

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

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

- Chapter 1 General Provisions (Articles 1 - 8)
- Chapter 2 Science and Technology Basic Plan(Article 9)
- Chapter 3 Promotion of Research and Development (Articles 10 - 17)
- Chapter 4 Promotion of International Exchange (Article 18)
- Chapter 5 Promotion of Learning on S&T (Article 19)
- Supplementary Provision

### 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 along 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 website

(accessed and cited November 1, 2001) <<http://www8.cao.go.jp/cstp/english/law.html>>

## 2. The Science and Technology Basic Plan (2006-2010) (unofficial version)

(Cabinet decision: March 28, 2006)

### Introduction

#### Chapter 1 Basic Ideas

1. Circumstances relating to S&T
  - (1) Progress in S&T measures
    - (i) Total amount of governmental R&D expenditure
    - (ii) Strategic priority setting in S&T
    - (iii) Development of a competitive R&D environment and other R&D system reforms
    - (iv) Industry-university-government collaboration and other S&T system reforms
  - (2) Results of S&T policies
  - (3) Changes that may have impact on S&T both at home and abroad and the roles of S&T
2. Basic stances in the third basic plan
  - (1) S&T to be supported by public and to benefit society
  - (2) Emphasis on fostering human resources and competitive research environments—Shift of emphasis from "hard" to "soft" such as human resources; greater significance of individuals in institutions
3. Ideas and goals of S&T policies
  - (1) Ideas and policy goals of the third basic plan
  - (2) S&T's contribution to the world, society, and public
4. Governmental R&D expenditure

#### Chapter 2 Strategic Priority Setting in S&T

1. Promotion of basic research
2. Priority setting in R&D for policy-oriented subjects
  - (1) "Four priority fields to be promoted" and "four fields to be promoted"
  - (2) Formulation of promotion strategies
  - (3) Selection of "Strategic Prioritized S&T"
3. Matters to be considered in the formulation and implementation of Promotion Strategies
  - (1) Emerging and interdisciplinary fields
  - (2) Clarifying the relationship with policy goals and establishing R&D goals
  - (3) Horizontal matters to be considered relating to "Strategic Prioritized S&T"
    - (i) S&T selected to resolve social issues immediately
    - (ii) S&T selected to win in international competition
    - (iii) S&T selected as a key technology of national importance
  - (4) Effective implementation of promotion strategies - Realization of "practical strategies"

#### Chapter 3 Reforming the S&T System

1. Developing, securing and activating human resources
  - (1) Creating an environment in which individuals thrive
    - (i) Ensuring fair and highly transparent personnel systems
    - (ii) Supporting the independence of young researchers
    - (iii) Improving the mobility of human resources
    - (iv) Suppressing the rate of inbreeding
    - (v) Promoting the activities of female researchers
    - (vi) Promoting the activities of foreign researchers
    - (vii) Utilizing the abilities of talented senior researchers

- (2) Enhancing the human resource development function in universities
    - (i) Human resource development in universities
    - (ii) Drastic enhancement of graduate education
    - (iii) Formulating an action plan on the reform of graduate school education
    - (iv) Improving financial aid for doctorate course students
  - (3) Developing human resources that meet the needs of society
    - (i) Human resource development by industry-university partnership
    - (ii) Promoting the activities of doctorals in industry
    - (iii) Development of diverse human resources responsible for utilizing and returning knowledge to society
  - (4) Expanding the horizons and scope of human resources who will build future S&T
    - (i) Developing children with exuberant intellectual curiosity
    - (ii) Developing the individuality and abilities of gifted children
2. Creating scientific development and persistent innovation
- (1) Developing a competitive environment
    - (i) Increasing competitive funds and indirect costs
    - (ii) Developing a competitive environment in organizations
    - (iii) Promoting the systemic reforms on competitive funds
  - (2) Enhancing the competitive edge of universities
    - (i) Creating universities that lead the world's S&T
    - (ii) Revitalizing universities that utilize uniqueness and characteristics
  - (3) Enhancing systems for creating innovation
    - (i) Maintaining the various research fund systems according to the development stage of R&D
    - (ii) Building a sustainable and progressive industry-university-government collaboration system
    - (iii) Promoting the utilization of new technologies in the public sector
    - (iv) Promoting the entrepreneurial activities of R&D ventures
    - (v) Promoting R&D by private enterprises
  - (4) Building regional innovation systems and creating vital regions
    - (i) Forming regional clusters
    - (ii) Developing smooth S&T policies in regions
  - (5) Effective and efficient promotion of R&D
    - (i) Effective utilization of research funds
    - (ii) Emphasizing the development and utilization of human resources in research funds
    - (iii) Reforming the evaluation system
  - (6) Resolving the institutional and operational bottleneck that acts against S&T activities and returning benefits from R&D to society
3. Reinforcing the foundation for promoting S&T
- (1) Intentional and selective improvements of facilities
    - (i) Improvements of facilities such as national universities and public research institutions
    - (ii) Development of facilities of national universities and public research institutions
    - (iii) Developing the facilities of public universities
    - (iv) Developing the facilities of private universities
    - (v) Promoting the development and shared use of advanced large-scale public research facilities
  - (2) Improving the intellectual infrastructure
    - (i) Strategic and selective development of intellectual infrastructure
    - (ii) Building a framework for promoting efficient development and use
  - (3) Creating, protecting and utilizing intellectual property
  - (4) Actively responding to standardization
  - (5) Improving the research information infrastructure

- (6) Promoting the activities of academic societies
- (7) Promoting R&D in public research institutions
- 4. Strategically promoting international activities
  - (1) Systematic efforts of international activities
  - (2) Cooperating with Asian nations
  - (3) Promoting general development for reinforcing international activities, and acceptance of talented foreign researchers

#### Chapter 4 S&T to Be Supported by Society and the Public

- 1. Responsible measures to resolve ethical, legal, or social problems caused by S&T
- 2. Accountability relating to S&T and the improvement of information transmission
- 3. Improving the public awareness of S&T
- 4. Promoting proactive participation of the public in S&T

#### Chapter 5 Role of the Council for Science and Technology Policy

- 1. Basic operation
- 2. Specific measures
  - (1) Effective, efficient promotion of governmental R&D
  - (2) Promotion of S&T system reforms
  - (3) S&T to be supported by the public and to benefit society
  - (4) Strategic promotion of international activities
  - (5) Removal of structural or operational obstacles for smooth S&T activities and the return of the results to society
  - (6) Appropriate follow-up of the S&T basic plan and the promotion of the progress

## Introduction

It is never easy for Japan, a resource-poor country, to occupy an honorable position in human society. In fact, the country's future prosperity depends on the development of unique, outstanding science and technology (S&T). With this understanding, Japan set the goal of "becoming an advanced science-and technology-oriented nation" as a national strategy, and the Science and Technology Basic Law was enacted. Under this Law, a comprehensive range of measures has been taken intensively based on the Science and Technology Basic Plan (hereinafter "Basic Plan"), including the "First Basic Plan" for FY1996-2000, and the "Second Basic Plan" decided by the Cabinet in March 2001 and scheduled for implementation during FY2001-2005.

The first and second basic plans were formulated and carried out during the period of prolonged economic stagnation in Japan following the collapse of the bubble economy. Even in those deteriorating financial circumstances, governmental R&D expenditure increased, and a broad range of structural reforms were conducted such as: strategic priority setting in S&T through promotion of basic research and prioritization of R&D on national/social issues; development of a competitive R&D environment by increasing competitive funds and reforming existing systems; and the reorganization of national research institutes and national universities into corporations.

At this time of formulation of the third basic plan, the Japanese economy has finally recovered from the prolonged stagnation and started to show signs of shifting toward a sustainable growth path. In S&T, also, policy efforts have been made persistently based on the first and second basic plans. As a result of these efforts, world-leading research papers and findings emerged, and some of the advanced findings have been turned into innovative industrialization. The competitiveness of the private sector is based on national S&T capability. In light of this, both effective increase of R&D expenditure and thorough execution of R&D system reforms during the period of the third basic plan (FY2006-2010) will be indispensable for the long-term development of the Japanese economy.

Of course, people expect much more than economic contributions from Japan's S&T in the third basic plan. They also expect: contributions to society, which is changing remarkably due to Japan's rapidly aging population and declining birth rate; resolution of safety issues relating to public concerns about large-scale natural disasters and accidents, as well as complicated global security issues including terrorist attacks; and resolution of deteriorating global-scale problems concerning population, the environment, and many other areas. Thus, society expects S&T to play more extensive and profound roles. Moreover, the world never stops making progress in S&T. China, South Korea, and other Asian countries, as well as the U.S. and Europe, are rapidly coming to enhance S&T as a basis of national strength.

To use investments accumulated during the period of the previous two plans and also to meet increasing social and economic needs in various fields, the third basic plan should further enhance accountability and strategies, and aim for S&T to be supported by the public and to benefit society. The core strategies of the third plan are: development of world-class researchers who can produce excellent research findings, creation of a competitive environment, promotion of science, and creation of persistent innovations through strategic investment; and removal of systematic or operational obstacles to return the R&D benefits back to society. S&T has a mission to address a broad range of these policy issues for the next five years. With this basic understanding, the third basic plan intends to indicate primary measures to be executed steadily by the government as a whole with the leadership of the Council for Science and Technology Policy.



## Chapter 1 Basic Concepts

### 1. Circumstances relating to S&T

#### (1) Progress in S&T measures

The first basic plan had as its primary principle aggressive promotion of both R&D to meet social and economic needs and basic research to create intellectual assets, and provided measures to be taken. In the plan, the total amount of governmental R&D expenditure was estimated to be around 17 trillion yen, and the final budget exceeded the estimation despite severe financial conditions.

The second basic plan provided three concepts as the core of the vision that this country should aim for in S&T policies, i.e. a nation contributing to the world by the creation and utilization of scientific knowledge; a nation with international competitiveness and ability to develop sustainably; and a nation securing safety and quality of life.

Based on these ideas, the second basic plan budgeted about 24 trillion yen, more than the amount in the first basic plan, as governmental R&D expenditure for the five years from FY2001 to FY2005, aiming at S&T system reforms and strategic priority setting in S&T through promotion of basic research and prioritization of R&D on national/social issues. The measures planned in the second basic plan have been implemented steadily as a whole. The progress in primary measures is described below.

#### (i) Total amount of governmental R&D expenditure

Due to economic stagnation over rather long periods of time and severe financial conditions, the total amount of governmental R&D expenditure did not reach 24 trillion yen, the amount planned in the second basic plan, but achieved higher growth compared to other general expenditures.

Note: The above expenditure of 24 trillion yen is based on an assumption that the governmental R&D investment should be 1 percent of GDP, the nominal growth rate of which is 3.5 percent, during the period of the second basic plan.

#### (ii) Strategic priority setting in S&T

Strategic priority setting in S&T, which aims at effective, efficient promotion of governmental R&D investments, made steady progress in resource allocation. More specifically, the significance of basic research steadily increased in governmental R&D as a whole, while the country's S&T formed a stronger basis. Competitive funds, in particular, increased remarkably. As for R&D on national/social issues, resources were allotted preferentially and primarily to four areas: life sciences, information and telecommunications, environmental sciences, and nanotechnology/materials. These areas are expected to contribute significantly to the vision toward which the country should aim (the three Ideas). In the other four areas, i.e. energy, manufacturing technology, infrastructure, and frontier, R&D on indispensable fields for the nation's existence in those areas were primarily promoted. As a result, in the S&T budgets for these eight areas, the percentage of budgets for the prioritized four areas increased from 38 percent in FY2001 to 46 percent in FY2005.

#### (iii) Development of a competitive R&D environment and other R&D system reforms

The amount of competitive funds (R&D funds distributed to researchers; the entities of resource allocation are diverse, and an expert team selects appropriate projects to be funded, from research projects gathered and proposed, mainly based on scientific or technical evaluation) did not double but increased, and the percentage of funds to the S&T budget increased from 8 percent to 13 percent in the period of the plan. In addition, certain progress has been made in system reforms, such as increase of indirect expenses, improvement of systems to cultivate young researchers, and strengthening of the managerial/evaluation system by program officers and directors (POs/PDs). However, other reforms-such as securing 30 percent of the budget for indirect expenses-remain unfinished. In the course of budgetary increase in prioritized areas, a broader range of government agencies have been

adopting a competitive fund system, and various types of expenses have been budgeted for competitive funds.

The numbers of universities and public research institutions adopting fixed-term appointments increased, while the percentage of fixed-term researchers to total researchers remained low.

Moreover, 68 national research institutes were reorganized into independent administrative institutions in April 2001 and national universities into corporations in April 2004, and research institutions became able to conduct more flexible research management. Under the National Guideline on the Method of Evaluation for Government R&D (Decided by the Prime Minister in November 2001; amended in March 2005; hereinafter "National Guideline"), other R&D system reforms were promoted, resulting in the steady recognition and execution of R&D evaluation by relevant ministries, agencies, and research institutions, and the improvement of their awareness.

#### **(iv) Industry-academia-government collaboration and other S&T system reforms**

S&T system reforms enabled steadily progress in industry-academia-government collaboration. This collaboration took such diverse forms as an increase in the numbers of industry-academia joint research, technology transfers by technology licensing organizations (TLOs), and university-derived ventures (the total number of such ventures has now surpassed 1,000). Regional S&T promotion has also advanced (18 regions for knowledge clusters; 19 projects for industrial clusters).

In accordance with the "5-Year Plan for Urgent Improvement of National Universities and Other Research Institutions," graduate schools and research institutions were developed and improved, and the congestion problem of facilities—the main priority—was resolved with planning. However, the improvement of deteriorated facilities was delayed, while the number of deteriorated facilities increased, mainly due to the elapse of time.

## **(2) Results of S&T policies**

Looking into the promotion of basic research and the results of investment strategies including the effects of accumulated investments, Japan has improved its international status steadily in the quality and quantity of research papers, resulting in world-class achievements. According to a survey on extensive technical areas for S&T experts, Japan—in comparison with the United States and EU—improved its international status in almost all fields compared to five years ago. Japanese researchers have been acknowledged for their unique findings, and Nobel Prizes have been awarded to three researchers in chemistry and one in physics since 2000.

As far as judging from the numbers of university-derived ventures and joint research conducted by universities and private companies, technology transfer from universities and public research institutions worked well during the period of the second basic plan. Moreover, Japan's unique research findings have created a new market that generates tens of billions of yen while contributing to defeating intractable diseases.

Comparing R&D levels in the aforementioned survey, the gap has narrowed between Asian countries and Japan. International competition has been growing fiercer in the numbers of international patent applications and U.S.-registered patents, and Japan is less likely to improve its market share. The country's balance of trade in technology improved as a whole but remained in deficit in many leading-edge industries such as information and telecommunications.

Reviewing the results of R&D investments, research levels have steadily improved, and industry-university-government collaboration has been promoted. In addition, research findings have been returned to the economy and society. More specifically, a new cancer therapy (heavy ion medical accelerator) was developed, materials for regenerative medicine (artificial bone using apatite) were applied practically, and other contributions were made to improve people's health. In solar power generation, Japan achieved the world's highest power conversion efficiency and developed solar technologies for mass production. The amount of solar power generated in Japan accounts for 50 percent of the world's total, and thus S&T results have been contributing to the viability of Japan as an environmentally developed country. In industries supporting economic recovery such as the home

information appliance and advanced materials industries, it is considered that governmental R&D results, especially those relating to information and telecommunications, nanotechnology/materials, and environmental sciences (the development of state-of-the-art semiconductor manufacturing technology, magnetic micro disks with the world-highest bit density, and photocatalytic materials with diverse effects), coupled with the country's industrial strength, have improved competitiveness steadily. These results have also been contributing to domestic and global security, such as clarifying the cause of the tanker accident that caused great damage to the Japan Sea coast due to an oil leakage, performing safety analysis, and incorporating new safety standards into international treaties in an appropriate manner.

These results, initially beginning with innovative findings and inventories, were developed by overcoming significant difficulties, including the so-called "Valley of Death." In the course of the development, public R&D investments were made appropriately at suitable times from the initial research phase to the practical application phase, and leading industry-university collaborations were made in the final phase. We must accelerate further development based on these results.

It will take many years to turn the increase of intellectual assets into the creation of value. Therefore, future efforts should be made to use the country's potential S&T capability that improved by investments in the period of the previous two plans, to create innovation in a broad range of social and economic areas (the innovation generating new social and economic values with advanced scientific findings and technical inventions combined with human insights), enhance industrial competitiveness, resolve a wide range of social issues such as safety and health, and ensure the sustainable prosperity of the Japanese economy and public life.

### **(3) Changes that may have impact on S&T both at home and abroad and the roles of S&T**

During the period of the third basic plan, the environment relating to S&T is expected to change remarkably at home and abroad, and people's expectations for S&T are also expected to grow.

It is obvious that demographic changes will have a greater impact on society. To achieve a stable economic growth despite its aging and decreasing population as well as its declining birth rate, Japan should tenaciously improve productivity. In addition, competitive companies are indispensable for Japan to achieve remarkable economic growth. Especially as other Asian countries have been rapidly improving their technological capabilities, some competitive Japanese manufacturers are facing fierce competition with companies in these countries. Therefore, Japan must produce more value-added products based on our national strength. S&T are a basis for improving competitiveness and productivity, and it is necessary to ensure economic recovery and sustainable growth by promoting S&T and turning the results into persistent innovation.

Japan's aging population and declining birth rate create a variety of new social issues, such as social security burdens on people, and national health, as well as economic issues. Meanwhile, social and national safety has been threatened by large-scale natural disasters, grave accidents, and complicated global security issues such as terrorist attacks, and there are growing concerns among people about safety and security. Since S&T are indispensable in resolving these issues, people's expectations for S&T will increase and thus S&T will assume responsibility for society.

Despite growing expectations, there remains a gap in different people's awareness of S&T. More specifically, many people are aware of S&T's contribution to society, while few people feel close to them. In particular, interest in S&T has been decreasing among young people. People are eager to obtain comfortable, safe, and spiritually affluent lives, while many feel anxiety about the rapid progress in S&T. Since the country's financial condition is getting worse, the development of advanced research facilities and other governmental R&D investments should be made more selectively and efficiently.

Fiercer international competition in S&T is one notable environmental change that has occurred in the world during the period of the previous two plans. Especially China, South Korea, and other Asian countries achieved remarkable economic growth, and their national policies for S&T promotion are considered to be playing a major role in this growth. In the U.S. and European countries, as well as

China, South Korea, and other rapidly-growing Asian countries, the development of capable human resources is deemed as a basis for S&T capability, and competition for procuring human resources has been taking place on a global basis. Japan once had abundant human resources based on its high educational level, but now faces a deteriorating situation relating to human resources due to declining academic standards in recent years and demographic changes in line with the aging of the population and declining birth rate.

Many efforts have been made to resolve global-scale problems concerning population, the environment, food, energy, and resources, but difficult challenges still remain such as: sustainable development of human society; and S&T achievements so as not to pass negative assets to the next generation. Japan, a country possessing excellent S&T, is expected, more than ever before, to contribute to human society through the resolution of the challenges by using its national S&T capability. Expectations for Japanese technology relating to earthquakes and other disasters are also high. S&T relating to natural, human, and social sciences are essential to ensure that Japan stays valuable in human society across centuries.

## **2. Basic stances in the third basic plan**

As outlined above, people strongly expect much from S&T in resolving fiercer S&T competition on a global basis, the aging of the population and declining birth rate, safety and security, and other global challenges. Meanwhile, a gap remains in different people's awareness of S&T. In light of these circumstances, the third basic plan should be executed based on the following two stances.

### **(1) S&T to be supported by public and to benefit society**

The effective implementation of S&T policies is possible only when they are understood and supported by the people. People's support and understanding should be achieved by: making R&D investments more effectively and strategically; tirelessly promoting the sciences, thereby creating intellectual and cultural values; making further efforts to return R&D results to society and the public through the creation of innovation; and clearly explaining S&T policies and their results to the people, thereby enhancing accountability. These efforts will increase people's interest in S&T and ensure that S&T are developed with their support.

### **(2) Emphasis on fostering human resources and competitive research environments—Shift of emphasis from "hard" to "soft" such as human resources; greater significance of individuals at institutions**

Human resources are the basis for S&T capability. The future of creative S&T in Japan depends on the capability of human resources who develop and play active roles in Japan. The country's policies for investments have shifted emphasis from "hard" (such as hard infrastructure) to "soft" (such as human resources through S&T and education investment in general). Therefore, in S&T policies, investment emphasis will be shifted from infrastructure to development of excellent human resources. The third basic plan intends to promote the development of creative human resources by discovering and training promising people, making personnel systems more flexible, securing a diversity of human resources, and promoting their creativity and willingness to take on challenges. The plan also aims to promote S&T system reforms to encourage each person to exert his or her willingness and enthusiasm, thereby maximizing creativity. The reforms should be made thoroughly so that young, female, and foreign researchers can express their willingness and abilities. In addition, efforts should be made to attract capable human resources at home and abroad and to develop world-class human resources. These efforts will improve Japan's S&T in the long run and contribute to building trust with other countries.

For the development of a competitive environment in S&T, it is important for people engaged in S&T to generate creative ideas, to have an opportunity to compete, and to receive fair judgment. To promote advanced S&T activities in modern society, it is also considered essential for researchers and

promising young people to belong to research or educational institutions with suitable facilities and equipment. To develop a competitive R&D environment, research or educational institutions should not be operated based on sectionalism but should develop researchers by encouraging them to generate creative ideas, to compete with others, and to exert their abilities to the maximum. Taking into consideration that research and educational institutions are a basis of individual S&T activities, S&T policies will shift to "greater significance of individuals at institutions" from the viewpoint of creating a more competitive environment.

### 3. Ideas and goals of S&T policies

#### (1) Ideas and policy goals of the third basic plan

The vision that Japan should aim for in the second basic plan (three Ideas) is universal; it can be shared by everyone. The three Ideas cover entire S&T policies, and are useful in developing future S&T policies.

Meanwhile, these general Ideas are not sufficient to clearly explain a variety of governmental R&D expenditure to the public, nor to develop practical, individual policies. Moreover, from the viewpoints of thorough accountability to the people and the return of S&T results to society, it is desirable to set practical policy goals for the realization of these Ideas, to develop measures based on the respective roles of the public and private sectors, and to evaluate the effects of these measures.

Therefore, the third basic plan will in principle inherit the three Ideas in the second basic plan and set more practical policy goals to realize these Ideas, giving full consideration to domestic and global changes and future prospects regarding S&T, the economy, and society. More specifically, the third basic plan will set the following six concepts, each of which contains two sub-goals. These concepts and goals are not placed in any order of priority, and are valuable equally as national goals. S&T policies are surely important for the goals to be achieved, but some of the goals will not be achieved without the results of R&D activities conducted by private companies and other non-governmental entities.

- <Concept 1> Create human wisdom: To build a nation that contributes to the world by creation and utilization of scientific knowledge
  - \* Goal 1: Quantum jump in knowledge, discovery, and creation: Accumulation and creation of diverse knowledge to ensure a bright future
    - (1) Discover and clarify new principles and phenomenon
    - (2) Create knowledge as a basis of discontinuous technical innovation
  - \* Goal 2: Breakthroughs in advanced S&T: Efforts for human dreams to come true
    - (3) Bolster S&T by conducting the world's most advanced projects

To be a nation that creates human wisdom and contributes to the world, Japan should first of all accumulate profound and diverse intellectual achievements that constantly generate remarkable knowledge. The accumulation of intellectual achievements, mainly from basic research to discover and clarify new principles and phenomenon, is expected to generate knowledge that is a basis of discontinuous technical innovation and that is pursued in the life/material sciences, where development and progress have been made at the atomic/molecular level. Japan lags behind the United States and Europe in accumulating intellectual achievements to make leaps in knowledge.

Another goal for S&T policies is to contribute to human society by making breakthroughs in S&T with the world's most advanced projects. Japan is expected to lead the world in the creation of international knowledge, including obtaining information on the unknown and discovering phenomenon occurring only in extreme conditions.

To achieve these goals, it is essential to develop capable researchers who enthusiastically pursue the creation of scientific knowledge, and to promote their activities. If Japan produces world-class, capable researchers, they will be good targets for young human resources, and enthusiasm for new

creation will be elevated. Therefore, the second basic plan set a goal of producing as many as 30 Nobel laureates in 50 years, aiming to increase the number of Japanese who win international prizes in science to the level of major European countries. For this purpose, S&T policies in the third basic plan are expected to promote basic research with emphasis on human resources.

- <Concept 2> Maximize national potential: To create a competitive nation that achieves sustainable growth
- \* Goal 3: Economic growth and environmental protection: Achieving sustainable economic growth based on environmental protection
    - (4) Overcome global warming and energy problems
    - (5) Realize an environmentally harmonized, recycling-oriented society
  - \* Goal 4: Innovator Japan: Realizing a strong economy and industries by the constant creation of innovation
    - (6) Realize a ubiquitous Internet society that attracts global interest
    - (7) Become the world's top manufacturing nation
    - (8) Enhance industrial competitiveness to win in global S&T competition

Japan must develop S&T as a basis of national strength to overcome the aging and decrease of its population, as well as its declining birth rate and global-warming/energy problems. It must also create a country that ensures sustainable growth in today's fierce international competition. To achieve this goal, S&T policies should focus on: how to decrease greenhouse gas emissions by 6 percent by 2012 from 1990 under international agreement, and to ensure the prosperity of the Japanese economy. Japan must also create an environmentally harmonizing, recycling-oriented society in the environmental sciences, a society in which people expect much from S&T.

Japanese industries are facing fierce competition with emergent Asian countries, especially from China and South Korea. To ensure our industrial competitiveness under such circumstances, the development of S&T should be made to generate highly-value-added innovation on a constant basis. For this purpose, policy goals should be set to build a ubiquitous Internet society that attracts people from around the globe, to lead the world in manufacturing as a national strength, and to establish an industrial capability to win in international S&T competitions.

The creation of competitive new industries is expected to generate high-quality employment and increase incomes. The minimization of environmental burdens such as greenhouse gasses is an essential challenge to be addressed by S&T for both economic growth and for environmental protection.

- <Concept 3> Protect the nation's health and security: To become a nation that secures safety and quality of life
- \* Goal 5: Nation's good health over a lifetime: Making Japan a country where people ranging from children to the elderly can stay healthy
    - (9) Overcome diseases afflicting the public
    - (10) Realize a society where everyone can stay healthy
  - \* Goal 6: The world's safest country: Making Japan the world's safest country
    - (11) Secure national, social safety
    - (12) Ensure safety in life

During the period of the second basic plan, the public has felt anxiety and strong expectations for S&T, primarily in health and safety issues. Safety and security, which are the basis of the country's sustainable growth, have been threatened by successive events such as: the outbreak of SARS, BSE, bird flu, and other international infectious diseases; a growing mistrust in food safety; deteriorating immune diseases such as hay fever; occurrence of grave rail accidents and other calamitous events, and large-scale natural disasters mainly due to earthquakes, tsunami, and typhoons; international security

that has become more complicated since the terrorist attacks of September 11, 2001; growing threats to information security; and the still severe situation of overall peace. Meanwhile, there are growing expectations for S&T to protect health and safety. These expectations include: development of innovative therapies for diseases by the life sciences, where notable progress has been made on a cellular or molecular basis; realization of healthy life by preventive medicine and good nutrition; and optimal utilization of advanced S&T for accidents, crimes, and natural disasters such as earthquakes.

Under these circumstances, S&T policies aim to combat diseases afflicting the public from children to the elderly, create a society where everyone can stay healthy over their lifetimes, and realize the world's safest nation where safety is ensured at social, national, and personal levels.

To achieve policy goals under these three Ideas, more practical goals must be set for each governmental R&D project. The relevant ministries and agencies will set policy goals for each project to realize 12 sub-goals with the leadership of the Council for Science and Technology Policy, and the Council will review these goals. Moreover, necessary modifications will be made to policy goals for each project to meet changing political needs in an appropriate manner.

By clarifying the Ideas and policy goals for governmental R&D investments and by creating a R&D system to realize these Ideas and goals, (i) accountability to the public will be promoted to clarify the goals or progress of R&D investments, and (ii) detailed guidelines and evaluation standards will be provided for each measure and project, contributing to the effective return of the results to society and the public.

## **(2) S&T's contribution to the world, society, and public**

Through the implementation of investments and measures to achieve new practical policy goals, S&T will also make a greater contribution to resolving a variety of deteriorating global-scale problems concerning population, the environment, food, energy, and resources, as well as the domestic issue of the rapid aging of the population and declining birth rate. More specifically, the six policy goals mentioned above should be achieved to address the following:

(Contributions to the world)

- \* Resolve problems common to all human beings
- \* Realize global peace and prosperity

(Contributions to society)

- \* Bolster growth in the Japanese economy
- \* Lead global rule-setting

(Contributions to the public)

- \* Provide security and energy for people's lives
- \* Ensure employment and lives of high quality

The Science Council of Japan, an organization representing the Japanese research community, announced the results of the discussion on S&T policies in the formulation of the third basic plan. These expectations are considered to be fulfilled by implementing the following policies based on the aforementioned basic stances, Ideas, and policy goals.

## **4. Governmental R&D expenditure**

R&D expenditure by the government and the private sector has increased during the period of the previous two plans; the percentage of total R&D expenditure to GDP in Japan now exceeds that in major developed countries. Despite the reduction of expenditure for other policies in under the recent severe financial climate, governmental R&D expenditure in Japan has increased considerably, reaching comparable levels of the United States and major European countries. These countries have been increasing R&D expenditure in recent years, and the public and private sectors should make continuous efforts to increase expenditure to win in international competition in the era of large-scale intellectual competition.

Further, it is necessary for Japan to make R&D investments steadily in consideration of respective roles of public and private sectors, to strengthen international competitiveness based on the investments through stronger public-private cooperation, and to return the results to the society and public.

In the period of the second basic plan, financial conditions in Japan were becoming worse than they were in the period of the first basic plan, and the worst among major developed countries. Therefore, it is essential to promote fiscal restructuring of both expenditure and revenues to create an active society and vital economy and to achieve sustainable growth.

Under these circumstances, from the viewpoint of continuing the effort of S&T promotion made during the period of the previous basic plans, the percentage of governmental R&D expenditure to GDP in the period of the third basic plan also should be raised up to at least the same level as in the United States and major European countries. The total amount of governmental R&D expenditure is estimated about 25 trillion yen in FY2006 to FY2010 .

Note: This estimation is based on the assumption that governmental R&D investment should be 1 percent of the GDP, of which the nominal growth rate is 3.1 percent, during the period of the third basic plan.

In light of these circumstances, annual budgets will be fixed to provide the expenditure necessary to promote measures in the basic plan. In budgeting, the trends of social and economic matters and needs of S&T promotion will be taken into account in the course of governmental fiscal restructuring, and the effects of governmental R&D investments will be maximized by implementing S&T system reforms steadily in financial conditions that are becoming worse than they were in the period of the second basic plan.

The quality of R&D activities will be upgraded by setting goals for the results to benefit the public and by evaluating the effects of investments based on a solid evaluation system. S&T system reforms will be promoted thoroughly by: increasing funds selectively to develop human resources and to create innovation; resolving the unreasonable allocation of research funds and improving the examination system; reforming the evaluation system; removing systematic or operational obstacles to ensure smooth S&T activities and to return the results to society; and understanding S&T activities in research or educational institutions. In addition, other financial resources should be obtained by, for example, introducing private funds and setting off properties by sale.

## **Chapter 2 Strategic Priority Setting in S&T**

Looking into the current progress and results of priority setting, as well as domestic social and economic circumstances and global trends for the future, priority setting in investments will continue to be essential from the viewpoint of effective, efficient promotion of S&T policies. Strategic priority setting in governmental R&D investments, too, will be further promoted. The third basic plan intends to enhance its strategy through selection and concentration. The second basic plan addressed the prioritization of research areas, while the third basic plan intends to include intra-sectoral prioritization as well. The basic plan also intends to clarify the relationship between strategic priority setting in S&T and the six policy goals newly created under the basic Ideas.

### **1. Promotion of basic research**

Basic research producing diverse wisdom and innovation will be steadily promoted with a certain amount of investments.

Basic research bringing human wisdom and serving as a source of knowledge is the most uncertain among all types of R&D activities. Generally, basic research does not produce desired outcomes on a planned basis; it realizes them in the steady, serious pursuit of truth and after much trial and error. The findings and inventions, which do not fall into the existing knowledge framework, will make leaps in knowledge. It is thus important to nurture innovative spirits among researchers.



Basic research consists of two types: Type-1 basic research that is conducted based on the free ideas of researchers in S&T, including human and social sciences; and Type-2 basic research, which aims at future applications based on policies. They will be promoted according to their respective significance. More specifically, Type-1 basic research will promote a variety of research activities from the very early stages in the pursuit of universal knowledge from a long-term perspective, aiming to accumulate intellectual achievements to generate new knowledge constantly. Meanwhile, Type-2 basic research is considered a part of the R&D for policy-oriented subjects that will be covered in the following sections, aiming to create knowledge, a source of discontinuous innovations that can reform the economy and society to achieve policy goals through prioritization based on Section 2 below.

Prioritization based on Section 2 below is not done for all types of basic research. For example, it must be clarified and thoroughly understood that research that derives from the free ideas of researchers and that are supported by Grants-in-Aid for Scientific Research will be promoted independently from R&D for policy-oriented subjects.

Of all research activities that derive from the free ideas of researchers, those requiring huge amounts of funds, in particular, will be promoted through thorough evaluation on researchers' ideas and through governmental prioritization of projects.

## **2. Priority setting in R&D for policy-oriented subjects**

### **(1) "Four priority fields to be promoted" and "four fields to be promoted"**

The second basic plan emphasized R&D on national/social issues, especially those relating to the life sciences, information and telecommunications, environmental sciences, and nanotechnology/materials, and funds were preferentially allocated to those four areas. The third basic plan deems those four areas as areas in which R&D activities should be promoted primarily (hereafter "four priority fields to be promoted"), and intends to allocate resources preferentially to those areas based on the following requirements of intra-sectoral prioritization.

- (i) The level of contribution to the three Ideas (relating to S&T, economy, and society) is generally high.
- (ii) People's expectations and interests are high according to the results of awareness surveys.
- (iii) Trends of S&T strategies in other countries are taken into account.
- (iv) Must be appropriate from practical perspectives, such as strategic viability and adoption by research sites.

In addition to the above, the third basic plan also deems the other four areas including energy, MONOZUKURI technology, social infrastructure, and frontiers as areas in which R&D activities are conducted with an emphasis on issues that are considered fundamental for the nation's existence and that need to be addressed by the government (hereinafter "four fields to be promoted"). Resource allocation will be made in an appropriate manner based on the principles of intra-sectoral prioritization mentioned in the following sections.

### **(2) Formulation of promotion strategies**

Prioritized resource allocation should not be made without close examination to R&D projects, even to those relating to the four priority fields to be promoted. Also, it is not appropriate to remove R&D projects relating to the four priority fields to be promoted, without such examination, from subjects for strategic resource allocation. Therefore, as for the four priority fields to be promoted and the four fields to be promoted, the Council for Science and Technology Policy will formulate strategies for promotion of each of the eight areas to achieve policy goals. These strategies will be formulated based on the following Ideas of intra-sectoral prioritization, and essential R&D issues will be selected in each area. These R&D issues must not be exhaustive or comprehensive.

- (i) Evaluate the future impact objectively on science, economy, and society by utilizing approaches such as the Delphi survey.

- (ii) Clearly recognize Japan's position and level in global S&T by using a benchmark, and clarify the necessity of investments. (e.g.: Is it an R&D issue to ensure Japan's competitive advantage by using national strength, an R&D issue to be resolved in response to strong social needs, or a R&D issue to lead a paradigm shift?)
- (iii) Identify the necessity of investments in R&D processes ranging from the creation of knowledge to the return of the results to society and the public, from the viewpoints of contribution to achieving policy goals laid down in the plan and a path to the goals.
- (iv) Understand the respective roles of the public and private sectors, and clarify the necessity of investments from the viewpoints of R&D risk, complementarity of the public and private sectors, and public spirit.

### (3) Selection of "Strategic Prioritized S&T"

There are a variety of investment patterns for essential R&D issues. One example is a case in which the amount of budget for the R&D does not increase because emphasis is placed on the utilization of previously accumulated investments. Another example is a case in which the R&D needs to be conducted in the long run within a certain amount of budget. Therefore, to formulate the Promotion Strategies for Prioritized Areas, R&D issues for which funds are to be budgeted preferentially in the period of the basic plan should be narrowed down based on certain criteria. In light of this, from the viewpoints below, the Council for Science and Technology Policy intends to select, within each area, the subject to which funds are to be allocated preferentially in the period of the basic plan, and to incorporate the subject as "strategically focused R&D" into the Promotion Strategies for Prioritized Areas.

- (i) Concentrated investments in the subject during the period of the basic plan are required for S&T to clearly indicate the method of meeting social and public concerns or needs that have been rapidly growing in recent years (e.g.: anxiety about safety and security).
- (ii) Taking into account the status of international competition and the development of innovations, concentrated investments and the production of results during the period of the basic plan are indispensable for Japan to win in global competition. If such investments are not made in the subject, it will be extremely difficult for Japan to catch up on what should have been done for the subject for the five years of the basic plan.
- (iii) For a long-term, large-scale project that is conducted under a government-supervised consistent framework to develop world-leading human resources, concentrated investments in the subject during the period of the basic plan are required to maximize social and economic effects and to ensure overall national security.

## 3. Matters to be considered in the formulation and implementation of promotion strategies

### (1) Emerging and interdisciplinary fields

The intellectual combination or merging of different fields through friendly competition played a major role in producing great inventions and findings in the 20th century. In the 21st century, global-scale competition relating to knowledge is becoming fiercer. Under these circumstances, to create new knowledge it is necessary to develop an environment that encourages the intellectual combination and merging of different fields. For example, R&D should be promoted to ensure that the knowledge of researchers in different fields is gathered easily in a cross-sectoral manner to revolve issues. The strategies for promotion of each of the eight areas will be formulated, giving due consideration to creating innovation through flexible combination or merging of different fields.

The creation of innovation by using S&T capability is highly likely to improve international competitiveness in the services industry, where the country's productivity is worse than other countries. Excellent outcomes in human or social sciences are expected to make manufacturers more high-value added. Therefore, to accelerate the creation of innovation, due consideration will be given

to the promotion of human and social sciences and the intellectual integration of these sciences and natural sciences.

## **(2) Clarifying the relationship with policy goals and establishing R&D goals**

Essential R&D issues selected based on the Promotion Strategies for Prioritized Areas should clarify S&T outcomes to be achieved (R&D goals) to attain policy goals for each R&D issue outlined in the basic plan and practical policy goals for each project. More specifically, it is fundamental to clarify the R&D goals to be achieved in the period of the basic plan, as well as those to be achieved ultimately. The government's accountability for the return of S&T outcomes to society and the public will be enhanced by clarifying the respective the roles of the public and private sectors, the roles of public research institutions, and the path to achieving policy goals through the accomplishment of R&D goals.

## **(3) Horizontal matters to be considered relating to "Strategic Prioritized S&T"**

### **(i) S&T selected to resolve social issues immediately**

This type of S&T provides an immediate, exact solution to socially essential issues such as: international terrorist attacks that have been threatening global safety and security in recent years; proliferation of weapons of mass destruction; large-scale accidents and natural disasters such as earthquakes and typhoons; threats to information security; and emerging or reemerging infectious diseases such as SARS and bird flu. R&D relating to this type of S&T should be conducted by the government with clear goals, integrating specialized or segmentalized knowledge in S&T, and human and social sciences. The Council for Science and Technology Policy intends to promote R&D activities relating to this type of S&T for the interdisciplinary resolution of issues.

### **(ii) S&T selected to win in international competition**

This type of S&T is selected in consideration of selection and concentration for R&D projects to establish stable international competitiveness, based on a competition strategy that is in compliance with the appropriate international benchmark. Examples are: S&T facing fiercer competition to reform the current structure of knowledge fundamentally and to make a leap in knowledge; S&T to which unsurpassed value should be added by using unique national advantages as soon as possible; and S&T that have a good opportunity to win in international competition in making breakthroughs that ensure the acquisition of huge added value.

### **(iii) S&T selected as a key technology of national importance**

This type of S&T is deemed as essential technology to be invested intensively in a large-scale national project during the period of the basic plan ("Key Technology of National Importance"), and is addressed based on definite national goals and long-term strategies. For example, next-generation supercomputing technology and space transportation system technology are considered to fall into this category. The Council for Science and Technology Policy intends to select key technologies of national importance in the course of selecting strategic prioritized S&T, based on national long-term strategies. R&D activities aiming to realize a key technology of national importance will be conducted after the Council for Science and Technology Policy closely examines and evaluates them.

## **(4) Effective implementation of promotion strategies: Realization of "practical strategies"**

Even during the period of the basic plan, when necessary, strategies for promotion of each of the eight areas will be amended or revised flexibly to make changes to essential R&D issues or strategic prioritized S&T. These changes will be made in consideration of updated S&T knowledge and trends of emerging or interdisciplinary fields. The Council for Science and Technology Policy will realize "practical strategies" as a basis for promoting networks or collaborations involving relevant ministries,

agencies, and research institutions, by establishing an annual policy cycle including: gathering of updated information to propose a policy of resource allocation; provision of the policy of resource allocation before the receipt of budgetary requests; prioritization of the budgetary requests; and preparation for proposing the next year's policy of resource allocation.

Moreover, to implement the "practical strategies" in a cross-sectoral manner, it's important that relevant ministries, agencies, and organizations review broad R&D processes ranging from basic research to application and exchange opinions or relevant information on a regular basis, regarding the trends of advanced R&D, technology maps, and road maps for the accomplishment of policy goals. The Council for Science and Technology Policy intends to strive to promote the smooth exchange of opinions and information sharing.

### **Chapter 3 Reforming the S&T System**

#### **1. Developing, securing and activating of human resources**

Maintaining and strengthening the future of Japan's S&T and global competitiveness depend on the abilities of actively working people developed by our country. As well as creating an environment in organizations that accurately responds to the new era in which diverse and versatile individuals— young researchers, female researchers, foreign researchers, and brilliant senior researchers— can exhibit their motivations and talents, the government will strive to secure quality and quantity of human resources in the midst of the accelerating aging of the population and declining birthrate by implementing consistent comprehensive human resource development measures, from elementary and secondary education to development of researchers.

##### **(1) Creating an environment in which individuals thrive**

###### **(i) Ensuring fair and highly transparent personnel systems**

Since creating new value through unconventional creative ingenuity requires the promotion of sound competition and the security of fairness in personnel affairs, as a leading rule, extensively ensure a fair and highly transparent personnel system based on a merit system by boosting the competitiveness, mobility, and diversity of human resources in Japan's S&T activities.

Specifically, in recruiting researchers, the government will urge each organization to carry out a competitive screening regardless of gender, age, or nationality by extensively seeking candidates. As for the treatment of researchers, it will actively reward outstanding efforts by evaluating the abilities and achievements fairly.

Universities and public research institutions are required to implement reforms and improvements by appropriately positioning the personnel system in self-inspection and evaluation while keeping in mind their respective characteristics. Responding adequately to ensure the reform and improvement of personnel systems is also desired in third-party evaluation implemented on universities and public research institutions. Furthermore, the government promotes the activities of universities and public research institutions by using the status of personnel system reform as an indicator of examination for the competitive support system for organizations.

###### **(ii) Supporting the independence of young researchers**

In aspiring to create a vibrant research environment by providing young researchers with independence and the opportunity to be active in a competitive environment based on a fair and transparent personnel evaluation, the government will promote the introduction of a mechanism of providing young researchers with independence and the opportunity to be active through measures including the tenure track system (a mechanism for allowing young researchers to gain experience as an independent researcher in fixed-term employment before obtaining a steadier job through stringent screening), while taking into consideration the improvement of personnel mobility and the conditions of the fields, particularly in universities, that are aiming to become global research and education

centers. Moreover, universities need to secure "jo-kyo" positions (assistant professor) and prepare the playing field for them to further promote the activities of young researchers.

The government will support universities that systematically engage in environmental improvement for this purpose (providing startup funds, improving the research support system, and securing research space), and use the status of activities of universities as an indicator for examining the competitive support system for the organizations. The government will also promote management of facilities of universities so that young researchers can secure their research spaces.

Furthermore, the government will encourage young researchers to actively apply for competitive funds in general, as well as selectively improve the support for young researchers in striving to improve competitive funding. In so doing, the government will pay attention to setting up a program that takes into account the startup time required, and will consider how to improve the program in which sufficient funds are paid to the young researcher to allow him/her to carry out the research at the head of a research organization. Through these undertakings, it will aim to raise research funding to young researchers to a respectable degree.

Concerning the eligibility for competitive funding for young researchers, the government will take into consideration diverse careers, including child birth/rearing, and experience as a full member of society, and promote system improvement according to the respective purport of the system by establishing a system that evaluates the applicant on his or her research background rather than on uniform age discrimination.

In addition, since a plan was formulated to support 10,000 young researchers, especially post-doctorals, post-doctoral fellows are contributing greatly to the active development of Japan's research activities. However, some criticism has been voiced on the uncertainty of the career path after reaching the post-doctoral stage. As such, the government will support post-doctorals who are aspiring to become researchers while positioning them as the preliminary step to young researchers who can carry out research independently. The government will also promote the transparency of the recruitment process and support the independence of young researchers. Moreover, as well as promoting the activities of universities and public research institutions to advance career support for post-doctorals, including career paths other than academic research positions, the government will expand the opportunity for post-doctorals to come in contact with private enterprises.

Moreover, so that young researchers and post-doctorals can accumulate international experience and be in friendly competition with foreign researchers, the government will continue to improve measures to increase the opportunities for carrying out research in foreign research organizations and the opportunity of interacting with foreign researchers.

### **(iii) Improving the mobility of human resources**

From the perspective of improving the mobility of human resources and creating a vibrant research environment, universities and public research institutions are to continue to strive for the extensive establishment of the fixed-term system.

Moreover, if a young researcher finds a steady job through a fixed-term position, he/she is expected to devote him/herself to research activities calmly. To sustain the vigor of those activities, the government will promote employment through a fixed-term system that allows for reappointment, and a review system in which aptitude, qualifications, and ability are regularly examined. In improving the fixed-term system, although the conditions differ by fields, because it is necessary for mobility to generally improve for researchers, including private researchers, a simultaneous transition to a fixed-term system by several universities and the improvement of mobility in private research organizations are required.

In placing a researcher in a steadier job, it is desirable to choose those who have changed organizations, i.e., university, or major at least once after graduating from a faculty under a fair and transparent personnel system (promotion of "General One-transfer Rule for Young Researchers").

### **(iv) Suppressing the rate of inbreeding**

Creating a research environment in which diverse human resources can exhibit creativity and work hard together while being intellectually stimulated is essential in creating new research areas and sustaining the dynamism of research organizations. Given this fact, although the percentage of teachers working for their old schools and faculties may rise as a result of recruiting truly brilliant human resources fairly and with transparency, its excessively high percentage is undesirable. As such, each university is to pay due caution to the percentage of teachers from the same schools, and universities with an excessively high percentage are expected to work on reducing that percentage. The government is to disclose the percentage of teachers from the same schools in each school by positions.

#### **(v) Promoting the activities of female researchers**

So that female researchers can fully exhibit their abilities, the government will expand the measures that take into account the balancing of research and child birth/rearing by acknowledging a fixed period of respite or postponement following child birth/rearing in receiving competitive funds based on the perspective of gender equality.

Universities and public research institutions are expected not only to implement general improvements, but also to steadily implement activities, including consciousness reform, by providing support for the balancing of research and child birth/rearing in the action plan to be formulated and implemented based on the Law for Measures to Support the Development of the Next Generation.

The government will provide support for research institutions that are implementing efforts that others should follow.

From the perspective of promoting the activities of diverse and talented researchers, universities and public research institutions are required to actively recruit through fair screening after openly seeking female researchers and candidates. Moreover, it is also desirable to actively promote female researchers for advancement and participation in policy-making bodies as well as for recruitment.

Concerning the percentage of female researchers, the objectives, philosophy, and realities of female researchers differ by organization, including in terms of institutions and specialties. However, there is hope that efforts will be made to promote the active recruitment of female researchers by each organization by setting numerical targets for the recruitment of women, and that efforts will be made to achieving those targets. Moreover, full disclosure of the status of achievement must be made, while taking into account the percentage of women in the doctorate courses of the relevant fields. Judging from the percentage of women in doctorate courses now, the prospective recruitment target of female researchers for the natural sciences as a whole is 25 percent (science 20 percent, engineering 15 percent, agriculture 30 percent, healthcare 30 percent).

The government will grasp and disclose the status of efforts related to the promotion of activities of female researchers in universities and public research institutions, and the percentage of female researchers by job classification.

Furthermore, in its efforts to expand the horizons of children who like science and mathematics, the government will promote the provision of information such as familiar examples that could be useful for women to go into the S&T field or to become role models, and to reinforce the efforts that contribute to arousing the interest of girls.

#### **(vi) Promoting the activities of foreign researchers**

In S&T activities, there is a need to prepare the conditions to enable many brilliant human resources, including world-class researchers, regardless of nationality, to gather information and to be active in the research community of Japan.

To promote the appointment or recruitment of talented foreign researchers in universities and public research institutions, the government will support the building of organizational preparations of acceptance that take living conditions into account, including the securing of housing and children's education, as well as the research environment. Universities and public research institutions that are aiming to become global research and education centers are expected to formulate an action plan for

promoting the activities of foreign researchers, and the government will grasp and disclose the status of their activities.

Furthermore, to facilitate the acceptance of foreign researchers, the reviews and improved administration required on the role of the immigration control system and visa issuance are to be promoted further. The securing of housing for foreign researchers is expected to be improved by universities and public research institutions working in partnership with local authorities to sponsor foreign researchers.

On the other hand, to help talented international students to establish themselves in Japan, the government will carry out improved administration to enable international students who have acquired a doctorate in Japan to apply straightforwardly to a foreign post-doctorate invitation program. Moreover, universities and public research institutions are expected to prepare the conditions to make it easy for foreign researchers to apply for positions by ensuring that announcements are published in English and by accepting applications in English when recruiting researchers.

#### **(vii) Utilizing the abilities of talented senior researchers**

Holding on to the seniority system and extending the term of employment easily without ensuring the merit system could deprive young researchers of a chance to be recruited and sap the vigor of the research scene. On the other hand, it is very important for the improvement of the standards of S&T in Japan for researchers who have been recognized as being truly excellent by international standards to continue to work and to achieve results. The government will urge universities to facilitate such researchers in some way, even after their retirement, to continue their work by utilizing competitive funds and external funds. It will also promote activities in which retired researchers can fully utilize their abilities and knowledge so that they can work extensively for the promotion of S&T in a non-official capacity.

### **(2) Enhancing the human resource development function in universities**

#### **(i) Human resource development in universities**

To develop human resources with a broad perspective and a flexible mindset who are highly creative and who can exhibit leadership globally in the creation and utilization of knowledge, the enhancement of the human resource development function in universities—which is pivotal for that endeavor—must be promoted. At the faculty stage of universities, the improvement of liberal arts education as well as the development of diverse and quality education that ensures the organic partnership of a liberal arts education and specialized education by identifying the characteristics and attributes of each university is expected.

In so doing, an education that develops a broad perspective and flexible intellect on a firm foundation, such as the establishment of a unique curriculum that combines major and minor subjects of study, is expected. Moreover, the introduction of a teaching method that enables students to learn deeply through practice, a method that emphasizes the development of the ability to rise to complex research challenges, is also expected.

Each university is expected to work on improving its staff's ability to educate and provide research guidance, and actively introduce evaluation on educational activities as well as on research activities.

#### **(ii) Drastic enhancement of graduate education**

Quantitative improvements have been made steadily, as indicated by the growth of the number of graduate school students, which more than doubled in the last ten years due to the improvements that have been made by graduate schools to date. In the future, efforts will be made to dramatically improve the quality of graduate school education.

Universities are expected to provide an education that cultivates the ability to utilize and apply

professional knowledge, including the capacity to deal with interdisciplinary fields by striving to provide graduate school education that enables students to acquire a high degree of expertise and a broad perspective, and by developing rudimentary education in relevant fields, in addition to acquiring advanced professional knowledge.

Universities are expected to work on reforms that focus on enhancing the systematic development of educational courses so that they can ensure the management of the process that leads students to receive degrees by organizing a systematic educational program that leads to degrees after clarifying the objectives of graduate courses, while taking the needs of society into consideration. The government will devote itself to the improvement of graduate school education by providing information on the examples of outstanding undertakings for society, as well as by developing on a full scale a competitive and intensive support system for the organizational efforts of an appealing graduate school education.

### **(iii) Formulating an action plan on the reform of graduate school education**

In reforming graduate school education, there is a need for comprehensive efforts that include the creation of world's leading centers of excellence, the establishment of graduate school evaluation, and the improvement of financials. As such, the government will formulate a systematic and intensive action plan (a platform for the promotion of graduate school education) for the next five years in graduate schools based on the feedback from the Central Council for Education. It will also develop policy initiatives based on this plan, which should be formulated as a part of the structural reform of graduate schools based on the systematic positioning of education. However, since graduate schools—which are the core organizations for advanced S&T-related human resource development and the leaders of research activities—form an important basis for the promotion of S&T, the government will formulate the plan by paying due attention to compatibility with the S&T basic plan.

### **(iv) Improving financial aid for doctorate course students**

Making improvements to enable human resources with excellent qualities and abilities to proceed to higher education without unduly fearing the financial burden that accompanies the advance to doctorate-level coursework is necessary from the perspective of ensuring talented researchers, and contributes to expanding the diversity of career paths for post-doctorals. For these reasons, financial aid for doctorate course (latter stage) students will be improved using as reference the United States, in which nearly 40 percent of graduate school students are reported to be receiving aid that is equivalent to their living expenses. Specifically, we will strive to enable 20 percent of doctoral students to receive an amount equivalent to their living expenses by increasing fellowships and competitive funding, which pays for research assistants while fully ensuring the competitiveness of selecting excellent human resources. Concerning the scholarship loan program that is expected to play an important part from the perspective of human resource development, while securing the soundness of the program, the effective operation of a system of exempting outstandingly performing students from repayment based on relevant nomination by each university will be promoted. Furthermore, the government will take appropriate measures that enable individual students to determine their eligibility for financial aid at the earliest possible time, before taking the exams for the doctorate courses in selecting their coursework.

## **(3) Developing human resources that meet the needs of society**

### **(i) Human resource development by industry-university partnership**

Because the improvement of the quality of education in universities and graduate schools brings direct benefits to industry, and since there is a limit to the self-reliance of human resource development that emphasizes in-house training after recruitment rather than university education, industries and universities are more than ever expected to engage in the development of human resources by building cooperative ties. For this reason, industries and universities are to support the creation of a quality



long-term internship system, focusing on engineering and premised on establishing credits at the graduate school stage. This internships system should be widely disseminated. In addition, improving the opportunities for graduate school students and post-doctorals to participate with a certain degree of responsibility in the development or implementation of university-based educational programs by industry-university partnership is necessary. Collaborative studies, too-with the industrial aspects operating under the appropriate guidance and supervision of guiding instructors-are required.

Through such activities and direct dialogue between industry and universities, the business community is expected to specify its needs for universities and graduate schools, and universities and graduate schools are expected to make constant improvements of their educational programs based on such needs.

#### **(ii) Promoting the activities of doctorals in industry**

Based on the standpoint that doctorals are those who should play active roles in leading and supporting an advanced knowledge-based society in various areas of society, it's necessary to enhance the development of doctorals who will play active roles in various areas of society by promoting the reform of graduate school education and industry-university collaboration in the aspect of human resource development. The industrial world is required to actively provide flexible and varied conditions for talented doctorals.

Furthermore, students as well as universities and the industrial world are expected to have a common view: that it is desirable for doctorals to play active roles not only in academic research professions, but also in various areas of society. Since it is extremely important for each university to know as much information as possible about the career paths of the doctorals and to utilize that information in improving the quality of its education, each university is required to work on continuing to get such information.

#### **(iii) Development of diverse human resources responsible for utilizing and returning knowledge to society**

##### **(Development of human resources that would be involved in managing intellectual properties and technology)**

Because there is a demand for both quality and quantity of human resources that will support Japan's creation of innovation, such as those that could strategically obtain and utilize S&T results as intellectual properties, and those that could effectively give R&D a market value by understanding both technology and management, independent efforts of universities involved in intellectual property and technology management education are to be promoted. In particular, from the perspective of the development of human resources with advanced and specialized vocational skills that would lead Japan's economy and society, we will support the qualitative improvement of professional graduate schools.

##### **(Development of S&T communicators)**

The development and activities of human resources that play the role of promoting communication between researchers, engineers and society-i.e. conveying S&T to the general public in an easy to understand manner, or providing feedback on society's awareness of the issues-will be promoted on a local level as well. Specifically, the area of activities as profession will be created and expanded by development S&T communicators, promoting the outreach activities of researchers, promoting the activities of exhibition planners and commentators, securing research funds of national and public research institutions, and spending for S&T communication activities in R&D projects.

##### **(Development of human resources that respond to new needs)**

The government will promote the development and securing of mobile human resources in information and telecommunications such as: 1) software security technology, 2) S&T that contributes to social safety such as measures against emerging and reemerging infectious diseases and terrorism,

3) the integrated fields of natural science, humanities and social science in which the social needs are evident, and 4) the rapidly developing fields of bioinformatics and technology.

### **(Development of engineers)**

Engineers with advanced professional skills who support Japan's technical bases play a crucial role in achieving sustained progress built on Japan's manufacturing and technology that create high added value. However, there has been fear in recent years concerning the aging of skilled engineers and the disassociation of young people from manufacturing.

International competition is intensifying. This includes the rise of Asian countries in the manufacturing field, and, since the baby-boomers will be gradually reaching retirement after 2007, the development of engineers for sustaining and securing the core competency of manufacturing that has been developed by the knowledge and know-how of the baby boomers in the manufacturing and building scenes has become a most urgent task. For this reason, private enterprises are expected to proceed with active human resource development that utilizes systems such as the human resource investment-promoting taxes for securing the human resources for manufacturing required in the manufacturing scene, and human resources for manufacturing that create high added value, and the smooth succession and dissemination of skills through the utilization of near-retirement human resources with outstanding skills, by relevant industries unifying and coordinating with education at schools. The government will support the intellectual production activities of engineers by organizing and widely providing elemental technologies related to the design and manufacturing processes, and past examples as knowledge or data.

Universities, colleges of technology, and special training schools are to proceed with practical education for the development of engineers, including future human resources for manufacturing. Moreover, as well as disseminating and promoting the application of the engineer certification system of professional engineers, the government will promote the building of an ongoing skill development system for engineers by various entities, the development and provision of educational materials for online learning, and the entry and reentry into graduate schools by adults to further enhance the opportunities of reeducation to meet adults' desire to study.

As well as promoting learning related to manufacturing techniques such as the enhancement of hands-on learning about manufacturing in elementary, junior high and high schools, and social education facilities, the government will implement efforts in industrial high schools and colleges of technology in partnership with local businesses.

## **(4) Expanding the horizons and scope of human resources who will build future S&T**

### **(i) Developing children with exuberant intellectual curiosity**

To develop children with exuberant intellectual curiosity by expanding the horizons of those who love science and mathematics, it is necessary to create an environment in which children can familiarize themselves with and study S&T from the beginnings of elementary and secondary education. For this reason, as well as expanding the chance for children to see the faces of talented researchers who visiting schools to talk to children and their parents, the government will improve the opportunities for hands-on and problem-solving learning, such as observations and experiments by supporting the efforts of motivated teachers and volunteers, and the schools' partnership with universities, public research institutions, businesses, science museums and other museums. Concerning the grossly insufficient and antiquated laboratory instruments and facilities of elementary, junior high, and high schools, their improvement will be a priority. In addition, as well as developing and providing child-friendly digital educational materials and programs, the government will promote the holding of S&T competitions by various entities.

Moreover, for training and improving the quality of teachers who can effectively teach subjects such as science, mathematics and industrial arts with advanced content, and who can conduct interesting classes, the government will review and improve the educational contents and methods of teacher training courses, especially in universities with a central focus on teacher-training universities.

Furthermore, as well as promoting the activities of teachers for obtaining advanced certificates, it will consider the application and role of the professional graduate school system in the of training teachers who can exhibit a high degree of professionalism and who demonstrate practical leadership. In addition, the government will continuously promote practical activities to schools from kindergartens to high schools attached to teacher-training universities in collaboration with universities, such as providing science and mathematics education that incorporates the results of research in universities concerning educational content and methods.

#### **(ii) Developing the individuality and abilities of talented children**

There is a need to develop the individuality and abilities of children who are interested in science and mathematics through effective science and mathematics education, and to develop outstanding human resources in S&T. For these reasons, the government will promote the participation of talented children in various international S&T competitions, as well as improve the support system for high schools that emphasize science and mathematics education.

In addition, the government will proceed with the linking of high schools and universities; in other words, the improvement of the high school-university link so that the individuality and abilities of talented children can be developed regardless of the influence of university enrollee selection. Specifically, it will make it possible for students who have achieved remarkable results in high school to obtain appropriate evaluation by methods such as Admission Office (AO) Entrance Exam, or have high schools organize a special curriculum for the development of S&T-related human resources with the help of universities. Furthermore, it will promote initiatives and improvements by providing high school students with opportunities to come into contact with university-level education and research by accepting high school students into universities as non-degree students and by having university instructors teach in high schools.

### **2. Creating scientific development and persistent innovation**

The government will strive for S&T that passes on the results to society and the nation by creating intellectual and cultural value through scientific development by making S&T-related resources work effectively. It will also reinforce the efforts for manifesting the results of R&D as social and economical value through innovation. In so doing, it is not only important to work on reforming the R&D system, but also to work on resolving the institutional and operational bottlenecks for smooth S&T activities and the passing on of results.

#### **(1) Developing a competitive environment**

Although competitive funds did not reach the goal of doubling set in the second basic plan, their improvement has progressed to a respectable degree. Moreover, there was steady progress in the efforts for the development of a competitive environment coupled with the progress of systemic reforms. There is a need to further the efforts to revitalize research activities by setting the principle of competition in motion in more aspects in the future.

#### **(i) Increasing competitive funds and indirect costs**

The government will continue to strive to increase competitive funds such as Grants-in-Aid for Scientific Research, which contribute to creating a competitive R&D environment, by expanding the breadth and freedom of the selection of researchers' research grants.

Concerning indirect costs in which a fixed percentage of the research grant is allocated to institutions that employ researchers who have won the competitive funds, the government will achieve a 30 percent allocation in all systems as early as possible. Indirect costs will be devoted to the expenses required for the management of research institutions in implementing the research, and they will be used, in principle, based on the decision of the institution. Among them all, competitive funds are expected to be used for preparing a research environment such as the departments and agencies

that employ the researchers awarded with competitive funds, providing financial benefits for such researchers, and enhancing the administrative system that supports smooth application by researchers.

## **(ii) Developing a competitive environment in organizations**

### **(Revitalizing research activities through competition)**

Competitive funds have the effect of promoting competition among organizations that employ researchers through the promotion of competition between researchers and measures for indirect costs. Accordingly, it is necessary to promote competition involved in securing human resources such as in universities by increasing the competitiveness and mobility for human resources. Further revitalization of research activities is also expected.

Just as it has been carried out in the world's top class research institutions, universities in Japan are also required to create a virtuous cycle of attracting brilliant researchers by devoting themselves to improving their research environments and then using competitive funds and indirect costs acquired by such brilliant researchers to further improve research environments.

### **(Effective combination of fundamental funds and competitive funds in universities)**

In universities in Japan, there is a research system in which basic funds (national university budget subsidy, facilities improvement grants, and financial aid to private educational institution) play an important part in supporting the existence of the organizations that form the foundation of education and research (securing human resources, preparing education and research environment), while competitive funds support varied and excellent research plans. Basic funds and competitive funds both have their own functions, and they both play important parts. As such, the government must examine an effective combination of basic funds and competitive funds in improving the overall governmental R&D expenditure.

In addition, since the whole of the national university budget subsidy is not something to be allocated according to the number of teachers in each university, and because it is important for allocated costs to be applied most effectively and efficiently coupled with competitive funds or external funds, from the perspective of developing a competitive environment, including the president's discretionary allocation, while respecting the independent and autonomous in-school allocation, the government will promote such endeavors.

## **(iii) Promoting the systemic reforms on competitive funds**

To fully exhibit the effects of each competitive fund system, carry out systemic reforms by clarifying the purport and objectives of the respective systems, so that the scale of the research funds, the research duration, research system, evaluation method, and promotion measures can be optimized according to the purport of the system.

### **(Establishing a fair and highly transparent screening system)**

As for the allocation of competitive funds, since the screening for a fair and highly transparent research subject that emphasizes the contents of the research and the capacity for implementation irrespective of the position or the title of the researcher is essential, the government will work to dramatically improve the screening system.

Concerning each system, the government will proceed with the reforms, i.e., increase of the number of judges, improvement of the research plan, and review of the screening standards, while streamlining the operation of screening. Particularly regarding increasing the number of judges, the research community is expected to actively cooperate on its own responsibility. In addition, concerning each system, the government will make efforts to recruit young researchers and foreign researchers as judges to secure fairness in screening from various perspectives.

### **(Feedback on the screening results)**

Since communicating the details of the screening results and the views expressed at screening in as much detail as possible is believed to secure the transparency of screening, the government will improve the quality of research, and contribute to improving the quality of researchers, including young researchers, and promote detailed disclosure so that the screening results will be fed back appropriately to the researchers in each system that relates to competitive funds.

#### **(Enhancing the functions of the distributing agencies)**

On the basis of transferring the allocation functions of competitive funds to independent distributing agencies, the systems with established policies will proceed with a steady transferal. Those with no established policies will respond appropriately by drawing a conclusion promptly while taking reality into account.

As for the program officer (PO) and program director (PD) that support each system, the government will give consideration to the benefits so that those with qualities appropriate for these professions can be secured in a quantity that corresponds to the scale of the system. In addition, it will turn PO and PD into full-time positions as early as possible, mainly with large systems. Furthermore, the research community as a whole is expected to adequately evaluate the job experience of POs and PDs so that they can be positioned as part of the career paths of researchers.

Because the improvement and enhancement of POs and PDs, as well as the research analysis functions for supporting their activities, and the operational functions related to screening, granting and managing are essential in the distributing agencies, the government will steadily carry out system improvements by securing a percentage of the competitive funds. In addition, distribution agencies will strive for the training of competent POs and PDs by improving overseas training and seminars in Japan. Moreover, in allocating competitive funds, it is necessary to take budgetary measures appropriately while taking the purport and objectives of the competitive funds into account to enable an efficient and flexible management of the competitive funds, such as carrying over the funds of the year, and multiple applications per year.

## **(2) Enhancing the competitive edge of universities**

In an age when the creation and application of new knowledge is dramatically increasing its importance, the enhancement of global competitiveness among universities is extremely important. Therefore, universities that will lead the world's S&T should be established. We are also in an age when it is essential for each university—be it national, public or private, including local universities—to enhance its competitive edge by utilizing its unique characteristics. With this understanding, fundamental funds that support the foundation of education and research will be provided responsibly.

### **(i) Creating universities that lead the world's S&T**

Universities with global competitiveness cannot be created without sound competition between universities. For this reason, the government will further promote the development of a competitive environment, and the improvement of the mobility of human resources in universities, be it national, public or private. Furthermore, to actively develop the creation of universities that rival other universities in the world, and to lead the world's S&T, it will promote the further enhancement of intensive investment under the principle of competition for organizations aiming to become the world's top-class research and education centers.

The 21st Century COE Program is currently being developed as a part of structural reforms of universities through national, public, and private universities. It is fitting to plan for further development in a more full and evolved way by implementing a stricter selection of focus based on the evaluation and validation of the program. In so doing, it is important to secure perspectives that universities play roles in further developing talented researchers and improving basic research as their primary missions. As such, it is appropriate to establish a wide range of disciplines as the scope and maintain the basic concept from the perspective of securing the diversity of fundamental research and

creating new areas, rather than placing a disproportionate emphasis on specific research areas.

While developing measures for securing the diversity of such fundamental research, in creating innovation, intensive investment for creating research and education centers must be secured by focusing on specific advanced research areas, while obtaining the cooperation of the business world from the perspective of creating research areas that may lead the world. Doing so will be extremely effective.

It is expected that these initiatives will create about 30 research centers that will be positioned as the world's top-class centers according to various evaluation indexes on research activities, i.e., centers of world's top-20 in the field thesis citation index.

## **(ii) Revitalizing universities that utilize uniqueness and characteristics**

### **(Developing universities open to the community)**

Local universities are important intellectual and human resources for the local community, be it national, public or private, and they, as an entity open to the local community, should contribute further to the progress of the overall community. With the understanding that it is indispensable for local authorities to perceive and utilize such universities as partners in community regeneration, active support is anticipated.

For instance, it would be desirable to create a virtuous cycle of creation of knowledge and human resources and community vitality through local universities by the community working together with the universities with the support of the government. Such an arrangement might include a community contribution type industry-academia cooperation undertaken by universities in the creation of technological opportunities and new technologies of indigenous industries or traditional industries, and the promotion of human resource development in partnership with those industries.

As a part of community regeneration through the revitalization and utilization of local universities, the Ministry of Education, Culture, Sports, Science and Technology, the Regional Generation Center and the Council for Science and Technology Policy will promote the "Regeneration Program for Local Knowledge Centers," which incorporates support measures and general improvements for the independent efforts of the community in partnership with universities.

### **(Utilizing the research and education functions of private universities)**

Private universities have been developing diverse and unique education and research activities based on the unique spirit on which their schools were founded. It is indispensable for the government to utilize the human resource development functions and research functions of private universities from the perspective of securing the improvement and diversity of the S&T standards of Japan as a whole. On the other hand, even private universities, which are aiming to become global research and education centers, suffer from shortcomings in their research environment in terms of human resources and facilities compared to national universities. Therefore, there is a need to improve those aspects.

For this reason, various measures should be undertaken to enhance private universities. Public subsidies should be provided for private universities to strengthen the research functions of such private universities. In addition, a 30-percent application of indirect costs in all systems should be achieved in managing the competitive funds. Preferential indirect costs should then be provided. Necessary condition ordering will also be carried out for promoting the introduction of various private funds.

## **(3) Enhancing systems for creating innovation**

To effectively link the innovative R&D results – including the results of outstanding fundamental research created by universities and public research institutions – with innovation continuously, industries, universities, and government will unite to enhance a system that creates innovation to fully exhibit Japan's potential.

**(i) Maintaining the various research fund systems according to the development stage of R&D**

The government will further define the purport of the research fund systems, the anticipated outcome, the evaluation method, and the promotion measures according to the development stage and the characteristics of the R&D, and adequately maintain and operate the various systems from fundamental research to innovation creation.

**(Efforts toward high-risk research in fundamental research)**

The system that supports fundamental research is improving in quality and in quantity by the past reforms of the competitive fund system, and research standards are improving steadily. Because the competitive fund system that supports fundamental research is based on what is called pure review screening, its improvement must be ensured.

On the other hand, just operating pure review screening uniformly may make it difficult to spot high-risk research (research that may create highly innovative results based on the fresh ideas of the researcher). For this reason, the government will take high-risk research into account by establishing a mechanism that flexibly selects the challenges by assessing the originality and possibility of the ideas of the researcher in the part of the system that supports fundamental research.

**(Enhancing competitive research for innovation creation)**

From the perspective of promoting the passing on of results to society and the nation, there is a need to enhance R&D that takes on the challenge of creating innovative technology so that scientific and technological discoveries created in fundamental research are linked to creating social and economical value without ending as mere articles. For this, an appropriate management of research is required so that the research does not end as a mere extension of the researcher's intellectual curiosity. For this reason, the government will enhance the management system for competitive funds that promote the target fundamental research and applied research for innovative technology that leads to creating new value by establishing innovation-oriented goal setting, or by putting in place a program officer (program manager) with the responsibility and discretion to carry out research progress management.

**(Creating bases for advanced interdisciplinary research)**

Innovation is frequently created from new interdisciplinary research areas, and such areas are effectively created by active involvement for business solutions based on socioeconomic needs. For this reason, the government will selectively create research education centers in universities that focus on advanced interdisciplinary research areas that will enable Japan lead to the world by bringing in the active participation of the business world. The following points must be respected in creating these centers (bases for advanced interdisciplinary research for innovation). These research centers:

- (i) are research and human resource development centers genuinely created by industry/academia collaboration
- (ii) carry out research from a fundamental stage with commercial viability in mind
- (iii) are open nationally and internationally
- (iv) have the clear commitment of the business world such as the provision of research resources
- (v) carry out innovative organizational operation and system reforms that facilitate the abovementioned points.

**(Reforming the research fund system beyond ministries)**

—Enhancing the appropriate management that corresponds to various systems—

By carrying out appropriate management according to various research fund systems, visible results visible are produced.

For this reason, the government will promote the enhancement of management for producing results by checking to see if appropriate institutional design and operation are implemented based on the anticipated results, according to the developmental stage and characteristics of the subject R&D on

the various research fund systems, such as competitive funds and project research funds.

—Building a mechanism that links outstanding research results to practical application beyond office and ministries—

Because the research fund system of each ministry, and R&D in industry-university-government research institutions range widely from the stages of fundamentals to practical application, the government will strive to build a mechanism for advancing R&D without interruption beyond systems and institutions, and link it to practical application for research that is about to produce outstanding results, and those that have the potential to develop to create innovation. The Council for Science and Technology Policy will promote such undertakings by each office and ministry.

As for research fund systems, which are expected to lead research to the next level, the government will introduce a mechanism that enables the research of outstanding projects to be continued without interruption by implementing an evaluation at an appropriate time before the completion of the research. In addition, it will incorporate it into the research fund system or the collaboration between industry-university-government research institutions beyond office and ministries. Specifically, it will promote efforts such as: 1) the prompt transmission of interim assessments and ex-post assessment results in various research fund systems and their utilization in other systems and institutions, 2) information sharing of advanced research trends and results, 3) R&D strategy and roadmaps through workshops between distributing agencies and research institutions, 4) the building of a database that extracted and collected the information on the potential for the application of the results, and 5) the enhancement of the functions of extensively studying other research results in planning R&D in distributing agencies and public research institutions.

#### **(ii) Building a sustainable and progressive industry-university-government collaboration system**

As a country that must create persistent innovation from its own unique research results amidst global competition, industry-university-government collaboration is an important means for realizing such a creation. Japan will build a sustained and progressive industry-university-government collaboration system.

#### **(Expanding into a full scale industry-university-government collaboration)**

With the view that efforts must be made to expand into a more full-scaled industry-university-government collaboration, in addition to the technological transfer of traditional collaborative research that utilizes brilliant seeds of universities, the government will promote a strategic and systematic collaboration that could boost the effects of the collaboration by getting the industries, universities and government to hold a dialogue from the stage of establishing the research project, and working on collaborative research that sees through all aspects from fundamentals to application from a long-term perspective. The government will aim to create research centers that carry out world-class research and human resource development under industry-university-government collaboration, as a part of such a collaboration.

In addition, from the standpoint of promoting improvement of competitiveness of regions, and the regional contribution of universities and public research institutions, the government will promote regional-contribution type collaborative research undertaken by universities on the technological opportunities and new technology creation of local industries including small businesses. Through these efforts, the government will aim to substantially increase the amount of research funds from private businesses for universities.

#### **(Sustainable development of industry-university-government collaboration)**

—Developing industry-university-government trust—

Mutual understanding between businesses and universities is essential for sustainable industry-university-government collaboration. For instance, there is a need to develop trust by solving problems through thorough discussions after both parties have understood the differences regarding



the considerations toward the characteristics of the collaborative research results, flexible and prompt response to corporate needs, thoroughness of awareness towards confidentiality, and characteristics of the university, which does not use patents involved in the joint invention. As well as providing opportunities for both parties to communicate, and information on best practice, the government will promote the independent formulation of rules by presenting guidelines where required.

As for the indirect costs that will be required for the collaborative research or sponsored research with businesses in universities and public research institutions, the government will promote appropriate provisions, because it is important to secure the costs in the relevant research funds based on thorough discussions by both parties.

—Promoting the autonomous efforts of universities—

Universities are required to appropriately position the activities of industry-university-government collaboration in their respective operation policies, and engage proactively in collaborative activities by perceiving social contributions including industry-university-government collaboration, as well as education and research, as important missions. Universities are also expected to appropriately evaluate the achievements of researchers who are actively engaged in industry-university-government collaboration. In addition, they are also required to improve the mechanism that properly manages the conditions of conflicting interest that occur with the progress of collaborative research. The government will strive to give incentives to universities that are actively engaging in the activities of industry-university-government collaboration.

—Revitalizing and enhancing the collaboration of university intellectual property centers and technology licensing organizations (TLOs)—

For the activities of industry-university-government collaboration to achieve sufficient results, it is necessary to further revitalize the activities of university intellectual property centers and TLOs and make them more effective.

Intellectual property centers in universities that carry out strategic creation, management, and utilization of intellectual property are a vital presence for universities to achieve their mission of passing on their research results to society, and the government will support their efforts while seeking the initiative of universities and management collaboration. As for TLOs that carry out technological licensing projects for the private sector, the government will strive to enhance the technological licensing system of other TLOs and universities by disseminating the success factors of TLOs that are achieving great results, and will support their launch.

Universities will further enhance collaboration between their intellectual property centers and TLOs from the perspective of fully utilizing the knowledge and know-how on technological licensing accumulated by TLOs and clarify their external contact by defining the relationship between their intellectual property centers and the TLOs.

—Developing smooth intellectual property activities—

The government will promote the efforts of organizations to properly secure the costs for intellectual property activities such as the costs of patent application in universities within organizations. In doing so, active utilization of indirect costs in competitive funds is expected. The government will also adequately aid the costs of overseas patent applications from the perspective of enhancing Japan's global competitiveness and improve the support for competitive R&D for promoting the passing on to society of research results produced in universities.

**(iii) Promoting the utilization of new technologies in the public sector**

Promoting the utilization of new technologies through public procurement is important not only from the standpoint of improving the functions of the activities of the public sector and increasing efficiency, but also from the standpoint of promoting the passing on of research results to society. For

these reasons, the government will promote the coordination and collaboration of the public sector's needs, and the R&D seeds in R&D, such as that for S&T and advanced equipment research that contribute to safety. With S&T that contributes to safety, the government will strive to build a network of research information.

Furthermore, as an introduction of low-pollution vehicles, the public sector's creation of advance initial demand for new technologies for which demand is high or market scale is still small has major significance not only in contributing to the policy goals of each sector but also for forming new markets and stimulating private-sector innovation. The public sector is expected to actively consider the introduction of new technologies to the business scene by actively utilizing bidding systems that emphasize technical capabilities such as the integrated evaluation bidding system.

In addition, as it is important for R&D type ventures to have their products procured by the public sector to boost the creditworthiness of their companies and to secure income at the inception stage, the government will take procurement from R&D-type ventures into consideration in the introduction of new technologies by the public sector.

#### **(iv) Promoting the entrepreneurial activities of R&D ventures**

R&D type ventures, including ventures initiated by universities, are a presence that ought to play an active part in creating new industries, in reforming the industry structure, and in passing on the research results of universities to society as the engine for innovation. For these reasons, the government will enhance the comprehensive support measures for R&D type ventures in the aspects of technology, funding, human resources, and demand creation, and promote general improvements on entrepreneurial activities. Particularly with regard to ventures initiated by universities, the government will competitively provide support to create ventures that grow and develop, and continue to support the creation of such activities.

In addition, since R&D type ventures can actively respond to the demands of the client due to their high motivation for taking on new businesses, the government will actively consider the utilization of capable R&D type ventures in R&D carried out by competitive funds for creating innovation, and R&D carried out by national and public research institutions on commission. Furthermore, the government will support the creation of a network between venture supporters, and strive to work on the facilitation of risk money supply to the ventures through developing entrepreneurial support type venture capital that utilizes fund contributions. It will promote the investment activities of private investors such as the expansion of the utilization of the tax system for angel investors, and promote efficiency in the system of lending among government organizations.

In addition, because there is criticism of the weakness of entrepreneurship in Japan by international standards, it is essential to create a thick layer of human resources, i.e., potential entrepreneurs that are motivated to take on challenges that may lead to commercialization in promoting essential entrepreneurial activities. For this reason, the government will encourage the efforts of promoting such entrepreneurial activities as the support of such activities by students, the creation of entrepreneurial opportunities through human interaction, and the improvement of quality such as business promotion related courses in universities.

#### **(v) Promoting R&D by private enterprises**

Since it is private enterprises that create market value in the form of new products from the results of R&D and industry-university-government collaboration, leading them to ultimately achieve innovation, it is important to revitalize private-sector R&D. As a nation, Japan will strive to utilize tax measures that contribute to the promotion of R&D activities, and improve the technological development programs that reduce the risks of R&D up to commercialization to boost their motivation on the basis of the self-supporting efforts of the private sector. In addition, with regard to small businesses that support the foundation of Japan's industrial competitiveness, the government will support efforts toward the enhancement and development of manufacturing technologies after taking the vulnerabilities of the financial base and managerial resources into account.

Moreover, amidst the increasing tendency toward the manufacture of in-house products by the utilization of external R&D capacity and results, there is a need to build a cooperative relationship that mutually develops in a sustainable way in the private sector by positioning universities and public research institutions as their partners for innovation from a long term perspective to accelerate the creation of innovation by the nation as a whole.

#### **(4) Building regional innovation systems and creating vital regions**

Because the promotion of S&T in regions contributes to building regional innovation systems and creating vital regions—thus enhancing the sophistication and diversification of S&T of Japan as a whole, along with the competitive edge of innovation systems—the government will actively encourage such promotion. Moreover, the government will promote broad-ranging activities as something that will contribute to achieving safe, secure, and quality lives for local residents, and produce creative and appealing regions and culture.

##### **(i) Forming regional clusters**

Formation of regional clusters not only requires R&D by industry-university-government collaboration; it also needs, various activities such as facilitation of finance, support of new business creation, development of the market environment, and building of cooperative networks. As such, the government will proceed with long term efforts based on the strategic initiative of regions and the collaboration of relevant organizations.

The government will continue to provide competitive support for cluster forming activities carried out under local initiatives. In so doing, the government will provide selective support to regions that have the potential to develop as world-class clusters, by assessing the global competitive edge of each region according to the progress of cluster formation and develop clusters across Japan with strengths that utilize regional characteristics, however small in scale.

##### **(ii) Developing smooth S&T policies in regions**

In promoting regional S&T policies, the government will expect local authorities to fulfill an active role and enhance inter-ministerial coordination by eliminating vertical divisions between ministries.

Since the enhancement of the functions of coordinators is crucial to promoting industry-university-government collaboration in regions, the government will develop the support system for them and support the building of coordinator networks. In addition, the government will support the development of human resources through collaboration of local universities and industries by methods such as internships.

Moreover, national public research institutions in the regions are expected to meet the needs of local industries while collaborating with local universities, and create and disseminate the seeds themselves. Although local authorities are carrying out technological developments and technical guidance that meets the needs of local industries and scenes, they are expected to play an effective role for regional industry-university-government collaboration. They will do this while choosing and converging in operations that utilize the respective characteristics and strengths, and planning extensive collaboration between regions by taking the effectiveness of past results into account.

#### **(5) Effective and efficient promotion of R&D**

##### **(i) Effective utilization of research funds**

##### **(Thoroughly eliminating waste in research fund allocation)**

Illogical overlap of research fund allocation and excessive concentration of research funds that exceed the relevant efforts of individual researchers (allocation of time that an individual engaged in various operations such as research, education and administration) must be thoroughly eliminated.

For this reason, the government must build a cross-ministerial R&D management system for

implementing inspections on overlap and other matters by sharing information between the competitive fund systems among all ministries as early as possible based on the e-Government Building Program. The cross-ministerial R&D management system will have an application receptionist function that enables researchers to input data and applies for whole research fund systems that include competitive research funds as a core.

Meanwhile, the Council for Science and Technology Policy will also proceed with preparing the database on research funds besides competitive funds such as project research funds by building a government R&D database to contribute to effective and efficient allocation of resources such as eliminating overlap by grasping the complete picture of the status of allocation of research funds as a whole, including funds other than competitive funds. The government will promote cross-ministerial "R&D management system" utilization after making sufficient adjustments with the R&D management system and the government R&D database. Through its utilization, ministries will appropriately fulfill the responsibility of providing explanations on allocation decisions by implementing inspections on overlap and other matters.

In addition, the government will rigorously respond by imposing limitations on the application eligibility for researchers for dishonest receipt or wrongful use of research funds.

#### **(Managing the efforts of researchers by universities and public research institutions)**

Universities and public research institutions should secure R&D through research funds researchers obtain externally by managing the efforts of researchers. In particular, universities aiming to become global research and education centers will work on early establishment of proper effort management. Moreover, they will ensure the description of efforts of researchers in the application form under the acknowledgement of the organization in applying for a research fund system, including competitive funds and project research funds.

#### **(ii) Emphasizing the development and utilization of human resources in research funds**

In view of the importance of the development of human resources in engaging in R&D, and stricter selection of focus on human resources that comes with the prioritization of R&D, developing and utilizing human resources should be further emphasized in research funds such as competitive funds.

Therefore, the government will carry out necessary system improvements by working on putting research funds into the development and utilization of human resources in each research fund system. Through this, the government will promote the independent formation of research institutions by young researchers. This will be accomplished by developing young researchers through providing funds equivalent to the living expenses of doctorate course students, and providing staff costs for post-doctorals, research supporters, and external research human resources.

At the same time, through ensuring application premised on the shared use of general purpose research equipment, and through promoting the use of common spaces, the government will do its utmost for the effective utilization of the facilities as a whole.

#### **(iii) Reforming the evaluation system**

R&D evaluation is extremely important in planning the creation of a flexible, competitive, and open R&D environment, the selective and efficient promotion of R&D and improvement of quality, the improvement of the motivation of researchers, and the formulation of better policies by fulfilling the responsibility of providing explanations to the nation. The government will implement such evaluations according to specific policies that set out the evaluation methods by office and ministries in line with general guidelines.

Furthermore, from the perspective of further developing Japan's evaluation systems, the government will review the general guidelines where required based on the implementation of R&D evaluations.

**(Direction of reforms)**

The government will make efforts to ensure that evaluations do not become unnecessarily bureaucratic from the perspective of evaluation, to boost motivation by taking the difficulty of the task taken on by the researchers into consideration, and to train and secure assessment personnel with a talent for spotting and cultivating unique and outstanding researchers and R&D, so that the evaluations encourage a spirit of creation and questioning of results.

The government will work on choosing appropriate survey analysis methods and evaluation methods according to the subject, timing, and objectives of evaluation in implementing evaluations, developing and reforming evaluation methods, training evaluation personnel, including young personnel, and improving their evaluation abilities (experts of respective fields skilled in evaluation, staff of ministerial organizations, researchers specializing in evaluation), so that evaluations will be reliable and of global standard. The government will work on clearly and specifically establishing the evaluation objectives after fully recognizing that evaluations are an important means of aiding strategic decision-making, and clarifying how and by whom the evaluation results will be utilized beforehand, so that they can be utilized and promote reform.

Furthermore, concerning evaluations of R&D measures from the perspective of the evaluation subject, the government will further establish and improve follow-up evaluations from the standpoint of implementation timing by taking its implementation into account.

**(Operating an effective and efficient evaluation system)**

From the perspective of avoiding unnecessary duplication of evaluations, maintaining the continuity and uniformity of evaluations, and operating effective and efficient evaluation systems as a whole, ministries and organizations that implement R&D will improve the evaluation systems by appointing personnel responsible for the operation of the evaluation systems, and implementing improvements of the system and foundation for the mutual coordination and utilization of the evaluations. In so doing, they will secure the budget for evaluation, train and secure evaluation personnel, and build and manage the database.

**(Promoting evaluations based on policy targets)**

Evaluations are implemented by establishing appropriate items of evaluation and evaluation standards according to the characteristics of R&D. However, in so doing, the government will work on establishing the items of evaluation and evaluation standards based on the policy targets related to the relevant R&D so that the results can be passed on to society and the nation effectively.

**(6) Resolving the institutional and operational bottleneck that acts against S&T activities and returning benefits from R&D to society**

In promoting S&T, an active interaction of human resources, a smooth implementation of research activities, the promotion of industry-university-government collaboration, and the improvement of institutional environments that support the smooth passing of research results to society are important matters for increasing the effects of human and material investments for S&T. Although there has been remarkable progress in such areas as the research exchange system, the fixed-term system of researchers, the independent organization system, the national university system, and the intellectual property system, there is much criticism that various institutional bottlenecks still remain, including, for example, immigration controls on foreign researchers, working environment of female researchers in relation to child birth/rearing, treatment of pensions and retirement benefits associated with personnel change, promotion of utilization of carrying forward for research funds, the clinical study environment, the employment environment for research supporters, and the financing environment for research institutions.

For this reason, the Council for Science and Technology Policy will actively deepen its involvement in the boundary areas of S&T policy and other policies, and work together with relevant ministries, agencies, and councils for resolving the institutional bottlenecks that hinder the promotion

of S&T, and for resolving the various obvious issues in operating the systems in the research scenes. In addition, they will provide their opinions where required and carry out follow-ups on their implementations.

### **3. Reinforcing the foundation for promoting S&T**

#### **(1) Systematic and prioritized improvements of facilities**

Promoting the improvements of such facilities as universities and public research institutions is essential for promoting the development of talented world-class human resources, creative and advanced R&D, and becoming a creative S&T nation. Such improvements need to be implemented by order of priority in public facilities as well.

In so doing, as universities are particularly required to turn out such outstanding human resources as researchers that will lead the next generation. They are also required to develop environments and atmospheres fitting for a place of creative learning and research.

#### **(i) Improvements of facilities such as national universities and public research institutions**

Although the restrictedness of facilities that have been worked on by priority through the "Five-Year Program for the Emergent Renovation and Building of Facilities of National Universities, etc." have been improved as planned, improvements on deteriorated facilities have fallen behind. As a result, they have increased in correlation with the demands for improvements because of deterioration by aging. Moreover, there have been new education and research needs such as responses to graduate schools newly established after 2001, responses to securing space for education and research activities of young researchers, and responses to the training and practice associated with the development of new diagnostic and treatment techniques.

The deterioration of such facilities as national universities built in large numbers from the 1960s to 1970s continues. Because they are unable to respond to the new educational and research needs in terms of function, and because safety issues such as earthquake resistance and the aging of key facilities loom, the government will take particular budgetary steps for systematic improvements from a long-term perspective by positioning the regeneration of the aging facilities as a high-priority issue.

The dimensions of improvements required in national universities have reached approximately 100 million square meters. The government will support systematic improvements by formulating a facilities improvement plan that incorporates facilities that require urgent improvements during the five years of the third basic plan from the perspective of carrying out the regeneration of deteriorated facilities as a high-priority for outstanding research centers, and basic facilities that emphasize human resource development functions.

Moreover, for university hospitals and nationally-run specialist medical centers that are implementing improvements through long-term borrowings, the government will support steady systematic improvements so that they can continue to fulfill their pioneering roles in advance medical care.

National universities are required to promote facilities improvements through new methods based on self-help efforts such as enhancing the collaboration with the business world and local governments. Other efforts include the utilization of long-term loans and the private finance initiatives (PFI), further enhancing facilities management systems such as facilities operation and maintenance, and securing flexible and mobile spaces from an all-campus perspective. To promote efforts for such reforms by national universities, the government will carry out necessary the necessary reviews of the systems, and carry out prioritized distribution of resources after actively assessing the efforts of national universities.

The government will also improve facilities to meet the needs of the times to produce outstanding R&D results, and develop talented human resources in public research institutions such as independent administrative agencies. In particular, the government will carry out the regeneration and

refurbishment of facilities preferentially and systematically for public research institutions established before the mid 1950's, since there are so many remarkably deteriorated facilities built in era.

Furthermore, the government will consider long-term improvement plans per organization for public research institutions, such as Tsukuba Science City, that have facilities with a risk of a simultaneous occurrence of future deterioration.

#### **(ii) Development of facilities of national universities and public research institutions**

The importance of laboratory facilities and advanced research facilities has dramatically increased with the advances in basic research. Because the use of those facilities in abstract research has an important role to play, the government will support national universities to enable them to intentionally develop their research facilities, including large-scale facilities, from a long-term perspective.

National universities and public research institutions will promote effective and efficient use of research facilities, such as shared use beyond the framework of organizations, reuse of facilities after completion of competitive fund supported research, as well as effective use of existing facilities by actively making efforts to share the use of the facilities within organizations.

#### **(iii) Developing the facilities of public universities**

With regard to education and research facilities of public universities, which are playing a major role as centers of education and research in regions, it would be best to strive to improve the financial measures based on the decision of local authorities.

#### **(iv) Developing the facilities of private universities**

Selective development of private university facilities are important in boosting Japan's research capabilities and promoting the sophistication of education and research. However, given that the development of private university facilities are not exactly sufficient, the government will improve financial aid to private educational institutions so that development of research facilities in private universities can be actively carried out.

#### **(v) Promoting the development and shared use of advanced large-scale public research facilities**

Because advanced large-scale public research facilities such as next-generation super computers and next-generation radiation sources require vast expenses for development and operation, and sharing them extensively would lead to producing the results in the world – rather than treating them as projects of specific research institutions – the government should take the responsibility for promoting their development and shared use by choosing the best organization from the various industry-university-government organizations to implement the development and shared use fairly and efficiently.

For this reason, the government will build a mechanism for integral promotion of development and operation of these facilities, including the development of laws for promoting shared use. Moreover, the government will carry out intentional and continuous development by giving priority to large-scale research facilities such as the Inter-University Research Institute Corporation after carrying out rigorous evaluations in selecting the specific advanced large-scale shared facilities.

### **(2) Improving the intellectual infrastructure**

#### **(i) Strategic and selective development of intellectual infrastructure**

Amidst rising dependency on knowledge of socioeconomic activities as a whole by the advances in research and development activities, the government will proceed with the selective development of the intellectual infrastructure (materials for research such as biological resources, measurement standards, methods of measurement, analysis, testing and evaluation, relevant advanced equipment, and related databases) that supports these activities. We will aim for the highest global standards by

2010, and proceed with selection and concentration by reviewing the intellectual infrastructure developments plan so that developments that use quantitative and qualitative perspectives, i.e., the level of response to user needs and usage frequency, as a guideline.

In addition, with regard to advanced equipment, given that equipment development in itself tends to lead advanced research, the government will carry out selective development of key elemental technologies and system integration technologies for equipment that are essential in the research of important areas. This selective development will also cover technologies that are rapidly developing in other countries, despite Japan having a comparative advantage in them.

### **(ii) Building a framework for promoting efficient development and use**

Aiming for development of user-friendliness and the integral operation of various intellectual infrastructures, the government will plan to turn public research institutions into centers by designating and developing them as core centers for various areas of intellectual infrastructure. Core centers are required to grasp the needs of the users, and reflect them in the development and operation of their intellectual infrastructure. Their common functions are: collaboration with relevant organizations, accumulation and transmission of the location of the intellectual infrastructure and technical information, and considerations on intellectual property.

Public research institutions and universities are required to build the framework that is required by securing full time personnel that will play a part in the development of the intellectual infrastructure, and position the required framework aptly in their respective operation policies so that the level of contributions to the development on the intellectual infrastructure of the researchers and engineers can be evaluated. The government will strive to improve social visibility of this area by commending researchers and engineers that have contributed to the development of the intellectual infrastructure.

Moreover, public research institutions and universities are expected to clarify the importance of digital archiving for accumulating R&D results, and the storage of materials for research in their respective operation policies, and to work on their intentional accumulation by formulating a research plan including the costs required in obtaining such research funds as competitive funds.

Because it is believed that giving and receiving materials for research will be carried out frequently in the future, the government will continue to work on development of rules on intellectual property with public research institutions and universities. In so doing, the abovementioned core centers are expected to contribute to the improvement of Japan's response capability toward issues related to intellectual property through sharing the results of considerations with other organizations.

In addition, they will actively participate in measurement standards development and biological resource stock development, particularly in Asia by continuing to rigorously participate in international endeavors related to the development of measurement standards.

### **(3) Creating, protecting and utilizing intellectual property**

To produce creative and innovative R&D results, and to pass them on to society and the nation, it is essential to revitalize the intellectual creation cycle by stimulating and activating intellectual activities and adequately protecting them as intellectual property. The government will promote measures on the creation, protection, and utilization of intellectual property for the promotion of Japan's S&T and for the enhancement of global competitiveness.

#### **(Improving the intellectual property systems in universities)**

Development of systems of intellectual property and formulation of rules including the consolidated management of inventions are being implemented in universities. The government will support the system development of university intellectual property centers and TLO for the development of future full-scale intellectual property activities, and promote efforts for carrying out prompt and flexible business operations by responding to various problems associated with intellectual property management and contracts.



In addition, since conflicts regarding intellectual property that universities are involved in are coming to the surface, the government will support system development in universities so that they can respond properly to resolve such conflicts.

#### **(Promoting intellectual property activities)**

It is important to utilize outstanding R&D results that become the source of global competitiveness by effectively obtaining the rights particularly as basic patents in Japan and abroad.

The government will encourage businesses to switch the emphasis of their patent strategies from quantity to quality so that they lead to obtaining high-quality basic patents. Because it is important for universities to utilize great intellectual property by obtaining rights properly, regardless of nation, the government will support the strategic efforts of universities. The government will also carry out the development of search systems for patent information so that outstanding quality research results can be obtained.

In addition, with regard to the various issues of intellectual property in advanced technology areas such as the life sciences, including smooth usage of others' patents in testing and research in universities, the government will make considerations that take into account the appropriate balance with the level of freedom of research in universities, and develop the intellectual property system and its operations as needed.

#### **(Developing regions through intellectual property)**

Universities, which are the creation centers of intellectual property, are expected to produce new intellectual property that leads to the development of regions as the core of regions. The government will support the efforts of promoting the creation and utilization of intellectual properties that match the needs of regions by reinforcing collaborations of universities with local businesses, local authorities and local research institutions, and encouraging the security and utilization of advisors on intellectual property in regions.

#### **(4) Actively responding to standardization**

It is important to actively respond to standardization to disseminate R&D results. As such, relevant organizations including the government will provide effective support while the business world proactively takes on the activities of standardization.

The government and public research institutions will engage in the activities of standardization by positioning intellectual property strategy as well as standardization strategy clearly in the R&D plan in implementing R&D projects. Moreover, to strategically gain global standards produced in Japan, the government will promptly, consistently, and effectively participate by exhibiting leadership through producing an international standardization proposal in areas with technical advantage. It will also further reinforce collaborations between relevant office and ministries, and industry-university-government collaborations for the activities of international standardization organizations such as the International Organization for Standardization (ISO), the International Electro technical Commission (IEC) and the International Telecommunication Union (ITU). Furthermore, in striving for international standardization, the government will speed up the deliberations of domestic standards so that they can be utilized strategically as a step toward international standards.

In addition, the importance of human resources that can accurately respond to the activities of standardization, i.e., people who will take on the role of international secretary in the activities of international standardization, has increased. As such, the government will reinforce the framework of training standardization experts through improving the training and educational programs, including the production of teaching materials on standardization, utilizing the experts of public research institutions, and improving support for participation in the activities of international standardization.

#### **(5) Improving the research information infrastructure**

Research information infrastructure has a quality as a sort of lifeline essential in research activities, and the government will always go ahead of advanced information and telecommunications technology and global trends to particularly improve host computers and high-speed networks. In addition, the government will carry out effective and efficient operations of research information infrastructure by promoting the systematic collection, storage, and effective transmission of research information such as essential research paper journals in research institutions, and the collaboration and efforts between researchers and research institutions.

Specifically, the government will reinforce global collaboration as well as achieve a flexible and efficient research information network through the introduction of the latest technologies, and a user-friendly computing environment. In addition, the government will carry out comprehensive and strategic efforts for foundational software development that reinforce hardware and its organic coordination, including the building of a system that encompasses them, and the securing of human resources.

Moreover, to advance the usage environment of research information, the government will improve the integrated search system of bibliographic information and patent information such as articles, enhance the system of collecting and storing research paper journals, and promote function reinforcement and coordination of university and national libraries, all while introducing the latest information and telecommunications technologies.

Furthermore, the government will support the digital archiving of research paper journals so that Japan's accumulated research information can be sent out at home and abroad as assets.

In addition, for the purpose of disclosing the results obtained by researchers in research under public financial support, we expect to be able to peruse research papers published in journals online without charge after a certain period of time.

## **(6) Promoting the activities of academic societies**

### **(Role of academic societies)**

Academic societies support Japan's research activities beyond research institutions such as universities as places for presenting research results, exchanging knowledge, and communicating and coordinating with researchers and academic societies at home and abroad. To improve the international position Japan's S&T, there is a need to enhance their functions by promoting reforms through self-help efforts of such academic societies.

Moreover, academic societies are expected to carry out broad activities such as active communication with society on S&T, support for children's participation in international S&T competitions, and contribution for ongoing ability development of engineers, while being aware of their social roles. As a country, the government will actively provide support so that such activities can be carried out briskly.

### **(Enhancing the global competitiveness of academic societies)**

Academic societies in Japan have seen a fall in their information transmission abilities compared to European and American academic societies, which outpace capital strength by the rapid globalization of the transmission and distribution of research information through journals via the Internet. There is concern that the presentation of research results is shifting away from academic societies at home toward abroad.

For this reason, academic societies are expected to carry out infrastructure development for boosting the abilities of collecting, analyzing, transmitting, and distributing research information using information and telecommunications, and enhancing information transmission by using active interaction of human resources such as bringing in foreign researchers to revitalize workshops. Furthermore, from the perspective of reinforcing the global competitiveness of research paper journals, academic societies are expected to promote globalization in the editing and referencing of research paper journals. They are also expected to utilize information telecommunications technologies under their self-help efforts for independence and progress, including the integration with research paper

journals of relevant areas. The government will provide competitive and selective support for strengthening their functions by promoting such reforms of academic societies.

#### **(7) Promoting R&D in public research institutions**

The mission of public research institutions is to achieve policy objectives. The institutions carry out selective R&D focusing on basic and pioneering research that lead to the improvement of Japan's S&T, and systematic and comprehensive research with specific targets that conform to policy needs. In so doing, they are required to strengthen their functions so that they can effectively disseminate the research results produced, put them to practical use, and pass them on to society by fully exhibiting their potential abilities for creating innovation while reinforcing their ties with universities and the business world.

Many public research institutions have evolved as independent organizations, but each organization is expected to engage in self-governing and self-active operation and reforms such as introducing flexible operation of research funds, and fair and highly transparent competitive personnel and payroll systems through their own managerial efforts under the discretion of their director. In addition, from the perspective of improving the functions of organizations, they are encouraged to carry out R&D by obtaining competitive funds. However, it is important first to have the necessary expenses for achieving the organizations' missions to be provided without fail through operating expense subsidies.

Furthermore, to increase competitive funds and promote strategic and selective S&T, the government will take measures so that there will be no immediate budgetary restrictions for competitive fund distributing organizations, and those that are properly involved in strategic and selective S&T, just for being independent organizations.

Tsukuba Science City and Kansai Science City will work on R&D collaborations and integration that utilize their advantage of having a concentration of several public research institutions within their cities.

### **4. Strategically promoting international activities**

From now, Japan needs not only to stay with the perspective of globalizing the activities of S&T, but also to implement them strategically. In so doing, the government will make efforts toward achieving the following objectives while using the approaches of competition, harmonization, cooperation, and support according to the condition of the counterparts based on sufficient research and analysis of global trends.

- Utilize Japan's S&T abilities to respond to the solving of international challenges, and the international imperatives and expectations from other countries to increase the trust toward Japan.
- Contribute to formulating international standards and rules on S&T through Japan's initiatives.
- Cultivate Japan's researchers as world-class human resources, and strengthen Japan's S&T abilities by improving the diversity of research and standards of research through accepting outstanding foreign researchers.

#### **(1) Systematic efforts of international activities**

With regard to the bilateral and multilateral frameworks in the international cooperative activities of S&T, the government will carry out systematic efforts for international activities of S&T, while keeping in mind the existence of mutual complementarities of S&T activities and common challenges between Japan and our counterparts

Among those undertakings are:

- (i) Forming of a multilayered network (government, research institutions, academic societies, researchers),
- (ii) extracting of common challenges that must be worked on jointly including Japan, and

the implementation of R&D and technological development for solving such challenges, and (iii) promotion of the creation of a seed bed of new international cooperation. In addition, the government will work on developing human resources that will lead in future international activities.

## **(2) Cooperating with Asian nations**

The government will continue to improve prior international frameworks, and cooperate and collaborate with European nations and the United States of America. It will also strengthen the ties of S&T with Asian nations to fulfill the role that is expected of Japan from both inside and outside the country, in view of international situations, i.e., geographical and environmental accessibility, the rapid improvement of the S&T standards, and the increasing closeness of economic relations. For this reason, the government will strengthen the collaboration of S&T. As such, the government will implement a policy dialogue called "Asian Region S&T Ministerial Summit" (tentative name) at a high level, including ministers involved in S&T policies with Asian nations, based on the existing government-to-government dialogue and interaction by researchers.

In parallel with this dialogue, the government will strengthen the S&T community with Asian nations through network formation and responses for common challenges in the Asian region by promoting interaction with researchers from Asian nations.

## **(3) Promoting general development for reinforcing international activities, and acceptance of talented foreign researchers**

To forcefully promote international activities, the government will strengthen the infrastructure that supports such activities, including the reinforcement of the administrative system that leads the international activities in universities and public research institutions, the effective promotion of overseas base activities of relevant organizations and the promotion of collaborations, and the development of the systems that systematically collect and analyze overseas S&T trends. In addition, to improve the international ratings and visibility of Japan's S&T activities, the government will support the active transmitting of information on research results, researchers and research institutions overseas, mainly for overseas centers, and the forming of the network of officials including those with research experience in Japan. Moreover, the government will continue to develop and improve Tsukuba Science City and Kansai Science City as international R&T centers open to all.

To promote the acceptance of foreign researchers and to expand their activities, the government will further promote necessary reviews and operational development on the future of immigration control systems and visa issuance. Specifically, the government will proceed with efforts for the extension of period of stay for foreign researchers, the relaxation of restrictions on permission of permanent residence, the relaxation of restrictions on issuance of short term stay via with multiple-exit, and the simplification and acceleration of various procedures, and put forward suggestions on the issuance of APEC business travel cards (ABTC) to researchers at APEC related meetings.

## **Chapter 4 S&T to Be Supported by Society and the Public**

S&T activities and systems do not exist independently from society and the public. It is no exaggeration to say that the development of S&T will be possible only when S&T activities and systems are extensively supported by society and the public. "S&T to be supported by the public and to benefit society" is a basic principle of the third basic plan. Therefore, entities at various levels, ranging from the Council for Science and Technology Policy, relevant ministries and agencies, municipal governments, the Science Council of Japan, academic societies, other research communities, research institutes, to individual researchers, will promote associated measures according to their respective roles and in an appropriate manner.

Human and social sciences are important to resolve the diverse problems of modern society. Therefore, we need to implement comprehensive measures combining these sciences and natural

sciences.

### **1. Responsible measures to be taken to resolve ethical, legal, or social problems caused by S&T**

Rapidly advancing S&T are coming to greatly influence social issues including legal and ethical issues. Some these include bioethical issues, including human cloning technology; anxiety about genetically engineered foods; concerns about the misuse of personal information; and ethical issues for researchers, including those who forge experimental data. To achieve social trust in S&T, the government and research communities will draw up, through open processes, a set of rules in consideration of global trends, while encouraging S&T researchers to conduct R&D activities in compliance with those rules. In particular, as well as promoting comprehensive and strategic review and study on the impact that nanotechnology has on society, they will enhance measures to resolve bioethical issues that have been growing rapidly in close relation with society.

In the formulation of those rules, the Council for Science and Technology Policy will be involved in the creation of the basic rules, with foresight and in cooperation with the relevant ministries and agencies. The Science Council of Japan, as an organization representing the Japanese research community, will also contribute to making the rules. In addition, to establish the ethics of researchers and engineers, we will encourage universities and other educational institutions to build education systems, and encourage academic societies to develop training systems and formulate ethical guidelines.

S&T activities for risk assessment, such as safety assessment, the devisal of test methods, and the collection, arrangement, and analysis of data, are important to rationally implement the risk control required to return the S&T results to society.

The activities for creating social consensus based on the results of scientific risk assessment are essential for the public to feel security. The government will support these activities.

### **2. Accountability relating to S&T and the improvement of information provision**

Returning S&T results to the public with clear explanations is fundamental in achieving people's support for S&T. The practical policy goals mentioned in Chapter 1 are the basis of strengthening of accountability for people for S&T. The Council for Science and Technology Policy will follow up the progress each of the ministries and agencies makes for accomplishment of the goals, as well as provide society and the public with relevant information.

The basic responsibilities of research institutions and researchers are to disclose their research activities as much as possible and to explain the details and results clearly to society. In the course of fulfilling their responsibilities, those research institutions and researchers are expected to use diverse media effectively and efficiently.

We will promote outreach activities that aim for the sharing of public needs among researchers through interactive communication between researchers and the public. Therefore, we will create and adopt a mechanism in the competitive fund system to ensure a certain amount of expenditure for outreach activities.

### **3. Improving the public awareness of S&T**

To increase public interest in S&T, it is important to improve adults' knowledge and abilities (S&T literacy) relating to S&T, as well as enrich science and mathematics education in elementary and secondary education. Therefore, we will formulate and widely spread the vision of S&T literacy (a document clearly explaining the knowledge, technology, and views relating to S&T). We also need to implement new methods for the merging of S&T, culture, and the arts, so that society and the public may gain a deeper understanding and awareness of S&T.

Furthermore, we will increase the opportunities for the entire public, from infants to the elderly, to come into contact with, experience, and learn about S&T. More specifically, we will enhance the

National Science Museum, the National Museum of Emerging Science and Innovation (Miraikan), and other museums, while promoting the development and securing of employees who support their activities, science volunteers, and NPO employees. In addition, we will promote the contributions of universities and public research institutions to the improvement of the people's awareness of S&T through social activities such as opening to the public of their facilities and equipment and lectures on demand. The government will also provide the public with an opportunity to experience the dream and excitement of S&T through a variety of competitions and events.

#### **4. Promoting proactive participation of the public in S&T**

The active participation of the public in S&T, as well as the approaches of S&T toward the public, are essential for increasing the people's understanding and support for S&T. Therefore, we will enhance measures to encourage the public to participate in S&T proactively. More specifically, measures will be taken to encourage ministries and agencies to actively disclose the basic plan, and research details and progress of the R&D project that may have a large impact on society and raise public interest extensively, as well as to encourage them to reflect the feedback obtained as a result of the disclosure to the public.

### **Chapter 5 Role of the Council for Science and Technology Policy**

#### **1. Basic operation**

With the leadership of the Prime Minister, the Council for Science and Technology Policy will operate with foresight and flexibility and suggest a national strategy as the chief controller of the promotion of policies so that essential policies mentioned in the S&T basic plan may be accurately and steadily realized by the nation as a whole.

In the operations, the Council will closely cooperate with the Science Council of Japan, Council on Economic and Fiscal Policy, Strategic Council on Intellectual Property, IT Strategic Headquarters, Council for Regulatory Reform, Council for Gender Equality, Headquarters for Regional Revitalization, and other entities.

Furthermore, the Council for Science and Technology Policy will pursue the vision for which human society in the 21st century should aim. It will always have a global view, and conduct proactive activities as "the meeting place of wisdom" that covers the natural, human, and social sciences. So that the Council may be well known to society and the public, it will also strive to develop interactive communication between S&T and society/the public and to improve public awareness of S&T, aiming at "S&T being supported by the public and benefiting the society."

#### **2. Specific measures**

##### **(1) Effective, efficient promotion of governmental R&D**

###### **(Enhancing strategic R&D)**

To enhance strategic R&D through selection and concentration, the Council will promote intra-sectoral prioritization, while formulating the Promotion Strategies for Prioritized Areas that indicate important R&D themes. The Council will also select strategic prioritized S&T to be incorporated in the Strategies. These Strategies will be amended flexibly in consideration of updated S&T knowledge and information, and an annual policy cycle will be established to reflect the amendments to the resource allocation policy and thereby realize "practical strategies." The policy goals of ministries and agencies for each project and related progress will be clarified to strengthen accountability.

###### **(Improving prioritization in the resource allocation policy)**

For more effective allocation of S&T-related resources and the removal of adverse effects of

sectionalism, the Council will implement prioritization more strictly and provide relevant ministers with its opinions. The Council will strive to improve the method of prioritization and make other improvements, including priority setting from viewpoints of policy goals in addition to S&T.

**(Full-scale promotion of S&T collaboration measures)**

The Council will enhance collaboration among ministries and agencies and remove adverse effects of sectionalism such as the unnecessary overlapping of measures. The Council will start taking S&T collaboration measures before the budget requests and thereby promote them on a full-scale basis, to exert the effects of synergy and merging to accomplish policy goals.

**(Promoting the understanding of S&T activities conducted by independent administrative institutions and national universities, and the publication of opinions offered regarding the activities)**

The Council will understand the current progress of S&T activities conducted by independent administrative institutions and national universities that play a major role in promoting national S&T policies, as well as the status of resource injections for these activities. The Council will then analyze their consistency with the basic plan and offer its opinions. Giving sufficient consideration to the characteristics of independent administrative institutions and national universities and their influence on research/educational activities, the Council will ensure a more thorough understanding of the current progress and status, and, when necessary, ask relevant ministries and agencies to take measures for improvement. By releasing the offered opinions publicly, the Council will encourage these corporations to accelerate their reforms by improving the transparency of their S&T activities.

**(Enhancing research and analysis functions and adjustment functions among ministries and agencies)**

In conjunction with the functional improvements mentioned above, the Council will enhance research and analysis functions, as well as adjustment functions among ministries and agencies.

**(2) Promotion of S&T system reforms**

The Council for Science and Technology Policy will promote evaluation system reforms, evaluation of large-scale R&D projects and other nationally important R&D projects, improvement of systems related to industry-university-government collaborations, and reform of the competitive fund system. The Council will also improve governmental R&D databases to avoid the unreasonable overlapping of research fund allocation and the concentrated fund allocation that exceeds the appropriate amount the individual should be granted for his/her efforts.

**(3) S&T to be supported by the public and to benefit society**

Taking adequate measures by ministries and agencies is essential for S&T to gain social understanding and public interest, and the Council for Science and Technology Policy will also promote these measures. In particular, the Council will promote understanding of the progress in the accomplishment of policy goals, provision of related information, strengthening of provision of information on S&T, expansion of functions of communicating with the public, and participation of the public in S&T.

**(4) Strategic promotion of international activities**

Due to the necessity for taking international measures strategically, the Council will promote high-level policy discussions with other Asian countries in the "Council of Ministries for Asian S&T" (tentative name).

**(5) Removal of structural or operational obstacles for smooth S&T activities and the return of the results to society**

The Council intends to be involved with S&T policies and border areas with other policies more proactively in cooperation with relevant ministries, agencies, and councils, to remove structural obstacles for S&T promotion and to resolve operational problems that appear at research sites.

**(6) Appropriate follow-up of the S&T basic plan and the promotion of the progress**

In addition to promoting the above, the Council will follow up the status of implementation of measures in the basic plan in cooperation with relevant ministries and agencies, and provide the Prime Minister and relevant ministers with the follow-up, and, when necessary, its opinions as well. The Council will conduct a follow-up at the end of each year and a more detailed one at the time three years have passed since the implementation of the measures. The Council will understand related progress and, when necessary, it will change the measures in the basic plan flexibly. The Council will take appropriate measures for S&T system reforms, when necessary, to promote the progress of the measures in the basic plan.