Chapter 4 Reinforcing the "Fundamentals" 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.

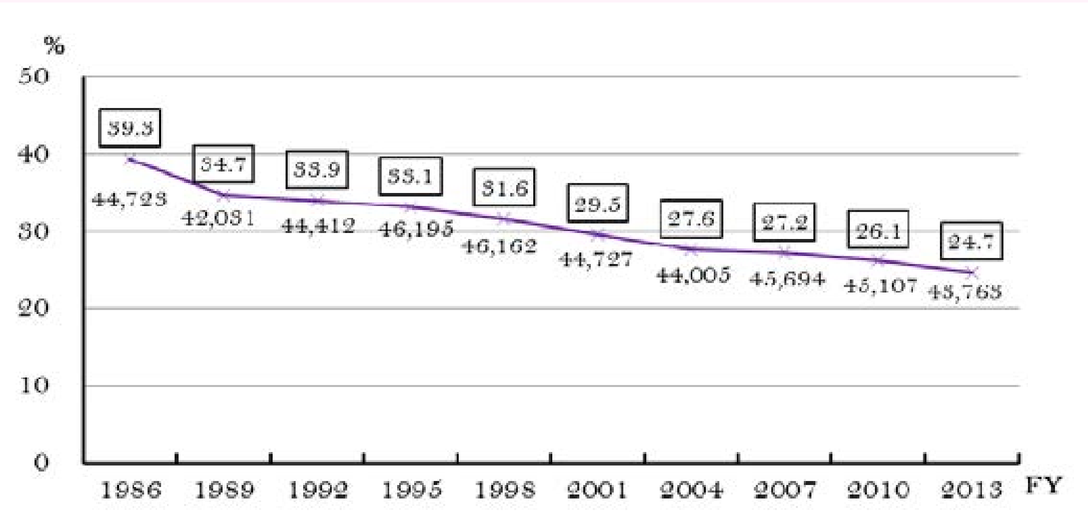
1 Developing, securing and improving career prospects of human resources as intellectual professionals

(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 (Figure 2-4-1).

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



Source: MEXT

①Realization 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 in research institutions of industry, academia and government across Japan. In FY2016 at least 119 young researchers (as of April 2017) 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. As of FY 2016 this program is supporting 50 organizations.

In order to expand employment of excellent young researchers by national universities, support using the subsidy for stepping up of the reform of national universities (specified support) started in FY2014. As of FY2016, 54 organizations have been supported by the program.

Futhermore, 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 2015, 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.

②Diversification of career options

For promotion of science and technology innovation, it is important that postdoctoral fellows not only work as researchers in universities, etc. but that they also actively participate in various activities of society, so that they can clearly see their career paths.

The Council for Science and Technology (CST)'s Committee on Human Resources set up by MEXT discussed the direction of efforts in the future with focus on contact points with society that will be the"activity area" of postdoctoral fellows, while keeping in mind trends of doctoral courses that are their "training place". Based on the discussions the committee compiled "Encouraging Doctorate Holders to Play an Active Role in a Variety of Sectors."

To increase career options for postdocs, the ministry implemented the Career Development Program for Postdoctoral Fellow to support universities that offer internship programs of three months or longer to postdocs. As of FY 2016, 8 organizations are being supported.

Furthermore, the "Building of Consortia for the Development of Human Resources in Science and Technology" has been implemented to secure stable employment for young researchers while increasing their mobility to help their career development, and also to support universities, etc. constructing a mechanism to diversify their career paths. The support has been provided to 10 organizations as of FY2016.

Under a program provided by the Japan Science and Technology Agency (JST) for supporting the use of career information, the Japan Research Career Information Network Portal site (JREC-IN Portal) is operated, through industry-university-government cooperation, to provide useful information for career development and to support the efficient use of such information.

③Improvement of research environment

Under the Grants-in-Aid for Scientific Research (KAKENHI), Grants-in-Aid for Young Scientists (A & B) are provided to support independent research arising from the original ideas of young researchers, who are potential future leaders.

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

①Efforts for development of management personnel 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 encouraging the development and employment of research administrators in order to improve research environments; for example to provide for more active research, strengthen R&D management at universities and increase career options for scientists/engineers.

With the aim of increasing world-class universities and also of enhancing universities' research capabilities, 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 FY2016, 22 universities and inter-university research institutes selected in FY 2013 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.

② 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, practical training in engineering is given to students shortly after they graduate from junior high school. In response to changes in the industrial structure and accelerated socioeconomic globalization, these colleges are improving their education such as to foster practical, creative engineers who can satisfy regional or industrial needs and the colleges are also developing engineers who are capable of creating innovations and 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, 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. In FY2016, 8,600 candidates passed the First-Step Examination and 3,648 candidates passed the Second-Step Examination. Data on candidates who passed the Second-Step Examination 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 (FY 2016)

Technical Discipline	No. of candidates (people)	No. of successful candidates (people)	Pass rate (%)
Mechanical Engineering	1,046	226	21.6
Marine & Ocean	11	5	45.5
Aerospace	49	12	24.5
Electrical & Electronics Engineering	1,439	206	14.3
Chemistry	130	32	24.6
Fiber & Textiles	47	15	31.9
Metals	104	36	34.6
Mining	15	4	26.7
Civil Engineering	13,648	1,786	13.1
Water Supply & Sewerage	1,500	193	12.9
Environmental Engineering	642	66	10.3

Technical Discipline	No. of candidates (people)	No. of successful candidates (people)	Pass rate (%)
Agriculture	817	125	15.3
Forest	341	106	31.1
Fisheries	142	24	16.9
Industrial Engineering	181	56	30.9
Information Engineering	517	64	12.4
Applied Science	556	74	13.3
Biotechnology & Bioengineering	50	24	48.0
Environment	551	92	16.7
Nuclear & Radiation	99	29	29.3
Engineering Management	3,147	473	15.0

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 "Knowledge Professionals" who think for themselves and act based on their sophisticated expertise and sense of ethics, create new knowledge and values based on their knowledge, work globally and lead the future. For example, the ministry is enhancing graduate school education based on the Graduate Education Reforms Leading the Future (Central Council for Education' University Division, September 15, 2015) and 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).

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

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

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 FY 2016, 62 projects have been supported.

The Japan Revitalization Strategy as revised in 2015 (Cabinet Decision in June 2015) states "establish TAKUETSUDAIGAKUIN PROGRAM (tentative) systems formed through cooperation of multiple universities, research institutions, companies, overseas organizations, etc. to enable integral education of multiple disciplines (e.g. humanities & science) and leading-edge education in the fields where Japan is strong." Based on the strategy, "Experts Meeting on TAKUETSUDAIGAKUIN PROGRAM (tentative)" consisting of industry, academia and government members compiled "basic approach to the TAKUETSUDAIGAKUIN PROGRAM (tentative) plan" in April 2016. The plan shows the basic direction of the selection of the fields forming a TAKUETSUDAIGAKUIN PROGRAM and the system for collaboration of multiple organizations. Toward its full-fledged implementation in FY2018, universities will conduct studies for realization of the plan. MEXT will accelerate the study through the "commissioned project to promote the TAKUETSUDAIGAKUIN PROGRAM (tentative)" for study on policies of public invitations, examinations, etc. in FY2017.

The Japan Student Services Organization (JASSO) provides scholarship loan programs to financially support to 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.

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 Special Fellowship (DC) Program under which fellowships are granted to doctoral students.

At the request of MEXT, the Science Council of Japan (SCJ) started deliberating the quality assurance of university education in each academic field in October 2014 and issued a response stating the concept of providing a Guideline for Curriculum Formation that focuses on the basic education given to all graduates and announced the reference standard for 25 academic fields by FY 2016. SCJ will continue to explore other fields.

(4) Development for the next generation of STI professionals

In addition, MEXT has deployed assistants for science observations and experiments in order to further improve observations and experiments in science education while reducing the burden on teachers involved in preparing science experiments. Improving facilities and equipment for scientific observations and experiments at schools has also been implemented, pursuant to the Science Education Promotion Act (Act No. 186, 1953). In these ways, the ministry provides comprehensive support for the enhancement of science and mathematics education.

MEXT designates high schools that provide advanced science and mathematics education as Super Science High Schools (SSH), to which support is provided through the JST. This initiative aims to help students develop scientific abilities and thinking and thereby develop human resources for science and technology who will play important roles globally in the future. Specifically, efforts are made to promote the development and use of curricula that are not based on the National Curriculum Standards, to promote project studies, to foster human resources for science and technology in the future and to share the results of these efforts among multiple schools. In FY 2016, 200 high schools throughout the country provide such advanced and specialized education.

The JST is promoting the following programs: 1) the Future Scientist Program, a systematic education program for talented, motivated children and students, which supports universities in implementing issue-specific research, and 2) the Program for Promoting the Science Club Activities of Junior/Senior High-Schoolers, which helps students to identify issues by themselves and to conduct activities constantly and independently while applying scientific methods. This is done in collaboration with schools, boards of education and universities

Furthermore, universities that develop and provide educational programs for motivated and capable students are supported as Global Science Campuses (GSCs) to develop international human resources for science and technology in the future.

In addition, MEXT sponsored the 6th Science Intercollegiate (March 4 and 5, 2017) in Tsukuba city, Ibaraki prefecture, 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 241 applications, 180 who had passed a documentary examination were presented (Figure2-4-3).

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 FY 2016, the 6th Japan High School Science Championship was held from March 17 to 20, 2017 in Ibaraki 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 Gifu Prefecture team won first place (Figure 2-4-5). The 4th Japan Junior High School Science Championship was held on December 2 to 4 2016 in Koto Ward, Tokyo. Gunma Prefecture team won first place in this nationwide competition of schools and teams (Figure 2-4-6).

MEXT established and held the Science Olympiads Promotion Council to grasp the current efforts and direction of various organizations implementing Science Olympiads as well as to exchange opinions with experts of relevant organizations on how to develop next generation human resources playing active roles in S & T innovation and nurture their capabilities.

MEXT, the Japan Patent Office (JPO), the Japan Patent Attorneys Association, and the National Center for Industrial Property Information and Training (INPIT) jointly host patent contests and patent design contests 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. Director-General, Science and Technology Policy Bureau Award is given to the schools of the participating students, which made active efforts for the contest to enhance the Intellectual Property Mind of students or deepen their understanding of the IP system.

■ Figure 2-4-3 / The 6th Science Intercollegiate opening ceremony

Source: MEXT

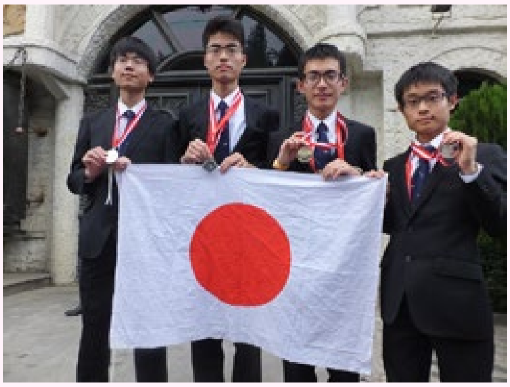
■ Figure 2-4-4 / Participants in the International Student Contests in Science and Technology (FY 2016)

International Mathematical Olympiad (Hong Kong) Participants

From left of the front row
Ko AOKI, 3rd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
Yuta TAKAYA, 2nd grade, Kaisei High School (gold medalist)
Hiroshi HASE, MEXT Minister (at the time)
Yasui MATSUSHIMA, 2nd grade, Musashi Senior High School (silver medalist)
Rikimaru KURATA, 3rd grade, Nada Senior High School (silver medalist)
Sogo MURAKAMI, 3rd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
Takuya INOUE, 3rd grade, Kaisei High School (bronze medalist)

By courtesy of the Mathematical Olympiad Foundation of Japan

International Chemistry Olympiad (Georgia) Participants



From left
Shota HIRA, 2nd grade, Nada Senior High School (silver medalist)
Takayoshi AKIYAMA, 3nd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
Keiya SAKABE, 2nd grade, Kaiyo Academy (gold medalist)
Yuki AMABE, 2nd Nada Senior High School (silver medalist)

By courtesy of Dream Chemistry 21 Committee/The Chemical Society of Japan

Chapter 4

International Biology Olympiad (Vietnam) Participants

From left

Taro TOYAMA, 2nd grade, Miyazaki Nishi Senior High School (gold medalist)

Yurika MURAKAMI, 3rd grade, Oin High School (silver medalist)

Yuichiro NAKAGIRI, 2nd grade, Ritsumeikan Keisho Senior High School (silver medalist)

Uzuki HORO, 1st grade, Nada Senior High School (silver medalist)

By courtesy of the International Biology Olympiad Japan Committee

International Physics Olympiad (Swiss and Liechtenstein) Participants

From left

Yuki TAKAHA, 3rd grade, Rakusei Senior High School (bronze medalist)

Kota FUKUZAWA, 3rd grade, Senior High School at Komaba, University of Tsukuba (gold medalist)

Satoshi YOSHIDA, 3rd grade, Osaka Seiko Gakuin Senior High school(gold medalist)

Kosuke YOSHIMI, 1st grade, Nada Senior High School (silver medalist)

Akihiro WATANABE, 2nd grade, Todaiji Gakuen Senior High School (gold medalist)

By courtesy of the International Physics Olympiad Japan Committee

International Olympiad in informatics (Russia) Participants

From left

Riku KAWASAKI, 2nd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)

Takahiro MASUDA, 3rd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)

Yuta TAKAYA, 2nd grade, Kaisei High School (gold medalist)

Takuya INOUE, 3rd grade, Kaisei High School (gold medalist)

By courtesy of the International Olympiad in Informatics Japan Committee

International Earth Science Olympiad (Japan) Participants

From left

Kyohei KASAMI, 3rd grade, Hiroshima Gakuin Senior High School (gold medalist)

Yuki KANBARA, 3rd grade, Osaka Prefectural Kitano High School (silver medalist)

Keiya SAKABE, 5th grade, Kaiyo Academy (gold medalist)

Sotaro HIROKI, 3rd grade, Kaijo Senior High School (gold medalist)

By courtesy of the International Earth Science Olympiad Japan Committee

International Geography Olympiad (Beijing) Participants

From left
Keisuke MATSUFUJI, 3rd grade, Fukuoka Prefectural Shuyukan Senior High School (silver medalist)
Kei AOKI, 3rd grade, Senior High School at Komaba, University of Tsukuba
Keisuke OTSURU, 3rd grade, Shibuya Makuhari Senior High School (silver medalist)
Go SATO, 3rd grade, Senior High School at Komaba, University of Tsukuba (silver medalist)

By courtesy of the International Geography Olympiad Japan Committee

Source: MEXT

■ Figure 2-4-5 / The 6th Japan High School Science Championship

Winning team: Gifu Prefectural Gifu Senior High School team
From left in the front row
Kazuha TAKAI (2nd grade)
Shunnosuke BAN (2nd grade)
Seiko KIRIHARA (2nd grade)
Hiroyuki SEKO (2nd grade)
From left in the back row
Naoki NISHIMURA (2nd grade)
Masahiro TOYODA (2nd grade)
Keitaro SAKAMOTO (2nd grade)
Yu TAKASHIMA (2nd grade)

By courtesy of the Japan Science and Technology Agency

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

Winning team: Gunma Prefectural team
From left
Hiyu AKAIKE, 2nd grade, Maebashi Daisan Junior High School
Sohei USUI, 2nd grade, Maebashi Daisan Junior High School
Rio MACHIYAMA, 2nd grade, Maebashi Daisan Junior High School
Hiroyuki SUGA, 2nd grade, Isesaki Municipal Yotsuba Gakuen Secondary School
Kazuki TAJIRI, 2nd grade, Isesaki Municipal Yotsuba Gakuen Secondary School
Itaru Nanba, 2nd grade, Isesaki Municipal Yotsuba Gakuen Secondary School

By courtesy of the Japan Science and Technology Agency

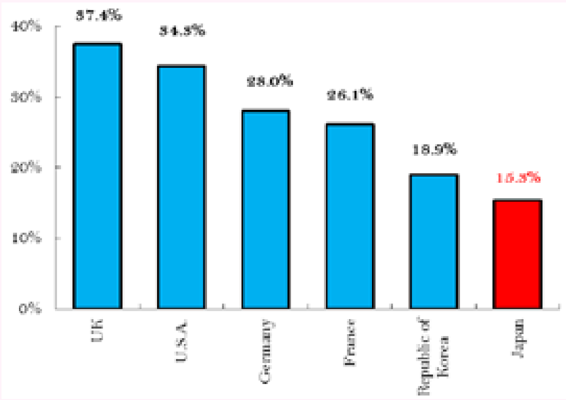
* Note: The grades are as of when the award was won.

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 Basic Plan aims to promptly achieve the numerical targets of the proportion of female researchers among new hires listed in the 4th 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. In Japan, by promoting employment and increasing the roles of female researchers, the share of female researchers has been increasing every year. However, woman still accounted for only 15% of researchers as of March 2016, 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 2013 for the U.S.A. and Germany, 2014 for the UK and France, 2015 for the Republic of Korea and 2016 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: The choice by female junior and senior high-school and university students to major in science[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 2016: Encounter Science/Engineering Jobs in universities and businesses from July to August 2016. Under this program, female students in lower/upper secondary schools are given opportunities to participate in a variety of events including science/engineering workplace visits, work experience and facility tours.

MEXT has implemented the Initiative for Realizing Diversity in the Research Environment, under which universities set targets and plans for such diversity through promotion of participation by female researchers. The initiative includes integrated promotion of leader training through support for researchers to allow them to balance their research with maternity, childcare and nursing care and support for female researchers in improving their research capabilities. MEXT is supporting 67 universities as of FY 2016.

The JST has implemented the "project to encourage female students of lower/upper secondary schools to follow scientific career paths." Under this program, female students in lower/upper secondary schools are given opportunities to communicate with female science and technology researchers, engineers and university students, as well as to take part in experimental classes and school visit programs.

The JSPS has implemented the Restart Postdoctoral Fellowship (RPD) Program to provide research

1 http://www.gender.go.jp/c-challenge/

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) implemented 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.

The National Institute of Advanced Industrial Science and Technology (AIST) organized the Diversity Support Office (DSO), a consortium of 18 universities and research institutions nationwide. The DSO promotes information-sharing and exchanges of opinions on diversity promotion among member institutions. DSO is also promoting the action plan based on the Act on Promotion of Women's Participation and Advancement in the Workplace in cooperation with universities and companies by further expanding the network and promoting information-sharing and exchanges of opinions on gender equality among member institutions, towards achieving work-life balance, career development and a raised awareness of research careers.

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 Finance (MOF) appointed three WINDS ambassadors. They have actively participated in various conferences and events for promotion of women’s success in STEM fields.

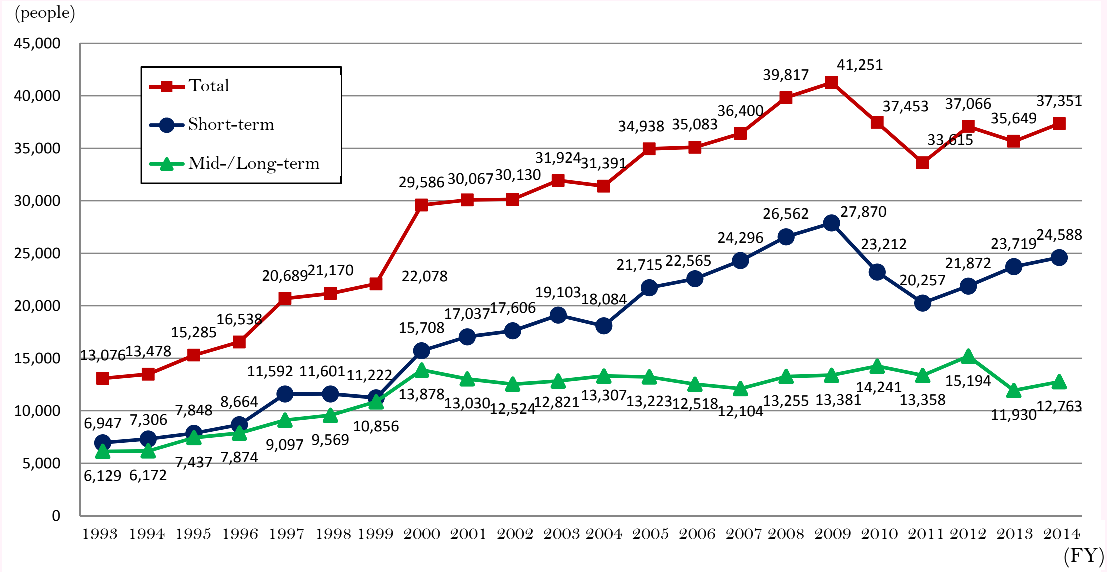
(2) Enhancing the international research network structure

①The development of international networks of researchers

(i) International mobility of Japanese researchers

According to the Survey on International Research Exchanges in FY 2016, the total number of short-stay foreign researchers accepted by universities and independent administrative institutions in Japan showed a tendency to grow until FY 2009, while the number decreased in FY 2011 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 FY 2000 (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 FY 2008 (Figure 2-4-9).

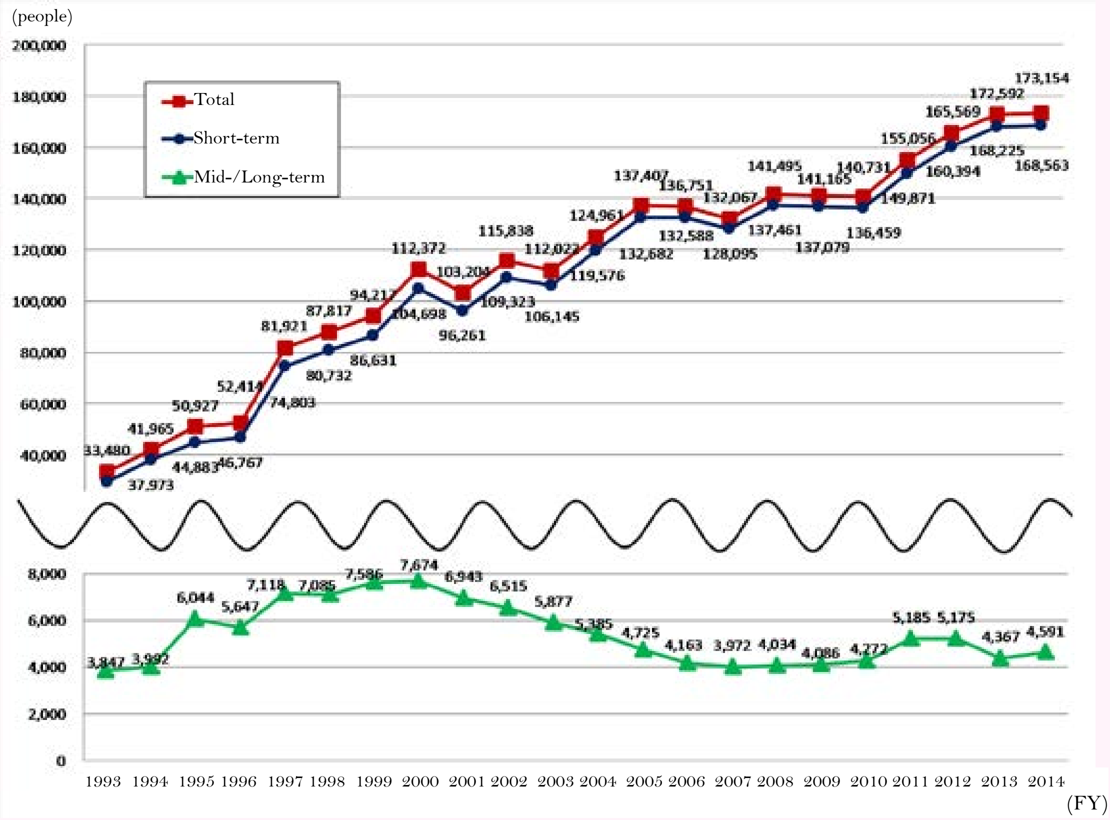
■ Figure 2-4-8 / Changes in the number of foreign researchers in Japan (Short or mid-length to long stay)



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 FY 2013 survey.

Source: Survey on International Research Exchanges, MEXT, March, 2017

■ 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: Survey on International Research Exchanges, MEXT, March, 2017

(ii) 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. JSPS has also established the Fund for the Promotion of Joint International Research in KAKENHI grant programsto provide grants for international joint research conducted by the selected researchers at an overseas research institution for a certain period of time.

In particular, the Program for Advancing Strategic International Networks to Accelerated the Circulation of Talented Researchers is a JSPS program to support universities and other research institutions that exchange young researchers with leading overseas research institutions and enable domestic research groups with high potential to strategically formulate research networks in their specialties. JSPS also offers the Postdoctoral Fellowship for Research Abroad. 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.

Invitation programs such as the JSPS Postdoctoral Fellowships for Research in Japan are provided to give outstanding foreign researchers opportunities to work at universities in Japan according to their various career stages and purposes. In addition, Bilateral Programs supports 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 FY 2014 to invite excellent youths (high school, undergraduate and graduate students and researchers aged under 40) from 35 Asia-Pacific countries and regions for a short-term visit (one to three weeks) to acquire outstanding foreign human resources.

② International research grant programs

The Human Frontier Science Program (HFSP) is an international research grant program first advocated by Japan at the summit at Venice in June 1987. This program aims at supporting international joint basic research on the complex mechanisms of living organisms. The HFSP is now operated by 15 parties (Japan, the U.S.A., France, Germany, the EU, the UK, Switzerland, Canada, Italy, Australia, the Republic of Korea, New Zealand, India, Norway and Singapore). Japan has been actively supporting the program since its establishment. This program provides grants for research expenses of international joint research teams, supports young researchers by covering the cost of overseas research travel and stays, and holds HFSP awardees' meetings.

(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, teachers work full time at multiple organizations while ensuring the necessary engagement ratio. The ministries published the "Basic Framework and Notes on Cross-Appointment System" compiling notes and recommended examples in December 2014 and has 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.

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

①Reform 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 FY 2016, around 27,000 research applications were newly selected by peer review screening (assessment of the research proposal by several reviewers whose specialization is close to that of the applicant) from over 100,000 applications in major research categories. About 75,000 projects, including those continuing for the past fiscal years, were funded. (The KAKENHI budget for FY 2016 is 227.3 billion yen, and in FY 2016, 234.3 billion yen was disbursed as grants-in-aid.)

The KAKENHI system has been reviewed continuously for improvements and fundamental reforms, such as its introduction of a foundation in FY 2015 for promoting high-quality scientific research and generating excellent knowledge.

In September 2015 MEXT formulated the Policy for Implementing Reforms in the KAKENHI System to show basic concept and road map of the reform, and has been promoting the following in an systematic and comprehensive manner: 1) a review of the screening system, 2) a review of research categories and frameworks, and 3) the promotion of the flexible and appropriate use of research funds. The content of the policy is reflected in the 5th Basic Plan with the quantitative goal of a new adoption rate at 30% included in the plan.

For 1), Subdivision on Science, Council for Science and Technology, MEXT, compiled "About Reform of the Review System for Grants-in-Aid for Scientific Research-KAKENHI" in January 2017. Based on this, about 400 examination categories will be reorganized into a smaller number of groups and new examination methods including "comprehensive examination" with more stress on multifaceted consultation will be introduced in earnest starting from 2018.

For 2), Subdivision on Grants-in-Aid for Research of the Subdivision compiled "On the Strengthening of Support for Challenging Research through KAKENHI" in December 2016. Proposals made by the document include: creation of the category "Challenging Research" to support research aimed at changing of the academic system; formulation of "KAKENHI Young Support Plan" to encourage challenging attempts by young researchers, and; limitation to multiple receipts in the largest category, "Specially Promoted Research", by the same researcher. In response, the new examination system mentioned above has been implemented ahead of others for examination of applications for "Challenging Research" for which grant will be provided from FY2017.

Based on these proposals of CST and the 5th Basic Plan the Enforcement Policy of KAKENHI Reform was revised in January 2017. Under the new policy, we will reform and strengthen KAKENHI while responding to modern academic demands and trends surrounding innovation.

② Promotion of shared use and joint research at universities and inter-university research institutes

MEXT has been promoting a Joint Usage/Research system in which researchers share facilities and equipment, as well as valuable documents and data, at inter-university research institutes and collaborative research centers[1] of national and private universities. This allows researchers to conduct their research beyond organizational boundaries.

In particular, regarding large-scale scientific research projects, in which many researchers from home and abroad participate, MEXT launched the Promoting Large Scientific Frontier Projects to support such projects by funding the installation and operation of large research facilities for outcomes that may lead global scientific research, by formulating a research center that attracts outstanding domestic and foreign research and by fostering young researchers in an international environment.

In FY 2016, 10 projects (Figure 2-4-10) were promoted from which world-leading research results are expected. For example, results from the B-factory high-energy accelerator and the Super-Kamiokande neutrino detector directly contributed to research by three winners of the Nobel Prize in Physics: Makoto Kobayashi, Special Professor Emeritus of the High Energy Accelerator Research Organization, and Hidetoshi Masukawa, Professor Emeritus of Kyoto University in 2008; and Takaaki Kajita, Director of the University of Tokyo's Institute for Cosmic Ray Research in 2015. The Science Information Network (SINET[2]) is making greater contribution to research/education activities in cutting-edge universities and other institutions through improvement of the research and education environment in Japan , which includes development of communications lines that can carry 100 gigabits per second of data to all areas of Japan, strengthening international communications lines, and support for cloud computing.

1 In FY 2016, the Minister of Education, Culture, Sports, Science and Technology approved 81 centers (Among them 13 centers were new). As of April 2016, 103 centers in 51 universities

2 Science Information NETwork

■Figure 2-4-10 / Large-scale projects that will be implemented under the Large-Scale Academic Frontier Promotion Project

Source: MEXT

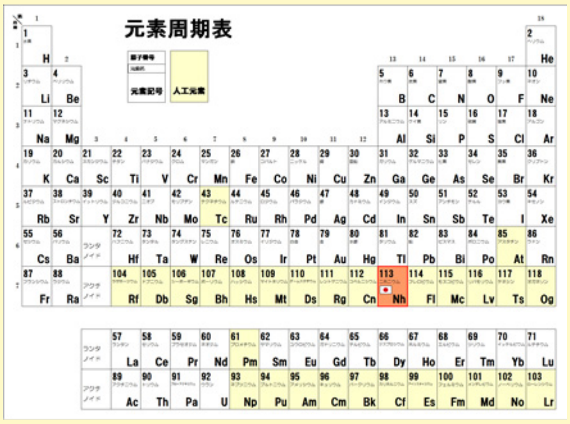
Column 2-5 The 113th element was formally named nihonium

On November 30, 2016, the International Union of Pure and Applied Chemistry (IUPAC) announced that the 113th element was named nihonium with symbol Nh as suggested by the research group led by Group Director Kosuke Morita of RIKEN.

The group succeeded in synthesizing three nihonium elements spending nearly 10 years and was given its naming right at the end December 2015. In March 2016 the group submitted its proposal for the element name and symbol to IUPAC. The union held a public review for five months from June 8.

This was the first time for a new element to be named by scientists in a country other than the United States, Russia and the European countries. This brilliant achievement demonstrated to the world that the level of Japan's basic research is very high. The element, the first discovered in Japan/Asia, will be added to the periodic table in textbooks around the world. It is hoped that this discovery will encourage many children in Japan to become more interested in science and lead to cultivation of next-genration scientists who will play active roles internationally.

Press conference on the decision on the element name, Dec.1, 2016
Group Director Kosuke MORITA (center); President MATSUMOTO of Riken (right); Director ENYO of Nishina Center for Accelerator-Based Science (left), Team Leader MORIMOTO (back)
By courtesy of RIKEN



Periodic table of elements
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 FY 2016.

(Strategic Basic Research Programs (Creating the Seeds for New Technology))

- Development of optical control technologies and elucidation of biological mechanisms
- Integration of measurement technology and advanced information processing for cutting-edge R&D

activities including materials science

- Development of new material properties and frontier of information sciences based on the advanced control of quantum states
- Creation of integration technology to enable utilizations of diverse and massive data using Artificial Intelligence core technologies rapidly growing in sophistication and complexity.

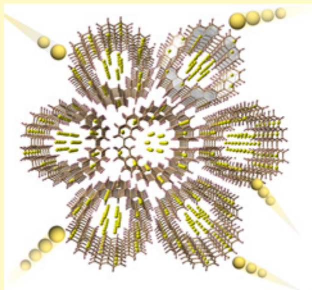
(Advanced Research and Development Programs for Medical Innovation)

- Understanding the crosstalk and symbiosis between the microbiome and host, and the applications to health and healthcare

Column 2-6 Success in increasing the capacity of lithium-ion battery using a new molecular material "holey graphene"

Lithium-ion batteries are widely used in our everyday life as energy source for mobile phones, personal computers, electric vehicles and other devices. Their capacity enlargement is essential for response to accelerated development of information society and spread of electric vehicles. For this purpose, research on basic materials of lithium-ion battery is actively conducted all over the world.

Professor Hiroyuki ISOBE (Graduate School of Science, The University of Tokyo) and others developed large-ring organic molecule "holey graphene (CNAP)" as part of JST Strategic Basic Research Programs in 2011. They discovered that CNAP can be used as negative electrode material enabling capacity enlargement of lithium-ion battery. CNAP is a molecule consisting of a ring of naphthalene that is used also for bug repellent. Battery using this solid as electrode can have an electric capacity more than two times of that using graphite electrode that is currently in practical use. It is found that the capacity is fully maintained after discharges and charges repeated 65 times. Because the battery uses solid electrolyte, it can help future development of the next generation battery "all-solid batteries" with higher energy density and increased safety compared with batteries using current liquid electrolyte. This research also shows that common molecular materials can be used for development of excellent new materials through accurate design including integrated structure, which promises application to development of molecular materials in the future.



Holey molecules (brown) hold lithium (yellow)
Source: The University of Tokyo

(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.

①International joint research with other countries

(i) International Thermonuclear Experimental Reactor (ITER)

The ITER project is managed under the international cooperation of seven parties, and Japan is promoting the production of superconductive coils, etc. (See Section 1, Chapter 3.)

(ii) International Space Station (ISS)

Japan operates the Japanese Experiment Module KIBO and the automated cargo spacecraft KONOTORI (HTV) in the ISS program.

(iii) International Ocean Discovery Program (IODP[1])

The International Ocean Discovery Program (IODP) was launched in October 2013 to replace the Integrated Ocean Drilling Program (IODP (2003 to 2013).) Drilling vessels work in groups to drill deep sea floors worldwide. These include a Japanese deep drilling vessel, CHIKYU, that features the most advanced drilling capabilities of the science drilling vessels and a U.S. drilling vessel that are acting as the principal vessels of the IODP; and Mission-Specific Platforms provided by European consortium. (See Section 4, Chapter 3.).

(iv) Large Hadron Collider (LHC)

In the Large Hadron Collider (LHC) project[2], the CERN member states, Japan and the U.S.A. collaborated to complete an accelerator in 2008, and now experiments are being performed in the energy field at the highest level in the world.

(v) International Linear Collider (ILC)

A group of international researchers is planning to construct an International Linear Collider (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 response to the proposal of the Science Council of Japan in September 2013, MEXT has been holding meetings of external experts since May 2014. The ministry compiled a summary of the discussions on its scientific significance in June of 2015, and those on policy for securing and development of human resources in July 2016. MEXT continues study of issues regarding the ILC plan by setting up a new working group on a domestic system led by researchers in this field and a management system to advance discussions.

② Efforts toward Creation of world-leading international research centers

MEXT has been promoting the World Premier International Research Center Initiative (WPI). Each research center selected for this initiative receives 1.3 -1.4 billion yen annually for 10 years. Research centers that produce outstanding results are supported for 15 years, and the research centers that were selected in FY2012 have been provided with up to 0.7 billion yen annually. As of FY 2016, nine centers are supported under this initiative (Figure 2-4-11). Under this program, the WPI Program Committee, chaired by Ryoji Noyori, the Director-General of Center for Research and Development Strategy, JST, is playing a central role in verifying the progress of research and taking annual follow-up measures strictly to meticulously ensure that these centers develop into globally visible research centers.

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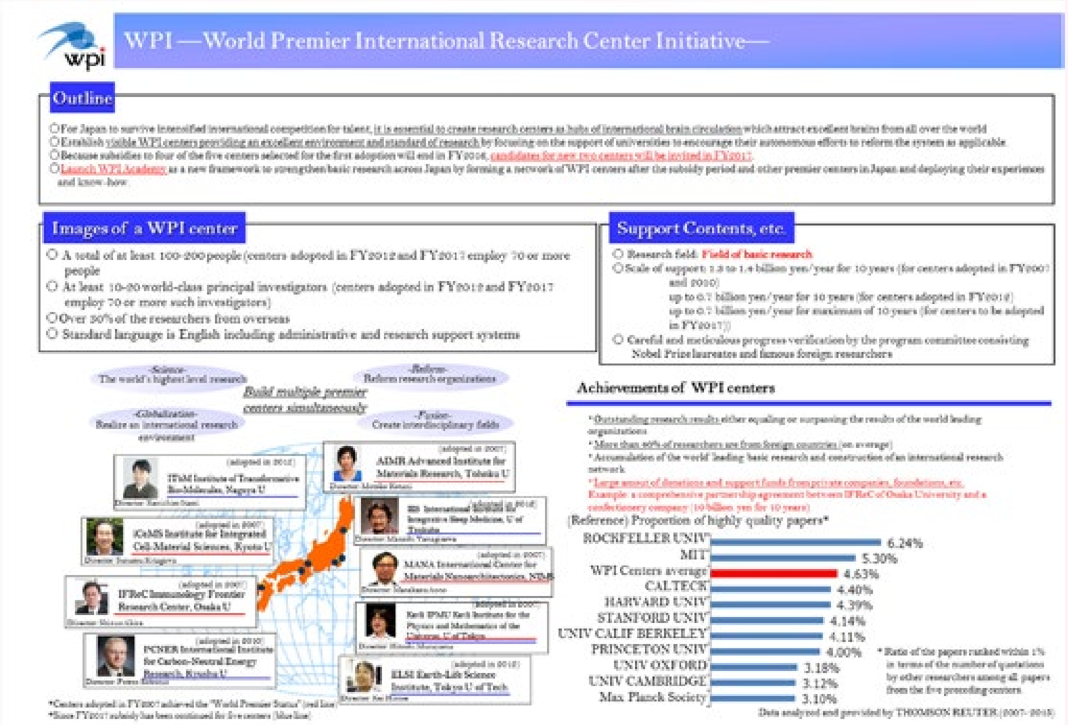
1 International Ocean Discovery Program: A multilateral cooperation project involving 25 countries (As of February 2017), led by the U.S. Japan and Europe, to elucidate global environmental changes, the earth's internal structure and crustal life zones by drilling beneath the ocean floor.

2 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.

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 by prospective world-class universities, so that the research capacity of the entire country will increase.

■Figure 2-4-11 / 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

①The development of technologies and instruments for advanced measurement and analysis

In line with the MEXT policies, the JST has been implementing the Development of Advanced Measurement and Analysis Systems program and promoting the development of the most advanced, unique instruments for measurement and analysis that serve the needs of world-leading researchers and manufacturers (Figure 2-4-12). As of March FY 2017, 53 prototypes had been developed and put into production.

■Figure2-4-12 / Examples of technologies and instruments for advanced measurement and analysis

Upper: The development of a fully automated analysis system that includes the preprocessing of samples using ultra-critical fluid technology and fast, highly accurate isolation and analysis (significant reductions in the use of organic solvents, preprocessing of unstable samples without experience or skill, and highly sensitive, fast, automated processing, isolation and detection)
Lower: Development of a mobile genetic testing device (smaller body and shorter measurement time by mounting a small fluorescence detector using micro lens and a micro fluid device)
Source: JST

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

①Promotion 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) (hereinafter: R&D Enhancement Act) stipulates that the government shall take necessary measures to promote the shared use of research facilities and equipment owned by universities and national 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.

(i) 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

a) 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. Since entering service 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.

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

b) 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. Epoch-making achievements in FY2016 include success in video filming of the moment when membrane protein is functioning, which could not be observed with conventional technologies. Usage environment has been also steadily improved by simultaneous operation of multiple beam lines, launch of the program to promote industrial use of SACLA and other efforts.

c) 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 that was officially made available for use as of the end of September 2012 is operated by the RIKEN Advanced Institute for Computational Science (in Kobe, Hyogo), in cooperation with the Research Organization for Information Science and Technology (RIST), which is a registration

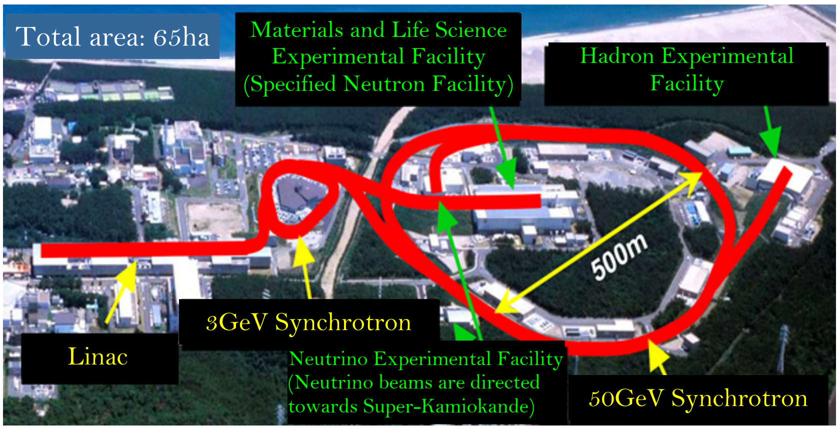
The "K computer" supercomputer
Source: RIKEN

organization supporting users of the K computer; and the HPCI[1] Consortium, which consists of organizations that represent user communities. It has underpinned breakthroughs in diverse fields, including advanced processes for novel drug development, the development of next-generation energy-saving semiconductors, manufacturing innovations, the mitigation of earthquake and tsunami damage, and the elucidation of the origin of matter and the universe.

In order to contribute to solutions of Japan's social and science challenges, MEXT has been promoting a project to develop both the world's leading computer Post-K succeeding K and at the same time applications contributing to solving problems in a coordinated manner toward commencement of operation by 2021. In FY2016 MEXT conducted trial and detailed design for the system development. In terms of applications, it worked on R&D in nine priority subjects including health and longevity, disaster prevention/mitigation, energy and manufacturing, and four emerging subjects in the field of social/economic phenomena, neural circuit of the brain, etc.

d) 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[2] 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

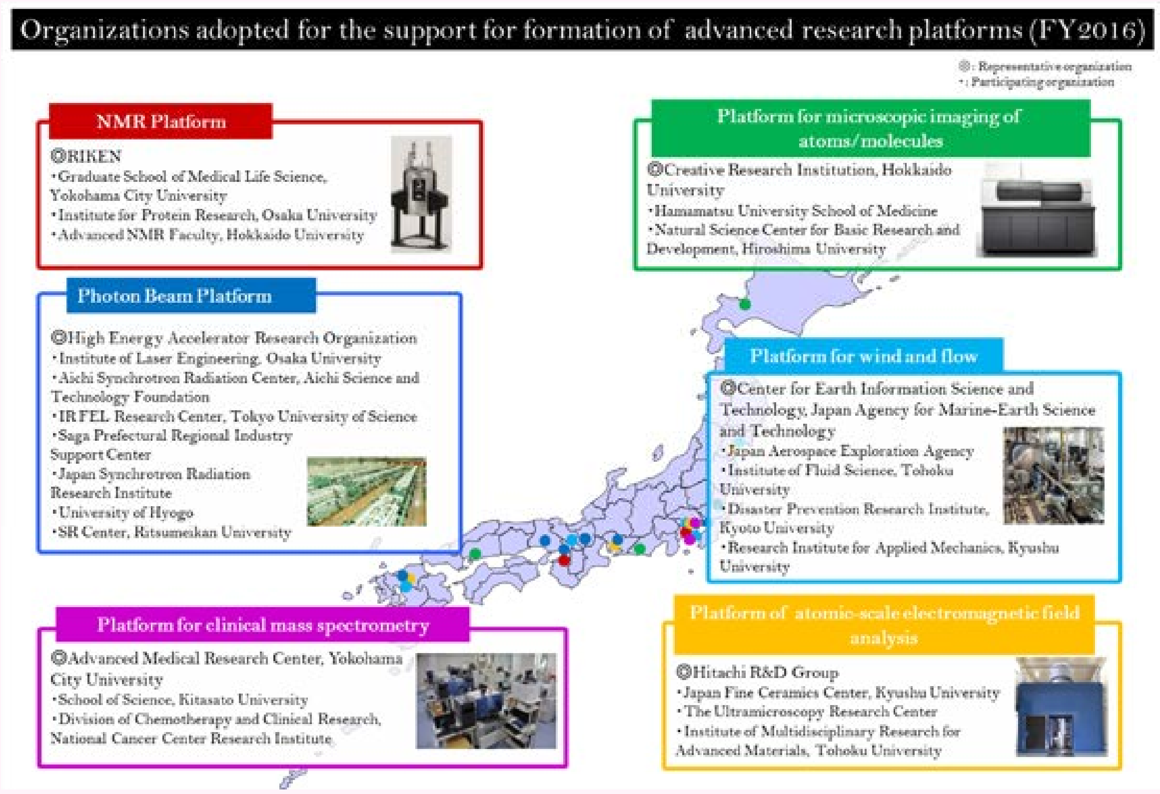
1 High Performance Computing Infrastructure
2 A neutrino is a neutrally charged, elementary subatomic particle. It is extremely difficult to detect neutrinos because they can penetrate ordinary matter without leaving any trace, and little is known about their characteristics or masses.

(ii) Constructing a network of research facilities and equipment

a) 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 2-4-13).

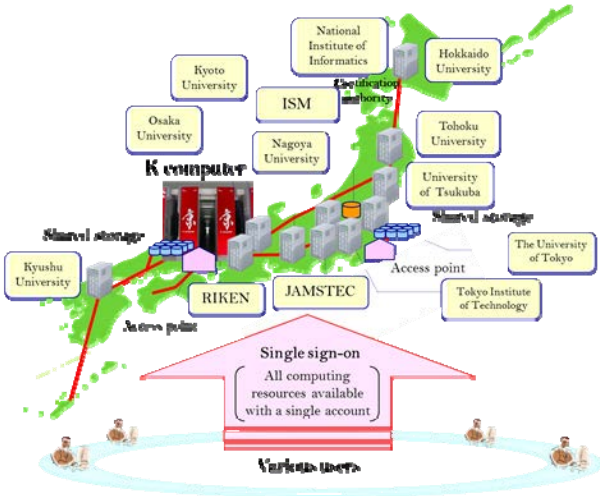
■Figure 2-4-13 / Organizations adopted for the Project for Promoting Public Utilization of Advanced Research Infrastructure (support for formation of advanced research platforms)



Source: MEXT

b) 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.



Conceptual rendering of Innovative, High Performance Computing Infrastructure (HPCI)
Source: MEXT

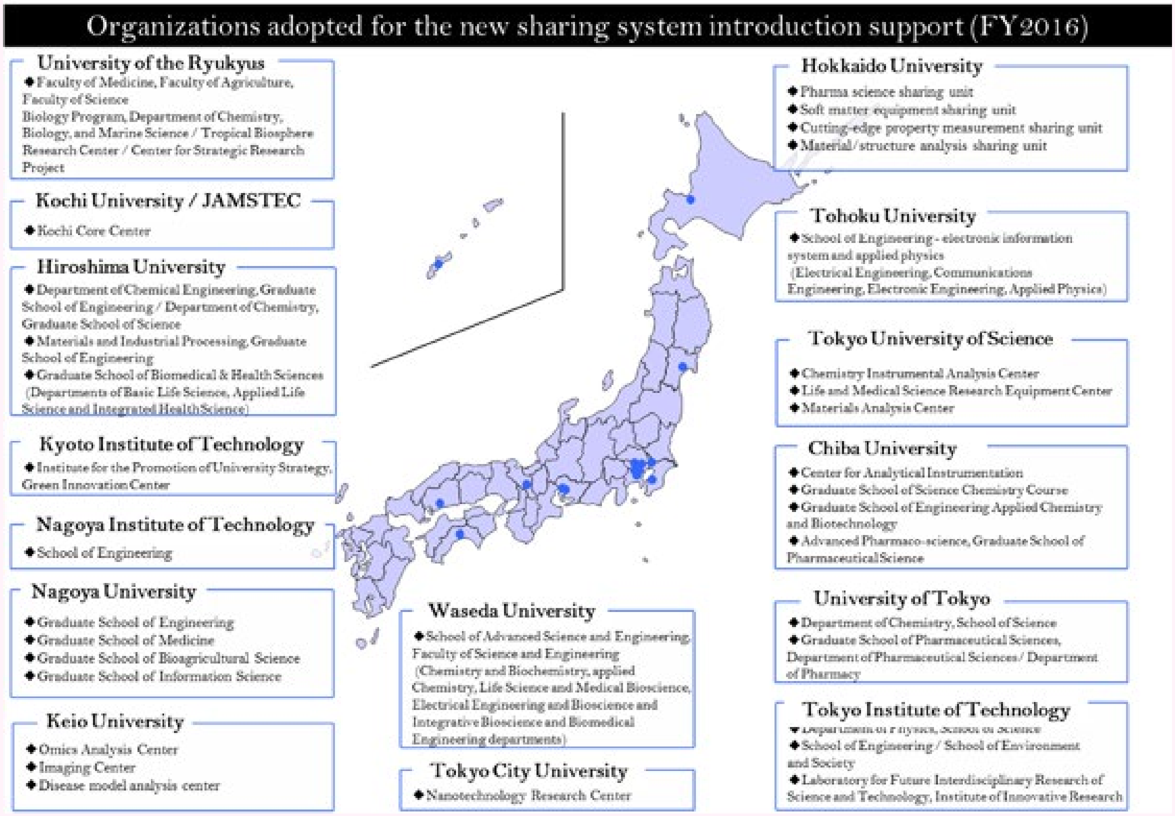
c) Nanotechnology Platform

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.

② 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 2-4-14).

■Figure 2-4-14 / Organizations adopted for the Project for Promoting Public Utilization of Advanced Research Infrastructure (support for introduction of the new sharing system)



Source: MEXT

③ 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.

In March 2017, 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.

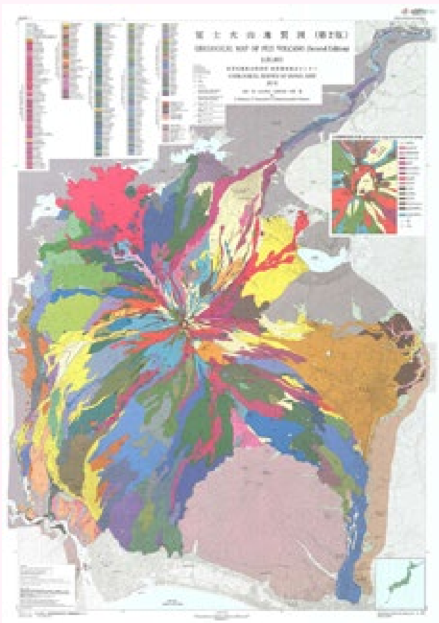
Regarding measurement standard, AIST developed physical standards for a.c. impedance evaluation devices, etc. The standards are expected to contribute to early detection of lithium-ion battery deterioration, for example. For chemical standard materials, AIST developed an organic carbon standard solution corresponding to the drinking water quality standard and transferred the technology of calibration with quantitative NMR to establish a system for requesting tests of agricultural chemicals with ensured traceability to 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. (7,739 strains of biological genetic resources had been distributed as of January 2017.) It has also constructed cooperative relationships with Asian countries by joining a network of 25 organizations from

14 countries, which aims for the preservation and sustainable use of microbial resources (the Asia Consortium, founded in 2004) and has actively supported Asian countries in their efforts to use microorganism resources through multilateral interchange programs according to the Convention on Biological Diversity (CBD). In addition to these initiatives, NITE is also supporting an exploration of microbial resources useful in industry and their transfer to Japan that is being conducted by Japanese business operators in Myanmar.

Regarding geological information, AIST produced four 1:50,000 geological maps and one 1:200,000 marine geological map, and also carried out a complete revision of the geological map of Mt. Fuji volcano for the first time in about 50 years (Figure 2-4-15). It also compiled a collection of land and sea seamless geological information "Northern coastal zone of the Suruga Bay" consisting of 14 kinds of geological information on coastal land and sea, which includes 1:200,000 geological maps and 1:50,000 geological maps focused on the Fujigawa river mouth fault zone. Furthermore, it also updated the next-generation seamless geological maps and published them tentatively. At the time of the Kumamoto Earthquake in 2016 and the earthquake in the central part of Tottori prefecture in October, AIST disclosed information on the earthquake centers on the Geomap Navi, a comprehensive portal for geological information and updated the information every day.

■Figure 2-4-15 / The geological map of Mt. Fuji volcano completely revised for the first time in about 50 years (second edition)



Source: AIST

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

①Facilities and equipment at national universities

Facilities at national universities are essential infrastructure for education and research activities, and also important facilities for creation of innovations and cooperation with industry and the communities.

Now, aging of the facilities of national universities has become a serious problem. About 60% of them are older than 25 years, while aging of water feed/drainage and gas pipes is also significant. As a result, there are many facilities with problems in their safety and functioning, which pose an obstacle to education and research activities and influence the university management.

With this in mind, MEXT formulated the 4th Five-Year Program for Facilities at National Universities (FY 2016-FY 2020) (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.

The 4th Five-Year Program prioritizes the following projects: 1) the improvement of infrastructure for safe and secure educational environments (approx. 4.75 million m^2), 2) responding to changes such as the functional enhancement of national universities through the construction of new buildings and extension (approx. 400,000 m^2) and improvement of university hospital facilities (approx. 700,000 m^2) (a total of approx. 5.85 million m^2) and 3) promoting lowering energy consumption and initiatives to serve as leading models for society towards creating sustainable campuses. In FY2016, the first year of the plan, the developed areas are expected to be approx. 300,000 m^2 combining: 1) approx. 150,000m^2 for the improvement of infrastructure for safe and secure educational environments, and 2) approx. 30,000m^2 responding to changes such as the functional enhancement of national universities through the construction of new buildings and extension and improvement of university hospital facilities (approx. 120,000 m^2). MEXT will continue systematic and focused improvement of facilities.

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. Regarding facility management, in order to achieve university visions and academic plans, MEXT started to hold expert meetings[1] in November 2013 to promote the facility management of all university facilities from a management perspective. The expert meeting published a report[2] in March 2015 targeting the administration of national universities. This report introduces the basics and detailed procedures for facility management, and examples of advanced practices. In October 2015 and March 2017, MEXT compiled a collection of examples for reference for facilities management based on the report.

It is crucial to improve facilities at national universities, as they are infrastructure that supports advanced research and quality education. Thus, MEXT financially supports these universities on the basis of a mid- to long-term master plan that each university has formulated for the systematic, continuous improvement of their equipment. Additionally, under a program for supporting the effective use of research equipment at national universities, MEXT supports the efforts of universities to promote effective and shared use of their equipment. Currently, national universities lack personnel qualified to implement the efficient and effective use of equipment and to manage aging or obsolescent equipment.

Under its Large-scale Academic Frontier Promotion Program, MEXT also provided support for the

1 Examination Committee for the Comprehensive Management of Facilities at National Universities
2 Strategies for the Management of University Facilities: Facility Management Strengthens Educational and Research Infrastructure

management of the world's most advanced research equipment developed based on the creative ideas of Japanese scientists (e.g., the Large-scale Cryogenic Gravitational Wave Telescope Project (KAGRA)).

■Figure 2-4-16 / Examples of functional enhancement by improvement of aged facilities

Source: MEXT

② 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.

③Enhancement of Research Information Infrastructure

The National Institute of Information and Communications Technology (NICT) has been promoting R&D and demonstration tests that use a next-generation communications network test-bed (JGN) 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 2016, more than 800 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 the end of March 2016, 87 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 52 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.

④Creation and provision of databases

The National Diet Library keeps a database on the publications, materials and the like. It collects and provides information on the database via its website[2].

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 been creating and providing 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). A common repository system is provided by NII to research institutions and universities to help them to develop their own institutional repository for preserving and disseminating their research/educational results. NII is operating JAIRO.

The JST is offering an information service, J-GLOBAL. In this service, a database on basic information is created regarding literature, patent, researchers, and research activities and in Japan and overseas and information is provided by linking a specific researcher, for example, to the relevant information. The JST has also been creating a database on abstracts in Japanese available online via the paid bibliographic information retrieval service (JDreamIII[3]). "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. In response to this initiative and the progress of open science, in addition to assisting in the development of open-access journals published by various academic societies, the JST has been providing a common-use system environment (J-STAGE[4]) (See 3 of this Section).

MAFF has been creating and providing databases on information regarding literature on agriculture,

1 Ministry of Agriculture, Forestry and Fisheries Research Network
2 http://iss.ndl.go.jp/
3 JST Document Retrieval system for Academic and Medical fields III
4 Japan Science and Technology information Aggregator, Electronic

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).

Column 2-7 Commemorating the 100th anniversary of the foundation of RIKEN

RIKEN is a National Research and Development Agency having a large number of bases in Japan and abroad. This is Japan's only institute for general research in natural science. With the aim of contributing to Japan's industrial development through scholarship RIKEN was established as an incorporated foundation using funds granted by the imperial family, subsidies by the government and donations by citizens in 1917. It will commemorate the 100th anniversary of foundation in 2017. Since then, while changing its form from incorporated foundation through stock company, special corporation, incorporated administrative agency to the current National Research and Development Agency, RIKEN has been committed to basic research based on freewheeling ideas of researchers in a broad area of natural science and used the outcomes for the development of industries.

In 1927 with the aim of industrialization of its R&D results, RIKEN founded Riken Kagaku Kogyo Inc. a pioneer of research institution-originated startups and made innovative efforts for industrial development. Now, the companies based on RIKEN's achievements are as many as 63 and are known as RIKEN Group. Since 1937 when RIKEN constructed the first cyclotron in Japan, it has strenuously continued research and technology development. In 2004 RIKEN succeeded in synthesizing a new element (the 113th element) first in Asia and its name "nihonium" entered the periodic table in 2016. This is a result of its continued efforts in steady basic research.

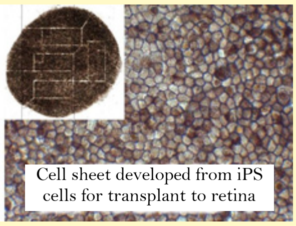
In October 2016, RIKEN was designated as Designated National Research and Development Agency to play a role to generate the world's top level R&D results forming the foundation of STI while leading the innovation system. The world's top-level R&D center maintains large synchrotron radiating facilities such as Spring-8 and SACLA, as well as the highest-level research infrastructure including Supercomputer K and collection, storage and provision of bioresources. In response to demands of the country and the times, RIKEN is advancing pioneering research in a broad range of fields including diverse life sciences such as brain study, developmental biology and aging study in addition to physics and chemistry. In April 2016, the Center for Advanced Intelligence Project opened as a R&D center of an integrated project of AI, big data, IoT and cyber security in Nihonbashi, Tokyo and started R&D of fundamental technologies of innovative AI.

RIKEN is expected to contribute to the prosperity of the country through deepening basic research and returning research outcomes to society also in the next 100 years.

Nameplate of RIKEN

Discovery of nihonium

Supercomputer K


Cell sheet developed from iPS cells for transplant to retina

Top-level research infrastructure and pioneering research of RIKEN
By courtesy of RIKENPress conference on the decision on the element name, Dec.1, 2016

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.

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 2015 for follow-up of activities for open science in Japan. The commission has met seven times and made discussions based on activity reports from relevant ministries/agencies, research institutions, etc.

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.

The Science Council of Japan compiled "Recommendations Concerning an Approach to Open Science That Will Contribute to Open Innovation" (Study Committee on Open Science, on July 6, 2016). Its proposals include development of research data infrastructure enabling management and openness of interdisciplinary research data and establishment of data strategy in the research community.

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

The JST showed its data management policy in its Strategic Basic Research Programs to store, manage and disclose data in the research area where effective generation of research outcomes is expected through active sharing and use of data.

AMEDt 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 Prevention (NIED) have been developing data platform centers to create new values by accumulating an enormous quantity of high-quality research data in a manner easy to use in the field of nanotechnology/materials, life science and disaster prevention where Japan can use its strength, and share and analyze the data in industry, academia and governments.

NII supports research institutions and universities in developing their own institutional repository for preserving and disseminating their research/educational results, and also is working for cooperation of the institutional repositories (JAIRO).

To assist in the development of open-access journals published by various academic societies, the JST has been providing a common-use system environment (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[1] 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.

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 FY2016, 1.945 trillion yen was allocated as government subsidies for national university corporations. The subsidies are basic research funds to ensure their continued and stable research/education activities. The amount was equal to that of the previous fiscal year, stopping the reduction trend since their

1 http://integbio.jp/

corporatization in 2004.

During the period of the third medium-term objectives starting from FY2016, national universities are expected to further demonstrate their strengths and unique characteristics for further acceleration of the university reform. National universities that are actively working on function enhancement are provided with supports finely tuned to the direction of the efforts. For this purpose, "three frameworks for focused support" were set up in the government subsidies for national university corporations. The subsidies are allocated strategically based on the results of evaluations.

Furthermore, for the purpose of supporting leadership and management capacity of university presidents using budgets, "expenses at the president's discretion" was established to promote review of education/research organization and resource allocation within the university.

(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 had been generally on a declining trend from FY2010 to FY2018. In the FY2017 budget, however, 468.9 billion yen (a 3.0% increase from the previous fiscal year) was allocated in consideration of their important missions. Starting from FY2017, the government subsidies are used for the budget necessary for development of data platform centers to create new values by accumulating an enormous quantity of high-quality research data in a manner easy to use in the field of nanotechnology/materials, life science and disaster prevention where Japan can use its strengths and share and analyze the data in industry, academia and governments.

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 (412 billion yen for FY 2016 budget, Table 2-4-17). Indirect costs, a feature of the competitive fund system, are allocated as a proportion of research funds (direct expenses) 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 92,000 researchers as of FY 2016) by taking into account the balance among research institutions and the aggressive promotion of young and female researchers. The disclosure of examination results has also improved every year. In addition to numerical information, such as a rough ranking of all unsuccessful research application 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.

(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 Funding (Chaired by Michinari Hamaguchi, president of the JST) on June 24, 2015, MEXT decided to allocate indirect expenses equivalent to 30% of the direct expenses to each research project that is newly qualified to receive competitive research funds in FY2916 and after. Government ministries are investigating reforms for research funding other than competitive funding in view of the progress of university reform. The reform of research funding under consideration includes the addition of indirect expenses to research funds and the improvement of the usability of research funds.

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

■Table 2-4-17 / List of competitive funds

Ministry	Implemented by	Program	Description	FY 2016 Budget (Mill. yen)	FY 2017 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.	194	177
Subtotal (Cabinet Office):				194	177
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 (ITC) 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	2,009	2,166
	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	250	291
	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.	38	39
	Fire and Disaster Management Agency (FDMA)	Promotion Program for Fire- and Disaster-Preventi on Technologies	A program established in FY 2003 to develop fire- and disaster-prevention technologies into innovative and practical technologies and to widely invite enabling research and development in industry, academia and government, including universities, private companies, research corporations and Fire-Defense Headquarters	128	126
Subtotal (MIC):				2,425	2,622
MEXT	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.	227,290	228,350
	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.	61,279	61,127
	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.	-	3,000
	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.	28,579	27,447

MEXT	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.	3,651	3,627
	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.	23,739	22,898
Subtotal (MEXT):				344,538	346,449
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	4,394	4,603
	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.	4,204	5,274
	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.	40,260	38,725
Subtotal (MHLW):				48,858	48,602
MAFF	MAFF	Promotion of research on S&T for agriculture, forestry, fisheries and the food industry	To foster innovation that promotes the growth of the agriculture, forestry, fishery and food industries, there is the need for a system that ensures the practical use, at production sites, of basic research results that are achieved by public research institutions. Such practical use is done in collaboration with private companies so that the investment benefits producers in the agriculture, forestry and fisheries industries and benefits society. This program aims to integrate domestic research capabilities and to activate exchanges of human resources by optimally exploiting Japan's high R&D capabilities in the agriculture, fishery, forestry and food industries, by enlisting the interdisciplinary research capabilities of private companies and by supporting industry-academia collaborative research to solve technological issues and improve industrial competitiveness. Under this program, seamless support is provided for each stage of R&D, as "seeds creation stage" for basic R&D, "development fusion stage" for application R&D and "practical technology development stage" for practical application R&D and research topic proposals are publicly invited.	3,203	3,070
Subtotal (MAFF):				3,203	3,070
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	10,890	10,253
Subtotal (METI):				10,890	10,253
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. There are two types of public invitation: The invitation for research proposals has two categories: the Public Invitation for Technology Development that Addresses Policy Issues (general topics; SMEs), and the Public Invitation for Technology Development that Addresses Issues Associated with Earthquake Disasters. MLIT provides grants for research on R&D themes appropriate for each category.	223	240
	MLIT	Program to Promote the Technological Development of Transportation	Research institutions are invited, through open annual invitation, to propose research topics related to policy issues of MLIT. Prospective topics are selected from these proposals, and the chosen institutions are commissioned to conduct the research under R&D projects.	155	146
Subtotal (MLIT):				378	386

Chapter 4

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	5,293	5,293
	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.	-	273
Subtotal (MOE):				5,293	5,566
Ministry of Defense (MOD)	Acquisition, Technology & Logistics Agency	Innovative Science & Technology Initiative for Security	Finding ingenious and promising research which is conducted at universities, national research institutions or private companies and may produce results applicable to defense equipment, for the purpose of commissioning these universities, national research institutions or private companies to conduct research on outstanding research topics that they propose.	520	10,780
Subtotal (MOD):				520	10,780
Total				416,299	427,905

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

3 Integrated promotion of the national university reform and the research funding 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 competitive research funds reform.

Specifically, indirect expenses equivalent to 30% of the direct expenses have been allocated for competitive funding[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 FY2916 and after.

Indirect expenses of other ministries/agencies are currently under review by "the liaison meeting of related offices and ministries on research funds" set up at the Cabinet Office. MEXT conducted analysis about the needs for appropriate allocation of indirect expenses, 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 researcher on the premise of reform of the human resource and payroll system at national universities. Through these efforts, MEXT will work for continuing creation of research outcomes using competitive research funds, while at the same time encouraging strengthening of 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