Chapter 4 Reinforcing the Fundamental Capability for STI

Section 1 Developing High-quality Human Resources

People drive STI. Despite increasing competition over the recruitment of highly trained personnel around the world, Japan's population of young people continues to decrease. Under these circumstances, improving the quality and exerting the capabilities of STI professionals are becoming even more important. Through various initiatives, in Japan, we are continuously developing and securing diverse and talented pool of professionals, and creating a society in which through their activities, STI professionals can play an active role as knowledge professionals in a variety of sectors, both in academia and in industry.

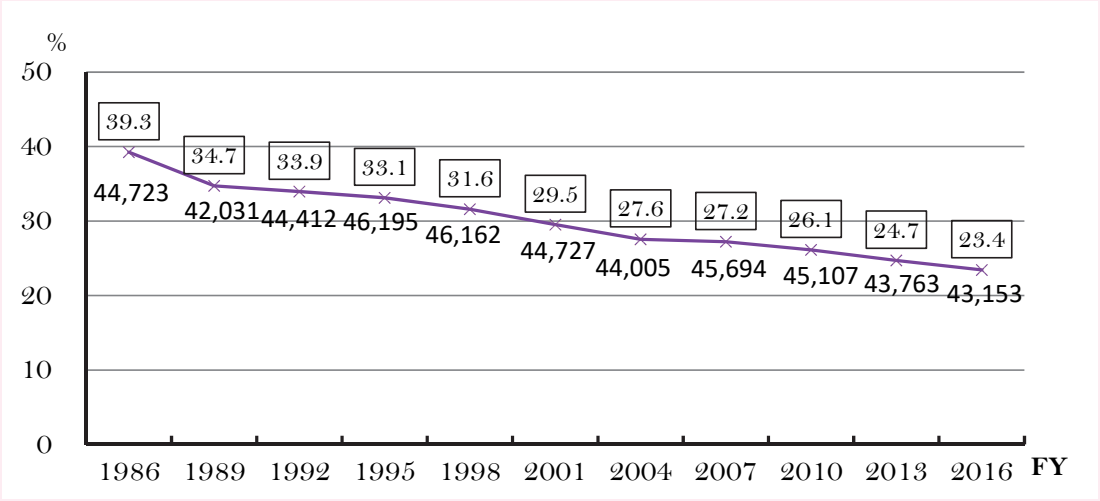
1 Developing, securing and improving career prospects of human resources as intellectual professionals

(1) Developing and improving career prospects of young researchers

It is necessary to develop and secure excellent young researchers who are important players for STI. For this purpose, it is important to increase opportunities of research funding and improve the research environment that ensures both stable employment and mobility to encourage excellent students to take a doctoral course to become the PhDs who are intellectual professionals, focus on their research activities and produce results.

In recent years, however, there have been suggestions of difficult situations of young researchers in Japan, as exemplified by the declining ratio of young full-time university teachers despite the increase of the total number of teachers (Figure 2-4-1).

■Figure 2-4-1/Ratio of full-time teachers aged 40 or younger in universities



Source: MEXT

In this context, the Committee on Human Resources, Council for Science and Technology, and the

Subdivision on Graduate Schools, University Division, Central Council for Education set up a joint subdivision in March 2018. The new subdivision discussed the direction of future activities with focus on carrier paths of doctoral talents and reform of the university personnel system. They compiled the "Summary of issues regarding development and securing of researchers to strengthen Japan's research capacity" in July of the same year.

A. Realization of stable and independent research by young researchers

Ministry of Education, Culture, Sports, Science and Technology (MEXT) launched the Excellent Young Researchers Program in FY2016 to create an environment for stable and independent research by excellent young researchers exploring new research areas. The program also presents new career paths by promoting matching with research institutions of industry, academia and government across Japan. By FY2018 at least 284 young researchers (as of January 30, 2019) found an environment for stable and independent research at positions created under the program.

For the purpose of securing research environments in which young researchers can concentrate on independent research and obtain secure positions, the ministry also has been implementing the Program to Disseminate the Tenure Tracking System, which provides support to universities that have newly adopt that system. In FY2018 this program is supporting 19 organizations.

Furthermore, the Act for the Amendment of the Act on Improving the Capacity, and the Efficient Promotion of Research and Development through Promotion of Research and Development System Reform and of the Act on Term of Office of University Teachers, etc. (Act No. 99 of 2013), enforced in December 2013, is expected to make it easier for researchers to achieve research results during the employment contract period and to receive fair evaluations of their achievements so that they can obtain stable positions.

B. Diversification of career options

MEXT has been implementing the "Building of Consortia for the Development of Human Resources in Science and Technology" to secure stable employment for young researchers while increasing their mobility to help their career development, and also to support universities, etc. in constructing a mechanism to diversify their career paths. The support has been provided to 3 organizations in FY2018.

The Japan Science and Technology Agency (JST) operates the Japan Research Career Information Network Portal site (JREC-IN Portal[1]) to provide researchers and assistants with information for career development including job information and to support the efficient use of such information.

C. Improvement of research environment

Under the Grants-in-Aid for Scientific Research (KAKENHI), JSPS formulated the "KAKENHI Young Support Plan" and has been working on measures to reinforce support in accordance with the career development of researchers while encouraging friendly competition in an open environment. In FY2018 "Fostering Joint International Research (B)" was established under the Fund for the Promotion of Joint International Research with the aim of accelerating joint international research with mandatory

1 https://jrecin.jst.go.jp

participation of young researchers. Public invitation started in April 2018. In FY2019 Grants-in-Aid (applications were received in September 2018), "Grant-in-Aid for Early-Career Scientists" for researchers within 8 years after receiving their doctorate was substantially expanded for focused support for young researchers. At the same time, JSPS has been working to enhance support for larger-scale "Grant-in-Aid for Scientific Research (B)" indispensable for sophistication of research under international competition and "Grant-in-Aid for Scientific Research (C)" that supports diversity and a broad base of research. JSPS also expanded "Grant-in-Aid for Research Activity Start-up" for researchers who are newly employed by a research institute and established a fund for the aid.

(2) Developing and improving career prospects of various people in STI

A. Efforts for development of research manager and promotion of their active participation

It is important to develop not only researchers but also diverse human resources and promote their participation. MEXT has been conducting survey and research on support measures for research administrators in order to improve research environments; to encourage more active research, strengthen R&D management at universities and establish diverse career options for scientists/engineers beyond research positions, for example. In FY2018, with the aim of further strengthening the Research Administration system at universities, etc., the "Study Committee on Strengthening of Research Administrator's Activities" compiled a summary of issues toward introduction of an authorization system that will contribute to improvement of their knowledge/skills and visualization of their executive ability. (September 2018).

With the aim of increasing world-class universities, support is also provided to prospective world-class universities based on quantitative indicators or evidence. Specifically, the government promotes intensive reform of research environments by helping these universities to employ research management personnel, including research administrators, so that the research capacity of Japanese universities will increase. In FY2018, 22 universities and inter-university research institutes selected in FY2013 were supported.

The "Program for development of Program Managers and promotion of their active participation" is implemented for excellent human resources in Japan to acquire practical knowledge, skill and experience of PM. Its aim is to present and establish this new job category for innovation creation, and to show a career path to work in funds allocation organs.

B. Development of engineers and their capabilities

Industries and engineers that underpin industrial activities assume a pivotal role in the promotion of science, technology and innovation. Increasingly advanced and integrated technologies require engineers to improve their qualifications and abilities. MEXT and related agencies have been making efforts to foster engineers who can keep pace with these changing requirements and to increase their capabilities.

MEXT is promoting efforts for practical education in engineering at universities and universities that are improving their educational content and methodologies. For example, students are provided opportunities to learn through hands-on experience, group exercises, presentations, debates and problem-solving. At national colleges of technology, integrated professional and practical training in engineering consistent through five years is given to students shortly after they graduate from junior high school. These colleges are strengthening cooperation with other fields, developing human resources who support local

industries and developing engineers who are capable playing active roles globally. Engineers who have a high level of applied skill in areas such as S&T and who can engage in planning and designing are qualified as professional engineers under the Professional Engineer Qualification System. The Professional Engineer Examination is divided into the First-Step Examination, which is given to determine whether the examinee has the expertise expected of a university graduate in science or engineering (6,302 successful candidates in FY2018) and the Second-Step Examination, which is given to determine whether the examinee has the high level of applied skill required of a professional engineer (2,355 successful candidates in FY2018). Data on candidates who passed the Second-Step Examination in FY2018 in each technical discipline are shown in Table 2-4-2.

■Table 2-4-2/Breakdown of successful candidates of the Second-Step Professional Engineer Examination by Technical Discipline (FY2018)

Technical Discipline	No. of candidates (people)	No. of successful candidates (people)	Pass rate (%)
Mechanical Engineering	1,058	224	21.2
Marine & Ocean	8	3	37.5
Aerospace	59	11	18.6
Electrical & Electronics Engineering	1,448	187	12.9
Chemistry	137	25	18.2
Fiber & Textiles	46	12	26.1
Metals	114	53	46.5
Mining	17	6	35.3
Civil Engineering	14,175	886	6.3
Water Supply & Sewerage	1,552	182	11.7
Environmental Engineering	649	70	10.8

Technical Discipline	No. of candidates (people)	No. of successful candidates (people)	Pass rate (%)
Agriculture	952	131	13.8
Forest	314	66	21.0
Fisheries	147	31	21.1
Industrial Engineering	278	57	20.5
Information Engineering	431	28	6.5
Applied Science	589	70	11.9
Biotechnology & Bioengineering	39	16	41.0
Environment	519	66	12.7
Nuclear & Radiation	103	22	21.4
Engineering Management	3,279	209	6.4

Source: MEXT

To aid engineers in acquiring a broader range of basic knowledge about science and technology, the JST provides online self-study materials[1] on common science and technology topics and specific science and technology disciplines.

(3) Promoting reforms of graduate school education

MEXT is promoting the Graduate Education Reforms to train "Professionals of Knowledge" who think for themselves and act based on sophisticated expertise and a sense of ethics, create new knowledge and values based on their knowledge, work globally and lead the future. In FY2018, the ministry continued enhancement of graduate school education based on the 3rd Platform for the Promotion of Graduate School Education (decision of the Minister of Education, Culture, Sports, Science and Technology, on March 31, 2016). In the same year, the Central Council for Education's University Division compiled

1 https://jrecin.jst.go.jp/

"Drastic reform of graduate school education with a view to 2040 – to respond to the demands of society and learners (summary of deliberation)."

Specifically, the Program for Leading Graduate Schools started in FY2011 to assist radical reform of graduate school education with the participation of industry, academia and government. The program aims to provide interdisciplinary doctoral programs consistently from both terms in order to foster leaders who can play active roles globally in industry, academia and government. As of FY2018, 62 projects have been supported.

In order to cultivate excellent doctoral talents and build excellent centers for sustainable activities for human resource development/exchange and new joint research, Doctoral Program for World-leading Innovative & Smart Education (WISE Program) started in FY2018. The program supports development of 5-year integrated doctoral program by universities based on their strengths, utilizing the results of their graduate school reform and in organized coordination with other universities, research institutes, private companies, etc. at home and abroad. 15 programs were adopted in FY2018.

The Japan Student Services Organization (JASSO) provides scholarship loan programs to financially support motivated students who excel academically but who have difficulty pursuing their studies due to financial constraints. Interest-free loan recipients who are recognized by JASSO as having achieved particularly outstanding results in their studies may be partially or completely exempt from repaying their loans. Starting from the enrollment in FY2018, JASSO has expanded the system to exempt doctoral students with excellent performance from repaying their loans. The aim is to encourage continued education by reducing financial burden on students of doctoral programs.

To foster top level researchers who will play major roles in future scientific research, the Japan Society for the Promotion of Science (JSPS) offers the Research Fellowship for Young Scientists Program under which fellowships are granted to doctoral students (DC).

At the request of MEXT, the Science Council of Japan (SCJ) has been developing a Guideline for Curriculum Formation that focuses on the basic education given to all graduates for the quality assurance of university education in each academic field and announced the reference standard for 32 academic fields by FY2018.

(4) Development for the next generation of STI professionals

MEXT supports deployment of assistants for science observations and experiments in order to develop a teaching system for further improvement of observations, experiments and teaching in science education. The ministry is also advancing plan-based improvement of facilities and equipment for science and mathematics education including equipment for scientific observations and experiments, pursuant to the Science Education Promotion Act (Act No. 186, 1953).

MEXT designates high schools that provide advanced science and mathematics education as Super Science High School (SSH). This initiative aims to help students develop scientific abilities and thereby develop human resources for science and technology who can play important roles globally in the future. Specifically, schools designated as SSH are promoting project studies in cooperation with universities, research institutes, etc., developing and using curricula focused on science and mathematics to foster highly creative talents. In FY2018, 204 SSHs throughout the country provided such advanced and specialized education.

Under the Global Science Campus (GSC) program, JST selects and supports universities that develop and implement programs to cultivate high-school students who have desire and talent into international human resources in science and technology. In FY2017, JST started the School to Cultivate Junior Doctors for elementary and junior-high school students with outstanding desire and ability in science and mathematics. In this initiative, universities, etc. provide special education programs to further develop their abilities.

Furthermore, MEXT sponsored the 8th Science Intercollegiate (March 2 and 3, 2019) in Tokyo, as a venue for undergraduate students from across the country in natural science courses to present their own research in a friendly nationwide competition. They also have opportunities to meet with business people, etc. Of a total of 224 applications, 100 who had passed a documentary examination were presented (Figure2-4-3).

In addition, the JST has sponsored preliminary domestic contests for international science and technology contents, such as the International Science Olympiads for mathematics, chemistry, biology, physics, informatics, earth science and geography, and the Intel International Science and Engineering Fair (Intel ISEF), as well as supporting Japanese students' participation in competitions abroad and international competitions held in Japan (Figure 2-4-4). In FY2018, the 8th Japan High School Science Championship was held from March 15 to 18, 2019 in Saitama Prefecture. In this nationwide competition of schools and teams, comprehensive strengths are determined based on paper tests and practical skills in science and mathematics. The Aichi Prefecture team won first place (Figure 2-4-5). The 6th Japan Junior High School Science Championship was held on December 7 to 9, 2018 in Ibaraki Prefecture. Aichi Prefecture team won first place in this nationwide competition of schools and teams (Figure 2-4-6).

MEXT, the Japan Patent Office (JPO), the Japan Patent Attorneys Association, and the National Center for Industrial Property Information and Training (INPIT) jointly host the Patent Contests and Design Patent Contest for students at high schools, colleges of technology and universities. The aim is to enhance public understanding and interests in intellectual property. Students participating in these contests are rewarded for inventions and designs and are given support when they apply for a patent or design registration to obtain a patent or design right. MEXT honors the schools of the participating students, which made active efforts for these contests to enhance the Intellectual Property Mind of students or deepen their understanding of the IP system.

■Figure 2-4-3/The 8th Science Intercollegiate opening ceremony

Source: MEXT

■Figure 2-4-4/Participants in the International Student Contests in Science and Technology (FY2018)

International Mathematical Olympiad (Romania) Participants

From left
NISHIKAWA Hiroto, 3rd grade, Aichi Prefectural Meiwa Senior High School (bronze medalist)
ARAI Tomochika, 3rd grade, Kaisei High School (silver medalist)
KURODA Naoki, 3rd grade, Nada Senior High School (gold medalist)
KIYOHARA Taishi, 3rd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
MASUGI Kazuki, 1st grade, Rakunan High School (silver medalist)
WATANABE Naoki, 1st grade, Attached High School of Hiroshima University (bronze medalist)

Source: Mathematical Olympiad Foundation of Japan

International Chemistry Olympiad (Slovakia and Czech) Participants

From left
FUKUMOTO Yuto, 3rd grade, Osaka Seiko Gakuin Senior High School (bronze medalist)
ISHII Takanao, 3rd grade, Senior High School at Komaba, University of Tsukuba (gold medalist)
NISHIGUCHI Taichi, 3rd grade, Koyo Gakuin High School (silver medalist)
MASUNAGA Yuta, 3rd grade, Seiko Gakuin High School (silver medalist)

Source: Dream Chemistry 21 Committee/The Chemical Society of Japan

International Biology Olympiad (Iran) Participants

From left
SUZUKI Masumi, 3rd grade, Tokyo Metropolitan Nishi High School (bronze medalist)
HAMA Shoko, 1st grade, Oin Senior High School (bronze medalist)
ISHIDA Kiyoshi, 2nd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
TOBA Shigetaka, 2nd grade, Nada Senior High School (silver medalist)

Source: International Biology Olympiad Japan Committee

International Physics Olympiad (Portugal) Participants

From left
YOSHIMI Kosuke, 3rd grade, Nada Senior High School (silver medalist)
NAGAHAMA Soma, 3rd grade, Osaka Seiko Gakuin Senior High school (silver medalist)
SUEHIRO Tamon, 2nd grade, Osaka Seiko Gakuin Senior High school (silver medalist)
MIZUOCHI Toshiei, State Minister of MEXT
KITA Rin, 3rd grade, Hatsushiba Tondabayashi Senior High School (silver medalist)
OKURA Takuma, 3rd grade, Okayama Prefectural Okayama Asahi Senior High School (gold medalist)

Source: International Physics Olympiad Japan Committee

International Olympiad in informatics (Tsukuba) Participants

From left
INOUE Wataru, 3rd grade, National Institute of Technology, Kitakyushu College (gold medalist)
SHIMIZU Ikumi, 3rd grade, N High School (bronze medalist)
NAMEKATA Koichi, 2nd grade, Senior High School at Komaba, University of Tsukuba (bronze medalist)
HOSOKAWA Hiroaki, 3rd grade, Nada Senior High School (silver medalist)

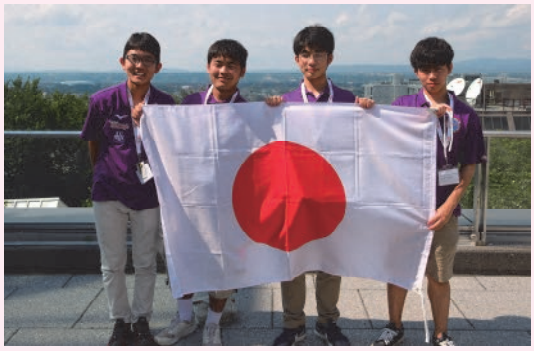
Source: International Olympiad in Informatics Japan Committee

International Earth Science Olympiad (Thailand) Participants

From left
AONUMA Keito, 3rd grade, Senior High School at Komaba, University of Tsukuba (gold medalist)
ONO Tomohiro, 2nd grade, Koyo Gakuin High School (gold medalist)
KAWAMURA Nanako, 3rd grade, Takada Senior High School (silver medalist)
TANAKA Takumi, 3rd grade, Eiko Gakuen Senior High School (gold medalist)

Source: International Earth Science Olympiad Japan Committee

International Geography Olympiad (Canada) Participants



From left
MUTO Akihiro, 3rd grade, Tokyo Metropolitan Hibiya High School
NAGAOKA Yuki, 3rd grade, La Salle High School
NAKAO Shunsuke, 2nd grade, Rakusei Senior High School
SATO Koshun, 3rd grade, Waseda Senior High School

Source: International Geography Olympiad Japan Committee

* Note: The schools and grades are as of when the award was won

■Figure 2-4-5/The 8th Japan High School Science Championship

Winning team: Kaiyo Secondary School team (Aichi Prefectural team)
From left of the front row
OKAMOTO Naoki (2nd grade)
HIRAISHI Yudai (1st grade)
FURUTACHI Hayato (1st grade)
From left of the back row
SAKURADA Kotaro (2nd grade)
ANADA Yuto (2nd grade)
KODAMA Taiyo (2nd grade)
Taguchi Hitoshi (2nd grade)

Source: Japan Science and Technology Agency

■Figure 2-4-6/The 6th Japan Junior High School Science Championship

Winning team: Aichi Prefectural team
From left
DODO Daiki, 2nd grade, Kaiyo Secondary School
ITO Hiromasa, 2nd grade, Kaiyo Secondary School
OHARA Ryota, 2nd grade, Kaiyo Secondary School
KIMURA Akinaga, 2nd grade, Kaiyo Secondary School
SUGA Haruto, 2nd grade, Kaiyo Secondary School
MAWATARI Yosuke, 2nd grade, Kaiyo Secondary School

Source: Japan Science and Technology Agency

* Note: The grades are as of when the award was won.

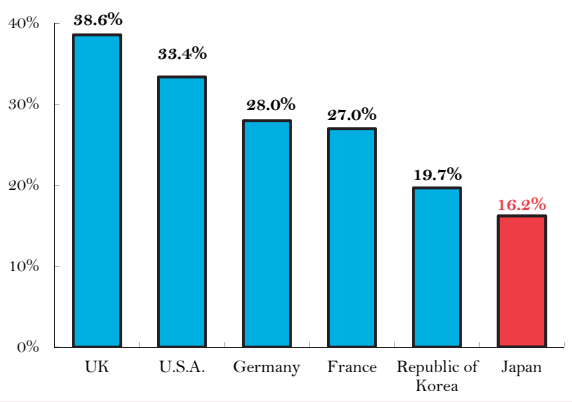
2 Promoting diversity and career mobility

(1) Improving women's career prospects in STI

Encouraging female researchers to fulfill their potential promotes economic and social revitalization and gender equality. The 5th Science and Technology Basic Plan (hereinafter referred to as the 5th Basic Plan) aims to promptly achieve the numerical targets of the proportion of female researchers among new hires listed in the 4th Science and Technology Basic Plan (30% of the total in the natural sciences overall, 20% in the physical sciences, 15% in engineering, 30% in agriculture, and 30% in medicine, dentistry and pharmacology combined) during the period of the 5th Basic Plan (28.2% in 2015). In Japan, by supporting employment and increasing the roles of female researchers, the share of female researchers has been

increasing every year. However, woman still accounted for only 16.2% of researchers as of March 2018, which is lower than in other advanced countries (Figure 2-4-7).

■Figure 2-4-7/Percentage of female researchers by country



Note: 1. The data are as of 2015 for the UK, the U.S.A., Germany and France, 2016 for the Republic of Korea and 2018 for Japan.
2. For the U.S.A. data on scientific professionals (i.e., bachelor's/ master's/ doctoral degree holders in science or engineering who engage in a science-related profession) are used instead of data on researchers. "Science" includes the social sciences.
Source: Adapted by MEXT based on *Survey on Research and Development* (MIC), *Main Science and Technology Indicators* (OECD) and *Science and Engineering Indicators* (NSF)

The Cabinet Office's website Science/Engineering Challenge[1] provides information on efforts by universities and companies to encourage such challenges and provides communications from female workers in science and technology. To encourage female students to choose careers in science and engineering, the Cabinet Office, together with MEXT and the Japan Business Federation, held an event entitled the Summer Science/Engineering Challenge 2018: Encounter Science/Engineering Jobs from July to August 2018. This program gathered a variety of events in universities and businesses to provide female students in lower/upper secondary schools with opportunities including science/engineering workplace visits, work experience and facility tours.

In addition, STEM[2] Girls Ambassadors started to present diverse role models with the aim of fostering momentum of society's support for female students' choosing careers in science and engineering.

MEXT has implemented the Initiative for Realizing Diversity in the Research Environment, to support initiatives for diversity implemented by universities and other institutions. The initiative includes integrated promotion of leader training through support for researchers to allow them to balance their research with maternity, childcare and other life events and support for female researchers in improving their research capabilities. MEXT supported 64 institutions in FY2018.

The JSPS has implemented the Restart Postdoctoral Fellowship (RPD)[3] Program to provide research incentives to male/female researchers who have temporarily discontinued their research due to maternity/childcare responsibilities.

In order to promote participation of female scientists and engineers, Ministry of Economy, Trade and Industry (METI) has been implementing the "program to support the success of female scientists and engineers." The program supports visualization of their skills and the skills sought by industry to help them understand what skills they need to develop. For example, the ministry is publicizing the program by holding a "symposium to promote the success of female scientists and engineers" for students, university

1 http://www.gender.go.jp/c-challenge/
2 science, Technology, Engineering and Mathematics
3 Refers to postdoctoral researchers restarting research activities

teachers and personnel management officers of companies in September 2017.

The National Institute of Advanced Industrial Science and Technology (AIST) organized the Diversity Support Office (DSO), a consortium of 20 universities and research institutions nationwide. The DSO promotes information-sharing and exchanges of opinions on diversity promotion among member institutions. The DSO is also implementing the action plan based on the Act on Promotion of Women's Participation and Advancement in the Workplace in cooperation with universities and companies and working to promote diversity by further expanding the network, supporting work-life balance and career development of researchers and raising awareness.

The G7 Ise-Shima Summit held in May 2016 chose women's empowerment as one of its agenda items and the G7 leaders agreed on the launch of the Women's Initiative in Developing STEM Career (WINDS). In November 2016, Ministry of Foreign Affairs (MOFA) appointed three WINDS ambassadors. They have actively participated in various conferences and events for promotion of women's success in STEM fields. In January 2018, one WINDS ambassador was reappointed.

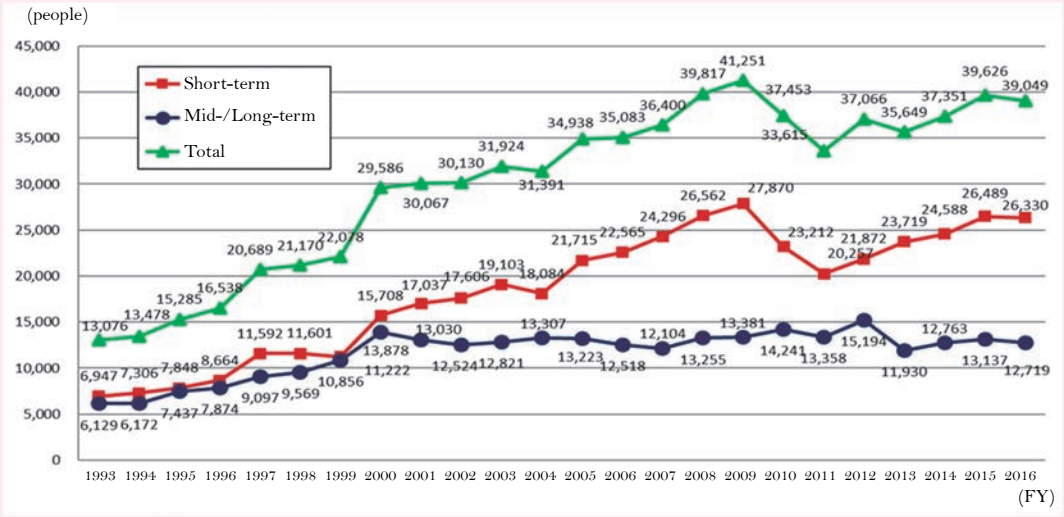
(2) Enhancing the international research network structure

A. The development of international networks of researchers

(A) International mobility of Japanese researchers

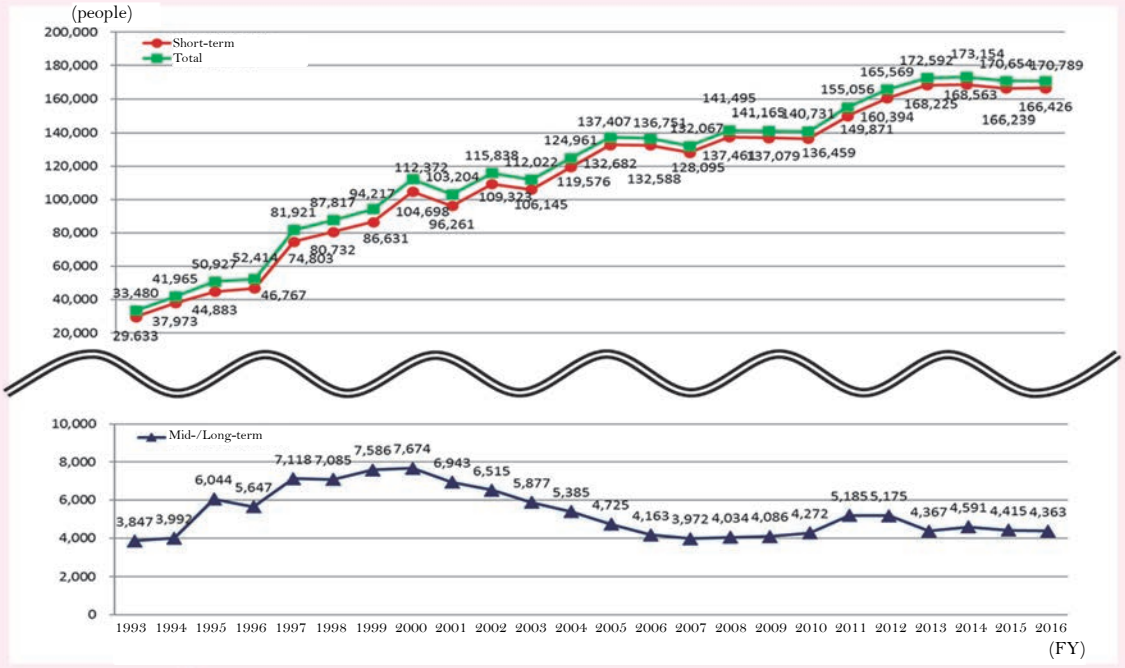
According to the Overview of International Research Exchanges published in FY2018, the total number of short-stay foreign researchers accepted by universities and independent administrative institutions in Japan showed a tendency to grow until FY2009, while the number decreased in FY2011 as a result of the Great East Japan Earthquake and then rebounded. The number of foreign researchers on mid-length to long stays varied between 12,000 and 15,000 for every year since FY2000 (Figure 2-4-8). The number of Japanese researchers on short stays overseas has tended to grow since the start of the survey. The number of Japanese researchers on mid-length to long stays overseas varied between 4,000 and 5,000 for every year since FY2008 (Figure 2-4-9).

■Figure 2-4-8/Changes in the number of foreign researchers in Japan (Short or mid-length to long stay)



Note: 1. "Short stay" means 30 days or fewer; "mid-length to long stay" means more than 30 days.
2. Postdocs and research fellows are included in the figures in and after FY2010.
3. The overlap caused by multiple counting of the same foreign researchers accepted at multiple institutions in Japan in the same fiscal year was eliminated from the FY2013 survey.
Source: Overview of International Research Exchanges, MEXT (September 2018)

■Figure 2-4-9/Changes in the number of Japanese researchers overseas (Short or mid-length to long stay)



Note: 1. "Short stay" means 30 days or fewer; "mid-length to long stay" means more than 30 days.
2. Postdocs and research fellows are included in the figures in and after FY2010.
Source: Overview of International Research Exchanges, MEXT (September 2018)

(B) Efforts to promote international exchanges of researchers

In the midst of the globally accelerating brain circulation, Japan is making efforts to ensure that Japanese

researchers and research teams can play a central role in networks of international research or researchers.

To foster young Japanese researchers who can play active roles internationally, the JSPS has provided various programs for sending young researchers abroad and inviting excellent researchers from other countries to Japan. Starting from the FY2018 Grants-in-Aid (KAKENHI) JSPS will expansively review the Fund for the Promotion of Joint International Research in KAKENHI grant programs to establish "Fostering Joint International Research (B)" for construction and further enhancement of the foundation of international joint research with the requirement of participation of young researchers.

JSPS has also been implementing the "Program for Fostering Globally Talented Researchers" to support universities and other research institutes that send and accept researchers to and from overseas research institutes. JSPS offers the Overseas Research Fellowships, aiming at fostering and securing highly capable researchers who have broad international perspectives and who will forge future academic activities in Japan. This fellowship program provides excellent young Japanese researchers with an opportunity to conduct long-term research at a university or research institution overseas. The Overseas Challenge Program for Young Researchers is offered to support doctoral students and other travels abroad.

JSPS accepts overseas research fellows under the Invitational Fellowships for Research in Japan to give outstanding foreign researchers opportunities to work at universities in Japan, which will contribute to internationalization of the research environment of Japanese universities, etc. In addition, Bilateral Programs support forming a sustainable network between Japanese and foreign research teams.

To foster young scientists and build networks in the Asia-Pacific and Africa regions, HOPE Meetings have been organized by the JSPS to provide selected graduate students and young researchers from these regions with opportunities to engage in discussions with Nobel laureates and other distinguished researchers.

The JST started the Japan-Asia Youth Exchange Program in Science in FY2014 to invite excellent youths (high school, undergraduate and graduate students and researchers aged under 40) from 41 countries and regions predominantly located in Asia for a short-term visit (one to three weeks) to call in outstanding foreign human resources.

B. International research grant programs

The Human Frontier Science Program (HFSP) is an international research grant program first advocated by Japan at the summit in Venice in June 1987. This program aims at supporting international joint basic research on the complex mechanisms of living organisms and providing the research results for the general interest of mankind. Currently the International Human Frontier Science Program Organization (HFSPO) has 15 members (Japan, Australia, Canada, the EU, France, Germany, India, Italy, The Republic of Korea, New Zealand, Norway, Singapore, Switzerland, the UK and the U.S.A.). Japan has been actively supporting the program since its establishment and playing a key role in its operation.

This program provides grants for research expenses of international joint research teams (Research Grants), supports young researchers by covering the cost of overseas research travel and stays (Postdoctoral Fellowships), and holds HFSP awardees' meetings. During the 30 years since the program began in FY1990, HFSPO has given research grants for about 1,100 research tasks of over 4,000 researchers worldwide and provided fellowships to about 3,200 young researchers. Among past winners of the research grant, 28 researchers were awarded with the Nobel Prize, including HONJO Tasku,

Distinguished Professor, Kyoto University, who won the Nobel Prize in Physiology or Medicine in 2018. The international cooperation program that supports original, ambitious and inter-disciplinary research is highly regarded throughout the world.

(3) Promoting cross-field, cross-organization, and cross-sector mobility

MEXT and METI recognize the importance of promoting cross appointment to increase the mobility of human resources. In cross appointment, researchers can be employed based on an agreement on secondment between multiple organizations and engage in R&D and education in the organizations according to their role in the respective organization under a certain activity management. The ministries published the "Basic Framework and Notes on Cross-Appointment System" compiling notes and recommended examples in December 2014 and have promoted introduction of the system The Guidelines for Fortifying Joint Research Through Industry-Academia-Government Collaboration formulated in November 2016 also encourages cross appointment.

MEXT has been implementing the Building of Consortia for the Development of Human Resources in Science and Technology. In this program, consortium is formed in multiple universities to ensure the stable employment of researchers while encouraging mobility for their career progression in cooperation with companies.

■Table 2-4-10/Major projects for strengthening of human resources (FY2018)

Ministry	Implemented by	Project
MEXT	MEXT	Grant for Science Education Equipment Servicing
		Expenses necessary for Management Expense Grant for National Institute of Technology
	JASSO	Scholarship program
	JST	Program to Disseminate Tenure Tracking System
		Building of Consortia for the Development of Human Resources in Science and Technology
		Initiative for Realizing Diversity in the Research Environment
		Excellent Young Researchers Program

Section 2 Promoting Excellence in Knowledge Creation

Continuous creation of innovations requires flexible thinking and novel ideas not bound by traditions or conventional rules. Through reforms and strengthening of such academic research and basic research as well as development of an environment for researchers to settle down to study, we work to strengthen the foundation of knowledge both in quality and quantity.

1 Promoting academic and basic research as a source of innovation

(1) Reform and enhancements to promote academic research

A. Reform and strengthening of Grant-in-Aid for Scientific Research

MEXT and the JSPS have been implementing the Grants-in-Aid for Scientific Research (KAKENHI). KAKENHI, which are available through MEXT and the JSPS, are the only competitive funds provided for all academic research in any field, from the humanities/social sciences to the natural sciences. KAKENHI grants have been supporting diverse, creative research, broadening the base of various research activities, continually advancing research, and generating profound knowledge. In FY2018, around 26,000 research applications were newly selected by peer review screening (assessment of the research proposals by reviewers selected from the research communities) from over 100,000 applications in major research categories. About 75,000 projects, including those continuing for the several fiscal years, were funded. (The KAKENHI budget for FY2018 is 228.6 billion yen).

The KAKENHI system has been reviewed continuously for improvements, including its introduction of a foundation. With the aim of promoting high-quality scientific research and generating excellent knowledge, based on the Policy for Implementing Reforms in the KAKENHI System (formulated in September 2015), MEXT is carrying out radical reform including a review of its screening system.

Specifically, based on "About Reform of the Review System for Grants-in-Aid for Scientific Research–KAKENHI" compiled by the Subdivision on Science, Council for Science and Technology, MEXT, about 400 examination categories were reorganized into a new examination category table of a smaller number of categories, and public invitation was made based on the new table starting from FY2018 Grants-in-Aid. New examination methods including "comprehensive examination" with more stress on consultative examination were also introduced.

MEXT will continue to work to improve KAKENHI for further promotion of academic research.

B. Promotion of shared use and joint research at universities and inter-university research institutes

The system for shared use and joint research has made a big contribution to the development of academic research in Japan. Under the system, researchers across the country can use leading edge large equipment and precious materials/data outside the framework of university. The system functions mainly through inter-university research institutes[1] and shared use/joint research centers of national, public and private universities certified by the minister of MEXT.

Because large academic research projects, in particular, require many physical and human resources, such projects are difficult to implement by individual universities and therefore implemented mostly under a

1 107 centers of 54 universities have been certified and are active as of April 2018.

shared use/research system. MEXT has been supporting these initiatives under Promoting Large Scientific Frontier Projects. In FY2018, 10 projects (Figure 2-4-11) were promoted from which world-leading research results are expected. For example, experiments and research of the Super-Kamiokande neutrino detector contributed to the research results by a winner of the Nobel Prize in Physics: KAJITA Takaaki, Director of the University of Tokyo's Institute for Cosmic Ray Research in 2015. In FY2018 detectors were improved to increase the accuracy of observation of neutrinos generated by supernova explosion, etc. with a view to further development toward the next stage. The Electron-Positron Collider (Super-B Factory) of the High Energy Accelerator Research Organization has been sophisticated since FY2010 and started full-scale operation in March 2018. In April 2018 the first collision of electrons and positrons was observed. The Factory has been promoting an international joint experiment (Belle II experiment) with about 900 participants from 26 countries/regions worldwide.

■Figure 2-4-11/Large-scale projects that will be implemented under the Large-Scale Academic Frontier Promotion Project

Source: MEXT

(2) Reform and enhancements to promote strategic and on-demand basic research

The Strategic Basic Research Programs (Creating the Seeds for New Technology) operated by the JST and the Advanced Research and Development Programs for Medical Innovation launched by the Japan Agency for Medical Research and Development (AMED) invite applications from researchers at universities and other institutions. These programs are carried under the strategic objectives set by the national government. The research is conducted through a fixed-term consortium that is connected over

institutional boundaries. The important results generated by the research are being accelerated and deepened.

MEXT established the following five objectives for FY2018.

A. Strategic Basic Research Programs (Creating the Seeds for New Technology)
- Creation of innovative materials and devices by establishing topological materials science
- Establishment of technologies for genome-scale DNA synthesis and its function expression, and creation of material production and medical technology seeds
- Creation of innovative computing that will support Society 5.0
- Creation of innovative reaction technologies for development of new production processes to contribute to realization of a sustainable society

B. Advanced Research and Development Programs for Medical Innovation
- Exploration of life phenomena and creation of medical technology seeds based on spatiotemporal understanding of the adaptation and repair mechanism of biological tissues.

(3) Promoting joint international research and forming world-class research centers

In order for Japan to be able to occupy an important position in global research networks and exert its presence on the global stage, it is important not only to take a strategic approach to the promotion of international joint research but also to build a research center that can become a hub of international intellectual circulation for the nation.

A. International joint research with other countries

(A) International Thermonuclear Experimental Reactor (ITER) project, etc.

The ITER project is managed under the international cooperation of seven parties for realization of fusion energy. The construction of ITER began in earnest in Cadarache, France, toward commencement of operations in 2025. Japan is promoting the production of major equipment of ITER including superconductive coils (See Section 1, Chapter 3.) Japan and Europe are also promoting the Broader Approach (BA) that is an advanced fusion R&D supplementing and supporting the ITER project at Rokkasho Village of Aomori prefecture and Naka city of Ibaraki prefecture.

(B) International Space Station (ISS)

Japan operates the Japanese Experiment Module KIBO and the automated cargo spacecraft KONOTORI (HTV[1]) in the ISS program. (See Section 4 2-(6), Chapter 3.)

(C) International Ocean Discovery Program (IODP)

The IODP is a multilateral international cooperation project led by Japan, the United States and Europe with the aim of elucidating global environmental change, the inner structure of the Earth, and Subsurface Geobiology, etc. The program has been implemented since October 2013 to replace the Integrated Ocean

1 H-II Transfer Vehicle

Drilling Program (IODP (2003 to 2013).) Drilling vessels work in groups to drill deep sea floors worldwide. A Japanese deep drilling vessel, CHIKYU, that features the world's top level drilling capabilities among science drilling vessels and a U.S. drilling vessel are acting as the principal vessels of the IODP; and Mission-Specific Platforms are provided by the European consortium. In FY2018 CHIKYU was used for drilling at the Kumano-nada Sea off the Kii Peninsula that is an assumed hypocentral region of the anticipated Tonankai earthquake.

(D) Large Hadron Collider (LHC)

In the LHC project[1], the CERN[2] member states, Japan and the U.S.A. have been collaborating in experiments in the energy field at the highest level in the world. The results of the collaboration include discovery of the Higgs Boson. Currently a study to increase the luminosity of LHC (HL-LHC[3] project) is underway.

(E) International Linear Collider (ILC)

A group of international researchers is planning to construct an ILC to investigate the properties of the Higgs Boson particle in more detail, and an ILC Technical Design Report was published in June 2013.

In light of the response from the Science Council of Japan in September 2013, MEXT has been holding meetings of external experts since May 2014 to discuss challenges pertaining to the ILC project. Later, considering the revised plan published in November 2017, the discussions were summarized in July 2018 from viewpoints including scientific significance, cost and technical feasibility, human resource development and acquisition, system and management, and international cooperation.

Based on the response from the Science Council of Japan issued in December 2018 after a retry in response to the summary, the review of the ILC project has been continued.

B. Efforts toward Creation of world-leading international research centers

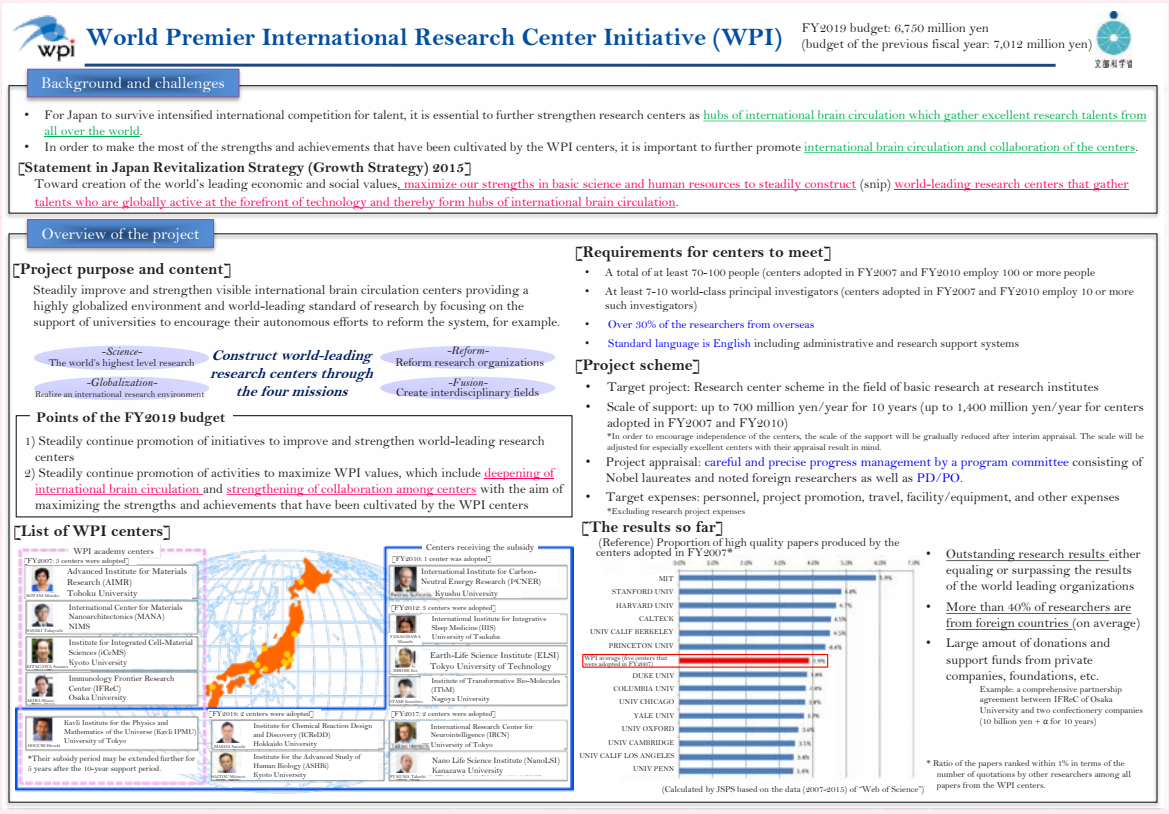
Through the World Premier International Research Center Initiative (WPI) MEXT has been steadily improving and strengthening the "globally visible brain circulation centers" with highly global research environments and the world's top-level research standards. Specifically, each research center selected for this initiative receives approximately 0.7 billion yen annually for 10 years (up to 1.4 billion yen for the research centers that were selected in FY2010 or earlier). As of the end of FY2018, 13 centers are supported under this initiative (Figure 2-4-12). Under this program, the WPI Program Committee, chaired by NOYORI Ryoji, Director-General of Center for Research and Development Strategy, JST, is playing a central role in careful and meticulous progress management carried out every year.

With the aim of increasing world-class universities and also enhancing universities' research capabilities, the government is implementing the Program for Promoting the Enhancement of Research Universities. Under this program it supports and promotes integrated efforts for securing/utilization of research management personnel, university reform and intensive reform of the research environment, so that the research capacity of the entire country will increase.

1 In this experimental project, the large circular collider of CERN is used to reproduce extreme conditions similar to those of shortly after the Big Bang, with the aim of discovering unknown particles and the deep internal structure of matter.
2 Conseil Européen pour la Recherche Nucléaire
3 High Luminosity-Large Hadron Collider

Cabinet Office has been supporting activities for expansion of the Okinawa Institute of Science and Technology Graduate University (OIST) toward a global center of science, technology and innovation.

■Figure 2-4-12/World Premier International Research Center Initiative (WPI)



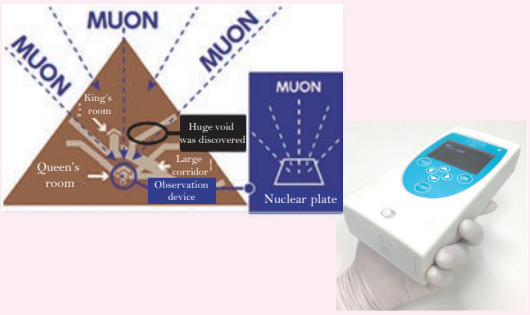
Source: MEXT

2 Strategic enhancement of common-platform technology, facilities, equipment, and information infrastructure supporting research and development activity

(1) Strategic development and use of common-platform technology and research equipment

In line with the MEXT policies, the JST has been implementing the Development of Advanced Measurement and Analysis Systems program to promote the development of the most advanced, unique instruments for measurement and analysis that serve the needs of world-leading researchers and manufacturers (Figure 2-4-13). As of March 2018, 61 prototypes had been developed and put into production.

■Figure 2-4-13/Examples of technologies and instruments for advanced measurement and analysis



Upper: Development of a nuclear plate that enables high accuracy (under 1μm) observation of cosmic ray muons that have high penetration of physical bodies. Observation using the plate led to the discovery of a huge unknown void at the center of the pyramid of King Khufu, the largest pyramid of Egypt.
Lower: Development of a mobile genetic testing device that can carry out virus/bacteria test in a short time (about 10 minutes)
Source: JST

(2) Maintenance, sharing, and networking of research facilities, equipment and intellectual infrastructure used by industry, academia, and government

A. Promotion of development/sharing of research facilities/equipment and their networking

As infrastructure to promote S&T, research facilities and equipment support a range of R&D; thus, they need to be further advanced and used more efficiently and effectively. The Act on Improving the Capacity, and the Efficient Promotion of Research and Development through Promotion of Research and Development System Reform (Act No. 63, 2008) stipulates that the government shall take necessary measures to promote the shared use of R&D facilities and equipment as well as intellectual infrastructure owned by national universities and R&D agencies.

Pursuant to the R&D Enhancement Act, the government has been promoting the effective use of key general facilities and equipment by industrial, academic and government research institutions for diverse R&D on science and technology. The government is also working on networking these facilities and equipment such that they will be available more conveniently in a mutually complementary manner and will be able to respond to emergencies.

(A) Specified Large-Scale High-Technology Research Facilities

The Act on the Promotion of Shared Use of Specified Large-Scale High-Technology Research Facilities (Act No. 78, 1994) (the Shared Use Act) defines large-scale research facilities of special importance as Specified Large-Scale High-Technology Research Facilities. This act stipulates the need for the systematic development and operation of these facilities, as well as for shared use in a fair, even manner.

(i) Super Photon ring-8 GeV (SPring-8)

SPring-8 is a research facility that delivers the top performance in the world in the analysis of atomic or molecular structure/function by using synchrotron radiation, the extremely bright light that is produced when electrons accelerated to near the speed of light are forced to travel in a curved path. For 20 years since the service commencement in 1997, this facility has been contributing to innovative R&D in various fields of research from life science to environment/energy and new materials development which help boost Japan's economic growth.

(ii) X-ray free-electron laser facility (SACLA)

SACLA is the most advanced research facility in the world with respect to the generation of light. The unprecedented light generated there has both laser and synchrotron radiation characteristics and allows instantaneous measurement and analysis of ultra-high speed movements/changes in atomic-level hyperfine structures and chemical reactions. SACLA has been in use since March 2012. MEXT also launched the Priority Strategic Research Issues Using X-ray Free-Electron Lasers program in the same year to promote pioneering research using the facility. In FY2017 simultaneous operation of two hard x-ray FEL[1] beam lines by dividing electric beams[2] started for the first time in the world. Its usage environment has been also steadily improved toward creation of further creation of high-impact results.

Super Photon ring-8 GeV (Spring-8) and
An X-ray free-electron laser facility (SACLA)
Source: RIKEN

(iii) The "K computer" supercomputer

As a third approach to S&T, following the theoretical and experimental approaches, supercomputer simulations have been crucial for cutting-edge S&T and improvements in industrial competitiveness. The K computer is operated by the RIKEN, in cooperation with the Research Organization for Information Science and Technology (RIST), which is a registration organization supporting users of the K computer; and the HPCI[3] Consortium, which consists of organizations that represent user communities. The K computer has underpinned breakthroughs in diverse fields, including upgrading of medical care and drug discovery, manufacturing innovations, the mitigation of earthquake and tsunami damage, and the elucidation of the origin of matter and the universe.

The "K computer" supercomputer
Source: RIKEN

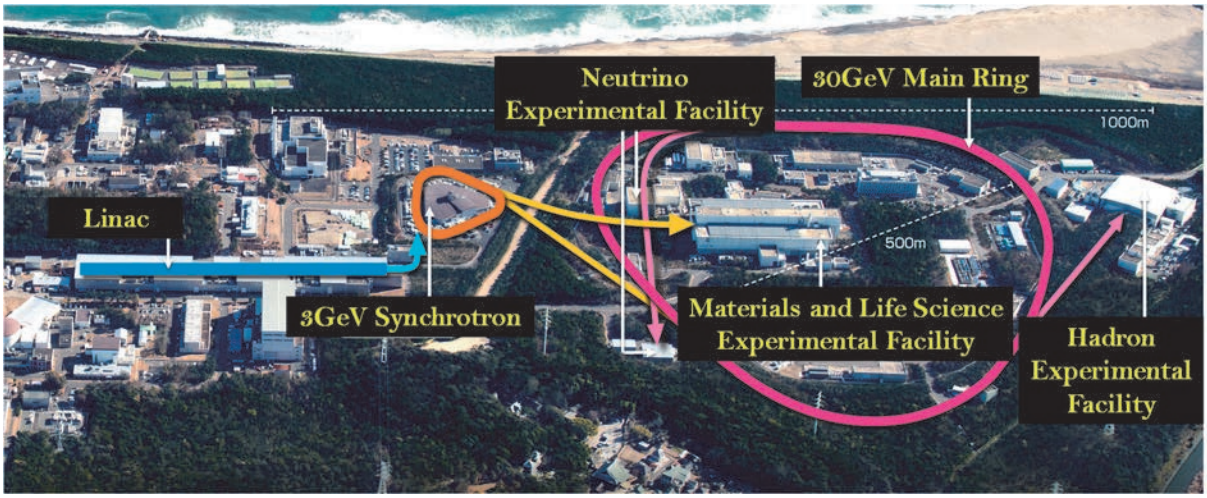
In order to contribute to solutions of Japan's social and science challenges, MEXT has been promoting a project to develop Post-K succeeding K toward commencement of operation in 2022. Through coordinated development of a system and applications contributing to problem solving, the ministry aims to realize the world's best versatile super computer. In response to the interim evaluation at the Council for Science, Technology and Innovation (CSTI) to the effect that it is appropriate to promote production and

1 Hard x-ray FEL is a free electron laser in the region of short hard x-rays at 0.3nm or shorter
2 By dividing electron beams from a linear accelerator pulse-by-pulse to multiple beam lines multiple beam lines can be used simultaneously.
3 High Performance Computing Infrastructure

installation of Post-K without delay, the ministry started its production in FY2018.

(iv) Japan Proton Accelerator Research Complex (J-PARC)

J-PARC has been contributing to a wide range of R&D, including basic research and industrial applications, by using secondary particle beams of neutrons, muons and neutrinos[1] that are generated by a proton accelerator with the highest beam intensity in the world. The Materials and Life Science Experimental Facility (Specified Neutron Facility) has been used for structural analyses which may spawn innovative materials and new drugs and numerous results have been achieved. The Shared-Use Act is not applicable to the Nuclear and Particle Experimental Facility (Hadron Experimental Facility) or the Neutrino Experimental Facility, but these facilities are used jointly by university researchers in Japan and abroad. At the Neutrino Experimental Facility, Tokai to Kamioka (T2K) experiments have been conducted with the aim of clarifying the characteristics of neutrino oscillations, following the research of neutrino oscillations that won the 2015 Nobel Prize.



Japan Proton Accelerator Research Complex (J-PARC)
Source: J-PARC Center

(B) Next generation synchrotron radiation facilities (high-intensity 3GeV-level radiation light source for soft x-ray)

Concerning the High-intensity 3GeV-level radiation light source (next generation synchrotron radiation facilities) that has strengths in soft x-ray, since the November 2018 MEXT at the Subcommittee on Quantum Science and Technology and its Subdivision on R&D Planning and Evaluation, CST, has been promoting deliberation and investigation on its significance for the science and technology innovation policy, its required performance, basic approach to development and operation, and concrete measures. In January 2018 the subcommittee compiled a report titled "Development of new High-intensity 3GeV-level radiation light source for soft x-ray." Based on the report, MEXT invited partners from communities and industry and carried out surveys and examination in order to promote specific efforts for the next-generation synchrotron radiation facilities in a public-private-community partnership. In July 2018, the ministry

1 A neutrino is a neutrally charged, elementary subatomic particle. It is extremely difficult to detect neutrinos because they can penetrate ordinary matter without leaving any trace, and little is known about their characteristics or masses.

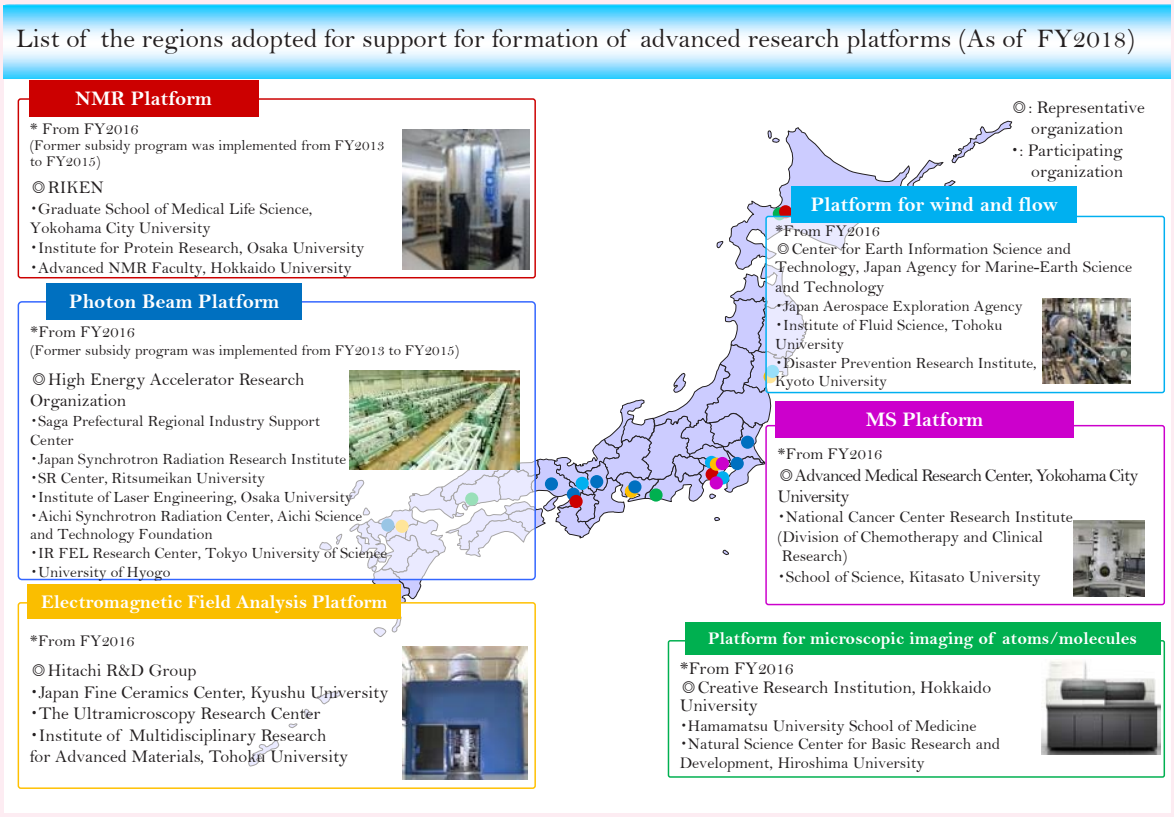
selected five partners: Synchrotron Light in Tohoku, Japan (representative), Miyagi Prefecture, Sendai City, Tohoku University and the Tohoku Economic Federation. The ministry will continue to promote the next-generation synchrotron radiation facilities together with the community and industry partners.

(C) Constructing a network of research facilities and equipment

(i) Platforms for shared use

MEXT has been working to maintain and advance the world's leading R&D infrastructure by forming platforms for shared use to construct a network of research facilities/equipment available for sharing by industry, academia and government (Figure 2-4-14).

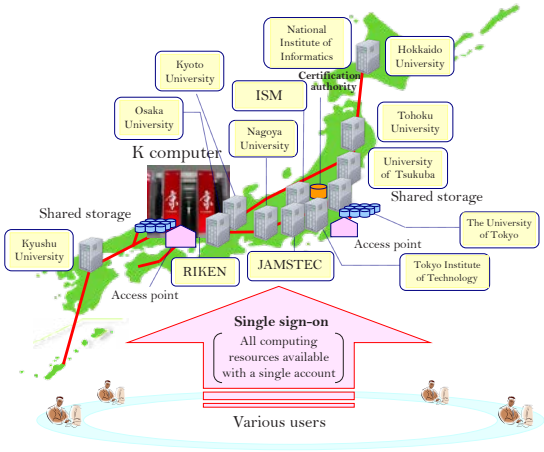
■Figure 2-4-14/Organizations adopted for the Project for Promoting Public Utilization of Advanced Research Infrastructure (support for formation of advanced research platforms)



Source: MEXT

(ii) The development of Innovative, High Performance Computing Infrastructure (HPCI)

MEXT has been advancing the development of an innovative High Performance Computing Infrastructure (HPCI) that provides a computing environment meeting the diverse needs of users. The HPCI is based on the K computer, one of the world's most powerful supercomputers, which is connected via high-speed networks with other supercomputers and storages at universities and research institutions in Japan. MEXT is also promoting its use in various fields while working for effective and efficient operation of HPCI.



Source: MEXT

(iii) Nanotechnology Platform

MEXT is providing a nationwide system for the shared use of advanced equipment and technology. Under that platform, research institutions that have cutting-edge nanotechnological research facilities and knowledge work closely to provide opportunities for researchers from industry, academia and government around the nation to use their facilities.

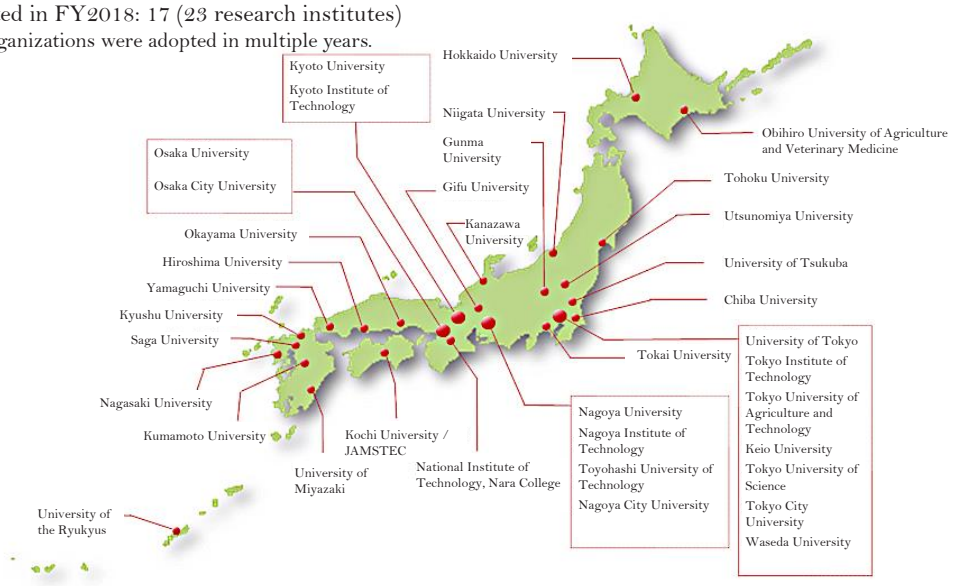
B. Introduction of new sharing system aligned with the competitive fund reform

MEXT is promoting introduction of a new sharing system to realize a virtuous cycle of R&D and sharing in conjunction with the reform of competitive research funds through early establishment of development and operation of research facilities/equipment integrated with the management of research organizations (Figure 2-4-15).

■Figure 2-4-15/Organizations adopted for the Project for Promoting Public Utilization of Advanced Research Infrastructure (support for introduction of the new sharing system)

List of areas adopted for support for introduction of the new sharing system (As of FY2018)

Number of implementing organizations: 37
Adopted in FY2016: 15 (23 research institutes)
Adopted in FY2017: 16 (24 research institutes)
Adopted in FY2018: 17 (23 research institutes)
*10 organizations were adopted in multiple years.



Source: MEXT

C. Promotion of development, sharing and networking of intellectual infrastructure

Under the National BioResource Project, through AMED, MEXT is improving the system so that biological resources, including animals and plants that may become the base of life science and that may be strategically important for the country, can be collected, preserved and distributed in a systematic manner. The ministry is also comprehensively promoting R&D on elucidation and control of the mechanism of aging and implementing "project for elucidation and control of the mechanism underlying aging" with the aim of forming centers of aging research.

In February 2019, METI checked the progress of a plan for the development of intellectual infrastructure in three areas (measurement standards, microbial genetic resources and geological information), checked specific measures for promoting the use of intellectual infrastructure and reviewed the plan.

Regarding measurement standards, AIST developed physical standards for harmonic voltage/current (power analyzer was added as calibrator). The standards are expected to be used for smart meter evaluation. Regarding chemical standard materials, AIST developed standards for inorganic analysis including a silver standard solution, and chlorite ion standard solution corresponding to the water quality standard for drinking water and thereby established a system for implementation of JCSS[1] and requested tests with ensured measuring traceability to AIST. AIST also contributed to the revision of the definition of a base unit (kilogram) of the International System of Units (SI) through determination of a fundamental physical constant (Planck Constant) using a technology for accurate measurement of number of atoms in a silicon

1 Japan Calibration Service System

sphere.

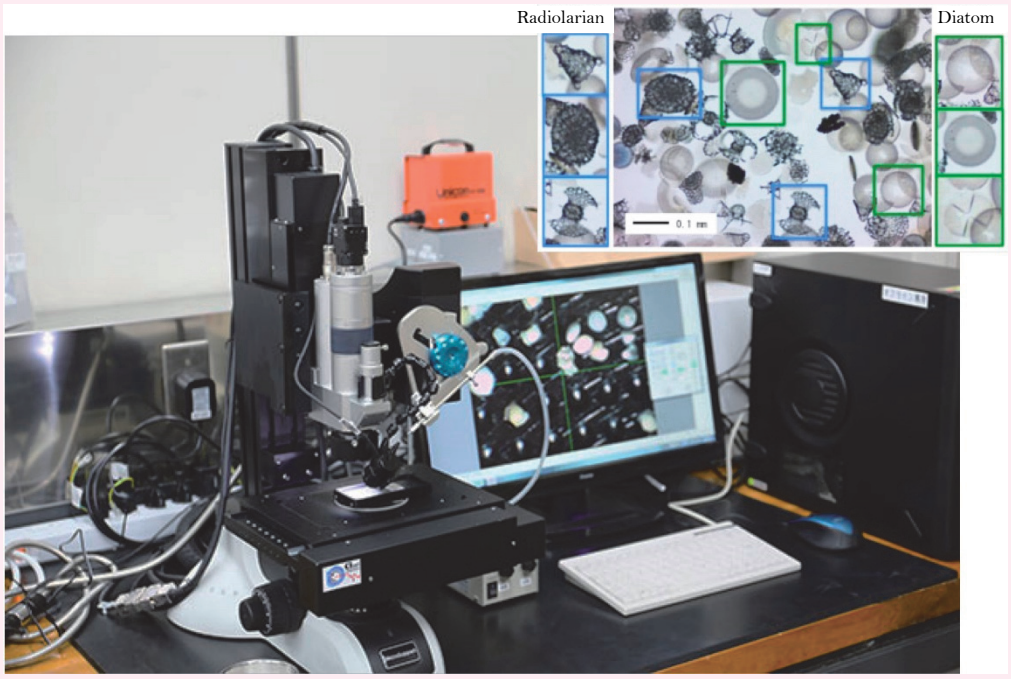
Enriched silicon sphere used for determination of Planck Constant
Source: AIST

The National Institute of Technology and Evaluation (NITE) has been collecting, preserving and distributing microbial genetic resources and has also been organizing information on these resources in terms of their genes and genetic lineages so as to make the information accessible to researchers and others (6,283 strains of biological genetic resources had been distributed as of the end of January 2019.). It has also constructed cooperative relationships with Asian countries by joining a network of 27 organizations from 15 countries, which aims for the preservation and sustainable use of microbial resources (the Asia Consortium, founded in 2004) and has supported Asian countries in their efforts to use microorganism resources through multilateral interchange programs according to the Convention on Biological Diversity (CBD) and the Nagoya Protocol. In addition to these initiatives, NITE implemented a workshop in Mongolia as part of its cooperation with Asian countries regarding genetic resources.

Regarding geological information, AIST published four 1:50,000 geological maps (Abashiri, Azumayama, Itoigawa and Minobu), one marine geological map (sea areas surrounding the southern Okinawa Island), a collection of seamless land-sea geological information (costal area of the eastern Boso Peninsula) and a geological map of volcanoes (Hachijojima island). In response to the Hokkaido Eastern Iburi Earthquake in September 2018, AIST vigorously collected information and promptly disclosed the information on the website, etc. The institute also developed the world's first AI-based system to assess a huge amount of diverse particles contained in sediments composing strata and to automatically isolate microfossils that have a very fragile and complex form (Figure 2-4-16). The system can carry out automatically and at a high speed assessment and isolation of microfossils, activities which have been conducted by microfossil researchers spending enormous time and labor. AIST in cooperation with geological survey agencies that

are members of CCOP[1] formally disclosed CCOP Geoinformation Sharing Infrastructure to the public in September 2018. The system lists over 570 data including geological maps, earthquakes, volcanoes, geological hazards, the environment, geophysics, geochemistry, groundwater, terrestrial heat, remote sensing and topographical maps. AIST also launched international training sessions for young geological researchers of CCOP member countries to support improvement of their practical survey techniques.

■Figure 2-4-16/ System for accurate assessment and collection of microfossils using AI



Source: AIST

(3) Development of university facilities and equipment, and enhancement of information infrastructure

A. Facilities and equipment at national universities

Facilities at national universities are places for development of human resources who lead the next generation, and also foundations of knowledge that contribute to realization of Society 5.0 by serving as centers for regional revitalization and creation of innovations. Now, about 60% of the facilities of universities are older than 25 years, while aging of water feed/drainage and electrical facilities is progressing.

With this in mind, MEXT formulated the 4th Five-Year Program for Facilities at National Universities (FY2016-FY2020) (approved by the Minister of MEXT on March 29, 2016) (Hereinafter: the 4th Five-Year Program) in March 2016, based on the 5th Basic Plan to promote the systematic and prioritized improvement of university facilities (Figure 2-4-17). In addition, "the three-year emergency response plan for disaster prevention and mitigation, and for building national resilience (Cabinet Decision on December 14, 2018)" that was formulated based on the damages caused by recent disasters plans improvement of national universities' outer walls and ceilings that could fall at the time of disaster and replacement of

1 Coordinating Committee for Geoscience Programmes in East and Southeast Asia

infrastructure equipment to continue research activities and ensure safety, for example.

The 4th Five-Year Program prioritizes the following projects: 1) the improvement of infrastructure for safe and secure educational environments, 2) responding to changes such as the functional enhancement of national universities, and 3) promoting creation of sustainable campuses. For "the improvement of infrastructure for safe and secure educational environments" MEXT is promoting earthquake resistance enhancement, strengthening of disaster protection functions and replacement of aged key facilities. For "response to changes such as the functional enhancement of national universities", the ministry is promoting securing of new space necessary for functional enhancement, introduction of active learning space through strategic renovation and steady implementation of redevelopment of university hospitals. For "creation of sustainable campuses" MEXT is promoting energy-saving measures and society-leading initiatives.

The plan asks national universities to create and improve their campus master plan based on their long-term vision, and strive to implement systematic, more effective and efficient facility development based on this plan in accordance with their basic principles, academic plan and management strategy. Furthermore, strategic facility management and facility development utilizing diverse sources of finance will be further promoted. For facility management amid the advance of aging of national university facilities, the ministry has been holding the committee on lifecycle optimization toward prolongation of service life of national university facilities ("Lifecycle Council") since November 2017 in order to adequately prolong the service life of the facilities, enhance their education and research functions and strengthen their management foundation. The Lifecycle Council discussed a basic approach toward prolongation of service life of facilities while sorting out renovation/renewal records and deterioration condition of each part of facilities and collecting practical examples that are effective for prolongation of service life, and compiled a report titled "Toward prolongation of service life of national university facilities" in March 2019.

Because facilities of national universities are infrastructure that supports advanced research and quality education, they require plan-based maintenance, management and improvement. In addition to the support for the development of large research equipment by universities, MEXT through its Large-scale Academic Frontier Promotion Program has provided support for the world's most advanced research equipment developed based on the creative ideas of Japanese scientists including the "Thirty Meter Telescope (TMT) project."

■Figure 2-4-17/Examples of functional enhancement by improvement of aged facilities

Source: MEXT

B. Facilities and equipment at private universities

MEXT supports development of facilities/equipment forming the foundation of high-quality education and research activities of private universities based on their establishment principles and characteristics.

C. Enhancement of Research Information Infrastructure

The National Institute of Information and Communications Technology (NICT) has been promoting technical and social verifications of IoT and a next-generation communications network by using the NICT Comprehensive Test-bed which NICT has developed and has been operating.

The National Institute of Informatics (NII) has been operating the Science Information Network (SINET) as a platform for supporting overall scientific research and education at universities. As of the end of Fiscal 2018, more than 900 Japanese universities and research institutions were connected to SINET. Through SINET, the distribution of academic information is secured for many people at institutions of education and research. The international distribution of research information is necessary for internationally advanced research projects. To promote such information distribution, SINET is connected with academic and research networks overseas, including those in the U.S.A. and Europe.

Ministry of Agriculture, Forestry and Fisheries (MAFF) has been developing and operating MAFFIN[1] a research network that connects research institutions related to agriculture, forestry and fisheries. As of

1 Ministry of Agriculture, Forestry and Fisheries Research Network

the end of Fiscal 2018, 82 institutions are connected in MAFFIN. MAFFIN, which is linked to an institution in the Philippines, is serving as part of a network for the distribution of research information overseas.

Ministry of Environment (MOE) runs the Network of Organizations for Research on Nature Conservation (NORNAC), in which 53 research institutions currently participate. The purpose of this organization is to contribute to the promotion of policymaking for nature conservation based on scientific information. National and local governments and research organizations related to nature conservation exchange and share information through this organization. MOE also serves as the secretariat for the Asia Pacific Biodiversity Observation Network (AP-BON). That network promotes the collection and integration of observation data, including monitoring data, on biodiversity in the Asia Pacific region, towards strengthening the scientific infrastructure that is necessary for the conservation of global-scale biodiversity.

D. Creation and provision of databases

The National Diet Library provides a database (NDL Search[1]) that enables integrated search not only for the materials that are collected and held by the library but also materials, digital contents and the like provided by libraries and academic research institutes nationwide.

To help enhance the efficiency and effectiveness of R&D activities, the NII systematically collects information on science and technology necessary for the creation of innovations, organizes the information into an easy-to-use format and posts it online. For example, the NII has created and provides a database on the whereabouts of information regarding bibliographies of academic books and journals kept by university libraries nationwide and on doctoral and other scientific papers in Japan (CiNii[2]). NII jointly with the Japan Consortium for Open Access Repositories is operating a service that provides a cloud-based institutional repository environment (JAIRO Cloud[3]) for universities, etc. to preserve and disseminate their research/educational results.

The JST is offering J-GLOBAL, a public service that anyone can use easily. In this service, a database on basic information is created regarding literature, patent, researchers, and research activities in Japan and overseas, information items are correlated and provided. The JST also provides a bibliographic information service (JDream III) to support specialists. Under this service a database has been created for comprehensive Japanese-language search for bibliography, abstracts, keywords, etc. of science and technology literature in Japan and abroad, with the added value of analysis and visualization of search sets. "researchmap" is a researcher database that centrally accumulates researcher information in Japan to manage and provide information on research achievements and support universities in their development of comprehensive researcher lists. J-STAGE[4] is a system to support electronic publishing of academic journals and information distribution (a system to support electronic publishing of academic journals and information distribution. The database and the system are provided in order to ensure speedy distribution of academic journals, etc. published by various academic societies and strengthen information transmission (See 3 of this Section).

1 https://iss.ndl.go.jp
2 Citation Information by NII
3 Japan Institutional Repositories Online Cloud
4 Japan Science and Technology information Aggregator, Electronic

MAFF has been creating and providing databases on information regarding literature on agriculture, forestry and fisheries as well as on the whereabouts of literature, including the bibliographic database (Japanese Agricultural Sciences Index (JASI)) on papers published in Japanese science journals related to agriculture, forestry and fisheries. MAFF is also creating and offering databases on digitized full-text information regarding research papers published by independent administrative institutions specializing in R&D, national/public R&D institutions and universities. These cover topics related to agriculture, forestry and fisheries; and topics of ongoing research conducted at R&D institutions.

MOE is collecting, managing and providing information on natural environments and biodiversity throughout Japan by means of the Japan Integrated Biodiversity Information System (J-IBIS).

3 Promotion of open science

(1) Development in Japan

The concept of Open Science includes open access and open research data. It is rapidly spreading in the world and attracting attention as an important foundation for open innovation. In light of this trend, funds allocation organs, academic society, industry, the government and other parties involved need to accelerate its promotion in appropriate international cooperation. Also, under the Integrated Innovation Strategy, measures including repository development and formulation of policies/plans for research data management and utilization have been promoted as "development of data infrastructure for open science" with the aim of constructing a "source of knowledge".

At the Expert Panel on Open Science the Cabinet Office compiled the report "Promoting Open Science in Japan" in 2015. The report suggests the expansion of utilization of research outcomes (papers, research data, etc.) that used public research funds as the basic approach to promotion of open science in Japan. Based on the suggestion, the commission for "follow-up on promoting open science" was set up in fiscal 2015 and 2016 for follow-up of activities for open science in Japan. In FY2017 the Committee on Promotion of Open Science Based on the International Trends" was set up to study promotion of open science based on the international trends, measures for improvement of international presence and other matters. The committee compiled "Guidelines for data policy formulation by national research and development agencies" in June 2018 and is currently conducting a deliberation on guidelines for development and operation of data repositories.

MEXT at the Science Information Committee, Subdivision on Science, Council for Science and Technology, compiled "Promotion of open science information (summary of deliberation)" in February 2016. In the summary, MEXT announced a policy that research papers written using public research funds and research data as their evidence shall be made public in principle and proposed matters to be worked on by relevant organizations. Based on this, MEXT compiled the "Summary of deliberation on follow-up of the implementation status of the 5th Science and Technology Basic Plan at the Comprehensive Policy Special Committee" at the Committee in January 2017. Considering the international trends surrounding open science and the situation in Japan, the summary suggested the direction and points of attention for concrete measures with focus on promotion of data sharing/disclosure concerning competitive funds, data disclosure/non-disclosure according to the characteristics of the research field and development of infrastructure pertaining to research data storage.

(2) Efforts concerning sharing and disclosure of research outcomes that use competitive funds

Japan Science and Technology Agency formulated its basic policy on handling of research results in April 2017 with the aim of creating a research environment for promotion of open science. This policy provides open access to all research papers created based on result of a research project in principle, and formulation of a data management plan specifying handling of research data. Disclosure of evidence data is recommended, while disclosure of other research data is desired.

AMED announced a data sharing policy for genomic medicine realization projects toward overcoming diseases and mandated data sharing in research projects in principle.

JSPS presented the direction of efforts pertaining to open access and is promoting open access to papers using KAKENHI etc.

(3) Initiatives for sharing and disclosure of research outcomes

RIKEN, National Institute for Materials Science (NIMS) and National Research Institute for Earth Science and Disaster Resilience (NIED) have been working to create new value by accumulating an enormous quantity of high-quality research data in a manner easy to use in the fields of life science, nanotechnology/materials and disaster prevention: areas where Japan can use its strength, and by sharing and analyzing the data in industry, academia and governments.

NII provides a cloud-based institutional repository service (JAIRO Cloud) for research institutions and universities to preserve and disseminate their research/educational results, and also is developing a system (NII-RDC[1]) that promotes management, disclosure and search of research data for sharing by research institutions and universities on cloud by using JAIRO Cloud, etc.

To ensure speedy distribution of journals published by various academic societies and strengthen global information dissemination, the JST has been providing a shared system that supports electronic publishing of journals and information distribution (J-STAGE). The JST Bio Science Database Center is promoting the Life Science Database Integration Program. Under the program, the center is promoting open science through expansion of a joint portal site[2] for centralized reference of life-science data bases held by four ministries (MEXT, MHLW, MAFF and METI), cooperation with the Japan Agency for Medical Research and Development and other efforts.

1 National Institute of Informatics－Research Data Cloud
2 https://integbio.jp/

■Table 2-4-18/ Major projects for strengthening of foundation of knowledge (FY2018)

Ministry	Implemented by	Project
MEXT	MEXT	Subsidy for facility expenses of national universities
	MEXT, RIKEN	Development and sharing of large-scale synchrotron radiation facilities (SPring-8) and X-ray free-electron laser facility (SACLA)
	MEXT, Japan Atomic Energy Agency	Development and sharing of a high beam-intensity proton accelerator
	MEXT, National Institutes for Quantum and Radiological Science and Technology	Promotion of the next generation synchrotron radiation facilities in a public-private-community partnership
	MEXT RIKEN	Development of Innovative, High Performance Computing Infrastructure (HPCI)
		Post K Computer Development

Section 3 Strengthening Funding Reform

Research funds provided by the government are divided into basic research funds for stable and continued support for research and education by universities, etc. and competitive funds to promote excellent research and research contributing to specific purposes.

The government is advancing the reform of research funds considering the appropriate balance of the two types of funds and promoting the reform of research funds and the organizational reform of national universities in an integrated manner to strengthen the foundation of ST innovation activities.

1 Fundamental funds reform

(1) National universities

In order to ensure the vitality and persistence of our society, expectations are greatly rising regarding the role of national universities in creating knowledge as the foundation of new values and developing human resources who support the creation. It is necessary to maximize their "function to create knowledge" as an "engine for social change."

It is important for national universities, by taking greater advantage of corporatization, to boldly change their way of thinking with a view toward the new economic society, to develop new research fields including fields of fusion and human resources that are playing important roles in industry of the new age, to respond to changes in industrial structure and employment needs and solve economic and social problems facing the communities, Japan and the world. At the same time, national universities need to change themselves into organizations that can make maximum contributions to advancement in knowledge and creation of innovations. For further advancement of reform, they must make further efforts to strengthen their financial bases and functions.

In FY2018, 1.0971 trillion yen was allocated as government subsidies for national university corporations. The subsidies are basic funds to ensure their continued and stable research/education activities as centers of human resource development and academic research of Japan. The amount was the same as the previous fiscal year.

During the period of the third medium-term objectives starting from FY2016, in order to ensure fine-tuned support for universities in accordance with the direction of functional enhancement based on their strengths and unique characteristics, focused support based on evaluation is provided under the "three frameworks for focused support" of the government subsidies for national university corporations. Functional enhancement of national universities is also promoted under the framework in FY2018.

(2) National Research and Development Agency

The 5th Science and Technology Basic Plan expects National Research and Development (R&D) Agencies to play the role of core organization for STI promotion. The government subsidies for the eight National R&D Agencies under the jurisdiction of MEXT were on a declining trend for a time. Since the FY2015 budget, however, the ministry has worked to secure their budget in consideration of their important missions. As a result, 875.6 billion yen (a 0.9% increase from the previous fiscal year) was allocated in the FY2019 budget bill.

In response to the allocation of the subsidies, National R&D Agencies are expected to reform their organizations and enhance their functions to lead innovation systems. In order to support their functional enhancement so that they can develop into international centers according to their respective missions/roles and effectively fulfill their function for cooperation and bridging with relevant organizations in Japan and abroad, MEXT is implementing the "Program to Support Innovation Hub Development".

2 Reform of public funds

(1) Improvement and enhancement of the competitive fund system

The competitive fund system is a core research-fund system for the establishment of a competitive research environment and for the consistent development of, and ongoing commitment to, researchers in various creative R&D activities. Efforts have been made to reserve budgets and improve the system (427.7 billion yen for FY2018 budget, Table 2-4-19). Indirect costs, a feature of the competitive fund system, are allocated as a proportion of research funds (direct costs) to the institution of the researcher to whom competitive funds are granted. The aim of the allocation is to promote competition among research institutions and increase the quality of research.

Regarding R&D management works, including the publication of information on public invitations and acceptance of applications for competitive funds, the Cross-ministerial R&D Management System (e-Rad[1]) is used. The system improves the efficiency of applications and management pertaining to requests for research funds for both researcher/research institutions and funds allocation agencies.

In order to ensure the fair, transparent and high-quality examination and evaluation of research proposals, the government ensures diversity in the age, gender and affiliation of examiners. It also aims to eliminate stakeholders, to develop an examiner-evaluation system, to specify methods and criteria for examination and adoption and to disclose examination results.

For example, the examination of KAKENHI applications is conducted via a process of peer review by more than 7,000 examiners. JSPS selects examiners from the examiner candidate database (about 103,000 researchers as of FY2018) by taking into account the balance among research institutions and the

1 The "E" of electronic is added to Rad, and abbreviation for research and development

aggressive promotion of young and female researchers. Disclosure of examination results to the applicants has been improved in order. In addition to numerical information such as a rough ranking of all unsuccessful research applications and the average score of each evaluation element, detailed items in each evaluation element that examiners have judged as being inadequate are disclosed through the Electronic Application System for KAKENHI to give the applicants a more detailed evaluation of the results.

Concerning measures to prevent the inappropriate use of competitive funds and other public research funds, guidelines have been formulated, which include the Measures to Prevent the Inappropriate Use of Research Funds (Council for Science and Technology Policy (CSTP), August 31, 2006) and the Guidelines for Management and Audit of Public Research Funds at Research Institutions (Implementation Standards) (Revised on February 18, 2014, Decision of the Minister of Education, Culture, Sports, Science and Technology). Efforts to prevent the abuse of public research funds include the following: conducting thorough monitoring including investigation of the research institution's system for prevention, guidance and measures for improvement if necessary, and urging them to establish an adequate system for their management and auditing of public research funds.

■Table 2-4-19/List of competitive funds

Ministry	Implemented by	Program	Description	FY2018 Budget (Mill. yen)	FY2019 Budget (Mill. yen)
Cabinet Office	Secretariat, Food Safety Commission	Research Program for Risk Assessment Study on Food Safety	Conducting research to determine guidelines and standards on risk assessments through a "research-area setting type" competitive fund system, which sets out research areas and publicly invites researchers to promote scientific food safety (risk) assessments.	183	193
Subtotal (Cabinet Office):				183	193
MIC	MIC	Strategic Information and Communications R&D Promotion Programme (SCOPE)	Inviting proposals publicly about unique and novel research subjects in the field of information and communications technologies (ICT) widely from research institutions at universities, incorporated administrative agencies, companies and local governments: Research is contracted out to institutions that are selected by external experts, whereby the following are promoted: 1) the fostering of young ICT researchers, 2) regional revitalization through ICT and 3) the international certification of communications technologies	2,106	2,435
	MIC	ICT innovation (the "I-Challenge!" program)	Promoting comprehensive support in order to develop businesses by using commercialization know-how, such as that possessed by venture capitalists, and by using R&D possessed by SMEs and universities, for the practical application of R&D results in ICT fields and for the creation of new businesses	255	101
	MIC	R&D of Technologies for Resolving the Digital Divide	Enhancing communications and broadcasting services for the elderly and disabled by offering political support for R&D to benefit these groups.	50	54
	Fire and Disaster Management Agency (FDMA)	Promotion Program for Fire- and Disaster-Prevention Technologies	The program was established in FY2003 with the aim of inviting R&D that will develop and utilize innovative and practical fire prevention and disaster prevention technologies from a broad range of researchers of industry, academia and government institutions including universities, private companies, research companies and the Fire-defense Headquarters.	126	142
Subtotal (MIC):				2,537	2,732
MEXT	MEXT AMED	R&D Promotion for National Issues	Setting detailed R&D themes for the challenges faced by Japan and selecting outstanding proposals based on the potential achievement of technological targets.	23,571	23,747
	MEXT JSPS	Grants-in-Aid for Scientific Research (KAKENHI)	Targeting the rapid advancement of scientific research according to researchers' own ideas in all scientific fields from the humanities and the social sciences to the natural sciences and funding creative and pioneering research selected by peer review (decided by multiple researchers with the same or similar specialties), supporting the foundation of an affluent society through.	228,550	237,150

Ministry	Implemented by	Program	Description	FY2018 Budget (Mill. yen)	FY2019 Budget (Mill. yen)
MEXT	JST AMED	Strategic Basic Research Programs	Forming time-limited consortia beyond institutional boundaries (virtual network institutions) to promote R&D for creating new technologies useful for solving critical issues in Japan under policies determined by a top-down approach based on social and economic needs.	58,884	57,419
	JST	Future Society Creation Program	Under the program technically challenging goals (high-risk) are set toward clearly defined targets with high economic/social impact (high impact) based on social/industrial needs; R&D is implemented toward a stage where the possibility of practical use can be determined (Proof of Concept: PoC) using diverse research outcomes created under the Strategic Basic Research Programs, Grant-in-Aid for Scientific Research, etc. while prompting private investments.	5,500	6,500
	JST AMED	Industry-Academia Collaborative R&D Programs	Promoting R&D using intellectual property by specific university (researcher) and specific company and R&D using a platform that supports multiple universities (researchers) and industry to promote the practical application of research outcomes at universities through industrial-academia collaboration and create innovation.	26,502	24,634
	JST AMED	International Collaborative Research Program	Promoting international collaborative research with developing countries to address global challenges in environmental and energy fields, disaster-prevention, infectious disease control and bioresources via excellent S&T and ODA in Japan and strategically promoting collaborative research on most advanced technologies with Europe and emerging Asian countries under equal (*50/50*) partnerships based on agreements among ministries and agencies. Also promote together with African countries international joint research for measures against Neglected Tropical Diseases (NTDs) that are stifling development in Africa.	3,521	3,728
Subtotal (MEXT):				346,528	353,178
MHLW	MHLW	Health and Labour Sciences Research Grants	Improving the technological level of health and medical services, welfare, environmental health, and workplace health and safety by fostering a competitive research environment for pioneering research, other original research and solutions eagerly sought by society; promoting research on health, labor and science, in order to ensure the scientific promotion of administrative policies	4,999	5,770
	AMED	Grant Programs of AMED	Enhancing translational R&D and practical application of R&D results in medicine, plus R&D for creating research environments that ensure efficient and effective R&D in medicine.	35,874	35,500
	AMED	Grants for promoting hygiene and medical care surveys	In order to promote health and hygiene measures, promote R&D consistent from basic to practical use in the medical field, and also R&D contributing to development of an environment for smooth application of their outcomes and smooth and effective R&D in the medical field.	7,349	7,766
Subtotal (MHLW):				48,222	49,036
MAFF	Bio-oriented Technology Research Advancement Institution, NARO	Program to promote R&D for innovation creation	In order to create innovation in the field of agriculture, forestry, fisheries and food, implement research based on proposal invitation with focus on R&D that combine diverse knowledge and technologies in various fields. Under this program, seamless support is provided for each stage of R&D, as "basic research stage" for basic R&D, "applied research stage" for application R&D and "development research stage" for practical application R&D, and research topic proposals are publicly invited.	4,132	4,080
Subtotal (MAFF):				4,132	4,080
METI	METI	Project for Strategic Promotion of Advanced Basic Technologies and Collaboration	Supporting R&D and prototyping leading to the improvement of 12 Specific Core Manufacturing Technologies, including design development, precision work and 3D modeling pursuant to the Basic Act for Buildup of Fundamental Monozukuri Technologies to advance fundamental monozukuri technologies of SMEs	10,532	10,904
Subtotal (METI):				10,532	10,904

Ministry	Implemented by	Program	Description	FY2018 Budget (Mill. yen)	FY2019 Budget (Mill. yen)
MLIT	MLIT	Construction Technology Research and Development Subsidy Program	Granting funds for R&D of technologies helping refine and enhance the international competitiveness of construction technologies under MLIT's jurisdiction to promote technological innovation in the construction field.	190	142
	MLIT	Program to Promote the Technological Development of Transportation	Research institutions are invited, through open invitation, to propose research topics contributing to solution of policy issues of MLIT. Prospective topics are selected from these proposals, and the chosen institutions are commissioned to conduct the research related to transport.	102	131
Subtotal (MLIT):				292	273
Ministry of the Environment (MOE)	MOE Environmental Restoration and Conservation Agency. (ERCA)	Environment Research and Technology Development Fund	Promoting scientific knowledge accumulation and technological development essential for implementing environmental policies to realize a sustainable society by preventing global warming, forming a recycling society, coexisting with the natural environment and managing environmental risk	5,107	5,836
	Nuclear Regulatory Agency	Grants for strategic promotion of research on regulation for radiation safety	The grants are aimed at promotion of research leading to solutions of technical problems identified by NRC, the Radiation Council, etc. while strengthening the research infrastructure of radiation protection through research activities. Outcomes obtained through the program will be used for incorporation of the latest findings into domestic systems as well as improvement of regulations. The aim is that these activities coordinate research and administrative policies to ensure the newest and best safety through continuous, efficient and effective radiation source regulation and radiation protection.	344	316
Subtotal (MOE):				5,451	6,152
Ministry of Defense (MOD)	Acquisition, Technology & Logistics Agency	Innovative Science & Technology Initiative for Security	System to publicly seek and commission basic research on advanced civil technologies that are expected to contribute to future R&D in the field of national defense. The amount is on a contract basis (the total of the fiscal year's expenditure and the amounts to be newly borne in the following year and after)	9,820	10,002
Subtotal (MOD):				9,820	10,002
Total				427,697	436,550

Note: Subtotals and totals may not match due to rounding.
Source: Adapted by MEXT based on data provided by the Cabinet Office

(2) Reform of competitive research funds for supporting the continuous production of research results

MEXT is advancing improvement of the competitive research fund system. For example, based on the interim report "Reform of competitive research funds for supporting the continuous production of research results (interim summary)" submitted by the Investigative Commission on Reform of Competitive Research Funds on June 24, 2015, MEXT decided to allocate indirect costs equivalent to 30% of the direct costs to each research project that is newly qualified to receive competitive research funds in FY2016 and after. Government ministries are investigating reforms for research funds other than competitive funds in view of the progress of university reform. The reform of research funds under consideration includes the addition of indirect costs to research funds and the improvement of the usability of research funds.

3 Integrated promotion of the national university reform and the research funds reform

In order to construct the foundation for Japan to become "the world's most innovation-friendly country" MEXT has been integrally promoting university reform and research funds reform. Specifically, indirect

costs equivalent to 30% of the direct costs have been allocated for competitive funds[1] of MEXT. The same measure has also been applied to competitive research funds[2] for research projects that are newly qualified to receive competitive research funds in FY2016 and after.

Indirect costs of other ministries/agencies are under review by "the liaison meeting of related offices and ministries on research funds" set up at the Cabinet Office. Currently the meeting is sorting projects to be covered. MEXT also conducted analysis about the needs for appropriate allocation of indirect costs, etc. and explained the results at the meeting.

MEXT is also conducting review toward flexible direct cost expenditure to enable paying of labor costs to the principal investigator on the premise of reform of the human resource and payroll management at national universities. Through these efforts, MEXT will work for the continuing creation of research outcomes using competitive research funds, while at the same time encouraging strengthening of the university governance and management that are key to university reform.

1 Resource allocation bodies broadly solicit R&D issues, adopt issues to implement based on evaluation by multiple evaluators including experts with a focus on scientific and technical aspects, and allocate R&D funds to researchers, etc. Practically, the term refers to the system registered with the Cabinet Office by individual ministries based on this definition.

2 Competitive funding pertaining to "research" and obtained by research institutions through public solicitation