Chapter 4 Enhancement of Basic Research and Human Resources Development

Section 1 Radical Enhancement of Basic Research

Basic research has become increasingly significant and meaningful, nurturing diversity by producing technological seeds that may grow into innovations. It helps create new intellectual and cultural value in a wide variety of fields and it directly or indirectly contributes to the development of society. To solidify the foundation of Japan's science, technology and innovation (STI) it is vital for Japan to focus on and strongly advance, diverse and creative basic research, as well as world-leading basic research. In view of this, the government has been making efforts to radically enhance basic research in Japan.

1 Enhancement of Diverse and Creative Basic Research

Academic research is initiated by researcher's intellectual curiosity or an impulse to explore, and strategic and requisite basic research plays significant roles to tie academic research and the resulting large amounts of knowledge to economic, social and public values. Academic and strategic and requisite research play significant roles to help create intellectual property common to all humans and accumulate in-depth knowledge. The government strengthens to promote creative and diverse research continuously and comprehensively.

(1) Grants-in-Aid for Scientific Research

Grants-in-Aid for Scientific Research (KAKENHI) available through MEXT and the Japan Society for the Promotion of Science (JSPS) are the only competitive funds provided for all research conducted according to researchers' own ideas in all scientific fields, ranging from the humanities and the social sciences to the natural sciences. KAKENHI has been supporting diverse and creative research, helping to broaden the base of various research activities, continually advancing research, and accumulating profound knowledge. In FY 2014, around 27,000 research applications were newly selected in a peer review screening process from about 100,000 applications for major research categories and about 73,000 projects, including those continuing for several years, were supported (The budget of KAKENHI in FY 2014 is 230.5 billion yen and the grants of the aid FY 2014 is 227.6 billion yen).

KAKENHI has been reviewed continuously for the improvements of the system and fundamental reforms started for promoting high quality scientific research and creating excellent "knowledge". The Science Subcommittee of Council for Science and Technology(CST) of MEXT published the "Promotion of academic research in Japan and reform of Grants-in-Aid for Scientific Research(KAKENHI) (report of deliberation on the 7th Research Fund Commission)(interim report)" in August 2014, in which the basic directions are proposed on the reform of KAKENHI as follows: 1) reform of the fundamental structure, 2) review in light of the promotion of continuous scientific research based on original ideas, 3) review in light of the formulation of international networks and maintenance of system, 4) review of the "KAKENHI(Multi-year Fund)" and 5) increases in visibility and application of research outcomes. Based on this proposal, reforms will be started from FY 2015 and specific reform plans and schedules determined duly in the continuous deliberation by the Research Fund Commission of CST will be put into action.

(2) Strategic Basic Research Programs

The Japan Science and Technology Agency (JST) launched the Strategic Basic Research Programs to stimulate creation of new technological seeds. In these programs, decisions on national strategic objectives and study areas are made using a top-down approach. Research proposals are accepted from researchers at universities and other institution for conducting studies through the formation of time-limited consortia that span institutional boundaries (the virtual institute system). These programs have also promoted strategic basic studies leading to innovations and have also helped accelerate and advance research that is expected to produce promising results.

MEXT established the following four strategic objectives for FY 2014:

- Development of mathematical sciences to describe and analyze social issues in which basic principle is unclear
- Development of intelligent information processing technology to realize creative collaboration between human and machines
- Creation of Integrated Single Cell Analysis Fundamental Technology contribute to the elucidation of biological functions
- Development of innovative materials and devices based on atomic or molecular two-dimensional functional films, and their applications to practical uses

MEXT also reformed the method of setting strategic targets to strengthen ties to Grants-in-Aid according to the "Guidelines for setting strategic targets" as indicated in the report of the "Expert Panel on Strategic Basic Research."

Column 2-3 Development of autostereoscopic image in the air

Susumu Tachi, Special Guest Professor of Keio University Graduate School of Media Design and Professor Emeritus at the University of Tokyo and others developed a 3D display "HaptoMIRAGE," which enables multiple users to see 3D images projected in the air without eyeglasses, in a project as part of the Strategic Basic Research Program of JST. With this newly developed device, a 3D image can be superimposed on the real environment by directly projecting two images associated with the right and left eyes to the right and left eyes of the viewer. Accordingly, multiple users can see stereoscopic images while eliminating the need to wear special eyeglasses according to their positions within a large space. The lack of obstacles between users and images means this display gives users new experiences; using a seamlessly amalgamated combination of real and information spaces, such as manipulating an image in the air directly by moving hands or projecting 3D graphic sketches drawn on the computer. The outcomes of this study are expected to be applied to museum exhibits, digital signage in public space and entertainment systems such as arcade games, where interactive 3D images reflecting real physical objects can be easily operated.

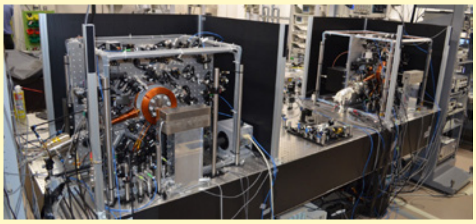
3D image projected by HaptoMIRAGE

Source: Keio University

Column 2-4 Succeeded in developing the world most precise "optical lattice clock"

Hidetoshi Katori, Professor of the Graduate School of Engineering at the University of Tokyo and others developed an optical lattice clock, with precision more than 100 times that of the cesium atomic clock, which currently defines "one second", in a project of the JST Strategic Basic Research Program. The development team demonstrated globally unrivaled clock precision, with only 0.8 second of error between two optical lattice clocks within 13.8 billion cosmic years, by operating the clock at low temperatures to reduce ambient thermal radiation, which is the main hindrance to precision.

The optical lattice clock having such a high precision will not only call for the "redefinition of one second", but also provide new applications transcending the conventional concept of the clock, such as a measuring tool to detect relative delays of time due to gravity by placing two optical lattice clocks at distant locations. It could be basic technology applicable to underground resource exploration and the detection of crustal deformation.



Two optical lattice clocks used to compare precision

Source: RIKEN

(3) Support of unique human resource development

MIC launched the "INNO vation" program ("INNO" means unusual talent in Japanese) in its "Strategic Information and Communications R&D Promotion Program (SCOPE)" to support R&D by researchers having unusual talent and challenging totally unexpected, ambitious technological themes, encompassing immense potential to produce global values, which may have destructive effects on the globally unpredictable ICT area, where new technologies and ideas emerge daily.

(4) Promotion of shared use and joint research at universities and inter-university research institutes

MEXT has been promoting research using facilities and equipment, as well as valuable documents and data, provided at inter-university research institutes and shared and collaborative research centers[1] at national and private universities; allowing 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 which may lead global scientific research, formulating a research center that attracts outstanding domestic and foreign research and fostering young researchers in an international environment.

In FY 2014, MEXT supported nine research projects[2], which challenge unprecedented themes as the

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1 Eight centers (including five new centers) were approved by the Minister of Education, Culture, Sports, Science and Technology in FY 2014. There were 95 centers at 46 universities as of April 2014.

2 "International Joint Research Network for Japanese Classics" to create interdisciplinary research using Japanese classics and the introduction of Japanese culture to the world; "Promotion of 30-meter Optical Infrared Telescope (TMT) Project" to develop new space images, including the exploration of extrasolar planets and initial celestial compositions; "Exploration of Physics beyond the Current Particle Theory with Super B-Factory" to "identify vanished antimatter and dark matter, and the origin of mass"; "Expansion of neutrino research at 'Super Kamiokande'" to clarify the neutrino; "Large-Scale Cryogenic Gravitational Wave Telescope (KAGRA) Program" for global first direct observation of gravitational waves (space-time curvature); "ALMA Project" for challenging to explore the formation of the galaxy immediately after the Big Bang and the origin of life with a giant radio telescope; "Promotion of research on material and biological sciences and nuclear/elementary particle physics using the Japan Proton Accelerator Research Complex (J-PARC)" to develop the world's most advanced research using various particle beams (e.g. meson, antiroton); "Studies on the shared

first projects in the field of humanities and social sciences to solve long-term issues such as dividing research into more detailed classifications and seeking new methodologies over and above conventional research methods. This includes the "Database of Japanese classical books" for establishing an international collaborative research network to promote interdisciplinary research, in which many researchers in history, sociology, philosophy, medicine and various other disciplines join and develop projects covering wide-ranging international collaborative projects.

2 Strengthening World-leading Basic Research

In an environment of increasing globalization of human activities in recent years, competition for securing top researchers has intensified. To further enhance basic research in Japan, support to formulate a group of universities facilitating excellent world-class research activities is required. At the same time, research environments must be favorable and attractive to world-leading researchers at home and abroad. Additionally, support is necessary to increase the number of universities that have the capacity to conduct outstanding, world-class research. Accordingly, the government has been increasing research type universities and research centers at which the world's most advanced research can be implemented.

(1) Program for promoting the enhancement of research universities

With the aim of increasing world-class universities and also of enhancing universities' research capabilities, support is 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 FY2014, 22 universities and inter-university research institutes selected in FY 2013 were supported, with funding of 200-400 million yen provided to each of them.

(2) Creation of world premier international research centers

MEXT has been promoting the World Premier International Research Center Initiative (WPI). Intensive, support is provided to research centers that are willing to establish themselves as the world's most advanced centers at which the best researchers play a leading role. By encouraging these centers to make independent efforts for system reforms, this initiative aims to create globally visible research centers that feature research conducted at world advanced levels in superb research environments and thereby attract leading researchers from around the world. Each of the research centers selected for this initiative receives 1.3 -1.4 billion yen annually for 10 years. Research centers that produce outstanding results are supported over 15 years and the research centers selected in FY2012 are provided with up to 0.7 billion yen annually. In FY2014, nine research centers are supported by this initiative (Figure 2-4-1). Under this initiative, the WPI Program Committee, chaired by Hiroo Imura, ex-president of Kyoto University, is playing a central role in verifying the progress of research at the nine research centers and taking follow-up measures strictly and meticulously annually to ensure development of these centers into globally

use of large scale optical infrared telescope 'SUBARU'" to observe the deepest part of the galaxy and explore the mystery of extrasolar planets; "Ultimate Green Innovation"; and "Demonstration of steady-state operation of ultra-high performance plasma" to clarify the principles behind atomic fusion "visible" research centers.

■ Figure 2-4-1 / World Premier International Research Center Initiative (WPI)

WPI - World Premier International Research Center Initiative -

(Background) While fierce global competitions to acquire best brain are going on, building WPI centers where researchers from all over the world eager to conduct their research and keeping Japan in the global, flexible "circle" of outstanding human resources are required to maintain and improve Japan's scientific and technological standard.

(Concept) Establish visible WPI centers providing an excellent environment and standard of research by focusing on the support of universities to encourage their autonomous efforts to reform the system as applicable.

Required Challenges

○Research operation and environment at the international standard
- English as the primary language during work
- Highly effective leadership of a center director
- Environment in which researchers can devote themselves exclusively to their research by adequate staff support etc.

○Critical mass of outstanding researchers

○Securing additional resources that match or exceed the national budget

Science / Reform / Establish World Premier Centers / Globalization / Fusion

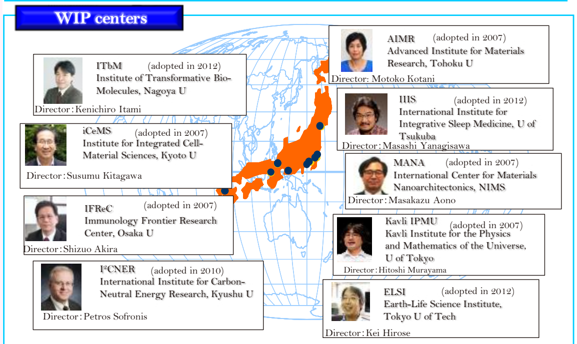
Images of a WPI center

- A total of at least 100-200 people (at least 70 in "WPI focus")
- At least 10-20 world-class principal investigators (at least 7 in "WPI focus")
- At least 30% of the researchers from overseas.

Support Contents

Research field: Field of basic research Period: 10-15 years (support from FY 2007)
Project grant (annually per year): ¥1.3-1.4 billion (up to ¥700 million in "WPI Focus")
Follow-up procedure: Close status assessment and progress control under a credible follow-up system mainly managed by the "Program Committee" comprising Nobel laureates and distinguished foreign experts

WIP centers



Promoting the successful establishment of 4 new centers

○Support and grasp the steady progress of constructing I²CNER (Kyushu Univ.) selected in FY 2010.

○ Accelerate construction of three centers in WPI focus (IIIS at Univ. of Tsukuba, SI at TIP and ITbM at Nagoya Univ., selected in FY 2012).

○ Join global competitions in advanced fields and expand the "visible part for competing with the world based on international standards."

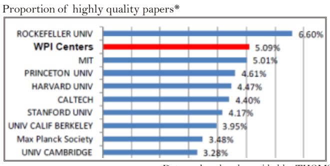
Supporting successful outcomes at existing 5 centers

○Recruit human resources in Japan and from abroad, with an average of 40 % of foreigners at each center, and English as the primary language.

○Make the centers globally visible by public offering of research positions to young researchers in the world at each center, and acquiring contributions from overseas financial bodies.

○Present quality papers on par with or exceeding top institutions.

■ Proportion of highly quality papers*



* Proportion of top 1% cited papers by researchers worldwide

Data analyzed and provided by THOMSON REUTER (2011.10)

Source: Created by MEXT

Section 2 Development of Human Resources capable of Active Roles in Science and Technology Research

In order to sustain growth and to create new value while facing rapid demographic aging and population decrease, Japan must foster and secure diverse human resources capable of active roles in the creation of STI.

MEXT has been implementing systematic development of human resources specializing in science and technology (S&T) through education at elementary, junior high and high schools, at universities and as well through programs for postdoctoral researchers. More active roles for young researchers, female researchers and research administrators are also being promoted through various measures. All these efforts are aimed at increasing the number of people who can contribute to S&T in Japan and foster high quality researchers.

To provide a sufficient number of qualified human resources in science and technology, MEXT commenced the "Science and Technology Human Resource Fostering Strategy" on March 13, 2015, to encourage industry-academia-government collaboration for developing human resources.

1 Development of Human Resources Capable of leadership in Diverse Fields

(1) Radical enhancement of graduate school education

The progress of globalization and knowledge-based societies has made it vital to foster highly-skilled, knowledgeable professionals who can assume leadership roles in the global society to help solve issues that contemporary people are facing. These professionals are expected to take a holistic view of expertise in various fields and to create or use innovations to provide new value to society.

Based on this recognition, highly-skilled professionals should be strategically developed, so that they are able to exercise leadership in the various fields of industry, academia and government at a global level. There is an urgent necessity to radically enhance the quality of doctoral programs, as well as to develop systems for providing education and research guidance in a structured manner.

As a result of the Graduate School Education in the Globalized Society (a report by Central Council for Education, January 31, 2011), MEXT formulated the Second Platform for the Promotion of Graduate School Education (approved by the Minister of MEXT on August 5, 2011) to implement measures for improving and ensuring the quality of graduate school education.

Specifically, the Program for Leading Graduate Schools was started in FY2011 to assist in efforts to develop leading graduate schools at which doctoral programs are provided consistently from the first term through the second term beyond the boundaries of different disciplines to nurture leaders who can play active roles in industry, academia, or government globally. As of FY 2014, 62 projects have been supported. To provide a more systematical education in doctoral programs, the Standards for the Establishment of Graduate Schools were revised in March 2012. This revision made it possible for universities to provide the "Qualifying Examination (Examination of Doctoral Thesis Study Basic Ability)" in place of writing master's thesis to complete the first term of a doctoral program.

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 18 academic fields (linguistics/literature, law, home economics, mechanical engineering, mathematical science, biology and civil engineering/architecture, history, regional research, politics, economics, material engineering, anthropology, psychology, geography, sociology and earth and planetary science) by FY 2014. SCJ will continue to explore other fields.

(2) Support for students pursuing doctoral studies and diversification of career options

In order to encourage qualified, ambitious students to continue their studies in doctoral courses[1], financial support is necessary to complete their doctoral studies. It is also important to provide various career options so that they can make use of their expertise not only in academia, but also in industry and local communities.

1) Support for students pursuing doctoral studies

As part of its efforts to financially support graduate students, MEXT has been increasing competitive research funds available for universities to employ graduate students. In consideration of educational benefit for students, these competitive funds are used to hire graduate students as Teaching Assistants (TA) or Research Assistants (RA).

Japan Student Services Organization (JASSO) provides scholarship loan programs to provide financial support to students who are academically excellent but have difficulty pursuing their studies due to financial restraints. Interest-free loan recipients, recognized by JASSO as having achieved particularly outstanding results in their studies, may be exempt from repaying all or part of their loan.

To foster top level researchers who will play major roles in future scientific research activities, the Japan Society for the Promotion of Science offers a special program under which fellowships are granted to doctoral students.

2) Diversification of career options

MEXT has been making efforts to develop leaders who can achieve active roles globally in industry, academia, or government (Chapter 4 Section 2, 1 (1)).

To increase career options for postdocs, the Career Development Program for Postdoctoral Fellow supports universities that offer three months or longer, internship programs to postdocs[2]. This program provides postdocs with opportunities to make use of their expertise to play active roles at universities, public research institutions, industries, local communities, or in other countries. As of FY2014, 21 universities are supported by this program.

In addition, MEXT has been encouraging development and employment of research administrators to improve research environments to provide for more active research, strengthen R&D management at universities and increase career options for scientists/engineers.

Within JST's program for supporting use of career information, the Japan Research Career Information Network Portal (JREC-IN[3]) is operated, through industry-university-government cooperation, to provide

1 Doctoral courses refer to the two-year second term of the doctoral programs (including the third, fourth and fifth year of the five-year consistent program for the doctoral course) and to the four-year consistent program for a Ph. D in medical, dental, pharmaceutical or veterinary science, unless otherwise annotated.

2 Postdocs refer to those who are doctorate degree holders or who left school after having studied for a standard doctoral course term or longer, and have earned the required credits, engaging in research at universities or research institutions under fixed-term contracts (Note: Professors, associate professors, lecturers, assistant professors, research associates, leaders of research groups, and principal investigators are excluded).

3 Postdocs are those who have obtained a doctorate and are employed under fixed-term contracts. They are either 1) those who engage in research at a university or a research institution and are not a professor, an associate professor, an assistant professor, or a research associate, or 2) those who engage in research at a research institution such as an incorporated administrative institution, and are not a leader or a chief scientist of the research group to which they belong (including those who left school after having studied for a standard doctoral course term or longer and have earned required credits

useful information for career development and also to support efficient use of such information. The provided information is about job offers to researchers and research administrators and applications by them.

In a project to build a medium- to long-term interexchange system for researchers, METI is supporting development of a framework and an environment for implementing medium- to long-term, two months or longer, research internships for students in master's/doctoral courses in the sciences at corporate laboratories. The aim of this project is the development of highly-skilled professionals in sciences who have expertise, a broad view of society and the capability for project management. Creation of innovations through enhanced mobility between industry and academia is also a goal.

(3) Development of engineers and their capacity

Industries and engineers underpinning industrial activities are assuming a pivotal role in the promotion of STI. Increasingly advanced and integrated technologies require engineers to enhance their qualifications and abilities. MEXT and related agencies have been making efforts to develop 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 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 learning.

At national colleges of technology, practical training in engineering is given to students shortly after graduating from junior high school. In response to the changes in industrial structures and accelerated socioeconomic globalization, these colleges are improving their education to foster practical, creative engineers who can satisfy regional or industrial needs and 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 an engage in planning and designing are qualified as professional engineers by the Professional Engineer Qualification System.

In order to be qualified as professional engineers, they must pass an examination which is given annually in each of the 21 engineering disciplines and then to be registered as professional engineers. The Professional Engineer Examination is divided into the First-Step Examination, which is given to confirm if examinees have the expertise expected of university graduates in science or engineering and the Second-Step Examination, which is given to confirm that examinees have the high level of applied skill required of professional engineers. In FY2014, 9,851 candidates passed the First-Step Examination and 3,498 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).

Chapter 4

(drop outs without degree after fulfilling course requirements))

■ Table 2-4-2 / Successful Candidates of the Second-Step Professional Engineer Examination by Technical Discipline (FY 2014)

Technical Discipline	Number of Examinees (people)	Number of Passers (people)	Pass Rate (%)
Mechanical Engineering	984	221	22.5
Marine & Ocean	6	1	16.7
Aerospace	36	6	16.7
Electrical & Electronics Engineering	1,287	203	15.8
Chemistry	132	32	24.2
Textiles	29	13	44.8
Metals	121	32	26.4
Mining	21	10	47.6
Civil Engineering	12,553	1,580	12.6
Water Supply & Sewerage	1,383	215	15.5
Environmental Engineering	575	61	10.6

Technical Discipline	Number of Examinees (people)	Number of Passers (people)	Pass Rate (%)
Agriculture	665	138	20.8
Forest	276	62	22.5
Fisheries	113	20	17.7
Industrial Engineering	196	52	26.5
Information Engineering	442	85	19.2
Applied Science	545	77	14.1
Biotechnology & Bioengineering	40	15	37.5
Environment	518	96	18.5
Nuclear & Radiation	79	17	21.5
Comprehensive Technical Management	3,206	562	17.5

Source: Created by MEXT

To aid engineers in acquiring a broader range of basic knowledge about S&T, JST is providing online self-study materials[1] for learning about common S&T topics and specific S&T disciplines.

2 Development of Top level, Creative Researchers

(1) Establishment of fair and transparent assessment systems

In order to develop top-level and creative researchers, positions to which young researchers can challenge need to be increased to provide them with opportunities to conduct research autonomously, to play active roles and present career options.

MEXT has been making efforts to establish the Tenure Tracking System[2] at more universities and public research institutions. It is a fair and transparent personnel system for employing high quality researchers (see Section 2-2 (2), Chapter 4).

(2) Career options for researchers

To foster and employ excellent young researchers, it is necessary to secure their positions, and encourage mobility for their career progress to guarantee them opportunities to obtain research funds and to improve their research environment so they can concentrate on their research and produce results.

For the purpose of ensuring research environments in which young researchers can concentrate on autonomous research and obtain secured positions, MEXT has been implementing the Program to Disseminate Tenure Tracking System that provides support to universities that newly adopt the Tenure

1 http://weblearningplaza.jst.go.jp/
2 In the Tenure Tracking System, young researchers selected through a fair process are employed under fixed-term contracts and can gain experience as autonomous researchers before obtaining secure positions.

Tracking System. As of FY 2014 this program supports 54 organizations[1].

The "Building of Consortia for the Development of Human Resources in Science and Technology" has started since FY 2014 to ensure the stable employment of young researchers while encourage mobility for their career progression and promote diversification of career paths, and MEXT supports seven centers, including universities, through this program.

In the "Act for the Amendment for the Act on Enhancement of Research and Development Capacity and Efficient Promotion of Research and Development by Advancement of Research and Development System Reform and the Act on term of Office of University Teachers, etc.[2]" (Act No. 99 of 2013) enforced in December 2015, university researchers are included in special job categories in the "Labor Contract Act" (Act No. 128 of 2007), and they can be employed under fixed-term contract to 10 years.

In the grant programs of KAKENHI, Grants-in-Aid for Young Scientists (A & B) are provided to support the autonomous research of young researchers (see Section 1-1 (1), Chapter 4).

The Japan Society for the Promotion of Science (JSPS) launched the "Special Fellowship Program" for young scientists, in which fellowships are granted to outstanding young doctoral students and postdoctoral researchers who will play leading roles in Japan's future scientific research.

JST also launched various promotional programs such as "Sakigake", which is popular among young researchers in the course of the "Strategic Basic Research Programs" (see Section 1 (2) of this chapter).

(3) Promoting the employment of female researchers

Encouraging female researchers to manifest their aptitude promotes socioeconomic revitalization and gender equality.

The 4th Basic Plan sought the early accomplishment of the numerical target set in the 3rd Basic Plan regarding the share of female researchers (25% in natural sciences) and an increase in the share to 30%. In view of this, the government has been promoting employment and increasing the roles of female researchers and the share of female researchers has been increasing every year, but comprised only 15% as of March 2014, which is lower than other nations (Figure 2-4-3).

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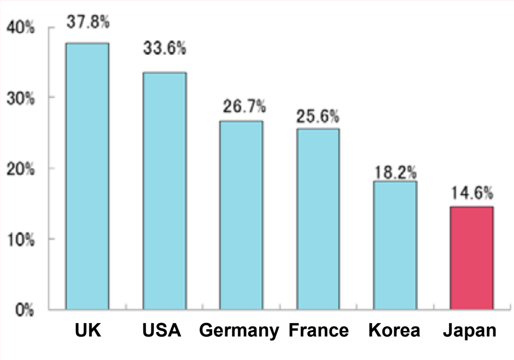
1 This figure includes universities supported by the Program for the Promotion of Environmental Improvement to Enhance Young Researchers' Independence that was implemented by former Special Coordination Funds for Promoting Science and Technology.

2 The provision for the special case in the Labor Contract Act was revised on April 1, 2014. This includes researchers and engineers at universities, inter-university research institutes and R&D institutes, personnel in charge of R&D operation and management (those responsible for planning projects, securing funds, and obtaining and using intellectual property), and teachers at universities and inter-university institutions.

■ **Figure 2-4-3 / Percentage of Female Researchers by Country**



Note: 1. Data as of 2010 for the US, 2011 for Germany, 2012 for the UK and France, 2013 for South Korea and 2014 for Japan.
2. For the US, data on scientific professionals (i.e., holders of a bachelor's/master's/doctoral degree in science or engineering, engaging in a science-related profession) are used instead of data on researchers. "Science" includes social sciences.

Source: Created by MEXT based on "Survey of Research and Development" (MIC), "Main Science and Technology Indicators" (OECD) and "Science and Engineering Indicators 2014" (NSF)

To improve the situation, MEXT has implemented the "Program for Support for Female Researchers" to improve workplace environments to help female researchers balance work with childbearing, childcare and nursing care and supports 48 organizations as of FY 2014.

JSPS has implemented the "Restart Postdoctoral Fellowship (RPD) Program" to provide research incentives to male/female researchers having temporarily discontinued research due to childbearing/childcare responsibilities.

The National Institute of Advanced Industrial Science and Technology (AIST) organized the Diversity Support Office (DSO), a consortium consisting of 21 universities and research institutions nationwide. DSO is promoting information sharing and opinion exchange with member institutions concerning gender equality to attain work-life balance, develop their careers and get motivated to pursue research careers. In FY 2014, the consortium earned the "Kurumin" mark in recognition of corporate efforts to support childrearing and the "Tomonin" mark for promoting the establishment of working environments that balance work and family care.

As part of the effort to foster future-generation scientists, 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 S&T researchers, engineers and university students, as well as to take part in experimental classes and school visit programs.

The Cabinet Office provides information encouraging female students to select science/engineering courses, including efforts by universities and companies as parties encouraging such challenges and messages from female workers in science and technology fields on its website "Science/Engineering Challenge: Selection by female high-school and university students to major in science[1]"

3 Development of Human Resources for Next-generation Science and Technology

To foster human resources for next-generation science and technology, the government launched a number of promotional programs to improve children's interest and talent in science and mathematics at elementary and secondary school levels for identifying and fostering talented children. To this end,

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

comprehensive efforts have been made as described below.

(1) Development of curiosity in children

JST is conducting a "Science Leaders Camp" to support science and math teachers and provide effective skills for teaching talented students and formulating networks between teachers at a training camp beyond regions and the "Establishing Training Centers for Core Science Teachers"; supporting efforts to nurture elementary and lower secondary school teachers who take leading roles in science and mathematics education in the schools and regions. JST has also developed digital materials for use in science education, which it offers online to provide children and students with opportunities to learn science topics which interest them. Other programs promoted by JST to foster future scientists include the "Future Scientist Program" to support universities in implementing issue-specific research, systematic education programs for talented and willing children and students and a "Promoting the Science Club Activity of Junior/Senior High-Schoolers"; supporting science club efforts and developing students' talent through collaboration with experts.

Improvement of science and mathematics education is required to develop S&T professionals. Education should help students to develop an interest in science and the ability to think and communicate in a scientific manner. However, children are said to increasingly dislike science. To counter this, MEXT added science to the subjects included in the National Assessment of Academic Ability in FY2012. The survey found that students had difficulties organizing and analyzing observation/experiment results for the purposes of interpreting, considering and explaining the results. Based on this survey, MEXT has been working to improve the quality of science education with respect to observations and experiments. In FY2013, MEXT began to provide support to schools for employing assistants who help with preparations and arrangements for scientific observations and experiments at school to lighten science teachers' workloads. Additionally, research and consultation were initiated regarding the improvement of teachers' skills and competence of instructing scientific observations and experiments. Improving facilities and equipment for scientific observations and experiments at school has been also been enhanced pursuant to the Science Education Promotion Act (Act No. 186, 1953). MEXT is providing comprehensive support to the enhancement of science and mathematics education by these means.

The National Institution for Youth Education set up a Children's Dream Fund to assist the various activities of private organizations, such as programs for giving children hands-on scientific experience.

The Japan Patent Office (JPO) has been collaborating with the National Center for Industrial Property Information and Training (INPIT) in spreading knowledge about intellectual property, as well as in providing support to senior high schools and colleges of technology that utilize intellectual property in practical education for human resources development.

(2) Development of the abilities of talented children

MEXT designates high schools that focus on science and mathematics education as Super Science High Schools (SSH), to which JST provides support. This initiative aims to develop S&T professionals who will assume important roles globally in the future. Specifically, efforts are being made to promote the development and practice of curricula which are not based on the National Curriculum Standards, to promote project studies, to foster future S&T professionals and to share the results of these efforts among multiple schools. In FY 2014, 204 upper secondary schools implemented distinctive educational efforts nationwide. The universities that develop and conduct an international S&T human resource development program are supported as the "Global Science Campus (GSC)."

MEXT sponsored the 4th "Science Intercollegiate" (February 28 and March 1, 2015) in Hyogo prefecture as a place for undergraduate students in natural science courses to present their voluntary research for nationwide, friendly competition and opportunities to exchange communications among researchers and companies. Of a total of 291 applications, 172 which had passed documentary examination were presented.

JST has sponsored preliminary domestic contests for international S&T contents such as the International Science Olympiads for mathematics, physics, chemistry, biology, informatics, geography and earth science 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 2014, the 4th Japan High School Science Championship was held on March 20-23, 2015 in Ibaraki prefecture. It is a nationwide interscholastic or team competition to determine comprehensive strength of paper tests and practical skills in science and mathematics and the Chiba team won first place (Figure 2-4-5). The 2nd Japan Junior High School Science Championship was held on December 5-7, 2014 in Koto ward, Tokyo and the Ibaraki team won the championship (Figure 2-4-6).

MEXT, JPO, the Japan Patent Attorneys Association and the National Center for Industrial Property Information and Training jointly host patent contests and design patent contests for high school/college of technology/university students. 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.

■ Figure 2-4-4 / International Student Contests in Science and Technology Participants, FY 2014

International Mathematical Olympiad (South Africa) Participants

From the left

Yuji YAMAMOTO, 12th grade, Tokai Senior High School (gold medalist)

Ryoushun OBA, 12th grade, Senior High School at Komaba, University of Tsukuba (silver medalist)

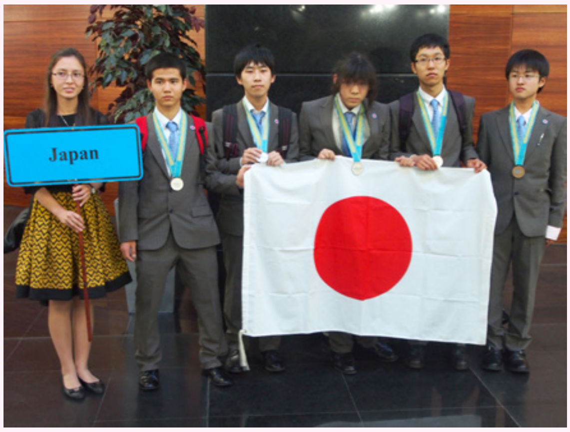
Takuya INOUE, 10th grade, Kaisei Senior High School (bronze medalist)

Takahiro UEORO, 12th grade, Waseda University Senior High School (gold medalist)

So KUMABE, 12th grade, Senior High School at Komaba, University of Tsukuba (gold medalist)

Satoshi HAYAKAWA, 12th grade, Rakusei Senior High School (gold medalist)

International Physics Olympiad (Kazakhstan) Participants



From the left

(Interpreter for the Japan team)

Koichi OYAKAWA, 12th grade, Osaka Seiko Gakuin Senior High School (silver medalist)

Yoshiki MARUYAMA, 12th grade, Miyazaki Nishi Senior High School (silver medalist)

Tatsuya HAYASHI, 12th grade, Gifu Kita Senior High School (silver medalist)

Yasuhito SUGIURA, 12th grade, Kaisei Senior High School (silver medalist)

Kazuki HAMADA, 11th grade, Nada Senior High School (bronze medalist)

International Chemistry Olympiad (Vietnam) Participants

From the left
Koichiro MASADA, 12th grade, Hakuryo High School (silver medalist)
Toshiya FUKUNAGA, 12th grade, Hakuryo High School (gold medalist)
Shunpei MORITA, 12th grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
Kyoka HAYASHI, 12th grade, Toshimaoka Female Senior High School (bronze medalist)

International Biology Olympiad (Indonesia) Participants

From the left
Kei NASUDA, 12th grade, Hamamatsu Kita High School (gold medalist)
Naoki KONNO, 11th grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
Nobuhiro KURATA, 11th grade, Hiroshima Gakuin Senior High School (silver medalist)
Shu ISHIDA, 12th grade, Senior High School at Komaba, University of Tsukuba (silver medalist)

International Olympiad in Informatics (Taiwan) Participants

From the left
Ken OGURA, 12th grade, Nada Senior High School (silver medalist)
Yuta TAKAYA, 9th grade, Kaisei Junior High School (gold medalist)
Ryoma SATO, 12th grade, Ibaraki Senior High School (bronze medalist)
Hirotaka ISA, 11th grade, Kaisei Senior High School (silver medalist)

International Earth Science Olympiad (Spain) Participants

From the left
Gaku NISHIYAMA, 12th grade, Sugamo Senior High School (gold medalist)
Masaki SUGI, 12th grade, Nada Senior High School (bronze medalist)
Shinsuke UNO, 12th grade, Nada Senior High School (gold medalist)
Kento NOMURA, 12th grade, Senior High School at Komaba, University of Tsukuba (gold medalist)

International Geography Olympiad (Poland) Participants

Source: MEXT

From the left
Eko KANEDA, 12th grade, Musashi Senior High School
Marie IIJIMA, 12th grade, Mito Daiichi Senior High School
Hibiki NAKANO, 11th grade, Senior High School at Komaba, University of Tsukuba (silver medalist)
Kento NOMURA, 12th grade, Senior High School at Komaba, University of Tsukuba

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

Winning team: Makuhari Senior High School team, Shibuya Education School

Front from the left

Taro SAWADA (11th grade)　　Takahiro MIKAMI (11th grade)

Hiroki AYABE (11th grade)　　Shu NAKAMURA (11th grade)

Rear from the left

Koki SHIRAISHI (10th grade)　　Keisuke OTSURU (10th grade)

Yugo TAKANASHI (11th grade)　　Kensuke SAKAMA (10th grade)

*The grades are at the time of award winning.

Source: Created by: MEXT

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

Winning team: Ibaraki prefecture representative team

Front from the left

Arata NAKAMURA (8th grade)　　Asahi SAKAI (8th grade)

Takeshi ANAMI (8th grade)

Rear from the left

Sohei HISHIDA (8th grade)　　Ami OKA (8th grade)

Toshiki NAKAMURA (8th grade)

*The grades are at the time of award winning.

Source: Created by: MEXT

Section 3 Establishment of a World-Class Research Environment and Infrastructure

1 Improvement of R&D Environments at Universities and Public Research Institutions

(1) Improvement of facilities and equipment at universities

Universities should have highly functional, quality facilities and equipment so that they are able to respond to demands for increasingly advanced and diverse education and research, to attract excellent human resources and to enhance global competitiveness, industry-university cooperation, local contribution and internationalization. Additionally, Japan's tight fiscal conditions and the damage caused by the Great East Japan Earthquake should be taken into consideration in promoting efforts for improving facilities/equipment at universities, as well as for stable operation of these facilities/equipment.

1) Facilities and equipment at national universities

Facilities of national universities[1] assume an important role as hubs for various activities such as creative, advanced scientific research, the development of excellent creative human resources and the promotion of advanced medical treatment.

With this in mind, MEXT formulated the "3rd Five-Year Program for Facilities of National Universities (FY 2011- FY 2015)" ("the 3rd Five-Year Program") in August 2011 based on the 4th Basic Plan to promote systematic and prioritized improvement of university facilities.

The 3rd Five-Year Program prioritizes the following projects covering a total of 5.5 million m²: 1) improvement of outdated facilities: approx. 4 million m², 2) elimination of cramped facilities: approx. 800,000 m² and 3) improvement of university hospitals: approx. 700,000 m². In conjunction with these projects, system reforms such as campus-wide improvement (campus master plans) and strategic facility management, including the effective use and suitable management of existing facilities, are recommended.

By FY 2014, the 4th year of the 3rd Five-Year Program, progress in each of the projects was estimated as follows: 1) improvement of outdated facilities: approx. 2.39 million m² (60 of the target), 2) improvement of cramped facilities: approx. 710,000 m² (89%) and 3) improvement of university hospitals: approx. 610,000 m² (87%)[2]. MEXT set up an expert panel[3] in March 2014 to prepare for the 5th Five-Year Program (FY 2016 - FY 2020) and published a "mid-term report for directions and issues of discussion" (July 2014) to consolidate discussions at the expert committee to the following three themes: ① Basic environment for safe and secure education, ② Formulation of sustainable campuses and cooperation with local communities and ③ Functional reinforcement of national universities.

To achieve the concept of universities and academic plans, MEXT held an expert meeting[4] from November 2013 to promote facility management covering various efforts concerning all the facilities from a management perspective and published a report[5] in March 2015 for management of national universities to suggest the basic concept of facility management, specific procedures and examples of advanced

1 Including inter-university research institutes and institutes of national colleges of technology
2 Including the results of FY 2013 based on various financial sources, including contributions
3 A meeting of cooperators for research and study on the improvement of facilities of national university corporations in future
4 An investigative commission on the comprehensive management of national university facilities
5 "Strategy of Facilities for National Universities Management - Facility Management Strengthens the basis of Education and Research -"

practices.

Improvement of the facilities at national universities is vital, as it is the infrastructure that supports advanced research and quality education.

Currently, national universities lack personnel qualified for implementing efficient and effective use of equipment and for managing aging or obsolescence of equipment. Thus, MEXT is financially supporting these universities on the basis of a medium- to long-term master plan that each university has formulated for systematic, continuous improvement of their equipment. Additionally, in the program for supporting the effective use of research equipment located at national universities, MEXT supports the efforts of universities to promote effective and shared use of their equipment.

In its Large-scale Academic Frontier Promotion Program, MEXT also provided support to the world's most advanced research equipment developed by using creative ideas of Japanese scientists (e.g. research project "Exploration of Physics beyond the Current Particle Theory with Super B-Factory"). (see Section 1-1 in this chapter).

MEXT provided costs for constructing advanced facilities in the revised budget In FY 2014 according to the "Emergency Economic Package" for improving the regional growth cycle to revitalize the local society and economy.

■ **Figure 2-4-7 / Basic Concept of the Improvement of Facilities at National Universities**

Source: Created by MEXT

2) Facilities and equipment at private universities

Private universities make up about 80% of Japan's higher education institutions and various researchers working at these universities positively engage in distinctive research. Private universities have also been playing significant roles in advancing higher education in Japan. MEXT is working to enhance private universities' research infrastructure by implementing the Strategic Research Foundation Grant-aided Project for Private Universities, a project to provide excellent research projects at private universities with comprehensive support to improve their research facilities and equipment.

(2) Promotion of the shared use and improvement of advanced research facilities and equipment

Regarding advanced research facilities and equipment requiring significant expenses for improvement and operation and suitable for shared use in multiple S&T areas, public research institutions have been playing a leading role in their improvement and operation. While these advanced research facilities and equipment are critical for producing outstanding R&D results as well as fostering researchers, maintaining and managing these facilities and this equipment have become concerns, given the decline in funding to public research institutions. Thus, the government has been taking measures to ensure that public research institutions can continue to improve and operate advanced research facilities and equipment and also to promote extensive shared use of them (see Section 1-5(2), Chapter 3).

The utilization of company-owned external advanced research facilities and equipment was investigated in the "Survey on Research Activities of Private Corporations" by the National Institute of Science and Technology Policy. Of the 431 companies engaged in advanced R&D for their major products and services in FY 2013, about half or 46.6% used external advanced research facilities and equipment.

Of all 189 companies which responded concerning the results of R&D using their external advanced research facilities and equipment, companies having obtained results for commercialization comprised 82.5% and companies whose R&D had resulted in joint research with external organizations (other companies, universities) comprised 40.7%. In effect, 88.8% of the companies that replied to the questionnaire are found to have admitted some effects by using external advanced research facilities and equipment (Table 2-4-8).

■ Table 2-4-8 / Effects of Using External Advanced Research Facilities and Equipment (cross tabulation)

		Results tied to joint research with external organization		
		Yes	No	Total
Results tied to commercialization	Yes	34.4%	48.1%	82.5%
	No	6.3%	11.1%	17.5%
	Total	40.7%	59.3%	100.0%

Source: "Survey on Research Activities of Private Corporations 2014" NISTEP REPORT No.163 (June 2015)

2 Enhancement of Intellectual Infrastructure

For effective and efficient promotion of R&D, intellectual infrastructure needs to be improved to ensure its safety, reliability and qualitative/quantitative stability, because intellectual infrastructure supports basic research activities such as experiments, measurement, analysis and evaluation and thus should be available to many researchers. Thus, systematization of intellectual property such as research results and research materials is necessary. Systematization of research materials, measurement standards and measurement/evaluation methods has been steadily advanced. To meet the needs of diverse users, improvement and effective use of intellectual infrastructure is being promoted while the improvement of the quality of intellectual infrastructure is also taken into account.

For the purpose of supporting research in life sciences, MEXT is developing a center of bio-resources in the National Bio-resource Project (NBRP) and the JST is implementing the Project for Promoting

Integration of Life Sciences Database (see Section 3-2, Chapter 2). MEXT has been collaborating with industries and universities in promoting the development of most-advanced unique technologies and instruments for measurement and analysis that serve the needs of the world's leading researchers and manufacturers (see Section 1- 5(1), Chapter 3).

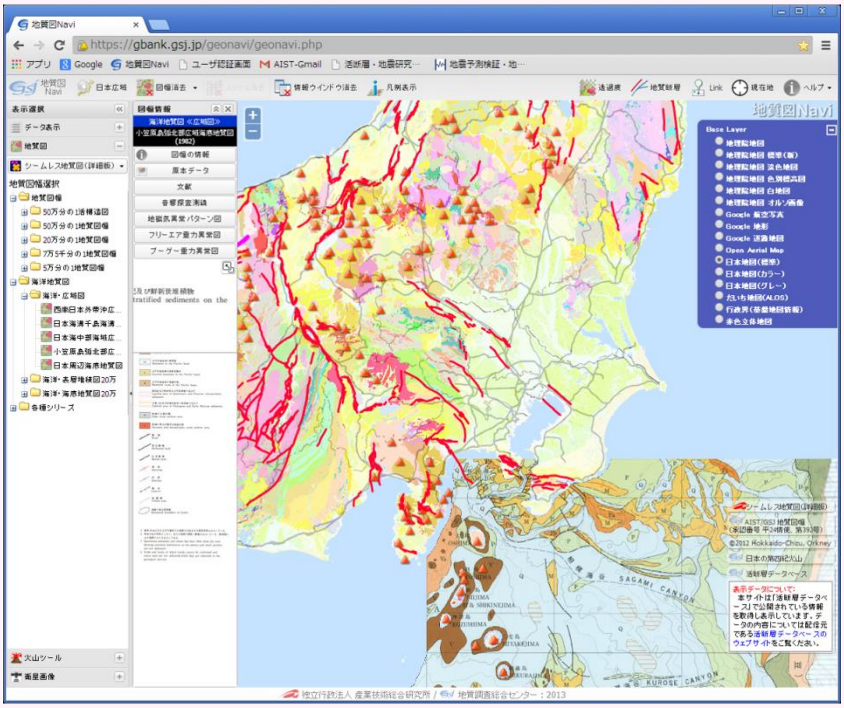
Because the 4th Basic Plan sought for the formulation of a new Intellectual Infrastructure Development Plan, in FY2013, METI held meetings of the special subcommittee on measurement standards and intellectual infrastructure (chaired by Koichi Kitazawa, president of Tokyo City University (until April 2014) and Kunihiko Hidaka , professor of the graduate school of the University of Tokyo (from December 2014)), which was jointly organized by the Industrial Structure Council and the Japanese Industrial Standards Committee. In March 2014, the subcommittee finalized a plan for developing intellectual infrastructure in three areas (measurement standards, microbial genetic resources and geological information) and also decided specific measures for promoting use of the intellectual infrastructure.

Regarding measurement standards, the National Institute of Advanced Industrial Science and Technology (AIST) developed technology for correcting trace moisture in argon as a world first and started distributing the technology, which is expected to improve the reliability of trace moisture meters used to manufacture semiconductors. It also started supplying 150-nm and 200-nm diameter particles and standard particle distribution matters, which are expected to help measure nanoparticles as required by the EC directives, etc. accurately.

Regarding geological information, AIST produced five 1:50,000 geological maps, two 1:200,000 marine geological maps and one 1:200,000 gravity map. AIST arranged the survey results regarding the Ishikari Lowland coastal area into a land-sea seamless geological information model of coastal areas. AIST updated its 1:200,000 seamless geological map of Japan[1] and compiled a next-generation seamless geological map. Geomap Navi (Figure 2-4-9), a comprehensive portal for geological information formally opened in FY 2013, was linked to GEOLIS (Japan geological literature database).

1 On the basis of the width of a 1:200,000 geological map, geological maps of Japan were uniformly compiled and made available for browsing online.

■ Figure 2-4-9 / Geological Information Integrated Portal Site (GeomapNavi) - Display Example -



Quaternary volcanoes and active fault distribution data was superimposed on 1:200,000 seamless geological map.
Source: AIST

The National Institute of Technology and Evaluation (NITE) has been collecting, preserving and distributing biological genetic resources and has also been organizing information on these resources in terms of their genes and genetic lineages to make the information accessible to researchers, etc. (6,438 strains of biological genetic resources were imparted as of January 2015). A Memorandum of Understanding (MOU) was signed by the representatives of NITE and the Government of Mongolia in May 2012 and the Government of Myanmar in March 2013 regarding the exploration and collection of microbes and their transfer to Japan for continuous use. Private companies in Japan can access and utilize these microbial resources through joint projects with NITE. It also joined a network consisting of 23 organizations of 13 counties for preserving and sustainable use of microbial resources (Asia Consortium founded in 2004) and has proactively supported Asian countries to preserve biological resources through multilateral interchange programs according to the Convention on Biological Diversity (CBD).

The Ministry of Agriculture, Forestry and Fisheries (MAFF) is developing a database and a system for higher-level analysis of fragmentary genomic information produced by next-generation genome analyzers, for the purpose of providing information on genes and genomes of agricultural, forestry and fishery products to breeders and researchers at universities and private companies. In its gene bank project concerning agricultural biological resources, MAFF collects, preserves, assesses and provides biological genetic resources related to agriculture and also preserves and provides genomic resources, including DNA, of rice and other crops.

3 Enhancement of Research Information Infrastructure

Research information infrastructure is indispensable for research activities, as the lifeblood of research and thus improvement of research information infrastructure in response to the rapid advancement of ICT is essential for securing the international competitiveness of Japan's R&D. Additionally, open science has been increasingly active worldwide to create more efficient and effective innovations by sharing and using papers and data resulting from research. To adapt to this tendency, the government has been developing and advancing networks among research institutions and has also been creating and offering databases.

(i) Development of networks

Computer networks, which make up core systems in the contemporary world, were the product of R&D in science and technology and have been applied to other disciplines. Further enhancement of network performance is required to promote advanced R&D.

The National Institute of Information and Communications Technology (NICT) has been promoting R&D and demonstration tests by using the next-generation communications network test-bed (JGN-X) which NICT has developed and has been operating (see Section 1-2 (2), Chapter 3).

The National Institute of Informatics (NII) has been operating SINET[1] as a platform for supporting overall scientific research and education at universities. It connects about 800 universities and research institutions in Japan as of the end of 2014, as the need for collaboration in research by sharing information has increased in advanced research and institutions using bulk data, as well as retaining close links to scientific networks abroad.

The MAFF has been developing and operating MAFFIN[2], a research network connecting research institutions related to agriculture, forestry and fisheries. As of the end of March 2014, 89 institutions are connected in MAFFIN. MAFFIN is linked to an institution in the Philippines, serving as the backbone network for the distribution of research information overseas.

(Creation and offering of databases)

Libraries and many other organizations provide access to original research papers, documents, etc. for reading, duplicating or borrowing. While the amount of information keeps increasing, creation of a database on bibliographic and whereabouts information regarding original documents owned by multiple organizations makes it possible to search online for necessary information more easily, quickly and precisely. As books and journals are increasingly read in the form of electronic journals and e-books these days, the importance of databases is more focused.

The National Diet Library archives all publications issued in Japan. The library creates a database on the publications, materials, etc. that it collects and keeps and provides database information on its website[3].

To help enhance the efficiency and effectiveness of R&D activities, NII systematically collects information on S&T necessary for creating innovations, organizes the information into an easy-to-use format and posts it online. For example, NII has been creating and offering a database on whereabouts information regarding bibliographies of academic books and journals kept by university libraries

1 Science Information NETwork
2 Ministry of Agriculture, Forestry and Fisheries Research Network
3 http://iss.ndl.go.jp/

nationwide and a database on scientific papers in Japan. A common repository system is provided by NII to research institutions and universities for helping them to develop their own institutional repository[1] for preserving and disseminating their research/educational results. NII is operating JAIRO[2].

JST is offering an information service, J-GLOBAL. In this service, a database on basic information is created regarding researchers, patents and S&T literature in Japan and overseas and information is provided by linking a specific researcher, for example, to the relevant information. In FY 2014, J-GLOBAL's search feature was enhanced to provide information on reference materials cited in the papers registered in the database. JST has also been creating a database on abstracts in Japanese available online via the paid bibliographic information retrieval service (JDreamIII[3]). From FY 2014, it started services to display highly interrelated articles from newspapers and magazines as well as information from domestic and international databases, regardless of the media. For the purpose of enhancing Japan's capacity for disseminating domestic research results worldwide, JST has developed the Japan Science and Technology information Aggregator, Electronic(J-STAGE) system to computerize the entire process of submission, peer review, screening and publication of papers written for science or other journals of academic societies. In FY 2014, the system was improved to automatically add URLs to documents cited by a paper having DOI[4]. The Japan Link Center (JaLC[5]), which adds DOIs to domestic research papers, was also functionally improved to add DOIs to books and research data in addition to papers.

MAFF has been creating and offering databases on information regarding literature on agriculture, forestry and fisheries as well as on literature's whereabouts, 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 on the topics related to agriculture, forestry and fisheries; satellite imagery; and topics of ongoing research conducted at R&D institutions.

Table 2-4-10 lists major projects conducted by research and information facilities in FY 2014.

1 An online archive for collecting and preserving digital copies of the intellectual output of research/educational activities at a research institution or a university, and for disseminating these copies for free of charge basically.
2 Japanese Institutional Repositories Online
3 JST Document Retrieval system for Academic and Medical fields III
4 Digital Object Identifier, an international identifier added to the electronic data
5 The only DOI registration body in Japan jointly managed by JST, NIMS, NII and NDL

■ Table 2-4-10/ Key Projects relating to Research and Information Infrastructure (FY2014)

Ministry /Agency	Implementation	Projects
Diet	National Diet Library	Collection and organization of S&T-related documents at the National Diet Library
MIC	NICT	Development of an advanced R&D testbed network (JGN-X)
MEXT	JST	Organization of basic S&T information and promotion of the use of such information (J-GLOBAL, etc.)
		Life Science Database Integration Program (by NBDC)
		Promotion of computerization, internationalization, dissemination and distribution of papers on S&T (J-STAGE, etc.)
	Japan Agency for Marine-Earth Science and Technology	Operating expenses for information infrastructure
	NII	Development of the Science Information Network (SINET 4)
MHLW	National Institute of Infectious Diseases	Budget for the Infectious Disease Surveillance Center
		Research project expenses for collecting, analyzing and assessing safety data on biological products
MAFF	Secretariat of Agriculture, Forestry and Fisheries Research Council	Operation of Agriculture, Forestry and Fisheries Research Information Technology Center (JASI, MAFFIN, etc.)
MLIT	Geospatial Information Authority of Japan	Promotion of Global Mapping Project (Development of techniques for preparing the 3rd edition of the global geological map)
MOE	Biodiversity Center of Japan	Promotion of the collection, management and provision of information on biodiversity
MEXT JPO	JST INPIT	Improvement of an integrated system for searching patent and literature information
JPO Relevant Ministry/ Agency	INPIT	Provision of a database on research tool patents (RTDB)