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

The Grant-in-Aid for Academic Research aims to dramatically advance academic research (research based on the free-thinking of researchers) across all fields including the humanities and social sciences as well as the natural sciences, and from basic research through to applied research. The program supports creative and pioneering research that passes a peer review process.

Basic Research Programs aims to produce new technologies that will lead to the development of science and technology and to the creation of new industries Japan Science and Technology.Agency establishes Research Areas based on Strategic Sectors, which Ministry of Education, Culture, Sports, Science and Technology designates on the basis of social and economic needs and under each Research Areas Basic Research Programs strategically promotes basic research mainly in four key research fields.

The Special Coordination Funds for Promoting Science and Technology (Chosei-Hi) is a competitive research fund managed by the Ministry of Education, Culture, Sports, Science and Technology along with the policies of the Council for Science and Technology Policy. Chosei-Hi promotes leading and/or cross-sectional measures to achieve the policy objectives laid down in the Science and Technology Basic Plan. Since 2004, "Research and Development Program for Resolving Critical Issues", which is mission-oriented research and development focusing on policy-inducing effects, have been promoted.

The Public Proposal System for Original and Innovative Technology Development Research and its successor, the Innovative Technology Development Research Project are aimed at encouraging the creation of new industries by further fostering innovative and highly creative technologies of private sectors into more innovative and practical technologies.

The Japan Science and Technology Corporation has been promoting the "Project for the Creation of University-based Start-ups" for the purpose of promoting the return of the fruits of university research to society and the economy through the creation of university-based start-ups and "advanced metrological analysis technology and equipment development" for the purpose of developing the worlds-first advanced metrological analysis technology and equipment development to meet the needs of the world's most advanced researchers.

(3) Ministry of Health, Labour and Welfare

The Ministry of Health, Labour and Welfare strives to improve technology standards through the scientific promotion of government measures related to health and medical care, welfare, environmental health, occupational safety and health, and other aspects relevant to the citizens of Japan.

The Grant for Health Sciences promotes research in four main areas, including (1) the administrative policy research area; (2) the life science infrastructure research areas, which includes "Research on Human Genome Tissue Engineering;" (3) the areas of research on disease/handicap measures, such as the "Third Comprehensive Cancer Strategy" and "Research on Emerging and Remerging Infectious Diseases." and (4) comprehensive research on safety management in the drug, food and technology area, which includes "Research on Health Sciences Focusing on Drug Innovation."

(4) Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture, Forestry and Fisheries is implementing the "Program for the Promotion of Research on the Integration of Different Fields for the Creation of Bio-oriented Industries," which aims to create new industries and enterprises through biotechnology and other bio-oriented advanced technologies. Existing programs include the "research project for utilizing advanced technologies in agriculture, forestry and fisheries," which aims to promote in-the-field experiments and research in the agriculture, forestry, and fisheries sector, and the "Technology Development Project for the Creation of Collective Private Agribusiness," which aims to revitalize agribusiness through the creation of new industries.

(5) Ministry of Economy, Trade and Industry

The Ministry of Economy, Trade and Industry subsidizes the New Energy and Industrial Technology Development Organization (NEDO), and implements the "Industrial Technology Research Grant Program" in an effort to develop human resources for industrial technology research and discover potential seeds of new industrial technologies that meet the needs of the industrial world and society by providing research funds to assist young researchers.

(6) Ministry of Land, Infrastructure and Transport

Through the Japan Railway Construction, Transport and Technology Agency, the Ministry of Land, Infrastructure and Transport implements the "Program for Promoting Fundamental Transport Technology Research." This program promotes creative and innovative basic research aimed at generating innovative new technologies with the potential for breakthrough technological innovation. In addition, the Construction Technology Research and Development Subsidy Program provides research and development subsidies to researchers at universities, etc., in order to promote cooperation with non-construction sectors, to promote innovations in construction technology in broad interdisciplinary areas, and to utilize innovative results in public works projects.

(7) Ministry of the Environment

The Ministry of the Environment utilizes the Global Environment Research Fund to promote research into global environmental conservation, based on the Comprehensive Promotion Program for Global Environment Research, Monitoring and Technology that is drawn up at the Council of Ministers for Global Environmental Conservation. The Global Environment Research Fund provides prioritized and strategic promotion for the development and diffusion of environmental technologies, while the Fund for Waste Disposal Science Research is used to promote restrictions on waste disposal and to encourage recovery and reuse, and develops research on all kinds of research into appropriate waste disposal measures. In FY2004, the "Project to Develop Technology for Global Warming Countermeasures" was established for the purpose of promoting practical use of basic CO2 emission control technologies.

(2)Improving the Mobility of Personnel through Popularization of the Fixed-term System

In order to train researchers with broad perspectives who are rich in creativity and originality, and to achieve competitive and dynamic R&D environments, it's important that the mobility of researchers is improved and that researchers gain experience at many kinds of research sites.

Aiming towards this kind of improved mobility of researchers, employment of fixed-term researchhers became possible at national experimental research institutions in accordance with "the Law Concerning the Special Measures for the Recruitment, Remuneration and Working Hours of Researchers with Fixed Terms in Regular Service" enacted in 1997. The results to date are shown in Table 3-3-2.

Table 3-3-2 The state of employment under the "Law Concerning the Special Measures for the Recruitment, Remuneration and Working Hours of Researchers with Fixed Terms in Regular Service"

	No. of institutions	No. of personnel used
National research institutes	39	1,014
Of which, by invitational type	21	151
Of which, researcher-fostering type	37	863

Note: The number of personnel used indicates the cumulative number as of October 1, 2004.
Source: Survey by National Personnel Authority (October 2004)

For universities and inter-university research institutes, "the Law Concerning the Fixed-Term Appointment of Faculty Members at Universities," enacted in 1997, gives them the discretion to adopt the fixed-term system. The status of the fixed term system adopted on the basis of this law is shown in Table 3-3-3.

Table 3-3-3 State of the fixed-term systems introduced under "the Law concerning the Fixed Term Appointment of Faculty members at Universities"

	No. of universities, etc.	No. of instructors used
National universities	88	5,485
Public universities	20	292
Private universities	139	2,580
Inter-university research institutions	10	107

Note: In Private universities it is limited to full-time staff.
Source: Survey by MEXT (October 2003)

(3) Increasing the Independence of Young Researchers

If Japan is to aim towards becoming an advanced science-and technology-oriented nation, it is critical to foster and secure exceptional young researchers with abundant creativity who will lead future research activities.

In consideration of the Basic Plan, which calls for “ensuring the independence of young researchers in order to maximize the abilities demonstrated by distinguished young researchers,” the Central Education Council reviewed the status of assistant professors and assistants and compiled the report, “The Future Form of Japan’s Higher Education,” in January 2005.

Among the proposals made in the report are ① creation of the post of “*jun-kyoju*” (mainly translated as associate professor) in place of “*jo-kyoju*”, ② creation of the post of “*jo-kyo*” (mainly translated as assistant professor) for “*joshu*” whose main job is education or research, ③ deleting the provision of the university establishment standards requiring in principle the subject system or the chair system and instead setting provisions to ensure an organizational system for division of responsibility and cooperation of teachers.

(Support for Creative Research Activities by Young Researchers)

Many of the researchers around the world who produce world-class research results have already conducted research in their 30s that laid the groundwork for later achievements. The relevant government ministries, therefore, promote various efforts to support creative research activities by young researchers during their foundation years.

(1) Ministry of Internal Affairs and Communications

Under the “Program for Promoting Strategic Information and Communications Research and Development,” established in FY2002, the “research and development program for nurturing young advanced-IT researchers” was instituted with the aim of nurturing young researchers aged 35 or younger.

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

MEXT is working to expand competitive funding for young researchers by appropriating approximately 24.3 billion yen of the Grants-in-Aid for Scientific Research for young researchers in order to create a system in which young researchers who have flexible mind-sets and a spirit of challenge can conduct independent research.

(3) Ministry of Agriculture, Forestry and Fisheries

The National Agriculture and Bio-oriented Research Organization (NARO) is working through the Basic esearch Promotion Project, which aims at the creation of new technologies and new sectors, to institute a young researcher support program that prepares the conditions for objective research by young researchers with flexible thinking and ambition.

(4) Ministry of Economy, Trade and Industry

In FY2000, NEDO started the “Industrial Technology Research Grant Program” for promoting basic and creative research and development by providing research funds to assist young researchers.

(Support for Postdoctoral Researchers)

The relevant government ministries can expand opportunities to improve the quality of postdoctoral researchers by having them participate in research projects funded with the expanded competitive funding, as well as promote various other systems to support postdoctoral researchers.

(1) Ministry of Education, Culture, Sports, Science and Technology

Through the Japan Society for the Promotion of Science, MEXT has been promoting the “Research Fellowships for Young Scientists” program that supports postdoctoral researchers who possess superior research abilities so that they can proactively engage in their research. Since FY2004, this program strives to achieve qualitative results by improving the method for selecting postdoctoral researchers and ensuring appropriate treatment of excellent researchers in accordance with their abilities.

Under Basic Research Program of Japan Science and Technology Agency young researchers, including postdoctoral researchers having flexible ideas and challenging spirits, researches to form intellectual properties and create new technologies.

Various other support programs for researchers are also being promoted, such as the Institute of Physical and Chemical Research’s (RIKEN) “Special Postdoctoral Researchers Program," which provides a place where highly creative young researchers can proactively conduct research upon their own initiative at RIKEN's research facilities.

(2) Ministry of Health, Labour and Welfare

The Ministry of Health, Labour and Welfare has adopted measures to support and utilize 489 postdoctoral researchers through its Health and Welfare Sciences Research Promotion Project.

(3) Ministry of Agriculture, Forestry and Fisheries

The Ministry of Agriculture, Forestry and Fisheries has adopted measures to utilize 138 young researchers as part of the Basic Research Promotion Project of the National Agriculture and Bio-oriented Research Organization (NARO), which aims to create new technologies and research fields. In total, the Ministry adopted measures to utilize 243 postdoctoral researchers.

(4) Ministry of Economy, Trade and Industry

The Ministry of Economy, Trade and Industry provided support and adopted measures to utilize a total of 90 postdoctoral researchers through the industrial technology fellowship program run by the New Energy and Industrial Technology Development Organization (NEDO).

(4) Reform of Japan's Evaluation Systems

To promote science and technology, it is important to conduct appropriate evaluation, which stimulate researchers and encourage outstanding research and development activities. Effective evaluation will increase the efficiency and vitality of R&D activities, facilitate better R&D achievements, and nourish superior researchers. Evaluation also offer benefits to society and the economy, and also serve to provide accountability to the public.

Based on the Basic Plan, the "National Guidelines for Evaluating Government Funded R&D" were decided upon by the Prime Minister in November 2001 to improve the evaluation program further. All ministries and agencies implement effecttive evaluation with detailed guideline specifying evaluation methodologies under the revised General Guidelines. In particular, based on the guidelines, the Ministry of Education, Culture, Sports, Science and Technology, which accounts for more than 60% of the expenditures related to science and technology, conducts ex ante evaluations of new and existing R&D topics worth more than 1 billion yen by utilizing external evaluation and using them as the criteria for judging the appropriateness of budget requests. The Ministry also conducts interim evaluation and ex post evaluation appropriate. Incidentally, the guideline was revised and a new set of guideline was decided by the Prime Minister on March 29, 2005 on the basis of the results, etc. of the follow-up studies on the progress of R&D evaluation conducted by the Council for Science and Technology Policy in cooperation with ministries and agencies.

In addition, the Cabinet Office, in cooperation with related ministries and agencies, developed a government R&D database system that brought together in a single, cross-ministerial system data on researchers, funds, accomplishments, evaluators, and evaluation results for government-funded individual R&D topics. Along with storing data, the system is being used for data analysis by the Cabinet Office and related ministries and agencies.

For other actions in this area, evaluation of the performance of incorporated administrative R&D agencies are now being implemented based on the Law on the General Rules of Incorporated Administrative Agencies (1999 Law No.103). As for national university corporations, evaluation of their performance is implemented based on the "National University Corporation Law" (Law No. 111 of 2003) (As for the progress of educational research, the outcomes of evaluation conducted by the National Institution for Academic Degrees and University Education are highly respected). In addition, under the Law for Evaluations of Policies Performed by Administrative Institutions (2001 Law No.86), which took effect in April 2002, it is now mandatory to conduct appraisal evaluation for R&D topics that are expected to incur large costs, given their preceding experience in project evaluation.

(5) Flexible, Effective, and Efficient Program Management

Flexible, effective, and efficient program operations and the efficient use of funding are necessary in accordance with the characteristics of research and development. For this reason, at the national experimental research institutions, efforts are being made to fully utilize organizational structures that allow mobile and flexible changes based on internal measures. These changes are aimed at responding to progress and changes in research and development, including the priority allocation of funding at the discretion of institute directors, etc., in response to research performance, and the placement of researchers and the establishment of research periods in line with research topics.

The Ministry of Education, Culture, Sports, Science, and Technology uses the Special Coordination Funds for Promoting Science and Technology (Chosei-hi) to position "Urgent Research and Development" as a program to ensure a timely response to situations requiring urgent measures to be taken during the fiscal year. Emergency investigation and research activities during FY2004 are as shown in Table 3-3-4.

Table 3-3-4 Urgent research and Development subjects

Year implemented	Name of core institution	Name of investigation and research subject
FY2004	National Research Institute for Earth Science and Disaster Prevention	Emergency research on the Niigata-Chuetsu Area Earthquake in 2004
	Japan Agency for Marine-Earth Science and Technology	Emergency research on the Great Sumatran Earthquake and Indian Ocean Tsunami , 2005

With regards to research presentations at study meetings, Section 30 of the Japanese Patent Law stipulates that "the fact that the person having the right to obtain a patent" "has made a presentation in writing at a study meeting held by a scientific body designated by the Commissioner of the Patent Office" shall be deemed as an exception to lack of novelty of invention. The Japan Patent Office (JPO) has been making this provision applicable to research activities at universities.

(6) Utilizing Personnel and Developing Diversified Career Paths

To reinvigorate research activities, universities and research institutions are expected to make active efforts to ensure the involvement of diversified personnel.

In the third recommendation, "Toward development of human resources from the viewpoint of science/technology and society," released in July 2004, the Council for Science and Technology's Committee on Human Resources made suggestions for moving toward the realization of environments in which diverse personnel can demonstrate their full abilities and concentrate on their research. These suggestions included the fostering of creative and competitive environments that encourage diversity, and the promotion of participation by female researchers.

In the "Report on the Strategic Promotion of Internatioanl Activities in the Field of Science and Technology," a report released in January 2005 the Council for Science and Technology Committee on International Affairs points out "securing international research personnel and establishing a network" as one of the strategic promotion measures to cope with worldwide competition for excellent researchers, and stresses the importance of inviting excellent foreign researchers to Japan, dispatching young researchers abroad, creating forums for "intellectual exchanges," and developing internationally attractive research and living environments.

Based on these reports and recommendations, the Japan Society for the Promotion of Science is enhancing its researcher exchange programs, including its overseas research fellowships and post-doctoral fellowships for foreign researchers. And, in order to support female researchers who interrupt their research for maternity leave, the Grant-in-Aid for Scientific Research has been employed flexibly so that they can resume research after one-year's maternity leave. In a like manner, the Japan Society for the Promotion of Science in July 2003 is permitting interruptions and extensions of fellowships at the request of young researchers for the purpose of childbirth and child-rearing.

As part of developing various career paths, the Japan Society for the Promotion of Science and the JST have established the program manager position for people with research experience who will be responsible for a consistent operation for the competitive funding system.

(7) Achieving a Creative Research and Development System

To create excellent research results and to realize a research and development system capable of pioneering a new era, the heads of research institutions need to use superior concepts and leadership to promote organizational reform, and to create Centers of Excellence (COEs) for personnel training and R&D with international appeal.

In terms of the Special Coordination Funds for Promoting Science and Technology (Chosei-hi), the "Strategic Fostering Research Centers of Excellence" program has been in operation since FY2001. The program fosters and supports R&D institutions that make creative and pioneering attempts to build novel R&D systems and reform organizational operations, whose highly successful efforts influence other R&D institutions.

As table 3-3-5 shows, three institutions were newly selected as institutions to implement the program in FY2004, bringing to 10 the number of institutions engaged in advanced organizational reform.

Table 3-3-5 Strategic Fostering Research Centers of Excellence (Implementing institutions)

	Name of targeted institution	Concept
FY2001	Research Center for Advanced Science and Technology, The University of Tokyo	Open laboratory for human- and society-focused advanced science and technology
	Frontier Research Center, Graduate School of Engineering, Osaka University	Plan for Frontier Research Center
FY2002	Horizontal Medical Research Organization, Graduate School of Medicine, Kyoto University	Formation of an open medical research center of excellence through harmonization of advanced fields
	National Institute of Advanced Industrial Science and Technology innovation Center for Start-ups	Innovation Center for Start-ups
FY2003	Tohoku University Biomedical Engineering Research Organization	Formation of an advanced biomedical engineering center of excellence
	Creative Research Initiative "Sousei", Hokkaido University	Plan for a Hokaido University research and business park
	International Center for Young Scientists, National Institute for Material Science	Specified District Young and International Innovation
FY2004	User Science Institute, Kyushu University	Institute for 'Integration of Technology and Sensitivity' with Research Based upon the Needs of the User
	Consolidated Research Institute for Advanced Science and Medical Care, Waseda University	Formation of Consolidated Research Center for Advanced Science and Medical Care
	Research Institute for Digital Media and Content, Keio University	Research Institute for Digital Media and Content

3.3.1.2 Promotion and Reform of R&D at Japan's Main Research Institutes

(1) Universities and Inter-University Research Institutes

As one of their directives, Japan's universities and inter-university research institutes are entrusted with the task of securing the academic foundation and improving the academic standards of Japan, with a focus on academic research. The essence of university-level academic research is to give rise to new and richly creative knowledge based on liberal and open ideas, and the independent research activity of researchers. Furthermore, university-level academic research shall be characterized by the goal of advancement in study carried out over a broad range of fields in the areas of humanities, social sciences, and natural sciences, shall possess a respect for the independent nature of researchers as being essential to such progress, and shall function for the integrated promotion of research and education.

Based on reports and suggestions forwarded by the Science Council, the Ministry of Education, Culture, Sports, Science and Technology strives to provide for Japan's foundation for academic research in a planned and prioritized manner, and to proactively implement a comprehensive policy for the nation by increasing research funding, improving research facilities and equipment at universities and inter-university research institutes, nurturing and recruiting exceptional researchers, prioritizing the promotion of basic research, forming COEs, improving the evaluation of research, and developing and expanding upon the science information infrastructure, in order to develop an academic research system that is open to the world, and which is capable of flexibly responding to advancements in scientific research.

Expanding the independence of management at national universities and inter-university research institutes in the areas of budget, organization, and personnel affairs, the National University Corporation Law came into effect in July 2003 so that national universities and inter-university research institutes could develop themselves as appealing ones with distinctive identities that actively address education, research, and contributions to society, and establishing management structures that are open to public scrutiny. In April 2004, national universities and inter-university research institutes were incorporated.

Furthermore, efforts are being made, primarily by the Cabinet Office, to establish a university in Onna-son, Okinawa, with a graduate school curriculum in science and technology of the highest international standards, that embrace the new mindset of "internationality" and "flexibility" as basic concepts, with the aim of getting Okinawa to take part in Japan's and the world's scientific and technological advances, and to develop Okinawa into a region of advanced, concentrated brain power within the Asia-Pacific region. A bill establishing the Okinawa Institute of Science and Technology Promotion Corporation in September 2005 to prepare for the establishment of the graduate school was approved and enacted during the 162nd ordinary session of the Diet.

(Academic Research at Universities and Inter-University Research Institutes)

Researchers at universities nationwide are making use of research at their universities, departments, graduate schools, research laboratories, and research facilities, as well as joint-use inter-university research institutes, without being tied to a specific university.

In an age of advancements in academic research that are characterized in particular by the increasing large scale and sophistication of research techniques, researchers in many research fields are finding it increasingly necessary and efficient to carry out joint research. For this reason, a system for joint use of laboratories attached to inter-university research institutes and universities (attached laboratories) has been strengthened and research funding necessary for unique basic research has been increased.

Sixteen existing institutes were reorganized into four organizations (National Institutes for the Humanities, National Institutes of Natural Sciences, High Energy Accelerator Research Organization, and Research Organization of Information and Systems) with corporatization of National Universities, but the inter-university research institutes continue making significant contributions to research advancements in a variety of fields by acting as centers for promoting joint research between researchers employed throughout the nation's universities, and by providing a place for the joint use of facilities, equipment, and materials that are unique or large in scale. Projects such as the B-Factory project of the High Energy Accelerator Research Organization (KEK) and SUBARU, an optical-infrared telescope, a project of the National Astronomical Observatory of Japan (NAOJ) also promote cutting-edge international research. Research laboratories devoted to research in designated specialized fields have also been established at universities. These research laboratories carry out specialized research in collaboration with education and research carried out at university departments and graduate schools. At the end of FY2004, a total of 59 research laboratories had been established at the national universities, including 19 research institutions for joint use for the nation's universities. Research projects such as neutrino research conducted by the Institute for Cosmic Ray Research (ICRR) of the University of Tokyo have produced research results of the highest international standards.

Starting in April 2004, budgets for national universities and inter-university research institutes are allotted as subsidies for operating costs without their use being specified. Moreover, after incorporation, individual corporations are allowed to reorganize and abolish their organizations by their own judgment, giving them a more flexible approach to engaging in research activities. Furthermore, a "special education research expense" has been established to give prioritized support to corporations engaged in characteristic and ambitious research programs, making necessary financial support available for strategic, international, and contributing to local communities research activities proposed or requested by each corporation.

(Expanding Support for Japan's Private Universities)

Roughly 75 percent of Japan's university students attend private universities, which actively carry out characteristic educational research activity based on the unique spirit upon which each university was created. Accordingly, the Ministry of Education, Culture, Sports, Science and Technology implements the following measures in order to support private universities.

To support operating costs, the Ministry established in FY2002 the "Special Expenses for Advancing Higher Education and Research Levels at Private Universities," with the aim of creating world-class universities. This aid provides priority-zed assistance according to the state of each university's efforts in education and research.

To assist in the development of facilities and equipment, the Ministry supports the remodeling of facilities to make them multimedia-capable, the installation of on-campus LAN systems, and the provision of the research facilities and equipment needed to implement the "Program for Promoting the Advancement of Academic Research at Private Universities," which offers comprehensive support, including facilities and equipment, to excellent research projects.

Procedures for donations to be allotted to expenses and funds necessary for private school education through the Promotion and Mutual Aid Corporation for Private Schools of Japan (recipient designated donations) were drastically improved in April 2004.

(Deliberations in the Council for Science and Technology)

The Council for Science and Technology conducts research and deliberations in response to inquiries posed by the Ministry of Education, Culture, Sports, Science and Technology regarding matters important to the comprehensive promotion of science and technology, and to the promotion of learning in general; it also provides opinions to the minister. The Subdivision on Science was established within the Council in order to conduct research and deliberations on matters important to the promotion of learning that takes place primarily at universities (see Table 3-1-6).

(2) Science Council of Japan (SCJ)

The Science Council of Japan represents Japanese scientists at home and abroad with the philosophy that science is the foundation upon which civilized nations are built. Its purpose is to promote the advancement and development of science and have it reflected and spread in administration, industry and national life. Through its eight special committees (note), the SCJ functionally responds to short-and long-term challenges and is proceeding with studies by giving due consideration to new viewpoints required in today's academic world, such as interdisciplinary, comprehensive viewpoints, including integration of the humanities and science, and gender viewpoints.

In the course of administrative reform centering on reorganization of the ministries and agencies in FY2001, the Council for Science and Technology Policy deliberated on the status of the Science Council of Japan and as a result of the deliberations, the "Law to Amend Part of the Science Council of Japan," which is designed to revise SCJ's jurisdiction, organization, and method of recommending members, etc., was enacted in April 2004. The Science Council of Japan was placed under the authority of the Cabinet Office in April 2005 and its new organization is scheduled to be inaugurated in October 2005.

The new Science Council of Japan has four functions: policy recommendation, liaison and coordination concerning science, international exchanges concerning science, and communicating with society. As the representative organization of Japanese scientists, it will contribute to the promotion of Japanese science and technology in close cooperation with the Council for Science and Technology Policy.

(Expectations on Japanese scientists)

In April 2004, the Science Council of Japan issued a declaration, "Toward dialogue with society." It calls on scientists to recognize the importance of talking about the significance of science and research in an easy-to-understand language as their social responsibility. As the first step, it calls on scientists to have opportunities to speak to society and then strive to achieve society's awareness and sympathy toward science and technology. To this end, a symposium was held in May 2004. The Science Council of Japan plans toimplement dialogues with local residents and refresh education of elementary and secondary school teachers throughout the country. The SCJ has been calling on the business world, mass media, academic institutions, administrations, etc. toprovide cooperation for such activities.

(Deliberation Activities)

With respect to the Minister of Agriculture, Forestry and Fisheries' inquiry on the "Content and Assessment of the Multiple Functions of Fisheries and Fishing Communities with Respect to the Global Environment and Human Life" on October 8, 2003, the council considered the issue from a wide-ranging perspective that integrates the humanities, social sciences, and natural sciences. On August 3, 2004, the SCJ submitted "Content and Assessment of the Multiple Functions of Fisheries and Fishing Communities with Respect to the Global Environment and Human Life" to the Minister of Agriculture, Forestry and Fisheries on August 3, 2004.

With respect to the Science and Technology Basic Plan, the Science Council of Japan, in cooperation with relevant academic research organizations, will cooperate in analysis and evaluation for the "Survey to Evaluate the Effects of Achievements of the Basic Plan" to be conducted, which is to be led by the National Institute of Science and Technology Policy of the Ministry of Education, Culture, Sports, Science and Technology. Also, In preparation for the 3rd Science and Technology Basic Plan, the SCJ conducted studies from comprehensive and overview based on the results of the analyses and evaluations of the effects of the achievements of 1st and 2nd basic plans, and submitted its opinion, "Recommendations on Important Issues in the Science and Technology Basic Plan," to the Council for Science and Technology Policy on February 17, 2005.

(International Scientific Exchange)

The SCJ represents Japan through its affiliation with 48 international scientific organizations, including the International Council for Science (ICSU) and the InterAcademy Council (IAC). It has been striving for cooperation with various countries by actively taking part in six international academic cooperative projects, including the International Geosphere-Biosphere Programme (IGBP).

The Asian Conference on Scientific Cooperation (ACSC) gathered scientists from ten Asian countries to a conference held in Tokyo on an annual basis until FY2000 for the purpose of collaboration and cooperation among Asian countries in scientific research. It was reorganized into an international scientific organization, the Science Council of Asia (SCA), for which the SCJ serves as secretariat, and member countries host its conference in rotation. Conferences are convened annually on the theme of sustainable development in Asia. The fourth conference was held in South Korea in May 2004.

In November 2004, the SCJ hosted the "International Conference on Science and Technology for Sustainability – Asian Megacities and Global Sustainability" in Tokyo. The conference adopted a statement proposing what the academic fields can contribute to the measures for Asian megacities and global sustainability.

The Science Council of Japan also obtains approval from the Cabinet to host important international conferences related to science. These conferences are held in Japan and jointly hosted with relevant scientific research organizations. In FY2004, the Council co-hosted eight such conferences, including the 16th International Congress of the IFAA Anatomical Science 2004.

(Open Lectures and Symposiums)

The SCJ sponsors open lectures as a way of returning science results to the citizens of Japan. The SCJ also actively sponsors symposiums that engage in various scientific issues. The Divisions and Liaison Committees of the SCJ play a central role in organizing such symposiums in cooperation with various academic institutions.

In FY2004, the SCJ hosted three open lectures and 139 symposiums.

Furthermore, the SCJ jointly hosted with the Cabinet Office and Nippon Keidanren (Japan Business Federation) the "Third Conference on the Promotion of Coordination between industry, academia and government" in Kyoto in June 2004, and the "Fourth Summit on Coordination between industry, academia and government" in Tokyo in December 2004, in order to promote collaboration between industry, academia, and government. The SCJ also hosted a "Regional Promotion Forum" in Kyoto in October 2004, in Fukuoka in December 2004, and in Sendai in February 2005.

Moreover, the SCJ jointly hosted with the Japan External Trade Organization the International Symposium "Boosting Science and Technology through Industrial Collaboration" in Tokyo in November 2004.

(3) National Experimental Research Institutions, Public Experimental Research Institutions, and Incorporated Administrative Agencies

National experimental research institutions, incorporated administrative agencies, and public experimental research institutions are assigned the task of achieving policy targets. It is critical for these organizations to carry out prioritized research and development that centers on basic, pace-setting research to improve the nation's science and technology levels. They should also carry out systematic and integrated research that sets concrete targets in line with policy needs. Public experimental research institutions that belong to local governments shoulder the responsibility for carrying out technical development, and providing technical guidance that meets the needs of local industry and their region.

The total FY2004 expenditure related to science and technology, which cover experimental research, personnel, and facilities expenditures for the national experimental research institutions (including the Geographical Survey Institute, the National Geography Institute, the Japan Coast Guard's Hydrographic and Oceanographic Department, and other institutes), incorporated administrative agencies, and public research institutions, was 1.4209 trillion yen.

(4) Private Sector Research and Development

It is critical for the nation to reinvigorate the research and development activities of the private sector, which play an important role together with the activities of the national government. Therefore, it is important for the national government to increase the drive for a broad range of private sector research and development activities, based on the fundamental concept of self-reliance among the private sector.

(Promoting Private Sector Research Activity through the Taxation System)

To promote research and development by the private sector, systems that provide a tax credit on a certain percentage of gross experimental and research expenses, and a tax credit on a certain percenttage of experimental and research expenses in joint academia-industry-government research collaborations and commissioned research are provided.

The FY2005 tax reform extended until FY2006 special measures concerning the real property acquisition tax and the fixed property tax for corporations subject to Article 34 of the Civil Law that develop facilities on the grounds of national universities for the purpose of joint research with those universities. The limitation of deductions for donation under income tax was raised to 30% of taxable income.

Table 3-3-6 shows the current tax measures through April 2005 that are related to the promotion of science and technology, including the measures introduced in this section.

Table 3-3-6 Major preferential treatment for science and technology promotion

Item	Purpose	Description	Applicable law	Date of enactment/ validity
R&D taxation system	Promotion of research and development investment by the private sector, etc.	I. Incremental Tax Credit for Increased Research Expenditures (Optional: Taxpayers may elect either I or II.) (1) The research credit is 15% of the excess of research expenses over the base amount. (The base amount is the average of annual research expenses for the three years with the highest expenses in the five tax years preceding the current business year.) The maximum amount is the sum of 12% of the corporation tax liability (Corporation tax). (2) Furthermore, when a corporation incurs special experimental and research expenses for joint research with public research institutes (including independent administrative institutions) and/or universities and colleges, a value equivalent to 15% of that value is added to the upper limit on the tax credit amount in (1) above (but the tax credit amount after the addition is limited to 14% of the equivalent of the corporation tax). (3) Same for individual businesses (Income tax)	Special Taxation Measures Law, Article 10 (income tax), Article 42-4, Article 68-9 (corporation tax), Local Tax Law, Supplementary Provision, Article 8, Item 1.	Enacted in FY1967, effective through FY2005
		II. Proportional Tax Credits for total research expenses (Optional: Taxpayers may elect either I or II.) a. Special Tax Credit for total research expenses (1) The tax credit amount is (increased by 2% for FY 2003-6) as a special measure of experimental and research expense totals (but limited to a value equivalent to 20% of corporation tax) (corporation tax). (2) Same for individual businesses (Income tax). b. Special Tax Credit on joint and entrusted research based on industry-academic-government cooperation (1) For joint experiments and research with, or experiments and research commissioned to, universities and public research institutes (including independent administrative institutions), consistent with item a. above, the tax credit amount is a value equivalent to 12% (increased by 3% to 15% for FY2003-6 as a special measure) of these experimental and research expenses (but limited to a value equivalent to 20% of corporation tax with the special tax credit from item a. above added in). (corporation tax) (2) Same for individual businesses (Income tax).		Enacted in FY2003 (The special measure period is effective until FY2005)
		III. Tax system to strengthen the technical base of small and medium-sized corporations (1) The tax credit amount is a value equivalent to 12% (increased to by 3% to 15% as a special measure for (FY2003-6) of test and research expenses at small and medium-size corporations (but limited to a value equivalent to 20% of corporation tax) (corporation tax). (2) Same for individual businesses (Income tax) (3) The tax credit amount in (1) above is excluded from the tax base for corporate inhabitants tax (Local tax).		Enacted in FY1985 (The special measure period is effective until FY2005.)

Item	Purpose	Description	Applicable law	Date of enactment/ validity
		IV. Special Depreciation for Equipment used in Development Research (1) When specified equipment for development research is acquired and used in domestic R&D, a special depreciation equivalent to 50% of the value at acquisition will be allowable (Corporation tax). (2) Same for individual businesses (Income tax).	Special Taxation Measures Law, Article 11-3 (income tax), Article 44-3, Article 68-20-2 (corporation tax)	Enacted in FY2003, effective through FY2005
Deductions for Donations, etc	Promotion of science and technology	(1) The following donations made by individuals or corporations shall be given preferential treatment: 1. Donations to public interest corporations that are designated by the Finance Minister as being publicly solicited, contributing to the promotion of education or science, and assuredly going to urgent causes (Designated donations) 2. Donations to public interest corporations that promote education or science, significantly contribute to the public interest, and are donated to specified, qualified public-benefit promotion institution in relation to the main activities of the corporation; 3. Donations to specified approved charitable trusts that receive approval of the competent minister as promoting education or science, significantly contributing to the public interest, and filling specified requirements. (2) With regard to donations of spot goods to corporations engaged in businesses in the public interest, and that receive approval of the Director-General of the National Tax Administration Agency as filling the requirements of promoting education or science.	Corporation Tax Law, Article 37, Item 4, Item 6 Income Tax Law, Article 78 Special Taxation Measures Law, Article 40	Enacted in FY1946 (corporation tax), Enacted FY1962 (income tax) Enacted FY1961 (corporation tax), Enacted FY1962 (income tax) Enacted in FY1987 Approval procedure streamlined in FY2003
Measures for Tax Exemptions on Research Assets of Scientific Research Corporations	Promotion of science and technology	Assets provided to corporations established under Civil Law Article 34 for the purpose of scientific research are exempted from the real property acquisition tax, fixed property tax, special land holding tax, and city planning tax, subject to their direct use in that research.	Local Tax Law, Article 73-4, Item 1, Article 348, Item 2, Article 586, Item 2, Article 702-2, Item 2	Fixed property tax in 1951, real property acquisition tax in 1954, city planning tax in FY1956, special land holding tax in FY1973
Special Measures for Property Taxation Standards related to Biotechnology Research Assets	Reduction of burdens related to prevention of danger and harm to the public	Of the equipment that is required for experiments and research in gene recombination technologies, etc., the tax base for the purpose of fixed property tax is reduced to three-fourths for three fiscal years for new equipment that is acquired for the purpose of taking nonproliferation measures in accordance with the "Law Concerning the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms."	Local Tax Law Supplementary Provisions, Article 15, Item 22	Enacted in FY1986, effective through FY2005
Tax system for Promotion of Research Exchanges	Promotion of research exchanges, and revitalization of local economies	When corporations subject to Article 34 of the Civil Law develop facilities on the grounds of incorporated national universities for joint research with those incorporated national universities or incorporated inter-university research institutes, the tax on real property acquisitions is reduced to one-half, while the tax base for the fixed property tax is reduced to one-half for the first five years after acquisition, and to three-fourths for the succeeding five years.	Local Tax Law Supplementary Provisions, Article 11, Item 15, and Article 15, Item 24	Enacted in FY1999 (real property acquisition tax), enacted in FY2000 (fixed property tax) (effective through FY2006)

(As of April 2005)

(Promoting Private Sector Research Activities through Investment and Loans)

To promote research activity in the private sector, fiscal investment and loan systems for technology development are implemented by various government-affiliated organizations. The following section introduces some of the main examples of this.

(1)National Agriculture and Bio-oriented Research Organization

With the aim of promoting experimental research in the private sector concerning the designated industrial technology of biological systems, The National Agriculture and Bio-oriented Research Organization provides funds and conditional interest-free loans, as well as referrals for joint research using investments and financing from the Industry Investment Special Account and investments from private sources.

(2) Other Financial Provisions

To ensure the development of new technologies recognized as being able to contribute to a major improvement in the level of Japan's industrial technology, the Development Bank of Japan is implementing the New Technology Research and Development Loan Program to provide long-term, fixed, low-interest loans to corporations for development costs related to new technologies.

(Promotion of Private Sector Research Activities through Subsidies)

A system of subsidies is made available to support research and development aimed at commercialization by the private sector. The main subsidies are as follows.

(1) Subsidies for Pharmaceuticals to Treat Rare Diseases

To support research and development on drugs, etc., for diseases that afflict small numbers of Japanese people, subsidies are provided for costs related to experimental research for applicable pharmaceuticals, etc.

(2) Research and Development Project for Advanced Industries in the Agriculture, Forestry, and Fisheries Industries, and the Food Industry

Subsidies are being provided to promote private sector research and development in the biotechnology sector, and to promote the practical application of exceptional research results obtained at incorporated administrative research agencies.

(3) Technology Development Project for the Creation of Collective Private Agribusiness

In order to stimulate agribusiness, support is given for research and development that utilizes the potential of universities and incorporated administrative agencies, and is conducted by private-sector enterprises that assume the task of turning research results into practical applications.

(4) Research and Development Project to Create New Enterprises

As part of the Millennium Project, the Ministry of Agriculture, Forestry and Fisheries, through joint research groups that bring together private-sector enterprises, etc., to implement research and development toward the realization of functional crops.

(5) Program for the Support of Research on the Integration of Different Fields for the Creation of Bio-oriented Industries

Orchestrating the R&D ability of industry, academia, and the government, integrative research conducted by researchers from different fields is implemented with an open invitation for proposals from the public, and support for the building of partnerships is given.

(6) Technology Developing Project for Strengthening Industrial Infrastructure

To strengthen the technological infrastructure of Japan's food industry, projects are subsidized after themes have been selected based on the evaluations of outside specialists and experts on specific topics canvassed from enterprises, following the government's indication of technological topics.

(7) Subsidies for Research and Development of Creative Technologies

From the perspective of technology development and improving the technological capabilities of small and medium-scale enterprises, subsidies are provided for costs related to the development of creative new products, and the research and development of new technologies.

(8) Subsidies for Cutting Edge Technology Research and Development

The National Institute of Information and Communications Technology (NICT) subsidizes the research and development costs for venture enterprises carrying out cutting edge R&D related to telecommunications technologies that will lead to the creation of new business in the future.

(9) Subsidies for Research and Development into the Improvement of Communication and Broadcast Services for Elderly and Disabled People

The NICT provides private sector corporations, etc., with subsidies for research and development costs necessary for the development of communication and broadcast services for the elderly and disabled.

(10) Program for Support (Subsidy) of Technology Development for Creation of New Industries

In order to revitalize regional economies through the creation of new regional industries/businesses, support is given to high-risk development technology for practical use, such as entry into new fields by small and medium-sized enterprises and start-ups by venture companies.

(11) Private Sector Fundamental Technology Research Support Scheme

In order to promote experimental research into infrastructure technologies conducted in the private sector related to the mining, manufacturing, electro-communications and broadcasting industries, public applications are invited for entrustment research contracts. Applications are accepted by the New Energy and Industrial Technology Development Organization for mining and manufacturing technologies, and by the NICT for communications and broadcasting technologies.

(12) Grants for Practical Application of Industrial Technology

To strengthen industrial technology in the private sector, the New Energy and Industrial Technology Development Organization (NEDO) provides financial support on a cost-sharing basis to private sector enterprises for development of practical new technologies aimed at creating new markets or responding to social needs.

(13) Subsidies and Consignment Expenses, etc., Conducted under the Small Business Innovation Program

This program is described under the section entitled, "3.3.2.4, Developing an Environment to Invigorate Research and Development-style Ventures."

(14) Project to Support Research for Putting Medical Products and Medical Equipment to Practical Use

Private enterprises engaged in practical use-stage research and development of technologies concerning medical products and medical equipment useful for the enhancement of health care are invited to apply for entrustment research contracts through the Pharmaceuticals and Medical Devices Agency.

(Other)

A number of measures are being implemented to ensure the availability of superior personnel in small businesses, venture businesses, and other corporations that have just started operating. These measures include the promotion of personnel exchanges between universities and industry, etc., in order to nurture and produce personnel with an entrepreneurial sprit, to implement model research for courses offered on leading entrepreneurship at universities, etc., to further promote internships at venture businesses, etc. (student enterprise experience program), and to encourage university graduates to go into venture business operations.

Additionally, to support the creation of new businesses through entrepreneurial activities within corporations or through corporate spin-offs, a share conversion and share transfer program is being implemented to ensure the smooth reform of corporate organizations through the use of corporate spin-offs and holding companies, etc. In addition, studies have commenced into the development of a legal system for breaking up companies.

In addition, when preparation by the private sector is difficult because of the need for large-scale and joint-use facilities, the national government is prepared to undertake the preparation of facilities and equipment for joint use with the private sector (Table 3-3-7).

Table 3-3-7 Development of large-scale and expensive joint-use facilities and equipment too difficult for the private sector

Ministry or agency	FY of first use	Facility name Summary of facility or equipment	No. of cases for private-sector use (Unit: No. of cases) FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Ministry of Internal Affairs and Communications	2001	Iwate IT Open Laboratory	–	–	–	–	–	–	8	11	14
		Honjo R&D Support Center for Telecommunications	–	–	–	–	–	19	19	17	16
		Hokuriku IT Open Laboratory	–	–	–	–	–	–	29	21	33
		Kitakyushu IT Open Laboratory Shared use research facilities were developed and established by the National Institute of Information and Communications Technology (NICT) with the aim of the advancement of local industrial structure by the acceleration of research and development in industry-academia and by the accumulation of research institutes in university areas.	–	–	–	–	–	–	12	16	17
Ministry of Education, Culture, Sports, Science and Technology	1996	Numerical Space Engine Supercomputer and various servers	1	4	2	0	0	0	0	0	0
	1997	Snow and Ice Disaster Prevention Test Facility Completed March 1997. Total construction costs: 1.4 billion yen. Two snow-making devices can generate two types of falling snow, the crystalline and globular types. Also equipped with rainfall, sunshine, and wind tunnel devices, to recreate all possible snow and ice phenomena. Low-temperature test facility: Temperature –35℃ to 25℃ Base area: 25m × 7m	–	1	3	0	3	6	6	8	8
	1997	Synchrotron Radiation Facility (SPring-8) The facility construction was carried out jointly by the Japan Atomic Enegy Research Institute (JAERI) and RIKEN and is designed for research in a wide range of disciplines using synchrotron radiation that is emitted from an electron traveling at almost the speed of light when its path is bent by a magnetic field. Japan Synchrotron Radiation Research Institute (JASRI), which was designated by law as the Organization for the Promotion of Synchrotron Radiation Research, has conducted facility management and striven to promote its public use.	–	5	14	26	50	62	100	115	139
	1997	High Enthalpy Shock Tunnel At 80 meters in length, the world's largest free-piston shock tunnel. Maximum pressure 150Mpa, maximum entropy 25MJ/kg.	–	0	1	0	0	0	0	0	0
	1998 *	Ultra-Strong Magnetic Field Generating Device (powerful field magnet) An advanced facility that uses a world–class 40–ton hybrid magnet and various other magnets for study into magnetic field strength, special expansion, precision, and stability, in order to conduct measurements into electronic properties, material properties, etc.	16	16	62	73	70	68	83	86	87
Ministry of Health, Labour and Welfare	1997	Joint use facilities, NIID Tsukuba Primate Center Health Science Studies on gene therapy, longevity, cranial nerves, and incurable diseases, etc., are promoted using healthy monkeys that are not infected with specific viruses, as a shared source.	–	0	2	2	–	–	–	–	–
	1999	Construction environment simulator (wind tunnel experiment facility) Research facilities used for the clarification of resistance to wind damage of provisional structures and of workability under certain wind conditions.	–	–	–	1	1	2	0	0	–
	2003	Vibration load equipment (dynamic electricity type), etc. Research equipment for measuring pallesthetic sensibility of the body by difference in postures, such as standing, sitting, sitting cross-legged, lying down and sitting in a seat.	–	–	–	–	–	–	0	2	–
	2003	Apparatus for estimating the effectiveness of anti-vibration gloves, etc. Research apparatus for estimating the effectiveness of anti-vibration gloves.	–	–	–	–	–	–	0	1	–
Ministry of Agriculture, Forestry, and Fisheries	1996	Building for engineering experiments related to earthquake resistance and comfortable wood construction Test facility for seismic resistance of wood structures: Reaction floor, Reaction wall, Actuators (2 units of 300KN, 2 units of 200KN, and 4 units of 100KN)	–	1	2	1	1	0	0	1	2
Ministry of Land, Infrastructure and Transport	1997	Sudden Braking and Increased Vibration Testing Apparatus with Intra-Pier Continuous Girders Involves the use of apparatus to conduct research into earthquake-resistant designs of bridges, by using air bearings to float a 32-meter-long intra-pier continuous girder and the entire supporting bridge structure, including bridge abutments and piers, and then running a freely suspended weight across it to collide and come to a sudden stop against a reaction wall, in order to input data about impact acceleration.	–	0	0	0	0	0	0	0	0
	1999	Aqua Restoration Research Center Researches the preservation of river and marshland ecologies, for the purpose of research and development that facilitates mankind's coexistence with nature.	–	–	–	5	3	0	2	1	0

3.3.2 Strengthening of Industrial Technology and Reform of the Structure for Co-ordination between Industry, Academia, and Government

3.3.2.1 Promoting Commercialization for the Practical Use of Research Results Achieved by Public Research Institutions

(1) Introduction

The 21st century is being referred to as the "century of knowledge." The creation and utilization of that knowledge is indispensable to Japan's future development, for which the cooperation among industry, academia, and government is an important effort. Cooperation among industry, academia, and government in Japan has made great progress recently. For instance, the number of joint research projects between National Universities, etc. and Industry has more than doubled in the last five years. As of the end of March 2004, 1,236 patent licenses had been secured through Technology Licensing Organizations (TLOs)—specialty organizations that transfer the fruits of university research to industry. In the past three years, over 450 venture companies have been created that utilize the fruits of university research. As of August 2004, there were 916 such venture companies. At the same time, however, the acquisition and execution of patents in Japan is not always sufficient, given the world-class R&D capabilities of Japanese universities. The future cooperation among industry, academia, and government must be promoted further, for which various efforts are being strengthened.

(2) Promoting Commercialization for the Practical Use of Research Results Achieved by Public Research Institutions

To encourage the practical use of research and development results obtained at universities, research institutions, etc., the JST offers a series of comprehensive programs covering the identification of exceptional research results, support for patent applications, and support for the commercial development of research results that are difficult to commercialize. The JST actively supports the patenting of research results obtained at universities, public research institutions, and TLOs, as well as other technology transfer endeavors, and also runs the Technology Transfer Support Center, which is responsible for foundational work related to these activities, including the education of human resources and comprehensive consulting on technology transfer issues. The JST also promotes the following efforts based on the research results of universities and public research institutions: the implementation of a test to secure applied patents helpful for achieving practical use of fundamental patents; the modeling of new technology concepts from R&D-oriented medium-and small-scale enterprises; and the formation of venture corporations stemming from universities and public research institutions through the promotion of R&D aimed at the creation of new industries. Furthermore, in collaboration with universities, public research institutions, and TLOs, the JST provides development referrals for, and help with, licensing research results. For the development of new technologies considered likely to involve high development risk, JST assists companies developing applications for practical use by providing Risk-Taking Funds (if the development is unsuccessful, there is no requirement for repayment).

The Ministry of Education, Culture, Sports, Science and Technology supports university researchers who are attempting R&D that links basic research and research for product development—a stage of R&D that has insufficient support and is nicknamed "death valley." The Ministry targets researchers whose research results can be expected to lead to entrepreneurial activities in the future and subsidizes their R&D expenses and the management expenses for preparing a business plan toward the establishment of a business. As of the end of March 2005, MEXT has also placed 110 coordinators in 82 universities and technical colleges nationwide, where they serve as bridges between universities and enterprises that are conducting joint research at the universities. Furthermore, MEXT has been promoting the opening of special continuing education courses at universities and educational institutions to create human resources that are experts in both advanced technology and management (Management of Technology or MOT) and those that are experts in intellectual property. To foster human resources that are well versed in the securing and utilization of intellectual property, since FY2002, MEXT itself has been training human resources that will perform specialized jobs in the future at research locations, and equipping them with special knowledge about the securing and utilization of intellectual property as part of the "Fostering Talent in Emergent Research Fields," program, which is supported with Special Coordination Funds for Promoting Science and Technology.

At RIKEN, in order to facilitate more efficient application of research results to practical use or technology transfer, a system has been established, under which researchers, who have established venture companies on their own, are given preferential treatment in their joint research with venture companies.

The Ministry of Agriculture, Forestry and Fisheries is implementing a Technology Results Transfer Promotion Program for the utilization and practical application of acquired patents by the private sector, through appointing coordinators to serve as a bridge between experimental research institutions and private-sector firms.

The Ministry of Economy, Trade and Industry helps translate university research results into businesses through implementation of the Practical Application Research and Development Program for University-based Business Creation, which supports joint research by making matches between industry and academia with the objective of creating practical applications, and through the Dispatch of Management Experts Program for university-based start-ups. Aiming at the creation of 10,000 MOT personnel, since FY2002, METI has also been promoting the improvement of environments for the cultivation of MOT human resources. It does this by supporting the development of curricula and educational materials needed to cultivate MOT personnel at a total of 113 educational institutions such as universities.

In order to provide the appropriate protection of research results at national and public experimental research institutions and universities, and to support the smooth transfer of research results to industry, the Patent Agency hosts patent promotion fairs to provide opportunities for interaction with industries interested in adopting technologies. These fairs were implemented in 67 cities nationwide in the period between FY1997 and FY2002. In addition, the National Center for Industrial Property Information and Training dispatches, as of the end of March 2005, patent promotion advisors to the 33 of 39 approved TLOs that are currently in operation.

In addition, the Patent Agency sponsors international patent promotion seminars for a broad range of researchers and students from universities and public research institutions, which bring together large groups of individuals who are experts in the transfer of technology both in Japan and abroad. The Patent Agency also implements basic and practical training on patent promotion and technology transfer necessary to promote the transfer of research results to industry.

The National Institute of Advanced Industrial Science and Technology inaugurated 15 venture companies in FY2004 to develop new industries and markets by utilizing their own technology seeds, eased regulations on side business, and enhanced support for intellectual property rights.

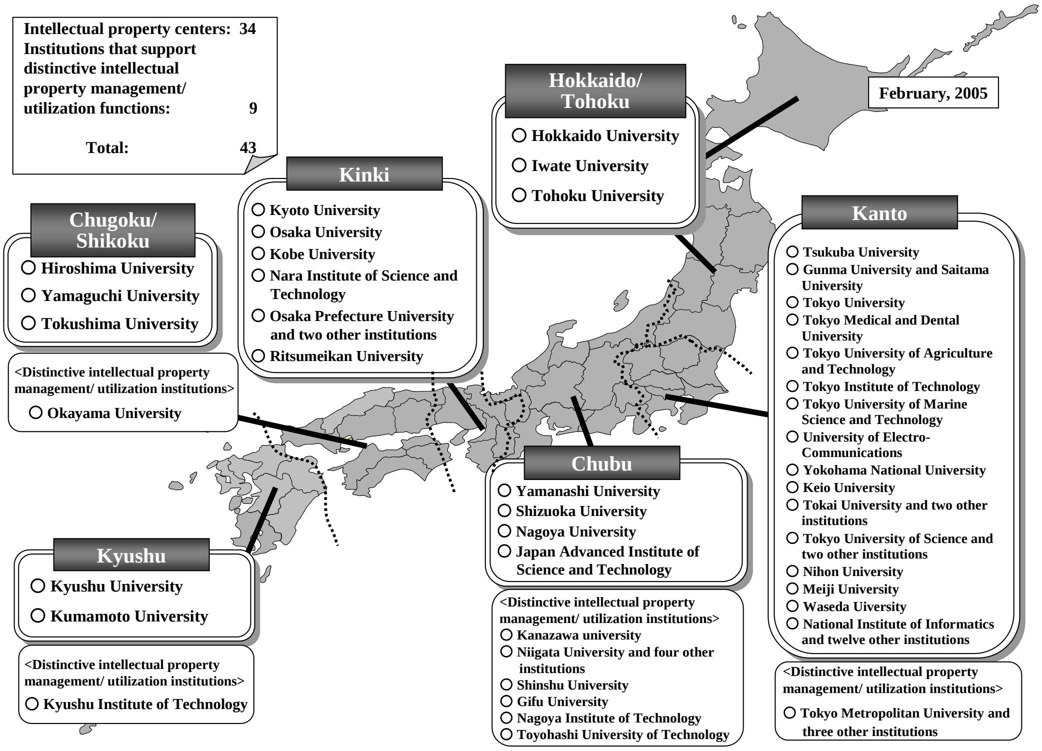
3.3.2.2 Developing an Environment for the Transfer of Technology from Public Research Institutions to Industry

With the aim of realizing a "nation built on intellectual property," the "Basic Law on Intellectual Property" was established in 2002 and various efforts are being made by the whole government to realize the "Intellectual Property Strategic Program" based on the Law.

Public research institutions must clarify the responsibility of institutions and researchers to explain to society the content and results of their research, and must give importance to intellectual property as well as research papers as performance evaluation of their researchers. Currently, the institutions are promoting that patents are to be attributed to the research institutions in principle, in line with proposals in the Basic Plan. Accordingly, the number of preferential licenses extended to private sector organizations resulting from patents obtained through joint research between national experimental research institutions and private sector organizations has increased with every passing year.

In line with the shift of attribution of patent and other university research results from individuals in principle to institutions in principle, the Ministry of Education, Culture, Sports, Science and Technology has established the Research Organization of Information and Systems (34 model institutions, and 9 support organizations with "unique intellectual property management/utilization function support programs" were selected) and is providing support in order to establish a strategic management system for control and utilization of intellectual property, such as patents, produced by universities, the source of "intelligence." Moreover, to promote patent procurement (especially strategic foreign patent procurement) originated from university research, the Technology Transfer Support Center is supporting the related costs.

Table 3-3-8 Regional distribution of university intellectual property centers under the improvement program



Based on the Law for Promoting University-Industry Technology Transfer (Law No. 52, 1998) with the aim of pioneering new business fields, improving industrial technology, and revitalizing research activities at universities by promoting the patenting of university research results and the transfer of technology to industry, three institutions were approved as TLO in FY 2004. Thirty-nine TLOs have been approved under this law as of the end of March 2005 (Figure 3-3-9, 3-3-10).

Table 3-3-9 Approved / authorized TLOs (Total of 39 institutions)

March 2005: 39 institutions approved as TLOs, 2 institutions recognized as TLOs

Name of TLO company	Date approved		Name of participating university
Hokkaido Technology Licensing Office Co., Ltd.	Approved	Dec. 24, 1999	Hokkaido University and other universities and colleges in Hokkaido
TOHOKU TECHNO ARCH Co., Ltd.	Approved	Dec.4, 1998	Tohoku University, other national universities, etc., in the Tohoku region
Institute of Tsukuba Liaison Co., Ltd.	Approved	Apr. 16, 1999	University of Tsukuba, others
Center for Advanced Science and Technology Incubation, Ltd.	Approved	Dec. 4, 1998	University of Tokyo
The Foundation for the Promotion of Industrial Science	Approved	Aug. 30, 2001	Institute of Industrial Sciences, University of Tokyo
Tokyo University of Agriculture and Technology TLO, Co. Ltd.	Approved	Dec. 10, 2001	Tokyo University of Agriculture and Technology
THE CIRCLE FOR THE PROMOTION OF SCIENCE AND ENGINEERING	Approved	Aug. 26, 1999	Tokyo Institute of Technology
Campus Create. Co., Ltd.	Approved Recognized	Feb. 19, 2003 Feb. 19, 2003	The University of Electro-Communications
Technology Advanced Metropolitan Area Technology Licensing Organization	Approved	Dec. 4, 2000	Tokyo metropolitan area universities
Yokohama TLO Co., Ltd.	Approved	Apr. 25, 2001	Yokohama National University, Yokohama City University, and other universities and colleges in Kanagawa prefecture
Niigata Technology Licensing Organization Co., Ltd.	Approved	Dec. 25, 2001	Niigata University and other universities and colleges in Niigata prefecture
OMNI INSTITUTE CORPORATION	Approved	Feb. 24, 2005	Nagaoka University of Technology, Nagaoka National College of Technology, University of Hyogo
KUTLO (Kanazawa University Technology Licensing Organization)	Approved	Dec. 26, 2002	Kanazawa University and other universities and colleges in Ishikawa prefecture and the Hokuriku region
Yamanashi Technology Licensing Organization Co., Ltd.	Approved	Sep. 21, 2000	Yamanashi University and Yamanashi Medical College
SHINSHU Technology Licensing Organization	Approved	Apr. 15, 2003	Shinshu University, Nagano National College of Technology
HAMAMATSU FOUNDATION for SCIENCE and TECHNOLOGY PROMOTION (January 17, 2002)	Approved	Jan. 17, 2002	Shizuoka University and other universities and colleges in Shizuoka prefecture
NAGOYA INDUSTRIAL SCIENCE RESEARCH INSTITUTE	Approved	Apr. 19, 2000	Nagoya University and other universities and colleges in the Chubu region
Mie TLO (Mie Technology Llicensing Organization)	Approved	Apr. 16, 2002	Mie University and other universities and colleges in Mie prefecture
Kansai Technology Licensing Organization Co., Ltd.	Approved Recognized	Dec. 4, 1998 Jul. 10, 2002	Universities and colleges in the Kansai region (Kyoto University, Ritsumeikan University, etc.)
Osaka Industrial Promotion Organization	Approved	Aug. 30, 2001	Osaka University and other universities and colleges in Osaka prefecture
New Industry Research Organization (NIRO)	Approved	Apr. 19, 2000	Kobe University and other universities and colleges in Hyogo prefecture
Okayama Prefecture Industrial Promotion Foundation	Approved	Apr. 28, 2004	Okayama University and other universities and colleges in Okayama prefecture
Hiroshima Industrial Promotion Organization	Approved	Oct. 09, 2003	Hiroshima University and other universities and colleges in Hiroshima prefecture
Yamaguchi Technology Licensing Organization Co., Ltd.	Approved	Dec. 9, 1999	Yamaguchi University
TECHNO NETWORK SHIKOKU CO., LTD.	Approved	Apr. 25, 2001	Universities in the Shikoku region
Kyushu TLO Company, Ltd.	Approved	Apr. 19, 2000	Kyushu University
KITAKYUSHU TECHNOLOGY CENTER CO., LTD.	Approved	Apr. 1, 2002	Kyushu Institute of Technology and other universities and colleges in the Northern Kyushu region
Nagasaki Technology Licensing Organization	Approved	Oct. 15, 2004	Nagasaki University and other universities and colleges in Nagasaki prefecture
Kumamoto Technology and Industry Foundation	Approved	Aug. 30, 2001	Kumamoto University and other universities and colleges in Kumamoto prefecture
Oita Technology Licensing Organization, Ltd.	Approved	Aug. 26, 2003	Oita University and other universities and colleges in Oita prefecture
Miyazaki TLO	Approved	Mar. 16, 2003	University of Miyazaki and other universities and colleges in Miyazaki prefecture
Kagoshima Technology Licensing Organization Co., Ltd.	Approved	Feb. 19, 2003	Kagoshima University, National Institute of Fitness and Sports in Kanoya, and Kagoshima National College of Technology
Keio University Intellectual Property Center	Approved	Aug. 26, 1999	Organizations on the Keio University campus
Tokyo Denki University Center for Research Collaboration	Approved	Jun. 14, 2000	Organizations on the Tokyo Denki University campus
Nihon University Business Incubation Center (NUBIC)	Approved	Dec. 4, 1998	Organizations on the Nihon University campus
NMS-TLO Center	Approved	Feb. 19, 2003	Organizations on the Nippon Medical School campus
Meiji University Intellectual Property Center	Approved	Apr. 25, 2001	Organizations on the Meiji University campus
WASEDA UNIVERSITY INTELLECTUAL PROPERTY CENTER	Approved	Apr. 16, 1999	Organizations on the Waseda University campus
RIDAI-SCITEC	Approved	Sep. 30, 2003	Organizations on the Tokyo University of Science campus

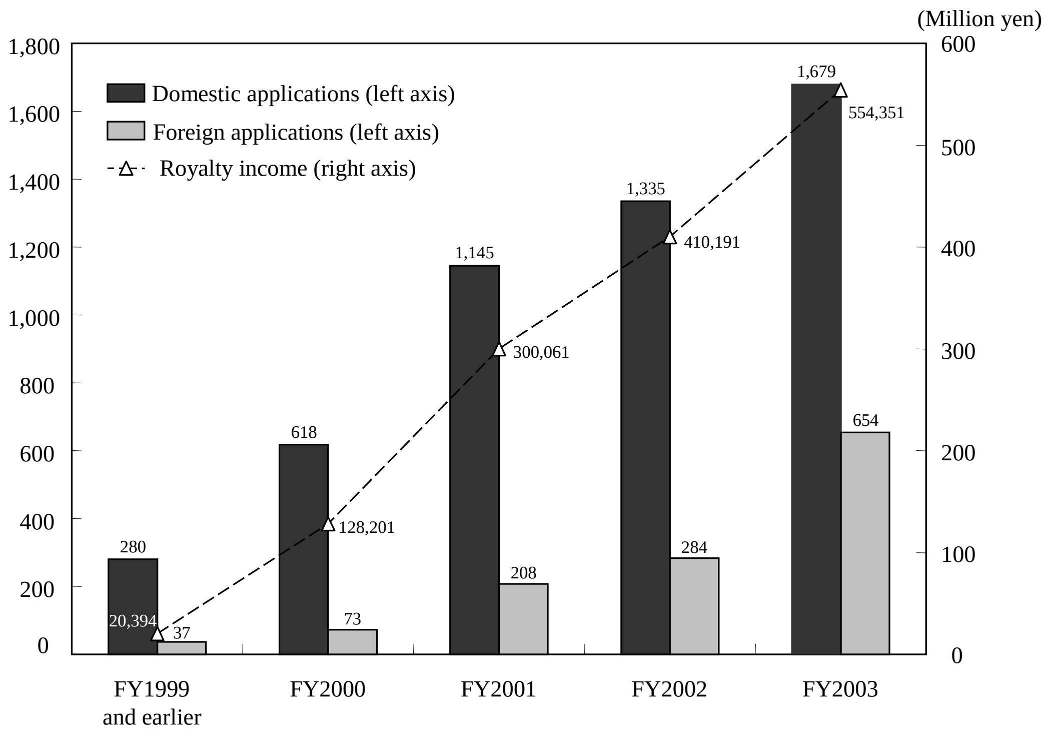


Figure 3-3-10 Trend in approved TLO patent applications and royalty income

To support TLO activities, the Ministry of Economy, Trade and Industry has issued subsidies to TLOs since the enforcement of (the early enforcement stages of) the Law for Promoting University-Industry Technology Transfer. (1998). In response to the large burden that foreign patent applications are having on TLOs, METI started in FY2003 to help cover foreign application costs with expanded subsidies.

Furthermore, METI drew up the "Guidelines for preparing trade secret management policy at universities," to enable universities to manage trade secrets to an appropriate extent under their own judgment, and to facilitate smooth technology transfer of universities research results to industry. The guidelines are being made widely known to university-connected individuals.

The National University Incorporation Law (Law No. 112 of 2003) lists the "promotion of diffusion and utilization of research results" as one of the businesses of national universities and has made it possible for national universities to invest in corporations to promote the utilization of research results. The investment in approved TLOs is allowed by a government ordinance.

Incidentally, the revision of the Trust Business Law in December 2004 has made it easy for approved TLOs to use patent rights, etc, as trust assets, raising expectations for a more active return of research results to society.

3.3.2.3 Reform of Structure for Disseminating Information and Research Exchanges Aimed at Strengthening Coordination among Industry, Academia, and Government

(1) Increasing the Dissemination of Information

To promote the strengthening of coordination among industry, academia, and government, it is essential to bring about a state of common recognition between industry and public research institutions, including universities. For this reason, public research institutions, including universities, are making research results available to the public and providing information in a number of ways, including the presentation of research results, the release of annual reports and other publications, the submitssion of research papers to various academic societies and journals, and the disclosure of government-owned patents.

The Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Economy, Trade and Industry, in cooperation with the Japan Science and Technology Agency and the New Energy and Industrial Technology Development Organization, sponsored "Innovation Japan 2004 ~ Fair of University-based 'Intelligence'," a nationwide Industry-academic matching event to disseminate the intellectual property of universities and public research institutions in the field of the most-advanced technologies, such as nanotechnology/materials, health care/biotechnology, information/IT, environmental technologies and manufacturing technologies, to industries, etc.

Furthermore, to contribute to the creation of new industries, the Ministry of Education, Culture, Sports, Science and Technology utilizes the JST to compile databases covering a broad range of R&D support data and research results data for wide availability over the Internet. Specific examples are the Directory Database of Research and Development Activities (ReaD) that compiles organizational data, researcher data, research theme data and research resource data from public research institutions, including universities, and the JST Science and Technology Research Result Database for Enterprise Development (J-STORE) that brings together and processes research results from public research institutions, including universities, etc., related patent information, for presentation in a readily understandable technology resource format.

In addition, as part of the "E-Village Development Plan," a basic outline drawn up in July 2003 for the development of rural villages through computerization, the Ministry of Agriculture, Forestry and Fisheries carries out the digital conversion of research results and other information contributing to the technology development of the agriculture, forestry, and fisheries industries, for wide availability over the Internet. Specifically, this involves the preparation of the Agriculture Information Search System known as Agropedia[17], which integrates and serves as a centralized source for the digital full text information database of reports from the Ministry's experimental research incorporated administrative agencies, national and public experimental research institutions and the field of agriculture, forestry and fisheries in universities; domestic and international databases of agricultural literature; a database of meteorological satellite images, and a database of research topics being explored at experimental research institutions.

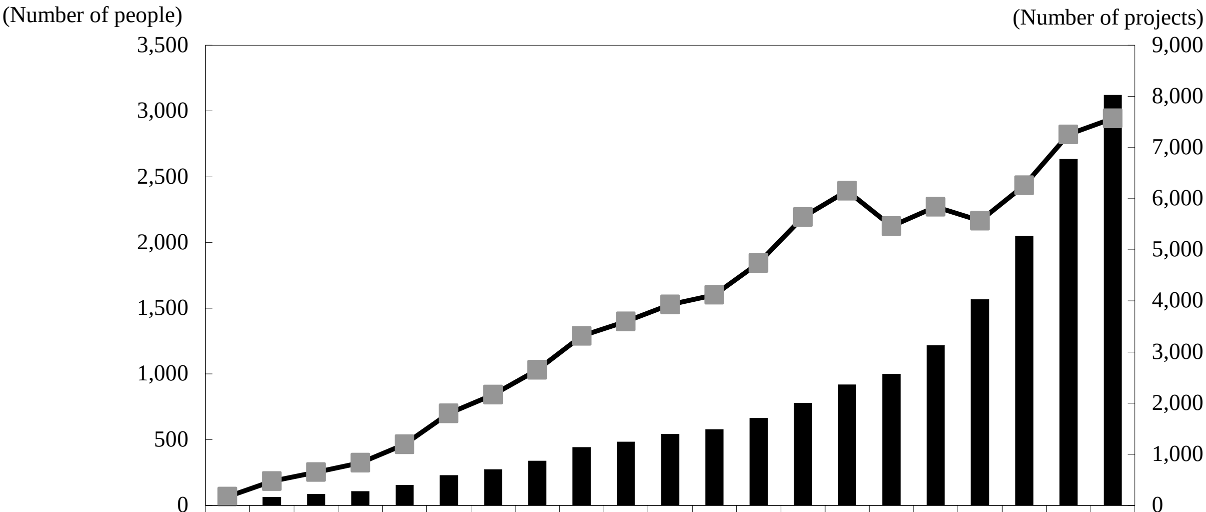
(2) Promotion of Research Exchanges

In recent years, research and development has increased in both sophistication and complexity, and has undergone an increase in the number of fields that are either interdisciplinary or are not included in any traditional discipline. To promote creative science and technology, it is critical to actively promote the development of infrastructures that allow such exchanges to be carried out, in order to promote personnel and material exchanges that extend beyond research institutions, and to efficiently and effectively utilize limited research resources. In addition, research exchanges are critical for the transfer of research results from public research institutions, including universities, to corporations, etc., and to encourage research by public research institutions, including universities, which reflects the needs of the corporations, etc.

(Joint Research and Contract Research)

To promote research exchanges between industry, academia, and government, the government ministries implement measures such as joint research programs. The number of joint research projects between national universities and the private sector has steadily increased over time, exceeding 8,000 projects in FY2003 (Figure 3-3-11). Since the incorporation of national universities in April 2004 has made it possible for national universities to engage in flexible coordination between industry, academia and government activities in accordance with their individuality and characteristics, they are expected to further promote joint research and contract research programs.

17 Agropedia: Derived from "Agriculture" and "Encyclopedia."



	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Number of projects	56	160	216	272	396	583	705	869	1,139	1,241	1,392	1,488	1,704	2,001	2,362	2,568	3,129	4,029	5,264	6,767	8,023
Number of people	66	184	254	325	465	700	842	1,031	1,288	1,398	1,527	1,602	1,843	2,192	2,394	2,124	2,271	2,165	2,435	2,821	2,944

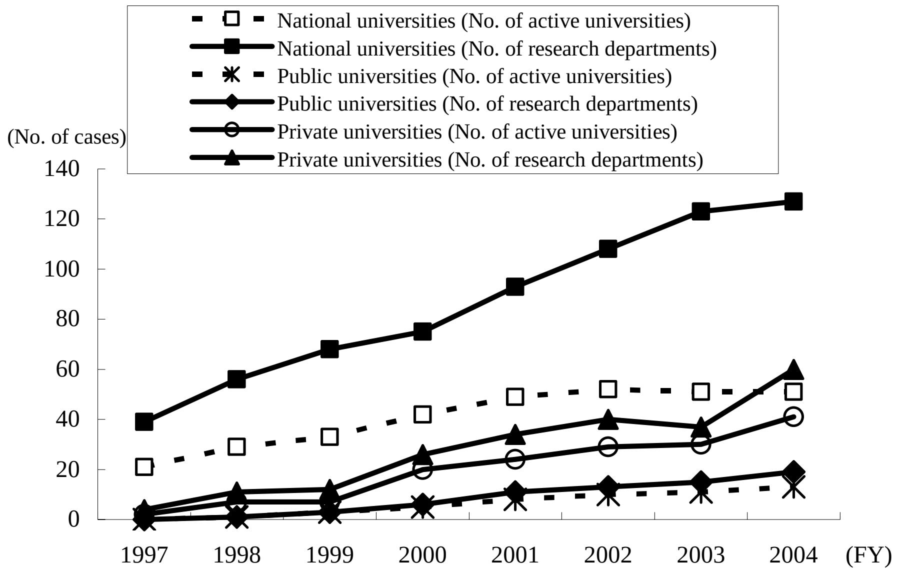
Figure 3-3-11 Trend in the number of research projects conducted jointly with the private sector

Government ministries have implemented a number of measures to promote joint research through collaboration among industry, academia, and the government. Examples include the "Effective Promotion of Joint Research with Industry, Academia, and Government" program, with matching funds from the Special Coordination Fund for Promoting Science and Technology, newly begun in FY2002, and the "Project for Research Advancement in Agriculture, Forestry and Fisheries Utilizing Advanced Technologies" implemented by the Ministry of Agriculture, Forestry and Fisheries. In addition, the Ministry of Economy, Trade and Industry implemented the Practical Application Research and Development Program for University-based Business Creation, promotion of coordination between industry, academia and government research through the most-advanced R&D test bed network established and operated by the National Institute of Information and Communications Technology the "Program for Industry-Academia-Government Development of Advanced Technologies," within the "Program for Promoting Strategic Information and Communications Research and Development," The Ministry of the Environment utilizes the Global Environment Research Fund. The above programs serve to promote integrated project research through coordination among industry, academia, and the government.

(3) Promotion of Personnel Exchanges

Currently, there are several programs in place to promote exchanges between researchers. Examples include the Government Guest Researcher Program implemented at various government ministries, the Flexible Employment System for Research Personnel that promotes flexible and creative research activities by researchers at national experimental research institutions, and programs to promote research exchanges such as the Program for Multidisciplinary Exchange implemented by the JST.

In addition, the Graduate School Coordination Program contributes to the promotion of personnel exchanges that are for the mutual benefit of universities, national experimental research institutions, corporations, etc. This program strives for coordination between graduate schools and both corporations and national research institutions, and is being utilized with increasing frequency (Figure 3-3-12).



(FY)		1997	1998	1999	2000	2001	2002	2003	2004
National universities	(No. of active universities)	21	29	33	42	49	52	51	51
	(No. of research departments)	39	56	68	75	93	108	123	127
Public universities	(No. of active universities)	0	1	3	5	8	10	11	13
	(No. of research departments)	0	1	3	6	11	13	15	19
Private universities	(No. of active universities)	2	7	7	20	24	29	30	41
	(No. of research departments)	4	11	12	26	34	40	37	60

Figure 3-3-12 Activity in the linked graduate school program

Note: 1. Summary of Program
Graduate students may receive research guidance from research institutes other than their own if their graduate school deems this appropriate due to educational considerations (Standards for Establishment of Graduate Schools, No.13). This linked graduate school system is asystematic implementation of this program.
2. The numbers are as of May 1 of each fiscal year.
Source: Prepared by MEXT.

To bolster the reforms of the system of collaboration among industry, academia, and government laid down in the Basic Plan, in continuation from the previous year, the nationwide "Fourth Business-Academia-Government Collaboration Summit" was held in December 2004, sponsored by the Cabinet Office, the Ministry of Internal Affairs and Communications, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Economy, Trade and Industry, the Japan Business Federation, and the Science Council of Japan. Taking "Learning from Pioneering Cases and Leading to Better Coordination between industry, academia and government Activities" as its theme, leaders of overseas pioneering universities, domestic universities and corporations were invited to the summit and presentations were made on case studies. Participants adopted the "Fourth Business-Academia-Government Collaboration Summit" calling for aggressive promotion of the fostering and securing of science and technology human resources, joint research and development and transfer of research results, university reform, support for regional science and technology promotion, and strategic protection and utilization of intellectual property. In addition, in order to further promote collaboration among business, academia, and government, the "Third Conference for the Promotion of Business-Academia-Government Collaboration" was held in June 2004 and working-level consultations were held, and were attended by representatives of universities, research institutions, and TLOs. In the conference, outstanding examples of successful collaboration among business, academia, and government that achieved remarkable success and contributed significantly to the promotion of such cooperative activities at universities and companies were recognized at the Second Awards Ceremony for Persons of Merit in Business-Academia-Government Collaboration, which included the presentation of the Prime Minister's Award, the Minister of Education, Culture, Sports, Science, and Technology Award, and other awards given by relevant hosts (Table 3-3-13).

Awards Ceremony for Persons of Merit in Business-Academia-Government Collaboration in FY2004

Award	Prize-winning example
Prime Minister's Award	Industrialization of photocatalytic technology for self-cleaning building materials, heat release materials, etc.
Ministerial Science and Technology Policy Award	Development and application of metabolome analysis technique
	Development and commercialization of new foods with enriched functional amino acid –GABA (gamma aminobutyric acid)-
	Development of monument-type wind power generator
Minister of Internal Affairs and Communications Award	Gigabit network for research and development (JGN：Japan Gigabit Network)
Minister of Education, Culture, Sports, Science, and Technology Award	Industrial expansion of the Micro Electro-Mechanical Systems (MEMS) using semiconductor micro fabrication technology
	Development and commercialization of form simulation software
	Development of an interferon-sensitive DNA chip
Minister of Economy, Trade and Industry Award	Development of new functional glass by nanostructure control and nano-processing technology
	Promotion of the e-ZUKA TRY VALLEY project
Chairman of the Federation of Economic Organization Award	Development of the ultrafine ink jet
Chairman of the Science Council of Japan Award	Development of cultured skin and cartilage from human cells and tissues
	Development and commercialization of the high-performance oxygenator – Platinum Cube NCVC –

Figure 3-3-13 Recognition of Persons of Merit in Business-Academia-Government Collaboration (FY2004)

The implementation of research activity for the private sector, etc., by researchers from national experimental research institutions and faculties at national universities, etc., contributes to the promotion of science and technology in Japan by cooperation among industry, academia and the public sector, and serves as an opportunity to demonstrate and build upon the individual capabilities of researchers. For this reason, it is necessary to manage the authorization of side jobs smoothly in which researchers employed by the national government are engaged in tasks such as research and guidance for the private sector, etc., outside of working hours. With regards to faculty members of national universities, they are allowed to engage in side jobs at the discretion of individual universities as the national university incorporation on April 1, 2004 has removed them from being employees subject to the National Civil Service Law.

(4) Response to conflict of interest

In promoting coordination between industry, academia and government, it is extremely important to appropriately deal with any "conflict of interest" that may arise in universities and research institutions on a daily basis. For this reason, the Ministry of Education, Culture, Sports, Science and Technology set up a "panel to study conflict-of-interest management" in August 2004 so that persons concerned at universities, etc. can share recognition and information on "conflict of interest." In addition, in March 2005, the ministry held workshops focused on "clinical study and clinical tests," in which special prudence is required in dealing with conflict of interest, so that parties concerned can have exhaustive discussions on the matter.

(5) Promotion of the Common Use of Research Facilities

The public use of cutting edge, advanced R&D facilities at national universities, incorporated administrative agencies and public corporations is crucial to the effective use of the facilities, as well as the promotion of cooperation among them.

The Ministry of Education, Culture, Sports, Science and Technology is promoting the public use of the third generation synchrotron radiation facility, SPring-8, constructed by the Japan Atomic Energy Research Institute (JAERI) and RIKEN, which began operation in 1997. Researchers place large expectations on SPring-8, since it is expected to contribute to the research results in a wider range of fields. For this reason, the "Law Regarding Promotion of Common Use of the Synchrotron Radiation Facility (SPring-8)" was established in order to promote its use by opening it to researchers from Japan and abroad.

In addition, based on the "Guidelines for the Effective Utilization and Operation of the Large-scale Synchrotron Radiation Facility, SPring-8" (Enquiry No. 20) issued by the Council for Aeronautics, Electronics, and other Advanced Technologies, the Ministry has been seeking policies for the efficient use and management of the facility, such as the promotion and upgrade of the facility's use and an effective management system.

In FY2004, reform of SPring-8's management system proceeded based on the recommendations given in the "Interim Evaluation Report on the Synchrotron Radiation Facility, SPring-8," prepared in September 2002 by the Council for Science and Technology's Subdivision on Research and Development Planning and Evaluation. In addition, the Organization for the Promotion of Synchrotron Radiation Research adopted approximately 1,120 research proposals for implementation between February 2004 and December 2004, promoting a wide range of research.

3.3.2.4 Developing an Environment to Invigorate Research and Develo pment-style Ventures

The promotion of private-sector research and development and the utilization of R&D results within the national government, etc. have played an important role in revitalizing the economy.

In the Small Business Innovation Research Program (SBIR), the relevant government ministries and agencies coordinate to increase the opportunities to provide small and medium-sized enterprises and so forth with subsidies, etc. Subsidies, business commissioning fees and so forth that are intended for small and medium-sized enterprises for the development of new technologies leading to the creation of new industries are designated as "special subsidies" and are applicable to this program. In FY2004, six government ministries, namely the Ministry of Internal Affairs and Communications, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labour and Welfare, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Economy, Trade and Industry, and the Ministry of the Environment designated a total of 60subsidies as "special subsidies." A target amount of approximately 28 billion yen in funds was supplied to small and medium-sized enterprises, through the coordination and cooperation of the government ministries.

3.3.3 Promotion of Research Activities in Regional Areas

With increasing concerns over the hollowing out of industry, there is a growing need to promote science and technology at the regional level, in order to revitalize regional industry and to improve the quality of life for residents in regional areas.

The First Science and Technology Basic Plan stressed the importance of promoting research activeties in regional areas, and called for the promotion of coordination and exchanges, etc., among local industries, academia, and governments, in accordance with the Basic Guidelines for Vitalization of Science and Technology Activities in Local Areas, which was approved by the Prime Minister in December 1995. With increasing importance placed on promoting regional research, the prefectural governments are actively making efforts to promote science and technology by establishing councils, etc., to deliberate policies for the promotion of science and technology, and adopting outlines and guidelines for science and technology policies individually (Tables 3-3-14 , 3-3-15).

Table 3-3-14 State of establishment of science and technology councils at the local government level

Prefecture	Name of science and technology council	Established
Hokkaido	Hokkaido Science and Technology Council	September 1952
Aomori	Aomori Industry, Science and Technology Council	December 1997
Akita	Akita Council for Science and Technology	August 2002
Iwate	Iwate Science and Technology Promotion Council	April 1989
Miyagi	Miyagi Conference on Guidelines for Promoting Science and Technology	July 1998 through March 1999
Yamagata	Yamagata Science and Technology Council	April 1999
Fukushima	Fukushima Science and Technology Promotion Council	May 1997
Tochigi	Tochigi Science and Technology Promotion Council	July 1999
Saitama	Saitama Science and Technology Council	January 1995
Chiba	Chiba Science Council	November 1994
Kanagawa	Kanagawa Science and Technology Council	June 1988
Niigata	Niigata Science and Technology Council	April 1998
Toyama	Toyama Science and Technology Council	November 1983
Ishikawa	Ishikawa Industrial Innovation Strategy Council （Transferred Ishikawa Industrial Science and Technology Council）	Transferred December 2003
Fukui	Fukui Science and Technology Promotion Council → Council for Fukui Production Planning Strategy	April 1998 through March 2004, May 2004
Yamanashi	Yamanashi Science and Technology Council	September 1991
Gifu	Gifu Science and Technology Promotion Council	July 1996
Aichi	Aichi Science and Technology Council	February 2000
Mie	Mie Science Academy Representative Conference	April 2001
Shiga	Shiga Science and Technology Promotion Council	April 2003
Kyoto	Kyoto Science and Technology Council	September 1961
Osaka	Osaka Science and Technology Roundtable	December 1986
Hyogo	Hyogo Science and Technology Council	April 2000
Wakayama	Wakayama Prefecture Science and Technology Strategy Council	September 2004
Tottori	Tottori Science and Technology Promotion Council	March 1999
Shimane	Shimane Science and Technology Promotion Council	October 1998
Hiroshima	Hiroshima Science and Technology Promotion Conference	May 1992 through March 1994
Yamaguchi	Yamaguchi Science and Technology Council	May 1991
Kagawa	Kagawa Science and Technology Council	August 1997
Ehime	Ehime Science and Technology Promotion Council	July 2001
Tokushima	Tokushima Forum for the Promotion of a vision for a Science and Technology	June 1998 through March 1999
Kochi	Kochi Science and Technology Promotion Council	June 1997
Saga	Saga Science and Technology Council	February 1996
Nagasaki	Nagasaki Science and Technology Promotion Council	October 1998

Prefecture	Name of science and technology council	Established
Kumamoto	Kumamoto Science and Technology Council	September 1999
Miyazaki	Miyazaki Science and Technology Council	August 2001
Kagoshima	Kagoshima Science and Technology Promotion Council	April 2003
Okinawa	Council for Promotion of Science in Okinawa	January 1995
Kawasaki City	Kawasaki City Innovation Promotion Meeting	August 2003
Yokohama City	Yokohama City Council for Promotion of Cooperation Between Industry and Academia	October 1999 through March 2003
Osaka City	Osaka City Council for Promotion and Planning of Industry, Science, and Technology	May 2000
Kitakyushu City	Kitakyushu City Science and Technology Promotion Council	November 2002 through March 2004
Hiroshima City	Hiroshima City Science and Technology Advisory Council	October 2003

Table 3-3-15 Enactments of science and technology promotion policies by local governments

Prefecture	Science and technology promotion policy	Date of enactment
Hokkaido	Guidelines for Promoting Science and Technology in Hokkaido	March 2000
Aomori	Guidelines for Promoting Industry, Science and Technology in Aomori Prefecture	December 1998
Akita	Basic Concept for Science and Technology in Akita Prefecture	June 2000
Iwate	Guidelines for Promoting Science and Technology in Iwate Prefecture (New Guidelines for Promoting Science and Technology in Iwate Prefecture)	May 1990 (Revised November 2000)
Miyagi	Guidelines for Promoting Science and Technology in Miyagi Prefecture	March 1999
Yamagata	General Outline of Science and Technology Strategies in Yamagata Prefecture	November 1998
Fukushima	General Outline of Science and Technology Strategies in Fukushima Prefecture	March 2002
Ibaraki	General Outline of Science and Technology Strategies in Ibaraki Prefecture	March 1994
Tochigi	Guidelines for Promoting Science and Technology in Tochigi Prefecture	December 1998
Gunma	Guidelines for Promoting Science and Technology in Gunma Prefecture	March 1999
Saitama	Saitama Technology Policy for the 21st Century	February 1998
Chiba	General Guidelines for Chiba Science Plan	February 1996
Tokyo	Tokyo Metropolitan Government Guidelines for the Promotion of Industrial Science and Technology	February 2004
Kanagawa	General Guideline for Kanagawa Science and Technology Sixth Plan	May 1990 (Revised March 2002)
Niigata	General Outline of Science and Technology in Niigata Prefecture	March 1998
Toyama	General Guidelines for Toyama Science and Technology (New Toyama Prefecture Science and Technology Plan)	October 1991 (Revised March 2001)
Ishikawa	Guidelines for Promoting Industry, Science and Technology in Ishikawa Prefecture	February 1999
Fukui	Guidelines for Promoting Science and Technology in Fukui Prefecture	January 1998
Yamanashi	Yamanashi Science and Technology Sixth Plan (Yamanashi Plan for Promoting Science and Technology)	March 1992 (Revised March 1999)
Nagano	Guidelines for Promoting Science and Technology and Industry in Nagano Prefecture	April 2000
Gifu	Basic Strategies for Science and Technology in Gifu Prefecture	March 1997 (Revised March 2002)
Shizuoka	Vision for Promoting Science and Technology in Shizuoka Prefecture	February 2000
Aichi	General Guidelines for Promoting Science and Technology in Aichi Prefecture	March 1999
Mie	Vision for Promoting Science and Technology in Mie Prefecture	July 1999
Shiga	Shiga Science and Technology Plan	March 1995 (Revised October 2004)
Kyoto	Promotion Plan for Industry and Technology in Kyoto	February 1995

Prefecture	Science and technology promotion policy	Date of enactment
Osaka	Osaka Research and Development Charter Guidelines for Industry, Science and Technology in Osaka → Guidelines for Promoting Industry, Science, and Technology in Osaka → Strategies for Promoting Science and Technology in Osaka	March 1988 → Revised March 1998 → May 2005 (Not fixed)
Hyogo	General Guidelines for Hyogo Science and Technology Sixth Plan (New General Guideline for Hyogo Science Technology Plan)	March 1991 (Revised March 1998)
Nara	Guidelines for Promoting Science and Technology in Nara Prefecture	March 2003
Wakayama	Vision for Promoting Science and Technology in Wakayama Prefecture	March 2000
Tottori	Investigative Report on the Promotion of Science and Technology in Tottori Prefecture	March 1998
Shimane	Guidelines for Promoting Science and Technology in Shimane Prefecture	March 1999
Okayama	Guidelines for Promoting Science and Technology in Okayama Prefecture	March 1998
Hiroshima	Fundamental Principles of the Promotion of Science and Technology in Hiroshima Prefecture	November 1993
Yamaguchi	Guidelines for the Promotion of Science and Technology in Yamaguchi Prefecture	March 1994
Tokushima	Vision for Promoting Science and Technology in Tokushima Prefecture	March 1999
Kagawa	Vision for Promoting Science and Technology in Kagawa Prefecture	March 1997 (Revised March 2001)
Ehime	Guidelines for Promoting Science and Technology in Ehime Prefecture	March 2003
Kochi	Guidelines for Promoting Science and Technology in Kochi Prefecture	March 1998
Fukuoka	Guidelines for the Creation of a Scientific and Technological Fukuoka Prefecture	March 1999
Saga	Vision for Promoting Science and Technology in Saga Prefecture	March 1997
Nagasaki	Vision for Promoting Science and Technology in Nagasaki Prefecture	June 1998
Kumamoto	Guidelines for Promoting Science and Technology in Kumamoto Prefecture	May 1999 (Revised March 2004)
Oita	Guidelines for Promoting Science and Technology in Oita Prefecture	March 2003
Miyazaki	Guidelines for Promoting Industry, Science, and Technology in Miyazaki Prefecture	March 2001
Kagoshima	Guidelines for Promoting Science and Technology in Kagoshima Prefecture	March 2003
Okinawa	General Guidelines for Science and Technology Promotion in Okinawa Prefecture	February 2000
Sapporo City	Vision for Promoting Science and Technology in Sapporo City	June 2004
Kawasaki City	Guidelines for Promotion of Science and Technology in Kawasaki City	March 2005
Yokohama City	Guidelines for Promoting Science and Technology in Yokohama-city	August 1999
Kyoto City	Concept for Super Technology in Kyoto City	March 2002
Osaka City	Plan for Promoting Industrial Science and Technology in Osaka City	March 2000
Hiroshima City	Hiroshima City Science and Techonology Policy	June 2003
Kitakyushu City	Blief Guidelines for Promotion of Science and Technology in Kitakyusyu City	August 2003
Fukuoka City	Vision for Promoting Science and Technology in Fukuoka City	June 2002

The Second Science and Technology Basic Plan calls for the government to promote research and development activities, including joint research, to develop and retain human resources, and to expand technology transfer functions, etc., for the effective and efficient creation of Knowledge Clusters under local initiatives. In response, the Ministry of Education, Culture, Sports, Science, and Technology launched the "Knowledge Cluster Initiative" in FY2002.

The following sections provide overviews of various policies that are being taken by the national government to support the promotion of science and technology at the regional level.

3.3.3.1 Aiming Toward the Creation of Knowledge Clusters and Industrial Clusters

(1) Knowledge Cluster Initiative

A "Knowledge Cluster" is a local technological innovation system organized around universities and other public research institutions that have unique R&D themes and potential. Businesses located inside and outside various regions are also expected to enter into these systems. More specifically, these systems successively drive technological innovation and create new industriesthrough mutual stimulation between technological seeds in research institutions and practical needs in the real business world. Human networks and joint research entities are also expected to be established in this process.

The Ministry of Education, Culture, Sports, Science and Technology launched the Knowledge Cluster Initiative in FY2002. In FY2004, the project was being run in 18 regions nationwide. In specific terms, each region sets up a "Knowledge Cluster Headquarters" staff with specialist science and technology coordinators, utilizes advisors such as patent attorneys, and carries out industry-academia-government joint research at university research centers or other institutions, which are expected to produce new technological seeds in accordance with industrial needs (Figure 3-3-16).

In addition, the Cooperation for Innovative Technology and Advanced Research in Evolutional Area (CITY AREA) program was implemented in FY2002 and was running in 37 areas in FY2004. This program aims to grow the seeds of new technologies by using the "wisdom" of universities, creating new enterprises, and fostering regional R&D-based industries while attaching importance to the unique characteristics of local areas and cities.

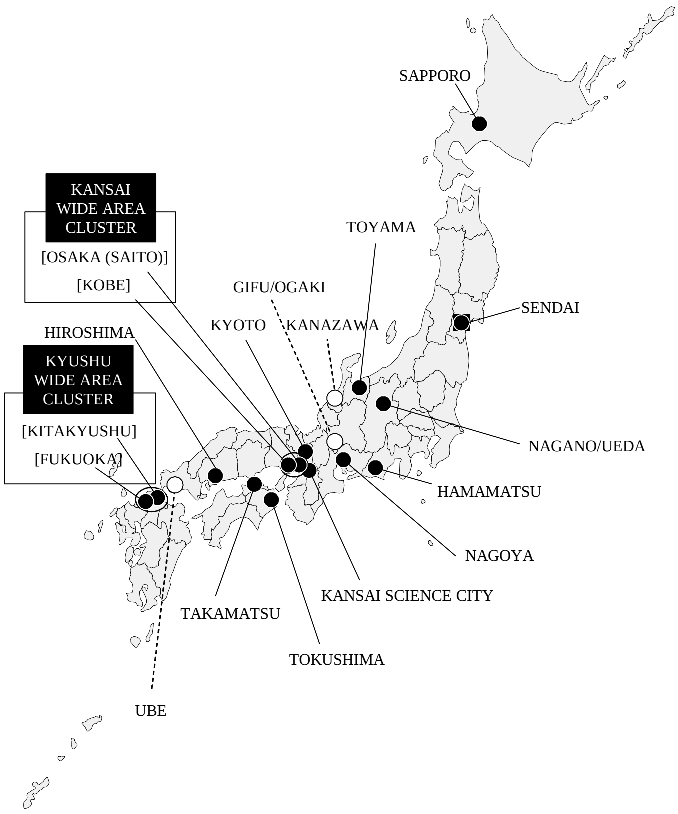


Figure 3-3-16 Map of the Knowledge Clusters

(2) The Industrial Cluster Project (Project for Regional Regeneration and Industrial Clustering)

An "Industrial Cluster" is a system that takes the technological innovation of universities and other public research institutions, and of business enterprises in the surrounding area, and encourages wider area cooperation between the universities, etc., and the business enterprises, and between different enterprises, to create a chain reaction of innovation and creation of new businesses and industries.

The Ministry of Economy, Trade, and Industry's "The Industrial Cluster Project" involves the regional bureaus of the Ministry of Economy, Trade, and Industry as the hubs of the formation of wide-area human networks of industry, academia, and government, including local enterprises, universities, etc., aiming for participation in world markets, and that uses comprehensive and effective implementation of the Ministry's regional measures to support local economies and form industrial clusters that can foster new business enterprises capable of competing in worldwide markets. Specifically, the Ministry currently has 19 such projects around Japan, operating with the cooperation of local public authorities, each forming wide-area personal networks of industry, academia, and government that include 5,800 small and medium-size companies with ambitions to enter world markets, and about 220 universities. These projects are implemented to promote improvements in the quality and volume of information flowing among industry, academia, and government, to supplement business management resources with information about technology, business management, and marketing channels, to support technology development that brings out local characteristics, and to develop entrepreneurial fostering facilities (business incubators) and business environments.

Support for technology development in local areas that leads to practical applications and the development of business incubators will be effective in promoting structural reform of industry and revitalizing the economy, by boosting industrial vitality and creating new business enterprises that will lead to the medium and long-term creation of industry and employment. Outlays of 49 billion yen from the FY2004 initial budget have strengthened measures related to the "The Industrial Cluster Project," centering on support for technology development in local areas that leads to practical applications. So far, a promotion organization was developed for each project, networks formed among industry, academia, and government, and efforts moved forward to develop technologies that lead to practical applications (Table 3-3-17).

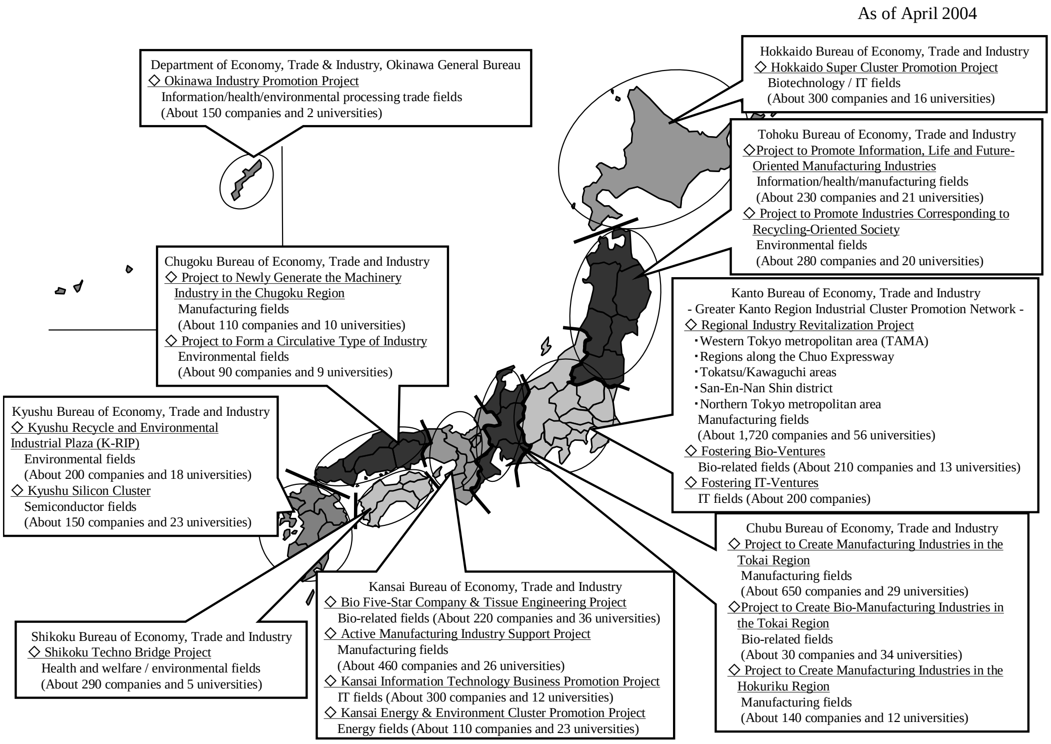


Figure 3-3-17 The Industrial Cluster Project

(3) Coordination between the Knowledge Cluster Initiative and the Industrial Cluster Project

The Ministry of Education, Culture, Sports, Science and Technology is working to create new technology seeds by promoting joint research among industry, academia, and government in fields of creative basic research, focusing on universities and public research institutions in regional areas. The Ministry of Economy, Trade and Industry is working to open up new fields for businesses, and to create start-ups and new products by promoting collaboration projects among industry, academia, and government, such as technology development that leads to practical applications, focusing on business enterprises.

Both ministries work together to promote the development of systems of collaboration among industry, academia, and government in regional areas, and both aim to revitalize regional economies and stimulate Japan’s national economy by working in close coordination to supply feedback on market needs and provide new technology seeds through their programs, which are adjusted to be in close coordination. Specifically, the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Economy, Trade and Industry, local public authorities, and other relevant entities established the “Committee for Regional Cluster Promotions” for each region, helped the project organizations of both ministries’ projects to work together, and promoted joint conferences to announce project results. Furthermore, a nationwide symposium to announce summarized versions of the achievements of both ministries’ projects and a nationwide cluster forum to discuss methods for promoting cluster policies were held in September 2004. In addition, close collaboration among ministries and agencies concerned is being promoted through the “Coordination Program for Science and Technology Projects” of the Council for Science and Technology Policy and the “Inter-Ministry Liaison Conference on Regional Science and Technology” and the “Regional Block Conference on Regional Science and Technology,” both established in October 2004.

3.3.3.2 Various Policies on the Promotion of Regional Science and Technology

The relevant national government ministries are implementing a variety of measures aimed at promoting regional science and technology (Table 3-3-18). The following sections introduce some of the main examples concerning research activities conducted by each government ministry.

Table 3-3-18 Major regional science and technology promotion measures

Ministry or Agency, related organizations	Item	Outline of measures
Ministry of Internal Affairs and Communications	Strategic Information and Communications R&D Promotion Programme (SCOPE) (Research and Development Promoting Info-Communications Technology for Community Development)	In the information and communication field, joint research is promoted between small and medium-scale Enterprises and universities, etc., to implement the creation of community-based new industries and to contribute to the promotion of local industry or invigoration of local community.
Ministry of Education, Culture, Sports, Science and Technology Science and Technology Policy Bureau	Knowledge Cluster Initiative	13 clusters (15 regions) were selected nationwide to create internationally competitive knowledge-centered systems for technological innovation (Knowledge Clusters). Knowledge Clusters will be organized closely around the knowledge creation bases, which consist of universities or public research institutions. Other related public institutions and R&D firms are also expected to come into this program. Proper attention to the autonomy of local governments should be paid in the whole process.
	Cooperation for Innovative Technology and Advanced Research in Evolutional Area (CITY AREA)	Through local independence, new technology seeds can be created by utilizing the “wisdom” contained in universities, achieving new industry creation and the development of R&D-type local industries. In addition, it is hoped to establish an independent and on-going industry-academia-government collaboration.
	Projects for development of locally led science and technology basic research	Supports projects run by local authorities for the development of the basic facilities that contribute to pioneering research using regional characteristics and potential.
	Promotion of Pilot Research (Special Coordination Funds for Promoting Science and Technology)	Implements pioneering R&D that brings out the character of local areas and that targets areas that require boundary or interdisciplinary research and development across a multiple number of science and technology sectors.
	Collaboration of Regional Entities for the Advancement of Technological Excellence (Japan Science and Technology Agency)	Aims to establish and reinforce a science and technology foundation that creates new technologies and industries in priority research fields set by the national government. Also explores new research areas through joint research by rallying regional potential in universities, national and other public research institutes, and R&D oriented private companies.
	Regional Science Promotion (RSP) Program (Japan Science and Technology Agency)	To help support local governments when they improve bases for regional coordination, Japan Science and Technology Agency commissions science and technology coordinators and promotes the creation of new technologies and industries by fostering university research results.
	Science and Technology Incubation Program in Advanced Regions (Japan Science and Technology Agency)	Aims to create new business projects through technological innovation. At Innovation Plazas located in 8 regions, the Japan Science and Technology Agency promotes the fostering of research results achieved through exchange among industry, academia, and government that utilize creative regional research results, and establish cooperation between local communities and researchers at universities, national research institutions, etc.
Ministry of Agriculture, Forestry and Fisheries, Agriculture, Forestry and Fisheries Research Council Secretariat	Research and development projects for creation of new projects	Brings together private-sector corporations, etc., into joint research groups, to promote research and development linked to the creation of new projects.
	Research project for utilizing advanced technologies in agriculture, forestry and fisheries	This project offers R&D funds to suitable projects in the fields of production, growing local seeds of technology or fulfilling regional needs (Competitive research fund).
Ministry of Economy, Trade and Industry	Regional consortium research and development system	Research and development by a joint research system by an Industry, Academia and Government consortium is implemented by utilizing technology seeds and wisdom contained in universities.
Ministry of the Environment, Environmental Policy Bureau	Research Funds for the National Organization for Pollution Prevention (Environment research to meet regional needs)	Implements joint research among national experimental research institutions, incorporated administrative research institutes and other public research institutions on research subjects where local needs are great and investigation into local environmental characteristics are required.

(1) Research Programs, etc.

To implement basic and pioneering research and development that fulfills regional needs and potential, it is important to promote coordination and exchanges among industries, academia, and governments. For this reason, it is necessary to develop a diverse range of research programs and to strengthen the coordination functions for research and development. In this regard, government ministries have implemented the following research programs.

(1)Ministry of Internal Affairs and Communications

The regional information and communications technology promotion-style R&D in the Information and Communications R&D Promotion Program is promoting joint research in the information and communications field between small and medium-sized enterprises and universities engaged in research and development contributing to the creation of local-based new industries, the promotion of local industries or the reinvigoration of local communities

In order to support the independence and social involvement of the elderly, the National Institute of Information and Communications Technology (NICT) seeks the cooperation of local government authorities and implements research and developpment that is aimed at establishing telecommunications systems with advanced features that are sought within the welfare sector.

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

The Japan Science and Technology Agency (JST) implements the Collaboration of Regional Entities for the Advancement of Technological Excellence, with the aim of contributing to the creation of new technologies and industries through joint research that brings together the research potential of local universities, national and other public research institutions, universities, and research and development-based companies toward specific R&D targets in priority research sectors designated by the national government. To help support local governments when they improve bases for regional coordination, the JST also implements the Regional Science Promotion (RSP) Program, which commissions science and technology coordinators and promotes the creation of new technologies and Industries by fostering university research results.

(3) Ministry of Agriculture, Forestry and Fisheries

In order to promote technology development directly related to agricultural production, the Ministry of Agriculture, Forestry and Fisheries implements research to promote key agricultural technology systems at the regional level, through large-scale and integrated research that includes on-site verifications in paddy fields.

In FY2002, the Ministry began implementing a project that invites proposals from the public. Relying on local initiative, the "Project for Research Advancement in Agriculture, Forestry, and Fisheries Utilizing Advanced Technologies" aims at rapid promotion of experimentation and research in the agriculture, forestry, and fisheries sector that has real relevance to working sites. Additionally, as part of the Millennium Project, since FY2000 the National Agriculture and Bio-oriented Research Organization has implemented the "Research and Development Project to Create New Enterprises". This program is aimed at the realization of functional crops that prevent lifestyle-caused diseases, and biotic pesticides that take the place of chemical pesticides, etc.

(4) Ministry of Economy, Trade and Industry

In order to create new regional industries and businesses, and to revitalize regional economies, advanced R&D for practical application is being implemented under a strong joint industry –academia-government research system (regional rebirth consortium) utilizing seed technologies and knowledge of universities, etc.

(5) Ministry of Land, Infrastructure and Transport

In order to facilitate coordination between industry, academia and government in various research and development programs that will contribute to the enhancement of international competitiveness, the realization of a safe and secure society, and solution of environmental problems, and to further promote the utilization of research results, the Second Advanced Technology Forum for Land, Infrastructure, and Transportation was held in Nagoya in February 2005, with 339 representatives of local industry, academia, and governments, as well as representatives of the Ministry and relevant research institutions attending. At the forum, the Ministry's pioneering research results and intellectual property, etc. were introduced, and the participants had face-to-face dialogues.

(6) Ministry of the Environment

The Ministry implements the Regionally Linked Environmental Research Program, which carries out joint research with national research institutions, incorporated administrative research institutions, and public research institutions. This program focuses on research themes for which there is strong demand at the regional level, and which require study that matches the characteristics of the regional environment.

(2) Promotion of Technology Transfers at Innovation Plazas (Science and Technology Incubation Program in Advanced Regions)

The Japan Science and Technology Agency (JST) aims to create new business projects through technological innovation. At Innovation Plazas located in 8 regions, JST promotes the fostering of research results achieved through exchange among industry, academia, and government that utilizes creative regional research results, and establishes cooperation between local communities and researchers at universities and national and public research institutions.

(3) Development of Research Facilities

It is important to develop research facilities and other infrastructure with regard to promoting regionally distinct science and technology. The Ministry of Education, Culture, Sports, Science, and Technology is promoting the new development of local infrastructure facilities for pilot science and technology, in support of local government programs for the development of infrastructure facilities that contribute to pilot research based on local characteristics and potential (these facilities include fundamental R&D facilities that contribute to the advancement of local research potential).

(4) Strengthening the Activities and Functions of Public Experimental Research Institutions as R&D and Technology Support Organizations

In order to provide R&D and technology support, etc., that leads to the advancement of industries and academia at the regional level, the relevant government ministries are implementing various measures directed at public experimental research institutions. These measures are summarized in Table 3-3-19.

Table 3-3-19 Strengthening of the activities and capacities of research and development and technology support functions at public research institutions

Ministry or agency	Summary of support function
Ministry of Internal Affairs and Communications	Adopts local tax grant measures for the research and development activity expenses of prefectural industrial technology centers, sanitation research institutes, agricultural test sites, livestock test sites, forestry test sites, and other public testing and research institutions.
Ministry of Agriculture, Forestry and Fisheries	Provides support for prefectural testing and research through the following projects: 1. Subsidized projects conducted by prefectural testing and research institutes ・Research required for the establishment of core agricultural technology systems for a local area 2. Projects consigned to prefectural test and research institutions, and implemented as part of national testing and research ・Quality improvement tests ・Compliant Tests on priority issues
Ministry of the Environment	・Promotes joint research with the pollution research institutes, etc., of local governments (prefectural or city governments), to contribute toward the preservation and improvement of the local environment ・The National Environmental Training Institute offers training for local governmental officers, etc., for the objective of training in analytical relationship technologies, etc.

(5) Interregional Coordination and Exchanges

The following measures are being implemented in order to encourage coordination and exchanges between the national government and local government authorities, as well as between different regions.

(Research Exchange and other Programs of the Japan Association for the Advancement of Research Exchange Cooperation)

The Japan Association for the Advancement of Research Exchange Cooperation (JAREC) was established in June 1992, based on funds provided by local government authorities, with the aim of supporting research exchanges and promoting regional research about S&T. This association implements various research support programs and natio nwide research exchange programs for regions commencing cutting edge or basic research.

(Industrial Technology Liaison Council)

The Industrial Technology Liaison Council was established in 1954 in order to strengthen cooperation among public research institutions and/or with national research institutions in relation to mining and manufacturing technology, to effectively promote experiments and research between institutions, and thus to improve industrial technologies. The council is composed of seven liaison divisions, eight regional councils, and a welfare technology division that is a horizontal organization. The council serves to facilitate research cooperation, research coordination, research exchanges, and information exchanges among public research institutions as well as between public and national experimental research institutions.

3.3.3.3 Supporting the Concentration of R&D Functions

Policies aimed at the promotion of industry in order to invigorate regional areas have hitherto tended to concentrate on enticing corporations to locate to that area, and on the incidental development of roads, harbors, and other hard infrastructure in the surrounding environment. In recent years, however, this approach has been supplemented by measures supporting the development of research equipment, research facilities and other items in the target regions, and the provision of subsidies and other measures for research and development. The following laws and measures represent an integrated approach to supporting the concentration of research and development functions

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 FY2004, a total of 80 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 709 national, public and private universities in Japan have graduate schools attached, with a total of 545 schools (as of May 2004), and the total number of graduate school students at all national, public and private universities has been steadily increasing, to about 244,024 students as of May 2004 (Figure 3-3-20).

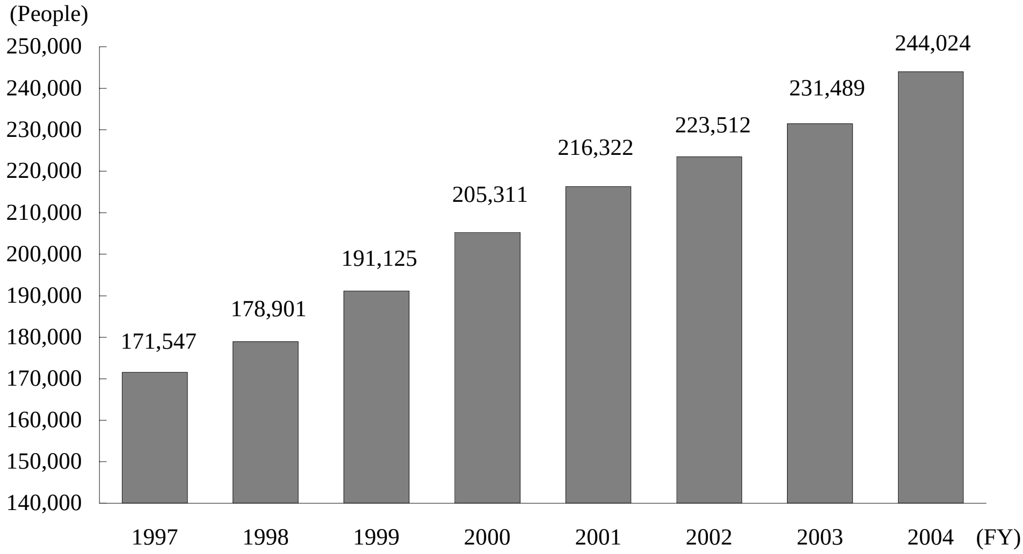


Figure 3-3-20 Trend in the number of graduate students

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

With the rapid technological innovations and changes in industrial structure seen in recent years, there is more demand than ever to promote creative and advanced education and research with a focus on the advanced science and technology sectors. So it is important to develop human resources, with special emphasis on graduate schools. The national universities play a major role for science and engineering-oriented graduate schools, and in FY2004, a total of eight postgraduate courses were established at five universities, while 72 majors were newly introduced at 18 universities.

Additionally, in order to heighten Japan's R&D capabilities, 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 (nationnal, 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 FY2004, 93 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[18], 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. The Ministry of Education, Culture, Sports, Science and Technology is also giving support to the upgrading and modernization of facilities for experiments and practice in science and technological departments, and to universities working for industry-academia collaborative education.

(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.

18 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 3-3-21).

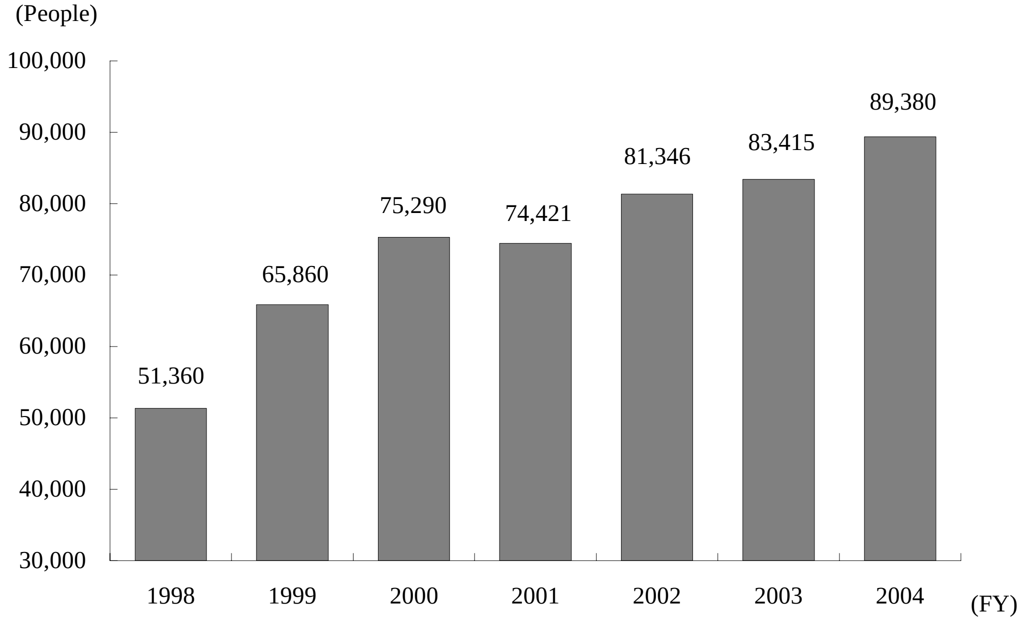


Figure 3-3-21 Trends in the total number of people (graduate students) receiving scholarships from the Japan Student Services Organization

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

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 nationnal 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.

(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 3-3-22).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 2003:① promotion of further exchange of students, such as accepting from and dispatching to foreign countries,② reinforcement of support for Japanese students to study abroad,③ 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.

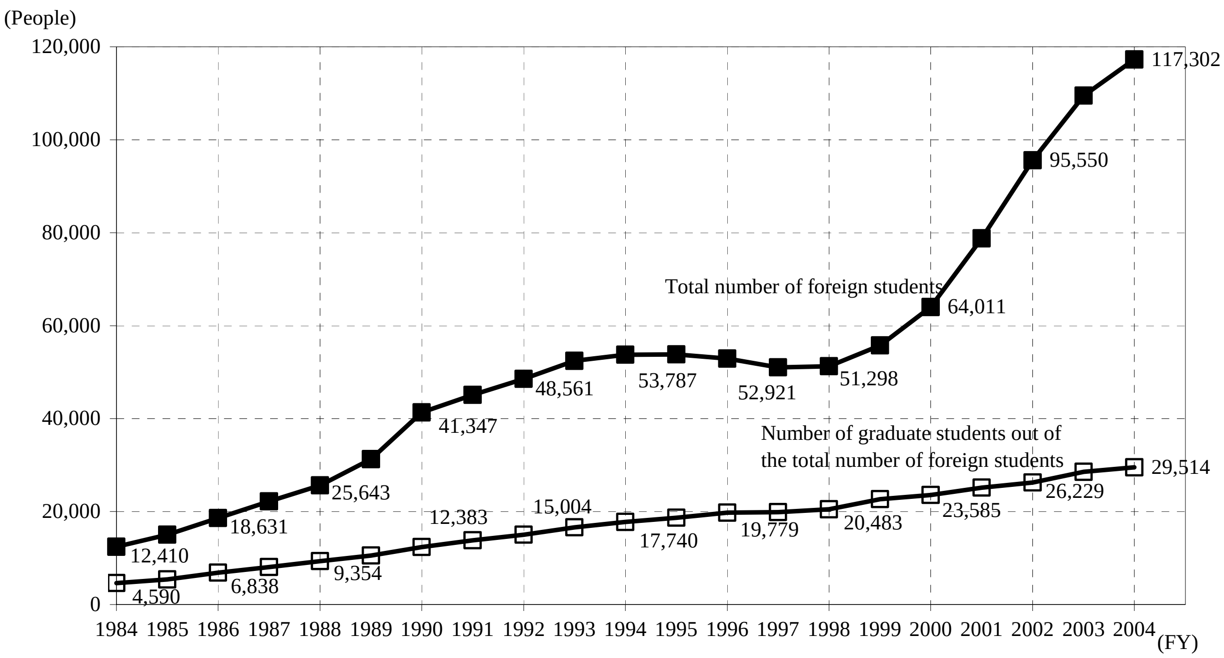


Figure 3-3-22 Trends in the number of foreign students in Japan

Note: As of May 1 for each year.

(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. As for national colleges of technology in particular, 55 colleges of technology across the country were established as a single independent administrative entity, which is assisting efforts to allow more flexibility into school management and to further improve the content of education.

(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. The Ministry implements the "Aspire to be a Specialist" program, which assigns specialized upper secondary schools that will be engaged in advanced research adopting cutting-edge technologies and skills.

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 FY2004, the test resulted in 22,978 individuals being certified as Associate Professional Engineers, and 3,437 being certified as Professional Engineers. As of the end of December 2004, there were a total of 14,883 people registered as Associate Professional Engineers, and 54,992 registered as Professional Engineers. The distribution by sector is shown in Figure 3-3-23.

Based on a report, "Review of the Technological Sections of the Professional Engineering Test," which addressed the establishment of a new section on nuclear energy and radiation, submitted by the Council for Science and Technology submitted to the Minister of Education, Culture, Sports, Science and Technology in June 2003, the Ministry of Education, Culture, Sports, Science and Technology revised the technological sections and test subjects of the professional engineering test. The revised test has been implemented since FY2004.

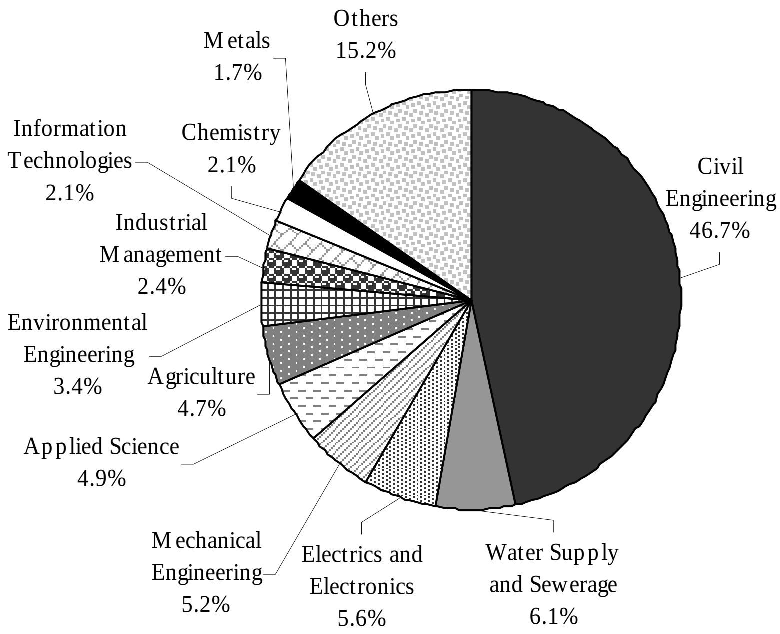


Figure 3-3-23 The distribution of Professional Engineers by the field of specialization (as of the end of December 2004)

(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 aceptance 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 qualifycation with corresponding qualifications overseas.

In November 2000, the "APEC Engineer Manual" was published based on the results of studies at APEC. As of June 2003, there were 11 participating economies in the register, including Japan.

In October 2003, Japan and Australia signed a mutual recognition of the Professional Engineer qualification framework, the first example of bilateral mutual recognition under this project. In response to this signature, Japan revised ministry ordinances and has been ready to receive Professional Engineer from Australia.

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 aware- ness 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 techno- logy. In light of the major role played by science and vocational education in such efforts, Japan strives to further enhance such education.

Science education at the elementary and seconddary education level emphasizes observation and experimentation, topic learning through pro-active investigation of topics, and learning through problem solving. Expanded efforts are also being made to foster in children scientific ways of looking at and thinking about the world around us.

Starting in FY2002, the Ministry of Education, Culture, Sports, Science and Technology has been implementing the "Science Literacy Enhancement Initiative," which integrates policies related to science and technology education. Specifically, the Ministry, in cooperation with the Japan Science and Technology Agency, is implementing efforts such as "Super Science High Schools," which is for training future international human resources of science technology, and the "Science Partnership Program," which provides opportunities to children to come into contact with science and technology, and enriches teacher training by promoting collaboration between universities or research institutions and schools. In addition, the Ministry is proceeding with efforts to develop and promote digital materials for science and technology education that make use of the latest research results, and to develop systems for providing these materials to schools. The Ministry is also moving ahead with efforts on the planned development and expansion of science education equipment, such as experimental equipment at schools. Moreover, decisions have been made for the future promotion of efforts such as the "Science Literacy Enhancement Schools Program," a model for the promotion of science and technology education, which will endeavor to raise children's intellectual curiosity and spirit of inquiry through an emphasis on observation and experimentation in elementary and junior high 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. In addition, the "Aspire to be a Specialist" program was newly implemented in FY2003 for schools that conduct education that introduces advanced technologies and skills in order to foster future specialists.

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 techno- logy 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 active- ties.

(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 supp- orts symposiums and science lectures targeted at either young people or adults in the general population to disseminate information about the latest research trends, etc. In addition, classrooms and other facilities at elementary and junior high schools, or at universities and specialized training colleges, are opened up on weekends to hold scientific experiment classes for children. Additionally, the Ministry is implementing specialized training for museum specialists employed at natural science museums, etc., in order to improve their level. Also, by dispat- ching expert staff such as curators working in museums and other facilities to museums (including natural science museums) in foreign countries for training, it is expected that they will obtain sophisticated expert knowledge and skills in relation to their work.

The National Science Museum conducts educational programs—such as science classes and experimentation courses for young people and children—that serve to deepen the understanding of science and technology. The Exhibition in the New Building, which explains about biodiversity, the history of lives on earth and the development of science and technology through a new explanation system, was opened to the public from November 2004.

The Japan Science and Technology Agency is a pioneer in developing 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 is often regarded as too difficult, are explained in an easily understood manner by employing methods such as interactive exhibition, experiments and projected images. It also develops and diffuses methods to reinforce the understanding of science technology, and promotes exchanges among researchers. 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 supp- ort these activities.

Also, in cooperation with the Science Council of Japan, the Japan Science and Technology Agency provided broader opportunities to diffuse knowledge on science and technology. It also implemented practices to evoke social interest on fostering hum- an resources in science technology through the provision of support for participation in international science and technology contests. Furthermore, it implemented business to support science and technology educational activities, through collaboration between science museums and local schools.

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 nurture richly creative and independent science and technology-oriented personnel who possess a passion and vision for science and technology, and 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)

In FY2004, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) implemented 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 the “Science and Technology Week,” the “Atomic Energy Day,” and the “Space Day,” MEXT implemented various nationwide events in cooperation with affiliated organizations. In addition, MEXT conducted PR activities by government publicity through television and radio programs. Many events were held during the Science and Technology Week in FY2004, including the opening of research facilities to the general public, science and technology experiment classrooms, and public lectures. These events were held at research facilities, science museums and other institutions across the country, with the cooperation of various science and technology-related organizations.

(Support for Hands-on Activities)

In FY2001, the “Children’s Dream Fund,” established by the National Olympics Memorial Youth Center, commenced 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. These are just two examples of efforts to create universities and research institutions that are open to the public, through concentrated measures on the part of organizations to open up their facilities to the public, carry out exhibitions, etc.

To get the young people and children who will lead the next generation to experience the enjoyment of space and the wonders of the earth, the Japan Aerospace Exploration Agency (JAXA) holds a variety of hands-on learning events throughout the year, including the “Cosmic College” and the “Space School.”

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 Ministry also established the Tama Forest Science Garden at the Forestry and Forest Products Research Institute, which provides exhibits on forestry science.

(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 Techno- logy" 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 Techno- logy" 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 nation wide, and is sold in government publications service centers and other places.

The latest issue, published in March 2005, has "Maritime Science and Technology and Global Environment" as its theme, and explains in an easy-to-understand manner the relation between the ocean and the global environment, the ocean as a frontier in deep waters and polar regions, and the importance of science and technology in the fields of global/maritime observation by using comics, photos and an attached CD-ROM.

(2) Awards for Science and Technology

In addition to promotion and awareness activities, an effective measure for promoting science and technology is to encourage research and develop- pment 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 on the science and technology fields in Japan. In FY2004, 15 people were awarded for science and technology merit, 35 people for research merit, 31 people for contributions in science and technology promotion, 6 people for contributions in the diffusion and enlightenment of science and technology, 987 people for ingenuity merit, and 26 schools that made notable achievements in fostering the ingenuity of elementary and junior high school students,. From FY2005, this awarding system will be enlarged to include group awards to cope with the increasing number of team research and developments, awards for young researchers, reinforcement of awards to those who contributed to activities to promote understanding, and expansion of the system for awarding those who contributed to preparing environments for research and development such as creation of venture companies and collaboration among industry, academia, and government, and will be implemented as a new system.

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

The Policy Subcommittee of the Council for Science and Technology (CST) sponsored a "Meeting to Consider Society and Science & Technology in the 21st Century" attended by individuals employed in a broad range of fields.

The results of this event were summarized in a report completed in November 2000, which focuses on a "Code of Conduct and Responsibility to Society for Persons involved in Science and Technology," and sets forth that "As group-oriented social based activities, science and technology are a part of society, and must be questioned in terms of their positioning within society and their societal value, not only based on the public support they receive in the form of budgets allocated from the national government and society, but also based on their effect and potential for all aspects of people's daily lives." The report further points out the "need to establish a socially based system that readily allows for science engineers to carry out a code of conduct and to carry out their responsibilities," and " for which the extremely critical issues are ethics education and the strict implementation of safety countermeasures by engineers."

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 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 3-3-24), 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 of national universities, etc., the Ministry is working on efforts such as the expansion of cutting edge research facilities that are necessary for the implementation of research that spurs development and growth in new fields of 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 information processing education.

In particular, the Ministry is promoting assistance for unique education and research projects, such as the "Program for Promoting Advancement of Academic Research at Private Universities," which offers comprehensive support with research facilities, equipment, and funds for top-level research projects undertaken at private universities.

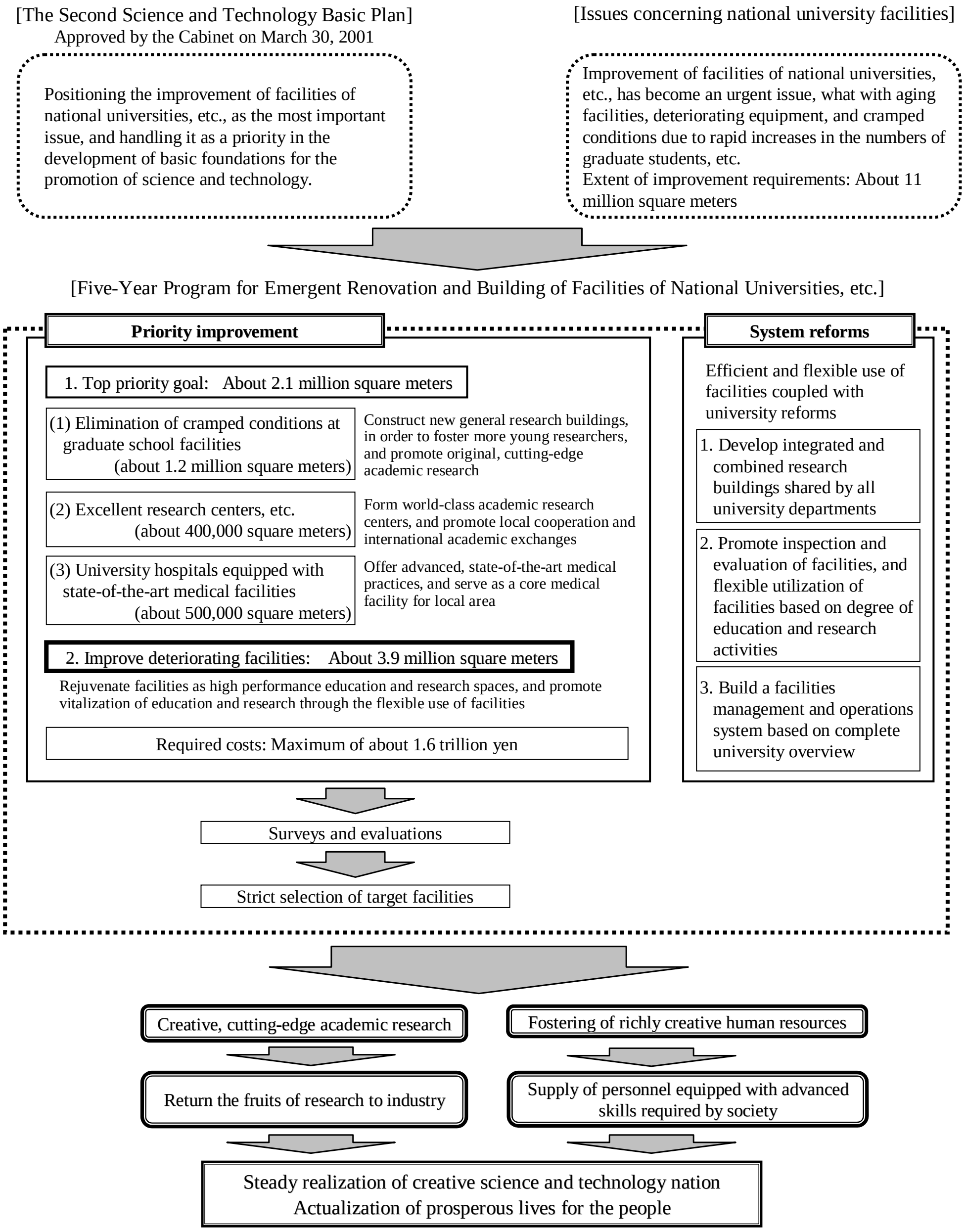


Figure 3-3-24 Five-Year Program for the Emergent Renovation and Building of Facilities of National Universities, etc.

(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 world's highest-performance large-scale synchrotron radiation facility, SPring-8, as one of its measures. As of FY2004, 48 beamlines, or approximately 2/3 of the maximum potential of 62 beamlines, are operational or under construction. Similar plans on large-scale synchrotron radiation facilities have been pursued in Europe and the United States. Europe started the public use of the facility in 1994, and the U.S. started in 1996 respectively, as shown in Table 3-3-25.

Table 3-3-25 Large-scale synchrotron radiation facilities in the world

Project	Site	Energy	Open for use
ESRF (Europe)	Grenoble (France)	6 GeV	1994
APS (the U.S.)	Argonne National Laboratory (Illinois)	7 GeV	1996
SPring-8 (Japan)	Harima Science Garden City (Hyogo)	8 GeV	1997

Note: ESRF: European Synchrotron Radiation Facility
(operated jointly by 17 European countries including France, U.K., Germany, Italy and Spain).
APS: Advanced Photon Source.

Additionally, the Ministry of Education, Culture, Sports, Science and Technology is promoting efforts such as the development of the "E-Defense" 3-D Full Scale Earthquake Testing Facility, which aims to dramatically reduce earthquake damage through improvement of earthquake-resistant structures.

3.3.6.2 Expansion 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 3-3-26.

Table 3-3-26 Trends in the number of supporting staff per researcher

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

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 junior colleges, 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 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 FY2002.

(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 FY2002 the Ministry began the National Bioresource Project with the aim of developing systems to systematically collect, preserve, and provide bio-resources 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 measureement, 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 developpments 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 3-3-27). On the basis of this situation, the Ministry also conducted a study of the development of advanced measurement and analysis technology and equipment in FY2003, 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 FY2004.

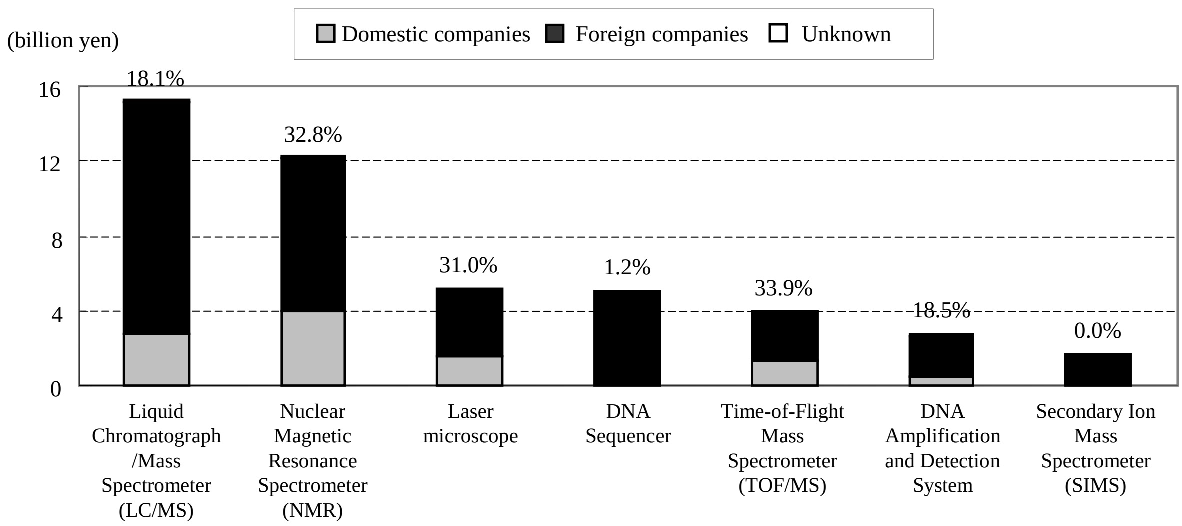


Figure 3-3-27 Shares of major measurement and analysis instruments by domestic and foreign companies (FY2003)

Note: 1. Domestic companies: shares of companies produce and sell instruments in Japan
2. Foreign companies: shares of companies selling instruments produced abroad
3. Figures 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" published by R&D Corp.

(3) Ministry of Health, Labour and Welfare

The Ministry of Health, Labour and Welfare has established "master banks" at the Nation Institute of Health Sciences (NIHS) and the National Institute of Infectious Diseases (NIID), which are set up 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).

At present, plans for merging these master banks into one have been put in place, with the construction of a pharmaceuticals basic technology research facility to serve as a key institution, complete with a research resources supply department, for basic technology related to the development of pharmaceuticals, etc.

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 National Institute of Health Sciences' Pharmaceutical Plant Breeding Station 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), annually revises the objectives for the development of intellectual infrastructure.

The National Metrology Institute of Japan (NMIJ), which is part of the National Institute of Advanced Industrial Science and Technology (AIST), improves and expands national measurement standards, and also makes efforts toward international mutual recognition. In addition, the New Energy and Industrial Technology Development Organization (NEDO) conducts R&D on remote calibration as part of a plan for the period from FY2001 to FY2005.

The National Metrology Institute of Japan (NMIJ), which is part of the National Institute of Advanced Industrial Science and Technology (AIST), improves and expands national measurement standards, and also makes efforts toward international mutual recognition. The standards of 196 physical standards and 196 reference materials are provided by the end of FY2004. In addition, the New Energy and Industrial Technology Development Organization (NEDO) conducts R&D on remote calibration as part of a plan for the period from FY2001 to FY2005. The base sequence of the filamentous bacterium, the Brevibacillus species, and the Rhodococcus species, etc., was identified in FY2004.

In FY2004, the NITE Biological Resource Center (NBRC) added approximately 16,000 microbial strains and DNA clones to its collection—now totaling approximately 56,000 items—which it maintains and provides to the public. Biotechnology Development Center started joint research with the industrial sector and universities as an effort to add high value to genetic resource information from FY2003, and currently conducts four joint research projects. Furthermore, it opened the NITE Patent Microorganisms Depositary (NPMD) in the Department of Biotechnology in FY2004, reinforcing its function as a genetic resource institute. It also established the "Asian Consortium for the Preservation and Sustainable Use of Micro Organism Resources" to establish 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 13 new kinds of geological sheet maps in FY2003.

(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 3-3-28.

Table 3-3-28 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 University	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, Japan Calibration Service System (Measurement Law), 196 physical standards, 196 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
	1995	National Institute of Advanced Industrial Science and Technology, National Metrology Institute of Japan	Testing and evaluation methods, etc.
	1996	National Institute of Technology and Evaluation, Chemical Management Center	Comprehensive chemical management information on 3,808 substances
	1998	National Institute of Advanced Industrial Science and Technology, National Metrology Institute of Japan	Physical standards, reference materials
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 JPO has been extending assistance to other IP Offices by dispatching IP experts, holding local seminars, implementing human resources development programs (e.g. receipt of trainees), and helping to enhance their computerization efforts. Moreover, the Patent Attorney Law has been thoroughly revised to provide more user-friendly technical services. With the revision, the patent attorney examination system has been simplified, and the scope of patent attorneys’ services has been expanded. 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.

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 FY2004, research and development was being implemented on 26 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 FY2004, the program was used to put two teams into operation.

From the perspective of promoting the development of new technologies in the fields of IT and environment, research and development on the fundamental technology for mounting low temperature lead-free soldering, with domestic and international standardization in mind, has been started from FY 2004.

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 FY2004, three 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, in order to adequately meet market needs, user needs, and technology trends, and to make the rapid and flexible formulation of practical international standards possible, proposals to improve the system and working procedures of ITU are being actively implemented. In the World Telecommunication Standardization Assembly held in October 2004 (WTSA-04), Japan led the discussion on how to consider NGN (next generation network), which is one of the most important standardization tasks for the future 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 (AS TAP).

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 Special Research Committee 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 May 2004, the "Intellectual Property Strategic Program 2004" was decided in the Strategic Council on Intellectual Property (Chief Cabinet Secretary: Prime Minister). The important policy issues for this Program is being studied in three different special research committees, and "Patent Protection for Medical Activities" (by Special Research Committee on the Patent Protection for Medical Activities, November 2004) and other reports were summarized. Also in November 2004, a "Working Group on Japanese Brands" was established, which is studying various measures to build a brand that resembles Japan in the new age.

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 provision of computers and development of LANs at research organizations; the development and upgrading of networks between research institutions; the development and provision of databases; and the sharing of research information through the use of networks.

An overview of the main measures for the research information infrastructure in FY2004 is shown in Table 3-3-29.

Table 3-3-29 Main measures for the research information infrastructure (FY2004)

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
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 and Computers

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 computers and networks.

In terms of developing networks, the National Institute of Informatics (NII) has established and operates the Science Information Network (SINET), which connects organizations such as universities. As of January 2005, a total of 728 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 2004, a total of 101 institutions were connected through MAFFIN. With SINET now linked to the United States, and Thailand, and MAFFIN linked to the Philippines, these networks are now becoming backbones for the distribution of research information among various countries.

In addition, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) promotes the development of campus information networks (campus Local Area Networks (LANs)), which connect various computers and telecommunications equipment within each university. Furthermore, the Ministry subsidizes private universities for the costs necessary to develop campus LAN systems.

By establishing the Advanced Network Testbed for R&D (JGN II[19]), operated by the National Institute of Information and Communications Technology, the Ministry of Internal Affairs and Communications promotes the pacesetting approaches that create am extensive ripple effect such as improvements in technological capabilities in Japan reinforcement of coordination between industry, academia and government, creation of new business and industries, vitalization of regional activities and effects on fostering human resources, through research and development and demonstration experiments. Furthermore, in order to promote collaborations with research institutes in Japan and abroad, the operation of the U.S.-Japan line started from August 2004.

The use of computer simulations has become essential in order to further research and development efforts in cutting edge fields such as the aerospace, environment, life sciences, and substance/materials sectors. These computer simulations are made possible through the use of computer-based calculations, and are positioned as a third research method along with the “theory” and “experimentation” research methods. For this reason, universities, research institutions, and other organizations are adopting equipment such as high performance supercomputers. Since FY2000, MEXT has been playing a central role in the creation of a high-speed network that links the supercomputers and databases of Japan’s research institutions, and promotes the IT-Based Laboratory (ITBL) concept, which represents a virtual research environment for the implementation of advanced research. MEXT is also playing a central role in efforts such as the creation of the Tsukuba Wide Area Network (Tsukuba WAN), a system of high-speed networks that connects research institutions in Tsukuba Science City that are equipped with supercomputers. Thus MEXT is promoting joint research at Tsukuba Science City in the computational science and technology fields. Additionally, in December 2002, the Ministry of Agriculture, Forestry and Fisheries established the Joint Use Telecommunications Hall, which has the function of serving as a connection base nicknamed Dennokan (or Electronic Agricultural Hall) between the Tsukuba WAN and the Norin Kenkyu Danchi (Norin Research Complex) WAN.

(2) Creation and Provision of Databases (Information on Documents)

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 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 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. It is also engaged in a joint project to establish metadata/database on academic information sources that are transmitted from universities and research institutes in Japan via the Internet. Furthermore, the Ministry of Agriculture, Forestry and Fisheries is creating a reference material management system that includes an information database for books and documents found at the incorporated administrative agencies, including experimental research institutions of the Ministry of Agriculture, Forestry and Fisheries, and is providing access to this database over the Internet.

19 JGN II is a successive project for Japan Gigabit Network (JGN, FY1999-FY2003), 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 addition, constructing databases of secondary information by using computers enables swift, accurate, and easy searching of increasing amounts of information. The Japan Science and Technology Agency (JST) is collecting information from 50 countries 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. Furthermore, NII creates databases for academic research, and provides a database service.

Additionally, the JST has 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.

Moreover, the Japan Patent Office provides and operates the Industrial Property Digital Library (IPDL), which allows users to search and extract patent bulletins and other information over the Internet. The Ministry of Agriculture, Forestry and Fisheries provides the Japanese Agricultural Sciences Index (JASI) of articles published in academic journals related to the agriculture, forestry, and fisheries fields online, and jointly creates and offers information on documents related to the agriculture, forestry, and fisheries fields, in its position of responsibility for information provision from Japan for the International Information Systems for the Agricultural Sciences Technology (AGRIS) and the Aquatic Sciences and Fisheries Abstracts (ASFA) databases prepared by the Food and Agriculture Organization (FAP) of the United Nations.

(Information on the Research Infrastructure)

The Japan Science and Technology Agency (JST) is upgrading databases essential to the development of bioinformatics and expanding the Institute for Bioinformatics Research and Development that will support promotion of standardization and R&D. JST is also implementing a program to support conversion of the knowledge stock accumulated at national experimental research institutions and other organizations into databases for broad distribution over the Internet.

The Ministry of Agriculture, Forestry, and Fisheries is engaged in development of a system that can coordinate various distributed management databases and allow their linked use over networks.

(Information on Research Themes and Researchers)

For information on research themes and researchers, the Japan Science and Technology Agency (JST) provides information over the Internet concerning research institutions, research themes, researchers, and research resources. JST's system is known as the Directory Database of Research and Development Activities (ReaD). Information related to agriculture, forestry, and fisheries research subjects has now been converted by the Ministry of Agriculture, Forestry, and Fisheries into databases usable as research planning and support systems, and these are now available on the Internet.

(3) International Distribution of Research Information

The Japan Science and Technology Agency (JST) currently provides information through more than 200 categories of databases via the Scientific and Technical Information Network (STN International), originally constructed in 1987 between the Chemical Abstracts Service (CAS) of the United States and the FIZ-Karlsruhe organization of Germany. In addition, research information related to science and technology in Japan is actively being converted into English for transmission over the Internet to foreign countries.

Furthermore, the National Institute of Informatics (NII) is promoting the international distribution of scientific data, through efforts such as information exchange and providing information retrieval services with research institutions and other organizations abroad, using research networksconnected to the Science Information Network (SINET).

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 competetiveness and of ensuring that fundamental technologies for manufacturing are passed on to the future, are causes for increasing concern in Japan.

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 FY2000, 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 FY2003, 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 FY2003, for the purpose of improving the quality and quantity of efforts to foster high-level professionals.

Colleges of technology aim to become an attarctive 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 communityand 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 activeties 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 "Digital Master Project" is based on the recognition of the need to objectify the skills of experienced technicians, who are the source of competitiveness, and replace them with reproducible technologies, to the greatest extent possible, in order to maintain and strengthen the competitiveness of Japan's manufacturing industry.

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 FY2000 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.

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 such as those related to the environment, energy, and resources. 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. Based on the close scientific capabilities between Japan and Western countries, scientific and technological cooperation between Japan and the West continues to advance effectively through burden sharing and complementary work. At the same time, scientific and technological cooperation with developing countries not only leads to the transfer of technologies that serve as infrastructure for independent and sustained development and strengthening of human resources in those countries, but is also important to the resolution of global problems. Therefore, Japan is not only cooperating through multilateral frameworks, such as the Asia-Pacific Economic Cooperation (APEC), but also promoting bilateral cooperation according to the conditions, needs, and potential of each country.

3.4.4.1 Development of Frameworks for Multilateral Cooperation

(Summit Meeting of Major Nations (G8 Summit))

First discussed at the 8th Versailles Summit at the proposal of French President Mitterrand, science and technology has subsequently been discussed frequently in summit meetings.

At the 30th G8 Summit at Sea Island held in June 2004, members adopted the “Science and Technology for Sustainable Development – A G8 Action Plan.” At the summit, Prime Minister Koizumi stressed the importance of environment issues, such as forest protection and new energy resources and proposed the “3R” Initiative aimed at creating a recycling-oriented society (through the promotion of Reduce waste, Reuse and Recycle resources). The Initiative has gained support from other countries. Regarding climate control, the Prime Minister also stressed the importance of the early entry into force of the Kyoto Protocol.

In particular, the Earth Observation Summit, which was first held on the occasion of the Evian Summit in June 2003, held its second meeting in April 2004 and its third meeting in February 2005, adopting a 10-year implementation plan starting in 2006.

(The United Nations (UN))

At the United Nations, various activities, including intellectual forums for education, science and culture, creation of international norms, and development cooperation, are being implemented through the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

UNESCO has designated “water and associated ecosystems” as the principal priority in the natural science field and is dealing with the water problem throughout the world through the International Hydrological Programme (IHP). Through this programme, preparations are now under way to establish the “International Center for Water Hazard and Risk Management” (ICHARM) in Japan as a hub for research, capacity-building and information network activities on water-related disasters and risk management. At the Intergovernmental Oceanographic Commission (IOC), oceanographic scientific surveys and research activities, such as oceanographic observation concerning global climate change and establishment of tsunami-warning systems, and regional cooperation projects are being implemented. Japan is cooperating in oceanographic surveys and education and training mainly in the western Pacific.

In the areas of human and social sciences, UNESCO elaborates the draft “Universal Declaration on Bioethics and Human Rights” to be adopted at the 33rd session of its General Conference in 2005.

(The 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 Communication Policy (ICCP), Committee on Industryand Business Environment (CIBE), Committee for Agriculture (AGR), Environment Policy Committee (EPOC), the Nuclear Energy Agency (NEA), the International 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.At the GSF meeting held in July 2004, an expert WG was established to hold a conference on declining student enrolments in science and technology. Japan is an active member in the WG. At the GSF meeting in February 2005, lively discussions were held under the strong initiative of Japan with two new activities – "WS on Science and Technology for a Safer Society" and "A Project on interdisciplinary issues" – approved.

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

Following a ministerial meeting of CSTP in January 2004, the first meeting of SFRI was held in October 2004. Japan has been actively participating in SFRI as a lead country of one of the three subgroups.

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

TIP is aimed to discuss the promotion of productivity, the creation and application of knowledge, the sustainable development and the creation of a skilled work force.

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 on Biotechnology (WPB)

WPB is to support the promotion of safe and effective utilization of biotechnology.

Continued discussions were held on the establishment of a "Global Biological Resource Center Network (GBRCN)". It was reported that a task force bureau for the establishment of GBRCN was set up at a meeting held in Paris in December 2004.

(5) Working Party of National Experts on Science and Technology Indicators (NESTI[20])

At a NESTI meeting held in June 2004, participants discussed revising the Oslo Manual, an international standard in the collection and interpretation of data on innovation activities, as well as improving new indicators about the Human Resources for Science and Technology (HRST) and the globalization of R&D, etc.

20 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.

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) forum was established in 1989 as a forum for economic cooperation, with the aim of achieving sustainable economic growth in the Asia Pacific region. APEC promotes open regional cooperation, and carries out cooperative activities in areas such as industrial science and technology, human resources development, and energy, with the aim of promoting the liberalization and smooth implementation of trade and investment and economic and technological cooperation.In particular, the Industrial Science and Technology Working Group promote the dissemination of science and technology information, the mutual use of research facilities, and a variety of concrete cooperation projects. The theme of the 4th APEC Science Ministers' Meeting, held in Christchurch, New Zealand in March 2004, was "Enhancing the capacity of science, technology, and innovation to deliver sustainable growth across the APEC region." The follow-up to that meeting is being conducted at present.

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

The Association of Southeast Asian Nations (ASEAN) was established with the aim of accelerating economic growth, social progress, and cultural development in the region. Dialogues between ASEAN member countries and Japan, China, and the Republic of Korea take place within the framework of ASEAN+3. At the 1999 ASEAN+3 Summit, recommendations were made for strengthening cooperation in the science and technology area.

Based on recommendations from the ASEAN Committee on Science and Technology (COST), the third ASEAN / COST+3 meeting convened in Pattaya (Thailand) in September 2004 with Japan, China, South Korea, and other ASEAN countries.

(Cooperation with Various Countries)

In relations with China, in addition to cooperation based on a science and technology cooperation agreement [21], the Japan-China seminar was jointly held in June 2004 with the Chinese Academy of Sciences, and Japan's Ministry of Education, Culture, Sports, Science and Technology and China's Ministry of Science and Technology held the third inter-government talks in November 2004 to promote exchanges of science and technology administrative officials between the two countries.

In trilateral relations among Japan, China, and Korea, as a result of an agreement at the Second Japan-China-Korea Directors-General Meeting on Science and Technology Cooperation held in Tokyo in March 2004, a ministerial-level meeting is slated for 2005.

In relations with Australia, the 11th meeting of the Japan-Australia Science and Technology Cooperation Joint Committee was held in Tokyo in August 2004 based on the Japan-Australia Science and Technology Cooperation Agreement. Participants in the meeting exchanged views on future cooperation between the two governments in various fields, such as science and technology policy, research cooperation activities, life science and earth science.

In relations with South Korea, Australia, Indonesia, India, and Israel, among others, under agreements for science and technology cooperation,cooperation is progressing in the form of information and research personnel exchangesand the implementtation 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.

21 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.

Furthermore, from a humanitarian viewpoint, Japan is working on the research and development of technologies for safer and more efficient detection and clearance of antipersonnel landmines, which stand as a significant impediment to reconstruction and development in Afghanistan and many other mine-affected countries. Japan is also providing mine-clearing training to retired military personnel and other Afghan people.

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 the life sciences, nanotechnology, raw materials, the environment, nuclear energy, and space development (Figure 3-4-1).

Table 3-4-1 Joint committee meetings and other activities held in FY2004 based on bilateral science and technology cooperation among European and North American nations

Nation	Name	Date	Location	Agenda
United States	Second Japan-U.S. Workshop on Science and Technology for a Safe and Secure Society	March 10-11, 2005	Honolulu	(1) Development of science and technology policies conducive to a safe and secure society (2) Prioritizing science and technology fields conducive to a safe and secure society (3) Review of current cooperative activities and identification of new opportunities 1) Infectious diseases 2) National borders and transportation safety 3) Safety related to important information infrastructure protection 4) Public-private technology partnership 5) Review of international dialogues on science and technology fields 6) the safety of food 7) Science and technology for anti-crime and anti-terrorism measures
Hungary	8th Japan-Hungary Science and Technology Cooperation Conference	May 24, 2004	Tokyo	About joint research projects
Finland	3rd Japan-Finland Science and Technology Cooperation Joint Committee	June 17, 2004	Helsinki	(1) Researcher exchanges (2) Signing of a memorandum between the New Energy and Industrial Technology Development Organization (NEDO) and the Finnish National Technology Agency (TEKES). (3) Bilateral cooperative activities (4) Technology forecasting (5) Multilateral cooperative activities
Norway	1st Meeting of Japan-Norway Science and Technology Cooperation Joint Committee	June 21, 2004	Oslo	(1) Existing cooperative activities (2) Materials and nanotechnology (3) Energies and the environment (4) the safety of food
Switzerland	4th Japan-Switzerland Science and Technology Roundtable	July 8, 2004	Tokyo	(1) Bilateral cooperative activities (2) Cooperation in 2 prioritized areas (materials science and nanotechnology) (3) Improvement of research environment
France	6th Japan-France Joint Committee on Science and Technology Cooperation	November 17-18, 2004	Tokyo	(1) Researcher exchanges (2) Life sciences (3) Genome (4) Materials (5) Bioethics/humanities (6) Innovation and partnership (7) Space (Earth observation) (8) Energies and the environment (9) Information science
South Africa	1st Session of the Joint Science and Technology Committee Between Japan and South Africa	May 13, 2004	Pretoria	(1) New materials and nanotechnology (2) ICT (3) Biotechnology (4) Infectious diseases

In relations with the United States, as a result of an agreement reac hed at the Ninth Meeting of the Japan-U.S. Joint High Level Committee (ministerial level) on Science and Technology, which was held based on the Japan-United States Science and Technology Cooperation Agreement, the Japan-U.S. Workshop on Science and Technology for a Safe and Secure Society was held in Honolulu and the two countries discussed the roles science and technology should play in protecting society from various threats and ensuring the safety and security of society, the two nations' common areas of concern, and the direction of future research cooperation. Under the framework of the Workshop, exchanges of researchers between the two countries have been implemented in various fields, such as science and technology for the protection of important information infrastructure and for measures against crime and terrorism.

In relations with Canada, the "Japan-Canada Female Researcher Exchange Program" was created with the aim of promoting women's activities in a wide range of science, technology and academic fields through mutual visits of first-rate female researchers between the two countries. In March 2005, two Canadian female researchers visited Japan.

And, in May 2005, the Japan-South Africa Science Forum and the first meeting of the Science and Technology Joint Committee were held based on the Japan-South Africa Science and Technology Cooperation Agreement.

Elsewhere, there are joint committees on science and technology with Germany, France, Italy, Finland, Russia, Poland, the Czech Republic, Hungary, and Romania based on science and technology agreements. In relations with Switzerland, the two countries regularly have a Science and Technology Roundtable to exchange information on current science and technology cooperation. In September 2004, the Japan-Mexico Economic Partnership Agreement was signed (came into force on April 1, 2005). The agreement includes science and technology cooperation between the two countries. Japan is implementing wide-ranging bilateral science and technology cooperation based on international agreements, including science and technology cooperation agreements with forty-one 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 began 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 research focused on the elucidation of the complex mechanisms of living organisms. Members of HFSP include the G-7 nations (Japan, the U.S., Germany, France, the U.K., Italy, and Canada), the EU, and Switzerland. 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 for presentation of their research results. In May 2004, the 15th anniversary celebration and 4th award-winners meeting was held in Hakone and attended by about 300 people, including former Prime Minister Nakasone, who is the proponent of the Program, HFSP officials and researchers.

With a total of 11 HFSP grant recipients having later been awarded the Nobel Prize as of FY2004, the Program has been highly acclaimed worldwide. Japan has been actively supporting the Program since its inception.

In 2005, South Korea and Australia joined the group of countries supporting the Program.

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

In March 1994, the United States, 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 58,000 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,) based on the Intergovernmental Agreement, is the international cooperation project to construct a manned space facility at low Earth orbit with an altitude of approximately 400km. The aim of the ISS Program is to develop infrastructure enabling full-fledged space environment utilization and manned space activities. Some components of the Japanese Experiment Module (JEM) “Kibo” have been shipped to NASA Kennedy Space Center.

The first module of the ISS was launched in November 1998, and the first long-term crew stay on the ISS began in November 2000. To date, one Japanese astronaut has stayed at the ISS for a short period of time to conduct assembly work. Another Japanese astronaut Soichi Noguchi, who is to be on board the first space shuttle (around May 2005) since the accident of the Space Shuttle Columbia, is stayed at the ISS.

(International Thermonuclear Experi mental Re-actor (ITER) Project)

The goal of the International Thermonuclear Experimental Reactor (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. Intergovernmental negotiations on matters including a joint implementation agreement, site selection, and cost sharing have been taking place between the six parties of Japan, China, the European Union, South Korea, Russia, and the United States. Japan’s basic policy is to push ahead with the ITER project through international cooperation, based on the conclusions laid down by the Council on Science and Technology Policy. The Cabinet consented to the presenting of Rokkashomura, Kamikita County, Aomori Prefecture as the candidate site for consideration at the Intergovernmental Conference. Under this policy, the government has been pushing its bid to host the ITER.

(The Large Hadron Collider (LHC) Project)

The Large Hadron Collider (LHC) is a project to construct a proton-proton colliding particle accelerator proposed by the European Organization for Nuclear Research (CERN). Construction is proceeding under international cooperation between the CERN member nations, Japan, the United States, Russia, Canada, and India, with experiments aimed to commence in 2007.

The LHC is a large circular accelerator with superconducting magnets placed in an underground tunnel 27 km in circumference. It will accelerate protons to nearly the speed of light, in opposite directions, to enable proton collisions. The ultra-high energies generated by these proton collisions make it possible to create previously undiscovered particles that will be useful in exploring and revealing the internal structures of matter.

In Japan, the LHC project is reviewed by the Ministry of Education, Culture, Sports, Science and Technology, which contributes to promoting the project with funds for construction of the particle accelerator, anticipating both its scientific significance as well as its potential to lead to the creation of new industries.

(Integrated Ocean Drilling Program (IODP))

The Integrated Ocean Drilling Program (IODP) is a multilateral cooperation project that began in October 2003 led by Japan and the United States and with the participation of Europe and China. The program aims at elucidating global environmental changes, the structure of the earth's interior, the biosphere of the earth's crust, etc. by drilling into deep seabeds primarily using Japanese riser drilling vessel "Chikyu," capable of deep drilling up to 7,000 meters below the seafloor 2,500 meters below the surface of the sea (in future: 4,000 meters) , and a U.S. drillship.

Prior to the commencement of the program, the Ministry of Education, Culture, Sports, Science and Technology and the U.S. National Science Foundation (NSF) signed a memorandum on April 22, 2003 for setting the framework of IODP.

The riser drilling vessel "Chikyu" is scheduled for completion in FY2005 followed by shakedown and training.

3.4.2 Promoting International Research Exchanges

3.4.2.1 Promotion of International Research Activities

Working with top rank researchers and gathering the latest scientific information enables Japan to yield world-class outcomes, which can be expected to resolve global problems. Therefore, internationalizetion of our Science and Technology environments is recognized as an essential mission.

For this purpose, through the “Leadership for International Scientific Cooperation” program, supported with the Special Coordination Fund for Promoting Science and Technology, and the “Strategic International Cooperative Program,” run by the Japan Science and Technology Agency, Japan promotes the convening of international forums and the conducting of surveys and research for Japan’s proactive promotion of international cooperation on important research issues and creation of sustainable cooperative relationships in the international community.

In addition, through its Global Network of Advanced Research Program and its Core University Program, the Japan Society for the Promotion of Science (JSPS) is promoting multilateral joint research with Western and Asian nations.

3.4.2.2 Promotion of Researcher Exchanges

In order for Japan to develop scientific, technological, and academic research, it is necessary to attract many first-rate researchers at home and abroad by opening up Japan’s research system to the world, and fostering Japanese human resources capable of demonstrating international leadership by encouraging them to study hard at an international level through promotion of researcher exchanges. From this standpoint, various researcher exchange programs have been implemented, including the foreign researcher invitation program by the Japan Society for the Promotion of Science (JSPS).

The facilitation of international exchange among young researchers is particularly important from the position of developing international joint research in the future, and of fostering researchers with international perspectives. For this reason, the Ministry of Education, Culture, Sports, Science and Technology is promoting the JSPS’s “Postdoctoral Fellowships for Foreign Researchers,” a program for inviting first-rate young researchers from abroad to Japan's universities and experimental research institutions, and providing an opportunity for them to conduct joint research with Japanese researchers. Another program being promoted is JSPS’s “Postdoctoral Fellowships for Research Abroad,” a program for sending young Japanese researchers to overseas universities or research institutions so that they can devote themselves to research.

Moreover, efforts are being made to improve and expand housing for foreign researchers and services to support foreign researchers’ daily lives in Japan.

As a result of these measures, the number of foreign researchers invited, and Japanese researchers dispatched overseas, has been rising at Japan's universities and experimental research institutions (Figure 3-4-2). By region, there are active researcher exchanges with Asia, Europe, and North America. In terms of the acceptance of researchers from abroad, nearly half are from the Asian region (Figure 3-4-3).

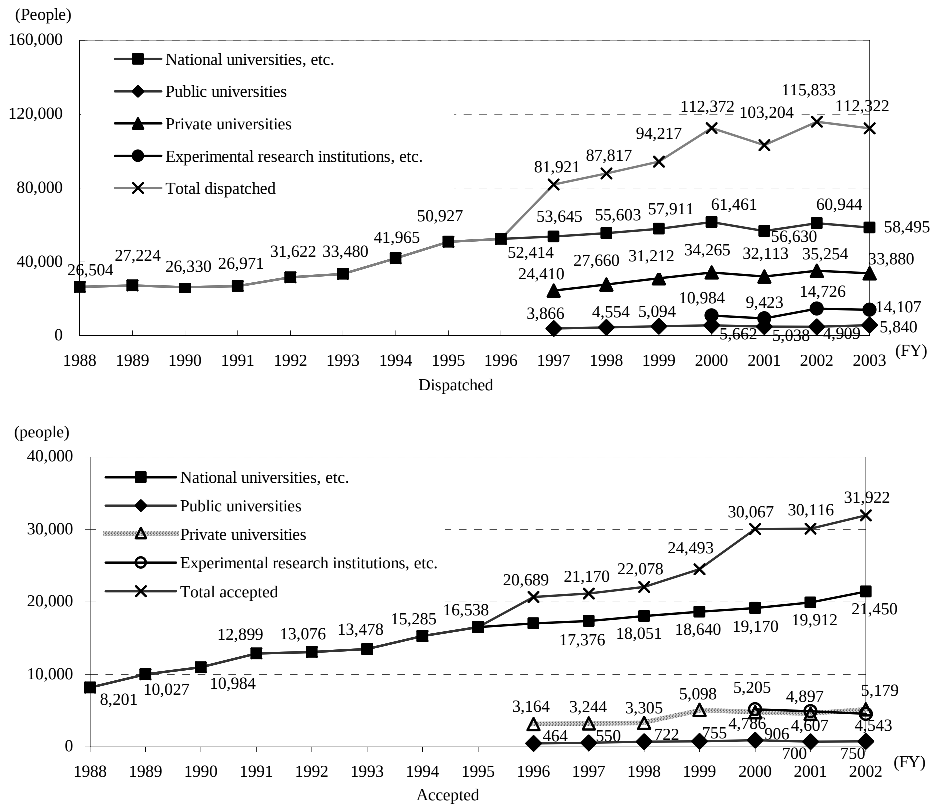


Figure 3-4-2 Progress of researcher exchanges in universities, research institutions, etc.

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 (FY2003)"

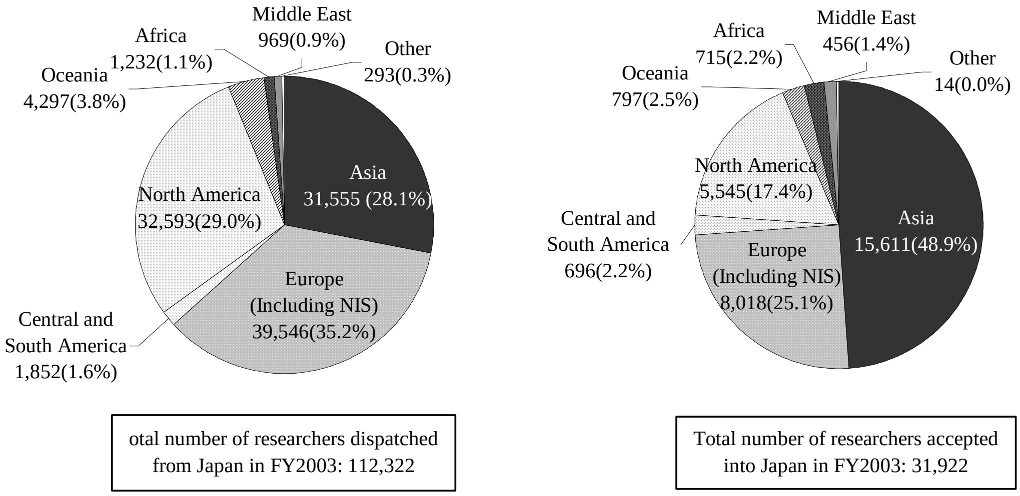


Figure 3-4-3 Researcher exchanges (dispatch and acceptance) by region

Source: MEXT. "Survey of International Exchange (FY2003)"

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

The nation should implement necessary policy measures to use R&D funds effectively corresponding to the progress of R&D in order to promote R&D smoothly.

(Making public the results of R&D)
Article 16

The nation should implement necessary policy measures to diffuse the results of R&D, such as the publication of the results of R&D and the provision of the information on R&D and measures to promote appropriate practical applications of them.

(Support of efforts by private enterprises)
Article 17

In consideration of the importance of the role played by the private sector in S&T activities in Japan, the nation should implement necessary policy measures to promote private sector R&D by encouraging initiatives in the private sector.

Chapter 4 Promotion of International Exchange
Article 18

The nation should implement necessary policy measures to promote international exchange such as international exchange of Researchers, international joint R&D and international distribution of information on S&T, in order to play an active role in international society, as well as to contribute to further progress in S&T in Japan, by intensely promoting international S&T activities.

Chapter 5 Promotion of Learning on S&T
Article 19

The nation should implement necessary policy measures to promote the learning of S&T in school and social education, to enlighten the people in S&T and to disseminate knowledge on S&T, so that all Japanese people including the young can deepen their understanding of and interest in S&T with every opportunity.

Supplementary Provision
This law shall enter into force on the day of its promulgation.

This English language version of this law is a translation of an original document produced in Japanese. Any questions that may arise about the interpretation of the law shall be resolved with regard to the original Japanese document.

Source: Council for Science and Technology Policy, Cabinet Office's Web site
(accessed and cited November 1, 2001) <http://www8.cao.go.jp/cstp/english/law.html>

2. The Science and Technology Basic Plan (2001-2005) (unofficial version)

(decided by the Government of Japan on March 30, 2001)

1) Universities and other academic institutions
2) National research institutes and other institutes
3) Private companies

2. Reinforcement of industrial technology and reform of industry-academia-government collaboration
   (1) Reform of systems of information distribution and human resource exchange
   (2) Improvement of environment of technological transfer from public research organizations to industry
   (3) Promoting commercialization of the R&D results of public research organizations
   (4) Environment for activating high-technological venture enterprises
3. Regional improvement of the S&T Promotion environment
   (1) Establishment of regional "intellectual clusters"
   (2) Implementation of regional S&T policies
4. S&T human resource development and S&T educational reforms
   (1) Education of researchers and engineers, and reform of universities and other institutions
   (2) Training and securing engineers
5. Establishment of interactive channels between S&T activities and society
   (1) Promotion of S&T learning
   (2) Establishment of channels toward society
6. Ethics and responsibility to society on S&T
   (1) Bioethics
   (2) Ethics of researchers and engineers
   (3) Accountability and risk management
7. Maintenance of infrastructure for S&T promotion
   (1) Improvement of facilities and equipment
   (2) Enrichment of research assistance
   (3) Improvement of intellectual infrastructure
   (4) Enrichment and standardization of intellectual property rights
   (5) Maintenance of the research-informational infrastructure
   (6) Maintenance of the manufacturing infrastructure
   (7) Promotion of academic society activities

III. Internationalization of S&T activities

1. Initiatives in International Cooperation
2. Enhancement of International Information Dissemination
3. Internationalization of Domestic Research Environments

Chapter 3 Missions of the CSTP

1. Basic steering of S&T Policies
2. Promotion of Research and Development in Prioritized Areas
3. Policy on Resource Allocation
4. Promotion of Nationally Important Projects
5. Settlement of National Guidelines on Important Policies
6. Evaluation
7. Follow-up of the Basic Plan

Introduction

During the last decade of the 20th century, the world underwent a great transition. Now that the Cold War is behind us, all but a few societies, those living in hotspots of regional conflict, are enjoying peaceful lives on a global level. The cross border flows of people, goods, information, and capital continue to accelerate, adding momentum to the trend we call globalization. In turn, economic competition is intensifying among advanced countries, spawning an era of mega-competition. As bases for this competition, IT and biotechnologies have advanced remarkably. Governments that recognize the importance of these and other new fields are making great efforts to promote Science & Technology (S&T).

Over the last decade, as these changes transpired globally, Japan has been ensnared in its first serious depression since World War II. Private companies, which used to conduct 80 percent of all Research and Development (R&D) in Japan, are no longer able to invest nearly as much in R&D as they once did. R&D facilities in universities and national research institutes are long overdue for renewal, and the system for collaboration among industry, academia, and government has been working inefficiently and ineffectively. The effects on Japan's S&T level and industrial competitiveness are a matter of growing concern. To overcome these debilities and put Japan back on track to becoming an advanced science- and technology-oriented nation, the government of Japan enacted the Science and Technology Basic Law in 1995. In 1996, based on the law, the first Science and Technology Basic Plan was adopted to drastically improve the S&T environment in Japan, to strengthen Japan's R&D capability, and to return R&D results smoothly to society. In the last five years, the effects of the First Basic Plan have wrought steady improvement in Japan's R&D. Notwithstanding, industrial competitiveness has yet to recover its former robustness, and future economic growth holds less promise in today's 'low-birth-rate society.' There is all the more reason to reinforce industrial technologies that will lead new industries and restore strong international competitiveness.

As we enter the new century, S&T in Japan is expected to undergo new developments. In numerous fast-growing fields, the United States and European countries maintain higher levels of R&D than Japan. To stay competitive, Japan must match and even exceed these levels in terms of R&D results. Japan must elevate its basic research, the source of new knowledge, as well as establish an environment in which internationally respectable achievements will flourish. In R&D geared to respond to social and economic needs, sectors of industry, academia, and government must remove the invisible walls that divide them and set up an environment for practical cooperation. Creative young researchers must be set in an environment in which they can actualize their talents and put them to full use. Further, ongoing communication will have to be maintained between S&T and society, to ensure that S&T meets society's expectations.

This year, the government of Japan has been reorganized. Among many other changes, several major national research institutes have been transformed into independent administrative institutions this year, and the government has newly established the Council for Science and Technology Policy ('CSTP' hereinafter) and the Ministry of Education, Culture, Sports, Science and Technology. A major part of the reform has been the reform of universities, institutions that play a great role in S&T. National universities are also deliberating whether to reestablish themselves as independent administrative institutes, and further reforms are expected. From now on, the CSTP will act as a control tower and direct the multifold processes S&T policy implementation. In addition to formulating promotion strategies on prioritized areas, principles of resource allocation, and guidelines for project evaluation, the council will strive to promote S&T activities of a quality high enough to contribute to the development of the world.

In keeping with the view that S&T in the 21st century, the "century of knowledge," should generate new knowledge, contribute to sustainable development for both people's lives and the economic activities in Japan, as well as contribute to the world, the first chapter of this document presents basic concepts that Japan should adopt, a vision that this country should aspire towards, and basic principles by which such goals can be achieved. The second chapter, in line with the first, demonstrates basic policies concentrating on prioritized / strategic R&D promotion and S&T system reform. The third chapter describes missions to be undertaken by the CSTP to promote this basic plan.

Chapter 1　Basic Concepts

1. Circumstances Relating to S&T

(1) A look back at the 20th century

In the 20th century, what some have called the "century of science and technology," outstanding advances in S&T brought about unprecedented changes across the globe. Thanks in part to the rapid progress of studies in fields such as physics, chemistry, and the life sciences, people in the more developed countries gained more affluence and convenience in daily life, as well as better health and longevity. But adverse influences of S&T also became foreseeable influences that posed threats to human society and the global environment.

As a consequence of Japan's successful modernization in the 20th century, the Japanese economy has grown enormous.Japan's industrial development and economic growth after the world have even been described as miracles. In terms of GDP, Japan's stature in the world ranks second only to the United States. This progress has enriched the standard of living in Japan, and the resulting improvements in health and welfare have made the Japanese the longest-living people on earth, statistically speaking. In the 1990s, however, Japan suffered a trying period of unprecedented economic depression, the so-called "empty decade."

(2) Outlook for the 21st century

In the 21st century, S&T is expected to make rapid progress, contributing further to the life and well-being of humankind, as well as to economic and social development. All over the world, S&T will continue to be a driver of sustainable growth.

The human society of the 21st century is expected to be a knowledge-based society. To evolve into such a society while maintaining economic development, Japan must surmount many problems.

As globalization advances and international competition grows keener, Japan is burdened with economic issues such as a deterioration of industrial competitiveness and job creation. Meanwhile, the nation must contend with a decreasing workforce coupled with increases in expenditures on healthcare and social security stemming from the low birth rate and graying of the population. To stabilize and develop people's lives, the nation's economic vitality will have to be restored through the fosterage of industries that have internationally high productivity and strong competitiveness. To this end, persistent technical innovation will be crucial.

In an aging society, it is important for the elderly not only to live long lives, but to live active, healthy, rewarding lives in which they can contribute their experiences and skills to society. Most important of all, perhaps, is to maintain the health and improve the quality of life of the elderly by overcoming illness through medical treatments and preventive therapies.

The IT revolution in recent years is spreading to all parts of society, bringing rapid and extensive changes in diverse spheres such as economy, industry, education, and recreation. As this trend goes on, the Japanese people can best enjoy the benefits if the nation generates new industries and social conveniences. To these ends, Japan needs to move forward in R&D on IT, the nucleus of the IT revolution, as well as to resolve the problem of the so-called digital divide within society.

Indeed, the brightness of our future depends upon S&T. S&T will be a key tool for tackling the multifold problems that face the world on a global scale in the 21st century the population explosion, global warming, epidemics with no known cures, dwindling supplies of fresh water, food, and energy and for achieving sustainable growth in developed and developing countries alike. In view of Japan's dependence on foreign countries for resources, energy, and food, the nation is particularly vulnerable to today's global-scale problems. To overcome these problems, it will be necessary to amass as much knowledge as possible, both from within Japan and the rest of the world.

To surmount the problems that face Japan and the rest of the world in the 21st century, the knowledge humankind has gained through its intellectual activities must be further concentrated and applied more effectively. Yet, if we place too much trust in S&T, our confidence may create more problems for the global environment, social welfare, and human happiness. The global-scale problems caused by mass-production, consumption, and disposal in the 20th century are valuable lessons to heed, albeit very expensive ones.

In the medium-to-long-term forecast for the 21st century, the influences of S&T on society and human beings will become broader and more serious, encompassing issues such as bioethics, the challenges to human dignity imposed by advanced life sciences, the safety/security of genetically modified organs, the digital divide, and the many problems of the environment. To proceed with foresight, society will require a new S&T discipline geared to analyze, assess, and appropriately respond. We must recognize the need for human wisdom to integrate the natural sciences with social sciences and the humanities.

2. A Vision of Japan and Concepts of S&T Policy

In helping people to develop a sound perspective for the future, S&T will play a key role. To pursue its fundamental goal of realizing "an advanced science- and technology-oriented nation," Japan must promote S&T by implementing practical policies based on the Comprehensive Strategy to Promote Science and Technology and the Science and Technology Basic Plan. As a basis for its S&T policy, Japan must form a clear vision of what it aims to become, synthesizing what it has learned in the 20th century with what it foresees for the 21st. This vision will take three forms:

- A nation that contributes to the world by creating and using scientific knowledge
- An internationally competitive nation capable of sustainable development
- A safe, secure nation where people enjoy a high quality of life.

(1) A nation that contributes to the world by creating and using scientific knowledge
– creation of wisdom

"A nation that contributes to the world by creating and using scientific knowledge" is: firstly, a nation that creates new knowledge by clarifying unknown phenomena and discovering new scientific laws and principles; and secondly, a nation that copes with various problems by utilizing accumulated knowledge. Moreover, if a nation works with other nations to resolve problems common to humankind by transmitting its knowledge and wisdom, it will win the trust of other nations.

For Japan to become such a nation, science must be rooted in society and fostered there. The nation will have to prepare an atmosphere where the scientific view, scientific way of thinking, and scientific mind are highly valued; and to build a knowledge-based society that nurtures talented persons who can create new knowledge.

More specifically, the goal is to create outstanding R&D results and to disseminate them widely across to the world, for example, by publishing a profusion of excellent papers that match investment, by increasing the percentage of internationally renowned papers, by providing centers of excellence that attract outstanding foreign researchers, and by producing just as many Nobel Prize winning scientists as the most technologically advanced European countries. (Some European countries have produced as many as 30 Nobel laureates in the last 50 years).

(2) An internationally competitive nation capable of sustainable development
– vitality from wisdom

"An internationally competitive nation capable of sustainable development" is a nation that can improve people's living standards and maintain vitality for sustainable economic growth and international competitiveness by overcoming current difficulties, creating value-added assets and services, and securing job opportunities.

Industrial technological power is not merely a foundation of international competitiveness for Japanese companies, but a driving force to vitalize all industrial activities that support people's lives. Industrial technology is also important in terms of utilizing results of scientific knowledge to benefit society. To maintain economic vitality for sustainable development, the nation must foster its more internationally competitive industries by providing an environment conducive to perpetual innovation of multifold processes, from the creation of new technologies to the development of new markets. It will be crucial to create new industries founded on R&D, and also to reform the interface between basic research and businesses.

More specifically, the goal is to strengthen international competitiveness by widely transferring R&D results from public research organizations to private companies, by proposing various international standards, by further increasing the number of international patents obtained, and by improving industrial productivity. Steps to achieve these ends would include activities of technology licensing organizations to accelerate technology transfer from public sectors and the establishment of venture businesses supported by public research organizations.

(3) A safe, secure nation where people enjoy a high quality of life
– enlightening society through wisdom

"A safe, secure nation where people enjoy a high quality of life" is a nation that reliably assures safe and high-quality living for its people. Such a nation serves its people by: improving disease treatments and prevention to maximize its citizens chances for a long and healthy life; minimizing the risks posed by natural and artificial disasters; ensuring a steady supply of food and energy, the bases for human activities; realizing industrial activity and economic development in ways that preserve the global environment; and maintaining stable international relations all over the world.

To achieve the foregoing aims entirely, it will be necessary to develop S&T and utilize them properly in society. For example, S&T can clarify how diseases and disasters occur and spread. At the same time, the nation must not lose sight of the negative influences of S&T to be contended with. As a nation advanced in S&T, Japan is expected to utilize S&T to resolve various difficult problems that confront the international community, including developing countries. Indeed, Japan's international status and national security depend on its ability to meet this expectation.

The specific goals are to form S&T bases to analyze genetically caused diseases and develop tailor-made medical therapies for their treatment, to minimize damage from natural disasters such as earthquakes and typhoons, and to secure stable supplies of high-quality foods by applying biotechnology, whilst minimizing the possible risks of S&T. Through such endeavors, Japan is also expected to contribute to disaster management and the prevention of infectious diseases in the developing countries.

To realize the vision described above, Japan will need to consider following two points.

- Japan's S&T development in the 21st century must flow as a continuation of it's remarkable accumulation of S&T knowledge during the 20th century. In doing so, Japan should concurrently pursue two targets: to use S&T to resolve the problems confronting Japan, and to use S&T to resolve world problems, thereby contributing to world development.
- As Japan commenced its modernization efforts earlier than any other countries outside of the West, it has gained long experience in harmonizing S&T and traditional cultures. Japan should use this experience to help create an environment in which the various peoples of the world can thoroughly enjoy the benefits of S&T while maintaining their cultures and value systems.

3. Comprehensive and Strategic S&T Policies

To actualize the vision based on the above concepts, the four principles set forth below will govern the management of S&T policies. These principles will ensure that the nation's S&T policies are promoted with a broad perspective and strategic procedures.

(1) New forms of S&T that support human living and form a basis for industrial competitiveness should be further developed. At the same time, the nation should take a comprehensive, panoramic view of S&T to develop it in harmony with model scenarios for human society in the 21st century. It is very important that the CSTP, a body newly inaugurated at the start of the 21st century, engages in discussions on S&T that integrate natural S&T with the social sciences and humanities.

(2) S&T is an inexhaustible intellectual resource whose promotion might well be regarded as an investment toward the future. To form the foundations for a knowledge-based nation, Japan should continuously invest in basic research based upon strict evaluations. The nation should strategically construct a dynamic circulative system in which high-quality results in basic research and prioritized areas are rapidly applied to social and industrial activities, thereby attracting further investment.

(3) In complicated modern societies supported by highly advanced S&T, we now see occasional instances where the inappropriate use and management of S&T may pose risks to people's lives and physical safety. To reconcile this Janus-faced aspect of S&T, it is useful to cultivate the concept of "S&T for and in society," as a basis for communication between S&T and society. Meanwhile, the technologists who work with S&T should heed their responsibilities to society and human beings, observing high ethical standards in their technical endeavors.

(4) To achieve the intellectual innovations expected in the 21st century for social and industrial activities and the symbiosis of human beings and nature, the CSTP should liken its role to a control tower, directing comprehensive and strategic policies. To achieve this, the council will demonstrate points of well-planned investment in prioritized areas, maintenance of R&D infrastructures, strict evaluation, and effective and efficient resource allocation. The council will also place importance on the observation and treatment of negative S&T influences.

4. Building New Relationships between S&T and Society

In promoting S&T to make Japan into the nation it aims to become, we must adopt and implement S&T policies formed on the basis of how they relate to society. As S&T holds true value only if accepted by society, society's understanding, judgment, and acceptance of S&T are crucial. This is a point to be recognized and strived not only by the natural scientists and technological experts, but by experts in the social sciences and humanities as well.

(1) Communication between S&T and society

Bearing in mind the concept of "S&T in and for society," we must establish fundamental forms of interactive communication between S&T and society.

First of all, society should be provided with accurate information on the present status of S&T, and the anticipated status of S&T in the future. For this to be effective, schools and public education will have to equip society with the capacity to receive and assimilate this type of information. And as S&T advances and grows more complex, experts in S&T fields will be responsible for routinely briefing society on the changes in S&T underway, elucidating these changes for the public as clearly and accessibly as possible.

To make difficult scientific and technical concepts accessible to the laypersons in society, the S&T experts will have to rely on communicators and interpreters as mediums. Indeed, S&T experts, professional commentators, and journalists will share the obligation not only to introduce society to the significance and salient features of the latest S&T, but to propagate scientific knowledge and ways of thinking throughout society as well. It will also be necessary to increase opportunities and widen channels for society to critique S&T and voice its expectations of what S&T should deliver; and likewise, S&T experts will have to respond thereto seriously and appropriately.

Experts in social sciences and humanities should take an interest in S&T, as well as study and remark on the relationship between S&T and society. They should also play an important role in the flow of interactive communication, wherein the opinions and demands of society are fed back accurately to S&T. Social sciences and humanities in Japan have not adequately addressed such issues in the past. Henceforth, these sciences should be developed in concordance with the idea of "S&T in and for society," and active intermediation works stemming from research results should be initiated.

These are background conditions requisite for realizing a society in which ordinary people can make scientific, reasonable, and independent judgment on matters of S&T, as well as on society in general.

(2) Return of R&D results to society through industrial activity

In considering the relationship between S&T and society, another important point to keep in mind is the need to apply R&D results to society practically. Conventionally, R&D results contribute to people's lives and national economy in the form of available products and services produced by industrial technologies. Society reaps the benefits of S&T by generating S&T achievements, publicizing them, accumulating them, applying them to industrial technologies, and using them. In light of the importance of this process, industrial technologies should be strengthened by promoting closer industry-academia-government collaboration and pursuing R&D systems that create excellent results.

5. Achievements and Problems of the First Science and Technology Basic Plan

The First Basic Plan was adopted by the government in July 1996, covering a five-year period from FY 1996 to 2000. The primary principle of the plan was to concurrently promote R&D to meet social and economic needs, and basic research to create human intellectual assets. To put this principle into practice, the plan endorsed policies to structure new R&D systems, realize desirable R&D bases, promote education on

S&T, and form a national consensus on S&T. Governmental expenditure on R&D under the plan was initially set at an estimated 17 trillion yen for the five-year period, while necessary budget to implement the plan was to be secured in annual negotiation, taking into consideration the severe fiscal situation.

Following is a summary of the achievements of the policies implemented during the period of the First Basic Plan, as well as the remaining problems.

To provide competitive and flexible R&D environments, the government nearly doubled funds for proposal-competition-based research (hereinafter referred to as "competitive research funds"), and substantially increased funds for young researchers.

The plan to support a targeted 10,000 young researchers, especially post-doctoral fellows, was numerically achieved in the fourth year. While this enriched the crop of young researchers and activated R&D fields, it failed to reconcile several problems, including the flawed relationship between young researchers and research advisors, and for some, difficulty in finding jobs after the post-doctoral period. Though mobility of human resources was not improved to the desired extent, there were constructive system innovations, such as fixed-term appointment and a relaxation of the restrictions on the side employment of civil servants for industry-academia-government collaboration.

With regard to R&D evaluation, the prime minister endorsed a set of "National Guidelines on the Method of Evaluation for Governmental R&D" in August 1997, and a system for the earnest evaluation of research institutes and research themes was introduced. Though there were several improvements in research evaluations, for example, the introduction of a system requiring universities to conduct self-evaluations, overall there was not adequate consideration of the transparency of the evaluation process and optimal ways to reflect evaluations in resource allocation and personnel changes. To upgrade effectiveness of R&D evaluation, the methods for evaluation and publication of results will have to be promptly improved.

To encourage industry-academia-government collaboration, national research institutes were restructured to facilitate the application and commercialization of R&D results, and reforms were made in several systems, including the system for the adoption of research sponsored by private companies to national institutes, and the system for patent rights for research results produced by such sponsorship. As a consequence, the numbers of patent applications by national research institutes and public-private joint research bodies have been increasing steadily, and technology licensing organizations to connect these patents with industry have become active all around Japan. Further, a law was revised to promote joint-research facilities in national universities.

However, research facilities and the number of research assistants have not been improved sufficiently. In spite of an expenditure of over 1 trillion yen in five years, national universities are congested and their facilities continue to fall into disrepair. The source of the problem lies partly in the rapid increase in the number of graduate students. The number of research assistants at national institutes increased slightly over the five year period of the First Basic Plan. While the number of research assistants at the national universities fell over the same period, conditions of research projects were supplemented with graduate students' participation.

The First Basic Plan did not clearly specify priorities among S&T related goals. Therefore, the second basic plan is expected to clearly specify R&D goals that relate to national and social problems, and to set forth a strategy and priorities regarding those goals.

The total budget for government R&D expenditure exceeded the 17 trillion yen initially estimated for FY 1996-2000, despite the government's severe fiscal constraints.

Although it is quite difficult to fully evaluate the effect of such expenditure at this stage, when only four years in the five-year period have actually passed, the policies under the First Basic Plan are thought to have activated R&D fields. During this period, Dr. Hideki Shirakawa was awarded a Nobel Prize in chemistry for his creative scientific achievements with conductive polymers. Moreover, the number of papers written by Japanese scientists and published in the world's highest-level science periodicals has been increasing. In basic sciences, as well as in newly developing fields, Japanese researchers have obtained the highest-level results in the world. Of special note are the elucidation of the so-called suicide mechanism of cancerous cells, and the findings on the origin of substances through world's first detection of a neutrino event by the Super-Kamiokande detector.

In line with the increase in R&D expenditure, various research institutions are now being encouraged to conduct higher-quality R&D more effectively and more efficiently than in the past, as well as to cooperate more closely, more appropriately allocating responsibilities amongst themselves.

In light of these achievements, further reforms called for during the period of the First Basic Plan should be pursued in the future, and the problems that emerged during the period should be appropriately addressed.

6. Basic Concepts for S&T Promotion

(1) Basic Policies

Building on the achievements of the First Basic Plan, and conscious of the problems that remain to be surmounted, Japan will pursue the following policies in its promotion of S&T, to best develop into the nation it seeks to become:

1) To make R&D expenditure more effective by setting priorities for S&T resource allocation;
   - to allocate resources on R&D challenging national/social problems with priority having definite target
   - to accurately bring up emerging S&T fields with foresight and mobility
   - to prioritize high-quality basic research that explores new lines of inquiry and unlocks the future
2) To pursue S&T systems that create world-class achievements, and to invest in R&D infrastructure for such systems;
   - to provide competitive R&D environments in which researchers can perform at their best with their original ideas, and to provide opportunities for young researchers
   - to train/secure excellent human resources, the basis of S&T activities, by promoting educational reform, and to promote the mobility of researchers as a means of widening their exposure to different R&D environments
   - to introduce fair and transparent R&D evaluation, and thereby encourage healthy competition
   - to improve facilities in national universities that have heretofore remained lacking, and to enrich intellectual bases for S&T, such as measuring standards and biogenetic resources
3) To thoroughly return S&T achievements to society
   - to strengthen technological capabilities in industry to facilitate the commercialization of R&D results through closer industry-academia-government collaboration, to resolve social problems concerning food, economy, industry, the environment, health, welfare, and security
   - to deepen people's understanding of S&T, a prerequisite not only for the promotion of S&T itself, but for the scientific, rational, and independent assessment of S&T subjects, as well as society in general, by having S&T researchers and engineers to present the content of S&T and promote S&T education.
4) To internationalize S&T;
   - to create outstanding R&D results, to operate independent international activities that help overcome the various problems that human beings confront, and to disseminate such activities widely across the world

- to establish world-standards and open R&D environments in which excellent researchers from around the world gather

As it pursues the basic policies aforementioned, Japan will advance reform as promptly and actively as possible, carefully weighing rapid international trends, globalization, and other factors. In the process, needless overlap and deleterious sectionalism among ministries will be eliminated.

In addition, the respective roles of public and private sectors in promoting S&T will be clarified, and the private sector will be encouraged to engage more comprehensively in the forms of R&D it is best geared to handle.

(2) Increase of governmental R&D expenditure and effective/efficient resource allocation

Since the inception of the First Basic Plan, governmental R&D expenditure has been steadily growing as a percentage of the national gross domestic product (GDP). Today the percentage almost equals the level in the United States and leading European countries, where R&D expenditure has been decreasing in recent years. As it sustains the S&T efforts embarked upon in the previous plan, Japan should further increase its R&D expenditure to at least match the percentage levels in the United States and European countries. During the period of the Second Basic Plan, the government is expected to spend about 24 trillion yen* on R&D (fiscal 2001-2005).

(*One percent of the GDP in 2005, assuming nominal GDP growth of 3.5 percent, during the period of the Second Basic Plan.)

While fiscal conditions in other industrially developed countries recovered during the five years of the First Basic Plan, Japan's fiscal conditions substantially worsened. At this juncture, an enormous fiscal deficit threatens to obstruct Japan's economy and future development. If Japan is to have a vital society and economy in the 21st century, financial affairs will have to be restored to a sound condition.

Annual budgets will be fixed in order to provide necessary expenditure for S&T policies in the Second Basic Plan, on the precondition that effective resource allocation will be prioritized by observing the effects of S&T system reform, the prospects for revenue for R&D, social and economic trends, the requirements of S&T promotion, and worsening fiscal conditions.

Top funding priority will go towards the main subjects listed in Chapter 2, namely, R&D to solve national/social problems, enhance competitive environments, and enrich S&T bases. In parallel, to spend the funds effectively and efficiently, unnecessary overlapping and deleterious sectionalism among policies, systems, and organizations will be eliminated, and the quality of R&D activities will be upgraded by goal setting for definite clarification of R&D effects, disclosure of R&D realities, accountability among researchers to explain their own R&D results, and strict evaluation of S&T policies/projects. Moreover, other financial resources will be obtained by introducing private funds, setting off properties by sale, and so forth.

Chapter 2　Important Policies

Based on the basic policies, three important policy themes are now adopted:

- strategic priority setting in S&T

- S&T system reform to encourage outstanding achievement
- internationalization of S&T activities

I. Strategic Prioritization in S&T

Japan will promote R&D activities that concur with policy priorities in resolving national and social issues, such as the enhancement of international competitiveness, or countermeasures against environmental problems or aging and the low-birth-rate society, in order to pursue the establishment and maintenance of an affluent, comfortable, and safe society.

Japan will also deal with newly emerging S&T fields that are expected to be developed rapidly in the future, with appropriate foresight and maneuverability.

At the same time, Japan will secure proper resources to promote of basic research. Because discoveries in R&D might bring breakthroughs, and basic research and industrial applications have been rapidly drawing closer together.

1. Promotion of Basic Research

Basic research, i.e., research that seeks to find new rules and principles, to build up creative theories, and to discover unknown phenomena, expands the compendium of human intellectual assets and leads to unprecedented R&D breakthroughs and innovative industrial technologies. Japan will attach more importance to basic research and promote it broadly, steadily, and continuously.

At universities in particular, Japan must promote basic research in a wide variety of fields, in line with enhanced training of excellent researchers and technical experts.

To upgrade R&D levels, research should be carried out in competitive environments based on fair and transparent evaluation. Research outcomes will be evaluated primarily from a scientific point of view.

Among research borne of original ideas, projects that require especially large amounts of resources will be evaluated to assess their potential to yield innovative knowledge, to generate distinguished research internationally and to share international roles appropriately. To effectively and efficiently promote the projects assessed most favorably, extensive resources will be allocated intensively in consideration of views of researchers in various fields and total balance among basic researches including competitive research funds. Further, adequate explanations on the significance and expected outcomes of projects will be requisite for the public's understanding.

With regard to the results of research, researchers must target the acquisition of intellectual property rights, as well as publish theses.

2. Prioritization of R&D on national/social issues

To promise the people a safe and comfortable life, with an economy and industries sufficiently activated to secure sustainable economic development, Japan must promote R&D through positive and strategic investment in prioritized areas. In promoting S&T fields instrumental in the realization of Japan's visions, Japan will adhere to three general policy priorities:

- Creating knowledge that engenders new developments (enhancement of intellectual assets)
- Promoting sustainable growth in world markets, improving industrial technologies, and creating new industries and employment (economic effects)
- Improving people's health and quality of life, enhancing national security, disaster prevention, etc. (social effects)

In the selection of specific S&T fields, priority will go to the following four:

1) Life sciences which resolve food shortages and prevent/treat disease in Japan's aging and low-birth-rate

society

2) Information and communication Technologies which are advancing rapidly and are vital to the building of an advanced IT network society and fosterage of IT and other high-tech industries
3) Environmental sciences which are indispensable for human healthcare and conservation of the living environment, as well as sustained foundations of human existence
4) Nanotechnology and materials which disseminate into a broad range of fields and help Japan maintain its technological edge R&D resources will be intensively allocated to all of the above.

In promoting R&D, peripheral fields or fields that may appear irrelevant should not be excluded, as new S&T fields are frequently borne of combinations of different fields, with the rapid advancement of S&T and its further specialization.

The following pages focus primarily on the roles of government, while R&D on national/social issues should be promoted in public-private collaboration.

(1) Life sciences

Some like to call the 21st century the "Century of Life." A thorough understanding of the nature of life is expected to propel the progress of medical science and lead to new solutions to food shortages, the environment, and other global scale issues. In a society such as Japan's, an aging society with fewer children, the life sciences are key to actualizing healthy, active, and comfortable lives.

While Japan compares favorably with the United States and Europe in some R&D fields in the life sciences, for example, the Rice Genome, specific microbe genome analysis, and livestock cloning techniques, as a whole Japan is still behind. For instance, the United States leads the world in both national research programs in the life sciences, under the auspices of the National Institutes of Health and venture business activities. European countries are second to none in research on Alzheimer's disease and the technology used to develop genome-information databases.

A draft sequence of the Human Genome was made public in February of this year. Genome information on various species has advanced very rapidly in recent years, and this information is expected to set a foundation for a wide range of more advanced research. In view of its situation, Japan must work selectively and strategically in the newly emerging fields of the advanced life sciences, such as post-genomic research. Specifically, Japan will focus on the following:

- Genome science: to promote proteomics, the elucidation of the three-dimensional structures of proteins and genetic markers of disease and drug reactions, and the development of new medicines, tailor-made medicines, and functional foods based on such technologies
- cellular biology: to advance organ transplantation and regenerative medicine
- clinical medicine and medical technology: to foster practical medical uses of R&D results
- food S&T: to advance biotechnologies that contribute to food security and promote a healthy diet, as well as sustainable food production
- brain science: to elucidate brain functions, to control cerebral development disorders and aging, to overcome neurotic diseases, and to develop information-processing and communications systems by applying principles that underlie the functioning of the brain
- bioinformatics: to support the aforementioned technological advances, by analyzing the tremendous amounts of gene-related data they yield, through the use of information/communications technologies

To promote the life sciences, Japan must implement basic R&D in basic science fields, training and securing of researchers and technicians required in merging fields, maintenance and widespread utilization of an intellectual infrastructure that includes biological genetic resources, action against international problems relating to patents, safety checks from a scientific point of view, promotion of public understanding in biology, and formulation of ethical guidelines relating to biological R&D.

(2) Information and Communication Technologies

R&D progress in the field of information and communication technologies (hereafter referred to as "IT") is very important for the creation and expansion of knowledge-intensive industries such as IT industries and high-tech industries, as well as for enhancing innovations in existing industries such as manufacturing technologies. Newly realized and diffused systems for electronic commerce, electronic governance, telecommuting, telemedicine, and distance-education/learning will have a great impact upon socio-economic activities in Japan at all levels, from everyday life to industrial production. Advances in IT will continue to be an important factor in Japan's ongoing efforts to secure safe and comfortable people's life.

Japan is thought to hold a competitive edge over Europe and the United States in R&D in IT fields, especially in mobile-phone systems, optical communications technology, and IT terminals. The United States, however, leads the world in both software technologies and strategies for de facto global standardization of PCs and related technologies.

In view of the great variety of needs in this field, as well as the rapid innovations of the technologies, Japan will promote its R&D with flexibility. It will also be important to promote R&D in the technologies required to realize an advanced IT network society in which people can make full and creative use of their capabilities by freely sending, receiving, and sharing information. Specifically, Japan will focus on the following:

- advanced network technology that enables all network activities to be performed safely, at any time, at any place, and without stress
- high-performance computing technology that enables rapid analyzing, processing, storing, and searching of vast amounts of distributed information
- human interface technology that allows everyone to enjoy the benefits of an IT society without mastering complicated equipment and feeling stress
- device technology and software technology to support the foregoing points

To promote IT R&D, Japan will emphasize fundamental and leading R&D fields that are unattainable strategically and effectively through market-motivated activities alone, while keeping close track of the variety of this field and speed of technological innovations. Private sector experts will be used to train and encourage outstanding researchers and engineers to pursue their innovative ideas through R&D. Japan will also promote institutional improvements by ensuring the privacy and security of network activities, by providing testing beds for developing technologies, by implementing activities for international standardization, and by developing education/learning programs for IT literacy that enable people to make good use of IT-related equipment and skills. Another indispensable competence will be disaster-preparedness, that is, readiness to respond to disasters stemming from computer glitches, service interruptions, or functional suspensions due to attacks on the network, poor control of information, and the digital divide.

(3) Environmental sciences

The environmental sciences are essential to preserve the natural environment, which of course includes ecologies that support the species of the planet. This forms the basis for the survival of humankind in the future, as well as a basis for protecting human health and lifestyle.

Japan's environmental R&D is on par with that in Europe and the United States in the struggle against global warming. In the area of global science, Japan is equal to them in measuring techniques for environmental monitoring, but behind Europe and far behind the United States in environmental monitoring itself. Japan's comprehensive evaluation and management technologies for chemical substances are at the same levels as those in Europe and the United States.

Given the limitations in Japan's land and natural resources, Japan relies heavily on the environmental sciences and must use them to become a world leader in tackling environmental problems. Specifically, Japan will focus on the following:

- introduction of production systems that minimize both the input of resources and output of wastes, and technology to support recycling in society where effective use of resources and waste control are achieved by utilizing natural circulative function and bio-resources.
- technology to minimize harmful chemical substances for human health and natural ecology, as well as to evaluate and manage them
- technology for measures against global warming, such as forecasting global changes that affect human survival and natural ecology, evaluation of how forecast results will influence social-economy, and minimizing the emission of greenhouse gases.

Considering the need to reduce the environmental impact, comprehensive technical evaluation is requisite. In the course of conducting technical evaluation, it will also be important to develop life-cycle-assessment methods, prepare databases, and provide information for consumers.

To promote the environmental sciences, it is very difficult to evaluate the added economic value of policies. To apply the environmental measures properly into society and economy, Japan will promote global-scale environmental monitoring, the development of common basic techniques, standardization of an intellectual base on the environment, and evaluation of model projects. Japan will also introduce systems designed for environmental preservation, initial demand excavation, and environmental education programs for consumers.

(4) Nanotechnology and materials

Nanotechnology and materials science/technology are important fields that provide bases for many kinds of scientific and technological advances in the three fields aforementioned, as well as many others. Nanotechnology is expected to lead to breakthroughs in all S&T fields in the 21st century.

・ Materials science/technology

In the area of materials science/technology, Japan's R&D is more advanced than that in Europe and the United States, insofar as existing materials are concerned.

Materials science/technology will provide the wherewithal for tremendous leaps in a wide variety of other fields. Ongoing investment in R&D in materials science and technology will help Japan retain its leadership position in technological innovation in these fields. Specifically, Japan will focus on the following:

- materials science/technology for analysis of material structures and forms, surfaces, and interfaces in the order of atomic/molecular size, which will be applicable to IT, medical science, etc.
- materials science/technology to develop energy and environmental applications for recycling, resource saving, and reduced energy consumption
- materials science/technology for creating a secured environment for living

The true value of materials lies in how they actually are used. In promoting R&D, the seeds created by researchers should be carefully tended to ensure they bear fruits that properly meet users' needs. It will be also important to apply IT methods, such as computer simulations, to promote international standardization, to improve the intellectual infrastructure, and to establish a comprehensive technique for evaluating the environment and/or security.

To promote materials science/technology, the priority in R&D should be assigned to basic/leading fields and those aiming at forms of industrialization that cannot be attained strategically or effectively through market-motivated activities alone.

・ Nanotechnology

Nanotechnology is an interdisciplinary and comprehension S&T field that encompasses IT, the environmental sciences, life sciences, materials sciences, and so on. By manipulating atoms and molecules on a nano scale (1/1,000,000,000 m), the unique material properties in the nano world lead to novel discoveries that can be exploited to innovate technologies in other fields. Nanotechnology also provides new materials, devices, and innovative systems to fields in IT, biotechnology, medical science, and so on.

Nanotechnological R&D in Japan is on the same or a slightly higher level than that in Europe and the United States. However, other nations are rapidly formulating national policies and implementing measures to promote their research in nanotechnology. If Japan is to maintain it's technological edge in this field, it will have to gather all possible industrial, academic, and governmental knowledge on nanotechnology and approach its further development strategically. Examples of nanotechnology include: nano materials that have extremely high strength, extremely low weight, and an extremely efficient luminescence that can be acquired when their material structures are controlled on the nano scale; nano information devices that realize extremely high-speed communication and information processing; nano devices in medicine that can be implanted inside patients' bodies to control, diagnose, and directly treat disease; and nanobiology techniques to observe and control various kinds of biological phenomena on the nano scale.

In promoting nanotechnology, Japan must maintain a balance between fundamental/leading research and research that aims for industrialization. It will also be important to construct a network for information exchange and collaboration among researchers in various academic fields, and to educate students and young researchers on the newly emerging branches of nanotechnology that involve various academic fields.

In addition to the four areas mentioned hereinbefore, there are other four areas: energy, manufacturing technology, infrastructure, and frontier. These are fundamental areas for the nation's existence, hence R&D on these fields should be promoted by the government at a national level.

(5) Energy

The energy supply is not expected to be secure in the future. To attain a maximum level of energy security, Japan will realize a safe and stable energy demand structure that relies less on fossil fuels and encompasses mechanisms to combat global warming and increase energy efficiency.

Examples include: fuel cells, solar power generation, new energy sources such as biomass, energy saving technologies, nuclear fusion technologies, innovative atomic-energy technologies, and technologies for nuclear safety.

(6) Manufacturing technology

Manufacturing technology is the very source of Japan's economic power. Many of Japan's high-precision machining technologies are unavailable anywhere else in the world, attesting to the extremely high level of the nation's manufacturing technologies. It is important to develop new innovative technologies, based on the advanced standards already set.

Examples include: high-precision technologies, fine-parts processing technologies, high-value-added advanced technologies such as micro-machines, environmentally friendly technologies, quality assurance/safety technologies for manufacturing sites, advanced manufacturing technology (especially using innovative technologies based on IT or bio principles), and medical/welfare apparatus technologies.

(7) Infrastructure

The field of "Infrastructure" is the basic framework for supporting the people's life. S&T in this field includes the development of disaster prevention / mitigation technologies; crisis management technologies; the development of transport systems such as automobiles, ships, airplanes and railways; geographic information systems; and the production and management of fresh water. The government promotes R&D on infrastructure to reduce social risks and improve quality of life.

Examples include: the science and technology of crisis control and management technology, such as emergency communications and prevention / mitigation of earthquake disasters; and information technology-related infrastructure developments such as Intelligent Transport Systems.

(8) Frontier

"Frontier" is a cutting-edge S&T field to explore unclaimed regions that are hoped to become new frontiers of human activities, for example, outer space and the ocean. The purpose of R&D in this category is to improve quality of life through the use of such technologies as the followings: space technologies that include utilizing space for satellite-based telecommunications and earth observation with satellites; and oceanic technologies that take advantage of the vast resources of the oceans.

Examples include: space development to contribute to the growth of the advanced information technology society; ocean development leading to the utilization of untapped natural resources.

3. Focus on emerging fields

In a new age where mobility and speed are required, the CSTP will continuously examine and promptly review the areas and targets to be prioritized. In concert with rapid intellectual accumulation, new ways of thinking, and technological development in recent years, mergers of different fields and new-born S&T realms have been becoming more common. The most recent examples include: nanotechnology covering materials science, IT, life sciences, and the environmental science; bio-informatics as a merger of life sciences and IT technology using developed computer processing and accumulated genetic information; newly emerging systematic biology; and nanobiology. Many other realms are forecasted to appear in the years to come. When a new realm appears on the horizon and shows the prospect for tremendous growth and advancement, CSTP should step in to facilitate the process.

II. S&T system reforms

An S&T system is a mechanism in which resources are invested on the basis of social understanding/agreement, human resources are developed, a necessary infrastructure is constructed, R&D is activated, and the results are enjoyed by society.

Accordingly, the system comprises four major parts: an R&D system, a training system for S&T related personnel, maintenance of facilities for promoting S&T, and an interface between industry and society. In order to upgrade S&T activities and accelerate social restorations, Japan will reform its S&T system while expanding its investment through the following initiatives: enriching its human resources and infrastructure, conducting high-quality R&D, generating world-class achievements, transferring them to industry and society, and explaining these activities to the public.

1. R&D system reforms

(1) Building an R&D system that generates excellent results

1) Establishment of a competitive R&D environment

Creative R&D activities are promoted in a competitive environment to ensure that all the capabilities of personnel are being fully applied in every phase. Such a competitive environment is encouraged not only within research organizations but also through the researchers' acquisition of competitive, outside funds.

(a) Increasing the amount of competitive funds

Funds received on a competitive basis will be increased continually. Taking the United States as a model the United States leads the world in the use of competitive funds for S&T the amount of competitive research funds will be doubled over the period of the Second Basic Plan. And to make the best use of the funds, the following reform actions, focusing on evaluation, will be essential.

- For evaluation of R&D themes, the system and operation of funds should be improved to clarify the ideas and abilities of individual researchers. For instance, the number of projects conducted by single researchers in cooperation with post-doctoral fellows and research assistants should be greatly increased. In the case of group projects, the responsibilities of collaborating researchers should be divided according to individual expertise.
- To attain valid results, each project should be granted a necessary and sufficient amount of funds, and its planned duration should range from 3-5 years.
- An interim and a follow-up evaluation should be properly conducted to assess the fund operation. The interim evaluation may recommend expansion, reduction, or suspension of the project, as well as an extension of the project period to achieve a better outcome. In addition, the judgments of the interim and follow-up evaluation will be utilized to make preliminary evaluations for the next competition. These evaluations will be helpful for the overall development of effective R&D activities in the long-term. They should also be used to assure that funds are applied fairly, particularly with respect to researchers who have relatively less experience.
- Every evaluation should properly disclose all information on procedures, checkpoints, processes, and results to the researchers of the project.
- Evaluations should be conducted in a systematic way using an adequate budget and full-time experts who have themselves made substantial contributions to R&D.
- In order to conduct a fair and transparent evaluation that properly accounts for each researcher's performance, a database of results and project progress should be established using information supplied periodically by the researchers themselves.
- Each ministry distributing competitive funds must allow a maximum number of researchers to apply.
- The research organization should be in charge of the account for research funds, including, in principle, competitive funds directly distributed to individual researchers.
- Objectives of the competitive funds operated by each ministry should be clarified, and all programs and systems related to the competitive funds should be properly integrated.

(b) Allocating funds for indirect expenses

As a result of the expansion of competitive funds, direct expenses for R&D have been increasing. To utilize funds effectively and efficiently, it is necessary to pay the administrative expenses of the research organizations managing the projects. For this reason, a set portion of the acquired research funds should be allocated for the indirect expenses incurred by the research organizations.

Taking the United States model as a reference, this rate will be set at 30% of the total acquired research funds, but may be changed upon review of the R&D system operation.

Indirect expenditures shall be used to improve the researchers' R&D environment and the organization's overall function, and an organization which has acquired several competitive funds is expected to utilize its total funds for indirect expenses efficiently and flexibly. This use of indirect expenses will promote competition among research organizations and upgrade the quality of research; however, the records of expenditure must be reported to the fund-distributing agencies to maintain transparency.

With regard to national universities, a special accounting mechanism should be arranged to allocate funds for indirect expenses to those universities that acquire competitive funds.

(c) Handling basic expenses

In conjunction with the projected doubling of competitive funds, the use of basic expenses should be examined so as to ensure a competitive R&D environment. In this context, the following should be assured:

- The basic expenditures for academic research should include funds to promote education and support the university's administration.
- The accumulated administrative costs for researchers should include expenditures for administrative operation of the research institutes.

2) Mobilization of human resources using fixed-term appointments

The tenure system under which permanent R&D positions are granted to young researchers based on their performance during fixed-term appointments is regarded as the principle source of R&D vitality in the United States. To realize such a vital R&D environment in Japan, efforts will be made to promote fixed-term appointments in which researchers can work in a competitive environment until their mid-30s. Also, to help researchers obtain a job corresponding to their talents and abilities, Japan will popularize recruitment and mobility of human resources on an apply-and-review basis in industry, academia, and government. It is highly important to formulate a market mechanism that meets the needs of both researchers and research organizations. For this reason:

- Governmental R&D organizations, such as national research institutes, independent administrative institutions, and national universities, should employ young researchers until their mid-30s under a fixed-term appointment, and provide job opportunities widely and fairly to talented and capable researchers on an apply-and-review basis of recruitment in principle. Governmental R&D organizations should issue guidelines for fixed-term appointments and apply-and-review basis recruitment. Implementation of such systems will be a checkpoint for evaluating the organizations.
- Although the period of the present fixed-term appointment for young researchers is less than three years, this period may be too short to attain the objective. In order to provide sufficient and various R&D opportunities, the organizations should secure at least five years for young researchers to work intensively, should permit reappointment under certain conditions, and should endeavor to treat researchers fairly according to their achievements and abilities. At the universities, policies should be revised so as to introduce talent-based treatment of lecturers, including fixed-termed appointments.

- In order to increase the mobility and range-of-experience of researchers, communication and cooperation must be enhanced among the industrial, academic, and government sectors. And to help researchers secure career paths not only in R&D but also in government or industry according to their interests, a system should be developed for dispatching post-doctoral fellows and young researchers to companies and government ministries.

3) Independence of young researchers

Young researchers should be encouraged to work independently, developing their self-reliance and making the most of their own instincts and capabilities. To this end:

- The positioning of assistant professors should be reviewed and, if needed, restructured to promote their autonomy in R&D. At the same time, in order to draw out the full abilities of researchers, the R&D support system should be reinforced and efforts made to encourage young researchers to be creative and have a broad perspective.
- Sufficient R&D space in research organizations should be provided for gifted young researchers.
- Research funds for young researchers should be expanded in conjunction with the doubling of competitive research funds, and applications by aggressive young researchers should be promoted in the competitive funds in general.
- Awards should be increased to young researchers whose work yields especially fruitful results.

In the case of post-doctoral fellows working under research advisors, a plan to support 10,000 post-doctoral fellows has been adopted, and has led to an improved environment for intensive and independent research. In the future, the post-doctoral fellowship system should be substantially improved with emphasis on the following: allocating funds to research advisors so that they can secure post-doctoral fellows themselves; treating post-doctors fairly according to their abilities; dispatching post-doctoral fellows to ministries or companies; assuring adequate support for especially gifted doctorial students; and a full system review.

4) Reform of evaluation systems

Evaluations of R&D have been conducted in accordance with The National Guidelines on the Method of Evaluation for Governmental R&D (hereinafter referred to as the National Guidelines on Evaluation), and Japan will reform the evaluation system for the competitive R&D environment and effective/efficient resource allocation in consideration of:

- Securing fairness and transparency of evaluations, and assuring that the results of the evaluations are reflected in the resource allocation;
- Securing the necessary resources for evaluations and arranging a system for the implementation and support of evaluation.

During implementation, systematic and efficient evaluations should be conducted for R&D themes, R&D organizations, and researchers' achievements.

The National Guidelines of Evaluation should themselves be revised with the following emphases:

(a) Securing fairness and transparency of evaluations, and reflecting evaluations into resource allocation

The evaluation of R&D themes should be conducted flexibly according to the subject or field of each project. In particular, evaluations of R&D projects according to policy objectives should be conducted by independent experts. In the preliminary evaluations, the checkpoints should be social/economic significance and effectiveness, and the clearness of the goals; in the interim/follow-up evaluations, the checkpoint should be progress against the implementation plan.

In the case of R&D using competitive funds, peer reviews should be performed by highly qualified individuals to verify that the scientific and technological progress is original and forward-thinking, and to evaluate the quality of R&D according to international standards. Results of the follow-up evaluations should be referred to the next preliminary evaluation of the same applicant's projects by the same or other competitive funds.

In addition to the preliminary, interim, and follow-up evaluations, each ministry should conduct a tracking evaluation of the spin-off effect and impact of R&D results, and then should verify previous evaluations. Moreover, the R&D systems and their operations should be evaluated in terms of effectiveness and efficiency in obtaining the objectives.

R&D organizations should be evaluated according to their organizational operation and their successful implementation of R&D to obtain their objectives. Organizational operation should be evaluated according to the performance for the organizational objectives or improvement of the R&D environment, under the discretion and the resources granted to the director. R&D implementation should be thoroughly evaluated according to both R&D themes done in the organization and the achievements of member researchers. Because the success of the R&D organization is a reflection of its leadership, this evaluation will also serve to evaluate the director of the R&D organization.

The performance evaluations of the researchers should be performed by the R&D organizations, and the director of the organizations should arrange the rules for evaluations and perform them responsibly. Versatile standards should be used in order to evaluate R&D and related activities, such as the contributions to society, and those activities with high grades in terms of any of these standards should be highly evaluated.

In order to secure fairness and transparency in implementing the evaluation, an objective evaluation index and external evaluations should be introduced, and evaluators should disclose their methods, standards and processes of evaluation.

Further, the results of the evaluation should reflect the resource allocation, such as the continuation, expansion, reduction or suspension of the project, and the treatment of researchers.

In addition, as to universities, attention should be paid to academic autonomy and the combined function of education and R&D. And education, R&D, contributions to society, and the organizational operation of universities should be evaluated externally by the National Institution for Academic Degrees.

(b) Securing required resources and arranging a system for the implementation and support of evaluation

Because evaluation is indispensable for effective and efficient S&T promotion, required resources should be secured and a system for the implementation and support of evaluation should be arranged.

- Due to the shortage of full-time, highly qualified evaluators, a portion of R&D funds should be allotted for assessing and securing veteran evaluation researchers either from Japan or abroad.
- In order to select appropriate evaluators and to evaluate each project reliably and universally, a national database of researchers, funds, evaluators, and results should be established.
- Computing systems should be introduced to rationalize and improve the system for the implementation and support of evaluation.

5) Flexible, effective, and efficient management of R&D systems

(a) Securing flexibility and efficiency in executing the R&D budget

Because R&D projects are generally several years in duration, they often cannot proceed as originally planned. For this reason, the governmental R&D budget should be executed flexibly and efficiently in accordance with the progress of the project, such as by using special budgets that can be carried forward into the fiscal year.

At the same time, competitive funds should be budgeted from the beginning of the fiscal year using smooth accounting procedures.

(b) Promoting a flexible working style

In order to fairly employ and evaluate researchers and thereby inspire their best performance, administrative institutions must be free to work with autonomy and discretion in the manner of private companies, promote the independence and performance of researchers, and consider developing leave of absence systems.

6) Utilization of qualified persons and development of a variety of career paths

(a) Expanding opportunities for gifted foreign researchers

It is important to provide an environment in which talented foreign researchers can engage in R&D activities competitively.

For example, public institutes might employ young foreign researchers according to a fellowship scheme, based on their abilities and achievements, and competitive research funds could be arranged to enable foreign researchers working in Japan to submit an application in English.

(b) Improving the environment for women researchers

In order to attain a gender-equal society, the job opportunities and working environment for women researchers should be improved. In particular, to help sustain the abilities of female researchers during maternity leave, as well as to encourage their return after maternity leave, various forms of support should be provided, such as work-at-home and limited-period positions, and special funds relating to their research.

(c) Developing a variety of career paths

A variety of career paths should be developed so that researchers can engage in a wide range of jobs, such as R&D planning/management, evaluation of R&D, and development of intellectual property rights. For young researchers to widen their work possibilities in the future, job opportunities in the government should be increased, and funding agencies should adopt individuals with research experience. In the private sector, companies are expected to employ capable young researchers, such as doctors and post-doctoral fellows.

7) Realization of creative R&D systems

To accomplish the reforms mentioned above and to realize creative R&D systems, major R&D organizations should be managed with flexibility and mobility under the director's leadership, and centers of excellence should be established.

Such R&D systems can be developed from existing R&D organizations by reforming the management and introducing novel methods that emphasize the abilities and achievements of researchers.

Moreover, new ideal R&D organizations comparable to top-level R&D organizations in Europe and the United States should be established in prioritized areas and emerging fields, without restricting existing organizational management. These organizations should focus on generating world-class R&D achievements with special emphasis on the following points:

- limiting the term of the organization;
- establishing a clear separation between the organizational and the R&D managers, and appointing experienced professionals to both positions;
- establishing a department for assisting in adequate management of R&D, technological support, and management of R&D achievements;
- promoting young researchers, including employment of post-doctoral fellows;
- appointing foreign researchers;
- promoting the participation of industry, academia, and government;
- allocating funds and treating employees according to their R&D abilities and achievements;
- managing funds flexibly;
- using English as the common language for R&D;
- establishing facilities based on international standards.

(2) Promotion and reform of R&D in major organizations

1) Universities and other academic institutions

Universities are required to play a number of significant roles in R&D systems, including educating and securing excellent human resources, encouraging international academic cooperation, and generating new discoveries to help unlock the future.

However, universities in Japan have often been criticized for their poor educational functions, excessively specialized fields of education, and exclusiveness or inflexibility of organizational management.

From the viewpoint of activation, qualification, and individualization of education/research in universities, the government has recently promoted numerous university reforms, such as presenting a national policy for universities, increasing the number of graduate courses, establishing an advisory committee with external members in all national universities, and establishing a National Institution for Academic Degrees. From this point forward, although the government will continue to promote institutional reforms to help universities establish their independence and operate more flexibly and autonomously, individual universities will also be expected to promote their own operational and educational reforms.

To this end, each university is expected to promote a systematic undergraduate education that fosters a spirit of inquiry, and to establish graduate schools as innovative bases of R&D and education that will be both competitive with and attractive to international researchers. Organizational flexibility will be needed to predict social/economic trends and to follow them autonomously, which is a key subject for national universities operating under the restrictions of public institutions. Universities should conduct strict self-evaluations and make their results fully available. When presenting their results, universities should reflect on their managerial reforms and educational and research activities. In this way, and through their wide presence in Japan, it is hoped that universities will form regional academic cores in cooperation with local governments and private companies. In addition, universities should intensify cooperation and collaboration with other R&D organizations or private companies in order to activate a variety of educational/research initiatives and elevate the university generally.

(a) National universities and other public universities

National universities and national research institutes should function as independent administrative institutions by promoting organizational reforms to be carried out autonomously under the president's leadership. And graduate schools, especially prominent ones, should vary and specialize their education and research.

Public universities are required to provide a high-level education for their geographic region and to contribute to studies for regional development, thereby intensifying both their educational/research functions and their unique regional contributions.

(b) Private universities

Private universities, which together account for 80% of student enrollment in Japan, have been enhancing their role in higher-education by asserting a unique educational philosophy.

They are expected to continue to upgrade their education and research while maintaining their autonomy as private institutions. To assist them, the granting of special funds and the acquisition of private sources of funding should be prioritized.

2) National research institutes and other institutes

National research institutes, independent administrative research institutes, and public corporations have a mission to accomplish policy objectives. To this end, they have conducted prioritized R&D, including basic/innovative researches for S&T progress in Japan and systematic/integral researches with concrete objectives to meet policy needs. Public research institutes in all prefectures have played important roles in technological development and analysis to meet the needs of local industries and communities. With the ever-increasing socio-economic expectations for S&T in Japan, these institutions are expected to continue yielding excellent results and making unique contributions to society. Special emphasis will be placed on the following activities in particular:

- National research institutes, independent administrative research institutes, and public corporations should execute R&D according to their own objectives, such as R&D on national/social needs, basic researches for future development, etc. These organizations should intensify their cooperation with universities and private companies, in order to more effectively industrialize and disseminate R&D results.
- Public research institutes are expected to contribute to industrial development based on the characteristics of their respective regions. These institutes should increase their efforts to transfer their basic and leading achievements to regional industries and see them commercialized locally.

Research institutes that will become independent administrative institutions should operate their organizations flexibly, generate and utilize outstanding R&D results, and place special emphasis on the following:

- expanding the discretion of their directors-general, managing R&D funds flexibly, and positively utilizing the results;
- conducting R&D using both outside funds and the budgets from their respective ministries;
- appointing top-notch researchers and treating employees according to their abilities under the discretion of their directors-general;
- seeking the advice of the National Personnel Authority in regard to R&D suspension and the appointment of fixed-term and other researchers.

3) Private companies

(a) Promoting R&D by private companies

R&D by private companies is a vitally important complement to governmental R&D. In order to promote it, the government should apply incentives which stimulate private companies to help themselves, such as tax reforms to promote R&D investments, and grant and loan systems that reduce the risks inherent in R&D. At the same time, systems for R&D for economic growth should be reviewed with an eye toward increased efficiency and effectiveness.

And the government should allow researchers or research organizations to hold/utilize the rights to patents generated from government-funded researches.

(b) Promoting the mobility of capable researchers

In order to promote the mobility of researchers in Japan, private companies are expected to employ capable young researchers, such as doctors and post-doctoral fellows.

2. Reinforcement of industrial technology and reform of industry-academia-government collaboration

In a competitive environment fueled by the market mechanism, R&D results become widely disseminated in the form of usable properties or services. The role of industrial technology is to serve as a bridge between intellectual properties and the economy i.e., people's everyday lives. In order to reinforce industrial technology, certain S&T reforms are indispensable.

Central among them is reform of the collaboration among industry, academia, and the government. A technological innovation system should be established in which industrial/academic/governmental collaboration can be promoted and innovative assets and services can be generated at the same time. This will require removing the invisible walls among the three sectors, such as by utilizing academic achievements in industry and transmitting industrial needs to public research organizations.

(1) Reform of systems of information distribution and human resource exchange

Today, when private companies in Japan are increasingly outsourcing their basic R&D to research organizations across the globe, it is more important than ever to formulate a common understanding between private companies and public research organizations, and to promote collaboration among Japanese industries, academic institutions, and government. Industry must present its needs, and public research organizations must promote R&D in consideration of these needs. Specifically:

- Public research organizations should strengthen their ability to disseminate information on their research systems, achievements and human resources by preparing or improving their database.
- Public research organizations should promote collaboration with industries through personnel exchanges, such as by proactively employing researchers from private companies, in order to accurately reflect the economic needs of society through their R&D topics. Public research organizations should also periodically hold meetings in which both sectors can exchange information on the latest R&D trends and requirements, and secure and train personnel to promote their collaboration. Joint-research centers and technology licensing offices should promote free exchange of information. Through these activities, public research organizations can rise to meet current economic, social, and socio-economic challenges.
- To stimulate incentives for private companies, public research organizations should simplify their procedures for joint or entrusted researches, cost estimation, reports, etc. such as by implementing organizations, cost estimations, reports, etc. And private funds for public research organizations should be made available for the indirect expenses of those organizations.
- In regard to competitive funds, workers in the industrial sector should be involved in the theme selection or interim/follow-up evaluations, and should be appointed as managers of industry-academia collaborative projects, in order to appropriately convey economic/social needs to the direction of R&D.
- Because there are strong economic/social needs with regard to international standardization, not only basic but also practical cooperative researches should be conducted.

(2) Improvement of environment of technological transfer from public research organizations to industry

(a) Promoting technological transfer of public research organizations

In order to promote technological transfer from public research organizations to industry, it is important to strengthen systematic measures for the collaboration. Particularly in universities, the function of joint research centers should be functionally enhanced by appropriate inter-faculty personnel exchanges. Technology licensing organizations should be utilized independently to commercialize R&D results in public research organizations.

Moreover, activity records of industry-academia-government collaboration should be regarded as one of the factors used to evaluate research organizations or researchers.

(b) Promoting patent management by public research organizations

Each public research organization should establish a mechanism to commercialize useful R&D results.

- During the period of the First Basic Plan, assignment of patent rights to individual researches has been promoted, in order to enhance incentives of researchers and to accelerate transfer of researchers with patent rights. And although the number of patent rights assigned to individual researchers has increased, the number of commercially applied patents has not necessarily been enhanced. In order that R&D results be applied more effectively and efficiently for commercial purposes, patent rights management should generally be shifted from individual to organizational.
- Research organizations should be equipped with functions for acquisition, management, and application of patent rights. And technology licensing organizations should support those functions of research organizations.
- Turning to organizational patent management, a system should be developed such that patent fees will be properly shared with the corresponding inventors. Even when researchers change employers, the inventor's privileges should be taken into consideration.

These reforms should first be introduced in independent administrative institutions, and then considered for universities and other institutions. In light of globalization relating to patents, public research organizations should also be encouraged to acquire patents not only in Japan but also in foreign countries.

(3) Promoting commercialization of the R&D results of public research organizations

R&D results of public research organizations, attained in joint researches with private companies or sponsored researches by private companies, should be applied to commercialization. The motivation of private companies to participate in joint research will be enhanced by promoting transfer of R&D results to private companies. Accordingly, the results of R&D attained in joint or sponsored researches should be transferred to the companies concerned. In particular, this should be accomplished by transferring government-owned patents to private companies or technology licensing organizations, and by granting exclusive licenses of government-owned patents to private companies or technology licensing offices. To realize these goals, public research organizations should be encouraged to assign their R&D results, by the contracts at discretion, to the companies concerned or to the TLOs authorized under the Law for Promoting Research Results of Universities to Private Companies (1998, Law No. 52), or to make contracts of the assignment with TLOs on a deferred payment basis.

In personnel matters, researchers in public research organizations should utilize the personnel systems to allow simultaneous employment with the companies concerned or employment suspension. The government should permit their engagements of study or instruction in private companies. These treatments will enable human resources in public research organizations to play an active part in society, so that technology transfer can be promoted.

(4) Environment for activating high-technological venture enterprises

The environment for activating venture enterprises in Japan has been improved in regard to both capital and human resources. Nonetheless, further measures should be conducted in consideration of the relative disfavor for entrepreneurship, the difficulty for securing initial risk money, and the individual risks of failure. In particular:

- Universities should foster human resources of entrepreneurial spirit, as by establishing courses that invite entrepreneurs or venture capitalists to appear as lecturers, etc. Graduate schools should enrich special education courses to improve capital/legal skills, and to promote joint researches with venture enterprises through joint research centers.
- Regional public research organizations should establish better cooperation with regional venture enterprises by functioning as coordinators, securing mobility of human resources, and promoting cooperative projects for industry-academia-government collaboration.
- The government should improve its system for promoting innovation and R&D by small and medium enterprises, particularly by positively utilizing the institution of Small Business Innovation Research (SBIR).
- Finally, the government should review its present legislation on stock-options, stock companies, and bankruptcy.

3. Regional improvement of the S&T Promotion environment

Economic/social globalization and rapid progress and dissemination of IT have been affecting individual regions directly, and local industries are now exposed not only to domestic competition, but also to global competition. At the same time, S&T achievements afford local companies a chance to establish businesses in the international market quickly and easily.

Regional R&D resources/potentials can be utilized to upgrade and vary S&T in Japan, as well as to revitalize the Japanese economy through regional technical innovation and creation of new industries.

(1) Establishment of regional "intellectual clusters"

The "intellectual cluster" is a regional system of technological innovations in which a public research organization uses its R&D potential and other unique abilities to lead companies in and around a particular region.

More specifically, by utilizing a human resource network and systematic collaborative researches, the system fosters interaction between the original technological seeds of the public research organization and the business needs of regional companies to create a chain of technological innovations and new industries. Within such a system, regional development can lead to world-class technological innovations. It is thus imperative that Japan establish and support intellectual clusters in as many regions as possible.

In order to establish the intellectual clusters effectively and efficiently, the government should promote various R&D activities, including collaborative researches, human resource training/securing, and technological transfer functions, etc.

And public research organizations including both national and independent administrative institutions should develop their R&D functions in the region in cooperation with the local government.

(2) Implementation of regional S&T policies

In order to realize a range of S&T development, it is important that public research organizations within a particular region, e.g., universities, develop their original potentials and commercialize the results.

For this purpose, several S&T policies should be adopted within each region, such as the securing of professional coordinators to judge/apply technologies and the promoting of interregional technological transfers.

The local government should work together with public research organizations such as national universities within a particular region to regionally promote industry-academia-government collaboration.

4. S&T human resource development and S&T educational reforms

(1) Education of researchers and engineers, and reform of universities and other institutions

The education of talented researchers and engineers is crucial to S&T system reform. As the very core of S&T education, the universities must endeavor to reform themselves.

Therefore, in order to be internationally competitive, universities should upgrade the quality of education/research to cultivate researchers and engineers who are creative and have expert skills and training. In addition, universities should accelerate both self-evaluation and external evaluation, and should fully disclose the results.

(a) Graduate schools

To ensure that students learn to think and perform logically within the context of a systematic education, and that their course-work strengthens their ability to research independently, graduate schools must elevate and diversify their education and research. At the same time, in order to produce the human resources needed in academic and industrial S&T in Japan, universities must enrich their education and research to foster students with a wide vision and a good balance of core skills and application abilities. To this end, universities should plan special lectures featuring experts in the private sector, and should sponsor courses for emerging S&T fields, etc.

To promote rapid S&T progress through world-class education and research, the government should equitably evaluate graduate schools and establish centers-of-excellence and prioritized resource allocation for those schools showing exceptional innovative promise. At the same time, the government should allow a wider range of graduate courses that produce experts in particular S&T fields.

And scholarships or other financial support should be provided to help excellent students advance to doctoral work without financial stress. Those forms of support that prove especially successful in producing excellent researchers should be highly evaluated.

(b) Faculties in universities and junior colleges

Faculties in universities and junior colleges should enrich their general education curriculum in order to rapidly advance S&T through total management of the school. In technical training curricula in specialized courses, schools should attach importance to principles and theories, thereby fostering the ability of students to investigate and resolve their own subjects independently.

(c) Technical colleges and vocational schools

Technical colleges should enrich their educational contents, improve job-training courses, and review classes to meet social needs in consideration of S&T progress and industrial structural reform.

Vocational schools should elevate their educational contents to promote more practical and vocational training.

(d) High schools

High schools should fulfill the goals of a scientific education through observation and experimentation, and should promote an industrial education correspondent with changes in society.

(2) Training and securing engineers

Engineers are in a unique position to promote technological innovations and strengthen international competitiveness in Japan. To keep abreast of rapid technical developments and economical globalization, it is necessary to secure many qualified engineers who can support technological fundamentals in Japan while also working internationally.

In order to achieve this, a social system will be established to certify the engineer's qualifications in the international community. An accreditation system of engineering and science curricula will be introduced in universities, a technological management education will be established, and practical educations will be implemented. The engineer's certification system will be promoted in Japan, and efforts made so that the system can be applied internationally, including in APEC countries. To keep engineers current with the latest technological developments, continuing education will be provided by academic societies or universities. Through these educational initiatives, including registered engineer and other certifications, and continuing education, a system that consistently improves the abilities of engineers can be established.

5. Establishment of interactive channels between S&T activities and society

Over the long term, S&T can only be developed and utilized in society if people fully understand its contribution to their daily lives. Thus the support of individuals in the community is indispensable for promotion of S&T. Everyone involved in S&T must recognize the basic precept that S&T and society are synergistic and inseparable.

This is why it is necessary to establish an environment in which laypeople have a deep scientific understanding that they can apply to make rational and independent judgments.

(1) Promotion of S&T learning

In order to increase social interest in S&T, to promote a general understanding of S&T, and to foster excellent human resources engaged in S&T activities, the government will provide people with a wide background in S&T.

High school students should learn scientific ways of thinking, scientific studies, and basic principles of S&T through observation and experimentation. To this end, schools should improve their guidance of students, train teachers, introduce internships in industries, introduce working people as lecturers, promote IT education, and enrich facilities.

Universities should refine their curricula so that even students who don't major in natural science courses can attain basic competency in S&T concepts.

In social education for children and elders, compelling opportunities to study both basic S&T and the latest S&T trends should be increased through the use of schools and museums.

(2) Establishment of channels toward society

S&T can only be promoted by encouraging understanding. Therefore, research organizations should be open and museum activities should be enhanced. And S&T information should be broadcasted more frequently through the mass media. At the regional level, trained S&T interpreters should be provided to explain S&T concepts to individuals in the community, as well as to convey the S&T-related opinions of individuals back to researchers and engineers.

In addition, researchers themselves should continuously evolve their understanding of the relationship between S&T and society, so that they can work on R&D activities with society in mind and even make suggestions to solve social problems based on their S&T knowledge.

6. Ethics and responsibility to society on S&T

S&T progress has been significantly affecting human beings and society in various ways. Bioethics are a prime example of the seriousness of ethical issues relating to S&T development. Organizations/researchers are increasingly faced with the need to address social problems. Given the present climate, the relationship between S&T and society will need to be restructured in the 21st century.

(1) Bioethics

On the one hand, life science developments have widely benefited society by improving disease diagnosis, prevention and treatment. At the same time, some of the new techniques have seemed to threaten human dignity, such as in vitro fertilization followed by embryo transfer, transplantation of organs from brain-dead patients, genetic diagnosis, gene therapy, human cloning, and use of human embryonic stem cells. Reproductive cloning of human beings in particular has caused great concern among the nations of the world. In Japan, a law prohibiting reproductive cloning of human beings was adopted in November 2000.

Clearly, modern physicians and researchers should have morals. And the basic human rights of patients must be respected through the use of informed consent and enforcement of patients' privacy rights. People are also concerned about such bioethical issues as clinical tests, transplantation, and regeneration of organs. Due to their unprecedented complexity, bioethics issues should be discussed openly as a problem for all of Japan.

In the future, S&T especially life sciences and IT will make even greater advances that impact society in new and unexpected ways. It is thus imperative that a social consensus be reached on bioethical issues, and that this consensus be used to forge ethical rules for life science research. Furthermore, in light of increasing globalization, it is also important to promote international cooperation on bioethics. S&T activities on this matter should be directed quite carefully, through discussion among experts and polls of public opinion in a spirit of complete disclosure.

(2) Ethics of researchers and engineers

S&T has the potential to seriously impact both individuals and society.

One example is the current rash of laboratory and manufacturing-site accidents. In order to manage R&D activities properly, researchers and engineers must recognize the import of their S&T activities and their responsibility to society.

R&D activities have generally been conducted under the rules adopted by academic communities. However, as the range of R&D activities continues to increase, and the relationships between R&D activities and society continue to gain in complexity, researchers will need to elevate their ethical standards in regard to dealing with conflicts of interest in S&T, application of R&D results, financial resource allocation, etc. At the same time, researchers and engineers will need to disseminate R&D information to society in order to explain the social impact of their results.

Considering the aforementioned, in order to ensure the highest professional ethics in researchers and engineers, academic societies will need to form guidelines on ethics for researchers and engineers, and ethical issues will have to be considered in the evaluation of an engineer's certification. Here again, education for professionals should be provided not only in universities but also in academic societies through various training courses.

(3) Accountability and risk management

Research organizations and researchers should recognize their responsibility to explain the contents and results of their research. Research organizations should have open exhibitions, open lectures, information disclosure through the Internet and academic societies. Researchers should maintain interactive communications with society. To achieve all of the above, the government will provide training courses to help researchers improve their communication abilities. This will help establish closer relationships between researchers and laypeople, so that people can more deeply understand S&T and researchers can direct their R&D activities in response to people's opinions.

Organizations related to S&T should evaluate the potential risks of accidents or crises, conduct R&D activities so as to minimize potential damage, and cultivate understanding of ethical issues among their researchers and engineers.

7. Maintenance of infrastructure for S&T promotion

(1) Improvement of facilities and equipment

(a) Improving facilities of universities and national research institutes

It is essential to improve facilities for education and research because these are vital infrastructures for the 21st century.

In order to activate research and education to produce S&T human resources and generate R&D results, it is necessary to maintain world-class facilities. A world-class facility is one in which a researcher can safely and successfully devote him or herself to research and education, and which will attract students and researchers from Japan and from universities and national research institutes throughout the world. To achieve this, the government will allocate sufficient budgetary resources to solve the deterioration/congestion problems of the current facilities in universities and national research institutes.

In national universities, the necessary floor space is estimated at over 11 million square meters. During the period of the second Basic Plan, the government will make an urgent plan to improve facilities. It will then implement this plan with deliberation, in full consideration of the congestion in graduate schools, the need for centers-of-excellence, the need for revitalization of existing facilities, and so on.

Then, in view of effective/efficient use, multipurpose laboratories for plural sections will be constructed and existing facilities will be reformed and equipped. These facilities will be used flexibly under the president's leadership, in accordance with the results of self/external evaluations.

In addition, improvement of facilities in national research institutes by non-governmental organs will be promoted under the Law for Facilitating Governmental Research Exchange.

National research institutes and independent administrative institutions will establish the most up-to-date facilities to promote effective research and to generate prominent results. By receiving top priority, their deteriorated facilities will be improved promptly.

(b) Improving the equipment of universities and national research institutes

In national universities and national research institutes, advanced equipment will be made available for use in/around prioritized S&T areas and emerging S&T fields, and large-scale equipment that can accelerate R&D will be routinely used. And all necessary equipment will be regularly updated to avoid decreases in research efficiency. Technicians and funds will be secured for large or advanced equipment in order to ensure stable operation and maintenance.

(c) Improving facilities and equipment of private universities

At private universities, in order to promote research projects highly demanded by society, the government will provide grants for research, long-term and low-interest loans, and aid on loans for revitalization.

For public universities as well, support will be provided for improved education and research conditions.

(2) Enrichment of research assistance

Research assistance is an integral part of R&D and will therefore be enriched. Because the types of needed research assistance are so widely diversified, and the improvements to research environments are becoming competitive, the government will not set a unified objective for enriching research assistant activities. Rather, the government will provide the needed money for research assistant activities to individual research funds. To provide the required assistant activities for each project, personnel dispatching and business outsourcing will be utilized. And to secure assistant activities common to all researches and assistant activities requiring high-order skills, each research organization will employ assistants by indirect expenses attained through competitive research funds. These assistants will be sent directly to individual projects. Or, alternatively, public corporations that provide research funds will send the necessary assistants to individual projects.

(3) Improvement of intellectual infrastructure

As the number of problems to be solved continues to increase and the R&D subjects continue to become more complex, it is increasingly clear that advanced, original and basic R&D must be promoted in Japan, and R&D results must be smoothly utilized in economic and social activities. Accordingly, the government will strategically and systematically improve the intellectual infrastructure, including research materials such as genetic data, measuring standards, testing methods, analyzing devices, and related databases.

- The government will promote improvement of the intellectual infrastructure relating to four prioritized areas in the public/private sectors, with a goal to achieving world-class status in 2010. In the process, the government and private sectors must recognize their individual roles. While the government will maintain those portions of the intellectual infrastructure that are considered strategically important or that are related to publicity/neutrality, private companies will invest in those that will be developed by the market mechanism.
- To ensure a highly diverse intellectual infrastructure that is convenient for users, the government will establish a mechanism for fast and easy location of all needed information, and will do so with the particular needs of users in mind. In addition, the government will participate in and lead international discussions, such as discussions on measurement standardization.
- In order to provide timely additions to the intellectual infrastructure for S&T development in the future, the government will gather the results of all R&D projects in Japan.
- The government will also formulate basic legal rules on intellectual property rights, and on provision for and utilization of S&T data, in order to provide a quick response on such matters.
- Researchers and engineers will be evaluated in part on their contributions to the intellectual infrastructure.

(4) Enrichment and standardization of intellectual property rights

To promote creative intellectual activities, it is extremely important to protect intellectual property rights ('IPR' hereinafter). IPR issues have been discussed internationally, and many national IPR systems have been improved. From this point forward, however, greater efforts will need to be made with respect to IPR in Japan.

- The government will promote professional, world-class IPR services and improve the mechanisms for settling disputes on IPR issues.
- The government will promote cooperation for preliminary technological investigations with the United States and European countries, and support Asian countries on their IPR systems. The systems should be operated transparently and harmonized internationally to protect IPR of advanced technologies, such as biotechnology and IT.

For easy dissemination of R&D results in the market, technological standardization will need to be improved. With the recent expansion of cross-business fields and development of a networking society, those who control international technological standards increasingly control the world market. And it is also important in international competition to have an internationally equivalent system for certifying new products that apply new technologies. In light of the above, the government will actively contribute to the international standardization activities of the International Standardization Organization (ISO), the International Electrotechnical Committee (IEC), and the International Telecommunications Union (ITU). At the same time, the government will work to establish international rules corresponding to economic globalization. And strategic cooperative relationships for standardization with Asian and Pacific countries will be established. Together with these measures, R&D for technological standardization will be implemented, and public research organizations will take part in this standardization activity.

(5) Maintenance of the research-informational infrastructure

In step with the rapid progress towards an IT society, R&D offices have been leading the effort to improve the research-informational infrastructure by deploying computers, establishing LAN, networking between laboratories, data sharing on computer networks, and establishing electronic libraries in universities.

To extend this improvement of the research-informational infrastructure in response to IT innovations, the government will further advance and streamline R&D in Japan by using the existing infrastructure to collect and disseminate research information. Specifically, in consideration of world trends, the government will help to improve the speed and effectiveness of pending research computer networks and LAN in laboratories by introducing new technologies. Ongoing efforts will also be made to digitalize research results, academic publications, and library catalogues.

(6) Maintenance of the manufacturing infrastructure

Anxieties about Japan's manufacturing capabilities and quality control traditionally one of the country's strong suits have recently been increasing. Concerns include the loss of high quality manufacturing infrastructure due to a lack of technological successes, an increasing tendency to undermine manufacturing, and frequent accidents. In order to maintain and improve manufacturing capabilities, the government will take the following systematic measures.

Because manufacturing is conducted using human resources, it is important to develop and secure human resources by familiarizing children with manufacturing processes, fostering educations that cultivate creativity, and providing practical engineering training and internship opportunities. More generally, it will be necessary to enhance public understanding and respect for manufacturing. To achieve these goals, the government will promote a commendation system, such as the Prime Minister's Award, for individuals/companies who display prominent abilities in manufacturing. Moreover, the government will systematize its intellectual assets on manufacturing in order to appropriately manage costs, quality, risks, and the scope of projects. In this way, the complexities of production and automated manufacturing can be handled without any "opacity of technology". And the government will develop qualified engineers for the project management system.

The advanced techniques of highly skilled engineers will be tapped for the creation of digitalized databases/software. The government will integrate IT and manufacturing technologies into a new manufacturing system by improving product development and manufacturing processes through detailed design simulations, and by providing a next-generation infrastructure for design/manufacturing utilizing IT.

To accelerate technological innovation, it is necessary to establish a mechanism to support the intellectual working environment for engineers. To this end, the government will collect and provide an array of data, including knowledge on basic techniques in the design/manufacturing process, stories of success and failure, and technical advice from public research organizations. It should be seriously acknowledged that artificial materials and substances created in the last half of the 20th century have been applied without evaluating their environmental impact, resulting in significantly adverse effects on individual lives and the global environment. With the goal of never overlooking these effects again, long-term safety must be evaluated and health and environmental risks assessed prior to the development of new materials and substances. And these results must be continuously disclosed and repeatedly reviewed.

(7) Promotion of academic society activities

Academic societies, which have a wide range of human/knowledge resources on a par with that of public research organizations, are expected to disclose S&T information, to promote exchanges of researchers among industry-academia-government sectors and with foreign countries, to make proposals regarding S&T policies, and to play a role in R&D system reforms. The government will support academic societies so that they can enhance the above activities.

In addition, non-profit organizations, which are uniquely able to respond to social/academic needs, will also be expected to expand their activities, including their information dissemination, technology transfers, researcher exchanges, and research support. The government will help establish a non-profit environment that fosters these changes.

III. Internationalization of S&T activities

The government will internationalize Japan's S&T activities by assembling world-class researchers and ensuring a flow of vital information into Japan. This internationalization will yield excellent R&D results, as well as solutions to global problems confronting humankind. To overcome the recent drain of high-quality researchers and private research funds away from Japan, it will be necessary to establish a fascinating and open research environment in which the world's top-notch scientists feel free to gather.

1. Initiatives in International Cooperation

To target such global-scale problems as global warming, food shortages, energy shortages, fresh water management, infectious disease prevention and disaster prevention/reduction, the government will propose and conduct international cooperative projects that combine the wisdom of the world's nations, with the understanding that any results obtained must be restored to the global community. At this time the government must strengthen its partnerships with Asian countries in particular. As mentioned above, the government will also take initiatives to globally harmonize the protection/standardization of intellectual property rights. Through these positive international activities, excellent human resources will be developed to perform further high-level activities.

2. Enhancement of International Information Dissemination

In order that Japan's S&T activities be widely recognized and respected, and consequently that world-class human resources and the latest information be gathered in Japan, it is important that information on R&D results, researchers and research organizations be actively disseminated to the global community. The government should support publication of research results in English and systematic dissemination, such as the publishing of studies of global importance in cooperation with academic societies.

3. Internationalization of Domestic Research Environments

In order to internationalize Japan's domestic research environments, it is crucial that top-notch S&T professionals, including foreign researchers performing on the international stage, be encouraged to gather in Japan, compete equivalently, and play active roles. To this end:

- Public research organizations will encourage gifted foreign researchers to continue their studies in Japan by properly evaluating their results and treating them according to their ability.
- Public research organizations will improve conditions for foreign researchers with respect to treatment, English communication, accessibility to the international society and livability.
- As for competitive research funds, the government will accept applications written in English from foreign researchers in Japan, and will promote the dissemination of R&D results in English.

In particular, the government will direct newly established public research organizations to provide such an international environment. Moreover, the government will facilitate Tsukuba Science City and Kansai Science City as international centers-of-excellence open to both Japan and the world.

At the same time, the government will expand opportunities for young Japanese researchers to study in a competitive environment of excellent overseas research institutes, and to compete and cooperate with first-rate researchers worldwide. Japanese researchers should also make efforts to extend their international network.

Chapter 3 Missions of the CSTP

1. Basic steering of S&T Policies

The CSTP will steer S&T policies in Japan with foresight and mobility, acting as a control tower under the prime minister's leadership, eliminating administrative sectionalism, and steadily implementing the policies described in the Basic Plan. The CSTP will continue to cooperate with the Council on Economy and Fiscal Policy and the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society.

The CSTP will play an active role as a source of wisdom for integrating natural S&T and social sciences/humanities. It will cultivate a broad worldview and envision a better society for the 21st century. Ever-mindful that S&T must exist for and within society, the CSTP will consider public expectations and anxieties in regard to the positive and negative aspects of S&T, and attach greater importance to ethics and responsibilities in S&T.

2. Promotion of Research and Development in Prioritized Areas

Based on the Basic Plan, the CSTP will draw up promotion strategies for prioritized areas that define important fields, as well as for R&D targets and implementing measures, and will express its opinions to the prime minister and the other related ministers. In especially important fields, the CSTP will formulate strategies by establishing up expert panels, etc.

S&T progress has become so rapid and society so changeable that the CSTP will need to follow the latest trends in prioritized areas, gather the advice of top experts, and continuously examine its response to the needs of emerging fields. In some cases, the CSTP may need to modify its promotion strategies in prioritized areas with flexibility and mobility.

3. Policy on Resource Allocation

Based on the Basic Plan and promotion strategies in prioritized areas, the CSTP will ascertain each ministry's policies, and then evaluate the effects of implementing them, along with the harmful effects of administrative sectionalism, such as unnecessary duplication of policies. In order to realize more effective/efficient S&T activities, the CSTP should express its conclusions to the prime minister, particularly in regard to special priorities in the next fiscal year and budgets for promoting S&T activities. The CSTP should also express its opinions to related ministers about important policies and basic concepts of resource allocation in the next fiscal year. When needed, the CSTP should also cooperate with the financial sector in the budgeting process to secure appropriate resource allocation following the CSTP's basic concepts.

4. Promotion of Nationally Important Projects

In addition to the basic concepts of resource allocation described above, the CSTP should express its opinions on nationally important projects to be implemented under inter-ministry cooperation. CSTP evaluations on these projects should be made with an eye to effective and efficient implementation, such as by avoiding unnecessary duplication. Upon implementation, the CSTP should further evaluate the progress and impact of projects.

5. Settlement of National Guidelines on Important Policies

Three years have passed since the National Guideline on Evaluation was established. Accordingly, the Guideline will be immediately revised with reference to the Basic Plan. Other basic guidelines on S&T system reform, such as the mobility of researchers, should be settled as necessary.

6. Evaluation

The CSTP will evaluate nationally important and large-scale R&D projects, disclose the results of its evaluation, and express its opinions to the related ministries so that they can take steps to improve the organizations and budget allocations. The CSTP should also evaluate the S&T policies of each ministry to help develop basic policies and important concepts.

7. Follow-up of the Basic Plan

While conducting the activities mentioned above, the CSTP will follow up the progress of policies in the Basic Plan in cooperation with related ministries, and report its findings and opinions to the prime minister and related ministers as necessary. In particular, the CSTP will request that the related ministries submit implementation plans, as described in the Basic Plan, as early as possible. The CSTP will conduct the follow-ups at the end of every fiscal year, and will conduct a detailed follow-up in the fourth fiscal year to flexibly amend policies in the Basic Plan where needed.

In cooperation with related ministries, the CSTP will ascertain the actual conditions of S&T activities in both Japan and the world, including private sectors.

In addition, the CSTP will continuously examine how best to implement R&D activities in Japan.

Source: Council for Science and Technology Policy, Cabinet Office's Web site (accessed and cited September 28, 2002) <http://www8.cao.go.jp/cstp/english/s&tmain-e.html>

3. Statistics

(1) Trends in R&D expenditures, etc. in Japan

FY \ Item	Gross domestic product	R&D expenditures	Government financed R&D	Defense-related R&D	A	B	C	D	Number of researchers	Population
	Trillion yen	100 Million yen	100 Million yen	100 Million yen	(%)	(%)	(%)	(%)	Persons	10 thousand persons
1981	261.9143	59,823.56	16,124.28	325.73	2.28	27.0	26.6	0.62	394,619	11,790
82	274.5722	65,287.00	16,661.64	364.87	2.38	25.5	25.1	0.61	407,197	11,873
83	286.2782	71,807.82	17,214.33	394.52	2.51	24.0	23.6	0.60	421,468	11,954
84	306.8093	78,939.31	17,777.80	446.07	2.57	22.5	22.1	0.58	450,083	12,031
85	327.4332	88,902.99	18,672.53	586.77	2.72	21.0	20.5	0.57	462,891	12,105
86	341.9205	91,929.32	19,553.11	661.33	2.69	21.3	20.7	0.57	489,100	12,166
87	359.5089	98,366.40	21,118.40	741.35	2.74	21.5	20.9	0.59	504,008	12,224
88	386.7361	106,275.72	21,177.81	827.00	2.75	19.9	19.3	0.55	530,495	12,275
89	414.7429	118,154.82	22,024.20	930.68	2.85	18.6	18.0	0.53	553,336	12,321
90	449.9971	130,783.15	23,465.62	1,042.68	2.91	17.9	17.3	0.52	579,552	12,361
91	472.2614	137,715.24	25,044.63	1,150.45	2.92	18.2	17.5	0.53	603,548	12,410
92	483.8375	139,094.93	26,967.17	1,269.89	2.87	19.4	18.6	0.56	620,014	12,457
93	480.6615	137,091.39	29,658.49	1,371.75	2.85	21.6	20.8	0.62	644,977	12,494
94	491.2717	135,960.30	29,181.77	1,407.88	2.77	21.5	20.6	0.59	664,855	12,527
95	500.0025	144,082.36	32,924.00	1,544.99	2.88	22.9	22.0	0.66	682,590	12,557
96	514.2689	150,793.15	31,605.51	1,652.79	2.93	21.0	20.1	0.61	698,280	12,586
97	520.8118	157,414.99	32,038.52	1,753.40	3.02	20.4	19.5	0.62	720,560	12,616
98	512.7840	161,399.25	34,984.92	1,441.76	3.15	21.7	21.0	0.68	731,017	12,647
99	508.2832	160,105.88	35,037.49	1,465.29	3.15	21.9	21.2	0.69	757,244	12,667
2000	513.4780	162,893.36	35,407.64	1,360.81	3.17	21.7	21.1	0.69	761,857	12,693
2001	501.2807	165,279.98	34,769.43	1,489.88	3.30	21.0	20.3	0.69	750,739	12,729
2002	497.5322	166,750.53	34,526.81	1,434.78	3.35	20.7	20.0	0.69	756,336	12,744
2003	501.6470	168,041.55	33,942.87	1,608.12	3.35	20.2	19.4	0.68	757,339	12,762
2004	505.1858	—	—	—	—	—	—	—	787,264	12,769

Notes: 1. A (b/a) =R&D expenditures as a percentage of gross domestic product, B (c/b) =the ratio of R&D expenditures financed by government, C ((c-d)/(b-d)) =the ratio of R&D expenditures financed by government excluding defence R&D expenditures and D (c/a) =government financed R&D expenditures as a percentage of gross domestic product.

2. R&D expenditures and the number of researchers are the total of natural sciences, social sciences and humanities.

3. The number of researchers is as of April 1 in each fiscal year, except for FY2002 and later, which are as of March 31.

4. Defense-related R&D expenditures are appropriations to the Defense Agency in the science and technology budget of the government.

5. The numbers of population are those of national censuses and estimations as of October 1.

6. Industries were added as new survey targets in FY1996 and FY2001.

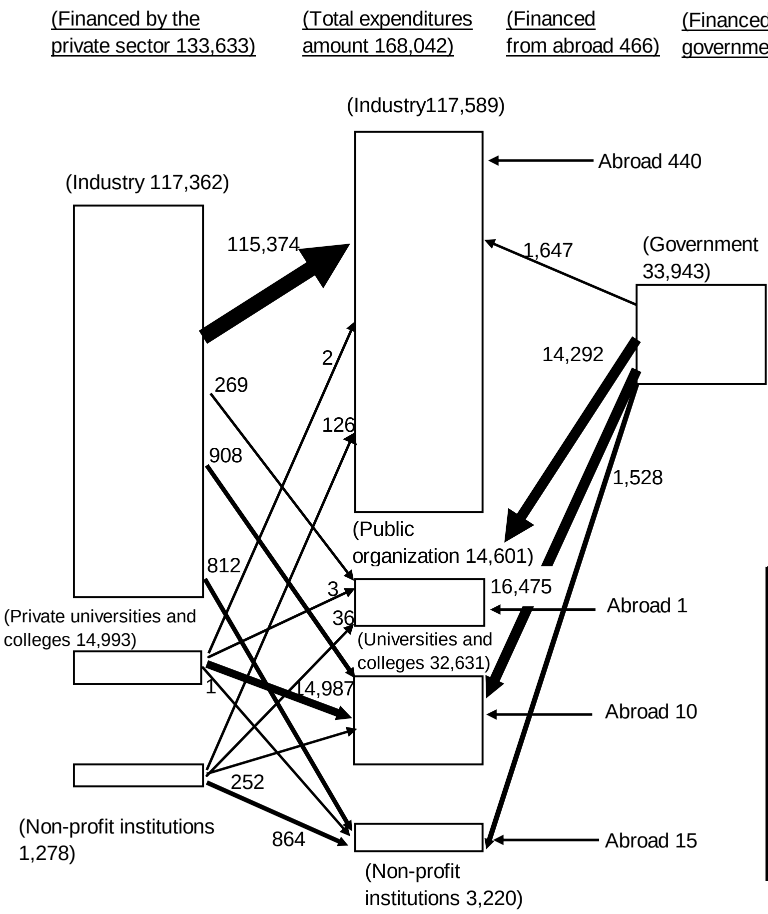
7. Survey coverage categories were changed in 2001; the definition under which the number of researchers was counted up to 2001 differs from that under which it was counted in 2002.

Sources:1. Gross domestic product: the Cabinet Office, Economic and Social Research Institute, "Annual Report on National Accounts", "Quarterly Estimates of GDP (Preliminary Report)"

2. R&D expenditures, government-financed R&D expenditures, and number of researchers: Ministry of Internal Affairs and Communications, Satastics Bureau, "Report on the Survey of Research and Development."

(2) Flow of R&D expenditures in Japan (in FY2001)

(Unit: 100 million yen)



Unit: %

Classification / Sector	Financing ratio	Performing ratio
Industry	69.8	70.0
Government	20.2	8.7
Universities and colleges	8.9	19.4
Non-profit institution	0.8	1.9
Abroad	0.3	-
Total	100	100

Notes:1. R&D expenditures include social sciences and humanities.

2. R&D expenditures are the funds spent by research institutions themselves for research. There are two concepts of R&D expenditures on a performing basis: disbursement and cost. Japan considers R&D expenditures to be disbursements. Disbursement includes expenditures on labor, materials, tangible fixed assets, lease fee and so on. In case of cost, it computed by adding the depreciation of tangible fixed assets instead of expenditures on the tangible fixed assets.

3. Coverage of each sector is as follows:

(1) Financing sector

1) Industry: companies, public corporations and incorporated administrative agencies whose major purpose is not in research activities.

2) Government: national and local governments, national local government-owned research institutions, research-centered public corporations and incorporated administrative agencies, and national and public universities and colleges (including junior colleges)

3) Universities and colleges: private universities and colleges (including junior colleges)

4) Non-profit institutions: nonprofit private research institutions including incorporated foundations and associations, etc.

(2) Performing sector

1) Industry: coverage is the same as in the financing sector

2) Public organizations: national and loal government-owned research institutions and research-centered public corporations and

incorporated administrative agencies.

3) Universities and colleges: national, public and private universities and colleges.

4) Non-profit institutions: coverage is the same as in the financing sector

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

(3) Trends in composition ratios of R&D expenditures by character of work in Japan

(Unit: %)

Classification / FY	Industry			institutions			Universities and colleges			Private research institutions			Total		
	Basic research	Applied research	Develop-ment	Basic research	Applied research	Develop-ment	Basic research	Applied research	Develop-ment	Basic research	Applied research	Develop-ment	Basic research	Applied research	Develop-ment
1981	5.2	21.8	73.0	14.5	32.1	53.4	57.4	35.0	7.6	9.8	36.1	54.2	14.6	25.6	59.8
82	5.5	21.9	72.6	14.4	31.8	53.9	56.5	36.4	7.1	8.3	32.6	59.1	14.7	25.8	59.5
83	5.7	22.0	72.3	14.0	30.7	55.3	56.4	35.7	7.9	9.1	31.2	59.8	14.6	25.3	60.1
84	5.6	22.0	72.4	14.0	29.8	56.2	56.4	35.4	8.2	10.7	31.6	57.7	14.1	25.1	60.8
85	5.9	21.9	72.1	13.1	28.5	58.3	55.7	36.2	8.0	10.4	33.5	56.0	13.4	24.9	61.7
86	6.1	21.6	72.3	13.7	27.3	59.0	55.8	36.2	8.1	14.1	27.8	58.1	13.8	24.4	61.9
87	6.6	21.7	71.7	14.7	28.3	57.0	55.7	36.3	8.0	18.0	21.1	60.9	14.5	24.3	61.2
88	6.6	21.7	71.7	13.6	26.8	59.6	54.5	37.2	8.3	17.6	22.5	59.9	13.8	24.2	62.0
89	6.4	21.5	72.2	13.3	27.3	59.5	54.9	36.8	8.3	19.2	22.8	58.0	13.3	23.9	62.8
90	6.4	21.8	71.8	14.3	28.6	57.1	54.6	37.1	8.3	18.2	22.9	58.8	13.0	24.2	62.8
91	6.8	22.2	71.1	14.6	29.3	56.1	54.5	37.1	8.4	18.7	26.2	55.1	13.3	24.6	62.1
92	6.9	22.1	71.1	16.6	27.6	55.8	54.3	37.3	8.3	17.0	20.4	62.6	13.9	24.4	61.7
93	6.7	21.4	71.9	18.7	26.9	54.5	54.0	37.4	8.6	20.1	20.5	59.4	14.8	24.0	61.2
94	6.8	22.2	71.1	18.5	27.8	53.6	54.2	37.1	8.7	21.1	18.7	60.2	15.0	24.6	60.5
95	6.6	22.0	71.3	20.6	27.7	51.7	54.6	36.5	8.9	20.1	18.9	61.1	15.5	24.5	60.0
96	6.2	22.1	71.8	19.8	26.9	53.3	54.7	36.4	9.0	18.5	19.2	62.4	14.6	24.3	61.1
97	6.2	21.6	72.2	21.3	31.8	46.8	54.3	36.7	9.0	14.9	21.1	64.0	14.3	24.4	61.3
98	5.6	21.9	72.6	24.5	29.9	45.6	54.8	36.3	8.9	14.4	21.9	63.8	14.4	24.6	61.0
99	5.8	20.5	73.7	25.0	27.9	47.1	54.0	36.9	9.1	15.3	21.9	62.8	14.6	23.5	61.8
2000	5.8	21.3	73.0	27.6	26.8	45.7	53.6	37.3	9.1	15.7	20.5	63.8	14.7	23.9	61.4
01	5.8	20.4	73.9	30.5	24.1	45.3	53.5	37.5	9.0	19.6	37.1	43.2	14.6	23.4	62.0
02	5.9	19.5	74.6	31.0	26.9	42.1	54.0	36.4	9.6	20.1	38.9	41.1	15.0	22.8	62.2
03	6.0	19.4	74.7	30.9	30.5	38.6	55.0	36.5	8.5	18.7	39.3	42.0	15.0	23.0	62.0

Note:1. The figures are for the composition of R&D expenditures by character of work in the natural sciences (physical science, engineering, agricultural science, and health science). Figures include institutions for the social sciences and humanities.

2. Survey coverage categories were changed in FY2001; figures for non-profit institutions up to FY2001 use the values for private research insitutions.

3. Some Industries were added as new survey targets in FY1966 and FY2001

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

(4) Trends in R&D expenditures by financing sector in Japan

(Unit: million yen)

Classification / FY	Total		National and local government		Private sector		Abroad	
	R&D expenditures (A)	Ratio (%)	Financing amount (B)	Ratio (%) (B/A)	Financing amount (C)	Ratio (%) (C/A)	Financing amount (D)	Ratio (%) (D/A)
1981	5,982,356	100	1,612,428	27.0	4,363,785	72.9	6,144	0.1
82	6,528,700	100	1,666,164	25.5	4,855,537	74.4	6,999	0.1
83	7,180,782	100	1,721,433	24.0	5,451,130	75.9	8,220	0.1
84	7,893,931	100	1,777,780	22.5	6,108,562	77.4	7,590	0.1
85	8,890,299	100	1,867,253	21.0	7,014,906	78.9	8,140	0.1
86	9,192,932	100	1,955,311	21.3	7,229,721	78.6	7,900	0.1
87	9,836,640	100	2,111,840	21.5	7,716,556	78.4	8,243	0.1
88	10,627,572	100	2,117,781	19.9	8,501,469	80.0	8,323	0.1
89	11,815,482	100	2,202,420	18.6	9,603,321	81.3	9,742	0.1
90	13,078,315	100	2,346,562	17.9	10,721,479	82.0	10,274	0.1
91	13,771,523	100	2,504,463	18.2	11,255,016	81.7	12,044	0.1
92	13,909,493	100	2,696,717	19.4	11,199,371	80.5	13,405	0.1
93	13,709,139	100	2,965,849	21.6	10,731,483	78.3	11,807	0.1
94	13,596,029	100	2,918,177	21.5	10,663,868	78.4	13,984	0.1
95	14,408,235	100	3,292,400	22.9	11,100,469	77.0	15,366	0.1
96	15,079,315	100	3,160,551	21.0	11,904,662	78.9	14,102	0.1
97	15,741,499	100	3,203,852	20.4	12,493,864	79.4	43,783	0.3
98	16,139,925	100	3,498,492	21.7	12,593,344	78.0	48,089	0.3
99	16,010,588	100	3,503,749	21.9	12,448,321	77.8	58,519	0.4
2000	16,289,336	100	3,540,764	21.7	12,684,198	77.9	64,374	0.4
01	16,527,998	100	3,476,943	21.0	12,986,146	78.6	64,909	0.4
02	16,675,053	100	3,452,681	20.7	13,162,679	78.9	59,694	0.4
03	16,804,155	100	3,394,287	20.2	13,363,302	79.5	46,566	0.3

Notes: 1. Including R&D in the social sciences and humanities.

2. Some Industries were added as new survey targets in FY1996 and FY2001.

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

(5) Trends in R&D expenditures by performing sector in Japan

(Unit: million yen)

Classification / FY	Business enterprises				Public organizations					Non-profit institutions	
	Companies	Public corporations/ Incoporated administrative (a)	Total (A)	Ratio (%) (A/E)	National	Local government owned	Public corporations/ Incorporated administrative (b)	Total (B)	Ratio (%) (B/E)	(c)	Ratio (%) (C/E)
1981	3,517,034	112,759	3,629,793	60.7	201,256	191,162	268,979	661,397	11.1	245,521	4.1
82	3,917,089	121,929	4,039,018	61.9	203,343	189,702	280,038	673,083	10.3	276,178	4.2
83	4,435,361	124,766	4,560,127	63.5	208,767	191,567	291,025	691,359	9.6	279,651	3.9
84	5,114,631	22,003	5,136,634	65.1	215,853	199,622	310,209	725,684	9.2	307,425	3.9
85	5,913,942	26,005	5,939,947	66.8	235,950	206,935	367,874	810,759	9.1	349,812	3.9
86	6,105,886	14,277	6,120,163	66.6	244,828	209,212	386,183	840,223	9.1	399,971	4.4
87	6,480,897	13,370	6,494,268	66.0	308,246	215,583	419,348	943,177	9.6	441,273	4.5
88	7,202,873	16,446	7,219,318	67.9	272,506	223,677	439,072	935,255	8.8	458,925	4.3
89	8,217,138	16,682	8,233,820	69.7	284,261	240,902	428,592	953,755	8.1	498,535	4.2
90	9,246,003	21,163	9,267,166	70.9	318,959	270,303	387,605	976,867	7.5	537,291	4.1
91	9,716,195	26,853	9,743,048	70.7	321,988	282,730	442,378	1,047,096	7.6	573,453	4.2
92	9,541,757	18,928	9,560,685	68.7	373,004	288,631	498,466	1,160,101	8.3	612,427	4.4
93	9,028,186	25,422	9,053,608	66.0	422,193	300,054	556,394	1,278,641	9.3	618,179	4.5
94	8,947,451	32,802	8,980,253	66.1	404,172	300,515	521,740	1,226,427	9.0	636,800	4.7
95	9,332,438	63,459	9,395,896	65.2	484,917	291,893	613,322	1,390,132	9.6	640,021	4.4
96	10,026,582	31,827	10,058,409	66.7	447,366	288,807	592,361	1,328,534	8.8	679,251	4.5
97	10,620,651	37,705	10,658,357	67.7	474,120	279,099	553,757	1,306,976	8.3	716,967	4.6
98	10,668,070	131,993	10,800,063	66.9	474,238	291,222	637,454	1,402,914	8.7	714,068	4.4
99	10,520,427	109,735	10,630,161	66.4	488,781	286,482	706,468	1,481,731	9.3	689,609	4.3
2000	10,766,366	93,848	10,860,215	66.7	499,508	273,139	740,986	1,513,633	9.3	707,069	4.3
01	11,364,628	86,383	11,451,011	69.3	214,302	260,076	1,007,645	1,482,024	9.0	361,570	2.2
02	11,496,855	79,985	11,576,840	69.4	202,161	249,788	1,031,261	1,483,211	8.9	332,664	2.0
03	11,704,668	54,271	11,758,939	70.0	225,382	239,553	995,205	1,460,140	8.7	321,968	1.9

(5) Trends in R&D expenditures by performing sector in Japan (continued)

Classification / FY	Universities and colleges: National	Public	Private	Total (D)	Ratio (%) (D/E)	Total (E)	Ratio (%)
1981	643,472	72,582	729,591	1,445,645	24.2	5,982,356	100
82	675,850	75,986	788,586	1,540,422	23.6	6,528,700	100
83	711,364	78,097	860,184	1,649,646	23.0	7,180,782	100
84	749,826	81,964	892,398	1,724,187	21.8	7,893,931	100
85	756,686	88,645	944,449	1,789,780	20.1	8,890,299	100
86	786,462	90,608	955,505	1,832,575	19.9	9,192,932	100
87	843,900	96,756	1,017,264	1,957,921	19.9	9,836,640	100
88	860,678	97,888	1,055,508	2,014,073	19.0	10,627,572	100
89	899,221	114,331	1,115,819	2,129,372	18.0	11,815,482	100
90	961,724	126,936	1,208,331	2,296,992	17.6	13,078,315	100
91	1,001,800	124,153	1,281,974	2,407,927	17.5	13,771,524	100
92	1,077,675	138,430	1,360,176	2,576,281	18.5	13,909,493	100
93	1,191,676	144,959	1,422,077	2,758,712	20.1	13,709,139	100
94	1,163,036	160,477	1,429,038	2,752,551	20.2	13,596,030	100
95	1,311,399	177,474	1,493,313	2,982,187	20.7	14,408,236	100
96	1,296,359	173,288	1,543,474	3,013,120	20.0	15,079,315	100
97	1,300,615	182,796	1,575,788	3,059,199	19.4	15,741,499	100
98	1,406,556	184,576	1,631,747	3,222,879	20.0	16,139,925	100
99	1,395,167	184,088	1,629,831	3,209,086	20.0	16,010,588	100
2000	1,385,637	188,106	1,634,675	3,208,418	19.7	16,289,336	100
01	1,390,794	186,617	1,655,980	3,233,392	19.6	16,527,998	100
02	1,435,972	183,965	1,662,401	3,282,338	19.7	16,675,053	100
03	1,410,545	181,350	1,671,214	3,263,109	19.4	16,804,155	100

Notes:1. Figures include the social sciences and humanities.

2. Survey coverage categories were changed in FY2001; figures for non-profit institutions up to FY2000 use the values for private research institutions.

3. Until FY2000, public corporations and independent administrative institutions (a) were those which were operated on a self-paying basis. Since FY2001, they indicate those whose main productive activities are classified into “Industries” in the input-output table.

4. Until FY2000, public corporations and independent administrative institutions (b) were those which were not expected to operate on a self-paying basis. Since FY2001, they indicate those whose purpose is to carry out examinations and research on scientific technologies.

5. Some Industries were added as new survey targets in FY1996 and FY2001.

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

(6) Trends in composition ratios of R&D expenditures by constituent elements in Japan

(Unit: %)

FY		1990	91	92	93	94	95	96	97	98	99	2000	01	02	03
Business enterprises	Labor cost	38.8	38.7	41.1	43.5	44.8	44.4	43.5	42.5	43.2	43.5	41.7	41.3	41.0	42.4
	Material cost	21.4	20.8	19.7	18.7	18.7	19.1	20.1	19.8	19.3	19.6	19.8	20.8	19.6	19.1
	Expenditure on tangible fixed assets	15.5	15.7	13.0	11.3	10.4	10.8	10.5	10.9	9.9	9.3	9.7	9.0	8.4	8.6
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	0.9	1.0	1.0
	Other expenses	24.4	24.9	26.2	26.2	26.1	25.8	25.9	26.8	27.6	27.5	28.8	27.9	30.0	28.9
Non-profit institutions	Labor cost	33.3	33.2	32.7	33.1	33.6	34.9	34.4	33.5	33.8	31.7	32.1	28.7	30.3	30.6
	Material cost	24.7	19.7	19.1	18.1	21.6	21.2	22.7	24.2	22.8	25.2	26.6	15.6	13.7	12.6
	Expenditure on tangible fixed assets	12.0	14.5	16.9	17.5	15.8	14.8	12.1	9.8	8.7	8.5	8.7	12.9	13.7	15.2
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.3	1.2	1.0
	Other expenses	30.0	32.7	31.2	31.3	29.0	29.1	30.8	32.5	34.7	34.6	32.7	41.5	41.2	40.6
Public organizations	Labor cost	36.2	35.0	32.8	30.7	32.7	29.4	31.1	32.2	31.4	29.7	29.6	31.2	30.5	30.6
	Material cost	15.3	11.8	14.4	13.5	14.2	13.7	15.1	16.5	13.7	13.5	13.3	14.0	13.8	18.0
	Expenditure on tangible fixed assets	26.7	23.5	23.9	29.3	28.7	30.7	23.4	21.0	24.6	27.6	13.3	23.8	24.0	22.0
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.1	1.2	1.2
	Other expenses	21.9	29.6	28.9	26.4	24.5	26.2	30.3	30.3	30.3	29.3	30.9	29.8	30.6	28.1
Universities and colleges	Labor cost	67.2	67.8	67.1	65.2	67.6	64.4	65.2	65.9	64.2	65.0	65.6	65.3	64.0	64.2
	Material cost	6.0	5.9	6.0	6.2	6.2	6.3	6.2	6.4	6.4	6.8	6.7	6.7	7.0	7.1
	Expenditure on tangible fixed assets	12.8	12.2	12.7	14.6	11.6	14.6	13.9	12.9	14.5	12.8	11.7	11.5	11.6	11.1
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.3	1.3	1.3
	Other expenses	14.1	14.1	14.1	14.1	14.6	14.7	14.7	14.8	14.9	15.4	15.9	15.3	16.1	16.3
Total	Labor cost	43.3	43.3	44.8	46.4	47.8	44.0	46.3	45.8	45.9	46.0	44.9	44.8	44.4	45.4
	Material cost	18.3	17.5	16.7	15.7	15.9	17.3	17.0	17.1	16.4	16.7	16.9	17.3	16.5	16.6
	Expenditure on tangible fixed assets	15.7	15.6	14.0	13.9	12.5	14.2	12.4	12.1	12.0	11.6	11.6	10.9	10.5	10.3
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.0	1.1	1.1
	Other expenses	22.6	23.7	24.4	24.0	23.7	24.5	24.3	25.0	25.6	25.6	26.6	25.9	27.6	26.6

Notes:1. Figures includes the social sciences and humanities.

2. Survey coverage categories were changed in FY2001; figures for non-profit institutions up to FY2000 use the values for private research institutions.

3. Lease fee was added as an expenditure in FY2001.

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

(7) Trends in number of personnel engaged in R&D activities in Japan

(Unit: person)

Year \ Classification	Number of R&D	Personnel engaged in R&D activities		Researchers		Assistant research workers		Technicians		Clerical and other supporting personnel	
1981	19,447	644,386	100	394,619	61.2	83,657	13.0	90,426	14.0	75,684	11.7
82	18,642	663,549	100	407,197	61.4	87,329	13.2	91,169	13.7	77,854	11.7
83	20,838	684,365	100	421,468	61.6	90,103	13.2	93,326	13.6	79,468	11.6
84	18,137	725,615	100	450,083	62.0	96,272	13.3	97,074	13.4	82,186	11.3
85	17,755	745,604	100	462,891	62.1	100,530	13.5	99,280	13.3	82,903	11.1
86	16,987	777,454	100	489,100	62.9	101,996	13.1	101,861	13.1	84,497	10.9
87	17,681	794,730	100	504,008	63.4	102,901	12.9	102,486	12.9	85,335	10.7
88	18,303	821,061	100	530,495	64.6	101,587	12.4	102,950	12.5	86,029	10.5
89	18,316	849,183	100	553,336	65.2	101,809	12.0	105,430	12.4	88,608	10.4
90	17,497	882,658	100	579,552	65.7	106,117	12.0	104,190	11.8	92,799	10.5
91	17,823	920,019	100	603,548	65.6	106,179	11.5	113,562	12.3	96,730	10.5
92	18,144	931,732	100	620,014	66.5	107,013	11.5	108,014	11.6	96,691	10.4
93	16,057	962,050	100	644,977	67.0	107,001	11.1	108,120	11.2	101,952	10.6
94	16,997	971,227	100	664,855	68.5	99,152	10.2	103,400	10.6	103,820	10.7
95	18,835	969,547	100	682,590	70.4	90,072	9.3	98,142	10.1	98,743	10.2
96	19,028	972,447	100	697,780	71.8	82,851	8.5	94,788	9.7	97,028	10.0
97	21,878	994,978	100	720,560	72.4	83,906	8.4	93,892	9.4	96,620	9.7
98	24,931	999,578	100	731,017	73.1	83,539	8.4	89,104	8.9	95,918	9.6
99	23,607	1,029,968	100	757,244	73.5	86,822	8.4	91,852	8.9	94,050	9.1
2000	27,061	1,022,079	100	761,857	74.5	84,527	8.3	84,441	8.3	91,254	8.9
01	22,056	1,000,014	100	750,739	75.1	78,951	7.9	81,157	8.1	89,167	8.9
02	18,468	972,495	100	756,336	77.8	68,754	7.1	67,138	6.9	80,267	8.3
03	29,663	968,092	100	757,339	78.2	67,040	6.9	65,143	6.7	78,570	8.1
04	—	994,348	100	787,264	79.2	67,389	6.8	62,450	6.3	77,245	7.8

Notes:1. The number of researchers includes those in the social sciences and humanities, and is as of April 1 of each year, except for FY2002 and later, which are as of March 31.

2. The number of R&D performing institutions is the figure for each year in question.

3. Survey categories were changed in 2002; numbers up to 2001 are for researchers whose primary duty is research (except at universities and colleges, where the number includes those who conduct research as an additional post).

4. Industries were added as new survey targets in 1997 and 2002.

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

(8) Trends in number of researchers by sector in Japan

(Unit: person)

Classification / Year	Business enterprises: Companies	Business enterprises: Public corporations/ Incorporated administrative agencies (a)	Business enterprises: Total (A)	Business enterprises: Ratio (%) (A/E)	Public organizations: National	Public organizations: Local government owned	Public organizations: Public corporations/ Incorporated administrative agencies (b)	Public organizations: Total (B)	Public organizations: Ratio (%) (B/E)	Non-profit institutions (c)	Non-profit institutions: Ratio (%) (C/E)
1981	181,892	2,997	184,889	46.9	10,706	15,497	2,589	28,792	7.3	4,861	1.2
82	189,952	2,990	192,942	47.4	10,704	15,655	2,652	29,011	7.1	7,408	1.8
83	198,132	3,005	201,137	47.7	10,795	15,269	2,767	28,831	6.8	5,971	1.4
84	220,835	3,047	223,882	49.7	10,777	15,287	2,697	28,761	6.4	6,856	1.5
85	230,445	652	231,097	49.9	10,641	15,464	2,713	28,818	6.2	7,198	1.6
86	251,138	633	251,771	51.5	10,770	15,340	2,780	28,890	5.9	7,565	1.5
87	260,457	389	260,846	51.8	10,697	15,294	2,918	28,909	5.7	8,427	1.7
88	278,904	394	279,298	52.6	10,766	15,004	3,139	28,909	5.4	9,632	1.8
89	293,789	413	294,202	53.2	10,899	15,215	3,174	29,288	5.3	10,788	1.9
90	313,527	421	313,948	54.2	10,864	15,094	3,364	29,322	5.1	11,497	2.0
91	330,573	423	330,996	54.8	10,895	15,107	3,514	29,516	4.9	12,405	2.1
92	340,387	422	340,809	55.0	10,943	15,037	3,623	29,603	4.8	13,459	2.2
93	355,957	449	356,406	55.3	11,096	15,048	3,750	29,894	4.6	14,104	2.2
94	366,845	433	367,278	55.2	11,210	14,862	3,835	29,907	4.5	14,734	2.2
95	376,179	460	376,639	55.2	11,223	14,957	4,083	30,263	4.4	16,262	2.4
96	383,565	535	384,100	55.0	11,243	14,936	4,167	30,346	4.3	16,113	2.3
97	399,859	502	400,361	55.6	11,370	14,698	4,173	30,241	4.2	16,746	2.3
98	403,737	495	404,232	55.3	11,412	14,347	4,453	30,212	4.1	16,905	2.3
99	428,693	502	429,195	56.7	11,471	14,576	4,863	30,910	4.1	16,113	2.1
2000	433,256	502	433,758	56.9	11,373	14,678	4,936	30,987	4.1	15,747	2.1
01	420,881	482	421,363	56.1	11,463	14,661	5,104	31,228	4.2	15,865	2.1
02	429,981	707	430,688	56.9	3,473	14,853	15,424	33,750	4.5	11,188	1.5
03	430,493	697	431,190	56.9	3,264	14,492	16,135	33,891	4.5	10,954	1.4
04	458,271	574	458,845	58.3	3,235	13,989	16,487	33,711	4.3	10,378	1.3

(8) Trends in number of researchers by sector in Japan (continued)

Classification / Year	Universities and colleges: National	Public	Rrivate	Total (D)	Ratio (%) (D/E)	Total (E)	Ratio (%)
1981	77,635	12,358	86,084	176,077	44.6	394,619	100
82	79,346	12,291	86,199	177,836	43.7	407,197	100
83	82,588	14,124	88,817	185,529	44.0	421,468	100
84	85,179	14,139	91,266	190,584	42.3	450,083	100
85	87,061	14,658	94,059	195,778	42.3	462,891	100
86	89,139	14,924	96,811	200,874	41.1	489,100	100
87	91,078	15,281	99,467	205,826	40.8	504,008	100
88	93,823	15,447	103,386	212,656	40.1	530,495	100
89	95,749	16,099	107,210	219,058	39.6	553,336	100
90	98,190	16,292	110,303	224,785	38.8	579,552	100
91	99,764	16,879	113,988	230,631	38.2	603,548	100
92	102,118	16,801	117,224	236,143	38.1	620,014	100
93	107,175	17,554	119,844	244,573	37.9	644,977	100
94	111,608	18,434	122,894	252,936	38.0	664,855	100
95	114,629	19,479	125,318	259,426	38.0	682,590	100
96	119,210	20,206	127,805	267,221	38.3	697,780	100
97	122,858	21,104	129,250	273,212	37.9	720,560	100
98	125,386	21,737	132,545	279,668	38.3	731,017	100
99	125,955	21,749	133,322	281,026	37.1	757,244	100
2000	125,796	22,090	133,479	281,365	36.9	761,857	100
01	126,749	21,974	133,560	282,283	37.6	750,739	100
02	126,673	21,978	132,059	280,710	37.1	756,336	100
03	128,159	22,217	130,928	281,304	37.1	757,339	100
04	131,081	21,963	131,286	284,330	36.1	787,264	100

Notes:1. The number of researchers includes those in the social sciences and humanities, and is as of April 1 of each year, except for 2002 and later, which are as of March 31.

2. Survey coverage categories were changed in 2002; figures for nonprofit organizations up to 2001 use the values for private research institutions.

3. Numbers up to 2001 are for researchers whose primary duty is research (except at universities and colleges, where the number includes those who conduct research as an additional post).

4. Until FY2000, public corporations and independent administrative institutions (a) were those which were operated on a self-paying basis. Since FY2001, they indicate those whose main productive activities are classified into “Industries” in the input-output table.

5. Until FY2000, public corporations and independent administrative institutions (b) were those which were not expected to operate on a self-paying basis. Since FY2001, they indicate those whose purpose is to carry out examinations and research on scientific technologies.

6. Some Industries were added as new survey targets in 1997 and 2002.

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

(9) R&D expenditures and number of researchers of companies, etc. by industry in Japan (in FY2003)

Industry	Number of companies, etc. conducting research activities	Number of employees of companies, etc. conducting R&D activities	Number of researchers	R&D expenditures performed	R&D expenditures per researcher	Number of researchers per 10-thousand employees
	(companies)	(persons)	(persons)	(million yen)	(10 thousand yen)	(persons)
All industries	25,440	6,754,992	458,845	11,758,939	2,563	679
Agriculture, forestry and fisheries	17	7,697	193	5,130	2,658	251
Mining	359	12,963	465	14,846	3,193	359
Construction	438	404,091	6,471	136,418	2,108	160
Manufacturing	20,686	4,801,952	400,924	10,032,013	2,502	835
Food	3,103	889,199	20,902	326,899	1,564	235
Textile mill products	1,341	61,494	2,118	37,231	1,758	344
Pulp and paper	169	61,623	2,364	51,441	2,176	384
Printing	275	70,011	2,282	42,015	1,841	326
Drugs and medicines	557	196,928	20,691	883,653	4,271	1,051
Chemical products	1,565	317,566	37,861	890,512	2,352	1,192
Industrial chemicals and chemical fibers	557	166,254	18,550	473,665	2,553	1,116
Oils and paints	339	55,643	8,528	146,287	1,715	1,533
Other chemical products	670	95,669	10,783	270,560	2,509	1,127
Petroleum and coal	124	33,264	1,555	41,791	2,688	467
Plastic products	380	95,802	6,399	122,776	1,919	668
Rubber products	535	101,181	7,012	169,590	2,419	693
Ceramics	569	125,782	5,793	123,260	2,128	461
Iron and steel	527	136,255	4,238	128,032	3,021	311
Non-ferrous metals and products	190	81,399	5,486	129,531	2,361	674
Fabricated metal products	891	186,269	5,683	85,372	1,502	305
General machinery	2,464	495,630	40,298	917,400	2,277	813
Electrical machinery, equipment and supplies	1,553	425,188	45,045	988,821	2,195	1,059
Electronic and electric measuring instruments	624	74,385	13,688	251,211	1,835	1,840
Other electrical machinery equipment and supplies	930	350,803	31,357	737,609	2,352	894
Information and communication electronics equipment	848	395,768	83,201	2,040,838	2,453	2,102
Electronic parts and devices	540	269,678	30,402	574,721	1,890	1,127
Transportation	583	570,974	48,299	1,846,028	3,822	846
Motor vehicles	396	510,381	45,020	1,789,871	3,976	882
Other transportation equipment	187	60,593	3,279	56,157	1,713	541
Precision machinery	1,583	160,807	19,433	502,594	2,586	1,208
Other manufacturing	2,888	127,135	11,864	129,510	1,092	933
Electricity, gas, heat supply and water	25	179,132	2,176	76,773	3,528	121
Information and communications	2,097	693,264	23,981	671,668	2,801	346
Software and information processing	2,022	294,027	16,685	251,845	1,509	567
Communications	30	357,033	6,354	398,153	6,266	178
Broadcasting	16	19,970	291	14,055	4,830	146
Newspaper, publishers and other data processing	29	22,233	651	7,613	1,169	293
Transport	30	258,498	602	24,131	4,008	23
Wholesale trade	1,017	144,885	4,806	80,209	1,669	332
Finance and insurance	19	54,713	224	3,477	1,552	41
Services	752	197,797	19,003	714,274	3,759	961
Professional services	330	75,699	1,618	18,104	1,119	214
Scientific research institutes	287	29,580	17,005	687,582	4,043	5,749
Other business services	134	92,518	380	8,588	2,260	41

Notes:The number of companies conducting research activities is the number of companies that conducted research activities in FY2003.

The number of researchers is as of March 31, 2004.

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

(10) Trends in ratio of company R&D expenditures to sales figures in Japan

(Unit: %)

Industry \ FY	1997	98	99	2000	01
All industries	2.85	3.14	3.06	3.01	3.29
Agriculture, forestry and fisheries	0.53	0.63	0.59	0.58	0.54
Mining	1.15	1.58	1.20	0.99	1.24
Construction	0.39	0.43	0.58	0.48	0.42
Manufacturing	3.67	3.89	3.68	3.70	4.03
Food	1.00	1.05	0.93	1.01	0.96
Textiles	1.77	1.59	2.17	2.17	1.87
Pulp and paper products	0.92	1.12	1.06	0.98	1.09
Printing and publishing	1.06	1.13	1.24	1.14	1.07
Chemicals	5.24	5.49	5.37	5.36	5.73
Industrial chemicals and chemical fibers	3.87	4.25	3.99	3.64	4.07
Oils and paints	4.57	4.25	4.47	4.43	4.71
Drugs and medicines	8.06	8.07	8.07	8.60	8.52
Other chemicals	5.30	5.36	4.99	5.11	5.07
Petroleum and coal products	0.49	0.48	0.32	0.24	0.26
Plastic products	2.24	2.32	2.17	2.38	2.83
Rubber products	3.37	3.19	4.09	3.64	4.02
Ceramics	2.93	2.96	2.35	2.48	2.84
Iron and steel	1.92	2.01	1.88	1.64	1.67
Non-ferrous metals and products	2.44	2.45	2.43	2.37	2.49
Fabricated metal products	1.46	1.52	1.41	1.70	1.49
General machinery	3.41	3.76	3.96	3.93	4.16
Electrical machinery	6.05	6.32	5.75	5.65	6.83
Electrical machinery, equipment and supplies	6.13	6.08	5.90	5.64	6.21
Communication and electrical equipment	6.01	6.43	5.69	5.65	7.09
Transport equipment	3.97	4.12	3.95	3.90	4.25
Motor vehicles	4.20	4.35	4.12	4.09	4.44
Other transport equipment	2.90	3.03	3.09	2.86	3.15
Precision instruments	6.28	6.33	6.83	6.34	6.58
Other manufacturing	1.70	1.84	1.66	1.70	1.79
Transport communication and public utility	0.91	0.80	1.11	1.15	1.14
Wholesale trade	-	-	-	-	0.35
Software data processing	7.84	10.08	8.35	5.79	3.69
Professional services	-	-	-	-	1.29
Miscellaneous business services	-	-	-	-	0.77
Scientific research institutions	-	-	-	-	75.59

(Unit: %)

Industry \ FY	2002	03
All industries	3.06	2.98
Agriculture, forestry and fisheries	0.53	0.74
Mining	0.93	0.93
Construction	0.39	0.42
Manufacturing	3.99	3.71
Food	1.08	1.06
Textile mill products	2.25	1.70
Pulp and paper	1.16	1.16
Printing	1.35	1.26
Drugs and medicines	8.91	8.43
Chemical products	3.59	4.13
Industrial chemicals and chemical fibers	3.90	3.66
Oils and paints	4.13	4.34
Other chemical products	2.95	5.13
Petroleum and coal	0.23	0.23
Plastic products	2.44	2.47
Rubber products	4.20	4.34
Ceramics	2.52	2.30
Iron and steel	1.50	1.45
Non-ferrous metals and products	2.45	2.13
Fabricated metal products	1.39	1.25
General machinery	4.43	4.12
Electrical machinery, equipment and suppl	5.20	5.05
instruments	4.98	5.14
Other electrical machinery equipment and supplies	5.26	5.02
Information and communication electronics equipr	7.43	6.75
Electronic parts and devices	5.13	3.88
Transportation	4.35	4.40
Motor vehicles	4.56	4.63
Other transportation equipment	1.87	1.69
Precision machinery	7.77	6.26
Other manufacturing	1.82	2.14
Electricity, gas, heat supply and wate	0.44	0.41
Information and communications	1.97	2.08
Software and information processi	2.41	3.13
Communications	1.97	1.85
Broadcasting	0.17	0.17
processing	1.07	0.79
Transport	0.29	0.24
Wholesale trade	0.19	0.29
Services	13.20	20.44
Professional services	0.81	1.05
Scientific research institutes	84.41	85.93
Other business services	0.80	0.89

Notes:1. Figures are the ratios of individual company R&D expenditures to sales amounts.

2. Figures are for companies only, excluding public corporations, incorporated administrative agencies and finance and insurance.

3. Some industries were added as new survey targets in FY1996 and FY2001.

4. Information processing is not included in the "software and information processing" category up to FY2000.

5. Industrial classification has been changed since FY2002.

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

(11) Trends in Japan's technology trade amounts

(Unit: 100 million yen)

Year \ Classification	Export (A)	Import (B)	Ratio (A/B)
1981	1,063	3,775	0.28
82	1,392	4,369	0.32
83	1,351	4,707	0.29
84	1,651	5,401	0.31
85	1,724	5,631	0.31
86	1,527	5,454	0.28
87	1,870	5,515	0.34
88	2,099	6,429	0.33
89	2,782	7,347	0.38
90	3,590	8,744	0.41
91	3,860	8,135	0.47
92	3,875	9,106	0.43
93	4,296	7,998	0.54
94	5,294	8,476	0.62
95	5,668	8,881	0.64
96	7,257	10,684	0.68
97	8,839	11,634	0.76
98	9,659	11,706	0.83
99	9,310	11,213	0.83
2000	11,024	11,863	0.93
01	12,689	13,490	0.94
02	13,907	13,705	1.01
03	14,388	12,893	1.12

Notes:1. Figures are values in each calendar year.

2. Method of figuring out has been changed since January 1996. Figures prior to 1991 have been revised based on the new method.

Source: The Bank of Japan. "Balance of Payments Monthly"

(12) Trends in technology trade amounts by industry in Japan

(1) Technology export amounts

(Unit: million yen)

Industry \ Fiscal year	1993	94	95	96	97	98	99	2000	01	02	03	Composition ratio (%)	Ratio to the previous year	Percentage of receipts to R&D expenditures (%)
All industries	400,362	462,128	562,077	703,033	831,563	916,098	960,800	1,057,853	1,246,814	1,386,769	1,512,189	100	1.09	20.3
Construction	4,360	7,820	3,063	13,251	3,274	2,398	434	3,779	667	719	1,424	0.1	1.98	14.1
Manufacturing	394,144	452,585	556,414	686,629	824,476	908,200	955,450	1,047,860	1,213,310	1,367,092	1,490,356	98.6	1.09	20.7
Food	5,432	9,096	10,564	8,924	8,830	8,851	10,519	10,579	12,649	17,694	15,338	1.0	0.87	15.2
Textile mill products	4,854	3,635	4,396	22,384	5,284	3,651	3,851	2,362	2,663	2,535	1,473	0.1	0.58	6.6
Drugs and medicines	–	–	–	–	–	–	–	–	–	142,212	135,912	9.0	0.96	24.2
Chemical products	59,348	64,113	72,064	95,089	106,755	122,769	144,992	130,517	156,263	56,524	54,573	3.6	0.97	9.6
Ceramics	9,808	10,495	11,658	11,836	13,717	13,129	11,604	11,550	11,974	14,079	11,398	0.8	0.81	16.3
Iron and steel	13,294	12,845	16,923	20,940	15,319	11,932	11,544	13,436	9,601	9,570	6,598	0.4	0.69	6.0
Non-ferrous metals and products	3,640	4,418	4,315	5,149	5,738	6,252	5,538	5,728	4,863	8,015	7,688	0.5	0.96	10.4
Fabricated metal products	4,698	3,154	3,690	20,035	3,295	6,715	3,053	2,286	4,035	2,304	2,221	0.1	0.96	8.8
General machinery	18,425	20,262	22,081	22,444	29,727	31,616	29,377	35,275	50,347	45,946	53,766	3.6	1.17	11.4
Electrical machinery	127,377	140,477	215,022	233,257	246,008	237,757	204,473	211,358	239,886	–	–	–	–	–
Electrical machinery, equipment and supplies	–	–	–	–	–	–	–	–	–	45,448	55,408	3.7	1.22	8.0
Information and communication electronics equipment	–	–	–	–	–	–	–	–	–	135,954	145,051	9.6	1.07	8.3
Electronic parts and devices	–	–	–	–	–	–	–	–	–	61,157	51,060	3.4	0.83	13.9
Transportation	127,670	164,234	163,975	211,049	350,947	435,717	500,018	588,961	675,545	771,384	893,159	59.1	1.16	53.3
Precision machinery	4,036	5,633	8,467	10,397	8,890	8,426	9,262	7,729	13,523	11,141	5,999	0.4	0.54	1.6
Other manufacturing	15,562	14,223	23,259	25,125	29,966	21,385	21,219	28,079	31,960	43,129	50,712	3.4	1.18	15.3
Other	1,858	1,723	2,600	3,153	3,813	5,500	4,916	6,214	32,837	18,958	20,409	1.3	1.08	8.2

(2) Technology import amounts

(Unit: million yen)

Industry \ Fiscal year	1993	94	95	96	97	98	99	2000	01	02	03	Composition ratio (%)	Ratio to the previous year	Percentage of receipts to R&D expenditures (%)
All industries	362,974	370,693	391,715	451,169	438,400	430,054	410,296	443,287	548,379	541,713	563,764	100	1.04	7.9
Construction	724	936	1,310	528	1,224	557	648	371	411	1,188	2,081	0.4	1.75	4.9
Manufacturing	359,601	367,843	388,257	439,097	430,420	406,251	388,068	423,002	488,708	473,294	486,439	86.3	1.03	7.1
Food	8,430	8,511	7,949	8,678	8,731	7,484	9,655	16,335	17,445	18,955	6,948	1.2	0.37	7.3
Textile mill products	6,188	7,829	8,087	10,561	6,889	4,849	4,050	4,450	3,585	2,045	1,931	0.3	0.94	18.2
Drugs and medicines	–	–	–	–	–	–	–	–	–	41,684	36,460	6.5	0.87	7.9
Chemical products	61,368	59,043	66,166	69,803	67,297	71,677	66,876	65,191	89,875	26,345	27,952	5.0	1.06	5.9
Ceramics	3,828	2,290	1,767	3,538	3,923	9,170	5,103	5,806	8,156	972	715	0.1	0.74	1.1
Iron and steel	3,403	2,342	4,187	3,020	5,210	4,880	2,419	2,269	2,242	2,013	804	0.1	0.40	0.8
Non-ferrous metals and products	3,620	2,707	4,084	4,629	15,701	3,694	3,227	5,823	44,132	41,158	54,403	9.6	1.32	70.6
Fabricated metal products	1,505	1,680	1,973	1,664	1,406	1,741	1,077	558	1,848	2,007	712	0.1	0.35	3.1
General machinery	25,554	23,270	21,066	23,295	21,932	23,581	28,775	38,841	30,615	49,485	53,669	9.5	1.08	10.6
Electrical machinery	159,159	177,382	199,746	222,324	218,942	204,999	202,274	216,367	223,006	–	–	–	–	–
Electrical machinery, equipment and supplies	–	–	–	–	–	–	–	–	–	33,761	31,357	5.6	0.93	4.9
Information and communication electronics equipment	–	–	–	–	–	–	–	–	–	151,645	151,130	26.8	1.00	8.2
Electronic parts and devices	–	–	–	–	–	–	–	–	–	45,626	50,726	9.0	1.11	12.3
Transportation	40,392	35,630	32,525	42,534	34,792	36,165	33,921	34,616	36,979	25,612	26,033	4.6	1.02	1.8
Precision machinery	22,747	10,618	11,911	12,836	15,085	9,742	6,759	7,731	14,354	12,749	18,846	3.3	1.48	4.7
Other manufacturing	23,407	36,541	28,796	36,215	30,512	28,269	23,932	25,015	16,471	19,237	24,753	4.4	1.29	8.5
Other	2,649	1,914	2,148	11,544	6,756	23,246	21,580	19,914	59,260	67,231	75,244	13.3	1.12	37.8

Notes:1. "Other" is the value of total industry exports and imports minus the value of the manufacturing industry and construction industry exports and imports.

2. Some industries were added as new survey targets in FY1996 and FY2001.

3. Industrial classification has been changed since FY2002. The ratio to the previous year for chemicals is compared to the total for drugs and medicines and chemical products for FY2002 and to chemicals for 2001.

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

(13) Trends in technology trade amounts of Japan by region and country

(1) Technology export amounts

(Unit: 100 million yen)

Region and country \ FY	1993	94	95	96	97	98	99	2000	01	02	03	Composition ratio (%)	Ratio to the previous year
Asia (excluding West Asia)	1,864.16	2,140.68	2,807.44	3,435.06	2,851.09	2,513.26	2,490.57	2,931.15	3,366.85	3,612.85	4,085.99	27.0	1.13
West Asia	17.80	23.14	15.34	18.58	26.45	20.74	23.04	42.56	57.58	71.77	76.63	0.5	1.07
North America	1,287.61	1,500.41	1,728.97	2,354.61	3,945.27	4,803.59	5,500.41	5,844.82	7,215.29	7,981.95	8,589.94	56.8	1.08
South America	37.50	49.52	47.80	83.10	82.83	87.00	64.17	108.99	95.00	84.75	118.19	0.8	1.39
Europe	677.23	810.04	943.37	1,070.47	1,245.95	1,550.39	1,373.80	1,480.68	1,556.08	1,933.93	2,025.52	13.4	1.05
Africa and Oceania	119.32	97.48	77.85	68.51	164.06	186.01	156.01	170.33	177.33	182.43	225.63	1.5	1.24
Total	4,003.62	4,621.27	5,620.77	7,030.33	8,315.65	9,160.99	9,608.00	10,578.53	12,468.13	13,867.69	15,121.89	100.0	1.09
South Korea	504	531	646	696	460	385	331	399	350	370	359	2.4	0.97
China	163	173	178	469	436	434	469	525	687	858	1139	7.5	1.33
Taiwan	207	300	441	402	508	503	549	529	483	648	630	4.2	0.97
Indonesia	119	152	216	232	205	159	138	182	228	314	380	2.5	1.21
Thailand	325	362	462	513	415	304	354	547	696	652	826	5.5	1.27
Singapore	248	265	284	408	289	251	180	211	210	176	166	1.1	0.94
USA	1192	1393	1606	2082	3653	4260	4691	4805	5856	6341	6785	44.9	1.07
Brazil	21	35	37	61	52	46	32	71	53	51	82	0.5	1.59
UK	307	442	413	459	578	753	609	660	546	717	775	5.1	1.08
Italy	28	27	49	61	61	60	50	56	69	134	129	0.9	0.96
Russia	4	2	1	1	—	—	—	2	2	2	1	0.0	0.61
Germany	95	92	139	136	137	154	159	131	190	272	206	1.4	0.76
France	106	101	148	155	144	170	159	186	239	246	266	1.8	1.08
Australia	54	53	20	19	65	104	95	90	103	109	127	0.8	1.16

(2) Technology import amounts

(Unit: 100 million yen)

Region and country \ FY	1993	94	95	96	97	98	99	2000	01	02	03	Composition ratio (%)	Ratio to the previous year
North America	2,590.50	2,618.70	2,793.09	3,305.47	3,135.17	3,061.49	2,915.56	3,314.45	3,743.35	3,679.45	3,818.16	67.7	1.04
Europe	1,023.80	1,077.08	1,097.44	1,160.94	1,198.38	1,185.42	1,135.90	1,051.06	1,691.61	1,672.70	1,711.33	30.4	1.02
Other	15.44	11.16	26.62	45.28	50.45	53.63	51.50	67.36	48.83	64.99	108.15	1.9	1.66
Total	3,629.74	3,706.94	3,917.15	4,511.69	4,384.00	4,300.54	4,102.96	4,432.87	5,483.79	5,417.13	5,637.64	100.0	1.04
USA	2,578	2,605	2,776	3,285	3,110	3,038	2,896	3,294	3,706	3,655	3,798	67.4	1.04
UK	140	125	121	134	116	130	153	134	321	243	264	4.7	1.09
Itary	37	17	25	18	16	16	14	16	24	27	69	1.2	2.52
Netherlands	216	218	234	242	237	268	219	184	170	327	118	2.1	0.36
Switzerland	158	204	205	173	179	185	164	194	196	185	169	3.0	0.91
Germany	188	211	194	248	271	229	211	199	226	213	204	3.6	0.96
France	161	174	189	201	202	166	163	149	551	557	691	12.3	1.24

Note: Some Industries were added as new survey targets in FY1996 and FY2001.

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

(14) Japan's technology trade amounts by industry and region (in FY 2003)

(Unit: million yen)

Item	Export amounts							Import amounts			
	Total	Asia (excluding West Asia)	West Asia	North America	South America	Europe	Other	Total	North America	Europe	Other
All industries	1,512,189	408,599	7,663	858,994	11,819	202,552	22,562	563,764	381,816	171,133	10,815
Construction	1,424	1,414	-	0	-	9	-	2,081	151	1,930	-
Manufacturing	1,490,356	393,811	7,489	854,869	11,415	201,800	20,971	486,439	323,100	155,564	7,775
Food	15,338	4,360	-	4,062	2,337	4,469	110	6,948	5,386	1,545	18
Textile mill products	1,473	953	22	451	-	46	-	1,931	56	1,875	-
Pulp and paper	2,811	1,717	-	265	159	670	-	156	64	92	-
Printing	3,800	3,626	-	128	-	46	-	927	286	620	21
Drugs and medicines	135,912	895	60	88,745	5	46,178	27	36,460	12,266	24,017	178
Chemical products	54,573	29,990	4	10,853	239	12,777	711	27,952	20,574	7,279	98
Petroleum and coal	402	284	0	61	3	49	5	1,570	606	964	-
Plastic products	7,432	5,880	24	794	-	644	90	1,868	1,540	315	13
Rubber products	30,347	6,271	722	14,440	-	7,654	1,260	3,705	3,043	654	8
Ceramics	11,398	7,977	18	1,602	178	1,406	218	715	329	381	6
Iron and steel	6,598	4,002	131	748	1,135	288	294	804	420	258	126
Non-ferrous metals and products	7,688	4,121	-	1,946	2	890	729	54,403	1,013	53,390	-
Fabricated etal products	2,221	1,196	4	862	9	115	35	712	455	257	-
General machinery	53,766	20,805	66	19,339	211	13,251	94	53,669	45,027	8,422	220
Electrical machinery, equipment and supplies	55,408	21,051	45	28,725	583	4,189	816	31,357	24,254	6,705	398
Information and communication electronics equipment	145,051	84,959	14	29,901	451	29,371	355	151,130	120,627	26,489	4,013
Electronic parts and devices	51,060	38,562	-	10,297	156	2,038	6	50,726	43,393	5,785	1,548
Transportation	893,159	153,272	5,729	637,512	5,906	74,681	16,059	26,033	11,941	13,840	252
Precision machinery	5,999	2,730	-	1,912	3	1,353	-	18,846	17,505	582	760
Other manufacturing	5,921	1,160	651	2,225	39	1,685	161	16,526	14,313	2,096	118
Other	20,409	13,374	174	4,125	404	743	1,591	75,244	58,565	13,639	3,040

Notes:1. "-" indicates figure is not applicable.

2. "Other" is the value of total industry exports and imports minus the value of the manufacturing industry and construction industry exports and imports.

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

(15) Deflators

Sector / Year	R&D expenditure deflators in Japan					GDP deflators							
	Natural sciences				Total including social science and humanities	Japan	USA	Germany	France	UK	EU-15	EU-25	South Korea
	Business enterprises	Non-profit institutions and public organizations	Universities and colleges	Total									
1981	84.1	82.4	73.2	80.9	82.6	84.6	59.1	65.8	52.8	44.5			33.1
82	86.6	84.7	75.9	83.6	85.1	86.4	62.7	68.9	58.8	47.8			35.4
83	87.8	85.8	77.7	85.0	86.3	88.6	65.1	71.2	64.1	50.5			37.5
84	90.1	88.1	80.3	87.5	88.8	91.3	67.6	72.6	68.6	52.7			39.6
85	91.3	89.3	82.2	89.0	90.1	93.3	69.7	74.2	72.4	55.7			41.4
86	88.8	87.7	82.3	87.3	88.0	94.7	71.2	76.6	76.0	57.6			43.6
87	89.3	88.3	83.4	87.9	88.6	94.9	73.2	78.0	78.2	60.6			46.0
88	91.2	90.3	86.3	90.1	90.6	95.6	75.7	79.1	80.6	64.4			49.5
89	95.1	94.4	90.4	94.2	94.6	98.3	78.6	81.0	83.1	69.2			52.3
90	97.9	97.8	93.8	97.2	97.6	100.7	81.6	83.6	85.5	74.5			58.0
91	99.4	99.3	96.3	98.9	99.2	103.5	84.5	85.2	88.0	79.4	81.7		64.2
92	99.7	99.7	97.4	99.3	99.5	104.8	86.4	89.5	89.8	82.6	84.2		69.2
93	99.2	99.3	97.9	99.0	99.1	105.2	88.4	92.8	91.9	84.8	84.8		74.0
94	99.7	99.7	99.2	99.6	99.7	105.1	90.3	95.1	93.4	86.1	86.6		79.7
95	100.0	100.0	100.0	100.0	100.0	104.5	92.1	97.0	95.0	88.4	87.9	87.4	85.4
96	101.2	100.9	101.6	101.2	101.2	103.7	93.8	98.0	96.4	91.3	90.9	90.5	89.8
97	102.2	101.7	102.4	102.2	102.1	104.4	95.4	98.7	97.6	93.9	93.3	93.1	93.9
98	100.1	99.9	100.5	100.2	100.1	103.8	96.5	99.8	98.5	96.5	94.9	94.8	99.4
99	99.0	98.6	99.4	99.0	98.9	102.0	97.9	100.3	99.0	98.7	97.1	96.9	99.3
2000	99.4	98.4	99.6	99.3	99.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
01	98.1	97.1	98.3	98.0	97.9	98.7	102.4	101.3	101.8	102.2	101.8	102.2	103.5
02	96.4	95.5	96.2	96.3	96.2	97.1	104.0	102.9	104.1	105.5	104.2	104.7	106.5
03	95.6	94.5	95.6	95.5	95.4	94.8	105.7	104.0	105.7	108.7	104.9	105.2	108.9

Notes:1. The R&D expenditures deflator in Japan and the GDP deflator in Japan uses a fiscal year value. FY1995 serves as the base year for R&D expenditures deflator, and FY2000 is for GDP deflator, with a value of 100.

2. The GDP deflator except Japan uses a calender year value. 2000 serves as the base year for GDP deflator, with a value of 100.

3. The deflator value for non-profit institutions and public organizations in Japan up to FY2000 is the figure for research institutions.

4. Concerning the GDP deflators in Japan, the values in the fixed-base year method (as a basis for FY1995) is used. FY2000 serves as the base year for the values with a value of 100.

Sources: R&D expenditure deflators in Japan: Statistics Bureau data

GDP deflators: Japan -- Cabinet Office data; other countries -- OECD "National Accounts" and "Main Science and Technology Indicators"