3.3.3.4 Consolidation of R&D Bases

The current national comprehensive development plan, known as the "National Grand Design for the 21st Century," places priority on networking and R&D investments directed at organizations representing industry, academia, and the government. The plan promotes the development of the Tsukuba Science City and the Kansai Science City, and sets forth the development of new research and development bases of an international standard that will serve as the nucleus for the establishment of far-reaching international exchange parks.

(1) Tsukuba Science City

Tsukuba Science City was created as a base to provide research and education of a high standard, and to contribute to the balanced development of the entire Tokyo metropolitan area. It was constructed also as part of a national government policy, in order to promote science and technology and enrich higher education.

Thirty-three national experimental research and education institutions are located in the city, and many private-sector research institutions are also moving in.

Various measures are currently being promoted to develop urban environments, to encourage science and technology, and to form bases for the creation of new industries both in Japan and abroad.

(2) Kansai Science City

The Kansai Science City is a part of Kyoto, Osaka, and Nara prefectures, and seeks to establish a base for new advancements in culture, science, and research of a creative and international nature that will extend across the 21st century.

The city is experiencing steady development in construction in accordance with the Kansai Science City Construction Promotion Law enacted in June 1987. At the end of FY2005, a total of about 250 facilities, including private sector research facilities, were established and operating within the city.

3.3.4 Development and Retention of Excellent Researchers and Engineers

3.3.4.1 Development of Researchers and Engineers; Reform of Universities

The development of excellent researchers and engineers is an extremely important issue within the reform of the science and technology system. Universities, which play the core role in that development, should step up the cultivation of researchers and engineers who possess abundant creativity and originality, have broad perspectives, and have acquired practical abilities. It is expected that universities will make various efforts to improve the quality of their education and research.

(1) Development of Human Resources at Universities

●Development of human resources with emphasis on graduate schools

Graduate schools promote learning that centers on theoretical research, and also play a role in developing researchers and other personnel with advanced expert skills. In Japan, about 80% of the 716 national, public and private universities in Japan have graduate schools attached, with a total of 558 schools (as of May 2005), and the total number of graduate school students at all national, public and private universities has been steadily increasing, to about 254,480 students as of May 2005 (Figure 3-3-17).

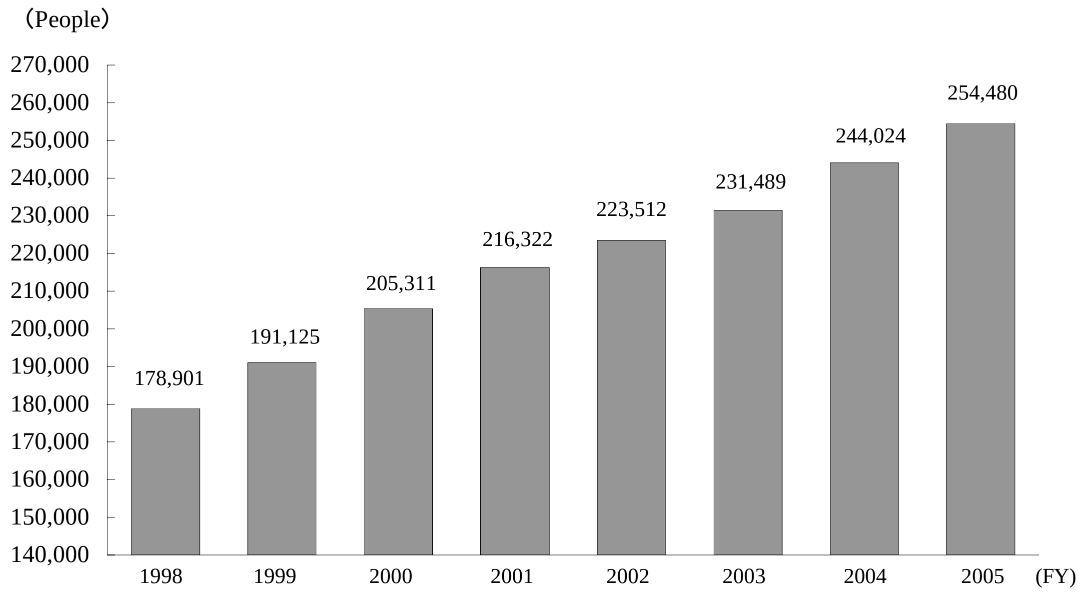


Figure 3-3-17 Trend in the number of graduate students

Note: The numbers are as of May 1 of each fiscal year.
Source: MEXT "School Basic Survey"

The report released by the Central Council for Education in September 2005, the "Graduate School Education in a New Age, Towards Development of Internationally Attractive Graduate School Education" called for measures to help substantialize graduate school education in Japan (the reinforcement of systematic development of school curriculum), and to improve their international acceptability and credibility.

In order to help strengthen the fostering function of young researchers who are rich in creativity and meet new needs of modern society, the Ministry of

Education, Culture, Sports, Science and Technology started carrying out in FY2005 "Initiative Graduate School Education in Graduate School" which provides intensive support to graduate schools which are engaged in aggressive and original educational efforts.

Additionally, the ministry is implementing "Long term internship program for graduate students" which supports the development and implementation of long-term high-quality internship programs aimed to foster advanced human resources who will play central roles in research fields in graduate schools and corporate activities.

It is also important to conduct off-campus graduate level education by utilizing the facilities, equipment, and human resources of private research institutions that have high research standards. Because of this, graduate students may receive research guidance from research institutions other than their own if their graduate school deems it educationally beneficial (Standards for Establishment of Graduate Schools, Article 13). The number of collaborative graduate schools that conduct research guidance of graduate students through coordination between graduate schools and private research institutions reached 105 universities (national, public and private) with 206 research courses in FY2004, and the number continues to increase year by year. Furthermore, a system of professional schools that specialize in providing practical education for the cultivation of high level professionals was established in April 2003. As of FY2005, 122 schools have been established.

●Development of science and engineering-related human resources

In order to resolve the diverse problems confronting modern society, and in order to open the path toward a prosperous future society, Japan must create new science and technology. In addition, Japan is expected to exhibit still more leadership and creativity, and to contribute further to international society, toward the goal of becoming a nation of creative science and technology. To support such efforts, it is extremely important for Japan to develop richly creative human resources in the science and engineering fields.

Additionally, it is necessary to strive for the growth of the manufacturing industry, which serves as a vital lifeline for Japan, and thus to promote the fostering of practically-oriented personnel in order to support fundamental technologies for manufacturing.

Universities are making efforts such as reorganizing and restructuring of departments and establishing graduate courses in graduate schools, to cope with the recent rapid technological innovation and changes in industrial structure. Also, the number of universities and colleges of technology using the Engineer Education Program Accreditation System[29], which is implemented by the Japan Accreditation Board for Engineering Education (JABEE) from the perspective of improving the quality of engineer education in universities and colleges of technology, and ensuring the international suitability and commonality of engineering education, is increasing. In FY2004, 84 programs were newly certified, and the total number of certified programs has now reached 186.

●Promotion of general education

General Education in universities must provide students a consolidated intellectual basis that can cope with rapid changes in society such as internationalization and progress in science and technology. Universities are expected to help the students to obtain knowledge and intellectual techniques such as thinking process commonly required beyond the borders of specialized fields, and to cultivate a profound insight in relation to the ideal way of existing and living for humans, and ability to accurately understand the realities.

Based on these points of view, the Ministry of Education, Culture, Sports, Science and Technology in FY2004 is supporting the active promotion of general education by universities through the implementation of necessary measures such as budgetary arrangements and information sharing, with the aim of expanding such education at universities. Universities are actively promoting general education courses by establishing courses of study with interdisciplinary and comprehensive content, as well as establishing classroom study incorporating internships and volunteer activities.

[29] Engineer Education Program Accreditation System: A system in which an external institution examines the contents of engineer education in institutions of higher education such as universities and certifies education programs fulfilling a certain level.

●Support for graduate students

To develop an environment in which exceptional graduate students can confidently proceed with their education, the Ministry of Education, Culture, Sports, Science and Technology works to support students in a number of ways, including the expansion of research scholarships provided by the “Research Fellowships for Young Scientists Program” of the Japan Society for the Promotion of Science (JSPS). Another is the expansion of teaching assistant (TA) programs for graduate students who excel. By having the TAs run educational assistance programs out of the educational concern of the Ministry, TA programs provide training opportunities to graduate students who will become future teachers and researchers and help assure undergraduate students receive individual and careful attention from their teachers. The Ministry also works to expand the scholarship program of the Japan Student Services Organization, which loans scholarships to exceptional students who need financial assistance with their studies in order to nurture personnel with the will and ability to lead the next generation (Figure 3-3-18).

In addition, research assistants are also promoted. Students with advanced standing in doctoral programs at graduate schools are made to participate in high-profile research projects undertaken by national universities, inter-university research institutes, and private universities. This develops the students’ abilities in carrying out research and also enhances the research system.

Moreover, to promote the research of scientists who have obtained competitive funding, the competitive funding system is being revised so as to allow the employment of doctoral students as a research expense. It is expected that the young researchers will develop into full-fledged researchers through participation in this research.

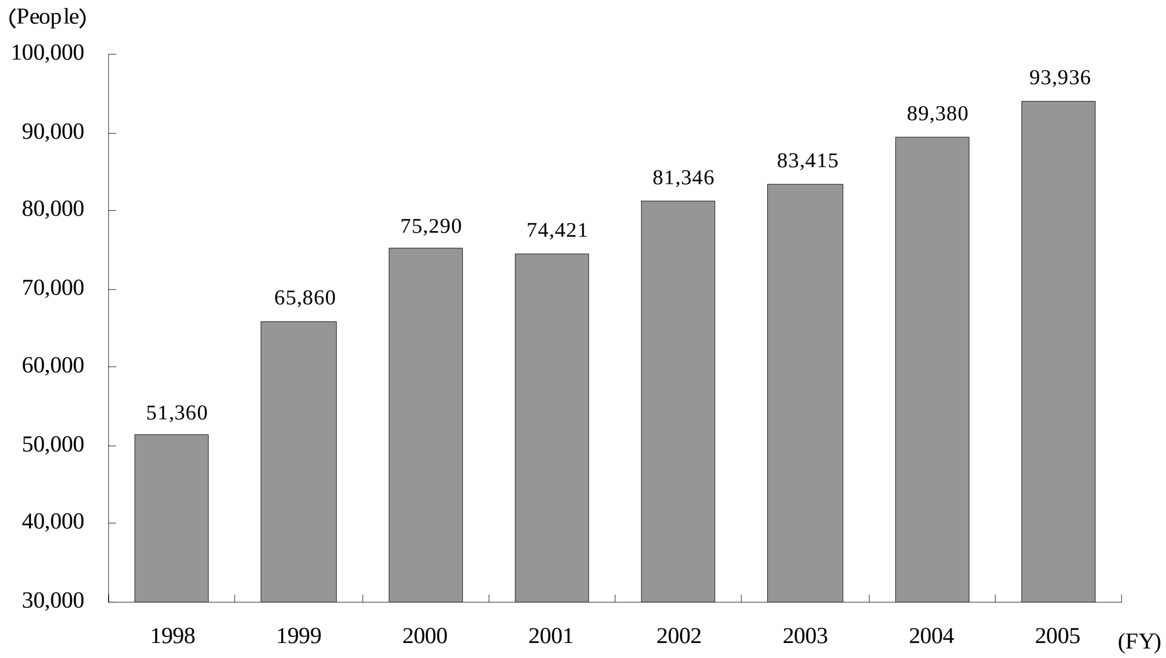


Figure 3-3-18 Trends in the total number of people (graduate students) receiving scholarships from the Japan Student Services Organization

Notes: 1. Figures include the number of scholarships budgeted each fiscal year.
2. Until FY2003, the scholarship program is implemented by the Japan Scholarship Foundation.
Source: Survey by MEXT

●Assistance for foreign students

The number of foreign students enrolled in Japanese institutions of higher education reached about 120,000, including about 30,000 graduate students (Figure 3-3-19).

On the other hand, the number of Japanese students studying abroad in universities and other institutions total 79 thousand in 33 major countries (FY2002), according to the statistics from the OECD and other sources.

The Ministry of Education, Culture, Sports, Science and Technology implements its policies in line with the fundamental direction shown in the report by the Central Council for Education in December 2003: (i) promotion of further exchange of students, such as accepting from and dispatching to foreign countries (ii) reinforcement of support for Japanese students to study abroad (iii) maintaining the quality of foreign students studying in Japan and enhancing the system to accept them.

Specifically, it founded a system for the long-term dispatch of students intending to obtain degrees such as doctors, and a scholarship system using loans for students studying abroad.

Efforts are made to accept foreign students with the focus on a graduate school level, such as a continuous approach to expand the acceptance of government-financed foreign students, as well as the enhancement of support to privately-financed foreign students by providing subsidies to encourage study for high-achieving students with a need for economic aid.

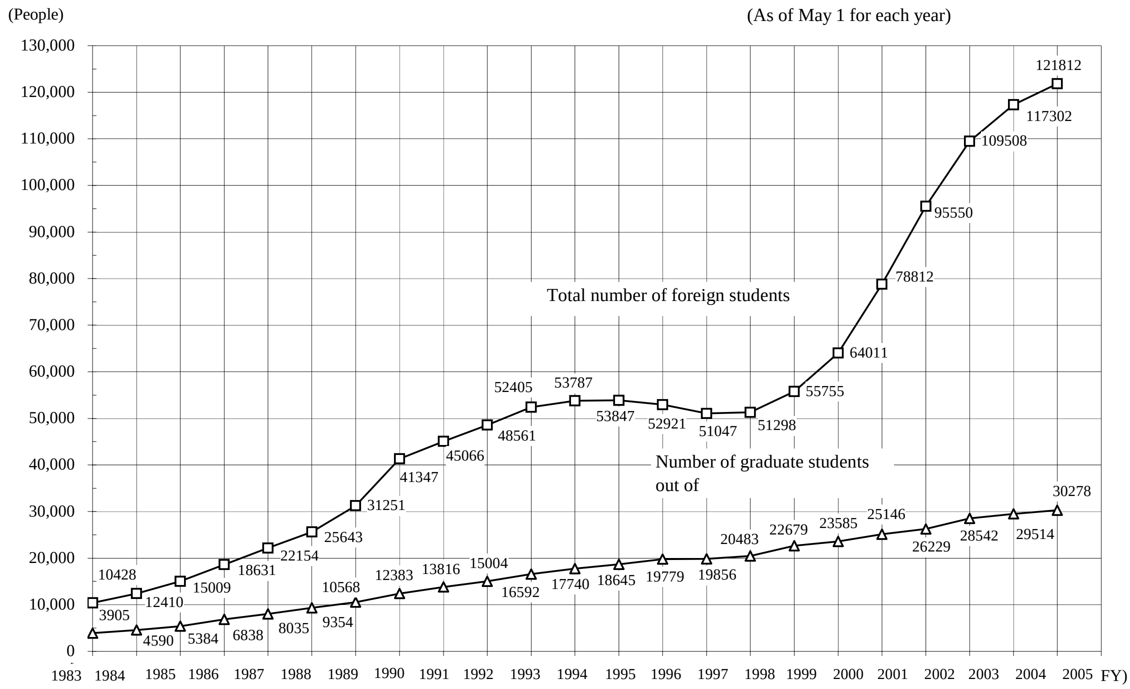


Figure 3-3-19 Trends in the number of foreign students in Japan

(2) Development of Human Resources at Colleges of Technology

Colleges of technology were established as institutions for higher learning that implement five-year programs designed to develop human resources with practical skills. The education results produced by these colleges of technology have been highly praised by industry and other corners. To fulfill the critical role of these educational institutions designed to develop practically skilled personnel with a rich capacity for creativity, colleges of technology are striving to expand upon further education, including the enhancement of “community-based” coordination based on the features and characteristics in each area. Moreover, in September 2005, the “Establishment Standard for Colleges of Technology” was revised, making it possible for each college of technology to design flexible curriculums based on originality and ingenuity.

(3) Development of Human Resources at Specialized Training Colleges

In order to support the development of human resources who will become the assets demanded by society, the Ministry of Education, Culture, Sports, Science, and Technology is implementing measures, including the development of e-learning and distance education between schools; the development of programs to respond to social needs; and the provision of financial assistance for the development of large-size education equipment and information processing-related facilities.

(4) Development of Human Resources at High Schools

Along with expanding "Super Science High Schools," where curriculums that emphasize science and mathematics are being studied and developed, efforts for the planned development and expansion of science education equipment, such as experimental equipment in schools, are now in progress. Moreover, efforts are being taken to expand facilities and equipment for experimentation and practice, to promote vocational education that responds appropriately to changes in society. Additionally, MEXT is implementing the "Aspire to be a Specialist! (Super Specialized Upper Secondary Schools)" program, which assigns specialized upper secondary schools, such as industrial high schools that will be engaged in education adopting cutting-edge technologies and skills in coordination with industry and research institutions, etc. in the region.

3.3.4.2 Fostering Engineers

To become a science and technology-based country, it is necessary to create industrial frontiers and strengthen international competitive power through technological innovation, as well as to strengthen the technological foundation. For this purpose, efforts are being made to foster sufficient leading engineers through the following policies.

(1) Professional Engineer System

The Professional Engineer System was established with the enactment of the Professional Engineer Law in 1957 (revised in 1983). It aims to contribute to the improvement of science and technology and the development of the national economy through sound engineering, by conferring the qualification of "Professional Engineer" on those who possess advanced and specialized abilities in applying science and technology to planning and design work.

Those who apply to become a Professional Engineer are required to pass the national examination that is given in 21 fields of specialization, and become registered as a Professional Engineer. The examinations are held annually for both Professional Engineer and Associate Professional Engineer (Engineer in Training). In FY2005, the test resulted in 10,063 individuals being certified as Associate Professional Engineers, and 3,664 being certified as Professional Engineers. As of the end of December 2005, there were a total of 18,636 people registered as Associate Professional Engineers, and 56,748 registered as Professional Engineers. The distribution by sector is shown in Figure 3-3-20.

Based on deliberations by the Council for Science and Technology's Subdivision on Professional Engineer, the Ministry of Education, Culture, Sports, Science and Technology revised the professional engineering test. Revised points included emphasis on oral questions on technological experiences of examinees, and the abolition of multiple choice questions. The revised test will be implemented in FY2007.

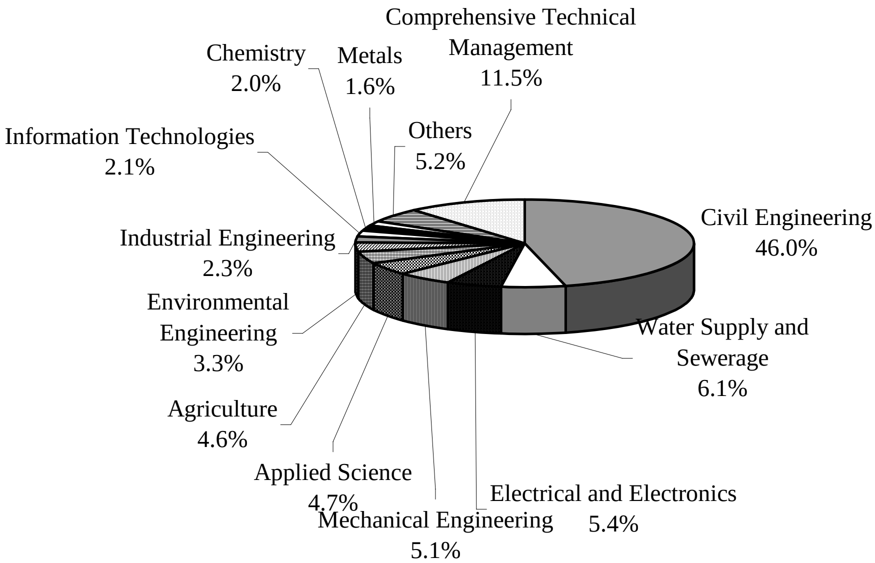


Figure 3-3-20 The distribution of professional engineers by the field of specialization (as of the end of December 2004)

(2) Mutual Exemption of Engineering Qualification

Based on the Osaka Action Agenda adopted at the APEC summit meeting of 1995, work has been progressing on the "APEC Engineer Mutual Recognition Project" for the promotion of mutual acceptance of engineer qualifications within the APEC region. Japan has actively participated in studies for this project, toward the realization of mutual recognition of the Professional Engineer qualification with corresponding qualifications overseas.

In November 2000, the "APEC Engineer Manual" was published based on the results of studies at APEC. As of June 2005, there were 13 participating economies in the register, including Japan.

3.3.5 Establishing Channels for Communication between Society and Science and Technology Activities

Only when the significance of science and technology and its relation to daily life are well understood by citizens can long term utilization and progress in science and technology can be made. The support of citizens must be essential to the promotion of science and technology. Furthermore, science and technology should fundamentally progress in accordance with the interests of citizens. The individuals engaged in science and technology should always bear this in mind.

Efforts should be made to ensure a deep understanding of science and technology among citizens so that people can judge various social issues in a scientific, rational, and independent manner.

3.3.5.1 Promoting the Study of Science and Technology

In Japan, many observers indicate that the younger generation and many other members of society are growing further alienated from science and technology. In order to improve this situation, it is extremely critical to foster an interest and awareness of science and technology among the younger generation, and to create an environment that fosters science and technology-oriented human resources of a high standard.

(1) Promotion of Science and Vocational Education at the Elementary and Secondary Education Level

The development of the socio-economy of Japan has been largely supported by science and technology. In light of the major role played by science and vocational education in such efforts, Japan strives to further enhance such education.

The Ministry of Education, Culture, Sports, Science and Technology is making expanded efforts to foster children's scientific ways of looking at and thinking about the world around us. To this end, science education at the elementary and secondary education levels emphasize observation and experimentation, learning through pro-active investigation of topics, and learning through problem solving.

Under the "Science Literacy Enhancement Initiative," which started in FY2002, the Ministry has been implementing efforts such as the "Super Science High Schools," which aims to develop curricula with an emphasis on science and mathematics, and conduct advanced science and mathematics education in collaboration with universities, the "Science Partnership Program," which promotes collaboration between universities or science museums, etc., and elementary, junior and senior high schools for their working together in learning activities and teacher training, and expand opportunities for children to come into contact with science and technology, and the "Science and Mathematics Literacy Enhancement Model Area Program," which aims to comprehensively combine educational resources such as local science museums and volunteers with schools playing a core rule, and expand opportunities for observation, experimentation and learning through pro-active investigation of topics, and learning through problem solving. In addition, the Ministry is proceeding with efforts supporting participation in International Science and Technology Contests, the development of digital materials for science and technology education that make use of the latest research results and their provision over the Internet, etc., and the planned development and expansion of science education equipment such as experimental equipment at schools.

At the same time, in the area of vocational education, practical, hands-on learning has been further expanded in order to adequately respond to progress in an industrial society. To achieve this objective, training sessions and other meetings are being held in order to train instructors in new industrial technologies, and efforts are being made for the planned development and expansion of vocational education facilities and equipment at the high school level, in keeping with the new courses of study. Moreover, MEXT is newly implementing the "Aspire to be a Specialist!(Super Specialized Upper Secondary Schools)" program, which assigns specialized upper secondary schools such as industrial high schools that will be engaged in education adopting cutting-edge technologies and skills in coordination with industry and research institutions, etc. in the region.

The prefectural and district boards of education are making good use of scientists, engineers, and other individuals who do not have a teacher certificate—but who do have exceptional knowledge and experience—to serve as special part-time teachers in order to support opportunities for children to learn directly from experts in their respective fields.

Additionally, instruction in specialized subjects has been enhanced by making it possible for junior and senior high school teachers who have greater expertise and skills in teaching specific subjects to provide instruction in science and other subjects at elementary schools.

(2) Technical College Education

With the unprecedented growth of science and technology in recent years, there have been major changes in the makeup of basic scientific knowledge that students need to acquire at the university level. There has also been an increase in the number of issues that require ethical judgments, including global environmental problems and life science fields, such as genetic engineering. For this reason, students specializing in disciplines other than science and technology must also acquire knowledge related to the natural sciences, and must foster an ability to make judgments in a broad range of fields based on this knowledge. Those students who are majoring in any subject within science and technology must acquire a broad range of scientific knowledge and ability to make judgments above and beyond their major of choice.

In light of this situation, it is critical to strive to cultivate in students an ability to make judgments from a broad perspective, by expanding the realm of general education. With the support of the Ministry of Education, Culture, Sports, Science and Technology, universities are actively engaged in efforts such as the establishment of courses of study with interdisciplinary and comprehensive content, in addition to courses of study made up of seminars with small groups of students, and classroom study that incorporates internships and volunteer activities.

(3) Increasing the Public's Understanding of Science and Technology

The Ministry of Education, Culture, Sports, Science, and Technology is implementing measures to promote the increased understanding of science and technology, through the holding of public lectures on science and technology at universities and colleges, and through the development and expansion of the University of the Air that offers courses in science and technology. The Ministry also supports symposiums and science lectures which aims to disseminate, in an easy-to-understand manner, information about research trends and research contents in fields which are considered to be of high interest to young people or adults in the general population. Additionally, the Ministry is implementing specialized training for museum specialists employed at science museums, etc., in order to improve their level. Also, by dispatching expert staff such as curators to science and other museums in foreign countries for training, it is expected that they will obtain sophisticated expert knowledge and skills.

The National Science Museum conducts learning support programs—such as science classes and experimentation courses for young people or general adults—that serve to deepen the understanding of science and technology. Specifically, the Museum started the University Partnership Project in FY2005 with the aim of improving students' science literacy and science communications capabilities. The project included free admission for students and deliberations for science communicator training in coordination with universities.

The Japan Science and Technology Agency is developing pioneering exhibition methods that allows the visitors to feel familiar to and experience state-of-the-art science and technology. It is also engaged in the operation of the "National Museum of Emerging Science and Innovation," a comprehensive base for transmitting information on cutting-edge science technologies. In this National Museum of Emerging Science and Innovation, the latest research results and details, which are often regarded as too difficult, are explained in an easily understood manner by employing methods such as interactive exhibitions, experiments and projected images, and allocating many interpreters (commentators). Through these activities, the Japan Science and Technology Agency is trying to activate interactive communication between society and science and technology, as well as fostering human resources for science and technology communication who support these activities. In addition, it is striving to The Japan Aerospace Exploration Agency (JAXA) is providing various experiential learning programs such as the "Cosmic College" and the

"Space School," in order to implement educational support activities with the aim of getting the young people and children who will lead the next generation to raise their interest in space science and other science, and spreading a network of science-loving children.

In FY2005, the Ministry of Agriculture, Forestry and Fisheries implemented the hands-on learning program of advanced agroforestry research targeted at elementary and junior high school students at the Tsukuba Agriculture and Forestry Research Complex.

3.3.5.2 Establishing Channels for Communication with Society

In order to promote science and technology, it is necessary to deepen the understanding of science and technology by citizens. For this reason, efforts are being made to implement various events related to science and technology, to open up research institutes to the public, and to enhance the functions of museums, science centers, etc. In addition, efforts are being made to expand the opportunities for disseminating science and technology in an understandable manner, using the media and other means. Furthermore, at the regional level, efforts are being made to foster and secure personnel who will shoulder the task of describing science and technology-related matters in an understandable manner, and conveying to experts involved in science and technology the science and technology-related opinions of regional citizens.

(1) Providing Opportunities for Better Familiarity with Science and Technology

It is critical to provide diverse opportunities for the citizens and youth in particular to deepen their familiarity with science and technology, in order to create a societal environment that embraces a familiarity and strong interest in science and technology.

●Efforts utilizing multimedia

The Japan Science and Technology Agency (JST) is engaged in the production of visual programs for presentation on the "Science Channel," which transmits information to the public about science and technology via CS (Communications Satellite) broadcasting, cable TV and the internet. The JST also uses the latest computer technology to provide science and technology information through a "Virtual Science Center".

●Other events

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) is implementing a variety of promotion activities, including broadcast of television and radio programs; production, and distribution of commercials; publications; and the sponsoring of various seminars related to science and technology. During commemorative weeks such as "Science and Technology Week," "Atomic Energy Day," and "Space Day," MEXT implements various nationwide events in cooperation with affiliated organizations, as well as conducting PR activities by government publicity through television and radio programs. During Science and Technology Week in FY2005, MEXT held the "Science Café" in Marunouchi, Tokyo, and created and distributed a poster which introduced the leading-edge uses of each element under a campaign titled, "One Sheet for a Family, the Periodic Table of the Elements." Many events were also held at research facilities, science museums and other institutions across the country, including the opening of research facilities to the general public, science and technology experiment classrooms, etc. These events were held with the cooperation of various science and technology-related organizations.

●Support for hands-on activities

The "Children's Dream Fund," established by the National Olympics Memorial Youth Center (since April 1, 2006, the National Institution for Youth Education), is providing support for children's science activities and other experiential activities conducted by private-sector groups.

In addition, the National Science Museum registers "Science Volunteers" who can lend a hand as lecturers or give instruction in experiments at events or exhibitions related to science and technology. That information is then provided over the Internet.

Additionally, the Ministry of Education, Culture, Sports, Science and Technology implements pre-admission familiarization programs at universities and colleges of technology, in order to share information with youth and society concerning the enjoyment of science and engineering-related fields.

●Opening of universities and research institutions to the public

Increasing numbers of university research institutions and inter-university research institutes are opening their doors to the public by introducing their research activities, holding lectures, and other meetings. For example, the National Astronomical Observatory of Japan holds a "Regular Stargazing Program" using the 50 cm Telescope for the Social Education. These meetings are held twice a month for the general public and youth. In addition, the Institute of Industrial Science (IIS), University of Tokyo offers tours for the general public, and junior and senior high school students in particular, as well as exhibitions of research exchanges between industry and academia.

Furthermore, the Ministry of Agriculture, Forestry and Fisheries has established the Tsukuba Agriculture Research Gallery, which provides exhibits on up-to-date results and achievements from agriculture, forestry, and fisheries technologies, with the aim of information dissemination and awareness. In addition to permanent exhibits, specially planned exhibits have been held since FY2003. The National Agriculture and Bio-oriented Research Organization is striving to disseminate research results by implementing the dispatch of the "Research Result Caravan" and other activities.

●Children's White Paper on Science and Technology

Since FY1999, the Ministry of Education, Culture, Sports, Science and Technology issues the "Children's White Paper on Science and Technology" every year, picking up a timely theme such as life science and space development, and explaining it in an easy-to-understand manner using comics. "Children's White Paper on Science and Technology" is released in full on the website of the Ministry of Education, Culture, Sports, Science and Technology. It is also distributed to elementary schools, public libraries and science museums nationwide, and is sold in government publications service centers and other places.

The latest issue, published in March 2006, has "Disaster Prevention Technology" as its theme, and explains, in an easy-to-understand manner, science and technology related to natural disasters centered on earthquakes from the viewpoint of "learning about and predicting" natural disasters, "protecting" ourselves, and "saving" ourselves from damage by using comics, photos, and an attached CD-ROM.

(2) Awards for science and technology

An effective measure for promoting science and technology is to encourage research and development through recognition for inventions and awards for outstanding service in science and technology.

Therefore, the Ministry of Education, Culture, Sports, Science and Technology gives an award to those who recently made notable achievements in the science and technology fields in Japan. In FY2005, 89 achievements were selected for the science and technology award and 162 people were commended. The number of the recipients by categories is 19 items and 51 people for development merits, 31 items and 54 people for research merits, one item and one person for contributions in science and technology promotion, 25 items and 36 people for technology merits, and 13 items and 20 people for contributions to the promotion of understanding. Additionally, 63 people were selected for the young scientist award, 984 people for ingenuity merits, and 21 schools for making notable achievements in fostering the ingenuity of elementary and junior high school students.

In order to address the decreasing interest in industrial technology and the distant trend away from science and technology in the younger generation, since FY1993, the Ministry of Economy, Trade and Industry has been carrying out fact-finding surveys on innovations in industrial technology and other programs, by evaluating and preserving industrial technologies, in order to ensure that these technologies are passed on to the youth who will be responsible for the future. As a part of this effort, the Ministry supported the "Industrial Technology History Exhibition: Technofesta 21" project, held in August 1997 as a joint effort among industry, academia, and the government. Furthermore, since 1993, the Ministry has implemented a "Dream Chemistry 21" campaign that consists of university chemistry experiments and other activities, with the aim of passing on chemistry technology to the younger generation who will lead in the 21st century.

3.3.5.3 Establishing an Ethical Code of Conduct for Researchers and Engineers

Science and technology support people's lives and develop society, but at the same time they can exercise considerable influence over the entire globe. Therefore, if ethical misconduct occurs in science and technology, it is a critical problem in that such behavior may not only seriously affect people's lives and welfare, but result in harming human dignity. The Science Council of Japan conducted a deliberation on the prevention of misconduct in research processes including fabrication, falsification and plagiarism, and compiled the report, "Misconduct in Science, Present Status and

Countermeasure" in July 2005. The proposals made in the report called on individual scientists to observe high ethical standards, and asked research institutions, academic societies and other entities to prepare their own code of ethics, etc. In accordance with the report, the Science Council of Japan established a committee to study the drawing up of a specific code of conduct for scientists, and started discussions in December 2005. At the same time, in February 2006, the "Special Committee on Scientific Misconduct" was established in the Council for Science and Technology at the Ministry of Education, Culture, Sports, Science and Technology, and survey and deliberations to respond to misconduct in research activities utilizing competitive funds are conducted.

3.3.6 Developing a Foundation for Promoting Science and Technology

3.3.6.1 Strategic and Prioritized Improvement of Facilities and Equipment

(1) Improvement of Facilities and Equipment of Universities, etc.

The facilities of national universities, etc., are centers of activity for creative and cutting edge academic research, and for the development of richly creative human resources, and constitute an essential foundation for Japan's aims to become a creative science and technology nation.

The Second Science and Technology Basic Plan positions the improvement of aged and increasingly cramped facilities at universities and colleges as the most important issue in the development of foundations for the promotion of science and technology. In response, the Ministry of Education, Culture, Sports, Science, and Technology in April 2001 drew up the "Five-Year Program for Emergent Renovation and Building of Facilities of National Universities, etc." (Figure 3-3-21), under which it is implementing the prioritized and systematic improvement of facilities at national universities, etc. and carrying out system reforms aimed at the efficient and flexible utilization of facilities.

For research facilities, the ministry held discussions to "improve academic research facilities at national, public and private universities," at the Working Group for Academic Research Facilities established under the Council for Science and Technology, and subsequently issued a report in June 2005.

In light of the report, the government is promoting more effective support for the improvement of facilities at national universities, including facilities as research infrastructure that are planned from mid- to long- term viewpoint and facilities that are required to promote specialized research.

In support of the development of research facilities and equipment at private universities, the ministry subsidizes expenditures necessary for large-scale education and research tools, educational equipment, on-campus LAN systems, and IT environments with computers and other equipment in order to promote the advancement of academic research and education.

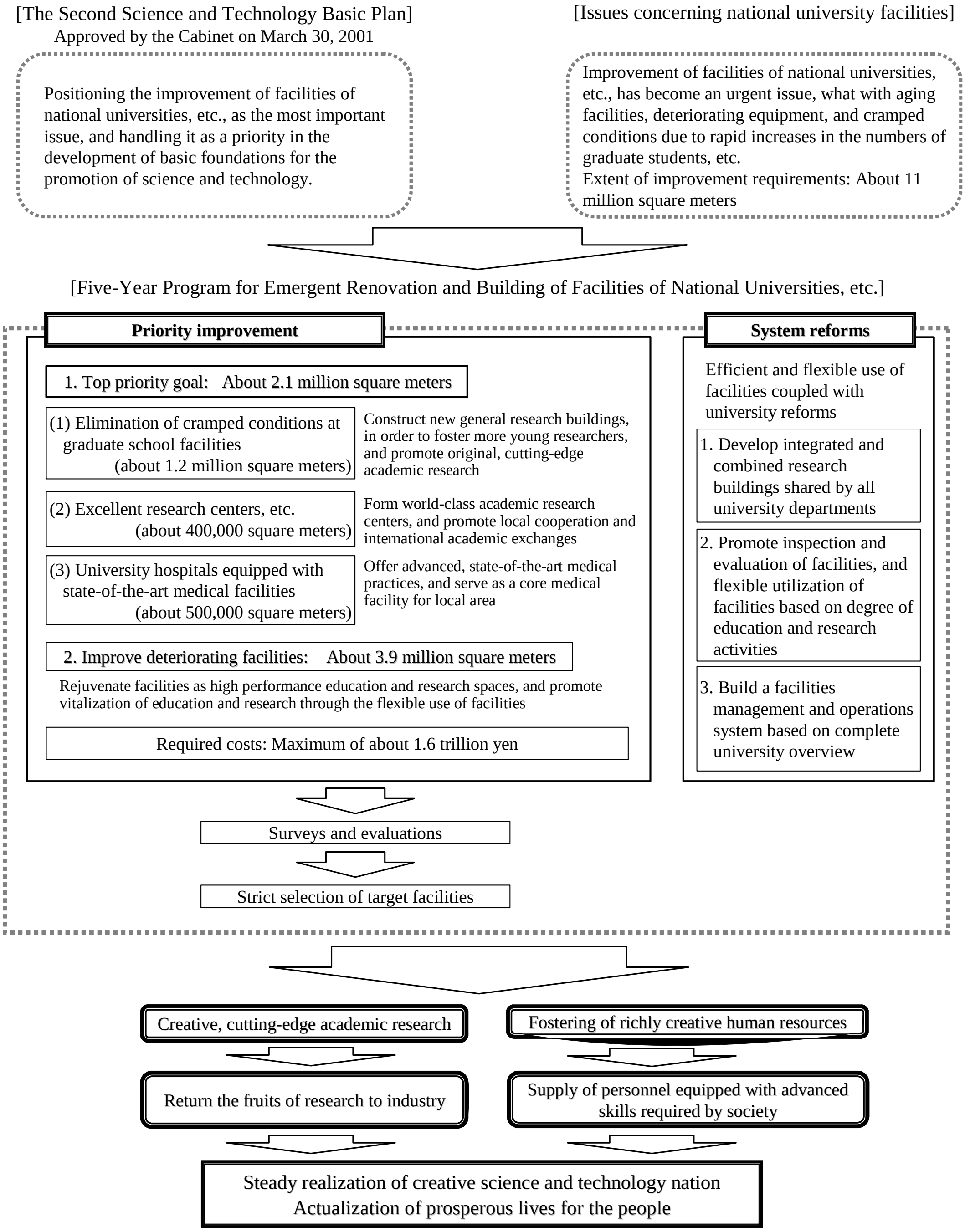


Figure 3-3-21 Five-Year Program for the Emergent Renovation and Building of Facilities of National Universities, etc.

(2) Development of Facilities and Equipment at National Experimental Research Institutions

As facilities and equipment which form the infrastructure for research activities are upgraded and expanded, the development of these facilities and equipment has not only become necessary for the promotion of efficient research, but also has had a major effect on the actual results of R&D. The national government is working to maintain and enhance research and development facilities at national experimental research institutions, etc., and focusing on priority research topics.

As for the upgrade of the facilities and equipment, the Ministry of Education, Culture, Sports, Science and Technology has been promoting a plan to upgrade the "X-ray Free Electron Laser (XFEL)," as one of its measures. XFEL, which produces dream light combining the characteristics of synchrotron radiation and laser, is expected to serve as an R&D infrastructure that enables the generation of many advanced research results in a wide range of science and technology fields. XFEL is now under construction and will be completed in Fiscal 2010. The United States and Europe are also developing XFELs, with planned completion dates of Fiscal 2009 and Fiscal 2012 respectively. Thus international competition is fierce (Figure 3-3-22).

The ministry is conducting R&D on basic technologies related to supercomputing hardware aimed at developing and improving next-generation supercomputers by Fiscal 2010 (see section 3.2.3.5).

Table 3-3-22 Large-scale synchrotron radiation facilities in the world

Main body of the project	Laser emission wavelength	Full length	Estimated FY of completion
SLAC (US)	0.15 nm	2.0 km	FY2009
DESY (Germany)	0.085 nm	3.4 km	FY2012
RIKEN (Japan)	0.06 nm	0.8 km	FY2010

Note) SLAC: Stanford Linear Accelerator Center
DESY: Deutsches Elektronen-Synchrotron
(German-led joint project participated in by 11 countries in Europe)

3.3.6.2 Expansion in Number of Research Assistants

Expansion of the research assistant system, which allows researchers to concentrate solely on research and development activities, is an essential element for the invigoration of research and development activity. The trend in the number of supporting staff per researcher since the adoption of the First Science and Technology Basic Plan is shown in Table 3-3-23.

Table 3-3-23 Trends in the number of supporting staff per researcher

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005
Incorporated administrative agencies and	0.77	0.79	0.84	0.84	0.82	0.96	0.98	0.88	0.87
National universities	0.24	0.24	0.24	0.25	0.25	0.26	0.26	0.27	0.28

Notes: 1. Supporting staff includes assistant research workers, technicians, clerical and other supporting personnel. The values are as of April 1 up until 2001, and as of March 31 from 2002.
2. Incorporated administrative agencies include public corporations that the main purpose at the R&D activities and national experimental research institutions. (However, until 2001, the numbers indicate only national experimental research institutions.)
3. The numbers for researchers at national universities and, until 2001, independent administrative agencies are for regular researchers.
4. Includes natural science departments only.
5. National universities refer to the departments of national universities (including graduate schools), national juniorcolleges, national colleges of technology, laboratories affiliated to national universities (including research facilities), and the Inter-University Research Institute Cooperation. These entities now intend to reinforce their system for research support at their own discretion.

Source: Statistics Bureau, Ministry of Internal Affairs and Communications "Report on the Survey of Research and Development"

3.3.6.3 Enhancement of the Intellectual Infrastructure

In order to reliably and effectively promote research, development and other related activities, it is necessary to undertake efforts such as ensuring the stable provision in quality and quantity, as well as ensuring the safety and reliability, of materials, standards, techniques, equipment, and other elements, that support fundamental activities for research and development, including experimentation, measurement, analysis, and evaluation. For this reason, it is necessary to promote organized development of an intellectual infrastructure that includes bioresources and other research materials, various measurement standards, advanced tools for measurement, analysis, and experimentation and evaluation, and various data-bases. Also, the Second Science and Technology Basic Plan calls for improvements toward the attainment of the world's highest standards by 2010. In response, the Council for Science and Technology, an advisory group to the Minister of Education, Culture, Sports, Science, and Technology, obtained the cooperation of the relevant ministries and agencies to adopt the "Intellectual Infrastructure Development Program," which lays out specific measures for the development of intellectual infrastructure by 2010. The proposed program was presented to the Minister in August 2001. The state of progress of the intellectual infrastructure development has been followed up annually since Fiscal 2002.

1) Ministry of Internal Affairs and Communications

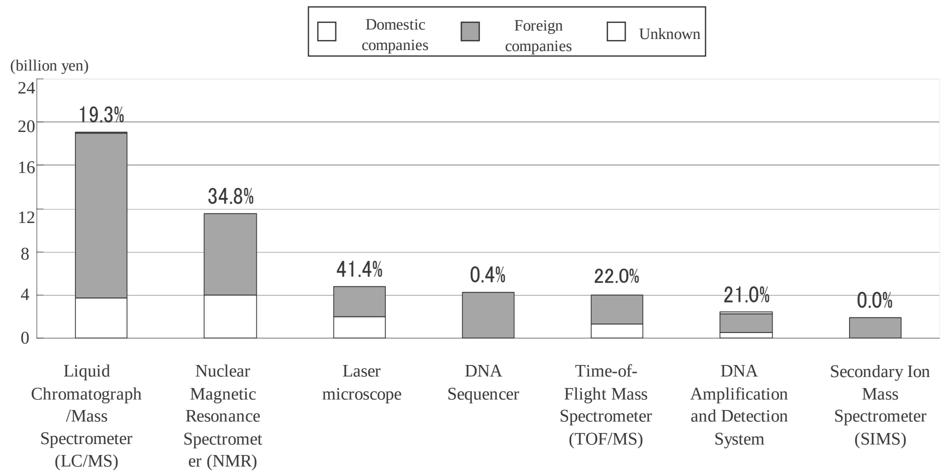
In the area of measurement standards, the Ministry of Internal Affairs and Communications has established national standards for frequency, and is developing facilities for standard time transmission, as well as working to ensure that transmissions are provided in a stable and consistent manner. The Ministry is also conducting research to improve the accuracy of the standards for frequency and time.

2) Ministry of Education, Culture, Sports, Science and Technology

In Fiscal 2002 the Ministry began the National Bioresource Project with the aim of developing systems to systematically collect, preserve, and provide bioresources deemed strategically important for the nation to maintain, including experimental plants and animals such as mice, various stem cell lines, and genetic resources, including the genetic material of various organisms.

In addition, the Japan Science and Technology Agency's Institute for Bioinformatics Research and Development (BIRD) upgrades, standardizes, and expands databases that are indispensable to the development of bioinformatics.

Independent research and development on measurement, analysis, experimentation and evaluation, and on the state-of-the-art technologies and instruments for them, is not only the basis that upholds the research and development activities. Supported by the fact that the many researches and developments of these kinds themselves receive the Nobel Prize, it is an extremely important task for our country to serve as one of the world's front-runners in the fields of science and technology. However, the degree of dependence to foreign countries for advanced measurement and analysis instruments in Japan is high. In particular, the area of life science relies on foreign companies for most of the instruments for pioneering research (Figure 3-3-24). On the basis of this situation, the Ministry also conducted a study of the development of advanced measurement and analysis technology and equipment in Fiscal 2003, in order to promote the development of the world's first "only one / number one" technology and equipment that can meet the needs of the world's most advanced researchers. The Ministry then took measures to launch a project for the development of advanced measurement and analysis technology and equipment in Fiscal 2004.



*Domestic companies: shares of companies produce and sell instruments in Japan
Foreign companies: shares of companies selling instruments produced abroad
*Figure shown with "%" in the table shows the share of domestic companies in the domestic market.
Source: Prepared by the Ministry of Education, Culture, Sports, Science and Technology, based on the "Kagaku Kiki Nenkan 2005" published by R&D Corp.

Figure 3-3-24 Shares of major measurement and analysis instruments by Domestic and foreign companies (FY2004)

3) Ministry of Health, Labour and Welfare

The Ministry of Health, Labour and Welfare has established "master banks" at the National Institute of Biomedical Innovation (NIBIO), in order to collect and store cultured cells and genes from humans and animals that are necessary for research in the life sciences, particularly in the fields of medicine and pharmacology. The ministry furnishes these cultured cells and genes to researchers and other experts through the Japan Health Sciences Foundation (JHSF).

Also, in line with the conclusions reached in "On the State of Research and Development Using Human Tissue Obtained During Operations, etc.," a report on human tissue issued by the Health Science Council's Advanced Medical Technology Evaluation Division on December 16, 1998, the Japan Health Sciences Foundation obtained the cooperation of medical institutions to collect human tissue for research use, doing so in careful consideration of bioethical issues, and commenced activities to dispense the tissue as necessary to researchers.

Elsewhere, on the issue of plants having medicinal value, as it has become difficult to secure good quality ones, the NIBIO's Research Center for Medical Plant Resources is engaged in research into technologies for the propagation (micro-propagation) of cloned plants having the same characteristics as the plants they are cloned from, and also systematically collects, preserves, and supplies medicinal plant resources. Moreover, at the Tsukuba Primate Center, the Ministry has bred kanikui-zaru monkeys, and furnished them for research use to researchers in Japan using joint facilities.

4) Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture, Forestry and Fisheries implements the MAFF Genebank project, in which genetic resources from plants, animals, microorganisms, forest trees, aquatic organisms, etc., are collected, classified and identified, then subjected to characteristic evaluation, multiplication, and preservation. This program also provides national experimental research institutions, the private sector, universities, etc., with genetic resources and genetic resource information. In addition, the Ministry implements the DNA Bank project, which collects, accumulates, and distributes both DNA and DNA information resulting from genome research and other genetic-level research.

The Ministry also established in April 2003 the Rice Genome Resource Center (RGRC) under the auspices of the National Institute of Agrobiological Sciences (NIAS). By collectively managing genome research data and resources, RGRC provides improved convenience and a smooth system of delivering information to the private sector and universities. Through the management and analysis of the information contained in the collectively managed resources, RGRC also provides highly precise associated resources and data.

5) Ministry of Economy, Trade and Industry

At the Ministry of Economy, Trade and Industry, the Special Committee on the Development of Intellectual Infrastructure, a joint body composed of the Industrial Structure Council Subdivision on Industrial Technology and the Japanese Industrial Standards Committee (JISC), revises the objectives for the development of intellectual infrastructure annually.

The National Metrology Institute of Japan (NMIJ), which is part of the National Institute of Advanced Industrial Science and Technology (AIST), is improving and expanding national measurement standards, and also making efforts toward international mutual recognition. In total, 232 physical standards and 225 reference materials had been provided by the end of Fiscal 2005. In addition, the New Energy and Industrial Technology Development Organization (NEDO) conducted R&D on remote calibration as part of a plan for the period from Fiscal 2001 to Fiscal 2005. Based on the research results achieved by Fiscal 2005, the ministry will conduct R&D to provide the standards to meet the actual conditions faced by industries as part of its plans for the period from Fiscal 2006 to Fiscal 2008.

With respect to information infrastructure for genetic information, DNA analysis is being performed for microorganisms at the genome analysis facility of the Department of Biotechnology, National Institute of Technology and Evaluation (NITE). The base sequence of the magnetic bacterium, the Gemmatimonas aurantiaca, and the Kocuria rhizophila, were identified in Fiscal 2005.

In Fiscal 2005, the NITE Biological Resource Center (NBRC) added approximately 20,000 microbial strains and DNA clones to its collection—now totaling approximately 76,000 items which it maintains and provides to the public. The Biotechnology Development Center started joint research through industry-academia-government cooperation as an effort to add high value to genetic resource information from Fiscal 2003, and currently conducts four joint research projects for the putting of the research results to practical use by research partners. In Fiscal 2005, the ministry increased the number of patents deposited at the NITE Patent Microorganisms Depositary (NPMD), which was established to strengthen the functions of biological resource centers in Fiscal 2004. The ministry also provided support for holding a meeting in Thailand, as a secretariat of the "Asian Consortium for the Preservation and Sustainable Use of Micro Organism Resources," the world's first framework for multinational cooperation at the government level in Asia for the purpose of cooperative management and use of microorganism resources. The National Institute of Advanced Industrial Science and Technology implements protein analysis based on data obtained from the analysis of the DNA of microorganisms. It also preserves and distributes microorganisms and plant and animal cells related to patents.

In terms of data infrastructure for chemical substance risk management, the Ministry collects and coordinates data of hazardous chemical substances. The Ministry also develops simplified testing methods to evaluate the safety of these substances, as well as screening test methods for endocrine disruptors. In addition, the Ministry carries out research and development regarding risk assessment methods of chemical substances.

For the development of infrastructure for quality life and welfare, the Ministry supports the development of products designed in consideration of human characteristics, through the improvement of 3D data maintenance and the development of methods for evaluating the function and performance of welfare equipment.

Moreover, the Ministry is involved in developing an improved materials database. Concerning geological information, the Ministry also promoted geological surveys that produced 11 new kinds of geological sheet maps in Fiscal 2005.

6) Ministry of Land, Infrastructure and Transport

The Ministry of Land, Infrastructure and Transport deals with a variety of information related to the Geographic Information System (GIS); it prepares GIS framework information such as digital maps, and develops distribution environments such as provision of data over the Internet, and the expansion of clearinghouses.

7) Ministry of the Environment

The Ministry of the Environment is engaged in the indexing of environmental pollutants, and in the collection, preservation, and furnishing of micro-organisms with environmental cleaning properties, and of novel genetically modified or recombinant microorganisms.

The status for the development of facilities to preserve and provide intellectual infrastructure by government ministries is shown in Table 3-3-25.

Table 3-3-25 The state of development of intellectual infrastructure

Ministry or agency	Fiscal year established	Name of facility	Type of data provided or preserved
Ministry of Internal Affairs and Communications	1940	National Institute of Information and Communications Technology	National frequency standards, and standard time
Ministry of Education, Culture, Sports, Science and Technology	1980	RIKEN (The Institute of Physical and Chemical Research)	Preservation of microorganism strains
	1997	Center for Genetic Resource Information, at the National Institute of Genetics	Genetic resource database
	1997	Genetic Strains Research Center, at the National Institute of Genetics	Mice, rice plants, and Escherichia coli
	1997	Cell Resource Center for Biomedical Research, at the Institute of Development, Aging and Cancer, Tohoku University	Cells for medical use
	1997	Barley and Wild Plant Resource Center, at the Research Institute for Bioresources, Okayama	Barley and wild plants
	1997	Institute of Genetic Resources, at the Faculty of Agriculture, Kyushu University	Silkworms
	1998	Institute of Resource Development and Analysis, at Kumamoto University	Genetically engineered animals
	1999	Drosophila Genetic Resource Center, at Kyoto Institute of Technology.	Drosophila
	2000	RIKEN (The Institute of Physical and Chemical Research)	Cultured cell lines and genes of higher animals and plants
	2001	Laboratory Animal Resource Center, at the University of Tsukuba	Genetically engineered animals
	2002	Institutes participating in the national bioresource project (RIKEN (The Institute of Physical and Chemical Research))	Mice, arabidopsis thaliana, ES cells, etc.
Ministry of Health, Labour and Welfare	1922	Mediclnal Plant Research Stations, at National Institute of Health Sciences	Seed and cultured cells, etc., of pharmaceutical plants
	1978	Tsukuba Primate Center, at National Institute of Infectious Diseases	Primates
	1984	National Institute of Infectious Diseases	Genes (bank)
	1984	National Institute of Health Sciences	Cells (bank)
Ministry of Agriculture, Forestry and Fisheries	1985	National Institute of Agrobiological Science, etc.	Genetic resources of plants, microorganisms, and animals
	1985	Forestry and Forest Products Research Institute	Genetic resources of forest trees
	1985	Fisheries Research Agency	Genetic resources of fisheries organisms
	1995	National Institute of Agrobiological Science, etc.	DNA
	2003	National Institute of Agrobiological Science, Rice Genome Resource Center	Rice mutant lines, cDND, etc.
Ministry of Economy, Trade and Industry	1882	National Institute of Advanced Industrial Science and Technology, Geological Survey of Japan	Geological data (geological maps of the country at a scale of 1:200,000 and 1:50,000, etc.)
	1903	National Institute of Advanced Industrial Science and Technology, National Metrology Institute of Japan	National measurement standards (232 physical standards, 225 reference materials)
	1993	National Institute of Technology and Evaluation, Department of Biotechnology	Genome information and biological resources, including microorganisms and DNA cloning of microorganisms for industrial use
	1996	National Institute of Technology and Evaluation, Chemical Management Center	Comprehensive chemical management information on 4,000 substances
Ministry of the Environment	1983	National Institute for Environmental Studies	Preservation of microorganism strains (1,400 strains)

3.3.6.4 Enhancing the Intellectual Property Rights System, and Active Response to Standardization

To promote creative activities for intellectual property, adequate protection of intellectual property rights (IPRs) is critical. The Patent Attorney Law has been thoroughly revised to provide more user-friendly technical services. With the revision, the JPO has simplified the patent attorney examination system and expanded the scope of patent attorneys' services. From the perspective of encouraging the exploitation of intellectual property, the National Center for Industrial Property Information and Training has been dispatching patent licensing advisors to local government facilities and technology licensing organizations (TLOs), developing patent licensing databases, and holding international patent licensing seminars/training programs with the aim of developing human resources with expertise in trading intellectual property. The JPO has been taking various approaches to establish a desirable market environment for patent licensing, which includes patent licensing fairs held nationwide in Japan. In addition, the JPO has been extending assistance to other IP Offices by dispatching IP experts, holding local seminars, implementing human resources development programs (e.g. accepting trainees), and helping to enhance their computerization efforts in the patent paperwork and examination process areas.

The Ministry of Economy, Trade and Industry is carrying out research and development under the Program for the Development of International Standards, with the aim of developing international standards in sectors in which the development of international standards is important for strengthening the industrial competitiveness of Japan. As of Fiscal 2005, research and development was being implemented on 29 themes under the program. Furthermore, the International Joint Research Grant Program in the area of International Standards is being used to put into service international collaborative teams that implement research with other countries for the development of international standards. In Fiscal 2005, the program was used to put two teams into operation.

From the perspective of promoting the development of new technologies, research and development on the fundamental technology for safety evaluation of nanoparticles, with domestic and international standardization in mind, has been started from Fiscal 2005.

In order to achieve international standards in the information and communications field originating from Japan, and to promote the strengthening of Japan's international competitiveness, "research and development targeting international technological standardization" (SCOPE-I) is being implemented based on research results solicited on the condition that proposed research should contribute to standardization activities, such as submitting proposals to standardization organizations like the International Telecommunication Union (ITU). In Fiscal 2005, two research projects were newly adopted under this program. In addition, due to the recognition that it is important to promote R&D and standardization together as a unit, ubiquitous network technology, etc. is being promoted in consideration of contributions to future international standards. Furthermore, the ITU is active in standardization activities for the NGN (next generation network) that is a basic technology indispensable for the realization of a ubiquitous Internet society. The ITU is also expected to conduct full-scale standardization activities for home networks and electronic tags. Japan has made proactive proposals on the standardization system for these technologies. Moreover, coordination of standardization activities in Asian countries is being strengthened, and joint proposals for standardization to the ITU are being promoted through the Asia-Pacific Telecommunity Standardization Program (ASTAP).

Amidst Japan's efforts to expand investment in R&D toward realization of the goal to become a nation of creative science and technology, it is important that expansion of investment in R&D be linked to the creation and assurance of results, and to stronger international competitiveness. Therefore, the Expert Panel on Management of Intellectual Properties was established under the Council for Science and Technology Policy, which summarized "Opinions on Intellectual Property Strategy" in May 2004, as a result of survey and inspection on the creation and utilization of outstanding intellectual properties in universities

The Japanese government has also been promoting its intellectual property strategy nationwide in various fields, including science and technology. In June 2005, the "Intellectual Property Strategic Program 2005" was decided in the Intellectual Property Strategy Headquarters (Director-General: Prime Minister). The important policy issues for this Program are being studied in two different task forces, and the results were announced in the form of the "Measures to Promote Priority Tasks Relating to the Intellectual Creation Cycle" (February 2006, Task Force on Intellectual Creation Cycle) and the "Strategy for the Development of Digital Content" (February 2006, Task Force on Contents), etc.

3.3.6.5 Developing a Research Information Infrastructure

Amidst the rapid development of advanced computerization, R&D sites are taking the lead by developing a research information infrastructure. In response to the rapid progress in telecommunications, it is critical for Japan to heighten and streamline its R&D in the future by continuously promoting the development of the research information infrastructure, and by collecting and disseminating R&D information through even greater utilization of these infrastructures.

The national government is taking concrete action through efforts such as the development and upgrading of networks between research institutions, and the development and provision of databases.

An overview of the main measures for the research information infrastructure in Fiscal 2005 is shown in Table 3-3-26.

Table 3-3-26 Main measures for the research information infrastructure (FY2005)

Ministry or Agency	Research institute or program	Subject
Diet	National Diet Library	·Acquisition and development funds for science and technology-related resources at the National Diet Library
Cabinet Office		·Strengthening the information collection function of R&D data funded through the government budget
Ministry of Internal Affairs and Communications	National Institute of Information and Communications Technology	· Establishment of advanced network testbed for research and development (JGN II)
Ministry of Education, Culture, Sports, Science and Technology	RIKEN (The Institute of Physical and Chemical Research)	· Research funds for IT utilization
	Japan Science and Technology Agency	· Construction of R&D databases (ReaD, J-STORE etc.)
		· Development of engineer ability and operation of "failure knowledge database" ("Web Learning Plaza" etc.)
		· Operation of Institute for Bioinformatics Research and Development (BIRD, GBIF etc.)
		· Operation of Science and technology information provision system (JOIS, J-STAGE etc.)
	Japan Agency for Marine-Earth Science and Technology	· IInformation infrastructure operating costs
	National Institute of Informatics	· Development of Scientific Information Network ("Super SINET" etc.)
Ministry of Health, Labour and Welfare	National Institute of Infectious Diseases	· Budget for the Infectious Disease Surveillance Center
		· Research project expenses for collecting, analyzing, and assessing safety data on biological drugs
Ministry of Agriculture, Forestry and Fisheries	National Agriculture and Bio-oriented Research Organization	· Operation of Agriculture, Forestry and Fisheries Research Information Center
		· Operation of Computer Center for Agriculture, Forestry and Fisheries Research
		· Construction of digital community for agriculture, forestry, and fishery research information
Japan Patent Office		· Industrial Property Digital Library (IPDL)
Ministry of Land, Infrastructure and Transport		· Promotion of collection, management and provision of hydrographic and oceanographic data/information
		· Enhancement of oceanographic observations and hydrographic surveys
		· Development of Geographic Information System (GIS) database for the coastal area
		· Strengthening of the earthquake observation system for Tonankai and Nankai earthquakes
Ministry of the Environment		· Funds for development of basic information for comprehensive ecosystem management

(1) Improvement of Networks

Computers and information networks are key systems in our modern society. These were first developed for research and development, and afterwards found a variety of different applications. In order to carry out cutting edge research and development, performance enhancements are necessary for networks.

The National Institute of Informatics (NII), an organization under the control of the Ministry of Education, Culture, Sports, Science and Technology, has established and operates the Science Information Network (SINET), which connects organizations such as universities. As of January 2006, a total of 710 organizations were connected to SINET. In addition, "Super SINET," the world's fastest research network, which connects advanced scientific research institutions at a maximum speed of 10Gbps (gigabits per second), is now up and running.

The Ministry of Agriculture, Forestry and Fisheries has established and operates the MAFFIN (Ministry of Agriculture, Forestry and Fisheries Network), which mutually connects research institutions related to agriculture, forestry, and fisheries. As of March 2006, a total of 97 institutions were connected through MAFFIN. With SINET now linked to the United States, Singapore and Hong Kong, and MAFFIN linked to the Philippines, these networks are now becoming backbones for the distribution of research information among various countries.

By establishing the Advanced Network Testbed for R&D (JGN II[30]), operated by the National Institute of Information and Communications Technology, the Ministry of Internal Affairs and Communications promotes the pacesetting approaches that create an extensive ripple effect such as improvements in technological capabilities in Japan, reinforcement of coordination between industry, academia and government, and creation of new businesses and industries, through R&D and testing. Furthermore, in order to promote collaboration with research institutes in Japan and abroad, the operation of the Japan-Thailand and Japan-Singapore lines started from November 2005.

(2) Creation and provision of databases

Perusal, copying, lending, and other clearing services for primary information (source materials for research papers, etc.) are being implemented at libraries and a variety of other information service organizations. In addition, constructing databases of secondary information by using computers enables the swift, accurate and easy search of increasingly large amounts of information.

In order to create a database of primary information, the National Diet Library (NDL) is preparing a database for collected materials that covers every publication issued in Japan and in the archives of the library. The National Institute of Informatics (NII), an organization under the control of the Ministry of Education, Culture, Sports, Science and Technology, creates and provides databases on titles and locations of academic books and magazines available at university libraries and other institutions, with the cooperation of institutions nationwide such as national, public, and private universities. Furthermore, the NII creates databases for academic research, and provides a database service.

The Japan Science and Technology Agency (JST) collects information related to the science and technology sectors, and is constructing a science and technology document database. This database is being made available through the JST Online Information System (JOIS) and JST Document Retrieval system for Academic and Medical fields (JDream), which allows for access over the Internet.

The JST has also created and been operating a joint system (J-STAGE) that allows for the on-line writing, editing, and publication of research paper periodicals and so forth issued by academic societies, etc. Furthermore, the JST is implementing the upgrades, standardization, and R&D on databases that are essential to promote bioinformatics.

The National Center for Industrial Property Information and Training developed the Industrial Property Digital Library (IPDL) and provides the IPDL services on the Internet. The IPDL allows users to easily search, based on reference numbers and classifications, about 54 million patent information listed in JPO's patent gazettes, etc. The Ministry of Agriculture, Forestry and Fisheries creates and offers information on documents related to the agriculture, forestry, and fisheries fields, as well as information on locations of books and materials, such as providing the Japanese Agricultural Sciences Index (JASI) of articles published in academic journals related to the agriculture, forestry, and fisheries fields online.

3.3.6.6 Developing an Infrastructure for Manufacturing

In recent years, the structure of employment has been changing, and business competition and other economic situations have been diversifying and changing structurally due to the advancement of industrialization abroad. These changes have in turn led to a decrease in the percentage of domestic gross production taken up by manufacturing industries. This situation, combined with the difficulty of strengthening manufacturing industrial competitiveness and of ensuring that fundamental technologies for manufacturing are passed on to the future, are causes for increasing concern in Japan.

[30] JGN II is a successive project for Japan Gigabit Network (JGN, Fiscal 1999-Fiscal 2003), which was used by 650 institutions and more than 2,000 researchers in total, and achieved a great success in areas such as improving the broadband infrastructure, revitalizing local economy and fostering human resources in our country.

In order for Japan to respond to this situation, and to ensure healthy growth in the future through the advancement of manufacturing industries that represent key industries for the national economy of Japan, it is critical to nurture a social sentiment that holds a high regard for capabilities related to fundamental technologies for manufacturing, and to actively promote fundamental technologies for manufacturing.

For this reason, the national government adopted the Basic Plan for Fundamental Skilled Manufacturing Technologies in September 2000, in accordance with the Fundamental Skilled Manufacturing Technologies Law enacted in March 1999. Based on this plan, the national government is comprehensively and strategically promoting measures related to the promotion of fundamental technologies for manufacturing.

(1) Fostering and Securing Personnel Engaged in Manufacturing

In order to promote fundamental technologies for manufacturing, it is inevitable to foster human resources, having rich creativity, to support it. Various measures are taken in school education and lifelong learning.

At the primary and secondary education levels, the Program to Promote and Assist Manufacturing Learning has been implemented since Fiscal 2000, which includes initiatives such as the creation of a database of "Manufacturing Study Instructors" who aim to promote study related to manufacturing, and the implementation of workshops for these Manufacturing Study Instructors, as well as to implement a study on manufacturing in related subjects based on the curriculum guideline from the elementary school. In particular, specialized upper secondary schools such as industrial high schools, have been serving important roles in fostering specialists that will bear the future of manufacturing industries in our country. In order to further reinforce such efforts the "Aspire to be a Specialist!" program has been implemented since Fiscal 2003, which concentrates on conducting education that introduces advanced technologies and skills in specialized upper secondary schools.

Activities such as experiencing actual workplace in lower secondary schools and internship in upper secondary schools evokes a willingness to learn among students, and will foster visions for labor and vocation. It is also a valuable opportunity for the students to learn knowledge and skills actually used in the workplace, including offices for manufacturing. These activities are therefore actively promoted by various facilities.

In the fields of higher education, due to the corporatization of national universities and national colleges of technology, the discretion of universities and colleges was expanded, promoting further improvement in uniqueness, vitalization and sophistication of educational content.

It is intended to prepare science and technological departments based on the autonomous and self-directive decisions of each university. Also, a system of professional schools was established in Fiscal 2003, for the purpose of improving the quality and quantity of efforts to foster high-level professionals.

Colleges of technology aim to become an attractive option, by conveying their appeal to manufacturing through approaches such as the "All-Japan Colleges of Technology Robot Contest." They also hold public lectures and experience classes targeted at people in the local community and elementary and junior high school students.

In special training colleges, the fostering of human resources for manufacturing is promoted through practical vocational education and specialized skill education. The special training colleges are also engaged in the "Program to Support Independence and Challenges by Young People Using Special Training Colleges," which develops short-term education programs utilizing special training colleges, in order to improve the capabilities of those who aim to become a permanent employee but cannot, such as part-time workers.

In the area of lifelong learning, opportunities for career improvement are being amplified through the acceptance of working people at universities and other schools or public lectures. It is also intended to foster human resources for manufacturing by providing children opportunities to experience and learn manufacturing in each region, through approaches such as utilizing citizens' public halls and museums or opening classes in educational institutes to the public.

The situation of employment for young people is still severe, with the number of part-time workers and unemployed increasing. To cope with this situation, efforts to solve the problems of young people are continuously made from an educational perspective, based on the "Plan to develop the capability and promote employment of the younger generation," which was summarized in June 2003 by the four ministries involved. These efforts include approaches in the area of fostering human resources throughout the entire educational activities at schools, such as the promotion of organizational and systematic career education from elementary schools, and implementation of reeducation for part-time workers.

(2) Merging Information Technology (IT) and Manufacturing Technology (MT) to reform production systems

In order to allow Japan's manufacturing industries, which represent the foundation of the national economy, to maintain and strengthen their competitiveness by means of information technologies, it was decided to establish techniques to scientifically analyze and digitize the skills, know-how, experience and other aspects of skilled individuals, as well as to develop an information system that includes software and databases to utilize the resulting digital data.

The Ministry of Education, Culture, Sports, Science and Technology has been utilizing RIKEN to implement research and development for the creation of an Integrated Volume-CAD system using advanced IT. This system will contribute to the upgrading and improved efficiency of new technology at manufacturing sites, and aims to lead a revolution in the information technology of Japan, in the context of serving as a common foundation for a broad range of technology systems. The system is being developed based on the new concept of "volume data". It completely integrates various simulation technologies, product measurement and testing technology (CAT: Computer-Aided Testing), and machining technology (CAM: Computer-Aided Manufacturing).

The Ministry of Economy, Trade and Industry is implementing the "Digital Master Project" to develop methods for taking the skills, know-how, and experience of skilled technicians at design and manufacturing sites—which exists as "implicit knowledge"—and turning it into "formatted knowledge" through scientific analysis, using IT to then create software and databases of this knowledge.

Furthermore, to promote the integration of manufacturing and IT at small and medium-scale enterprises, 3D CAD/CAM facilities introduced to prefectural public experimental research institutions were used in Fiscal 2000 for training people at small and medium-size enterprises in the use of CAD/CAM, continuing from the previous year.

(3) Accruing Information Related to Manufacturing

The Ministry of Economy, Trade and Industry has taken three measures to accrue manufacturing-related information. These measures included establishing links through the cooperation of universities, the National Institute of Advanced Industrial Science and Technology (AIST), and other organizations, with public experimental research institutions at the regional level playing the central role, as well as building up a database that assembles technology information on successful cases of manufacturing and cases of technology consultations for public experimental research institutions. This database, known as the Techno-Knowledge Network, was made available over the Internet in order to provide precise and efficient technology support for small and medium-sized enterprises.

In addition, to support the design of innovative products from the vantage point of the elderly, development of a system that automatically calculates the dimensions of the human body from three-dimensional measurements of the shape of the body has begun, and the speeding up, simplification, and cost-reduction of dimensional measurement is being promoted.

The Failure Knowledge Database of the Ministry of Education, Culture, Sports, Science and Technology is used to prevent accidents and failures from occurring at manufacturing sites. The Database contains the analysis of accidents and failures that occur in production processes relating to machines, construction and chemicals, as well as lessons gained from the accidents and failures. The database was made available to the public on March 27, 2004, and stored 1,135 cases of accidents and failures as of February 2006 (http://shippai.jst.go.jp).

3.3.6.7 Promoting Activities of Academic Societies

Academic societies and associations are voluntary organizations made up of researchers of organization such as universities. They play an important role in terms of research evaluation, and also information and personal exchange, beyond the framework of individual research organizations. Major contributions are made to the advancement of academic research through activities of academic societies, such as the dissemination of the latest exceptional research results via academic research meetings, lectures, and symposia, and through the publication of academic journals.

To promote these types of activities by academic societies, Grant-in-Aid for Publication of Scientific Research Results, which is one of the categories of Grants-in-Aid for Scientific Research, are awarded by the Ministry of Education, Culture, Sports, Science and Technology to support activities such as international conferences held in Japan with the participation of overseas researchers; symposia that provide youths and adults with up-to-date information on research trends, and the publication of academic journals.

3.4 Promoting International Science and Technology Activity

3.4.1 Developing Leading Activities for International Cooperation

Science and technology creates intellectual assets that should be the common property of all mankind, and also contributes to the resolution of various global issues, etc. Science and technology also contributes to the promotion of industry and economy. To develop international science and technology activities positively in these areas is important for fulfilling Japan's role in international society and for more fully developing science and technology in Japan. Therefore, Japan is not only cooperating through multilateral frameworks, such as the Organisation for Economic Co-operation and Development (OECD), but also promoting bilateral cooperation according to the conditions, needs, and potential of each country.

3.4.1.1 Development of Frameworks for Multilateral Cooperation

●Summit Meeting of Major Nations (G8 Summit)

At the G8 Gleneagles Summit, held in July 2005, various environmental problems such as the issue of climate change were discussed and comments were made concerning the importance of science and technology for environmentally-minded growth. More specifically, topics addressed include alternate energy technologies such as clean energies (including nuclear power), clean coal, and recyclable energy, as well as technologies to reduce greenhouse gases and technologies related to energy-saving. Further, the Summit re-confirmed the need to construct a Global Earth Observation System of Systems (GEOSS), already implemented. Prime Minister Koizumi spoke of the importance of science and technology that balance the environment and economic growth, as well as the need for society-building using the "3Rs" (Reduce, Reuse, and Recycle). Additional statements were also made, including the "Gleneagles Statement on Non-proliferation" and the "G8 Response to the Indian Ocean Disaster, and Future Action on Disaster Risk Reduction."

●United Nations (UN)

The United Nations is taking measures regarding the prevention of disasters and observing the Earth in the field of science and technology. Japan is participating and cooperating in science projects/activities of the UNESCO (United Nations Educational, Scientific, and Cultural Organization).

The UNESCO is involved in the global water problem through the International Hydrological Programme (IHP). An International Center for Water Hazard and Risk Management (ICHARM) was built in Japan under the auspices of UNESCO, in March 2006 to promote the research, training and information networking activities about managing the danger and risk of water-related disasters.

At the Intergovernmental Oceanographic Commission (IOC), oceanographic observation concerning global climate change and the establishment of tsunami-warning systems are being implemented. In addition, a special emphasis is placed on issues concerning the ethics of science and technology including bioethics.

●Organisation for Economic Co-operation and Development (OECD)

The Organisation for Economic Co-operation and Development (OECD) works through its Committee for Scientific and Technological Policy (CSTP), Committee for Information, Computer and Communications Policy (ICCP), Committee for Industry and Business Environment (CIBE), Committee for Agriculture (AGR), Environment Policy Committee (EPOC), Nuclear Energy Agency (NEA), Internationnal Energy Agency (IEA), and others to engage in activities related to science and technology, including the exchange of opinions, experiences, information and personnel between member countries, preparation of statistical information, and implementation of joint research.

The CSTP established of the following five subgroups, which implement specific activities in their respective fields.

1) Global Science Forum (GSF)

The forum was established in June 1999, in order to take over the activities of the Mega Science Forum, and to serve as a forum for science and technology policymakers to exchange opinions about important issues within the science and technology sector that require international cooperation and concerted action. The forum is also intended to issue proposals that contribute to design of science and technology policies. In December 2005, a "Science and Technology Workshop for a Safe Society" was held in Tokyo as a Japanese proposal activity. Further, responding to requests from the international community, in the February 2006 meeting of the GSF, Japan took an initiative to start a GSF joint research project to prevent illegal activities in science. Active discussions are under way, led by a strong initiative taken by Japan.

2) Working Group on the Steering and Funding of Research Institutions (SFRI)

In November 2005, the third meeting of the Working Group on the Steering and Funding of Research Institutions was held; Japan actively participates in this group as the leader of one of its subgroups (the "Subgroup on Appeal of a Research Career").

3) Working Group on Innovation and Technology Policy (TIP)

TIP has discussed and evaluated technology policies, focusing in particular on the National Innovation System (NIS).

For two years from 2005 to 2006, TIP held discussions on such topics as the evaluation of innovation policies, globalization of R&D and innovation, diffusion of IPR, innovation and knowledge, and the NIS of China.

4) Working Party for Biotechnology (WPB)

Discussion is continuing concerning the formation of a "Global Biological Resource Center Network (GBRCN)" as international operational standards for handling microbes and plants and others were discussed in Paris in October 2005.

5) Working Party of National Experts on Science and Technology Indicators (NESTI[31])

At the NESTI meeting held in June 2005, a revision of the "Oslo Manual," the international standards concerning the collection and interpretation of data on innovation activities, was adopted. In addition, new directions and coordination were discussed concerning globalization of human resources in science and technology as well as of research and development.

3.4.1.2 Cooperation with Nations in the Asia-Pacific Region

●Cooperation under the Asia Pacific Economic Cooperation (APEC) Forum

The Asia Pacific Economic Cooperation (APEC) is involved in cooperative activities in a variety of fields, supported by open regional cooperation. In March 2004, New Zealand hosted the 4th APEC Science Ministers' Meeting. Under the Industrial Science and Technology Working Group (ISTWG), mutual use of research facilities, promotion of the distribution of scientific and technical information, and other specific cooperative measures are implemented. In September 2005, as an ISTWG project, an EqTAP seminar concerning the mitigation of earthquake/tsunami disasters in the Asia-Pacific region was held in Jakarta, Indonesia, with the cooperation of the National Research Institute for Earth Science and Disaster Prevention, University of Tokyo, Kyoto University, Port and Airport Research Institute, and others.

●Cooperation with the Association of Southeast Asian Nations (ASEAN)

Japan offers its cooperation in science and technology with the ASEAN in accordance with the Tokyo Declaration and activity plans, adopted in the December 2003 ASEAN Special Summit Meeting; Japan promotes human-resources development in science and technology and encourages research cooperation, such as through researcher-exchange programs with the support of the Japan Society for the Promotion of Science. Further, to promote local cooperation among East Asian countries, the so-called "ASEAN+3" cooperation by Japan, China, and Korea is carried out; in the field of science and technology, cooperation is under way with the ASEAN Committee on Science and Technology (COST).

[31] The Working Party will monitor, oversee and advise on statistical work undertaken for the Committee for Scientific and Technological Policy (CSTP) taking into account the priorities established by the Committee.

●Cooperation with Various Countries

As for cooperation with China, in accordance with the Science and Technology Cooperation Agreement[32], the 11th Japan-China Science and Technology Cooperation Joint Committee was held in August 2005, in Beijing. In April 2005 and February 2006, the Japan-China seminar met at the Chinese Academy of Science, and in November 2005, a fourth government-level conversation was held between the Ministry of Education, Culture, Sports, Science and Technology and Ministry of Science and Technology of China. Conversation between science and technology administrative officials of the two countries is thus being promoted.

As for cooperation with India, in accordance with the Japan-India Science and Technology Cooperation Agreement, the 7th Japan-India Science and Technology Cooperation Joint Committee was held in November 2005 in Delhi, India.

In relations with South Korea, Australia, Indonesia, and Israel, among others, under agreements for science and technology cooperation, cooperation is progressing in the form of information and research personnel exchanges, and the implementation of joint research. Opinion exchanges on the possibility of future cooperation are also being pursued with other countries that have not signed science and technology cooperation agreements with Japan.

In a project called the Research and Development for Supporting Humanitarian Demining of Antipersonnel Mines, a prototype of a mine detector/sensor developed in Japan was taken into Croatia for a field test in that country between February and March of 2006. Based on the local evaluation, research and development efforts are being carried out in order to find mines more safely, accurately, and efficiently.

3.4.1.3 Cooperation with Nations in Europe and North America

Cooperative activities such as holding joint committee meetings based on bilateral science and technology cooperation agreements among European and North American nations are actively being carried out in order to resolve common challenges faced by advanced countries, including those in life sciences, nanotechnology/materials, environmental sciences, nuclear energy, and space development (Figure 3-4-1).

[32] Science and technology cooperation agreement: An agreement entered into between Japan and a foreign nation in order to promote cooperative relations in the science and technology sector for peaceful purposes. The agreement establishes the form of cooperative activities, the framework for intergovernmental discussions such as joint committees, and also how to handle intellectual property rights stemming from cooperation. Various cooperative activities are implemented under this agreement, including the exchange of R&D data, researcher exchanges, and joint research. Joint committee meetings are held every few years to report on cooperative activities up to those times, and to discuss future cooperative activities.

Table 3-4-1 Joint committee meetings and other activities held in FY2005 based on bilateral science and technology cooperation among European and North American nations

Country	Name	Dates	Location	Topics
United States	11th Japan-U.S. Joint Working Level Committee (on Science and Technology Cooperation)	July 12, 2005	Washington, D.C.	(1) Earth science, and environment (2) Nano-technology (3) Life science (4) Science and technology for a safe and secure society
Canada	9th Japan-Canada Joint Committee on Science and Technology Cooperation	Oct. 12, 2005	Ottawa	(1) Earth science and environment (2) Life science
Italy	8th Meeting of the Japan-Italy Joint Committee on Co-operation in Science and Technology	June 13, 2005	Rome	(1) Research-support programs (2) Space (3) Erosion and sediment control (4) Researcher exchanges
France	6th Meeting of the Japan-France Joint Committee on Science and Technology Cooperation	March 8, 2006	Paris	(1) Science and technology policy in each country (2) Report and follow-up on the 6th Meeting of the Japan-France Joint Advisory Council on Science and Technology Cooperation (3) Researcher exchanges (4) Basic science (5) Life sciences (6) Information and communication technology (7) Material, nano-technologies, and new energies (8) Environment and oceanology (9) Space (10) Building secure and safe society (11) Promoting public understanding of science and technology (12) Science and technology cooperation for developing countries
Sweden	3rd Japan-Sweden Joint Committee on Science and Technology Cooperation	March 10, 2006	Stockholm	(1) Science and technology policy in each country (2) Researcher exchanges (3) Interchange of universities (4) Life sciences (5) Nano-technologies (6) Promoting R&D investment (7) Health care (8) IT
Russia	9th Meeting of the Japan-Russia Committee on Cooperation in Science and Technology	Feb. 22—23, 2006	Tokyo	(1) Information exchange on science and technology policies of both countries (2) Summary of results of science and technology cooperation between the two countries (3) Opinion exchange on the current status and prospects of cooperation between the two countries on the industry-academia-government level in science and technology
Ukraine	1st Japan-Ukraine Joint Committee on Science and Technology Cooperation	Feb. 15, 2006	Kiev	(1) Current status and government's basic policies on science and technology in Ukraine and in Japan (2) Review and discussion on cooperative activities (3) Discussion on priority areas for future cooperation
China	11th Japan-China Committee on Science and Technology Cooperation	Aug. 30, 2005	Beijing	(1) Life science (2) Research exchange
India	7th Japan-India Joint Committee on Science and Technology Cooperation	Nov. 3, 2005	Deli	(1) Explanations on activities of science and technology administration of India and Japan (2) Review of current status of the Japan-India science and technology exchange (3) Roles to be played by the governments and science and technology joint committees in the field of science and technology (4) Areas where cooperation is possible

As for the United States, in accordance with Agreement between the government of Japan and the government of the United States of America on cooperation in research and development in Science and Technology, the 11th Japan-U.S. Joint Working Level Committee on Science and Technology Cooperation was held in July 2005. As for Canada, in accordance with Agreement between the government of Japan and the government Canada on cooperation in Science and Technology, the (9th Japan-Canada) Joint Committee on Science and Technology Cooperation was held in October 2005.

Elsewhere, there are joint committees on science and technology with Germany, France, Italy, Finland, Norway, Russia, Poland, the Czech Republic, Hungary, and Romania based on science and technology cooperation agreements. Japan is implementing wide-ranging bilateral science and technology cooperation based on international agreements, including science and technology cooperation agreements with forty-two nations around the world, and promoting multilateral scientific, technological, and academic cooperation. At present, Japan is at the final stage for negotiations with the EU for concluding the Japan-EU Science and Technology Cooperation Agreement and is conducting negotiations with Switzerland to conclude a science and technology cooperation agreement.

3.4.1.4 Taking on International Programs

●Promotion of the Human Frontier Science Program (HFSP)

The “Human Frontier Science Program (HFSP)” was proposed by Japan at the Venice Summit of June 1987, with the aim of promoting, through international cooperation, basic international joint research focused on the elucidation of the complex mechanisms of living organisms. With the addition of Australia and Korea, who joined this program in 2005, now a total of eleven nations are operating this program, including Japan, the United States, France, Germany, EU, Great Britain, Switzerland, Canada, and Italy.

Based on the principles of “international cooperation among continents,” an “interdisciplinary approach to the life sciences,” and “youth-oriented” action, the International Human Frontier Science Program Organization (HFSPO) provides research grants to subsidize international joint research teams, fellowships to subsidize travel expenses, accommodation, and other expenses for young researchers conducting research abroad, and organizes meetings of HFSP grant recipients. In June 2005, the fifth award ceremony was held at the United States' National Institutes of Health, where about 150 researchers were in attendance.

With a total of 11 HFSP grant recipients having later been awarded the Nobel Prize as of FY2005, the Program has been highly acclaimed worldwide. Japan has been actively supporting the Program since its inception.

●Cooperation under the International Science and Technology Center (ISTC)

In March 1994, the United States, Japan, the EU (then the EC), and the Russian Federation established the International Science and Technology Center (ISTC) in order to provide an opportunity for scientists and engineers from the former Soviet Union, possessing knowledge and skills related to weapons of mass destruction, to engage in peaceful activities and to contribute to the resolution of technology issues, both internationally and within the nations of the former Soviet Union.

To date, a total of approximately 600 million dollars has been approved to initiate specific projects aimed at achieving the goals of the organization. Furthermore, over 60,000 researchers have been engaged in research activities.

The number of projects supported by private-sector corporations as partner projects has also been increasing due to the high caliber and originality of science and technology in the former Soviet Union.

Additionally, Japan is actively involved in the expansion of the number of new participants, including corporations, and in the implementation of projects that contribute to the resolution of global issues.

●International Space Station (ISS) Program

The International Space Station (ISS) program participated by fifteen countries (Japan, the United States, the European Governments, Canada, and Russia) is the international cooperation project to construct a manned space facility at low Earth orbit with an altitude of approximately 400km. Japan is participating in this project through its development of the Japanese Experiment Module (JEM), "Kibo," and a space-station supplier H-II Transfer Vehicle (HTV).

In September 2005, the results of a review on the ISS project by the United States were reported to each participating party. According to the report, the Japanese Experiment Module (JEM), "Kibo," would be launched by space shuttle in three phases, as promised before, while the launching of "Centrifuge" was canceled.

●ITER (International Thermonuclear Experimental Reactor) Project

The goal of the ITER project is to develop a tokamak experimental fusion reactor through international cooperative efforts, in order to demonstrate the scientific and technological feasibility of fusion energy, which is expected to become one of the future permanent energy sources for humanity. The project originated in 1985 from proposals by leaders of the United States and the former Soviet Union to promote international cooperation for research and development on nuclear fusion for peaceful purposes. Currently, seven parties are participating: Japan, China, EU, Republic of Korea, Russia, United States, and India. In addition, Japan plans to implement the Broader Approach parallel with ITER project, through cooperation with EU.

●The Large Hadron Collider (LHC) Project

The LHC Project includes a huge circular accelerator whose circumference reaches 27 km, which is being constructed by the European Organization for Nuclear Research (CERN). Protons and antiprotons are accelerated in opposite directions, almost to the speed of light, and they generate high energy interactions when protons collide. In this project unknown particles may be discovered, deepening our understanding of the internal structure of things. The construction is almost completed, with international cooperation among the CERN member states, Japan, United States, and other nations, so that the experiments could begin in 2007.

In Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) contributes to the fund for construction of the particle accelerator, anticipating its scientific significance as well as its potential to lead the creation of new industries.

●Integrated Ocean Drilling Program (IODP)

The IODP is a program, under the direction of the United States and Japan, to explore the deep parts of the Earth using internationally operated vehicles such as American scientific drilling vessels and the Japanese riser drilling vessel "Chikyu," which, with a capability of drilling from the deep ocean floor to 7000 m below the bottom of the ocean, is anticipated to reach the earth's mantle. In April 2003, a memorandum was signed between the Ministry of Education, Culture, Sports, Science and Technology and the National Science Foundation of the United States, and the IODP began in October of the same year. According to this program, research on the deep parts of the Earth and inner strata is promoted; the project is thus expected to make contributions to our understanding of the global environmental changes, the structure of the inner Earth, etc., and possibly even lead to a discovery of an unknown biosphere and new resources.

The basic design for "Chikyu" began in 1999, and the vessel was completed in July 2005. Since then, its operation has been undergoing shakedown and training for international operation for the IODP, which is to begin in September 2007.

3.4.2 Promoting International Research Exchanges

3.4.2.1 Promotion of International Research Activities

It is necessary to gather superior human resources and the latest information in Japan, and internationalize science and technology activities in order to respond to challenges that human beings will be facing. To this end, Japan is promoting activities like joint international research and international conferences through programs such as the "Strategic International Cooperative Program," run by the Japan Science and Technology Agency, and the "Core University Program" run by the Japan Society for the Promotion of Science. In addition, since June 2005, Japan has been supporting the Strategic Fund for Establishing International Headquarters in Universities, and at the selected universities, the organizational structure has been modified to create interdisciplinary, cross-sectional bodies like an "international strategy headquarter" to coordinate the basis for promoting strategies for international activities.

3.4.2.2 Promotion of Researcher Exchanges

For the development of science and technology as well as academic research, it is essential that Japan attracts many excellent researchers—both Japanese and foreign—to Japan, and to allow Japanese researchers to compete at a cutting-edge level at the international standard. For this purpose, various researcher-exchange programs are being carried out. Particularly promoted are the program, "Postdoctoral Fellowships for Foreign Researchers," which invites superior young foreign researchers to Japanese universities and research institutes to promote international exchange of young researchers who will pioneer future research, and the program, "Postdoctoral Fellowships for Research Abroad," (both programs by the Japan Society for the Promotion of Science) which sends young Japanese researchers abroad to foreign universities and other research institutions abroad. Additionally, living environments of foreign researchers are also being improved, such as securing housing for them foreign researchers and providing them with living support.

As a result of these measures, the number of foreign researchers invited, and Japanese researchers dispatched overseas, has been rising at Japanese universities and experimental research institutions (Figure 3-4-2). By region, there are active researcher exchanges with Asia, Europe, and North America. In particular, there has been a drastic increase in the number of researchers going to various locations in Asia; in FY 2004, for the first time ever, the number in Asia exceeded the number of researchers in Europe (Figure 3-4-3).

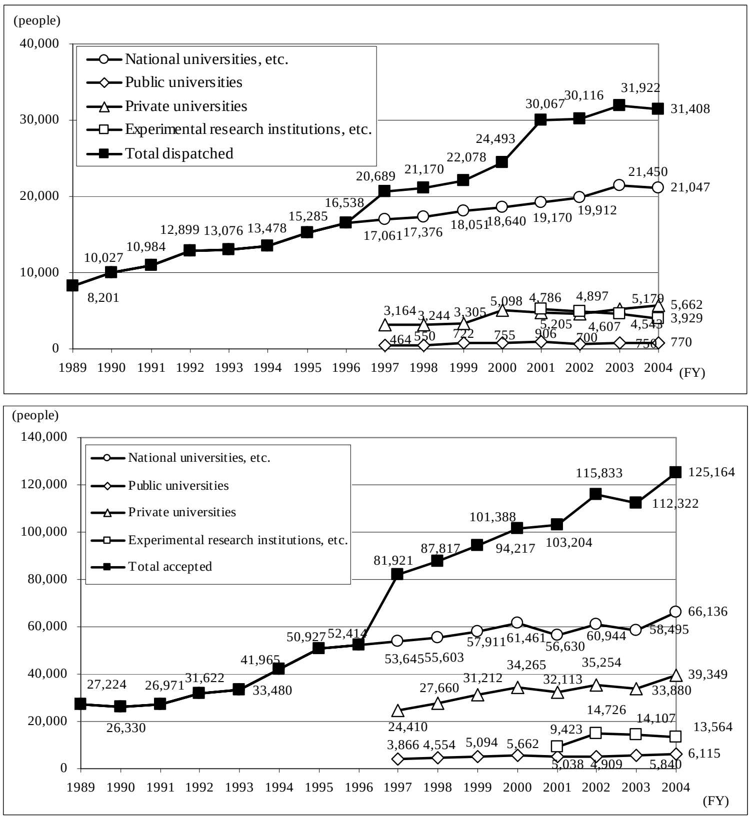


Figure 3-4-2 Progress of researcher exchanges in universities, research institutions, etc.

Note: "National universities, etc." indicates national universities, inter-university research institutes, national junior colleges, and national technical colleges. "Experimental research institutions, etc." indicates national experimental research institutions, incorporated administrative agencies, and public research and development corporations. Public and private universities and national junior colleges have been included in this research since FY1997. National technical colleges, national experimental research institutions, and public research and development corporations have been included since FY2000.

Source: MEXT. "Survey of International Exchange (FY2004)"

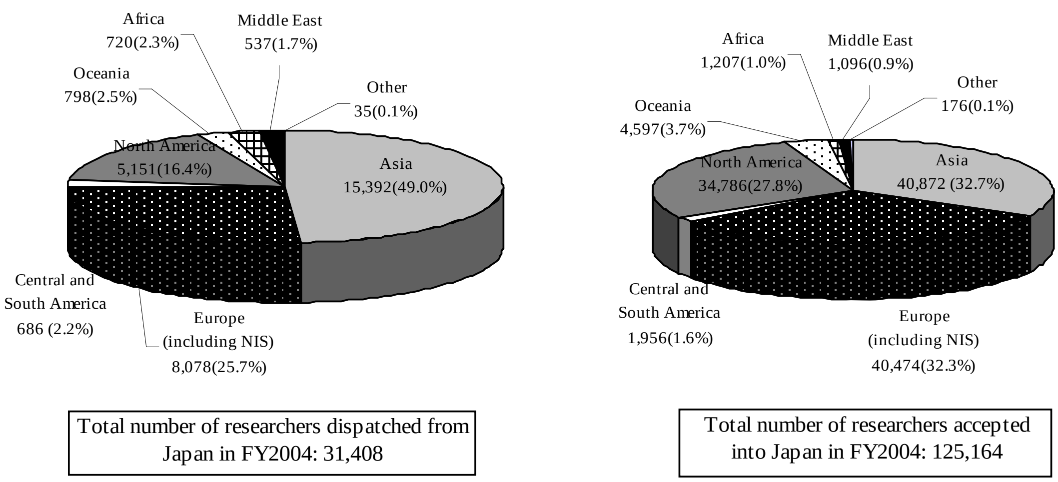


Figure 3-4-3 Researcher exchanges (dispatch and acceptance) by region

Appendix

Appendix

1. The Science and Technology Basic Law (Unofficial Translation)

(Law No. 130 of 1995. Effective on November 15, 1995)

Chapter 1 General Provisions
(Objective)
Article 1

The objective of this law is to achieve a higher standard of science and technology (hereinafter referred to as "S&T"), to contribute to the development of the economy and society in Japan and to the improvement of the welfare of the nation, as well as to contribute to the progress of S&T in the world and the sustainable development of human society, through prescribing the basic policy requirements for the promotion of S&T (excluding those relevant only to the humanities in this law) and comprehensively and systematically promoting policies for the progress of S&T.

(Guidelines for Promotion of S&T)
Article 2

S&T shall be actively promoted in harmony with human life, society and nature with the recognition that the creativity of researchers and technicians (hereinafter referred to as "Researchers") can be fully developed, in consideration of the fact that S&T provides the basis for the future development of Japan and human society and that the accumulation of knowledge on S&T is the intellectual asset common for all mankind.

2 In the promotion of S&T, the improvement of balanced ability of research and development (hereinafter referred to as "R&D") in various fields, harmonized development among basic research, applied research and development and organic cooperation of national research institutes, universities (including graduate schools in this law.) and private sector etc. should be considered, and in consideration of the fact that the mutual connection between natural science and the humanities is essential for the progress of S&T, attention should be paid to the balanced development of both.

(Responsibility of the Nation)
Article 3

The nation is responsible for formulating and implementing comprehensive policies with regard to the promotion of S&T.

(Responsibility of Local Governments)
Article 4

The local governments are responsible for formulating and implementing policies with regard to the promotion of S&T corresponding to national policies and policies of their own initiatives in accordance with the characteristics of their jurisdictions.

(Necessary Consideration to be given by the Nation and Local Governments in Formulating Policies)

Article 5

In formulating and implementing policies with regard to the promotion of S&T, the nation and local governments shall pay attention to the importance of their roles in promoting basic research and consider that basic research has the following characteristics:

(i) It could bring about discovery and elucidation of new phenomena and make the creation of novel technologies possible;

(ii) Forecasting its results at the outset of research is difficult; and

(iii) The results are not necessarily directly connected to practical applications.

(Necessary Consideration in Policies with regard to universities)

Article 6

In formulating and implementing policies related to universities and Inter-university Research Institutes (hereinafter referred to as "Universities"), with regard to the promotion of S&T, the local and national governments shall make an effort to activate research in Universities, respect the autonomy of Researchers and consider the characteristics of research in Universities.

(Legislative and other Measures)

Article 7

The Government shall take the appropriate legislative, fiscal, financial and other necessary measures required to implement the policies with regard to the promotion of S&T.

(Annual Report)

Article 8

The Government shall annually submit a report on the policy measures implemented with regard to the promotion of S&T to the National Diet.

Chapter 2 S&T Basic Plan

Article 9

The Government shall establish a basic plan for the promotion of S&T (hereinafter referred to as "Basic Plan") in order to comprehensively and systematically implement policies with regard to the promotion of S&T.

2 The Basic Plan shall stipulate the following matters:

(i) The comprehensive plans for the promotion of R&D (the term "R&D" means basic, applied and developmental researches and includes technology development in this law.);

(ii) The policies taken comprehensively and systematically by the Government with regard to the installation of R&D facilities and equipment (hereinafter referred to as "Facilities"), the promotion of information intensive R&D activities and the maintenance of the necessary environment for the promotion of R&D; and

(iii) Other matters required to promote S&T.

3 The Government shall consult the Council for Science and Technology Policy on the Basic Plan prior to formulation.

4 The Government shall consider the progress of S&T and the effect of policies taken by the Government with regard to the promotion of S&T, examine the Basic Plan properly, and revise it if necessary. The preceding paragraph shall apply in the case of revisions.

5 When formulating the Basic Plan in accordance with paragraph 1 above or revising it in accordance with the preceding paragraph, the Government shall publish the summary of the Basic Plan.

6 In order to secure necessary funds for the implementation of the Basic Plan, every fiscal year the Government shall take the necessary measures for the smooth implementation of the Basic Plan such as including the necessary fund in the budget within the limits of national financial status.

Chapter 3 Promotion of R&D
(Balanced Promotion of various levels of R&D)
Article 10

The nation should implement necessary policy measures for the balanced promotion of various levels of R&D in comprehensive fields as well as take necessary measures for the planning and implementation of R&D in the specific fields of S&T where the nation considers further promotion important.

(Securing Researchers)
Article 11

The nation should implement necessary policy measures to improve education and research in graduate schools, to secure and train Researchers and to improve their quality in order to promote R&D corresponding to the progress of S&T.

2 The nation should implement necessary policy measures to improve the occupational conditions of Researchers in order for their positions to be attractive commensurate with their importance.

3 In consideration of the fact that R&D supporting personnel are essential for the smooth promotion of R&D, the nation should implement necessary policy measures corresponding to the preceding two paragraphs in order to secure and train them and to improve their quality of service a long with their occupational conditions.

(Improvement of Facilities)
Article 12

The nation should implement necessary policy measures to improve research facilities of R&D institutions (the term "R&D institutions" is defined as national research institutes and institutions for R&D in Universities, private sector and so on in this law) in order to promote R&D corresponding to the progress of S&T.

2 The nation should implement necessary policy measures to upgrade supporting R&D functions such as supplying research materials smoothly in order to promote R&D effectively.

(Promotion of Information Intensive R&D)
Article 13

The nation should take necessary policies to promote information intensive R&D activities such as the advancement of information processing in S&T, the maintenance of databases on S&T and the construction of information networks among R&D institutions in order to promote R&D effectively.

(Promotion of Exchange in R&D)
Article 14

The nation should implement necessary policy measures for the promotion of R&D to enhance various exchanges such as the exchange of Researchers, joint R&D of R&D institutions and joint use of Facilities of R&D institutions, in consideration of the fact that promoting the fusion of various Researchers' knowledge through exchanges between R&D institutions and/or Researchers is the source of new R&D progress and that this exchange is essential for the effective promotion of R&D.

(Effective use of R&D funds)
Article 15