible.

In other words, Japan will work toward the achievement of the following specific targets in order to integrate with fields in which Japan is strong.

Major goal

    Integration of AI with fields where Japan is strong

Specific target
- Further focus on AI applications in fields such as medicine, drug discovery and materials science
- Promotion of AI use and application in cultural and other industries where Japan is strong
- Pursue fusion of AI and Japan's strengths to address challenges unique to Japan ((1) health, medical care, and nursing care ; (2) agriculture ; (3) infrastructure and disaster prevention ; (4) transportation infrastructure and logistics ; (5) regional revitalization ; (6) manufacturing ; and (7) security)

Part IV STEADY EFFORTS AIMED FOR "AI FOR ALL"

In Part IV, based on the results of the steady implementation of the Strategy, we will develop Japan's AI technology and the human resources that support it, and steadily build an AI-native society and industrial structure that uses it as the source of competitiveness. To achieve these goals, we will promote initiatives related to "education reform," "restructuring of research and development systems," "data collaboration infrastructure development," "digital government in the AI era," "support for small and medium-sized enterprises and venture companies," and "ethics."

1. Education reform

Today, our society is undergoing a major transformation through digital transformation (DX). In recent years, DX of Japanese society as a whole has been accelerating in response to changes in people's lifestyles due to the impact of COVID-19 and the apparent delay in digitalization. The technology at the core of this DX is AI, and there is an increasing need for human resources who can create new value, utilizing AI in design of products and services suitable for a new society. It is no exaggeration to say that together with the ability to collect, accumulate and analyze big data, it is one of the biggest factors that will determine the vitality of society and industry in the future.

Therefore, the development and securing of related human resources is not only an urgent task but also a long-term task including primary and secondary education, higher education, recurrent education[25], and lifelong education, and has been tackled since the formulation of the AI Strategy 2019. In particular, the ability to design new ways of society and products and services based on knowledge and skills in "mathematics, data science and AI" and culture in humanities and social arts is important. Fundamental improvement of existing educational methods, introduction and strengthening of new methods such as STEAM Education[26], and cross-curricular learning to solve problems in real society are indispensable. Therefore, it is necessary to continue to focus on these issues.

First of all, it is essential to understand the relationship between various social issues and science and mathematics from an early stage, and to have experience of thinking to solve them with science and mathematics. To realize this, we will expand the ICT infrastructure of schools, including an information education environment for each student and a school work support system that supports education, and implement

education that makes use of it. Furthermore, Japan will be ahead of other countries in building new mathematics, data science and AI education as a model for education in the age of Society 5.0, so that it will be strongly disseminated around the world, particularly to Asian regions.

<u>Major goal</u>

Aiming for all citizens to develop the skills necessary to create a sustainable society, including knowledge and skills related to "mathematics, data science and AI," which is the basic knowledge of a digital society (so-called "reading, writing and abacus"), and the basic skills necessary to design new ways of society and products and services, and for human resources to play an active role in all fields of society, the following goals will be set for future education with the realization in 2025 in mind :

- All high school graduates have acquired basic literacy in mathematics, data science and AI. Cultivating creativity through experience in discovering and solving problems in order to create a new society and design products and services

- Develop human resources who understand data science and AI and can apply it in each specialized field (approximately 250000 people / year)

- Discover and develop human resources capable of playing an active role in the world by creating innovation using data science and AI (approximately 2,000 people / year, of which approximately 100 people / year are the top class)

- Implementation of recurrent education to foster mathematics, data science and AI to many members of society (approximately 1 million people / year) (including recurrent education to promote women's participation in society)

- Promote opportunities for international students to learn data science, AI, etc.

(1) Literacy Education

High School

> **Specific target**
>
> All high school graduates (approximately 1 million per year) acquire basic knowledge of science and mathematics and basic information knowledge, which are the foundation of data science and AI. In addition, they will experience the knowledge of humanities and social sciences, as well as the discovery and solution of problems for the design of products and services as well as new ways of society.

Universities, Technical Colleges, and Adults

> **Specific Target 1**
>
> All university and technical college students (approximately 500000 graduates per year) acquire elementary level mathematics, data science and AI in their courses, regardless of their majors.
>
> **Specific Target 2**
>
> Provision of opportunities for many members of society (approximately 1 million people per year[27]) to acquire basic information knowledge and practical application skills such as data science and AI using all means
>
> **Specific Target 3**
>
> Enhancement of liberal arts education[28] for university students and adults (including the development of critical thinking skills to avoid believing the results of one sided data analysis and AI)

<u>Elementary and Junior High Schools</u>

Specific target

In the fields of science and mathematics as the basis of data science and AI

① Maintain and improve the current state in which the percentage of people with higher proficiency levels is at the top level in the world

② Increase interest in science and mathematics, which is in a low state compared to the international level

Ensuring opportunities to understand and consider the relationship between science and mathematics and various social issues

(2) Applied basic education

Specific Target 1

University and technical college students of a certain scale (approximately 250000 graduates per year[29]) acquire basic skills in applying mathematics, data science, and AI in their specialized fields, regardless of their majors.

Specific Target 2

Develop AI personnel capable of solving regional issues (target of approximately 1 million employees per year)

(3) Expert education

Specific target

Develop expert human resources (approximately 2,000 people per year[30], of which approximately 100 people per year are top-class[31]) and improve the environment in which they can develop and demonstrate their abilities and engage in the creation of innovation

(4) Mathematics, Data Science and AI Education Certification System

> Specific Target 1
>
> Establishment and promotion of a system in which the government certifies outstanding educational programs in mathematics, data science and AI that are recognized as graduation credits for universities and technical colleges.
>
> Specific Target 2
>
> Dissemination and promotion of excellent education and qualifications certified by the government for mathematics, data science and AI

2. Restructuring of R & D system

(Rapid improvement through "Strategy and Creation" and establishment of a sustainable research system)

The world's business, especially in the field of Internet business, is currently led by large IT companies, mainly in the United States and China. In the AI-related field, including these companies, there is an extremely intense competition in research and development, and fierce competition for research personnel is occurring all over the world.

Under such circumstances, Japan has a history of independent and dispersed development of basic research, general-purpose research, and sector-specific applied research. While these have formed AI-related core centers[32] with excellent capabilities in specific basic research and public research institutions with excellent results in real-world applied research in specific fields, there have been few cross-sectional activities.

In light of this, since the formulation of AI Strategy 2019, "the AI R & D network (AI Japan)" has been promoted leaded by AI-related core centers. In particular, each of the AI-related core centers has been working on AI research and development with the aim of quickly making its research results available in society as follows: RIKEN AIP aims to be the world leader in research and development of innovative basic technology centered on theoretical research on AI. NICT aims to be the world leader in the construction and application of neural cognitive models that aim to realize dialogue technology for heartfelt communication and innovative natural language processing using large-scale data, multilingual translation and voice processing technology including Asian visitors to Japan and foreign residents. AIST AIRC aims to lead the world as a global core organization in research on AI basic technology for real-world

application of AI and research to bridge to society.

These efforts are essential for Japan to build advanced AI technologies, and we will continue to focus on them. In order for Japan to compete with the rest of the world, we will create a Japanese model of AI R & D and make it an attractive AI research center chosen by researchers from around the world. Furthermore, in this environment, we will create cutting-edge AI technologies that Japan can lead in.

<div style="border:1px solid">

Major goal

- Build a comprehensive R & D cycle based on this strategy, from basic research to implementation in society

- Ensuring international initiatives in advanced AI technology and standardization where Japan can take leadership

- While strengthening and fundamentally reforming the AI-related core centers, by building a network centered on them, we will create a Japanese model for AI R & D and promote the creation of an attractive AI research base that is chosen by researchers around the world.

- Strategic promotion of emergent research and fundamental and integrative R & D that are important for realizing a "society that embraces diversity and achieves sustainable development"

- Promote emergent research in which world-class researchers can lead the world with freedom and originality.

- Building a research promotion system that brings together the wisdom of the world

</div>

(1) Development of research environment

①Establishment of core research network

> **Specific Target 1**
>
> Strengthening and Fundamental Reform of AI-Related Core Centers under the Promotion System in Line with this Strategy
>
> **Specific Target 2**
>
> Construction and operation of an "AI Research and Development Network" that provides opportunities for research and development by discovering and gathering Japanese wisdom (including engineers with strong implementation skills, AI researchers, and basic mathematics and information science researchers) in cooperation with universities and public research institutes that are actively engaged in AI research and development centered on AI-related core centers
>
> **Specific Target 3**
>
> Development of attractive R & D systems and infrastructure in line with this strategy, favored by researchers from around the world

② Enhancement of emergent research support system

> **Specific target**
> ・ Securing and developing world-leading high-quality research personnel
> ・ Building a research support system that allows researchers to continuously challenge emergent research
> ・ Ensuring diversity in research (and researchers) to strengthen the intellectual foundation of emergent research

(2) Launch of core research programs: Promotion of fundamental and integrative research and development

<u>Specific target</u>

Systematize basic and integrated AI technologies (AI Core), which are important for achieving major goals, into the following four areas, and strategically promote research and development in these areas

1. Basic Theories and Technologies of AI

2. Device and Architecture for AI

3. Trusted Quality AI

4. System Components of AI

3. Data-related infrastructure development

The development of AI technology is supported by a large amount of data. It is extremely important to collect high-quality data and to use it for analysis while protecting it from risks such as cyber-attacks. For this reason, since the formulation of AI Strategy 2019, Japan has been working on collaboration and standardization of data held by the government and the private sector, without lagging behind other countries. In addition to compiling the "Basic Policy for Reform to Realize a Digital Society" (December 2020) and the "Comprehensive Data Strategy" (June 2021), the government has been promoting implementation in society through the second term of SIP.

In the future, activities for data collaboration and standardization should be further promoted, and in the process, bias in big data should be prevented and the risk of AI utilization should not arise. In addition, it is extremely important to ensure the authenticity of data and the reliability of identity verification. In the United States, trust infrastructure in the government procurement field is being constructed, and in the European Union, common trust infrastructure is being constructed. In Japan, a related study has started. For example, it is necessary to accelerate the study of ensuring the security of the entire supply chain ("cyber / physical security measures framework").

> **Major goal**
>
> Construction of next-generation AI data-related infrastructure premised on international collaboration

(1) Data base

> **Specific target**
>
> Full-scale operation of data collaboration infrastructure for AI utilization in fields such as health, medical care and nursing care, agriculture, national resilience, transportation infrastructure and logistics, and regional revitalization
>
> Implementation of initiatives that contribute to assurance and confirmation of the quality of collected big data

(2) Trust

> **Specific target**
>
> Construction and development of trust data cooperation infrastructure enabling international mutual certification with the United States, Europe, etc.

(3) Network

> **Specific Target 1**
>
> Promoting the nationwide installation of 5G mobile communications systems and optical fiber, which are the core information and communications infrastructure for the 21st century that supports Society 5.0
>
> **Specific Target 2**
>
> Upgrading network infrastructure and ensuring safety and reliability so that AI can be used throughout Japan

4. Digital government in the AI era

The delay in digitization in the public service sector combined with the rapid aging of society, particularly in rural areas, has led to an increase in administrative costs for local governments. At the same time, a shortage of administrative staff has become apparent. As a result, the decline in productivity in the public sector has further progressed, and the utilization of AI-related technologies to solve this problem is desperately needed. In particular, in response to the delay in digitalization revealed by the response to the novel coronavirus, although the establishment of the Digital Agency and the consideration of a comprehensive data strategy are underway, the state of AI utilization in national administrative bodies has not necessarily progressed at present. As people's lifestyles and ways of working are changing, it is necessary to consider more active use of AI than ever before in order to respond to these changes and to further improve the efficiency of work national administrative bodies and provide high-quality administrative services.

When national administrative bodies use AI, they need to understand that it is particularly important to ensure transparency, fairness and accountability, and to promote the introduction of AI. To this end, we will compile and implement comprehensive measures such as organizing the basic concept of AI introduction in national administrative organs and establishing AI introduction guidelines. In addition, AI will be actively used in the work of government agencies.

<div style="border:1px solid">

<u>Major goal</u>

· Promote thorough digital government and use AI to improve efficiency and convenience and realize inclusion

· Government administration and policy planning based on appropriate data collection and analysis

· Secure sustainable public services by reducing costs and improving operational efficiency and sophistication through the use of AI and robotics in local government administration.

</div>

5. Support for SMEs and venture companies

"Although the need for work style reform has long been called for, the labor productivity of Small and Medium-sized Enterprises (SMEs) in particular is at a lower level than that of large enterprises, despite the need for significant improvements in the overall productivity of Japan." Progress in the utilization of AI technology can be expected to lead to drastic improvements in corporate productivity. To achieve this, it is essential to first increase the AI literacy of companies, including small and medium-sized enterprises, and to match their technological needs with the AI technology seeds they need.

AI technology also offers a huge opportunity to create new ventures. In fact, in the United States and China, AI-related venture investments are growing rapidly, and many unicorns are emerging. It is necessary to promote the sharing of AI technology and the use and application of AI in companies and governments, and to create an environment for the creation of new products and services. In recent years, investment in AI venture companies and the number of start-ups have been on the rise in Japan as well. In light of the development of DX in society, the role of SMEs and venture companies is expected to increase more than ever.

In the future, it will be necessary for small and medium-sized manufacturers to continue working to improve labor productivity through the advancement and utilization of AI.

Major goal

- Improve productivity and growth by using AI and developing data infrastructure in low-productivity and growth fields

- More support for AI-related startups

(1) Support for SMEs

<div style="border:1px dashed">

Specific target

Improving SME productivity using AI

</div>

(2) Support for young AI-related start-ups

<div style="border:1px dashed">

Specific target

Support for AI-related start-ups

</div>

6. Ethics

With growing interest in AI utilization, excessive pursuit of civilized convenience could expand the negative aspects of AI. In order to curb this, it is important to take a high ethical perspective of cultural background into account. In order to promote the use and application of AI with greater respect for human beings, the AI Social Principles were announced in March 2019 in Japan and in April in the EU. Furthermore, at the OECD Ministerial Council meeting in May of the same year, recommendations on AI were adopted, and at the G20 Osaka Summit in June of the same year, the "G20 AI Principles" were agreed as an annex to the Declaration. Subsequently, various international frameworks, including the GPAI (Global Partnership on AI), which was launched in June 2020, and UNESCO, which adopted the "Recommendation on the Ethics of Artificial Intelligence" at the General Conference of UNESCO at its 41st session in November 2021, have been conducting studies on how AI technology should be trusted and held accountable as AI is implemented in society. At the GPAI Council Meeting at Ministerial level in November 2021, it was decided that Japan would be the chair of GPAI for one year from the end of 2022. At the end of 2022, the GPAI Summit including Council Meeting are scheduled to be held in Japan.

Under such circumstances, it is necessary for Japan to implement international cooperation such as the promotion of international standardization activities in cooperation with other countries, centering on comrades, so that Japan's socio-economic activities will not be unduly restricted.

<div style="border:1px solid">

Goal

Dissemination of AI Social Principles and Establishment of International Cooperation System

</div>

1. Regarding artificial intelligence (AI), for example, in the EC High-Level Expert Group Report, it is described as "a system that performs intelligent actions (which may have a certain degree of autonomy) in response to environments and inputs". However, the substance of "intelligent actions" also depends on interpretation. In addition, the AI100 Report published in the United States in 2016 cites Nils J. Nilsson's definition of AI as a field of study, that is, "research to create machines with intelligence, and intelligence is to function properly and with some insight in a given environment". This definition also has significant ambiguity. In fact, the report also notes that the vagueness of the definition of AI itself is a positive aspect of accelerating AI research. In light of these circumstances, although there is a certain consensus on what constitutes "AI" or "AI technology," it is not meaningful to define it strictly based on the technology used for it. At the same time, it should be noted that such systems can be incorporated into highly complex systems. Furthermore, it is difficult to implement AI systems without infrastructure, ultra-high-speed communications networks, sensors and robots, which enable to collect, store and access large-scale data. Without the development and implementation of technologies that ensure the safety and soundness of such systems, such as cybersecurity and AI ethics, it will be difficult for AI to gain widespread acceptance. AI encompasses a wide range of systems that realize intelligent functions and is expected to be deployed in all areas, from society and industry to everyday life, to scientific research and technology development. Therefore, it is necessary to plan these areas in an integrated manner as the target of the Strategy.

2. Generic term for industries that provide some value in the Physical Real World, such as medical care, agriculture, materials, logistics, and manufacturing facilities. In contrast to SNS and search services, it does not end up in cyberspace, but rather creates value through interaction with people, nature, hardware, etc.

3. Nominal labour productivity (per hour) in 2019 for the major countries: US $ 71.6, German $ 66.7, UK $ 59.8, and Japanese $ 47.6 (all converted to purchasing power parity terms in 2015 dollar terms) (Source : https://www.meti.go.jp/shingikai/sankoshin/shin_kijiku/pdf/001_05_00.pdf))

4. Mora, C., et al, "The projected timing of climate departure from recent variability", Nature 502, 183-187, 2013.

5. "Vision of the future that the Moonshot Research and Development Program aims for and ambitious goals for its realization" The 4th Visionary Conference on Moonshot R & D, 2019
(https://www8.cao.go.jp/cstp/moon_visionary/4kai/siryo1.pdf   )

6. Le Quere, C., et al., "Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement", Nature Climate Change 10, 647-653, 2020.

7. Forster, P., et al., "Current and future global climate impacts resulting from COVID-19", Nature Climate Change 10, 913-919, 2020.

8. http://www.bousai.go.jp/kaigirep/teigen/pdf/teigen_03.pdf

9. The Digital Twins, for example, should be used as a model to simulate the following events divided into departments and layers in conjunction with each other, to reflect situations that change from moment to moment when a disaster occurs, to grasp near-future issues, and to visualize the effects of actions. The following events should be linked to each other : 1) simulation of weather and topography; 2) prediction of damage to the ground surface such as bank collapse and landslides; 3) prediction of people's flow and location immediately after the occurrence of the disaster; 4) prediction of scramble rescue of the fire department, the police, the Self-Defense Forces and allied forces and identification of bottlenecks; 5) identification of the extent of damage to core infrastructure such as electricity, water supply and sewerage, roads and waste treatment and identification of recovery conditions; 6) identification of evacuation sites and identification of evacuation and response conditions; 7) identification of supply conditions of food and necessary goods and identification of bottlenecks ; and 8) identification of cooperation between central and local governments and identification of governance conditions, trouble and bottlenecks. To realize this, it is essential to reflect and integrate various information on space that changes every moment in

real time, to predict changes not only in each layer but also in rescue and infrastructure divisions that are organized within each layer, to provide feedback between layers, to change flexible models and to build reflection capabilities, to support distributed information processing infrastructure, to provide sensing functions including communication and electric power supply robust in the event of a natural disaster, and to strengthen technical and human resources that support realization.

10. Virtual Singapore, National Research Foundation (https://www.nrf.gov.sg/programmes/virtual-singapore) / Energy Market Authority of Singapore, "Singapore's First Digital Twin for National Power Grid," 27 Oct. 2021 (https://www.ema.gov.sg/media_release.aspx?news_sid=20211023u4Natua5xC8 b)

11. India Stack (https://indiastack.org/)

12. https://wagri.naro.go.jp/

13. Hajime Hotta, Kazuhiro Ohara, "Double Harvest : Strategic Design for the AI Era," Diamond, 2021, "

14. Jim Collins, "Visionary Company : The Rule of Bounties," Nikkei BP, 2020

15. AI for Good, https://aiforgood.itu.int/

16. Lacy, P. and Rutqvist, J., Waste to Wealth: The Circular Economy Advantage, Palgrave Macmillan, 2015.

17. UN Environmental Programme, Cities and Climate Change, 2020.

18. 31 Trilion USD is estimated to be exposed to environmental is estimated to be exposed to environmental risks. World Economic Forum, BiodiverCities by 2030: Transforming Cities' Relationship with Nature, World Economic Forum, January 2022.

19. Jacobs, J, The Death and Life of Great American Cities, The Random House Publishing Group, 1961.

20. Hass, T. and Westlund, H. (eds.), In The Post-Urban World: Emergent Transformation of Cities and Regions in the Innovative Global Economy, Routledge, 2018.

21. Dasgupta, P., The Economics of Biodiversity: The Dasgupta Review, HM Treasury, London, 2021.

22. World Economic Forum, BioDiverCities by 2030: Transforming Cities' Relationship with Nature, World Economic Forum, January 2022.

23. World Economic Forum, Urban Transformation: Integrated Energy Solutions, World Economic Forum, September 2021.

24. Kitano, H., "Building Cities to Withstand the Worst," Pour La Science (Innovation Special Issue), January, 36-38, 2015.

25. Education given to working people, mainly professionals, after completing school education, once they enter society. This includes not only full-time re-education given away from the workplace, but also part-time education given while they are working.

26. Cross-curricular education to utilize learning in each subject such as Science, Technology, Engineering, Art, and Mathematics to solve problems in the real world

27. To provide literacy education in data science and AI to 25% of Japan's approximately 60 million working population (approximately 15 million people) over the next 10 years, the annual scale of approximately 10 million people (approximately 1 million people x 10 years) will be set, excluding approximately 5 million new graduates of universities and technical colleges that will be produced during the period.

28. Unlike the acquisition of skills as professional education, education that aims develop intellectual abilities and to provide general knowledge for the ability to think and make decisions

29. Set a target of the number of students per grade in the colleges of science, engineering, agriculture, medicine, dentistry, and pharmacy (approximately 160000 students) and approximately 30% (approximately 110000 students) of the number of students per grade in the colleges of humanities and social sciences (approximately 370000 students) of universities

30. Set the targets based on the number of Japanese companies with capital of 1 billion yen or more (approximately 6,000 companies).

31. Set the targets based on the number of industries in Japan (approximately 500)

32. Center for Advanced Intelligence Project (AIP) of RIKEN, Artificial Intelligence Research Center (AIRC) of the National Institute of Advanced Industrial Science and Technology, Universal Communication Research Institute (UCRI) of National Institute of Information and Communications Technology (NICT) and Center for Information and Neural Networks (CiNet) of NICT