Chapter 3 Science and Technology with Society and People

As science and technology have been increasingly involved in our daily lives and new discoveries and inventions brought about by the development of science and technology are said to have more impact on society and people, science and technology now have a deeper relationship with society more than ever. To produce economic and social value from scientific and technological research, it is necessary for the government, research institutions, and researchers to be able to clearly explain such research to people so they may be able to form opinions regarding social issues. Such opinions can then be appropriately reflected into policies and research. To date, activities including talks by researchers for citizens are underway with the ideology of the 3rd Science and Technology Basic Plan, "science and technology to be supported by the public and to benefit society." However, further efforts are needed for changes in consciousness and actions of those who are most affected.

Considering these circumstances, the administrative policies of the government have significantly changed since a change of government in September 2009. As in the Administration of Science and Technology, the Council for Science and Technology Policy (CSTP) has made efforts to enhance transparency and promote participation of citizens in the policy making process. In particular, "budget screening" conducted in November 2009 provided an opportunity to draw the attention of not only researchers but society and people and opportunities to discuss accountability and management of science and technology further. In addition, discussions consider what a new framework science and technology should be promoted in including structural reform of the CSTP.

From this perspective, this chapter outlines the current status of projects conducted under the 3rd Science and Technology Basic Plan to enhance understanding of and sympathy for science and technology, and the new dimensions in relation to science and technology policy.

1 Enhancing of Understanding and Sympathy for Science and Technology

1) Outreach Activities

Based on the providing for promotions of outreach activities by the 3rd Science and Technology Basic Plan[1], the number of outreach activities conducted by researchers has been increasing in recent years.

"Science Café" is one of these outreach activities that was initiated in the United Kingdom and France around 1997. This activity originated from "Café Scientifique[2]," in which people can relax and have casual conversations with scientists while drinking coffee or tea, in contrast to conventional academic lectures and symposia, in which scientists make presentations on their achievements from research in front of their fellow colleagues. In Japan, this project was mentioned

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1 Outreach activities are interactive communications for researchers to share the needs of the public while having a conversation with people.

2 "Café Philosophique" originated in France in 1992 as a trial to provide opportunities for people to talk about their philosophical thoughts. Then in 1997, stimulated by the café, "Science Café" was opened in France. Meanwhile, in the United Kingdom, there were vigorous debates on transgenic foods and problems of BSE, etc, increasing distrust among people towards science,

in the Annual Report on White Paper on Science and Technology 2003, subsequently reported in newspapers and other media. As a consequence, the efforts of the activity have become widely known by the public. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Science Council of Japan (SCJ) have hosted the "Science Café" in science and technology week and since then, the activity is now expanding throughout the country with various ingenuity being added by various organizers[1].

In 2005, ahead of other competitive funding programs, MEXT implemented a system to allot about 3% of the direct expense for newly adopted projects into outreach activities as part of the "Promoting Program for Critical Mission-oriented Research" in Special Coordination Funds for Promoting Science and Technology, requiring researchers to provide society and people with intelligible explanations regarding their research's scientific and political significance.

In relation to Grants-in-Aid for Scientific Research, the program titled "HIRAMEKI TOKIMEKI SCIENCE (Science that Inspires and Inspirits)-Welcome to University Research Labs-KAKENHI" has been held targeting students in junior high or high school to see some of the research achievements funded by the Grants-in-Aid for Scientific Research to understand the significance of science and its connection with their daily lives. Since its inception, over 10,000 people have participated in this project. In relation to the Grant-in-Aid for Publication of Scientific Research Results, academic societies and other organizations have been supporting projects to enlighten young people and adults and to disseminate knowledge about the trends and contents of research contents.

Since 2005, through the efforts of the Special Coordination Funds for Promoting Science and Technology, MEXT supports specialists training unit in new fields of study in Hokkaido University, the University of Tokyo, and Waseda University, which have successfully trained sciences communicators and journalists on abundant information about science and technology, as mediators between the scientific and technological community and society. These three mentioned universities have continued to improve these projects as their own programs since FY2010.

In the future, universities and other institutions are requested to train and secure specialists, while promoting their organizational projects to disseminate and establish outreach activities.

2) Efforts to enhance science and technology literacy

The 3rd Science and Technology Basic Plan states "to increase public interest in science and technology, it is important to improve adults' knowledge and abilities (science and technology literacy) relating to science and technology. Therefore, we will formulate and widely spread the vision of science and technology literacy (a document clearly explaining the knowledge, technology, and views relating to science and technology).

With the goal of explicitly expressing the knowledge, skills, attitudes, and perspectives of science, mathematics, and technology, a report was written in March 2008 by "Project of Science

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[1] The first Science Café in Japan is said to be the one organized by the NPO "Sunday University" (former) in October 2004. SCJ defined the Science Café as "a place for people and scientists to have free and generous conversations and discussions on 'science' over a cup of coffee at a cafe in the city," and the university has been actively supporting the project. In recent years, there are permanent science cafés.

and Technology Wisdom[1].” This project was founded with the initiative of the Subcommittee on Science and Technology Literacy of the Science and Society Committee in SGJ as a research project for the Special Coordination Funds for Promoting Science and Technology.

With a sense of impending crisis regarding the serious situation of science and technology, some 150 people participated in the “Science and Technology Wisdom” project from a variety of fields and professions, including scientists, educators, journalists, and industry. They all participated in seven sectional meetings (Mathematical sciences, Life science, Material science, Information science, Space, earth, and Environmental sciences, Human and Social sciences, and Technology), with the objective of clarifying the basics of science and technology that all Japanese people need to know, i.e., the “Science and Technology Wisdom.” Such activities must continually develop as the times and the environment change in the future.

3) Enhancing activities of science museums

Science and other museums[2] have been places for holding exhibitions of specimens and materials or holding lectures for better understanding of science and technology. They also are centers for scientific and technological communication activities through partnerships with science museums and institutions throughout the country, for transmission of information via the Internet to the Japanese public, and for learning support programs which offer places to experience and observe nature for educational purposes. Efforts have been made to educate human resource with specialized knowledge for engagement of these activities and secure and enhance volunteers. National Museum of Nature and Science started off the educational volunteer program in January 1986, as a pioneer program, with only eight registered volunteers. Now there are 333 volunteers[3] working as guides around the facilities and displays, as staff members for lectures and observation events, and as other activities to support people’s learning opportunities. In the National Museum of Emerging Science and Innovation, 551 volunteers[4] are working as staff members to provide guidance of displays, to assist in experiments in the experimental workshop, to administer tours in the research buildings, and to hold self-organized events, and other

A volunteer giving a tour for visitors
Photo: National Museum of Emerging Science and Innovation

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1 Project leader: Dr. Kazuo Kitahara, professor at the College of Liberal Arts, International Christian University (project website: http://www.science-for-all.jp/). The precedents that this project modeled included “Science for All Americans” published in 1989 in “Project 2061” organized by the American Association for the Advancement of Science. This project was intended to address the crisis in scientific education in the Untied States in the 1980s, as part of science education reform, and it summarized the scientific literacy to be acquired by all American people.

2 According to the MEXT “Survey on Society and Education 2008 (interim report)” (as of Oct. 1, 2008), museums and similar facilities numbered 5,773 and the number has been growing consistently since the survey began. Among them, general museums, which collect, store, and exhibit materials related to cultural sciences and natural sciences, accounted for 429, science museums, which collect, store, and exhibit mainly materials related to natural sciences, accounted for 485. The number of visitors to museums and similar facilities was 280 million people in FY2007 (up 2.6% compared to FY2004), whereas the number of visitors to science museums amounted to 350 million people in the same year (up 14.4% compared to FY2004).

3 Record of FY 2008. As a breakdown of the 333 volunteers (average age 56.8), there were 147 males (average age 63.9) and 186 females (average age 51.2), and many of them are housewives or retired (male: 109, female: 115). About 90% of them renew their registration every year.

4 As of April 1, 2009.

various activities.

In the future, it will be necessary to train supporting staff members and to enhance support for volunteer activities for reinforcement of the scientific and technological communication activities of the Science Museum and other museums.

Column 8 Approach of scientists and engineers to legislators in Western countries

The United States and the United Kingdom have been engaged in various efforts to enhance scientific and technological policies through mutual understanding between scientists or engineers and legislators.

1) United States

The Center for Science, Technology and Congress of the American Association for the Advancement of Science (AAAS) arbitrarily provides the latest objective information and professional knowledge on science and technology to congresspeople and staff members and supports the mutual understanding and cooperation between the scientific and technological community and Congress. In addition, with the main focus on various policies related to science and technology, the Center as the representative body of the AAAS provides its opinions and attitudes through open letters to concerned policymakers and organizers or even through petitions when necessary. It continuously provides educational and enlightening activities for congresspeople and people to understand the necessity for investments in science and technology, and in some highly important cases, several explanatory sessions are held in Congress.

AAAS has also been implementing the Science and Technology Policy Fellowship since 1973. This project is intended to send scientists and technicians to Congress, commissions of both houses, congresspeople's offices, and other governmental offices, basically for the period of one year to have first-hand experience in the process of science and technology policy making. The project also provides support on the theoretical aspects of complicated issues related to science and technology that the federal government faces every day by providing scientific knowledge and professional analysis to congresspeople.

Eligible people for the Fellowship are limited to those who are people of the United States and have a doctoral degree or equivalent in the natural sciences or social sciences (for engineering, master's degree holders with three or more years of professional experiences are also eligible). For the estimated 150 yearly positions[1] offered by the program, there are about 400 applicants in various fields, including universities, corporations, NPOs, and research institutions of the federal government, from different age groups and professions, ranging from postdoctoral researchers in their 20s to university professors on sabbatical leave, and sometimes even retired scientists or technicians in their 70s. Fellowships are not exclusive to any one area. In FY2010, there were four areas: (1) Congressional; (2) Diplomacy, Security & Development; (3) Energy, Environment, Agriculture & Natural Resources, and (4) Health, Education & Human Services. It is to be noted that fellows receive an annual grant of about 75,000 dollars in addition to travel expenses, health insurance costs, etc.

So far, over 2,000 scientists, among others, have been recruited as fellows, and in recent years, 40-50% of them remain in Washington D.C. after the fellowship period expires, utilizing their expertise in the policy making of the federal government. Of the remaining, 20-25% returns to their previous jobs or starts on new paths with the experiences gained as a fellow.

2) United Kingdom

In the United Kingdom, scientists and Members of Parliament (MPs) reaffirmed the importance of understanding science and technology after much debate regarding the problems of genetically modified crops and bovine spongiform encephalopathy (BSE) in the 1990s. The Royal Society (RS), which advocates "Science in Society," started an exchange program called the "Royal Society MP-Scientist Pairing Scheme" in 2001 with the support of ex-scientist MPs.

To be eligible as a successful candidate, (1) one has to be a doctoral degree holder who is, in principle, receiving a scholarship from RS, Research Councils, the Welcome Trust, or the National Endowment for

[1] Except for Congress, it is possible to extend the term of the fellowship for one year. The figure includes such fellows who have extended their term.

Science, Technology and the Arts (NESTA), (2) one has to have a research base in the United Kingdom, and (3) one requires strong interests in scientific and technological communications and policies. About 25 candidates are selected annually, with the ratio of total to successful applicants being around 3 to 1, and paired with MPs who have interest in their program, regardless of their political parties. In 2009, the pairing was extended to government officials, resulting in over 170 scientists being paired with MPs or government officials to date.

In this program, scientists have the opportunity to experience committees, meetings inside the parties, Q&A with the Prime Minister, and interviews with journalists by accompanying (shadowing) the paired MPs. The MPs, on the other hand, visit laboratories to hear in person researchers' explanations on current situations, and sometimes even perform experiments. Through such experiences, scientists will not only be able to understand the scheme and process of policy making in relation to science and technology, but also have a chance to directly provide their expertise to MPs. Conversely, the MPs can observe the actual of research situation and exchange opinions with scientists regarding the issues related to career building and research funding, and such first-hand knowledge obtained from the scientists can subsequently be utilized in future debates and discussions. Such projects to promote mutual understanding have influenced the European Parliament and the French government, in which similar programs are implemented.

2 New Development in Science and Technology Policy

(1) Heightened debate on science and technology

The CSTP has been working actively on increasing open debates and enhancing the transparency of the budgeting process. The Council called for public comments for the first time in November 2009 while opening the discussion to the public at that time for judging the priorities of science and technology policies. Based on this process, they made judgments on priorities. The Council later called for public comments from researchers in December 2009 to be used as references for designing the "Funding Program for Next Generation World-Leading Researchers." The Council decided to open to the public the regular "Conference of the Minister of Science and Technology Policy and CSTP Expert Members of the Diet (Minister-Experts Conference)", and hold another Minister-Experts Conference in March 2010 to exchange opinions with researchers and the general public and open communications about thoughts on science and technology policies. MEXT also called for public opinions in relation to science and technology in March 2009 to be used as reference material in science and technology policy making. As described, CSTP and government offices have been actively working on the projects to secure the transparency of the policy making processes and to enhance citizen's participation.

In addition to the actions mentioned above, the Government Revitalization Unit conducted budget screening in November 2009 and made judgments on revisions of their operations and reduction of their budget in many operations within the field of science and technology. There was a great response from many fields in relation to the outcomes of the screening. For example, academic societies objected regarding the results of the screening, stating that "development of research in various fields will be hurt," "the people will leave the fields," and so on. Furthermore, there was a joint suggestion by expert Diet members from CSTP regarding the "securing of the budget for science and technology (emergency proposal)" (November 19, 2009) concerning human resources. They said that although they understand the recent severe financial conditions, if the budget is reduced, talented people in these reduced projects will leave their fields and it will be difficult to resume the current level of research. Foreseeing the distant future, they strongly proposed to enhance the budget in relation to science and technology.

At the time of budgeting for FY2010, the budget was determined based on the results of the budget screening and the priorities determined by CSTP. Taking advantage of the budget screening, MEXT called for opinions regarding those operations reduced as a result of the screening between November 16 and December 15, 2009. MEXT received about 20,000 opinions regarding science and technology.

For example, as a consequence, the next-generation supercomputer project was continued by reducing the expenses by prolonging the completion deadline of a computer with the capacity of 10 PFLOPS (calculation capability of 10 quadrillion times per second) from November 2011 to June 2012, thereby eliminating the expenses needed for accelerating the project after negotiation with the Ministers. In addition, the project objectives were changed from simply developing a next-generation supercomputer to developing a computer connected with other supercomputers throughout Japan which will serve a variety of needs. Since a new requirement, "fulfilling accountability through explanatory sessions, etc., so that citizens sufficient understand," was added at the time of agreement by the Ministers involved, MEXT and the other project implementer, RIKEN, held a session to explain to the public the next-generation supercomputer.

Innovative High-performance Computing Infrastructure Forum

In this manner, following the recent change in administration, calls for public comments and budget screenings, in addition to hot to promote science and technology, have resulted improved transparency and more effective and efficient promotion of science and technology policy making.

(2) Development in new science and technology policies

As stated in Chapter 1, the "Public Opinion Poll on S&T and Society" conducted by the Cabinet Office showed a high percentage of people who agreed that new problems in society, such as energy, environment, water, food, infectious diseases, etc. will be resolved by advancement of science and technology. However, as for the fields with which they are concerned in regards to science and technology, they gave multiple answers, including global environmental issues (50.7%); safety of genetically modified food, nuclear power generation, etc. (50.2%); IT-related crimes such as cyber terrorism, unauthorized access, etc. (43.8%); ethical issues such as cloning humans, utilizing clones as weapons, etc. (42.3%); among others. In the future, to promote science and technology policy making, it is important to be accountable to people and to understand their opinions in relation to social issues and demands. Only then can the impact of science and technology on society be appropriately reflected in public policies.

Technology Assessment (evaluation of technological impact) is a method to predict and evaluate the influence of science and technology on humans, society, the economy, and the environment. With this method, positive and negative social influences, such as financial benefits and effectiveness, risks and ethical problems, are objectively evaluated and examined from multiple points of view, in order to support public policy making through comprehensive evaluation while predicting possible problems and implementing countermeasures. This was a system developed in the United States in the latter half of the 1960s when pollution and other negative aspects of science and technology became significant[1]. European countries and the European Parliament also adopted this system[2], although implementation differs by country. The common characteristic of the Technology Assessment in European countries is the small implementing bodies, as focus is placed more on broad participation by people, rather than by experts and stakeholders. Discussions on how to enforce the Technology Assessment in Japan are vital for the implementation of policies with the consensus of the public.

In addition, Council for Science and Technology Special Committee on the Science and Technology Basic Plan in MEXT has the opinion that the science and technology policy should not be limited to the objectives of promoting science and technology. Based on the demands of society and the public, the Council should consider, as one of the principles of social and public policies, to link scientific and technical knowledge with the value of new creations for the improvement in the lives of people and development of a better society. At the same time, the Council insists that public policies must be made comprehensive by incorporating policies of science and technology along with related innovations and promoting projects to solve important political issues based on social needs Council for Science and Technology Special Committee on the Science and Technology Basic Plan in MEXT "For Comprehensive Strategies on Science and Technology of Japan with Middle- to Long-Term Visions", in December 2009. In other countries, policies inclusive of the creation of innovation (i.e., science, technology, and innovation policies) are considered to be important, and the science, technology, and innovation policies is being promoted in such fields as development of index and evaluation methods, arrangement of systematic statistics, etc. (Figure 1-3-1)

In the future, development of research communities related to science and technology will be promoted, and systems will be in place in which experts from such communities can play active roles in government offices, research institutions, etc.

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1 Office of Technology Assessment (OTA), an implementing organization of the system, was established in 1972 as an affiliated organization of the federal congress. Until it was abolished in 1995, as part of the congressional reform aiming to reduce costs with the initiative of the Republicans, OTA had influence on science and technology policies in energy and environment, and was a model in Europe when the EU was introducing the system. Recently, there is a debate on whether to re-establish a similar organization under the Democratic administration in the United States.

2 The major implementers of Technology Assessment in Europe include OPECST (France) established in 1983, OST (United Kingdom), Rathenau Institute (Netherlands), DBT (Denmark), TAB (Germany), and STOA (European Parliament).

Figure 1-3-1 Adopting Science, Technology, and Innovation policy

○Major countries have started a variety of efforts while the importance of science has heightened for science and technology innovation policy

Scientific importance for science and technology and innovation policy

1. Visions necessary for transdisciplinary policy-making to understand and deepen the increasingly complex scientific fields
2. Diversified innovation policy for science and technology required by changing environment in the global economy and society, and necessity to build a "New Social System" to promote it
3. Increasing importance of pursuing efficiency for innovation policy regarding science and technology and for evaluation of the outcomes
4. Essential to understand adequately social needs for innovation policy of science and technology due to diversification of social needs

Projects in major countries

<OECD>
Policy: OECD Innovation Strategy (2010)
Framework/host: NESTI (Working Group of National Experts on Science and Technology Indicators), etc.
Indicator/statistics: Innovation survey, MicrodataProject (2006-)

<United States>
Policy: Palmisano Report (2004), Augustine Report (2006), American Competitiveness Initiative (2006)
Framework/host: Collaboration task group, NSFSciSIP Program
Indicator/statistics: Census Bureau:Business Research and Development Survey (2009-) etc.

<EU>
Policy: Aho Report (2006)
Framework/host: EUROSTAT
Indicator/statistics: Innovation score board (2000-), etc.

<United Kingdom>
Policy: Innovation National White Paper (2008), etc.
Framework/host: NESTA (National Endowment for Science, Technology and the Arts)
Indicator/statistics: Making innovation indicators (2008-2010)

For building science for innovation policy of science and technology

1. A "place" to have discussions to build science for innovation policy of science and technology. Approaches to cross different scientific areas considering the relations to knowledge and society is necessary, requiring active involvement of scientific and cultural sciences

2. Creating a "Place" to have discussions between academia pursuing science for policy and policymakers, policy implementers.

3. Creating a "place" for collaboration between academia, building the theoretical framework and Statistic department, takes statistics of evidence to understand the policy's evaluation and records based on evidence.

Source: Prepared by MEXT based on JST Center for Research and Development Strategy "Science technology and innovation policy: Aiming at evidence-based science and technology innovation policy"

In Japan, many governmental offices and other organizations are reallocating their roles or creating partnerships, as science and technology are deeply related in every field in which these organizations are involved. However, new science and technology policies are currently being deployed mainly by the initiative of CSTP. CSTP is making attempts to focus on the budget process for science and technology, by making it more efficient, while reinforcing its effort to implement an annual budget so that the policy making will be integrated under the unified guidelines of the entire governing body. More specifically, in addition to the conventional Asset Allocation Policy, Basic Guidelines for Asset Allocation Policy has been newly set forth to indicate a rough framework regarding the budget requests to be followed by every ministry for the next fiscal year. At the same time, the Science and Technology Importance Policy Action Plan was set forth to promote problem solving-oriented innovation in cooperation with the entire governing body. The Science and Technology Basic Plan for the next term, which indicates the basic direction of science and technology policy, is also under discussion, in addition to further discussions on the structure of comprehensive promotion concerning the whole country, including the structure of the above-mentioned R&D corporations and positive restructuring of CSTP into the Strategic Office for Science and Technology (tentative).

Under such circumstances, new developments are expected in terms of the relationships among society, people, the government, and administrators as well as between the national and local governments. The political development to gain the consensus and participation of the people, and to implement policy making is based more on scientific foundations. For instance, under the philosophy of the "New Public[1]," enhancement of tax incentives for donation is currently under discussion targeting specified nonprofit organizations[2] and other organizations who are the main participants in the community. In the future, these organizations may have more significant roles in the field of science and technology, and enhancement of their activities is needed through grants for research by the private sector. Grants will encourage new participants and lead to expansion of a series of efforts in the future. To achieve practical results in the development of new policies, it is important to train and secure human resources for the support of such efforts with middle- or long-term perspective. In addition, implementation of science and technology policy with the collaboration of society and the people raises some issues, including how to enhance people's participation and how to incorporate their opinions in the policies.

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1 A component that it is not the "government", but which supports people and is necessary for each citizen involved in education, childcare, community creation, prevention of crime and fire, health care, and welfare, who participate in the support of others. (Citation from the policy speech of the Prime Minister in the 173rd Diet Meeting)

2 Non Profit Organization: The general term for organizations established to carry out activities for social contributions by volunteering and not after profit. Within these organizations, the NPO Corporation, known as Non Profit Organization by the public for its general term is based on "Law to Promote Specified Non Profit Activities [Literal translation]" for non-individuals acquired the rights and obligations which are considered as the main juridical personality. It is expected to meet various social needs by playing an important role in the fields such as welfare, education/ culture, revitalization of cities, environment and international cooperation and etc., where acquisition of juridical personality is not questioned.

Conclusion

Chapter 1 illustrated science and technology contributing to solving problems related to global warming, diseases, natural disasters, food provision, and water. However, we are still faced with various problems concerning exhaustion of rare metals and other resources, conservation of biodiversity, maintenance and improvement of manufacturing technologies, and the information gap. Further promotion of science and technology and creation of innovation are thus essential to overcome such problems.

Basic research is essential for human intelligence and the foundation of knowledge, and this knowledge can be a source of innovation. For example, basic research of optical fiber in the 1960s resulted in its practical use more than 20 years later, and now has a major impact on global information and communications.

Achievements of science and technology have another aspect: the hopes and dreams they give to citizens and youth. For example, the space development project in FY2009 resulted in not only the completion of the Japanese Experiment Module, “Kibo,” but also excellent performance of a Japanese astronaut, a successful launch of the H-II Transfer Vehicle (HTV) launched by the new rocket H-II B and a successful resupply mission. These achievements exemplify the height of Japan’s technological capabilities, providing optimism to Japanese people. They represent results of the International Space Station Program which began in the 1980s, a program that has already been in operation for over a quarter of a century. During such time, we have worked on training experts and developing new technologies, to overcome incidents such as the U.S. space shuttle disaster allowing for further advancement. In this respect, science and technology can be characterized by the tedious effort of obtaining explicit results and the occurrence of unexpected findings, which together may lead to new knowledge and technology. Results are thus produced as a consequence of constant efforts of researchers and technicians.

The major players involved in the development of science and technology with such significance and characteristics as mentioned above are “human resources and know-how”, they are the foundation that supports highly sophisticated Japanese science and technology. Aside from the researchers introduced in Chapter 1, a number of Japanese researchers and technicians with excellent skills and capabilities are working on R&D to produce world-class findings in relation to science and technology. On the other hand, Japan also faces various problems, such as the realization of a society in which “Value-creating Human Resources” can actively work and reform of the other science and technology systems, as indicated throughout this White Paper.

To solve these problems through the creation of innovation using science and technology, people in industry, universities, public research institutions, and the national and local governments need to work to fulfill their individual duty to the full extent. Researchers and technicians need to produce excellent research findings, industry, universities, and research institutions must train and secure human resources and maximize production from other organizations by creating conducive environment for research activities. In addition, governments and public administrative institutions should work on improving research funding and systematic reform to support such activities.

For Japan as a resource-poor country, science and technology are indispensable to guarantee sustainable growth and development in the future and to enhance its presence in the world. Our efforts to promote science and technology as a national movement thus need to be twofold in the future.