tentative version

The Science and Technology Basic Plan

(2001-2005)

Government of Japan

March 30, 2001

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The Science and Technology Basic Plan
decided by the Government of Japan
on March 30, 2001

Introduction

During the last decade of the 20th century, the world underwent a great transition. Due to the termination of the Cold War, people are now enjoying peaceful life on a global level, even though disputes are still occurring in various regions. As a result, not only the flow of people and goods, but the cross-border movement of information, capital, and so on has increased, further accelerating globalization in various ways. That in turn has intensified economic competition among advanced countries and has resulted in the advent of so-called mega-competition. As the basis of such competition, IT technologies and biotechnologies have advanced remarkably, and governments of various countries have made more efforts on implementation of S&T policies, recognizing them as one of key policies among others.

Under such international environments, Japan has experienced a serious depression for the first time since the World War II. This downturn, in the early part of 1990s, has led to a decline in R&D investment of private companies which used to account for approximately 80 percent of the investment in Japan. And R&D facilities in universities and national research institutes have been remained in poor condition, industry-academia-government collaboration has not worked effectively, resulting in the grave situation of Japanese S&T level and the deterioration of competitiveness of Japanese companies.

To overcome this situation, in 1995, the government of Japan, enacted the Science and Technology Basic Law, aiming to be an advance science- and technology-oriented nation. Based on the law, in 1996, the first Science and Technology Basic Plan was adopted to improve drastically S&T environment in Japan, to strengthen Japan's R&D capability and to restore R&D results smoothly to society. In the five years, due to the impact of the First Plan, R&D level in Japan has been elevated. However recovery of industrial competitiveness is not yet sufficient and economic growth of Japan is not promising in the aging and low-birth-rate society. It is further important, therefore, to reinforce industrial technology leading new industry generation and to restore strong international competitiveness.

With the beginning of a new century, S&T in Japan is expected to have a new development. As regards various fast-growing fields, Europe countries and the United States maintain higher levels of R & D than that of Japan. Japan must match and even exceed such levels in terms of the R&D results. Therefore in basic research which creates new knowledge, Japan's level of R&D should be elevated and an environment should be established to yield internationally

respectable achievements. In R&D to respond to social and economical needs, each sector of industry, academia, and government should remove invisible walls standing among them to set up an environment to enable practical cooperation. At this time, for creative young researchers, an environment in which they are able to exercise their ability should be provided. Also it is necessary to maintain permanent communication between S&T and society, to answer to social expectation on S&T.

This year, the government of Japan has been reorganized; which includes establishment of the Council for Science and Technology Policy, the Ministry of Education, Culture, Sports, Science and Technology and so on, and transformation of major national research institutes into independent administrative institutions. As a part of this reform, reform of universities, which play a main role in S&T, has been underway. National universities are also engaged in deliberations regarding their transformation into independent administrative institutes and further reforms. Since now, as a control tower to implement S&T policies, the council will formulate promotion strategies on prioritized areas, principles of resource allocation, guidelines for project evaluation, and will strive to promote S&T activities in such high quality that are able to contribute development of the world.

In consideration of the foregoing, based on the view that S&T in the 21st century, called the "century of knowledge", should generate new knowledge, maintain sustainable development of both people's life and economic activities in Japan, and contribute to the world; the first chapter of this document presents basic concept that Japan should adopt, a vision that this country should aim, and basic principles to achieve these goals. The second chapter, in line with the first chapter, demonstrates basic policies concentrating on prioritized and strategic R&D promotion and S&T system reforms. The third chapter describes missions of the council to promote this basic plan.

Chapter 1 Basic Concepts

1. Circumstances Relating to S&T

(1) A look back at the 20th century

In the 20th century, which has been called the “century of science and technology”, outstanding advances in S&T brought about unprecedented changes across the globe. Thanks in part to the rapid progress of studies in such subjects as physics, chemistry, and the life sciences, people in the more-developed countries have gained the benefits of affluence and convenience in daily life, and of better health and longevity as well. However, the possible negative influences of S&T also became apparent, and they came to pose threats to human society and the global environment.

Japan, due to its successful modernization in the 20th century, has developed into a nation having an enormous economy. After World War II in particular, against the backdrop of an impressive development of industries, Japan achieved economic growth that was so great it was referred to as miraculous, and this country became an economic giant in terms of GDP, ranking second in the world only to the United States. That progress enriched the Japanese people’s living standard and extended their average life span substantially, thus allowing them to enjoy long and healthy lives. In the 1990s, however, Japan suffered an unprecedented economic depression and experienced a difficult period that is sometimes referred to as “the empty decade”.

(2) The outlook for the 21st century

In the 21st century, S&T are expected to make further rapid progress, to increase their contributions to the life and well-being of human beings, as well as to the economical and social development, and to continue to be an engine driving sustainable growth across the world.

In this century, human society is expected to become one that is knowledge-based. Meanwhile, to become such a knowledge-based society and to develop further economically, Japan is faced with many problems that have to be resolved.

Now Japan is burdened with economic issues such as the deterioration of the industrial competitiveness and job opportunities while economic globalization is advancing and international competition is intensifying. Furthermore, Japan is facing a decrease in workforce and an increase in expenditures on health care and social security resulted from aging and low-birth-rate. In order to stabilize and develop the people’s life, it is essential to foster industries that have internationally high productivity and strong competitiveness through persistent technical innovation to restore the nation’s economic vitality.

In an aging society, it is important that elderly should be able not merely to live long but to enjoy high-quality, healthy, active, and worthwhile life and to contribute their experience and skills for society. It is particularly necessary to enable elderly to maintain health and to improve quality of life, by overcoming illness with help of medical care as well as preventive therapy .

In recent years, IT revolution, which has spread into all parts of society, including economy, industry, education, and recreation, is bringing rapid and extensive changes to society. Against this background, it is a subject for Japan to enable people to enjoy such benefits through generating new industries and improving social convenience. In this quest, Japan needs to move forward on R&D relating to IT technologies, which are the nucleus of this revolution, as well as to make efforts to resolve the problem of the so-called digital divide within society.

For human beings to have a bright future, S&T is indispensable to tackle multiple problems which the world faces on a global scale in the 21st century — such as population explosion, shortage of fresh water, food, and energy, global warming, undiscovered infections— and to achieve sustainable growth in all over the world including developing countries. These issues are of particular importance to Japan which is dependent upon foreign countries for resources, energy, and food. To defeat such aforementioned problems, it is necessary to accumulate as much domestic and overseas knowledge as possible.

In order to overcome such problems on Japan and the world in the 21st century, both extensive knowledge accumulated through human intellectual activities and wisdom to apply it effectively, are needed. In this regard, over-confidence on S&T will spoil the global environment, social welfare, and happiness of human beings. Some global scale problems caused by mass-production, consumption, and disposal in the 20th century must be valuable lessons.

In a forecast in the medium-to-long- term in 21st century, S&T influences on society and human beings, such as bioethics issues on the dignity of human beings brought by advanced life sciences, safety security of genetic modified organs, digital divide, and the environmental problems, will become broader and more serious. In order to have a foresighted approach under such circumstances, it is required to explore a new S&T field that is able to analyze, assess, and appropriately respond. For this reason, it must be recognized that wisdom of human beings, integrating natural S&T with social sciences/humanities.

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

In helping people to develop a sound perspective for the future, S&T must play a key role. Japan has to promote S&T through implementation of practical policies based on the Comprehensive Strategy to Promote Science and Technology and the Science and Technology Basic Plan, standing on the primary principle to realize "an advanced science- and technology-oriented nation". Therefore Japan, taking into account the experiences of the 20th century and the outlook regarding the 21st century as described above, should have a clear vision as a basis for S&T policies that has three characteristics as :

- A nation contributing to the world by creation and utilization of scientific knowledge
- A nation with international competitiveness and ability of sustainable development
- A nation securing safety and quality of life

(1) A nation contributing to the world by creation and utilization of scientific knowledge — creation of wisdom

"A nation contributing to the world by creation and utilization of scientific knowledge" is a nation that creates new knowledge by clarifying unknown phenomena and by discovering new scientific laws and principles, and that copes with various problems by utilizing accumulated knowledge. And also the nation, which transmits to the world knowledge and wisdom thus contributing to resolving problems common to human beings, thereby wins the confidence and trust of other nations across the globe.

In order for Japan to become such a nation, a framework is necessary to make science rooted in the society and to foster it. This requires to prepare an atmosphere where value of scientific view, scientific way of thinking and scientific mind are placed; and to construct a knowledge-based society which generates talents who can create new knowledge.

More specifically, the goal is to create outstanding R&D results and to disseminate them widely across to the world, for example by publishing a lot of excellent papers that match investment, by increasing percentage of internationally renowned paper, by producing a number of Japanese who win international prizes , as represented by the Nobel Prize, in science to be the same level of the number as major European countries – as many as 30 Nobel laureates in 50 years –, and by providing a number of center-of-excellences which gather many excellent foreign researchers.

(2) A nation with international competitiveness and ability of sustainable development — vitality from wisdom

"A nation with international competitiveness and ability of sustainable development" is a nation that can improve people's living standard and maintain vitality for sustainable economic growth in the international competitiveness, through overcoming current difficulties, creating value-added assets and services and securing job opportunities.

Industrial technological power is not only a source of international competitiveness of Japanese company but also a driving force to vitalize all industrial activities that support people's life. Industrial technology is also important in terms of utilizing results of scientific

knowledge to benefit society. To maintain economic vitality for sustainable development, it is necessary to foster industries superior in international competition, through providing an environment in which innovations are constantly taking place in processes from the creation of new technologies to the development of new markets. It is particularly important to create new industries footing on R&D, and it is urgent to reform the interface between academia and industry.

More specifically, the goal is to have strong international competitive power by widely transferring R&D results from public research organizations to private companies, by proposing various international technical formats, by increasing the number of obtained international patents further more, and by improving industrial productivity. These are conducted, for example, by the activities of some technology licensing organizations to accelerate technological transfer form public sector and venture establishment supported by public research organizations.

(3) A nation securing safety and quality of life — sophisticated society by wisdom

"A nation securing safety and quality of life" is a nation that reliably assures safe and high-quality living for people in which: people live long and healthy in the aging society by improving ability of illness treatment and disease prevention; damages caused by natural and artificial disasters are minimized; food and energy, which form the basis for human activities, are supplied steadily industrial activity and economic development are realized in ways that preserve the global environment; and the nation maintain stable international relations all over the world.

In order to achieve the foregoing aims entirely, it is necessary to develop S&T and to introduce them properly into society. For example, S&T can clarify how diseases or disasters occur and spread. At the same time, it must be kept in mind to minimize S&T negative influences. As one of advanced countries in S&T, Japan is expected to make efforts to utilize S&T to resolve various difficult problems that confront the international community including developing countries, so that Japan can maintain international status and national security.

More specifically, the goals are to form S&T bases to analyze genetic-caused disease, to apply them for custom-made medical treatments, to minimize the damage from natural disasters such as earthquakes and typhoons, to secure stable supplies of high-quality foods by applying biotechnology; and to reduce the possible risks of S&T. Thus Japan is expected to contribute for infectious disease prevention and disaster management also in the developing countries.

In order for Japan to become a country that has the three characteristics mentioned above, it is necessary to take followings into consideration.

- It is essential in the 21st century for Japan to continue to develop S&T that based on the world-class accumulation during the 20th century. By so doing, Japan should simultaneously achieve the following two targets: to resolve problems confronting Japan, and to contribute actively to develop human society by resolving problems in the world using S&T in Japan.

- Because Japan started modernization efforts earlier than any nations except European countries and the United States, it has a long experience in harmonizing S&T and traditional cultures. Japan should use the experience to contribute to an environment that will enable people in the world to extensively enjoy benefits of S&T while maintaining their respective cultures and value systems.

3. Comprehensive and Strategic S&T Policies

To actualize the vision based on the above ideas, S&T policies in Japan are to be managed as indicated below, because such policies should be promoted with a broad perspective and strategic procedures.

(1) New S&T that support human living and that form a basis for industrial competitiveness should be further developed. At the same time, S&T must harmonize with human society and the natural environment, watching S&T comprehensively and panoramically to consider what human society should be like in the 21st century. It is very important that the Council for Science and Technology Policy , newly inaugurated at the start of the 21st century, has discussions on S&T which integrates natural S&T with social sciences/humanities.

(2) Because S&T is inexhaustible intellectual resources, its promotion might well be regarded as prior investment toward the future. Continuous investment on basic researches should be promoted further through strict evaluation as a basis for a knowledge-based nation. Also, a dynamic circulative system, in which high-quality results in basic researches or in prioritized areas are speedily applied to social and industrial activities attracting further investment, should be constructed.

(3) In complicated modern societies supported by highly advanced S&T, potential negative S&T influences, on such as people's life or physical safety by inappropriate utilization/management, are occasionally emerging. Regarding this Janus-faced aspects of S&T, it is necessary to hold a concept of "S&T for and in society". With this understanding, communication between S&T and society should be established. At the same time, those concerned with S&T should be conscious of their responsibilities to society and human beings and should have high ethical standards.

(4) In order to achieve intellectual innovations which is expected in the 21st century for social and industrial activities and symbiosis of human beings and the nature, the Council for Science and Technology Policy should prepare and promote comprehensive and strategic policies as a control tower. To achieve this, the council will demonstrate points of well-planned investment on prioritized areas, maintenance of R&D infrastructures, strict evaluation, and effective/efficient resource allocation; and fulfills its mission to implement them. The council also puts importance on observation and treatment of negative S&T influences.

4. Building New Relationships between S&T and Society

In promoting S&T so that Japan can become a nation it aims, we must adopt and implement policies that reflect consideration of relationship between S&T and society. S&T has meanings only if accepted by society, consequently, how society understands, judges, and accepts S&T is crucial. Therefore, it is necessary that this is recognized not only by natural scientists and technological experts, but also by experts relating to social sciences and humanities, and accordingly they are required to have recognition and to make effort to do so.

(1) Communication between S&T and society

Keeping in mind the idea of "S&T in and for society", it is indispensable to establish fundamentals of interactive communication from S&T and society .

First of all, accurate information concerning the present situation and the future of S&T should be provided. For this to be effective, however, society should have enough capacity to receive and understand such information through upgrading school and public education. Then experts in S&T field should provide, routinely and understandably, information of S&T which is getting more advanced and complicated. Of course S&T experts are responsible for providing such information, then, interpreters become important because specialized information may be difficult to understand for ordinary people. S&T experts themselves, professional commentators or journalists should have an obligation to introduce to society the significance and contents of the most advanced S&T in a way readily apprehended, and to propagate scientific knowledge and ways of thinking throughout society. It is also necessary to increase opportunity and to widen channels to transmit opinions and demands from society to S&T, and S&T experts must work on and respond thereto seriously and appropriately.

Experts in social sciences and humanities should be interested in S&T, to study and remark about relationship between S&T and society. And they should also play an important role in the interactive communication in which opinions and demands in society can be transmitted accurately to S&T. Up to now, social sciences and humanities in Japan have not adequately addressed such issues, however in the future, these sciences should be developed in line with the idea of "S&T in and for society", and intermediation works resulted from the research should be active.

Thus, a society, in which ordinary people are able to make scientific, reasonable, and independent judgment on subjects of S&T as well as society in general, will be created.

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

Another important point to be kept in mind when considering relationship between S&T and society, is to apply R&D results to society in practical manner. R&D results contribute normally in a form of available products or services produced by industrial technology to people's life and national economy. Society can enjoy S&T benefit in terms of application to industrial technology, which are generated in publication, accumulation, application of new knowledge. Attaching importance to this process, it is needed to strengthen industrial

technology through pursuing R&D systems to create excellent results and promoting closer industry-academia-government collaboration.

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

The First Basic Plan was adopted by the government in July 1996, covering five years period of 1996-2000. The plan had primary principle as promotion of both R&D to meet social and economic needs and basic researches to create intellectual assets of human beings. The plan described implementing policies to achieve the principle as structuring new R&D systems, realizing desirable R&D basis, promoting education concerning S&T, and forming a national consensus on S&T. In the plan, governmental expenditure on R&D was estimated as around17 trillion yen for the five-year period, while necessary budget to implement the plan would be secured in annual negotiation with considerations for severe fiscal situation.

The achievements of policies during the period of the First Basic Plan, and problems remained, were as follows:

To provide competitive and flexible R&D environments, research funds of proposal-competition base (referred to as "competitive research funds" hereinafter) were nearly doubled and funds for young researchers were increased substantially. The 10,000 researchers-support-plan (including post-doctoral fellows) was achieved in number in the fourth year and enriched young generation in Japan to activate R&D fields, leaving, however, problems such as relationship between young researchers and research advisors and difficulty in job hunting after post-doctoral period. Mobility of human resources, despite the system innovation such as in fixed-term appointment and relaxation of civil servant's side-employment for industry-academia-government collaboration, had not been improved entirely.

With regard to R&D evaluation, "National Guidelines on the Method of Evaluation for Governmental R&D" was decided by the prime minister in August 1997 and the earnest evaluations of research institutes and research themes have been introduced. Although such research evaluations were improved like universities were obligated to have self-evaluation, reflection of evaluation to resource allocation/personnel changes and transparency of evaluation process have not been considered sufficiently. To upgrade effectiveness of R&D evaluation, it is needed to improve promptly evaluation methods and result publishing.

In order to encourage industry-academia-government collaboration, some systems, such as adoption of national institutes' research consigned by private company and patent rights for consignment research results, were reformed and national institutions were restructured in aiming to apply and commercialize the R&D results. Consequently the numbers of patent application by national research institutes and public-private joint research have been increasing steadily, and technology licensing offices to connect these patents with industry have become active all around Japan. Also a law was revised to promote joint-research facilities in national university.

However, research facilities and the number of research assistants have not been improved sufficiently. In particular, about facilities of national universities, deterioration and congestion have not been resolved, despite the expenditure of over one trillion yen in five years, partially due to rapid increase of the number of graduate students. The number of research assistants had increased slightly only in national research institutes. The number of

research assistants, on the contrary, had been decreasing in national universities, conditions of research projects were enhances by incensement of graduate students' participation.

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

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

Although it is quite difficult to fully evaluate the effect of such expenditure at this stage, when only four years in the five-year period have actually passed, policies under the first basic plan is regarded to have activate to R&D fields. During this period, Dr. Hideki Shirakawa was awarded a Nobel Prize in chemistry for his creative scientific achievements concerning conductive polymers. Also, the number of papers written by Japanese scientists and published in the world's highest-level science periodicals has been increasing. In basic sciences and in newly developing fields, too, other Japanese researchers have obtained the highest-level results in the world, including those relating to the origin of substances by using the Super-Kamiokande detector to first observe a neutrino event and the elucidation of the so-called suicide structure of cancerous cells.

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

In light of such achievements, further reforms that are included during the period of the first basic plan should be pursued in the future, and problems had emerged during the period should appropriately be treated.

6. Basic Concepts for S&T Promotion

(1) Basic Policies

Based on the aforementioned achievements and problems of the first basic plan, in order to enable Japan to become a nation it aims, Japan will promote S&T pursuant to the following policies:

1) To set priorities for S&T resource allocation to make R&D expenditure more effective;
- to allocate resources on R&D challenging national/social problems with priority having definite target
- to accurately picking up S&T emerging fields with foresight and mobility
- to attach importance to high-quality basic research which inquires new knowledge and unlocks the future

2) To pursue S&T systems which create world-class excellent achievements and to expense on R&D infrastructure for the systems;
- to provide competitive R&D environments in which researchers are able to devote their maximum ability to their original idea, especially to provide opportunities for young researchers
- to train/secure excellent human resources, which is the basis of S&T activities, by promoting educational reform, and to promote mobility of researchers to train them through experiences of a wide range of R&D environments
- to adopt fair and transparent R&D evaluation systems for desirable competition and to enhance them effectively
- to improve facilities intensively in national universities which remained in insufficient condition and to enrich intellectual basis for S&T such as measuring standards and biogenetic resources

3) To pursue restoration of S&T to society;
- to strengthen technological capabilities in industry to accelerate commercialization of R&D results through closer industry-academia-government collaboration, to resolve social problem concerning food, economy, industry, the environment, health, welfare, and security
- to deepen people's understanding of S&T, which is essential for S&T promotion and also necessary for scientific, reasonable, and independent judgment on subjects on S&T as well as society in general, through presenting the significance and contents of S&T from scientists and engineers on their own responsibility and promoting education concerning to S&T

4) To promote internationalization of S&T;

- to create outstanding R&D results, to operate independent international activities to contribute to overcome various problems that human beings confront, and to disseminate them widely across to the world
- to establish world-standards and open R&D environments where excellent researchers in Japan and the world will gather form national and abroad

Pursuant to the basic policy mentioned above, Japan will reform as promptly and actively as possible, considering rapid international trends and globalization. In the process, unnecessary overlap and harmful sectionalism among ministries shall be eliminated.

In addition, respective roles of public and private sectors for S&T promotion will be clarified and R&D in private sector, which can be done by them, will be promoted

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

During the period of the first basic plan, governmental R&D expenditure as a percentage of the national gross domestic product (GDP) has steadily been increasing in Japan, now coming up to almost the same level as in the leading European countries and the United States, where that percentage has been decreasing. In order to continue the effort of S&T promotion in the previous plan, during the period of the second basic plan, this percentage should be raised up to at least the same level as in those countries. Then the total amount of the governmental R&D expenditure is estimated about 24 trillion yen in the fiscal year 2001-2005.

(Note that this estimation is based on an assumption that the governmental R&D investment should be one percentage of the GDP, of which nominal growth rate is 3.5 percent, during the period of the second basic plan.)

Japan's fiscal conditions had, however, been deteriorated substantially into the worst level among developed industrial countries in the comparison of fiscal deficit percentage in the GDP which have been recovered or turned to surplus. A huge amount of the fiscal deficit threaten to affect Japan's economy and to obstruct its development. Therefore, in order for Japan to have active society and vital economy in the 21st century, the financial affairs have to returned into sound.

Under these circumstances, annual budgets will be fixed in order to provide necessary expenditure for S&T policies in the second basic plan with preconditions of prioritized and effective resource allocation, observing effects of S&T system reform and possibility of revenues for R&D, as well as taking into consideration trends of social/economical matters, needs of S&T promotion, the fiscal conditions that are worse than those during the first plan.

In particular the funds for main subjects listed in Chapter 2, such as R&D challenging national/social problems, enhancement of competitive environments, enrichment of S&T basis, will be provided with top priorities. In parallel, to spend the fund effectively and efficiently, unnecessary overlapping and harmful sectionalism among policies, systems, or organizations will be eliminated, and also the quality of R&D activities will be upgraded by goal setting for

definite clarification of R&D effects, disclosure of R&D reality, explanation of R&D results on researcher's responsibility, and strict evaluation of S&T policies/projects. And also other financial resources should be obtained by, for example, introducing private funds and setting off properties by sale.

Chapter 2 Basic Policies

Based on the basic concepts, following three themes are adopted as important policies:

- strategic priority setting in S&T
- S&T system reform to create excellent achievement
- internationalization of S&T activities

I. Strategic Priority Setting in S&T

Japan will promote necessary R&D activities in accordance with priorities on resolving national/social problem such as enhancement of international competitiveness and countermeasures against aging and low-birth-rate society or global environmental problem, so that affluent, comfortable and safe society can be established ;and maintained. Also Japan will deal with newly emerging fields that rapid development are expected with foresight and mobility.

At the same time, Japan will secure proper resources for promotion of basic researches, because new findings in R&D might bring breakthroughs and linkage of basic research and industrial application has been getting tight.

1. Promotion of Basic Researches

Basic researches, which aims to find out new rules and principles to build up creative theories and to discover unknown phenomena, contributes to accumulate human intellectual assets and brings out breakthroughs for world-top-level R&D results or innovative industrial technologies. In light of this, Japan will attach more importance to such basic research, and promote it broadly, steadily, and continuously.

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

In order to upgrade R&D level, researches should be carried out in competitive environments having fair and transparent evaluation. The research outcomes will be evaluated primarily from a scientific point of view.

Among researches form researchers' original idea, research projects, that require an especially large amount of resources, will be evaluated also from a viewpoint of promoting internationally distinguished research, exploring innovative knowledge, and internationally assigning role to participate; will be intensively allocated resources taking into consideration balance in whole basic research including competitive research funds and opinions of researchers in various fields; so as to promote them effectively and efficiently. Then significance and expected outcomes of the projects should be explained to obtain people's understandings.

With regard to the results of research, researchers must publish theses as well as target to acquire/utilize patent rights.

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

In order to achieve sustainable economic development by activating industry and to secure people's comfortable and safe life, Japan must promote R&D through positive and strategic investment in prioritized areas. Policies of priority setting is to be set on, among S&T fields to attain the vision of Japan, as follows:

- creating knowledge that will be the source of new developments (intellectual assets enhancement)
- Promoting sustainable growth in world markets, improving industrial technologies, and creating new industries, and employment (economic effects)
- Improving people's health and quality of life, enhancing national security or disaster prevention (societal benefits)

and to grant priority on 4 areas:

1) Life sciences — which contributes to prevent/treat disease in aging and low-birth-rate society and to resolve food shortage
2) Information and telecommunications — which are advancing rapidly, and lead directly building advanced IT network society and fostering an IT industry and a high-tech industry
3) the environmental sciences — which are indispensable for human health care and conservation of people's living as well as sustainment of human existence
4) nanotechnology and materials — which can disseminate into a broad range of fields, and keep bring Japan at an advantage

and to allocate R&D resources intensively.

S&T is developing rapidly, and knowledge is becoming specialized. And because new S&T fields are born in combination or mergence of different fields, in R&D promoting, border or irrelevant areas should be paid attention to.

R&D challenging to national/social problems should be promoted in public-private collaboration, and in the followings, roles of the government will be described mainly.

(1) Life sciences

As the 21st century is also called the "Century of Life", deeper understandings of the nature of life are expected to contribute to rapid progress in medical science and solution to food shortage/the environmental problems. This area is important, in coming aging and low-birth-rate society in Japan, to actualize healthy, active and comfortable life.

The level of some R&D fields in life sciences in Japan has been kept high in the world competition with European countries and the United States in Rice Genome, specific microbe genome deciphering, and livestock cloning technique, however, it has been still behind as a whole. For instance, the United States leads the world with both national programs by the National Institute of Health and venture business activities. European countries are second to none in the researches of Alzheimer's disease and the technology necessary to develop a genome-information database.

A draft sequence of Human Genome was revealed in February of this year. Deciphering of genes of various species has advanced very rapidly in recent years, and a wide range of researches are expected to develop and to progress further based on these information. In light of the rapid growth of research, such as post-genomic researches, in advanced life sciences, Japan must work selectively and strategically in these fields, taking Japan's situation into consideration. Specifically Japan will focus on the followings:

- proteomics, elucidating three-dimension structure of proteins and drug-reacting genes, and genome science to develop new medicine, tailor-made medicine and functional food based on such technology

- cellular biology, so as to achieve advances in organ transplantation and regenerative medicine
- clinical medicine and medical technology, so as to foster practical medical uses of R & D results
- food S&T for biotechnology that contributes to food security and promotes a healthy diet, as well as sustainable food production
- brain science, so as to elucidate brain functions, to control cerebral development disorder and aging, to overcome neurotic diseases, and to develop information-processing and communications systems by applying principles that underlie functioning of the brain
- bioinformatics, supporting the above-mentioned technological revolution, in order to analyze a tremendous amount of gene-related data by utilizing continually evolving information/communications technologies

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

(2) Information and telecommunications

R&D development in the field of information and telecommunications (referred as "IT" hereinafter) is very important for formation and expansion of knowledge-gathering industries like IT industries and high-tech industries, as well as for enhancing innovations in existing industries such as improvement of manufacturing technologies. Through realizing and diffusing electronic commerce, electronic governance, home offices, remote medical treatments, and distance-education/learning programs, such development also has a great impact on socio-economic activities in Japan at all levels, from everyday life to industrial production. Advances in IT area have now become an important factor in safe and comfortable life of people in Japan.

In R&D in IT area, the level of Japan is considered to be superior to that in European countries and the United States, especially in mobile-phone systems, optical communications technology, and IT terminals. The United States, however, leads the world in both PCs and their related technology and in software technologies.

In this area there are a great variety of needs and technologies are innovating rapidly, so that Japan will promote R&D with mobility. It is also important to promote R&D concerning common technologies necessary to realize an advanced IT network society in which people can use their capabilities to the maximum in a creative way through freely sending, receiving, and sharing of information. Specifically Japan will focus on the followings:

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

In order to promote IT R&D, Japan will emphasize fundamental and leading R&D fields that are unattainable strategically and effectively through market-motivated activities alone, and will always keep in mind variety of this field and speed of technological innovations. Then

R&D done by innovative individual researcher should be focused, and excellent researchers and technicians must be trained and secured through lectures of veterans in private sectors. Also it is necessary to promote institutional improvement to secure safety activities on the network, to prepare a system for ensuring the privacy and security of network activities, to provide testing beds for developing technology, to prepare international standardization, and to foster education/learning for IT literacy that enables people to make good use of IT-related equipment and skills. In addition, it must be noted to respond against disaster due to computer errors/service interruptions and social functional suspension caused by illegal use of network, and to correct of digital divides.

(3) The environmental sciences

The environmental science is essential for human beings to maintain their survival base for the future, and to preserve the natural environment including the ecology that supports a great variety of species and to protect human health and life style.

The environmental R&D in Japan is on par with European countries and the United States in measures against global warming. In the area of global science, Japan is behind Europe, and far behind the United States, in environmental monitoring but equal in measuring techniques. Comprehensive evaluation and management technology of chemical substances is on the same level as European countries and the United States.

The environmental sciences are extremely important for Japan as it has limited land and natural resources, and so Japan must be a world leader in tackling the environmental problems. Specifically Japan will focus on the followings:

- introduction of production systems that will minimize both the input of resources and the output of wastes, and technology to support recycling in society where effective use of resources and waste control are achieved by utilizing natural circulative function and bio-resources.
- technology to minimize harmful chemical substances for human health and natural ecology, as well as to evaluate and manage them
- technology for forecasting global changes that affect human survival bases and the environment, for impact assessment on society and economy, and for global worming prevention such as minimizing green-gas emission

Considering needs to reduce the environmental impacts, comprehensive technical evaluation is necessary; so life-cycle-assessment method and databases to offer such information to consumers must be developed.

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

(4) Nanotechnology and materials science/technology

Nanotechnology and materials science/technology is an important field which is a basis of various kinds of scientific and technological advances, including above-mentioned three fields. Nanotechnology is especially expected to give breakthroughs to all S&T fields in the 21st century.

+ Materials science/technology

In the area of materials science/technology, the R&D level in Japan is superior to that in European countries and the United States, so far as existing materials science/technology is concerned.

Materials science/technology is important in the sense that they will give keys to tremendous leaps in a wide variety of fields, and Japan has kept a high level of R&D up to now. Successive investment in R&D in these fields is required in order to keep the leading position in the world for technological innovation. Specifically Japan will focus on the followings:

- material science/technology for analysis of material structures and forms, surfaces and interfaces of the order of atomic/molecular size, which will be applicable to IT, medical science, etc.
- material science/technology for energy and environmental applications for reducing energy, recycling, and resource saving
- material science/technology for creating safe space for living

The true value of materials lies in how they actually are used. Therefore, R&D should be promoted carefully so that seeds created by researchers can meet properly needs of users. It will be also important to make use of IT such as computer simulations, to promote international standardization, to improve the intellectual infrastructure, and to establish a comprehensive evaluating technique for the environment or security.

In order to promote material science/technology, Japan should emphasize R&D of basic/leading fields and for industrialization, which is unattainable strategically and effectively through market-motivated activities alone.

+ Nanotechnology

Nanotechnology is an interdisciplinary S&T that encompasses IT technology, the environmental sciences, life sciences, materials science and etc. It is for controlling and handling atoms and molecules in the order of nano(1/1,000,000,000) meter enabling discovery of new functions by taking advantage of its material characteristics unique to nano size, so that it can bring technological innovation in various fields. Also nanotechnology also provide new materials, devices and innovative systems to fields in IT, biotechnology, medical science, etc.

The level of nanotechnological R&D in Japan is on the same level or slightly higher than that in European countries and the United States. However, other nations are rapidly formulating national policies and implementing measures regarding such research. Thus, it is urgent for Japan to gather all possible industrial, academic, and governmental knowledge concerning nanotechnology and to deal strategically with this matter. An example of nanotechnology is: nano materials which has extremely high strength, extremely low weight, and extremely high efficient luminescence by means of controling material structure in nano-scale; nano information devices which realize extremely high-speed communication and information processing for next generation; medical technology in which microscopic system is put inside patient's body to control, diagnose and treat directly; and nanobiology which makes use of such mechanism or controls it through observing various kinds of biological phenomeda in nano-scale.

In promoting nanotechnology, Japan must maintain a good balance between fundamental/leading researches and those which aim for industrialization. It is also important to construct a network for information exchange and collaboration of researchers or fields, to educate students and young researchers for such newly emerging regions which involve various kinds of academic fields.

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

(5) Energy

Energy supply insecurity is expected in future. From a viewpoint of securing energy supply, Japan will realize safe and stable energy demand structure and less reliance on fossil fuel at the same time, while taking measures against global warming for the global environment preservation or for increase of efficiency.

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

(6) Manufacturing technology

Manufacturing technology is the very source of economic power that is so crucial to Japan. The fact that some kinds of high-precision machining technologies are available only in Japan shows that the level of manufacturing technology in Japan is in one of the highest in the world. Based on such high level techniques, it is important to develop new innovative technologies.

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

(7) Infrastructure

Infrastructure is an essential base to support people's life that includes S&T for disaster prevention/mitigation, crisis management technology, transportation appliances such as automobiles, ships, aircrafts and railways, geographic information systems, and fresh water production/management technologies. R&D for infrastructure must be promoted to realize advanced, safe, and comfortable society by minimizing social risks and by improving availabilities of the high quality of life.

Examples are: S&T for earthquake disaster prevention/mitigation, crisis control/management technology such as emergency communication, and IT related infrastructure such as intelligent transport systems.

(8) Frontier — outer space and the oceans

Frontier-exploration-spiriting R&D will be pursued in the new realm such as space and ocean in which further developments are expected. Both utilization of space such as communications/earth observations by artificial satellite and utilization of ocean having various resources/spaces will contribute to the socio-economy in the way of improvements of the quality of life.

Examples are: space development for advanced IT society and oceanic developments for untouched resources.

3. Focus on emerging fields

In a new age where mobility and speed are required, the Council for Science and Technology Policy will examine continuously and review promptly the areas and targets to be prioritized.

Along with rapid intellectual accumulation, new way of thinking, and technological development in recent years, mergers of different fields and new-born S&T realms have been emerging frequently. The most recent examples are: nanotechnology covering materials science, IT, life sciences, and the environmental science; bio-informatics as a merger of life sciences and IT technology using developed computer processing and accumulated genetic information; newly emerging systematic biology; and nanobiology.

Many other realms are forecasted to appear in the years to come. When an indication of new realms is shown and expected to grow up tremendously, even it is still small, the CSTP should pick it up accurately.

II. S&T system reforms to create and utilize excellent results

A S&T system is a mechanism in which resources are invested on the basis of social understanding/agreement, human resources are developed, necessary infrastructure is constructed, R&D is activated, and its achievement is enjoyed by the society. Therefore the system consists of R&D system, training of personnel relating to S&T, maintenance of facilities for promoting S&T, and also interface to industry and society.

In order to upgrade S&T activities and to accelerate restoration to society, Japan will reform the S&T system, while expanding the investment, as followings: enriching human resources and infrastructure, conducting high-quality R&D, generating the achievement at the world's highest level, offering it to industry and society, and explaining these activities to the public on its responsibility.

1. R&D system reforms

(1) System building to generate excellent results

1) Establishment of a competitive R & D environment

Creative R&D activities are promoted in a competitive environment, so that an environment where all whole personnel capability has to be applied in every phase under the principle of competition process, through promoting a competitive environment within research organizations and acquiring competitive funds from outside by researchers themselves.

(a) Increasing the amount of competitive funds

Funds on competitive basis, which expand fund availability and provide a competitive environment, will be increased continually. Referring the United States leading the world S&T using competitive funds, the amount of the competitive research funds will be doubled in the period of the Second Basic Plan. And to make the best use of the fund, following reform actions, focusing on evaluation, are indispensable.

- For evaluation on R&D themes, system and operation of the funds should be improved to clarify the idea and ability of individual researcher. For instance, number of project, which is conducted by a single researcher in cooperation of post-doctoral fellows and research assistants, should be greatly increased. In the case of group project, multiple researchers should collaborate on divided responsibility.
- To attain valid results, each project should be granted necessary and sufficient amount of funds, and its period should be planned 3-5 years.
- Interim and follow-up evaluation should be conducted properly to reflect its judgment into fund operation. Judgments of interim evaluation can be reflected for expansion, reduction, or suspension of the project, as well as for extension of the period of expectable projects to achieve more excellent outcomes. Also, judgments of interim and follow-up evaluation shall can be utilized in making preliminary evaluation of the next competition. These evaluations will be helpful to the total develop R&D activity in the long-term. In addition, the opportunity to apply the funds should be granted fairly even for researchers who has no experience.
- In every evaluation, all information of procedure, check-points, process, and results should be properly disclosed to researchers of the project.
- A necessary system in evaluation should be arranged by securing enough budget and full-time experts who have achievement in researches.
- In order to conduct fair and transparent evaluation for adoption considering researcher's performance, a database of results and progress of projects, reported periodically from researchers, should be established.
- Each ministry responsible for distributing competitive funds must operate so that as many researchers as possible can apply.

- Research organization should be in charge of the account of research funds, including in principle competitive funds directly distributed to individual researchers.
- Competitive funds, operated by each ministry, should be clarify the objectives and be arranged in a integrated system.

(b) Allocating funds for indirect expenses

As a result of expansion of competitive funds, funds for R&D projects have been increasing. To utilize the fund effectively and efficiently, it is required to provide necessary administrative experiences of the research organizations which manage the projects. For this reason, to the researcher' organizations, some funds for indirect expenses in a certain rate to the acquired research funds should be allocated. The rate shall be set at 30%, referring a sample of the United State, but it is changeable reviewing the R&D system operation.

This indirect expensed shall be utilized to improve the researchers' R&D environment and the organization's overall function, and an organization which has acquired several competitive funds can utilize total funds for indirect expenses efficiently and flexibly. Such operation of indirect expenses will promote competition among research organizations and upgrade the quality of research, however, the records of expenditure have to be reported to the fund-distributing agencies to keep transparency.

With regard to national universities, a mechanism should be arranged in the national-schools special accounting to allocate funds for indirect expenses to the university that acquires competitive funds.

(c) Handling ~~of~~ basic expenses

While attempting to double the amount of competitive funds, the stance of basic expenses ~~,~~ should be examined so as to ensure to create a competitive R&D environment. Then it should be noted:

- to have features as the expenditure to promote education and to support university's administration, in the basic expense for academic research
- to have features as the expenditure to administrative operation of research institutes, in the accumulated administrative cost for researchers.

2) Mobilization of human resources using fixed-term appointment

The tenure system, under which permanent R&D assignment is granted reflecting the evaluation in fixed-term appointment for young researchers, is regarded as the source of vitalizing the R&D environment such in the United States. Aiming the vital R&D environment, Japan will make effort to introduce and spread such a fixed-term appointment in which researchers can work in the competitive environment with fixed-term assignment until their middle 30s. Also, in order for researchers to obtain a job correspond with their talent and capacity, Japan will plan to popularize apply-and-review basis recruit and human resources mobility among industry, academia, and government, then it is important to formulate a market mechanism to meet needs of both researchers and research organizations. For this reason:

- Governmental R&D organization -- such as national research institutes, independent administrative institutions, national universities -- should employ young researchers until the middle 30s with the fixed-term appointment, and provide job opportunities widely and fairly to talented and capable researchers with the apply-and-review basis recruit in principle. Governmental R&D organizations should publish guidelines for the fixed-term appointment and the apply-and-review basis recruit. Implementation of such systems will be a check-point for evaluating the organizations.
- The period of the present fixed-term appointment to cultivate young researchers is less than three years, however, it is remarked too short to attain the object. In order to provide

sufficient and various R&D opportunities, the organizations should secure at least five years for young researchers to work intensively, permit reappointment under certain conditions, and also treat them according to their achievement and ability. In universities, it should be examined and revised to introduce the talent-based treatment of lecturers including fixed-termed.

- In order for researchers to increase the mobility and to have a variety of experience, human resources exchange should be enhanced. For securing various career path to work not only in R&D but also in government/industry according to their interest, a system to dispatch post-doctoral fellows and young researchers to ministries or companies should be promoted.

3) Self-reliance of young researchers

Young researchers' self-reliance should be respected so that excellent young researchers can make the most of their capabilities. For this reason:

- The positioning of associate professors and assistant professors(?) should be reviewed, including restructuring, to secure their self-reliance in R&D. In combination with it, R&D support system should be reinforced to draw out their full ability, and human resource cultivation should be promoted to let them have a wide view such in universities.
- Sufficient R&D space in research organizations should be provided for excellent young researchers.
- Research funds for young researchers should be expanded in the doubling competitive research funds, and applications by aggressive young researcher should be promoted in the competitive funds in general.
- Awards should be increased to young researchers whose research yields especially excellent results.

Also as for post-doctoral fellows who work under research advisor, since a plan to support 10,000 post-doctoral fellows was adopted, the environment has been building for them to conduct intensive researches with their self-reliance. In the future, the post-doctoral fellowship should be developed substantially in which research advisors using funds of their own responsibility could secure post-doctoral fellows, post-doctors could be treated according to their ability, post-doctoral fellows could be dispatched to ministries or companies, and excellent doctorial students could get sufficient support; and the system should be evaluated.

4) Reform of evaluation systems

Evaluations of R&D have been conducted in accordance with the national guidelines, and Japan will reform the evaluation system for the competitive R&D environment and effective/efficient resource allocation, considering:

- Securing fairness and transparency of evaluations, and reflecting evaluations into resource allocation
- Securing required resources and arranging an implementing framework for evaluation —

In the implementation, systematic and efficient evaluations should be conducted for R&D themes, R&D organizations, and researchers' results.

And the national guidelines should be revised:

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

The evaluation of R&D theme should be conducted flexibly according to the subject or field of each project. Especially evaluations of R&D projects for political objectives should be conducted by independent experts. The check points are social/economic significance and effectiveness, and definiteness of the targets in the preliminary evaluations; and progress

against the implementation plan in the interim/follow-up evaluations. In the case of R&D by competitive funds, in principle, originality and initiative in a scientific and technological viewpoint should be checked by veteran experts of foresight, to perform internationally qualified evaluation. And results of the follow-up evaluation should be referred to the next preliminary evaluation of same applicant's projects.

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

The evaluation of R&D organizations should be conducted on the organizational operation and the R&D implementation according to those objectives. Organizational operation should be evaluated by the performance for organizational objectives or improvement of R&D environment, under the discretion and the resources granted to the director. R&D implementation should be evaluated totally by both R&D themes done in the organization and achievement of belonging researchers. The R&D organization is operated under leadership of the director, therefore the organizational evaluation will results in the director's evaluation.

In order to secure fairness and transparency in implementing evaluation, neutral guidelines and external evaluations should be introduced and evaluators should disclose methods, standards and process of the evaluation. And the results of evaluation should be reflected on resources allocation and researcher's treatment such as continuation, expansion, reduction and suspension of the project.

In addition, universities should be pay attention for academic autonomy and combined function of education and R&D. And education, R&D, contribution to society, organizational operation of universities should be evaluated externally.

(b) Securing required resources and arranging an implementing framework for evaluation

Evaluation is indispensable for effective and efficient S&T promotion, so that required resources should be secured and an implementing framework should be arranged.

- In consideration of shortage of fulltime evaluator in quality and quantity, a framework for evaluation should be arranged through allotting a part of R&D funds for evaluating, securing veteran researchers in an evaluation section form national or abroad, and developing human resources for evaluation.
- In order to select appropriate evaluators and to evaluate each project reliably and universally, a national database of researchers, funds, evaluators, and results should be established.
- Computing systems should be introduced to rationalize and improve the evaluation framework.

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

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

R&D projects are carried out for several years in general but it is difficult to proceed as the initial plan. Therefore the governmental R&D budget should be executed flexibly and efficiently in accordance with the progress of the project, such as using special budget able to be carried forward the fiscal year. And competitive funds should be able to expense from the beginning of the fiscal year, through smooth accounting work.

(b) Promoting flexible working style

In order to treat researchers properly through evaluation and to extract their best performance, utilization of discretional working in the independent administrative institutions, resemble with private companies, is expected. And to promote researcher's self-reliance and initiative, work suspending should be systematized.

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

(a) Expanding opportunities for excellent foreign researchers

An environment, in which excellent foreign researchers are able to engage in R&D activities competitively, should be provided in Japan. For example public institutes could employ and treat young foreign researchers on corresponding to their ability and achievement by the fellowship scheme, and competitive research funds should be arranged to enable foreign researchers working in Japan to apply in English.

(b) Improving the environment for women researchers

In order to attain the gender-equal society, job opportunities and working environment for women researchers should be improved. Especially to encourage their return to R&D activities after maternity leave, various supports should be provided to maintain their capability, such as works at home, limited-period position, and special funds relating to their research.

(c) Developing a variety of career paths

A variety of career paths should be developed, to enable researchers to engaged in a wide range of job, such as R&D planning/management, evaluation of R&D, and development of intellectual patent rights. For young researchers to widen their working possibility in the future, job opportunities in the government should be increased; also funding agencies should adopt persons experienced researches. In the private sector, companies are expected to employ capable young researchers such as doctors and post-doctoral fellows.

7) Realization of creative R&D systems

To accomplish the reforms mentioned above and to realize the creative R&D systems, major R&D organizations should be managed flexibly under the director's leadership, and internationally top-class R&D bases should be established. Aiming at developing such R&D basis from existing R&D organizations, these organizations should reform their management introducing novel methods to utilize the ability and achievement. Moreover in the prioritized areas and emerging fields, without restrictions in existing organizational management, new ideal R&D organizations should be established which are comparable with top-level R&D organizations in Europe and the United States and generate world top-class R&D achievement.

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

1) Universities and other academic institutions

Universities are required to play a number of significant roles in R&D systems; including educating and securing excellent human resources, succeeding intellectual resources of humankinds, creating new knowledge to unlock the future, and encouraging international academic cooperation. However universities in Japan have been claimed for poor educational functions, excessively specialized fields of education, and exclusiveness/inflexibility in organizational management.

Up to now, form the viewpoint of activation, qualification, and individualization of education/research in universities, the government has promoted university reform; such as presenting a national policy for establishing university, increasing graduate courses quantitatively, establishing an advisory committee in all national universities, establishing special educating agencies. From now on, the government should promote further institutional reform respecting university's autonomy, and universities should promote operational reforms and professors' conscious revolution to realize university reform concretely. Each university is expected to promote systematic education to foster split of inquiry to become an innovative R&D base, so as to develop qualitatively both education and R&D with international attraction and competitiveness. For this purpose, organizational flexibility in universities is needed to foresee social/economical trends and to follow them autonomously, which is a key subject for national universities under public institution's restriction. Universities should conduct self-evaluations strictly and reveal their results positively, to reflect on educational and research activities and management reform; and should become to a regional academic core among local governments and private companies using geographical advantage. Also universities should intensify cooperation and collaboration with other R&D organizations or private companies to activate a variety of education/research and to elevate the level of the university.

(a) National universities and other public universities

National universities and national research institutes, which are planned to be independent administrative institutions, should promote organizational reforms to be operated autonomously under president's leadership. And graduate schools, especially prominent ones, should vary and specialize their education and research. Public universities are required to provide high-level education and in the region and to contribute for studies on regional development, so that they should intensify their educational/research functions and their originality.

(b) Private universities

Public universities, which holds around 80% of student, have been developing based on its own unique philosophy of education, playing a great role in the progress of higher-level education in Japan. And they are expected to upgrade their education and research holding the originality as private.

As for private universities, therefore, to intensify their educational/research functions, special funds should be granted with priority and taxations should be arranged to induce funding from private sources.

2) National research institutes and other institutes

National research institutes, independent administrative research institutes, public corporations have a mission to accomplish political objectives and have conducted prioritized R&D, such as basic/innovative researches for S&T progress in Japan and systematic/integral researches to meet political needs. Public research institutes in each prefecture have played an important role in technological developing and technical advice to meet needs of local industries and

communities. These organizations, while socio-economic expectation to S&T has been increasing, are more strongly expected excellent results and contribution to society.
Research institutes which will become an independent administrative institution should operate its organization flexibly and generate/utilize excellent R&D results, making use of their new features.

3) Private companies

(a) Promoting R&D by private companies

In order to activate R&D by private companies, which is important together with governmental R&D, stimulating their motivation on the base of their self-help effort, the government should apply R&D supporting systems such as tax deduction and risk reduction. Then systems for R&D for economic growth should be reviewed for more effectiveness and efficiency. And also the government should allow researchers to hold/utilize their patent rights, which are generated in government-funded researches.

(b) Promoting the mobility of capable researchers

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

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

While results of R&D are widely spreading into society, taking forms of usable properties or services, under competitive environment based on the market mechanism, the role of industrial technology is to contribute as a bridge for intellectual fruits to the economy and people's lives. For reinforcement of industrial technology, among the effective S&T system reforms, an indispensable one is a reform of industry-academia-government collaboration. Therefore, removing invisible walls between sensors and using merits of each sector, a technological innovation system, in which academic results are utilized in industry and industrial needs are notified to academia, should be constructed.

(1) Information distribution and human resource exchange

While private companies in Japan intends to outsource basic R&D to research organizations in Japan, as well as in abroad, it is most important to formulate common recognitions between private companies and public research organizations more than before. So industry should appear their needs, and academia should promote R&D through accepting them.

- Public research organizations should offer information for industry by a database of its organization, achievements, and human resources.
- Public research organizations should employ persons in industry and a meeting of both industrial and academic sectors should be prepared periodically, to promote human resource exchange. Joint-research centers and technology licensing offices should promote free exchange of information. Through those activities, industrial socio-economic needs can meet seeds in academia.
- To stimulate incentive of private companies, public research organizations should make entrust researches and joint researches easy to understand, such as implementing body, cost estimation, reports, etc. And private funds for public research organizations should be usable for indirect expenses.
- Also in competitive funds, persons in industry should be involved in theme selection or evaluations, and be appointed as a manager of industry-academia collaborative projects.
- As socio-economic needs on international standardization are quite strong, basic cooperative researches should be conducted aiming not only commercialization but also technical formatting.

(2) Environment of technological transfer from academia to industry

(a) Promoting technological transfer of public research organizations

In order to promote technological transfer form academia to industry, it is important to enhance systematic measures in academia. In universities, joint research centers should be enhanced functionally by appropriate inter-faculty personnel change. Technology licensing offices should be utilized independently to commercialize R&D results in academia. Moreover activity records of industry-academia-government collaboration should be regarded as one of factors to evaluate research organizations or researchers.

(b) Promoting patent management by research organizations

Each official research institution should establish a mechanism to commercialize useful R&D results.

- During the period of the First Basic Plan, patent rights have promoted to be owned by individual researchers, to enhance incentives and to accelerate mobility of rights holders. The number of patent rights assigned to individual researchers has increased, however, such patents have not necessarily been commercially applied. In order to patented results

to be applied more effectively and efficiently for commercial purposes, patent rights management should be turned in general from individual to organizational.

- Research organizations should equip functions for acquisition, management, and application of patent rights. And technology licensing offices should support those functions of research organizations.
- In the turning to organizational patent management, a system should be made that patent fee would be properly shared to its individual inventors, to enhance researcher's incentive. Even when researchers change the employer, the inventor's privilege should be taken into consideration.

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

(3) Commercialization of R&D results of public research organizations

R&D results, attained in joint researches or sponsored researches, should be applied to commercialization, enhancing the motivation. So technological transfer to companies should be promoted, in particular by

- regulation of government-owned patent transfer and exclusive licenses for private companies or technology licensing offices

To conduct those, technology licensing offices should promote commercialization using transfer contracts which are authorized under the Law for promoting University-Industry Technology Transfer.

In personnel matters, researchers in public research organizations can manage the technological transferred projects in private companies, such as using simultaneous employment or employment suspension. The government should permit appropriately their engagements of study or instruction in private companies. These treatments enables human resources in public to play an active part in society, so that technological transfer can be promoted.

(4) Environment for activating high-technological venture enterprises

An environment in Japan for activating venture enterprises has been improved in regard to both capital and human resources, however, further measures should be conducted considering insufficient admiration for entrepreneurship, difficulty for securing initial risk money, and individual risk in failure.

- Universities should foster human resources of entrepreneur spirit, such as by courses of entrepreneurs or venture capitalists. Graduate schools should enrich special education for capital/legal matters, also promote joint researches with venture enterprises.
- Official research organizations in each region should be cooperative for venture enterprises, through functioning as a coordinator, securing human resources, and promoting cooperative projects for industry-academia-government collabration.
- The government should improve a system for small business innovation, and allocate innovating funds for small companies.
- And the government should review business registration for such as the stock-option, stock company, and bankruptcy.

3. S&T Promotion in regions

Economic/social globalization and rapid progress of IT technology have affect directly in regions, and local industries are now exposed not only to domestic competition, but also to global competition. At the same time, local companies have chances to make business quickly/easily in the international market using regional S&T achievement.
Regional R&D resources/potentials are able to be utilized for upgrading and varying S&T in Japan, as well as vitalizing Japan's economy through regional technical innovation and new industrial creation.

(1) Establishment of "intellectual cluster" in the region

An "intellectual cluster" is a system of technological innovation under the incentive of the region, in which a public research organization leads companies in/around the region with its originality and potential.
More specifically, in the system through a human resource network and systematic collaborative researches, technical seeds of public research organization and business needs of companies stimulates each other resulting in a chain of technological innovation and new industry creation. Regional development with such system is able to bring successful technological innovation of world class. Therefore it is needed for Japan to establish and support the intellectual clusters in each region.
In order to establish the intellectual clusters effectively and efficiently, the government should promote R&D activities including collaborative researches, human resource training/securing, and technological transfer functions, etc. And public research organizations should develop its R&D functions in the region in cooperation with the local government.

(2) Implementation of S&T policies in the region

In order to realize various S&T development, it is important that public research organizations in the region, like universities, would develop original potentials and commercialize the results. For this purpose, several S&T policy should introduced in the region, such as securing professional coordinators to judge/apply technologies and promoting interregional technological transfers. The local government, under its initiatives, together with national universities and public research organizations, should promote industry-academia-government collaboration in the region.

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

(1) Education of researchers and engineers, and reform of universities and others

Education of excellent researchers and engineers is extremely important in the S&T system reform, so that universities have to reform themselves as the core of S&T education. Therefore, aiming to be called internationally respectable, universities should upgrade the quality of education/research to cultivate researchers and engineers who have creativity, originality, wide-view and practical capacity. And universities should accelerate self-evaluation, external evaluation, and disclosure of these results.

(a) Graduate schools

In order that students can attain ability of logical thinking and actual practicing in a systematic education, and strengthen capacity of independent researching through course-work, graduate schools should elevate and diversify its education and research. At the same time, in light of producing human resources needed in S&T in Japan, including industry, universities should enrich its education and research to foster wide vision with good balance of basic ability and applying capacity, through special lectures by excellent persons in private sector and additional courses for emerging S&T fields, etc.

To develop education and research, which is comparable to the world, in rapid S&T progress, the government should establish center-of-excellences by prioritized resource allocation to graduate schools, which are expected to attain some prominent results or challenges innovative education and research. And the government should allow additional courses and classes in graduate schools to produce professional experts in some S&T fields.

Then financial supports or scholarships should be provided for excellent students to advance to doctorial courses without financial stress. In particular some supports to produce excellent researchers should be highly evaluated.

(b) Faculties in universities and junior colleges

Faculties in universities and junior colleges should enrich its general education curriculum for rapidly progressing S&T by total management of the school. In technical training curriculums, attaching importance on principles and theories, the schools should foster students' ability to investigate and resolve own subjects independently.

(c) Technical colleges and vocational schools

Technical colleges should enrich its educational contents, improve job-training courses, and review classes to meet social needs considering progressing S&T and industrial structural reform.

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

(d) High schools

High schools should fulfill scientific education by using observation, experimentation, and experience; and promote industrial education following changes in society.

(2) Training and securing engineers

Engineers, who have specialty to promote technological innovation, are playing an important role to strengthen international competitiveness in Japan. In rapid technical progress and economical globalization, engineers, who can support technological fundamentals in Japan and also work internationally, should be secured in both quality and number.

For this needs, a social system should be established, which should certify engineer's qualification in the international community. In universities, accreditation system should be introduced into such as the faculty of engineering and the faculty of science, a technological management education should be established, and practical educations should be implemented. And the engineer's certification should be generalized in Japan and prepared mutual recognition internationally such as in the Asia-Pacific Economic Cooperation. As well as continuous educations for engineers should be provided in academic societies or universities to acquire the latest technological knowledge at any time. Through these movements of education of engineer, certification such as registered engineer, and continuous education, the consistent system, which upgrade engineer's ability and capability, could be established.

5. Interactive channels between S&T and society

S&T can be developed and utilized for a long period only if people in society fully understand the significance and the contribution to daily life, so that people's support is indispensable for promoting S&T. Everyone relating to S&T have to recognize the fact that S&T has a destiny to walk with society.

At the same time, it is necessary to establish an environment in which people can understand S&T deeply and make scientific, rational, and independent judge on various problems in society.

(1) Promotion of S&T learning

In order to increase social interest in S&T, to attain general understanding of S&T, and to foster excellent human resources in S&T, people's background in S&T should be developed.

Up to high school days, students should learn scientific way of thinking, scientific study, and basic principles of S&T, through observation, experimentation, and experience with curiosity for S&T. Therefore their school should improve guidance for students, train teachers, introduce working people as a lecturer, promote IT education, and enrich facilities.

Universities should refine its curriculum so that even students out of natural science courses can study basic S&T knowledge to cultivate their judgment from wide view.

In social education for children to elders, to learn basic S&T and its latest trends, the opportunities should be increased and contents should be satisfiable utilizing schools and museums.

(2) Construction of channels toward society

For S&T promotion it is necessary to require people's understanding. Therefore research organizations should be open and museums' activities should be enhanced. As well as S&T information should be broadcasted through mass medias.

In regions, S&T interpreters should be trained and secured, who will explain S&T information to people easily to understand and also transfer people's opinions on S&T to researchers and engineers.

In addition, researchers themselves should carry out conscious innovation so that they can work on R&D activities keeping awareness on the relationship with society, and make suggestions to solve social problems based on the S&T knowledge.

6. Ethics and responsibility on S&T

S&T progress has been significantly affecting human beings and society in various ways. As bioethics is notable, ethical issues relating to S&T development have become very serious. Responsibility of organizations/researchers has been one of social problems. Under these conditions, relationship between S&T and society should be restructured in the 21st century.

(1) Bioethics

While development in life sciences has been widely benefiting people and society through improved diagnosis, prevention, and treatment of diseases, the latest techniques, such as in vitro fertilization-embryo transfer, transplantation of organ from brain dead patients, genetic diagnosis and gene therapy, and furthermore human cloning technique, human embryonic stem cells, etc, have brought a serious bioethical problem on the dignity of human beings. Especially reproductive cloning of human beings causes great concern of many countries in the world. In Japan, the law which prohibites reproductive cloning of human beings with penalties was adopted in November 2000.

In the modern medical science, it is obvious that physicians and researchers should have ethics. Beside that, patient's human rights have to be respected such as through informed consent for the autonomy, and individual privacy have to be protected. Also people are strongly concerned in bioethics issues such as clinical tests, transplantation, and regeneration of organs. Bioethics issues have to be discussed as a problem for all of Japan.

In the future, it is foreseen that S&T, especially life sciences and IT, will advance much further and will affect people and society. Accordingly, it is indispensable to form a social consensus on bioethics and to make rules for life science researches from bioethical aspects. Furthermore, because society had been globalizing more and more, it is also important to promote international bioethical cooperation. S&T activities on this matter should be directed quite carefully, through discussion among experts and polls of public opinion in complete information disclosure.

(2) Responsibility of researchers and engineers

S&T has a potential to seriously affect both people and society.

Recently accidents and troubles in laboratory or manufacturing site have been reported frequently. Researchers and engineers have to recognize the position of their S&T activities and their responsibility in society, to utilize S&T and to manage R&D activities in a appropriate way.

R&D activities have been conducted under a rule adopted in the academic community, however, among advertising R&D activities and problems concerning society, researchers and engineers should elevate ethical standards regarding conflicting interests in S&T, application of R&D results, financial resource allocation, etc. And also researchers and engineers should disseminate R&D information into society and explain effects of R&D result to society.

Considering these matters above, to lead researchers and engineer to have higher professional ethics, guidelines for ethics should be formed by academic societies and engineer's certification should be evaluated with ethical issues. And education for professionals should be provide not only in universities but also in academic societies by various training courses.

(3) Accountability and risk management

Because accountability is one of the tasks in society, research organization should have open exhibitions, open lectures, information disclosure through the internet and academic societies; and researchers should maintain interactive communications to society. One idea, to

achieve this, is to provide training courses for researchers to improve their ability for communication. That helps to make closer relation of researchers and people in society, so that people can deeply understand S&T and researchers can direct their R&D activities reflecting people's opinions.
Organizations relating to S&T should evaluate risks in potential such as accidents and troubles, operate R&D activities to minimize the damage, and enhance researcher's and engineer's understanding on ethical issues.

7. Maintenance of infrastructure for S&T promotion

(1) Improvement of facilities and equipment

(a) Improving facilities of national research organizations

It is essential to improve facilities for education and research as necessary academic infrastructure in the 21 century.

In order to activate research and education producing S&T human resources, generating R&D results, attracting students and researchers in Japan/the world, It is needed to maintain world class facilities in universities and national research institutes. Therefore the government should allocate sufficient budgetary resources to solve deterioration/congestion problem of facilities in universities and national research institutes.

In national universities, necessary floor space is estimated over 11 million square meters. During the period of the second Basic Plan, the government should improve facilities according to an urgent implementation plan provides for dissolving congestion in graduate schools, establishing center-of-excellences, reviving existing facilities, and so on. Then in a view of effective/efficient use, multipurpose laboratories for plural sections should be constructed and existing facilities should be reformed and equipped. These facilities should be used flexibly under the president's leadership, in accordance with results of self/external evaluations.

National research institutes and independent administrative institutions should fulfill the most up-to-date facilities to promote effective researches and to generate prominent results. With top priority, their deteriorated facilities should be improved promptly

In addition, improvement facilities in national research organizations should be promoted by non-governmental organs under the law for research exchange.

(b) Improving facilities of national research organizations

In national universities and national research organizations, advanced equipment should be improved in/around prioritized S&T areas and emerging S&T fields, such as a big-scale equipment which can develop researches. Such equipment should be maintained in the best conditioned avoiding becoming commonplace. And funds and persons for specified equipment should be secure to operate and maintain stably.

(c) Improving facilities and equipment of private universities

For private universities, in order to promote research projects highly demanded in society, the government provide grant for research, long-tern and low-interest loan, and aids on loan for revitalization. Also for public universities, support for education and research should be promoted.

(2) Enrichment of research assistance

Research assistance, which is important part of R&D activities, should be enriched. Because required assistance works are quite diversified and improvement of research environments are becoming competitive, research assistance should not be set an unified standard but be treated properly in each research funds. To provide required assistance to each project, personnel dispatching and business outsourcing should be applied. So that common services can be secured in a research organization by indirect expenses which is attained with competitive research funds, and highly specified assistants can be stocked in public corporations.

(3) Improvement of intellectual infrastructure

While problems to be solved are increasing and R&D subjects are getting complicated, it is necessary that pioneer, independent, and basic R&D would be promoted in Japan and these results would contribute for economic/social activities. Therefore the government should

strategically and systematically improve intellectual infrastructure, such as research materials like genetic data, measuring standards, testing methods, analyzing devices, and related databases.

- Intellectual infrastructure relating to four prioritized areas should improve in public/private sectors, as to be world top level by 2010. Then the two sectors should recognize a role division, as the government maintain one of publicity/neutrality or of strategic importance, private companies invest on what is reasonable in the market mechanism.
- To upgrade convenience of users and to systematically operate a variety of intellectual infrastructure, the government should establish a mechanism which can provide any information needed by users. And the government should participate into and lead international discussions such as for measuring standardization.
- In order to provide further intellectual infrastructure for developing S&T field in the future, the government should accumulate results, data, findings in all R&D projects.
- The government should formulate basic legal rules, including intellectual property rights, for provision for and utilization of S&T databases.
- Efforts formulating intellectual infrastructure should be regarded as one of factors to evaluate researchers and engineers.

(4) Enrichment and standardization of intellectual property rights

To promote intellectual creative activities, it is extremely important to protect intellectual property rights. Its international standardization has been discussing for long time, and further efforts should be made.

- The government should provide professional intellectual services to the world and enhance a function for settling disputes on intellectual issues.
- The government should promote cooperation for preliminary technological investigations with the United States and European countries, and support Asian countries for their intellectual property rights system. The systems should be operated transparently and harmonized internationally for protecting patent rights of advanced technology such as biotechnology and IT.

To disseminate R&D results, it is required to precede in technological standardization, for spreading new technology easily in the market. Especially due to expansion of cross-business fields in the networking society, who control an international technological format can control the world market. And it is also important in international competition to have an internationally equivalent system for certifying new products applying new technology. In light of the above, the government should actively contribute to international standardization efforts such as the International Standardization Organization (ISO), the International Electrotechnical Committee (IEC), the International Telecommunications Union (ITU), as well as ruling for economical globalization. In addition, the government should strategically establish a cooperative relationships for standardization with countries in the Asian Pacific Economic Cooperation Conference (APEC). Together with these measures, R&D for technological formatting should be implemented and , and public research organizations should take part in this standardizing activity.

(5) Maintenance of research-informational infrastructure

In the rapid progress towards IT society, R&D offices have been leading improvement of research-informational infrastructure, especially in deploying computers, establishing LAN, networking between laboratories, data sharing on computer network, establishing electro-libraries in universities.

Succeeding this improvement of research-informational infrastructure applying IT innovations, the government should elevate and qualify R&D in Japan through collection and dissemination of research information using the infrastructure. Specifically, following waorld trends and introducing new technology, the government should arrange intendedly research computer network and LAN in laboratories for further speed and intelligence. And the government should promote continuously to digitalize research results, research information like resources, magazines of academic societies, library's functions.

(6) Maintenance of manufacturing infrastructure

In recent days, serious anxious about manufacturing ability, which was Japan's advantage including quality control, is getting bigger; for example loss of high quality manufacturing infrastructure due to lack of technological succeeding, trends of slighting manufacturing, frequent accidents. In order to maintain and improve manufacturing ability, the government should take systematic measures.

Because manufacturing is conducted by human resources, it is important to develop and secure such resources for manufacturing, through opportunities for children to get familiar with manufacturing, education to cultivate creative individuals, practical engineering training in schools, and internship working in society. And it is required to realize a environment in society which understand and respect significance of manufacturing. Therefore the government should promote a commending system, such as the Prime Minister's Award, for individuals/companies who has prominent ability in manufacturing. Moreover the government should systematize all projects to manage each costs, quality, and risks, to avoid "opacity of technology" in progress of complicated production and automatic manufacturing; and develop qualified engineers for the project management system.

High-level techniques of skillful engineers should be succeeded substantially and reproducibly in digitalized databases/software. IT technology and manufacturing technology should be integrated into an innovated manufacturing system, such as by improving product development and manufacturing process by detailed simulations in designing, and by providing next-generation infrastructure for design/manufacturing.

To accelerate technological innovation, it is necessary to establish a mechanism to support intellectual productive activities, in which engineers can concentrate into brain works. Therefore the government should collect and provide knowledge/data, such as basic techniques for design/manufacturing process, successful and failed samples, technical advices of public research organizations.

It should be acknowledged seriously that artificial materials and substances created in the last half of the 20th century were applied without evaluating the effects on the environment, and brought significantly adverse influences on lives and the global environment. Never forgetting them, before developing new things, long-term safety has to be evaluated and risk on people's living or the natural environment has to be assessed. And these results have to be disclosed.

(7) Promotion of academic societies' activities

Academic societies, which have a wide range of human/knowledge resources comparably with public research organizations, should communicate S&T information to society, promote exchanges of researchers among industry-academia-government sectors and with foreign countries, send proposals regarding S&T policies, and play a role for R&D system reforms. The government should support academic societies so that they can enhance their activities.

In addition, non-profitable organizations, which are able to respond to social/academic needs, are expected to expand their activities, such as information dissemination, technological

transfer, researcher' exchange, research support. The government should arrange environments necessary for them.

III. Internationalization of S&T activities

The government internationalizes Japan's S&T activities, assembling world-class researchers and information into Japan, to create excellent R&D results and to solve global problems confronting human beings. To overcome alarming that excellent researchers and private research funds have drained away from Japan in recent years, it is necessary to establish brilliant research environments that is open and fascinating for first-class researchers in the world to gather in.

1. Initiatives in International Cooperation

Targeting to solve global-scale problems such as global warming, food security, energy shortage, fresh water management, infections diseases prevention and disaster prevention/reduction, the government proposes and conducts some international cooperative projects assembling world wisdom, and obtained results must be restored to the world. At this time the government must strengthen partnership with all countries especially in Asia. Also the government should take initiatives to promote protection/standardization of intellectual property rights. Through these positive international activities, excellent human resources will be developed to perform further high-level activities.

2. Enhancement of International Information Dissemination

In order that Japan's S&T activities are recognized and evaluated so that world-class human resources and the newest information will gather into Japan, it is important to disseminate actively to the world information on R&D results, researchers, and research organizations. The government should support publication of research results in English and systematic dissemination such as publishing magazines of world-class papers in cooperation with academic societies.

3. Internationalization of Domestic Research Environments

In order to internationalize Japan's domestic research environments, it is also needed that a lot of excellent human resources including foreigner performing on the international stage experience in world would gather into Japan, compete equivalently, and play active parts.

- Public research institutes should encourage excellent foreign researchers to continue their study in Japan by evaluating their results properly and treating them corresponding to their ability.
- Public research institutes should improve its condition for foreign researches concerning treatment, English communication, accessibility to abroad, and livability.
- The government should revise competitive research funds to accept applications written in English from foreign researchers in Japan and to promote English dissemination.

Especially, the government should direct newly establishing public research organizations to provide such international conditions. Moreover, the government facilitates Tsukuba Science City and Kansai Science City as international center-of-excellence open to both Japan and the world.

On the other hand, the government should expand for Japanese young researchers opportunity to study and exchange in a competitive environment of excellent overseas research institutes. Also, Japanese researchers should make efforts to extend international network.

Chapter 3 Missions of the Council for Science and Technology Policy

1. Basic steering of S&T Policies

The Council for Science and Technology Policy will steer S&T in Japan with foresight and mobility, acting as a control tower under the prime minister's leadership eliminating administrative sectionalism, to implement policies described in the basic plan. Then the council will keep cooperation with the Council on Economy and Fiscal Policy and the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society.

The council will play an active role as a "source of wisdom" integrating natural S&T and social sciences/humanities, holding views to the world and vision of desirable society of human beings in the 21st century. Under a recognition of "S&T for and in society", the council will take into consideration people's expectation and anxiety for positive and negative S&T influence, and attach greater importance on ethics and responsibility of S&T.

2. Promotion of Research and Development in Prioritized Areas

Based on in the basic plan, the council draws up a promotion strategy for prioritized areas, which defines important fields and R&D target/implementing measures, and expresses its opinion to the prime minister and related ministers. For some important themes, the council will make a strategy by establishing an expert panel.

At this time, S&T progress is so rapid and society is so changeable that the council will follow the newest trends of prioritized areas gathering advices of top experts in various fields, and examine continuously to respond to needs of emerging field. Consequently the council can accept some modifications in promotion strategies with flexibility and mobility.

3. Policy on Resource Allocation

Based on the basic plan and promotion strategies in prioritized area, the council should comprehend each ministry's policies and evaluate effects of implementing policies and harm of administrative sectionalism such as unnecessary duplication. Referring results of the evaluation, for realization of more effective/efficient S&T activities, the council should express opinions to the prime minister, regarding to special priority in the next fiscal year and amount of budget to promote high-quality S&T activities. The council should also express opinions to related ministers about key policies and resource allocation in the next fiscal year. At the same time, the CSTP, as necessary, cooperates with financial sector in budgeting process to secure appropriate resource allocation as the CSTP's policy.

4. Promotion of Nationally Important Projects

In addition to resource allocation mentioned above, as for nationally important projects particular projects to be implemented under inter-ministry cooperation, the council should express necessary opinion to adjust implementation as the most effective/efficient, such as avoiding unnecessary duplication. On implementation stage, also, the council should evaluate

progress and effects of projects so that all S&T activities in Japan can be promoted the projects most effectively/efficiently.

5. Settlement of National Guidelines for Important Policies

After 3 year since its establishment, the National Guidelines on Evaluation for R&D should be revised referring the basic plan. Other basic guidelines for important policy, such as researchers' mobility and S&T system innovation, should be settled as necessary.

6. Evaluation

The council should evaluate nationally important R&D, such as large-scale ones, disclose results, and indicate it to related ministries for improving organization and budget allocation. The council, also, should evaluate S&T policies of each ministry, to develop basic policies and implementing measures.

7. Follow-up of the Basic Plan

While conducting activities mentioned above, the council should follow up progress of policies in the basic plan in cooperation with related ministries, and report it to the prime minister and related ministers with necessary opinions as necessary. Particularly the council should request submission of implementation plans, described in the basic plan, as early as possible. Continuing the follow-up every fiscal year, the council should conduct a general follow-up in the forth fiscal year to amend flexibly policies in the basic plan if necessary.

In cooperation with related ministries, the council should comprehend trends of S&T activities in both Japan and the world including private sector. In addition, the council should examine continuously how to implement R&D activities in Japan.