of Informatics (NII), in cooperation with national, public, and private universities nationwide, compiles the union catalog databases of academic books and serials in the collection of university libraries. 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.

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), 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 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.

3.3.6.5.2.2 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.

Furthermore, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) promotes the development of various scientific databases of national universities and the National Institute of Informatics (NII). MEXT also provides subsidies for the creation of databases by university researchers and academic societies.

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.

3.3.6.5.2.3 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). A system provided by the National Institute of Informatics (NII), known as the Directory of Research Activities and Resources (NACSIS-DiRR), was integrated into ReaD in April 2003.

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.

3.3.6.5.3 Developing an Electronic Library Service at University Libraries

University libraries play an important role as fundamental facilities that support education and research activities at universities, etc. In addition, university libraries are increasingly expected to offer diverse and advanced information services according to the advances of multimedia technology and the growth of the Internet in recent years.

The Ministry of Education, Culture, Sports, Science and Technology is working to enhance and strengthen the digital library function at university libraries by promoting advanced digital library projects at four national universities, including the development of a prototype digital library at the Nara Institute of Science and Technology (NAIST), and by allocating funds to national universities for the systematic introduction of electronic journals (academic journals delivered via computer networks) in fields earmarked in the Science and Technology Basic Plan for the priority distribution of R&D resources.

3.3.6.5.4 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 networks connected 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 competitiveness 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 societal 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.

3.3.6.6.1 Fostering and Securing Personnel Engaged in Manufacturing

Since manufacturing is implemented through human efforts, actions have been taken such as expanding education for manufacturing, and promoting lifelong learning for manufacturing, in order to foster and secure personnel engaged in manufacturing.

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. In addition, efforts are being undertaken such as the promotion of internships, and the provision of experimentation and training equipment for industrial education at lower and upper secondary schools.

At the higher education level, a number of initiatives were implemented, including: (1) the upgrading of experimentation and training equipment in science and engineering departments; (2) the promotion of internships at production sites, etc.; (3) the promotion of practical education in engineering departments, mainly related to manufacturing; and (4) the development of the education program for nurturing creativity in students, and of the university-industry joint education program. At the regional level, seminars were implemented with the aim of popularizing the internship system, a system in which students use their summer vacations to gain working experience at business enterprises, and internship businesses, which do such things as open up enterprises that accept interns and the schools that will dispatch them and match students with enterprises.

It has become increasingly difficult to secure the skilled technicians who have played a critical role in the economic development of Japan in various fields of industry, and to foster successors to skilled technicians. This situation has arisen due to factors such as the lost interest in manufacturing occurring primarily in the younger generation, the shortage of successors for skilled technicians due to aging, the shift to overseas production bases, and decreasing opportunities for participation in skilled activities as a result of mechanization and automation.

One of the factors contributing to this situation is the lack of opportunities for the younger generation to understand the joy and wonder of manufacturing, as a result of factors such as a lack of experience in manufacturing, and a lack of opportunities to observe manufacturing sites.

To promote research and studies concerning the implementation of effective measures for hands-on education and learning that instill the joy and wonder of manufacturing in the young people who will bear responsibility for the next generation, the Ministry of Education, Culture, Sports, Science, and Technology and the Ministry of Health, Labor, and Welfare joined forces to convene the "Conference on Education and Study for Manufacturing" in FY1999 and FY2000. These Roundtables studied how people experienced in manufacturing skills and techniques should be utilized for education and learning, and published the results in "On the Utilization of Skilled Workers in Education and Learning about Manufacturing for Young People." Based on this report, the Ministry of Health, Labor and Welfare implemented education and learning projects utilizing experienced technicians to teach youths how to build things. Information about the material and curricula used in the education and learning project were provided over the Internet. Utilizing skilled local technicians as instructors, the FY2003 manufacturing education and learning projects were implemented in ten prefectures in order to have schoolchildren experience the joy and wonder of building things. Examples of items made by students at 26 elementary schools in nine of those prefectures during regular or after-school classes included: magazine racks and picture stands made by children in Iwate Prefecture; birdhouses, CD cases, mosaic tiles, and drawstring bags made by children in Miyagi Prefecture; copper reliefs, small round *tatami* mats (Japanese rush matting) and bookstands made by children in Chiba prefecture; personal seals (used as signatures in Japan) and mosaic tile message boards made by children in Tokyo; Ise paper patterns (for dying *kimono* fabrics) and copper reliefs made by children in Mie Prefecture; wooden planters and flower arrangements made by children in Nara Prefecture; universal seats (can be used as seats, stools, or stands) made by children in Hiroshima Prefecture; and small partition screens and garden chairs made by children in Oita Prefecture.

In four prefectures, items made by students at seven junior high schools during regular or after-school classes included: thin, bordered *tatami* mats (for placing small heating stoves on), photo stands, and personal seals made by students in Miyagi Prefecture; bench tables for schools and sliding bookstands made by students in Aichi Prefecture; and antique mirrors made by students in Nara Prefecture. High school students in Hiroshima Prefecture made paperweights.

In addition, weekend and holiday programs planned for children of elementary and junior high school age and their parents or guardians offer instruction in making *yukata* (summer *kimono*), personal seals, bookstands, penholders, and copper reliefs, among other items, making use of many materials for hands-on experience in manufacturing.

3.3.6.6.2 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 technologies for utilizing the new concept of "volume data." It completely integrates various manufacturing simulation technologies, including product measurement and evaluation 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.

3.3.6.6.3 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-scale corporations.

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 to fulfill Japan's role in international society and to more fully develop science and technology in Japan. Based on the close scientific capability 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 leads not only 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 Asia-Pacific Economic Cooperation (APEC), but also by promoting bilateral cooperation according to the conditions, needs, and potential of each country.

3.4.1.1 Development of Framworks for Multilateral Cooperation

3.4.1.1.1 Summit Meeting of Major Nations (G8 Summit)

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

At the 29th Evian Summit, held in June 2003, members adopted the "Science and Technology for Sustainable Development – A G8 Action Plan." In this plan, members agreed to develop an implementation plan for the next ten years of global observation by the spring 2004 Tokyo ministerial level meeting. The plan also noted the development of advanced nuclear technologies within the field of energy technology. The summit further issued the statement, "Securing Radioactive Sources – A G8 Statement," among others.

3.4.1.1.2 The United Nations (UN)

The United Nations utilizes various committees and organizations to address important issues related to natural resources, energy, food, climate, the environment, and natural disasters, since these problems require solutions from a global perspective.

Participants at the World Summit on Sustainable Development (WSSD), held between August and September 2002, adopted an implementation plan that included, among other proposals, the development of global observation technologies. In line with the WSSD implementation plan, the Japan Aerospace Exploration Agency (JAXA) (formerly the National Space Development Agency of Japan) held seminars for Asian countries in 2003.

Japan also actively participates in and cooperates with a broad range of programs and activities in science and technology fields that are initiated through the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

UNESCO has designated "water science and wetland ecosystems" as the principal priority in the natural sciences field, and is dealing with the water problem in the world through various programs such as the International Hydrological Programme (IHP). UNESCO announced the first World Water Development Report (WWDR) at the Third World Water Forum held in Japan in March 2003. In October of the same year, the 32nd session of UNESCO's General Conference adopted the International Declaration on Human Genetic Data, which lays down guidelines for the use of genetic data. Japan is a member of the IHP Intergovernmental Council and actively participates in and co-operates with UNESCO's activities.

3.4.1.1.3 The Organization for Economic Co-operation and Development (OECD)

The Organization for Economic Cooperation and Development (OECD) works through its Committee for Scientific and Technological Policy (CSTP), Committee for Information, Computer and Communications Policy (ICCP), Committee on Industry and Business Environment (CIBE), Agriculture Committee (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 objective of the CSTP is to promote cooperation between member countries in the field of science and technology policy, in order to contribute to the economic and social development of member countries. In January 2004, a ministerial level meeting was held in Paris with the participation of science and technology-related ministers from each state. Discussions included the interface between science and innovation, fostering the development and mobility of human resources in science and technology, and international cooperation in science and technology, among other issues.

The Committee consists of the following four subgroups, which implement concrete activities in their respective fields.

(1) Global Science Forum (GSF)

The primary objective of the Global Science Forum (GSF) is to promote international science and technology cooperation that contributes to the resolution of issues on a global scale.

The forum was established in June 1999, in order to take over the activities of the Megascience 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 the determination of science and technology policies.

At the ministerial level meeting held in January 2004, ministers approved statements regarding the GSF proposals on neuroinformatics and a linear collider, and also approved the extension of GSF activities for the next five years. Based on these approvals, lively discussions were held at the 10th GSF meeting in February 2004, including the establishment of the International Neuroinformatics Coordinating Facility, the Consultative Group on High-Energy Physics, a task force on Near Earth Objects (NEOs), a task force on declining interest in science studies among young people, and GSF's future activities.

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

The primary objective of the Working Party on Innovation and Technology Policy (TIP) is to clarify procedures and working methods in order to enhance productivity; facilitate the creation, diffusion and application of knowledge; and foster sustainable growth and the creation of a highly skilled work force.

Since its founding in 1993, TIP has discussed and evaluated technology policies, focusing in particular on the National Innovation System (NIS).

In recent years, TIP has engaged in studies related to the evaluation of innovation policy; case studies on innovation; micro-policies for growth and productivity; and public/private partnerships for innovation.

In line with the conclusions of a ministerial-level meeting of the CSTP held in January 2004, future discussions will include intellectual property rights, innovation, and diffusion of knowledge; and scientific innovation and interfaces.

(3) Working Party on Biotechnology (WPB)

The primary objective of the Working Party on Biotechnology is to support the promotion of safe and effective utilization of biotechnology.

The WPB held continued discussions on biotechnology for sustainable growth and development, among other topics. Ministers at the CSTP ministerial level meeting held in Paris in January 2004 agreed to build a framework for a Global Biological Resource Center Network (GBRCN) by 2006.

(4) Working Party of National Experts on Science and Technology Indicators (NESTI1)

1The 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.

At an NESTI meeting held in Paris in June 2003, participants discussed revising the Oslo Manual, an international standard for the collection and interpretation of data on innovation activities, as well as improving the Human Resources in Science and Technology (HRST) indicators.

3.4.1.2 Cooperation with Nations in the Asia-Pacific Region

3.4.1.2.1 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 is promoting 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."

3.4.1.2.2 Cooperation under the Asia- Europe Meeting (ASEM)

The Asia-Europe Meeting (ASEM) was established as a forum for frank discussions between Asia and Europe, in order to strengthen the relationship between the two regions, which had hitherto been weaker than the relationships between North America and Europe and between Asia and North America.

Reports on concrete cooperative activities in the water sector were presented at the Fourth ASEAM Summit held in Copenhagen in September 2002. Follow-up in 2003 sought promotion of cooperation in the science and technology sector.

3.4.1.2.3 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 second ASEAN / COST+3 meeting convened in Manila in April 2003 with Japan, China, South Korea, and other ASEAN countries.

3.4.1.2.4 Cooperation with Various C-ountries

In relations with China, in addition to cooperation based on a science and technology cooperation agreement1, Japan's Ministry of Education, Culture, Sports, Science and Technology and China's Ministry of Science and Technology held intergovernmental talks in November 2003 between science and technology- administrative officials on the theme of collaboration among industry, academia, and government.

In trilateral relations among Japan, China, and Korea, the Second Japan-China-Korea Directors-General Meeting on Science and Technology Cooperation was held in Tokyo in March 2004. Each country introduced its science and technology policies, and discussions were held on roles of the three countries as the core Asian nations.

In relations with the Republic of Singapore, the first joint committee meeting on mutual recognition of science and technology and occupational skills (including professional engineer qualifications) was held in Singapore in November 2003, based on the "Japan-Singapore Economic Partnership Agreement (JSEPA)."

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 exchanges, and the implementation of joint research.

Opinion exchanges on the possibility of future cooperation are also being pursued with other countries that have not signed science and technology cooperation agreements with Japan.

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.

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

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).

Figure 3-4-1 Joint committee meetings and other activities held in FY2003 based on bilateral science and technology cooperation among Western nations

Nation	Name	Date	Location	Agenda
United States	Ninth Meeting of the Japan -U.S. Joint High Level C ommittee on Science and Technology	April 21, 2003	Tokyo	(1) Earth Science, the environment, and energy; (2) L ife sciences; (3) Nanotechnology and advanced materials; (4) Science education; and (5) Science and technology for peace
	First Japan -U.S. Worksho p on Science and Technology for a Safe and Secure Society	February 12-13, 2004	Tokyo	(1) Overview / roles of science and technology in supporting a secure and safe society (2) Intergovernmental coordination of science and technology to support a secure and safe society (3) Requirements for technological research, development, testing, assessment, and use, and the working out of priority lists (4) Matters of common concern: 1. Infectious diseases and the safety of agriculture and food 2. National borders and transportation safety 3. Safety related to i mportant information infrastructure protection 4. Social infrastructure protection and analysis of interdependence 5. Science and technology for anti -crime and anti -terrorism measures
France	Fifth Japan -France Joint Committee on Science and Technology Cooperation	July 1, 2003	Tokyo	(1) Personnel exchanges; (2) Life sciences; (3) Space; (4) Oceans; (5) the Environment and new energies; (6) Resources; and (7) Information and communications technology
Canada	Eigh th Japan -Canada Joint Committee on Science and Technology Cooperation	July 17, 2003	Tokyo	(1) Cooperation among industry , academia, and government; (2) Life sciences; (3) Research information networks; (4) Space; and (5) the Environment
Sweden	Second Japa n-Sweden Joint Committee on Science and Technology Cooperation	October 27, 2003	Tokyo	(1) Researcher exchanges; (2) Life sciences; (3) Nanotechnology; (4) Climate issues (including research in the polar regions); (5) Industrial design; (6) Deep-sea drilling; and (7) Agriculture
Netherlands	Third Japan -Netherlands Joint Committee on Science and Technology Cooperation	December 15, 2003	Hague	(1) Internationalization of science and technology activities; (2) Researcher exchanges; (3) Multilateral science and technology cooperation; and (4) Agriculture, forestry, and fisheries
United Kingdom	Fifth Japan -United Kingdom Joint Committee on Science and Technology Cooperation	February 24, 2004	Tokyo	(1) Life sciences; (2) Earth observation and climate change; (3) N anotechnology; (4) Particle physics and space; and (5) Researcher exchanges

In relations with the United States, the Ninth Meeting of the Japan-U.S. Joint High Level Committee (ministerial level) on Science and Technology was held in Tokyo in April 2003, based on the Japan-United States Science and Technology Cooperation Agreement. The Joint Committee exchanged opinions on individual areas of cooperation, including each nation's trends in science and technology policy, the global environment, energy, the life sciences, nanotechnology, science education, and science and technology for peace. The Joint Committee also agreed to implement an exchange program for young researchers in the nanotechnology field. Furthermore, in line with the agreement reached by the Joint Committee, the First Japan-U.S. Workshop on Science and Technology for a Safe and Secure Society was held in February 2004. Discussions at the workshop included 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.

In relations with Germany, in August 2003, Prime Minister Junichiro Koizumi visited Germany, where he held talks with German Chancellor Gerhard Schroeder. The two leaders agreed to strengthen exchanges of young researchers between Japan and Germany.

In relations with the United Kingdom, in July 2003, Prime Minister Tony Blair visited Japan, where he held talks with Prime Minister Koizumi. The two leaders were in agreement on strengthening cooperation in science and technology, the environment, and information and communications technology, about which they issued joint statements.

Elsewhere, there are joint committees on science and technology with the Germany, France, Italy, Finland, Russia, Poland, the Czech Republic, Hungary, and Rumania based on science and technology cooperation agreements. In relations with Switzerland, the two countries regularly have a Science and Technology Roundtable to exchange information on current science and technology cooperation.

Furthermore, Japan entered into two new science and technology cooperation agreements: one with Norway in May 2003, and one with the Republic of South Africa in August 2003. With the conclusion of these new agreements, Japan is implementing wide-ranging bilateral science and technology cooperation based on international agreements, such as science and technology cooperation agreements with forty nations around the world, and promoting multilateral scientific, technological, and academic cooperation. Negotiations are also underway with the EU on a draft agreement.

3.4.1.4 Challenge for International Program

3.4.1.4.1 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, accommodations, and other expenses for young researchers conducting research abroad, and implements international research workshops. With a total of nine grant recipients from the program having later been awarded the Nobel Prize, the program receives great acclaim all over the world. Japan has been actively supporting the program ever since it first proposed it.

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

In March 1994, the United States, the EU (then 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, who possess 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 51,000 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.

3.4.1.4.3 International Space Station (ISS) Program

Fifteen countries, including the five partners of Japan, the United States, the European Union, Canada, and Russia, participate in the International Space Station (ISS) program based on the Agreement concerning Cooperation on the Civil International Space Station. The aim of the ISS program is to develop infrastructure that makes possible full-fledged utilization of the space environment and manned space activities by constructing a manned space station in low orbit about 400km above the Earth.

Assembly of the International Space Station in orbit commenced in November 1998, and the first long-term crew stay on the space station began in November 2000. Japan is participating in this project with its own experiment module, the Japanese Experiment Module (JEM) “Kibo,” the development of which is nearly complete. Japanese astronauts are scheduled to stay for a long period of time at the space station in the future. However, following the Space Shuttle Columbia accident in February 2003, deliberations are being held among the concerned parties as to how to proceed in the future.

3.4.1.4.4 International Thermonuclear Experimental Reactor(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 involved parties of Japan, China, the European Union, South Korea, Russia, and the United States. Negotiation Meetings have been held nine times to date, at which Rokkasho (Japan) and Cadarache (France) have been proposed as potential sites. 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 Rokkasho-mura, Kamikita County, Aomori Prefecture as the candidate site for consideration at the Intergovernmental Conference.

3.4.1.4.5 The Large Hadron Colid-er (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, aiming for the commencement of experiments 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.

3.4.1.4.6 Integrated Ocean Drilling Program (IODP)

The Integrated Ocean Drilling Program (IODP) is an international research program involving joint operation of a Japanese riser drilling vessel capable of deep drilling as deep as 7,000 meters below the seafloor to reach the mantle, and a U.S. non-riser drilling vessel.

On April 22, 2003, the Ministry of Education, Culture, Sports, Science and Technology and the United States' National Science Foundation (NSF), which lead the project, signed a memorandum that got IODP underway in October of the same year. As IODP moves forward it is expected to further research into deep crustal and sedimentary strata, thereby contributing to the elucidation of the mechanisms for environmental change and the tectonic mechanism in earthquakes, as well as to the search for undiscovered life forms and new resources.

Basic design of the riser drilling vessel began in 1999, and construction was underway two years later. The vessel was named "Chikyu," and a launching ceremony was held in January 2002 in Tamano City, Okayama Prefecture.

3.4.2 Promoting International Rsearch 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 are expected to resolve global problems. Therefore, internationalization 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

Considering the importance of enhancing international openness in the research environment in Japan, and accepting more first-rate foreign researchers into Japan in order to develop scientific and technological research, a number of researcher exchange programs are being implemented, such as the JSPS's Invitation Fellowships Programs for Research in Japan.

The facilitation of international exchange among young researchers is particularly important from the views 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 to 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).

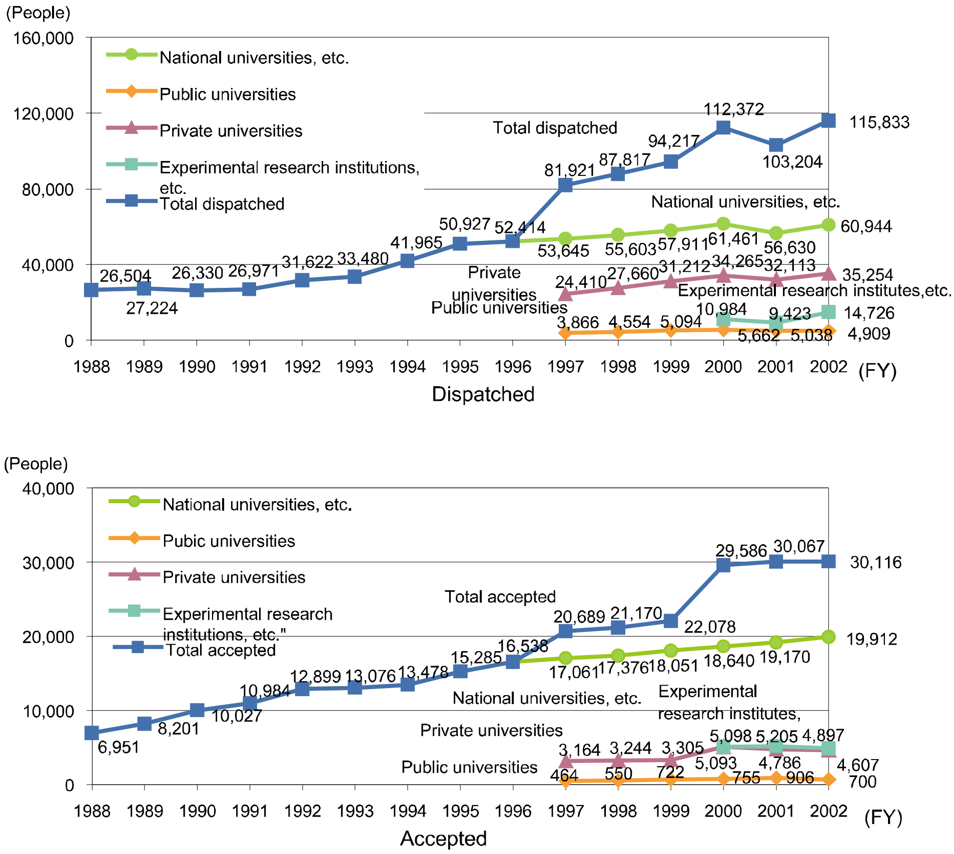


Figure 3-4-2 Progress of researcher exchanges in universities, research institutions, etc.

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.

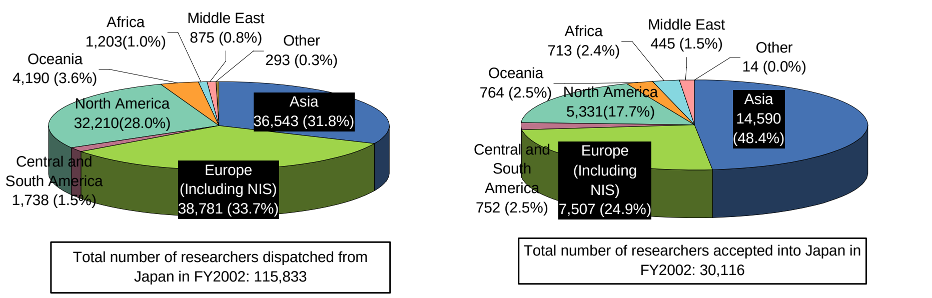


Figure 3-4-3 Researcher exchanges (dispatch and acceptance) by region

Source: MEXT. "Survey of International Exchange (FY2002)"

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 (Trillion yen)	R&D expenditures (100 Million yen)	Government financed R&D expenditures (100 Million yen)	Defense-related R&D expenditures (100 Million yen)	A (%)	B (%)	C (%)	D (%)	Number of researchers (Persons)	Population (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	480.6625	137,091.39	29,658.49	1,371.75	2.85	21.6	20.8	0.62	644,977	12,494
94	491.2746	135,960.30	29,181.77	1,407.88	2.77	21.5	20.6	0.59	664,855	12,527
95	500.0055	144,082.36	32,924.00	1,544.99	2.88	22.9	22.0	0.66	682,590	12,557
96	514.1687	150,793.15	31,605.51	1,652.79	2.93	21.0	20.1	0.61	698,280	12,586
97	520.6128	157,414.99	32,038.52	1,753.40	3.02	20.4	19.5	0.62	720,560	12,616
98	512.4417	161,399.25	34,984.92	1,441.76	3.15	21.7	21.0	0.68	731,017	12,647
99	508.0004	160,105.88	35,037.49	1,465.29	3.15	21.9	21.2	0.69	757,244	12,667
2000	513.2094	162,893.36	35,407.64	1,360.81	3.17	21.7	21.1	0.69	761,857	12,693
01	500.9200	165,279.98	34,769.43	1,489.88	3.30	21.0	20.3	0.69	750,739	12,729
02	497.6466	166,750.53	34,526.81	1,434.78	3.35	20.7	20.0	0.69	756,336	12,744
03	-	-	-	-	-	-	-	-	757,339	12,762

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

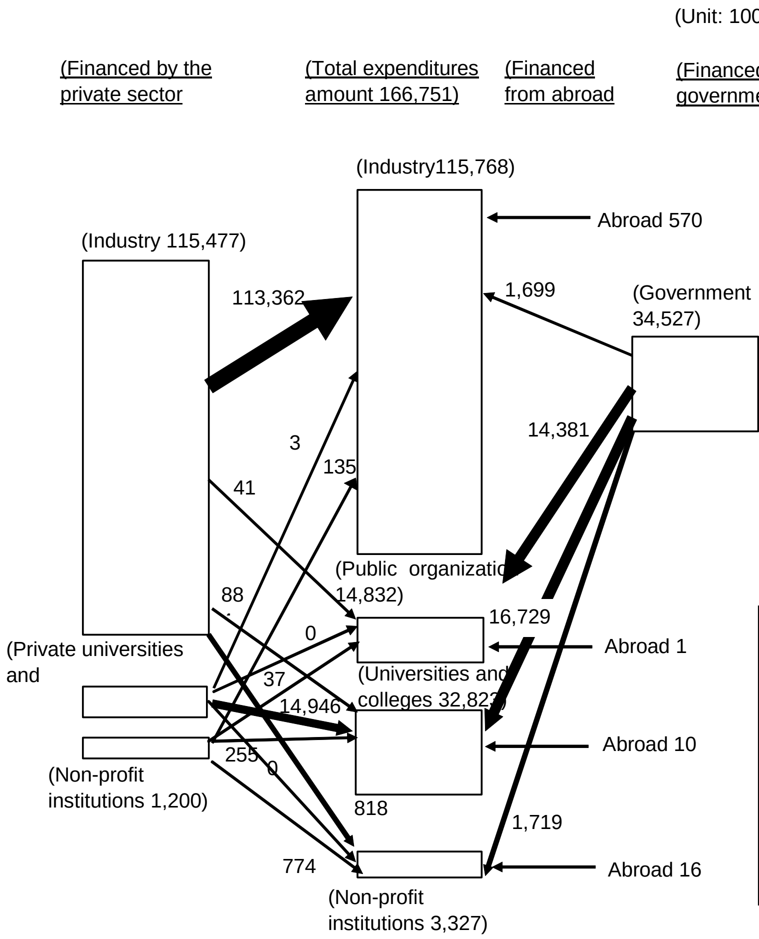
7. Survey coverage categories were changed in 2001; the definition under which the number of researchers was counted up to 2001 differs from that under which it was counted in 2002.

Sources:1. Gross domestic product: the Cabinet Office, "National Account."

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."

3. Population: "Population Census" and "Population Estimation (as of October 1 of each year)."

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



Unit: %

Classification / Sector	Financing ratio	Performing ratio
Industry	69.3	69.4
Government	20.7	8.9
Universities and colleges	9.0	19.7
Non-profit institution	0.7	2.0
Abroad	0.4	-
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 uni versities 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			Government research 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

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

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: Companies	Business enterprises: Public corporations/ Incoporated 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	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

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

FY \ Classification	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

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. Public corporations and incorporated administrative agencies (a) are those which are operated on a self-paying basis and public corporations and incorporated administrative agencies (b) are those which are not expected to operate on a self-paying basis.
4. 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

(%)

	FY	1990	91	92	93	94	95	96	97	98	99	2000	01	02
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
	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
	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
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	0.9	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
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
	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
	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
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.3	1.2
	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
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
	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
	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
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.1	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
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
	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
	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
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	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
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
	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
	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
	Lease fee	-	-	-	-	-	-	-	-	-	-	-	1.0	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

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

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	—	968,092	100	757,339	78.2	67,040	6.9	65,143	6.7	78,570	8.1

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				Public organizations					Non-profit institutions	
	Companies	Public corporations/ Incorporated administrative agencies (a)	Total (A)	Ratio (%) (A/E)	National	Local government owned	Public corporations/ Incorporated administrative agencies (b)	Total (B)	Ratio (%) (B/E)	(c)	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

(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

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. Public corporations and incorporated administrative agencies (a) are those which are operated on a self-paying basis and public corporations and incorporated administrative agencies (b) are those which are not expected to operate on a self-paying basis.
5. 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

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	14,258	5,750,029	431,190	11,576,840	2,685	750
Agriculture, forestry and fisheries	19	7,687	166	4,011	2,416	216
Mining	16	8,707	442	16,439	3,719	508
Construction	653	423,745	6,089	134,590	2,210	144
Manufacturing	11,004	4,060,451	383,973	10,081,287	2,626	946
Food	1,352	347,463	11,360	250,304	2,203	327
Textile mill products	426	59,177	2,547	51,237	2,012	430
Pulp and paper	156	68,150	2,573	53,647	2,085	378
Printing	19	35,484	1,421	35,841	2,522	400
Drugs and medicines	271	202,531	21,676	965,723	4,455	1,070
Chemical products	1,316	329,444	39,642	868,574	2,191	1,203
Industrial chemicals and chemical fibers	448	156,747	18,932	476,498	2,517	1,208
Oils and paints	432	61,078	9,229	136,295	1,477	1,511
Other chemical products	436	111,620	11,481	255,782	2,228	1,029
Petroleum and coal	103	27,149	1,254	39,507	3,150	462
Plastic products	338	84,402	4,785	107,773	2,252	567
Rubber products	117	82,181	5,907	156,984	2,658	719
Ceramics	400	122,867	6,287	146,037	2,323	512
Iron and steel	127	122,358	4,204	129,660	3,084	344
Non-ferrous metals and products	182	87,428	5,838	145,822	2,498	668
Fabricated metal products	1,250	155,483	5,478	78,262	1,429	352
General machinery	1,914	499,641	40,792	939,225	2,302	816
Electrical machinery, equipment and supplies	936	379,578	40,629	939,995	2,314	1,070
Electronic and electric measuring instruments	252	67,287	10,964	206,641	1,885	1,629
Other electrical machinery equipment and supplies	684	312,291	29,665	733,354	2,472	950
Information and communication electronics equipment	288	415,058	86,862	2,233,089	2,571	2,093
Electronic parts and devices	432	263,109	31,688	636,013	2,007	1,204
Transportation	356	528,666	45,747	1,737,925	3,799	865
Motor vehicles	287	476,770	42,660	1,677,626	3,933	895
Other transportation equipment	69	51,896	3,087	60,299	1,953	595
Precision machinery	478	120,514	18,455	452,884	2,454	1,531
Other manufacturing	540	129,767	6,827	112,784	1,652	526
Electricity, gas, heat supply and water	24	180,610	2,138	83,077	3,886	118
Information and communications	618	445,256	20,107	665,585	3,310	452
Software and information processing	501	308,142	13,250	196,983	1,487	430
Communications	57	94,451	6,142	442,208	7,200	650
Broadcasting	16	19,883	283	14,881	5,258	142
Newspaper, publishers and other data processing	44	22,780	431	11,514	2,671	189
Transport	28	260,528	629	27,611	4,390	24
Wholesale trade	909	130,114	3,282	48,868	1,489	252
Finance and insurance	32	31,753	164	3,391	2,068	52
Services	955	201,177	14,201	511,981	3,605	706
Professional services	450	108,796	1,404	17,613	1,254	129
Scientific research institutes	290	21,389	12,186	485,319	3,983	5,697
Other business services	215	70,992	611	9,049	1,481	86

Notes:The number of companies conducting research activities is the number of companies that conducted research activities in FY2002. The number of researchers is as of March 31, 2003.

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	1996	97	98	99	2000	01
All industries	2.77	2.85	3.14	3.06	3.01	3.29
Agriculture, forestry and fisheries	0.42	0.53	0.63	0.59	0.58	0.54
Mining	0.87	1.15	1.58	1.20	0.99	1.24
Construction	0.46	0.39	0.43	0.58	0.48	0.42
Manufacturing	3.43	3.67	3.89	3.68	3.70	4.03
Food	0.98	1.00	1.05	0.93	1.01	0.96
Textiles	1.44	1.77	1.59	2.17	2.17	1.87
Pulp and paper products	0.93	0.92	1.12	1.06	0.98	1.09
Printing and publishing	0.96	1.06	1.13	1.24	1.14	1.07
Chemicals	5.15	5.24	5.49	5.37	5.36	5.73
Industrial chemicals and chemical fibers	3.87	3.87	4.25	3.99	3.64	4.07
Oils and paints	4.33	4.57	4.25	4.47	4.43	4.71
Drugs and medicines	8.11	8.06	8.07	8.07	8.60	8.52
Other chemicals	4.50	5.30	5.36	4.99	5.11	5.07
Petroleum and coal products	0.45	0.49	0.48	0.32	0.24	0.26
Plastic products	2.48	2.24	2.32	2.17	2.38	2.83
Rubber products	3.36	3.37	3.19	4.09	3.64	4.02
Ceramics	2.51	2.93	2.96	2.35	2.48	2.84
Iron and steel	1.84	1.92	2.01	1.88	1.64	1.67
Non-ferrous metals and products	2.21	2.44	2.45	2.43	2.37	2.49
Fabricated metal products	1.27	1.46	1.52	1.41	1.70	1.49
General machinery	3.26	3.41	3.76	3.96	3.93	4.16
Electrical machinery	5.81	6.05	6.32	5.75	5.65	6.83
Electrical machinery, equipment and supplies	5.64	6.13	6.08	5.90	5.64	6.21
Communication and electrical equipment	5.90	6.01	6.43	5.69	5.65	7.09
Transport equipment	3.59	3.97	4.12	3.95	3.90	4.25
Motor vehicles	3.76	4.20	4.35	4.12	4.09	4.44
Other transport equipment	2.77	2.90	3.03	3.09	2.86	3.15
Precision instruments	5.74	6.28	6.33	6.83	6.34	6.58
Other manufacturing	1.41	1.70	1.84	1.66	1.70	1.79
Transport communication and public utility	0.89	0.91	0.80	1.11	1.15	1.14
Wholesale trade	-	-	-	-	-	0.35
Software data processing	9.83	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
All industries	3.06
Agriculture, forestry and fisheries	0.53
Mining	0.93
Construction	0.39
Manufacturing	3.99
Food	1.08
Textile mill products	2.25
Pulp and paper	1.16
Printing	1.35
Drugs and medicines	8.91
Chemical products	3.59
Industrial chemicals and chemical fibers	3.90
Oils and paints	4.13
Other chemical products	2.95
Petroleum and coal	0.23
Plastic products	2.44
Rubber products	4.20
Ceramics	2.52
Iron and steel	1.50
Non-ferrous metals and products	2.45
Fabricated metal products	1.39
General machinery	4.43
Electrical machinery, equipment and supplies	5.20
Electronic and electric measuring instruments	4.98
Other electrical machinery equipment and supplies	5.26
Information and communication electronics equipment	7.43
Electronic parts and devices	5.13
Transportation	4.35
Motor vehicles	4.56
Other transportation equipment	1.87
Precision machinery	7.77
Other manufacturing	1.82
Electricity, gas, heat supply and water	0.44
Information and communications	1.97
Software and information processing	2.41
Communications	1.97
Broadcasting	0.17
Newspaper, publishers and other data processing	1.07
Transport	0.29
Wholesale trade	0.19
Services	13.20
Professional services	0.81
Scientific research institutes	84.41
Other business services	0.80

Notes:1. Figures are the ratios of individual company R&D expenditures to sales amounts.
2. Figures are for companies only, excluding public corporations and incorporated administrative agencies.
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	13,065	13,797	0.95

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	1992	93	94	95	96	97	98	99	2000	01	02	Composition ratio (%)	Ratio to the previous year	Percentage of receipts to R&D expenditures (%)
All industries	377,691	400,362	462,128	562,077	703,033	831,563	916,098	960,800	1,057,853	1,246,814	1,386,769	100	1.11	18.2
Construction	3,159	4,360	7,820	3,063	13,251	3,274	2,398	434	3,779	667	719	0.1	1.08	5.4
Manufacturing	372,778	394,144	452,585	556,414	686,629	824,476	908,200	955,450	1,047,860	1,213,310	1,367,092	98.6	1.13	18.2
Food	7,596	5,432	9,096	10,564	8,924	8,830	8,851	10,519	10,579	12,649	17,694	1.3	1.40	12.8
Textile mill products	3,450	4,854	3,635	4,396	22,384	5,284	3,651	3,851	2,362	2,663	2,535	0.2	0.95	6.3
Drugs and medicines	—	—	—	—	—	—	—	—	—	—	142,212	10.3	—	19.3
Chemical products	57,057	59,348	64,113	72,064	95,089	106,755	122,769	144,992	130,517	156,263	56,524	4.1	1.27	10.2
Ceramics	16,155	9,808	10,495	11,658	11,836	13,717	13,129	11,604	11,550	11,974	14,079	1.0	1.18	14.0
Iron and steel	8,802	13,294	12,845	16,923	20,940	15,319	11,932	11,544	13,436	9,601	9,570	0.7	1.00	8.4
Non-ferrous metals and products	3,318	3,640	4,418	4,315	5,149	5,738	6,252	5,538	5,728	4,863	8,015	0.6	1.65	8.4
Fabricated metal products	3,173	4,698	3,154	3,690	20,035	3,295	6,715	3,053	2,286	4,035	2,304	0.2	0.57	10.0
General machinery	21,847	18,425	20,262	22,081	22,444	29,727	31,616	29,377	35,275	50,347	45,946	3.3	0.91	9.0
Electrical machinery	106,728	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	3.3	—	6.7
Information and communication electronics equipment	—	—	—	—	—	—	—	—	—	—	135,954	9.8	—	7.8
Electronic parts and devices	—	—	—	—	—	—	—	—	—	—	61,157	4.4	—	13.6
Transportation	126,519	127,670	164,234	163,975	211,049	350,947	435,717	500,018	588,961	675,545	771,384	55.6	1.14	47.6
Precision machinery	5,058	4,036	5,633	8,467	10,397	8,890	8,426	9,262	7,729	13,523	11,141	0.8	0.82	3.0
Other manufacturing	13,075	15,562	14,223	23,259	25,125	29,966	21,385	21,219	28,079	31,960	43,129	3.1	1.35	13.0
Other	1,754	1,858	1,723	2,600	3,153	3,813	5,500	4,916	6,214	32,837	18,958	1.4	0.58	22.6

(2) Technology import amounts

(Unit: million yen)

Industry \ Fiscal year	1992	93	94	95	96	97	98	99	2000	01	02	Composition ratio (%)	Ratio to the previous year	Percentage of receipts to R&D expenditures (%)
All industries	413,908	362,974	370,693	391,715	451,169	438,400	430,054	410,296	443,287	548,379	541,713	100	0.99	7.2
Construction	1,190	724	936	1,310	528	1,224	557	648	371	411	1,188	0.2	2.89	2.6
Manufacturing	410,677	359,601	367,843	388,257	439,097	430,420	406,251	388,068	423,002	488,708	473,294	87.4	0.97	6.5
Food	7,691	8,430	8,511	7,949	8,678	8,731	7,484	9,655	16,335	17,445	18,955	3.5	1.09	15.1
Textile mill products	6,719	6,188	7,829	8,087	10,561	6,889	4,849	4,050	4,450	3,585	2,045	0.4	0.57	7.2
Drugs and medicines	—	—	—	—	—	—	—	—	—	—	41,684	7.7	—	6.1
Chemical products	70,672	61,368	59,043	66,166	69,803	67,297	71,677	66,876	65,191	89,875	26,345	4.9	0.76	6.1
Ceramics	7,852	3,828	2,290	1,767	3,538	3,923	9,170	5,103	5,806	8,156	972	0.2	0.12	1.2
Iron and steel	3,467	3,403	2,342	4,187	3,020	5,210	4,880	2,419	2,269	2,242	2,013	0.4	0.90	1.9
Non-ferrous metals and products	6,314	3,620	2,707	4,084	4,629	15,701	3,694	3,227	5,823	44,132	41,158	7.6	0.93	41.4
Fabricated metal products	1,738	1,505	1,680	1,973	1,664	1,406	1,741	1,077	558	1,848	2,007	0.4	1.09	10.2
General machinery	27,907	25,554	23,270	21,066	23,295	21,932	23,581	28,775	38,841	30,615	49,485	9.1	1.62	9.6
Electrical machinery	178,879	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	6.2	—	5.3
Information and communication electronics equipment	—	—	—	—	—	—	—	—	—	—	151,645	28.0	—	7.5
Electronic parts and devices	—	—	—	—	—	—	—	—	—	—	45,626	8.4	—	10.4
Transportation	53,374	40,392	35,630	32,525	42,534	34,792	36,165	33,921	34,616	36,979	25,612	4.7	0.69	1.8
Precision machinery	22,051	22,747	10,618	11,911	12,836	15,085	9,742	6,759	7,731	14,354	12,749	2.4	0.89	3.4
Other manufacturing	24,013	23,407	36,541	28,796	36,215	30,512	28,269	23,932	25,015	16,471	19,237	3.6	1.17	6.7
Other	2,041	2,649	1,914	2,148	11,544	6,756	23,246	21,580	19,914	59,260	67,231	12.4	1.13	31.5

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	1992	93	94	95	96	97	98	99	2000	01	02	Composition ratio (%)	Ratio to the previous year
Asia (excluding West Asia)	1,663.67	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	26.1	1.07
West Asia	15.81	17.80	23.14	15.34	18.58	26.45	20.74	23.04	42.56	57.58	71.77	0.5	1.25
North America	1,260.79	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	57.6	1.11
South America	42.69	37.50	49.52	47.80	83.10	82.83	87.00	64.17	108.99	95.00	84.75	0.6	0.89
Europe	643.91	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	13.9	1.24
Africa and Oceania	150.04	119.32	97.48	77.85	68.51	164.06	186.01	156.01	170.33	177.33	182.43	1.3	1.03
Total	3,776.91	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	100.0	1.11
South Korea	394	504	531	646	696	460	385	331	399	350	370	2.7	1.06
China	165	163	173	178	469	436	434	469	525	687	858	6.2	1.25
Taiwan	217	207	300	441	402	508	503	549	529	483	648	4.7	1.34
Indonesia	131	119	152	216	232	205	159	138	182	228	314	2.3	1.38
Thailand	245	325	362	462	513	415	304	354	547	696	652	4.7	0.94
Singapore	240	248	265	284	408	289	251	180	211	210	176	1.3	0.84
USA	1,119	1,192	1,393	1,606	2,082	3,653	4,260	4,691	4,805	5,856	6,341	45.7	1.08
Brazil	22	21	35	37	61	52	46	32	71	53	51	0.4	0.97
UK	248	307	442	413	459	578	753	609	660	546	717	5.2	1.31
Italy	62	28	27	49	61	61	60	50	56	69	134	1.0	1.94
Russia	2	4	2	1	1	—	—	—	2	2	2	0.0	0.87
Germany	99	95	92	139	136	137	154	159	131	190	272	2.0	1.43
France	113	106	101	148	155	144	170	159	186	239	246	1.8	1.03
Australia	50	54	53	20	19	65	104	95	90	103	109	0.8	1.06

Notes: 1. The data for Russia until 1991 are that for former Soviet Union.

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

Source: Statistics Bureau, Ministry of Management, Home Affairs, Post and Telecommunications. "Report on the Survey of Research and Development"

(2) Technology import amounts

(Unit: 100 million yen)

FY / Region and country	1992	93	94	95	96	97	98	99	2000	01	02	Composition ratio (%)	Ratio to the previous year
North America	2,938.98	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	67.9	0.98
Europe	1,187.33	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	30.9	0.99
Other	12.77	15.44	11.16	26.62	45.28	50.45	53.63	51.50	67.36	48.83	64.99	1.2	1.33
Total	4,139.08	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	100.0	0.99
USA	2,922	2,578	2,605	2,776	3,285	3,110	3,038	2,896	3,294	3,706	3,655	67.5	0.99
UK	166	140	125	121	134	116	130	153	134	321	243	4.5	0.76
Itary	41	37	17	25	18	16	16	14	16	24	27	0.5	1.15
Netherlands	224	216	218	234	242	237	268	219	184	170	327	6.0	1.92
Switzerland	166	158	204	205	173	179	185	164	194	196	185	3.4	0.94
Germany	234	188	211	194	248	271	229	211	199	226	213	3.9	0.94
France	209	161	174	189	201	202	166	163	149	551	557	10.3	1.01

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 2001)

(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	1,386,769	361,285	7,177	798,195	8,475	193,393	18,244	541,713	367,945	167,270	6,498
Construction	719	455	-	120	-	144	-	1,188	44	1,080	64
Manufacturing	1,367,092	346,687	6,954	794,759	7,874	192,678	18,140	473,294	313,743	154,037	5,514
Food	17,694	5,917	8	7,305	943	3,433	88	18,955	5,640	13,299	16
Textile mill products	2,535	922	22	955	-	636	-	2,045	67	1,978	-
Pulp and paper	1,676	133	101	524	147	771	-	705	626	79	-
Printing	7,735	7,677	-	12	-	46	-	921	561	328	32
Drugs and medicines	142,212	2,904	53	92,436	2	46,815	2	41,684	11,462	30,027	195
Chemical products	56,524	28,080	1,465	10,186	214	14,821	1,758	26,345	20,980	5,335	30
Petroleum and coal	402	244	-	108	3	44	3	2,147	587	1,560	-
Plastic products	6,078	4,043	18	1,421	-	567	29	1,346	844	492	10
Rubber products	21,067	4,882	663	10,973	-	3,861	688	4,063	3,555	508	-
Ceramics	14,079	10,072	39	1,859	187	1,621	301	972	462	498	12
Iron and steel	9,570	5,387	202	1,445	1,451	742	343	2,013	633	1,375	5
Non-ferrous metals and products	8,015	4,123	-	2,883	60	865	84	41,158	3,555	37,599	4
Fabricated etal products	2,304	1,337	-	827	3	132	5	2,007	1,698	309	-
General machinery	45,946	16,209	23	17,609	157	11,838	110	49,485	40,599	8,332	554
Electrical machinery, equipment and supplies	45,448	17,018	15	25,052	251	2,704	408	33,761	26,625	6,396	740
Information and communication electronics equipment	135,954	79,219	1,451	28,175	436	26,260	413	151,645	122,284	27,449	1,912
Electronic parts and devices	61,157	46,549	-	10,086	464	4,058	0	45,626	40,538	4,532	556
Transportation	771,384	105,126	2,891	577,338	3,467	68,848	13,714	25,612	12,714	12,187	711
Precision machinery	11,141	6,232	-	2,712	2	2,196	-	12,749	11,103	952	694
Other manufacturing	6,172	614	2	2,852	87	2,421	196	10,053	9,210	803	40
Other	18,958	14,143	223	3,316	601	571	104	67,231	54,158	12,153	920

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

Year	R&D expenditure deflators in Japan: Natural sciences: Business enterprises	Natural sciences: Non-profit institutions and public organizations	Natural sciences: Universities and colleges	Natural sciences: Total	Total including social science and humanities	GDP deflators: Japan	USA	Germany	France	UK	EU	South Korea
1981	84.4	83.2	76.2	82.7	81.1	80.4	63.5	66.8	55.6	50.7	53.8	38.7
82	86.9	85.5	78.9	85.3	83.8	82.1	67.4	69.9	61.9	54.5	58.3	41.5
83	88.0	86.6	80.5	86.5	85.2	84.0	70.1	72.2	67.5	57.4	62.2	43.9
84	90.4	88.7	83.0	89.0	87.7	86.7	72.7	73.7	72.3	60.0	65.6	46.4
85	91.5	89.9	84.8	90.4	89.3	88.7	75.0	75.3	76.2	63.4	68.7	48.5
86	88.8	87.9	84.1	88.0	87.3	90.2	76.7	77.7	80.1	65.5	71.8	51.0
87	89.2	88.5	85.0	88.6	87.9	90.4	79.0	79.1	82.4	68.9	74.2	53.9
88	91.2	90.6	87.8	90.6	90.1	91.1	81.8	80.3	84.8	73.2	76.9	58.0
89	95.1	94.6	91.7	94.6	94.1	93.2	84.9	82.2	87.5	78.6	80.3	61.3
90	97.9	97.9	94.9	97.6	97.2	95.5	88.2	84.8	90.0	84.5	84.3	67.9
91	99.4	99.5	97.2	99.2	98.9	98.3	91.4	87.8	92.7	90.2	88.2	75.2
92	99.7	99.8	97.9	99.5	99.3	99.9	93.6	92.2	94.5	93.8	91.8	81.0
93	99.2	99.4	98.2	99.1	99.0	100.4	95.9	95.6	96.7	96.2	94.9	86.7
94	99.7	99.8	99.2	99.7	99.6	100.5	97.9	98.0	98.4	97.5	97.3	93.3
95	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
96	101.2	100.9	101.4	101.2	101.2	99.2	101.9	101.0	101.4	103.3	102.3	103.9
97	102.2	101.7	102.1	102.1	102.2	99.5	103.9	101.7	102.8	106.2	105.6	107.2
98	100.1	99.8	100.2	100.1	100.2	99.4	105.2	102.8	103.7	109.4	107.0	112.6
99	99.0	98.6	98.9	98.9	99.0	98.0	106.8	103.3	104.3	112.1	109.1	110.3
2000	99.4	97.8	98.9	99.1	99.2	96.0	109.0	103.1	105.3	114.6	112.0	109.1
01	98.2	96.6	97.8	98.0	98.1	94.6	111.6	104.6	107.2	117.2	114.8	111.8
02	99.0	97.9	98.8	98.8	98.8	93.5	112.9	106.1	109.1	120.9	117.6	113.7

Notes:1. The R&D expenditures deflator uses a fiscal year value, while the GDP deflator uses a calendar year value. FY1995 serves as the base year for both, with a value of 100.
2. The deflator value for non-profit institutions and public organizations up to FY2000 is the figure for research institutions.

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"