# Long-term Strategic Guidelines
# "Innovation 25"

(Unofficial Translation)

Government of Japan

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## Chapter 1 Basic Concepts: Japan's future created by innovation

In order to realize the Abe Cabinet's new national image for Japan, known as "Beautiful Country," it is essential to ensure a vibrant economy and a society in which everyone can enjoy wealth. Even in the advent of a society with a declining population, we are able to incessantly generate innovative technologies, products and services, which are accepted by the people of Japan as well as of the world. This in turn creates economic and social energy, contributing to the realization of a society where people can have bright hopes and dreams for the future and live with peace of mind. Moreover, strategic approaches to science and technology as well as diplomacy are greatly needed to solve global issues that are posing a threat to humanity, such as the issues of environment, energy, water, food and infectious diseases.

The long-term strategic guidelines "Innovation 25" cover the years up to 2025, discuss how to create the future of Japan with prosperity and hopes, and set out the policies to be addressed on a short- and long-term basis, including research and development, social reform and human resources development.

Innovation is not just confined to technical revolution. It creates new values and brings about drastic social changes by incorporating new concepts and systems that are completely different from conventional ones. To that end, a mere extension of conventional ideas or systems is insufficient, and what is most important is to create a society where the capacity of the people, who are the foundation of all, can be employed to the maximum. This requires not only the efforts of the government but also endeavors of the private sector. It also involves a radical change in the values of each individual. Therefore, the policies concerning the creation and promotion of innovation have to be drastically shifted from the conventional "industrial promotion type" or "government-led type" by the policy initiatives to the "infrastructure creation type," which supports the ambitious and challenging efforts of individuals with diverse thought.

Since the nature of innovation radically changes the existing systems, the stakeholders should not be confined to the established organizations or systems. Instead, it must be the society where various stakeholders, such as venture businesses, small- and medium-sized enterprises, non-profit organizations (NPOs), and entrepreneurs, are able to execute activities towards the creation of innovation and to be more deeply engaged in the creation of innovation.

We must not forget that there is a global issue of responding to global warming, as a reason for why all countries in the world are making strenuous efforts to promote innovation policies. The method of economic development in the 20$^{th}$ century is not necessarily an

appropriate response to the issues that are posing a threat to the sustainability of the earth. In this respect, too, a new approach different from the conventional is needed.

We may face various difficulties to obtain a consensus of the people about shaping the country so that outstanding innovation can happen incessantly. Thus, the government should share its visions of the future of Japan with the people, and exert all efforts to realize the vision in a concerted manner without deflecting attention from the urgent issues.

Innovation is also an unpredictable, creative means of destruction, and when implementing policies, it is always important to keep the PDCA cycle (Plan-Do-Check-Action) in place.

The long-term strategic guidelines "Innovation 25," sets out the following five points as basic concepts based on the characteristics of innovation:

- Setting the goals high and anticipating challenges for the future
- Timely and effective response to the globalization and advancement of informatization
- Significance of the perspective of ordinary citizens
- Changes with diversity and reform of a society filled with possibilities
- Primary importance on the human resources development - encouragement of people who think creatively or "out of the box, often called "the nail that sticks out."

## 1. Setting the goals high and anticipating challenges for the future

The first flight by man was in 1903, only eight years after a famous scientist said, "Objects that are heavier than air cannot fly." When computers were first invented, people did not anticipate the need for the high performance we get from today's personal computers. However, small and high-capacity memories were made available due to the rapid progress of semiconductor technologies, and small personal computers perform better than the old large computers. They are now used as a means of networking, including e-mails and search engines, rather than the initial function of computing.

What is common in the past is that there were "high goals that seemed impossible at first," "people with ambitious spirits who boldly faced and overcame difficulties," and "people with drive" at the starting point. A giant leap has been made, overcoming various challenges and numerous failures. Other than a simple scientific discovery or technological revolution, there is a certain process behind the success, in which such discovery or revolution is integrated over time, demanding changes in the social system and generating a new dimension. The repetition of this process has formed our present world.

Doing away with convention and setting high goals, boldly tackling challenges and

keeping the ambitious spirit alive are the most important factors to make Japan the country where innovations never cease to be.

## 2. Timely and effective response to the globalization and advancement of informatization

Apparent global issues in the 21st century include further increase in population, global warming, degradation of the environment and a widening gap between North and South. These issues are not always region–specific, but they do affect the entire world. In the globalization of economy and the groping for a new framework for peace in the post-Cold War era, the world in the 21st century is transforming into the one where all countries (developed countries such as Japan, the United States, and the European Union, rapidly developing countries, Asia, Middle East and Africa) largely influence each other, while each faces its own regional issues. The current of globalization will not backflow. Furthermore, revolutionary advance of informatization is drastically changing the mentality of the people, values and society in various aspects, including industries, economy, finance and education.

Under these circumstances, international competition is getting even more intense in the area of science and technology, serving as an incubator for economic development. In recent years, there has been a rapid increase in the world's awareness of the importance of innovation propelled by a technological revolution. That is to say that the importance is widely recognized as a tool to bring the outcomes of science and technology into both domestic and foreign markets as quickly as possible and to translate them into economic and social values. Achievements of basic science, research and development and discoveries alone are not sufficient for the translation into economic and social values, and the establishment of an appropriate environment is extremely significant to create new values with the integration of various knowledge.

Furthermore, having awareness that the basis of innovation is the brain and that an excellent brain is the greatest resource in the 21st century, the world is now in the era of intense international competition for the best brains. Unless universities, corporations and local communities voluntarily respond to such international trend and rapidly prepare for excellent human resources, it is not possible to secure human resources who play a leading role in the future. The increase in opportunities to have daily contact with various human resources, abilities and rare talents will broaden the horizon of the Japanese youth, will instill a sense of appreciation of various cultures and talents, and will increase the chance to realize their potential.

In view of rapidly changing times, decisions with bird's eye view of the whole world and

the speed of implementation are the driving force for creating innovation.

Japan has established a close relationship with the United States and Western Europe over the past century in the fields of economy, diplomacy and science and technology. On the other hand, Japan is essentially an island country located in East Asia, and has close historical and geopolitical relationships with Asian countries. In steering Japan in the right direction in the globalized world, it must be remembered that Asian countries are changing greatly, represented by the rapid development of the hugely populated China and India. A key factor behind the economic development of Japan for the last 50 years in the latter half of the 20th century is the presence of favorable attributes, such as high production capabilities and adherence to high quality. However, in order to navigate a Japanese path through the 21st century, some attributes of Japan are regarded as disadvantages, such as its closed nature, lack of international perspective, and insufficient ability to exert the potential of individuals due to organization-oriented systems. It is particularly necessary to strategically consider the strengths and weaknesses of Japan in an era of fierce international competition.

The economic recovery of Japan in recent years owes largely to the economic growth of Asia and the United States. If companies neglect continuous efforts for a full-fledged structural reform and an improving competitiveness in the international markets, it is impossible to maintain the superiority of Japan. Incessant and speedy execution of entrepreneurship is of great importance in the globalized era. Companies are rapidly shifting the orientation of their activities from the pursuit of corporate values focusing on tangible goods to the pursuit of intangible values, such as corporate governance, high transparency, services and social contributions.

## 3. Significance of the perspective of ordinary citizens

Outcomes of innovation generate values only when they are brought to the market and they improve the satisfaction of the people. No matter how innovative and excellent the technology or service is, no values are created unless it is accepted by the people and the market.

Traditionally, technological renovations have focused on materialistic fulfillment and the pursuit of convenience. From now on, the benefits of technological renovations should satisfy the compelling needs of each individual and reach disadvantaged people. It is because maintaining innovation is not possible without the understanding and support of ordinary citizens, or taxpayers. Being constantly aware of our own strengths and weaknesses, it is important to proceed strategically with the creation of economic and

social values.

Due to the advance in informatization, individual citizens are vested with considerable power and the wisdom of the people is growingly influencing various aspects of society. Innovations are generated by a sort of demand-led framework in which the suppliers meet the needs of the demand side by probing for, exploring, and anticipating the needs of the citizens, in response to the diversification of needs. This is one of the essences of new innovation.

In principle, innovation is the creative destruction of established organizations and values and is revolutionary. Therefore, a niche market is created at the beginning. Innovation rapidly and widely expands the niche to the domestic and international markets and is the process of drastically changing and creatively destroying existing corporate and social systems.

Natural resources are scarce in Japan and the spirit of “Mottainai” (a Japanese word meaning “too precious to waste”) has been manifested through experiences. This spirit has been the engine to create the most advanced technologies, products and services of the world. By further utilizing this large pillar of values of ordinary citizens in every way, we should actively expand the strengths, strong products and strong services of Japan into the ever-increasing world market, particularly focusing on Asia. Such technological strength is a great achievement of science, technology, industries and society in Japan. Such international contribution can improve Japan’s credibility and presence in the international community more than Japan’s economic benefits can.

## 4. Change with diversity and reform of a society filled with possibilities

Many discoveries and inventions are born in research institutions. This is why investment in science and technology is encouraged.

However, some point out that the outcomes of research and development have not sufficiently translated into society and people. Creative and new edgy knowledge often emerges from unusual ideas in unexpected places. “Uniqueness” (unusual talent / unorthodox idea) is important.

When observing the achievements of novel prize winners and the backgrounds of those who have drastically changed society, you find, in many cases, social conditions and an environment where it is easy for “uniqueness” and “outstanding elements” to emerge and grow. It is necessary to build an environment where “uniqueness” is not suppressed and one that offers opportunities for various unique talents to meet.

Scientists are not always gifted with the ability to explore the needs of ordinary citizens, to

understand the meaning of research, discovery and incipient ideas, to improve and combine other technologies and ideas, to secure funds, and to commercialize and bring the outcomes of science to society and the people. The environment, where different people with unique talents can mingle freely, attracts a lot of people as a place for innovation. The primary issue is the very environment that can create various teams and combinations suitable for a given situation.

In the era of globalization, the terms “ordinary citizens” and “society” do not refer only to those in Japan. An essential condition is to create a place where a variety of people can integrate, a place that can respond to numerous combinations, irrespective of territoriality and nationality. It is necessary for the government and each entity to urgently implement necessary reforms by reinforcing strength, supplementing weakness, identifying optimal conditions and scrutinizing universities, institutes, corporations, investment and financial and human resources.

In order to transform society to one with changes and various possibilities, we need policy research based on scientific rationale, formulation of several policies appropriate for the induction toward such society, presentation of options, and political decisions and implementation based on the concept of drastic selection and concentration. Both national and corporate policies must gain international credibility. They must further be based on scientific rationale, and eliminate the precedent-based system. It is important to decide and implement highly transparent policies by appropriately utilizing various opinions and perspectives from independent policy formulation agencies, various think tanks and scientist communities. Reform to create a society with changes and various possibilities should be prompted as a policy that entails changes in values, allowing and encouraging challenges and retrials.

## 5. Primary importance on the human resources development - encouragement of people who think creatively or “out of the box, often called “the nail that sticks out.”

Every organization, whether it is political or corporate, charts its course based upon how people think, plan and behave. Thus, the basis of a policy of innovation is to decide who should be developed and how to develop human resources.

Needless to say, universities are responsible for human resources development. Entrance examinations to universities have a huge impact on education as a whole, not just high-school education, which have been criticized as having a tendency to attach too much importance to standardized deviation scores. Thus, some universities have adopted new approaches to implement original and unique entrance exams, including promotion of

diversification in selection methods and expansion of evaluation criteria. When encouraging uniqueness, often called the person “the nail that sticks out,” along with various capabilities, further improvement in the contents and methods of selection process is warranted as well as the promotion of radical reform at universities. Furthermore, the options that Japanese people have for higher education are not limited to Japanese institutions. Rather, promoting contact with foreign values and cultures will aid in developing a Japanese sense of identity. Therefore is an important tool for developing human resources with an understanding and tolerance of different cultures.

If you have more experience with international exchange at a young age, in other words “opportunities to live by other rules,” you are able to make Japan widely open to the outside world. For human resource development it is imperative to have open universities that are not constrained by the existing framework and conventional ideas. They can then serve as places for highly motivated young people from various backgrounds to develop themselves through friendly competition. In any case, graduate schools and research institutions are required to have high international profiles.

It is necessary for Japan to envision what kind of country it intends to be in the context of a rapidly developing Asia, what country it aspires to be in the world, and what Japan can do to contribute to the international community up to 2025, during which time global issues will be more prevalent, such as the issues of climate change, resources/energy, water/food, population growth, poverty and human security. The most important task to that end is to develop human resources filled with creativity without being constrained by conventional ideas.

## Chapter 2 Next 20 years of Japan and the world

There are three large currents at present and in the next 20 years as listed below.

- Rapid demographic aging and population decline in Japan
- Advance of knowledge-based society, information-based society and globalization at an explosive rate
- Increase in the issues posing a threat to sustainability of the earth

These issues are the ones we are already facing, but the speed of the trend is expected and predicted to be faster. Each of them is a new current that has never been experienced in the past.

## 1. Rapid demographic aging and population decline in Japan

The total population of Japan reached its maximum in the year 2005, and a population decline has become a reality. Since baby boomers will begin making their way toward retirement, the working-age population (i.e., population aged 15 to 64), based on the current statistical definition, is projected to decline rapidly, possibly by as much as 13.5 million people by 2025. The ratio of working-age population to the population aged 65 and over was 3.3 to 1 in 2005, but is expected to fall to 2 to 1 in 2025. This estimated figure means that the working power, which supports one elderly person, will decline drastically in 20 years provided that various social systems remain unchanged.

In the midst of aging and the population decline, the potential growth rate will decline unless willing women or elderly people with motivation can join the workforce, or unless productivity improves.

On the other hand, due to the remarkable economic growth of newly developing countries, such as BRICs[1] (particularly China and India), the world's current economic landscape is expected to change drastically.

The future of Japan's economic status depends on the efforts to take part in the development of global economy in cooperation and coordination with the countries with huge emerging markets: instead of considering the economic growth of China and India as a threat.

## 2. Advance of knowledge-based society, information-based society and globalization at an explosive rate

In the latter half the 20th century, globalization came in the form of corporate activities represented by trade and local production.

Today's globalization is developing in a much larger scale and speed, and the major cause for this is the progress of the so-called "informatized society." Because consumers around the world have easy access to foreign goods and services (including healthcare and education), suppliers are expected to take action with constant consideration of consumers, who know the world.

Another notable characteristic of globalization in the future is an international competition over knowledge and the brain. It is hard to keep pace with the speed of progress in science and technology in the fields of IT, nano-technology and bio-technology by domestic

[1] Brazil, Russia, India and China

human resources alone, and each country is in fierce competition to gain the brains of the world.

There is no doubt that the progress of globalization described above will accelerate even further. On the other hand, there is a possibility that the gap between North and South will widen since some developing countries miss out on the wave of international competition, losing a chance to escape from poverty.

### 3. Increase in the issues posing a threat to sustainability of the earth

#### (Population)

The population explosion in many countries throughout the world is expected to continue into the future, reaching 8 billion by 2025. Out of that number, about 4.7 billion are estimated to be in Asia, including the hugely populated China and India.

Increasing concerns are being voiced about further deepening various issues that pose a threat to sustainability of the earth, and that have already come to surface.

#### (Resource and energy)

Along with the population growth, the demand for resources and energy is also expected to increase rapidly. This issue is particularly notable in Asia where high economic growth is expected. China is currently the second largest energy consumer, surpassing Japan, and there is a high probability that China will depend of foreign oil for 80% of its energy needs in 2030.

The increase in consumption of resources and energy influences the economy of Japan through the distortion of the supply-and-demand balance. At the same time, there is a great impact on environmental issues as described below.

#### (Climate change and environment)

If energy needs will continue to be largely covered by fossil fuels, its increase will be directly linked to the increase in the emissions of greenhouse-effect gases.

The Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (February, April, May 2007) reports that warming in the last 100 years has caused about a 0.74 °C increase in global average surface temperature, and increased frequencies of heavy rainfalls, and it is concluded that the cause of global warming is most likely the increase in the greenhouse-effect gases, as a result of human activities. It is also predicted that the global average temperature will increase by 1.8—4.0 °C (Prospected Confidence Interval 1.1 – 6.4 °C ) at the end of the 21$^{st}$ century, relative to the 1980 to 1999 averages,

and the risk of floods, storms and high tides will increase.

Furthermore, there is concern that the global population increase and economic growth will affect the global issues and cause environmental degradation at the regional level. The regional environmental degradation is highly likely to be prominent in Asia due to outstanding economic growth, huge populations and advancing urbanization.

### (Water and food)

Along with the population increase and the advancement of global warming, the unstable water supply has become a concern and some predict that 4 billion people will be exposed to water stress in 2025.

With regard to a food crisis, although the number of undernourished people will be reduced, the least developing countries (regions) such as Africa will remain in a severe condition.

### (Terrorism)

Since after the terrorist attacks of September 11, 2001, the “war on terror” is still a work in progress, and terrorism issues are no longer those of specific countries but those of the entire world. It is a difficult task to completely eliminate the threat of terrorism.

### (Infectious disease)

With the advance of globalization and the greater and faster mobility of people, animals and goods globally, Japan is always facing the risk of the transmission of a disease-causing agent and the entrance of infected patients/animals, which can take place in a very short period of time. Population increase and economic growth through development in developing countries are the factors causing the emergence of new infectious diseases. It is expected that the impact of newly emerged and re-emerged infectious diseases on the world will be increasingly pronounced.

## Chapter 3 Why is innovation important now?

As described earlier, Japan and the world will enter an era that human beings have never experienced before. Conventional ideas and subsequent responses will not help us through this era.

In light of the increase in the world population and buoyant growth in the BRICs, developed countries of the world are now aware that innovation is a key factor to maintaining growth while overcoming the global-scale constraints, and each country has established its own innovation strategies. Amidst the competition in the globalized era, if

Japan cannot remain highly competitive, some predict that the ratio of Japan in the world's GDP will decline from the current 15% to only 4% in the year 2025[2]. The only tool for sustainable economic development in a country like Japan, a country with a declining population, is the improvement of productivity, and its basis is undoubtedly innovation with a holistic view of the world.

To that end, it is necessary to take on a new concept without being constrained by the conventional methods concerning the work style of individuals, organizational structures and various regulations. In other words, it is fundamental to increase per capita productivity by sharing and implementing the basic principles of innovation, which are to enhance individual abilities, to integrate foreign and unique elements utilizing advantages of an informatized society, to exploit the maximum ability of individuals through cooperation, to create new added values by new science, technology and services, and as a result, to bring about changes in society, including in the lives of ordinary citizens.

Fortunately, Japan has high quality technology, which was derived from demanding consumers. Also as a result of constantly seeking energy-saving solutions, being the country with limited natural resources, Japan has a high level of energy-saving technologies. As symbolized by these examples, problems do not represent risk but a chance to create a new technology.

The aging society creates a new demand, which then is an engine to develop new technologies and services, and in the end, our lives will be healthier and economic development will be achieved. Global-scale issues, such as global warming, present the opportunity to further improve environmental technology, in which Japan has strength, and to call on the world to create a new international framework. Japan's challenge to these issues will generate innovation, which brings about economic growth and a more abundant public life.

In order to tackle the issues Japan is facing, it is necessary to further expand the investment in science and technology in the field of strength. In the field of weakness, it is necessary to enhance the technologies if they are necessary to maintain responsiveness under a changing international environment, and if not, they must be enhanced in cooperation with the world.

Since innovation is born from unexpected ideas, investment must be constantly put into the diversified and unpredictable research and development activities. In order to strengthen Japan's competitiveness and international contribution, there is no other time than now for investment in science and technology (basis of innovation), enhancement of

[2] Japan's 21st Century Vision/ Globalization Working Group Report (April 2005)

the development and framework of human resources who make optimum utilization of the outcomes of innovation to be considered crucial.

Innovation has played a role in removing various social barriers. The IT innovation, specifically the dissemination of the Internet, has enabled instant communication among people around the world, and temporal, spatial and information walls, which kept people separated from one another, have virtually vanished. We are free from various diseases due to advances in medical technology, and it is a significant advantage in saving physically frail people. The advancement of means of transportation shortens geographical distance and facilitates people's activities, making the issue of where to live trivial.

Thus, innovation plays a significant role in eliminating or reducing the conventional handicaps, such as age, disability and gender difference. Furthermore, innovation plays a great role in narrowing or eliminating various differences observed among individuals, such as regions, international scenes and information and family patterns.

The advancement of science and technology brings various benefits, and the genuine goal of innovation is to extend the benefits to as many people as possible. Further down the road of the "innovation-based country," we envision a vigorous society where individuals can exercise their maximum abilities.

From a macro-economic perspective, innovation has three effects: 1) effect to boost the GDP growth rate through an increase in the labor force by an increase in the participation rate of women and elderly people; 2) effect to create a new market, values and employment opportunities; and 3) effect to raise the living standards of the people to a new level. Various policy programs including "Innovation 25" are greatly expected to sufficiently facilitate these effects.

## Chapter 4 Japan 2025 through innovation

The following future images of Japan in 2025 are foreseeable from the outlook of Japan in 20 years, in reference to public opinions[3], Japan Perspective[4], the Gist of Japan's Policy on Science and Technology [5], the Future Society Envisioned by the Science Community[6] and Technology Forecast Survey, etc[7].

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[3] Soliciting public opinions
Public opinions on "Society in 2025 Established by Innovation" was solicited through the Cabinet Office website and others from October 27 to December 31, 2006. A total of 385 responses were obtained. Details are available at: http://www.kantei.go.jp/jp/innovation/dai5/siryou1-2.pdf

[4] Science Council of Japan Proposal (September 2002)

[5] Science Council of Japan Statement (April 2005)

[6] Science Council of Japan Report "The Future Society Envisioned by the Science Community" (January 2007)
In response to request made by the State Minister (in charge of innovation), Sanae Takaichi, the Science Council of Japan set up the "Committee for the Investigation of Innovation Promotion" in October 2006, and spent 3 months collecting 2200 voluntary proposals from the members and affiliate members of the Science Council of Japan.

[7] Technology Forecast Survey, etc.

The five social images presented below are based on the assumption that Japan can achieve sustainable economic growth through the improvement of productivity even when faced with population declines.

### 1. Society where everyone can stay healthy throughout life

Provision of medical care is expanding to the daily lives of individuals from the time when the majority of it was provided by medical institutions.

Constant checkups during sleep and preventive medical care through lifestyle improvements, such as diet and exercises, are not carried out at an individual level. At the same time, information pertaining to health and hospitals can be shared as needed through a medical information network.

Preventive medical care tailored to individual needs is available anywhere. It helps those living on a remote island maintain their health in the same way as those living in urban areas.

Once cancer, cardiac infarction, and cerebral stroke can be overcome, there will be few life-threatening diseases left.

The developments of regenerative medical technology, an advanced human-care robot and a specific agent for dementia will drastically reduce the number of so-called “bed-ridden” people and the burden of the family members and caregivers will notably decrease.

People with accidental injuries or illnesses will be swiftly brought to the 24-hour emergency medical care institutions under the developed emergency medical information system to save their lives.

### 2. Safe and secure society

Automatic ID and automatic monitoring systems are in place everywhere in living areas, and crime prevention, disaster prevention network systems, emergency medical information systems and advanced emergency medicine devices (such as portable Automated External Defibrillator) are developed within local communities. They assist children, elderly people and handicapped people to live safely in a society full of protections with a spirit of self-help and mutual-help.

Many buildings last longer and have an increased capacity owing to sturdy material technologies with self-repair function, etc., contributing to the development of houses and towns that can resist disasters and are comfortable to live in. Progress in advanced

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A holistic forecast survey on medium- and long-term development of science and technology conducted by the National Institute of Science and Technology Policy of the Ministry of Education, Culture, Sports, Science and Technology for two years from FY2003, in which a total of 2500 experts participated. Many other experts contributed to the survey.

prediction technologies and a disaster information network will drastically reduce damages caused by natural disasters such as earthquakes, tsunamis, landslides, floods and typhoons.

Advanced system for transport and mobility support has been developed. It incorporates cars and pedestrians, roads and townships, contributing to smooth traffic, including the elimination of congestion, to the drastic reduction of auto accidents and to virtually no deaths caused by auto accidents. Smooth traffic also contributes to the reduction in $CO_2$ and distribution costs.

Cards with an electronic chip enable users to make various payments and conduct public procedures under a safe and secure environment, with the protection of personal data.

Access to data on the history of food production and delivery has been made easy by the use of RFID (Radio Frequency Identification) tags, etc., and safety information on foods is now available.

Advanced authentication technology, automated detector, RFID tags or sensor with proper place such as harbor or airport enable us to establish the public peace and security to prevent terrorism.

### 3. Society that embraces diversity in life

Changing jobs is easier owing to the diversified working patterns and improved pension portability. Career formation has been realized due to the enhancement of a framework in which one can learn whenever he/she wishes. All of these have contributed to creating a society where everyone (including those who are raising families (both men and women), elderly people, handicapped people and foreign nationals) can work with enthusiasm, achieving a work-life balance.

The realization of barrier-free facilities (a living environment where handicapped people can engage freely in social activities), universal design (design that caters conveniently to people of all ages and abilities), close office-to-home proximity and an automatic transportation system enable handicapped people, elderly people and those who are raising families to continue working and makes cooperation easier, including with foreign personnel.

Telework (flexible work patterns using IT without being constrained by place and time, such as home offices) has made it possible to work at home while taking care of children. The installation of a home LAN (Local Area Network) and artificial intelligence-programmed robots connected to the home LAN have reduced the time spent on house work. Each individual is able to afford the time to be engaged in various activities as they wish, such as local activities and self-development programs, thus helping them

live more fulfilling and abundant lives.

Retired elderly people are able to have many options to live and work, such as engagement in different career paths and participation in social contributions and hobbies. Necessary learning systems have been developed. Also, an environment where you can work without geographic and physical constraints was made available owing to mobile displays that give access to the latest news anywhere and at anytime and also owing to robots taking dangerous jobs. We now enjoy convenience and safety, allowing us do our daily shopping and use financial institutions.

Also, for the sake of cooperation among all generations and the passing on of knowledge from one generation to the next, a community life has been established in which the experiences and communication abilities of the elderly are effectively utilized.

### 4. Society contributing to solving global issues

Japan has the world's top environmental and energy technologies, such as in resource- and energy-saving technology, hydrogen/fuel cell technology, artificial photosynthesis technology, vegetation and regeneration technology, and superconducting super fast transportation technology (linear motor car). Japan also leads the world in contributing to the improvement of global-scale environmental issues, involving not only the government and businesses, but also ordinary citizens, to solve such issues as a drastic reduction of greenhouse gases, resources and energy, waste management, and water and foods.

Opportunities to learn about environment and energy are offered at primary schools, and urban greening is promoted in various forms. People have more opportunities to get in touch with the natural environment, are more interested in environmental protection, and take more active actions toward energy saving and 3Rs (reduce, reuse, recycle) in their daily lives. Many people, from children to the elderly, participate in environmental volunteer activities. Businesses also take support measures on a nation-wide scale to grant leaves of absence to their employees who take part in such activities.

Japan's sustainable recycling-oriented society is the envy of the world, and many researchers from all over the world visit Japan to gain knowledge and experience on the matter. We have observed that many young people from Asian countries have studied environment at universities and companies in Japan and returned to their home countries to promote economies that are in harmony with nature.

Owing to revolutionary environmental technologies, environmental business has expanded and the international competitiveness of Japanese corporations has improved. Our society now leads the environmental market in Asia and the world.

### 5. Society open to the world

The spread of automatic translation systems enables us to communicate with anyone around the world, deepening mutual understanding.

Japanese people have a broad and deep knowledge about human resources, goods, technologies, traditions and cultures in which Japan takes pride, and Japan sends its message to the world. Also, many people around the world have more direct contacts with Japanese people through travel, work and studying abroad, particularly by overcoming the barrier of the language. Living with people with different nationalities has become an ordinary part of our daily lives.

Furthermore, virtual reality technologies have been advanced, and people are now able explore the real world while at home. Japanese people can get a sense of the cultures and historical heritages of the world and the people of the world can do the same for Japan. Based on such experiences, the number of Japanese people who excel in an international arena is increasing. At the same time, the number of foreign nationals coming to Japan and doing well in Japan is dramatically on the rise.

In the meantime, these five social images have been identified from the perspective of ordinary citizens. When they are observed from a different perspective, it can be defined as an economic society with strong international competitiveness that was achieved by improvement in productivity (including the productivity of existing companies) and through the creation of new businesses and industries that bring about various innovations.

Furthermore, from the aspect of the lifestyle of each individual citizen, it is a society where various stereotypes are defied, individual's abilities are fully tapped, and people can maintain a purpose in life throughout their lives and live healthy lives, or at least a society where such opportunities are equally available to everyone.

In 20 years time, the state of Japan presented here is a country in which we can sense true wealth, not just material abundance, and where we can live and develop together with the world.

In order to realize the state of Japan in 2025, we must overcome very high hurdles in terms of technology, systems and society. Those hurdles are set too high to be overcome through conventional approaches. However, each one of us must remember that we can accomplish drastic social reforms that bring forth new added values, only when all the hurdles are cleared.

## Chapter 5 Policy roadmap towards Japan based on innovation

The international competition over innovation is virtually a competition of how fast and effectively the seeds of innovation (many of which are the outcomes of science and technology) can be applied to society or how to establish a social framework that can promote the fruition of the seeds.

Particularly, the creation of an environment where new businesses and services continue to emerge is an essential factor for Japan's development. It is therefore vital to change social systems to make sure that excess regulations and outdated practices do not nip the bud of innovation.

In light of these circumstances, we have the urgent tasks of eliminating the institutional bottleneck so that the achievements of science and technology can be transformed into practice and of developing a new framework to accelerate the transformation process.

The base of creation of innovation is human resources. If Japan is to prosper as a leading nation of innovation for the next 20 years and beyond, it is necessary to urgently develop human resources and capacity utilization measures with a view of future directions.

Moreover, specific actions must be taken for the future of strategic policy responses, which includes a revision of various systems to transform new technologies into practice in response to the development of science and technology in the future. In the same context, it is also vital to consider now the cases that will require setting up of a new system and the fundamental issues on social systems to be discussed from the perspective of innovation creation, even though national consensus has yet to be achieved.

In creating a social environment that cranks out innovations one after another, it is important for the government to share with the people a vision of the future we need to attain for Japan and exert concerted efforts for the task. In order to create an environment that generates innovations, it is important to create policy innovations, including systems based on new ideas and revisions and modifications of flexible policies, without being constrained by traditional systems and practices. To that end, discussions in this chapter will highlight reform strategies for social systems to create a social environment towards the world's leading nation of innovation. It is necessary to place priorities particularly on the following factors, when implementing these strategies.

- Promotion of inter-ministerial policies
- Framework to provide various policy options
- Perspective of the people of the world
- Framework to utilize independence and vigor in local areas
- Framework to make the most of private initiatives, instead of bureaucratic ones

- Strategies encompassing the international market and international contributions
- Strategies fostering social systems to promote the development of social entrepreneurs
- Development and support of NPO activities and social entrepreneurs to achieve public interest
- Establishment of investment transformation process from materials to people
- Promotion of awareness of the people about the society driven by innovation

In the aspect of science and technology, it is necessary to provide to a whole science and technology community and to the general public a roadmap of technological issues to be addressed, not only from the short-term but also from medium- and long-term perspectives. Groundbreaking discoveries and technological revolutions in science and technology do not always occur in harmony with expectations or in a planned manner. However, it is expected that the presentation of the roadmap will accelerate the creation of innovations by encouraging stakeholders' strategic responses, which include the final stage of innovation—the social application of technologies.

In addition to these concepts, policies for both social system reform and innovation in research and development area should be promoted based on a policy map comprising the strategies for reforming social systems and the roadmap of strategies for technological revolutions, upon examination of the Biomass Nippon Strategy (Cabinet Decision, 31 March, 2006), the institutional reforms for the advancement of science and technology, and for the return of research results to society (Council for Science and Technology Policy, December 25, 2006), the New Health Frontier Strategy (New Health Frontier Council, April 18, 2007), the Program for Enhancing Growth Potential (Council on Economic and Fiscal Policy, April 25, 2007), Five-year Plan for the Development of Innovative Pharmaceutical Products and Medical Devices (Ministry of Education, Culture, Sports, Science and Technology, Ministry of Health, Labor and Welfare, Ministry of Economy, Trade and Industry, April 26, 2007), the Asian Gateway Initiative (Council for the Asian Gateway Initiative, May 16, 2007), the Council for the Promotion of Regulatory Reform's First Report (May 2007), Promotion Plan for Career Education (Council for the Promotion of Career Education, May 2007), Outline of the Economic Growth Strategy (decided on July 6, 2006, revised in 2007), Japan's Strategy for Leading Global Environmental Policies in the 21st Century (2007), the Second Report of the Education Rebuilding Council (2007), Intellectual Property Strategic Program 2007 (Strategic Council on Intellectual Property, 2007), Priority Policy Program 2007 (to be decided by the IT Strategy Headquarters in May 2007).

In the meantime, the progress of policy implementations based on this policy roadmap will be revised on an as-needed basis, with annual follow-up evaluations, based on

national and international trends, etc.

## 1. Strategies for social system reform

### (1) Urgent measures to be addressed

Science and technology alone cannot generate innovation. The following are the issues to be addressed roughly in the next three years in order to develop a society that facilitates the creation of innovation.

#### 1) Development of society towards the creation and promotion of innovation

Science and technology alone cannot generate innovation. Innovation is created only when its outcomes are brought to the society at large and markets, and generate economic and social effects.

It is clear from the past experience that the innovation led by science and technology that drastically changes society requires a considerable amount of time until the outcomes of basic research reach the society. Thus, it is necessary to build a framework (innovation ecosystem) that not only enhances the investment in basic research and advanced science and technology, which are the seeds of the future innovation, but also rapidly introduces the outcomes to society. Also, since innovation always entails a considerable risk, investment and implementation systems considered such a risk are important.

Various measures have already been taken thus far. However, bolder and speedier measures must be taken under the international competition framework in the global age.

Furthermore, in the face of an aging and decreasing population, it is essential for society at large that women who are willing to work are able to realize their maximum potential, from the perspectives of purpose in life, challenges and productivity. At the same time, the elderly people are expected to actively participate in society more than ever before, and an environment should be developed to enable them to do so.

Various regulations, although they functioned appropriately and effectively at the time of their adoption, should be efficiently reviewed from the perspective of innovation creation, in light of dramatic changes, such as globalization and a decreasing and aging population in Japan.

The following approaches will be undertaken with these concepts in mind.

**(i) Development of social environment including the review of regulations to promote innovations in service area**

The following actions will be taken to develop an environment to provide new services to meet the people's demand for "new wealth and spiritual wealth," which include the

review of various regulations, from the perspective of innovation creation.

- Discussion on the enhancement of international competitiveness of the financial market and improvement of customer convenience, for example, making payment systems more robust, and diversifying the type of goods traded on an exchange
- Discussion on the development of an environment, including the review of regulations through the establishment and verification of services integrating related technologies and ideas in order to promote new services, such as mobile shops, watch for children and the elderly, living support by robots, health management across national borders, secondary trade of use of spectrum, and distribution of new generation automobiles
- With respect to the so called “Overreaction” to the protection of persona data, promotion of efforts in line with “Smooth Promotion of the Protection of Personal Information (agreed by the Inter-ministerial Committee for the Protection of Personal Information on February 28, 2006), and efforts for a thorough dissemination of legal information, including exemptions of the limitation of the provision by the third-party provision will be promoted

**(ii) Establishment of a new system that induces innovation**

**- Promotion of the use of new technologies in the public sector**

In order to create initial demand and accelerate technological revolutions, efforts will be exerted so that the public sector initiates the procurement, use and evaluation of new technologies, products and services made in Japan towards utilization of new technologies in the public sector. When doing so, efforts will be made to use the evaluation results for the evaluation method including the comprehensive evaluation bidding method for public procurement within FY2009 to emphasize not only price but also functions.

**- Review of regulations through experimental studies and pilot projects**

Experimental studies and pilot projects will be promoted by integrating technologies and ideas that may require social reform, in order to review effective regulations, systems and rules. This would allow new businesses that are using new technologies to readily take off.

**- Building a system to fairly evaluate efforts and challenges**

The following actions will be taken to expand support for the commercialization of innovative results of research and development as well as for the challenges, learning from setbacks.

- Implementation of business evaluation of venture companies at an early stage and

public disclosure of excellent venture companies

- Implementation of support for patent licensing agents by holding seminars for networking experts in patent distribution and technology transfer
- Enhancement of support and consultation of experts for financial procurement for entrepreneurs who wish to re-challenge and for medium- and small enterprises working on business reconstruction, and promotion of loans to avoid excessive dependence on mortgage collateral or personal guarantee

- Promotion of distribution of digital contents

Legal framework and contract rules will be developed by FY2009 concerning the protection and use of copyrights to promote distribution of digital contents.

- Introduction of a system contributing to enhancement of food safety and reliability

The following actions will be taken to ensure food safety and reliability.

- Introduction of risk reduction technologies at every stage, from production to distribution and processing of agricultural and food products, and traceability technologies.
- Implementation of the procedure to ensure the security, food safety and quality such as Good Agricultural Practice for agricultural product or Good Manufacturing Practice for safety food product.

- Building new public-private partnership to ensure safety and comfort

In order to ensure safety and comfort of the people, a new public-private partnership will be built through, for example, holding of the Round Table Meeting of Stakeholders for the Promotion of Social Accountability, which comprises business entities, consumer organizations, labor organizations, NPOs and administrative offices. The purpose will be to develop an environment that promotes voluntary efforts of companies beyond the framework of laws and regulations.

**(iii) Building a framework for new "work patterns" and "ways of living"**

- Efforts for work-life balance

The following actions will be taken with a view to realize a diversified society in which one can take on various activities with a balance of his/her own, among work, family life, community life and self-development.

- Development support system to help strike a work-life balance and to enable diversified and flexible work styles in accordance with each life stage

- Establishment of a framework to deepen understanding and strengthen impetus, which facilitates the formation of shared understanding within society of the significance and importance of a work-life balance (The whole society promotes the efforts of the companies and provides support and services, which offer various options for individuals.)
- Utilization of women's counseling centers throughout the nation to promote re-entry to the workforce and setting up of a business by women who are raising children; provision of recruitment information for women in cooperation with private organizations and examinations on the improvement of learning and capacity-building opportunities in view of employment
- Discussions on the development of an environment to facilitate use of child-care leave to respond to further diversification of values and lifestyles of workers

- Efforts to secure comfortable housing conditions and cities harmonized with nature

The following actions will be taken to secure comfortable housing conditions suitable for the 21st century, meeting diversified values and lifestyles, by using highly advanced technology sensitive to environmental burden and cost such as energy saving technology.

- Provision of support for further technological development and pioneering projects to prolong the durability of houses (houses lasting 200 years) and to create high-quality housing stocks and a living environment in harmony with the surrounding cityscape, and in response to the diversification of values on work and lifestyle and family forms; development of various systems for the use of ultra-long-period housing, specifically, maintenance and management system, distribution system, and financial system
- Reinforcement of activities by diverse stakeholders to revitalize green area in urban setting such as urban planning in cohabitation with nature through development and dissemination to assess the efforts of private businesses that have actively participated in the creation of green spaces in the urban development projects

- Promotion of telework

Aiming for increasing the ratio of teleworkers to be 20% of the entire working population by 2010, dissemination campaign activities mainly by Telework Promotion Forum will be carried out. A proper environment will be developed through, for example, improvement and enhancement of a support and consultation system to facilitate the system introduction and establishment of a model of the telework system. Discussions

will be made on the employment contract, which would contribute to the realization of flexible and diverse work styles by telework. An environment for labor-related systems will be developed, which will contribute to smooth dissemination of telework.

- Expansion of job opportunities

The following actions will be taken to expand opportunities for challenges and re-challenges for anyone regardless of academic background or age.

- Support for those who have few opportunities for career development by developing the Career Development System (a.k.a. Job Card System), in view of creating a society where anyone can participate in career development and manifest his/her potential anywhere
- Promotion of the following support measures in view of supporting young people and women who are seeking new challenges, measures for employment of young people, such as support for companies to hire part-time workers as regular employees, job replacement office project for mothers, and comprehensive support for women who are raising children to return to work; launch of a new national civil servant examination system to recruit mid-career employees in FY2007, revision of academic requirements for various qualifications and the age range for employing civil servants
- Continuous provision of various support in cooperation with concerned organizations to assist those on public benefits (welfare) to be independent through work while maintaining safety nets, which include holistic approaches covering both work support and promotion of employment, and promotion of transformation of welfare-oriented employment of handicapped people to regular employment
- Utilization of subsidies and human resources centers for the elderly and enhancement of job-placement functions to create job opportunities to assist the elderly to work by drawing on their knowledge and experience
- Implementation of locally-adapted job training so that people could get and continue a secure job at small and medium size companies

**(iv) New developments of intellectual property strategies and standardization activities**

- International intellectual property strategies

In order to undertake market activities in the future, it is necessary to envision the world market; and therefore, the following actions will be taken concerning intellectual property strategies.

- To realize a global patent system ; Standardization of the patent application format

among the Trilateral Offices (the Japan Patent Office, the United States Patent and Trademark Office and the European Patent Office) by FY2009 ; Acceleration of discussions on the draft of the Substantive Patent Law Treaty to build consensus among developed countries within FY2007 ; Promotion of the mutual exploitation of examination results

- Strong encouragement to acquire patent rights based on patent strategies with international perspectives in view of raising the percentage of applications abroad to 30%
- Further strengthening of efforts for expeditious and efficient patent granting led by the Headquarters for Expeditious and Efficient Patent Examination , through enhancement of human resources for patent examiners and appeal examiners, improvement of their efficiency and reinforcement of quality management systems

- Strengthening of intellectual property strategies of universities

- Discussions on the effective support of the government to the measures made by universities of their own from FY2008, about further use of intellectual properties and about improvement of human resources in different areas who are responsible for the use of intellectual properties, with respect to patent application abroad for important discoveries that would contribute to basic patent in universities, international partnership of industry-government-university, technology transfer, and commercialization
- Establishment of a system to strategically and organizationally promote the creation, management and use of intellectual properties of universities through integration and strengthening of cooperation between intellectual property headquarters of universities and Technology Transfer Organization, enhancement of industry-government-university partnership in local communities, and promotion of inter-university cooperation

- Strengthening of measures against counterfeit and pirated goods

In order to protect intellectual property rights that are the basis of innovation, the following actions will be taken with respect to counterfeit and pirated goods.

- Strengthening of measures against counterfeit and pirated goods through discussion in various international and bilateral cooperation
- Efforts for early realization of a “Possible International Legal Framework on Preventing the Proliferation of Counterfeit and Pirated Goods” to strengthen international rules

- Further strengthening of support for companies to combat counterfeit and pirated goods through embassies and consulates overseas or JETRO (Japan External Trade Organization)

- International activities for standardization

The following activities will be taken in view of drastically strengthening the activities for international standardization.

- Enhancement of human resources who play a leading role at international organizations and conferences; discussions on a promotion of the evaluation of the human resources who play a leading role in business, research center and universities and measures to allow a single person to be engaged in various negotiations in the field of international standardization for a long period of time; encouragement to utilize senior citizens who have expertise in the area of international standardization; involving human resources in the formulation of international standards
- Promotion of international activities for standardization in cooperation with Asian countries in the areas of environment/energy in which Japan has strength (such activities include environment management accounting, methods for design for environment concerning electric and electronic products, and use of recyclable resources) and strengthening of cooperation with Asian and Pacific regions for international for international standardization activities and exchange of engineers, through, for example, the formulation and promotion of the Asia-Pacific Initiative for Standardization
- Promotion of the international activities for standardization in research and development funded by the government by setting them as one of the factors for evaluating research activities at each level, namely, pre, mid-term and final evaluation.

**(v) Creation of environment to support corporate activities open to the world**

- Reform of aviation, seaport and trade procedures

In view of making Japan the Logistics Hub in Asia in the advent of the age of great exchange in Asia, the following activities will be taken to reform aviation, seaport and trade procedures based on the users' point of view.

- Further internationalization of Haneda Airport; launch of 24-hour operation of the international airport in the metropolitan areas, including the integrated operation of Haneda Airport and Narita Airport

- Development and promotion of simple and effective trade procedures based on the international standards in terms of time and cost
- Promotion of seamless network covering land, sea and air
- Renewal of the Single Window System and promotion to harmonize trade systems in Asian countries
- Development of effective inspection equipment for exporting and importing goods

- **Development of the common development infrastructures in Asia (Establishment of Seamless Asia)**

The following activities will be taken to strengthen the hub function of research and the cooperation to solve common issues in Asia, to develop a business environment within the Asian region utilizing private power, and to establish a seamless Asia in which business can be conducted without a wall between Japan and Asia or other regions.

- Establishment of a wide logistics network by implementing pilot experiments, developing human resources and developing computerized procedures, in view of establishing a seamless logistics network covering the whole of Asia
- Development of ICT infrastructure through Japan's initiative to promote safe and smooth information distribution in and out of the area
- Encouragement of the development of a business environment in each country through the public-private and inter-ministerial cooperation utilizing the EPA framework
- Standardization of IC-Ticket and promotion of its mutual use in the East Asia

**(vi) Strengthening of efforts towards improving productivity in the service industry area based on the people's point of view**

- **Enhancement of support for productivity improvement in the service industry**

Cross-sectoral efforts of industries, government and universities will be supported to accumulate know-how of manufactures that can be applied to service industries and develop customer satisfaction indicators for quality assessment.

Roadmap on service research will be developed by FY2007 to extract research themes in the service industry and establish communication tools between industries and universities.

Also, pioneering research and development application examination projects will be implemented to improve productivity in the service industry, and the results will be accumulated and disseminated throughout the service industry.

- **Developing human resources who play a leading role in service innovation**

In view of developing human resources with the capacity to contribute to the improvement of productivity and the creation of innovation in the service area, inter-disciplinary and multi-disciplinary education and research on services at universities will be promoted.

- **Developing an open and universal IT infrastructure**

The following actions will be taken to improve productivity and strengthen competitiveness of the Japanese industries as a whole, in view of realizing an "Ubiquitous Community" that solves various local issues by using and utilizing IT by the year 2010.

- Start of discussions since FY2007 about the following issues: establishment of a wide and inter-industry infrastructure to share information beyond businesses and trade-relations using IT, development of an environment to carry out IT management in small- and medium-sized enterprises, development of human resources in advanced IT to accelerate investment in IT
- Development of optic fiber network by 2010 to promote the broadband infrastructure available to anyone, anytime and anywhere, while giving consideration to local need; launch of establishing pioneering approach models from FY2007 in industry-government-university cooperation to promote solutions to the local issues in the fields closely related to welfare, education, local industry, transportation, and disaster prevention by utilizing the IT infrastructure (e.g., monitoring children and the elderly people living alone); nationwide installation of IT infrastructure in accordance with the regional characteristics focusing on ordinary citizens, by sharing the outcomes of established models
- Establishment of geospatial information platform, which allows a wide sharing and advanced usage of information on locations, including the development of computerized fundamental geospatial data by FY2010; building an infrastructure that makes information on locations and things available anytime and anywhere by installing RFID tags and sensors in public spaces
- Creation of a safe IT environment to eliminate concerns and drawbacks of IT society, where information is secured by the comprehensive measures based upon The First National Strategy on Information Security and where young people are not exposed to illegal and harmful information by filtering systems

### (vii) Promotion of mobilization of human resources

- Mobility among universities, independent administrative institutions and private companies

In order to promote mobilization of human resources in view of providing scientists with opportunities for commercialization of research activities and research contents, discussions will be carried out about a specific system where researchers of universities or independent administrative institutions can take sabbatical leave to conduct research activities at private companies, aiming for early introduction of the system.

- Mobilization of a research team

In view of promoting mobilization of technologies of a research team and human resources, establishment of a system will be discussed to promote mobilization of a research team (spin-off and spin-out companies), aiming for early introduction of the system.

### (viii) Promotion of efforts for creating vigorous local communities

- Vitalization of local industries

In view of regional vitalization from the people's point of view, while taking advantage of regional features, discussions will be held on the revision of impeding legal systems and specific measures for utilization of special zones to produce and sell local specialties appealing to customers, such as value-added foods, making use of regional characteristics.

- Support for the development and commercialization of new products/new services utilizing local resources

In order to foster an environment to make regional efforts for independent and sustainable growth in the region by strengthening its own traits, supports will be provided to small- and medium-sized enterprises that develop and commercialize new products and new services utilizing local resources.

- Support for local governments taking initiatives for the formation of industrial clusters

Supports will be expanded for the local governments taking initiatives for the formation of industrial clusters from FY2007. Furthermore, supports by public research center, local government, universities will be strengthened and wide-sector coordination or network beyond region will be promoted.

- Promotion for the creation of a compact city

Urban transportation measures based on comprehensive transportation strategies and urban development will be promoted in order to halt the progress of urban sprawl, in which urban functions spread in a chaotic manner, to create a center (compact base) where urban functions are concentrated, and to create a compact city where accessibility is ensured with public transportation as an axis in the compact base and other areas within the metropolitan area, while decreasing the burden to the environment by using the energy saving technology with an cooperation between public and private sector.

### (ix) Promotion of research activities concerning the design of social systems that induce innovation

- Implementation of research on measurement and evaluation of innovation

In order to efficiently generate research outcomes that would lead to the effective promotion of innovation, a simulation model will be developed to quantitatively measure and evaluate impacts of research and development on society. Also, Japan will lead the discussions on measures concerning innovation by being actively involved in the discussions on an “OECD Innovation Strategy,” scheduled to be formulated by the OECD.

- Implementation of research on a social environment that induces innovation

In view of contributing to the creation of an environment that induces innovation, research to clear up the activities or mechanism of assimilations made by distinct technologies and knowledge will be promoted and inter-disciplinary and multi-disciplinary research activities centered on humanities and social sciences will be promoted, contributing to the solutions of and responses to various problems in modern society, including those entailing progress in technologies and changes in society and those concerning human psychology and values. Its outcomes will be presented to society as proposals.

### 2) Improvement and reinforcement of the next-generation investment

The basis for making incessant innovations is “people,” and the key to sustainable economic growth in the advent of the age of the decreasing population in Japan depends on the power of “people,” the core of society.

Thus, the focus of the investment in science and technology and education will be shifted to “people,” who are the root of competition. Particularly with an awareness that the priority issue to create Japan, which induces innovation, is a drastic improvement of training of those in the generation that will lead society in 2025, an investment in the leading young people of the next generation should be improved and reinforced.

In the fields of science and technology, which are the seeds of various innovations and whose outcomes are the driving force of economic growth, and in the face of intensified international competition, investments in science and technology should be improved and reinforced upon analyzing strengths and weaknesses in international competition, in order to solve problems of not only Japan but also the world, to create wisdom to generate innovation and to transmit the outcomes to the world. This process should be based on the 3rd Science and Technology Basic Plan (Cabinet Decision, March 28, 2006), while proceeding with the establishment of a system to conduct research and development effectively and efficiently.

At the same time, in the present day, at the dawn of the information revolution, the basic infrastructure to increase productivity over the course of future years is IT. Thus, use of IT in fields where IT is not sufficiently used will be promoted, and a system development to put various and private sector-led ideas on IT usage will be strengthened. In doing so, it is necessary to shift the emphasis from hardware-oriented approach to the system-oriented/infrastructure-oriented one.

The following actions will be taken under these concepts.

#### (i) Research-funding reform such as bold investments in young researchers and ambitious and challenging research

- **Improvement and reinforcement of funds for young researchers**

  A consistent and competition-based funding system will be developed to support independence of young researchers and to extend the research base, and the world’s top researchers will be developed. A system will be introduced to provide postdoctoral researchers with PhDs with opportunities to become independent in about five years and to explore new areas. Furthermore, the system will foster the outcomes obtained there. Also, efforts will be made to develop a research and living environment, including

strengthening of economic support for excellent doctoral students, and the creation of an environment where young researchers can be independent and female researchers can demonstrate their abilities without interrupting their research activities due to childbirth and childrearing. With these measures, funds for young researchers will be improved and reinforced by FY2010.

- Expansion and review of competitive funds

The following actions will be taken to reinforce basic science and promote advanced and high-risk research activities under a competitive environment.

- Expansion of competitive funds in order to improve the quality of research by the principle of competition
- Expansion of researchers eligible for receiving payrolls from competitive funds
- Urgent review of assessment methods, including assessment by highly acclaimed researchers who are actively engaged in international research activities regardless of their nationality
- Promotion of availability of multi-year funds in view of contributing to the facilitation of research activities (and subsequently contributing to facilitation of funds and expansion of research outcomes) by transferring the competitive funds to independent administrative institutions; research and development activities of R&D-oriented independent administrative institutions, after eliminating restrictions on independent administrative institutions and by expanding multi-year contracts for research funds
- Expedite the fulfillment of the ratio of indirect expenditures to 30% of the entire competitive fund system at an early stage

- Promotion of development and sharing of research facilities

Facilities of universities and research institutions will be developed in a planned manner, such as basic and common research facilities to be used by various researchers, and facilities to be used for education and research purposes. Overlapping functions of costly research facilities should be avoided and active use of common facilities will be promoted, including existing research facilities, in view of developing young researchers and use by the private sector.

- Smooth fund supply to promote research activities with outstanding results

To prevent research activities with outstanding results from being interrupted due to disruption of the supply of funds, inter-ministerial and inter-organizational systems will

be made seamless. On the assumption of implementation of a full-fledged funding program provided by the FY2009 budgets, research themes will be selected on a trial basis in accordance with the characteristics of the system using the budget of FY2008. To facilitate the seamless fund supply, an evaluation will be performed a year prior to the termination of the research and development program, to give feedback of the results in the next fund supply. Accordingly, evaluations will be streamlined by, for instance, making evaluation time more flexible. Furthermore, the methods to adopt the research projects which are conducive to each system will be discussed.

**(ii) Creation of a hub that embraces the brains of the world**

**- Creation of the world's top level research base**

In order to generate innovation, it is necessary to drastically raise the function of basic research, such as universities, which are the starting point of innovation, and reinforce international competitiveness. To do this, it is imperative for Japan to establish the world's top research base, without being constrained by conventional notions, and to create a place where the world's best brains are gathered, outstanding research results are generated and human resources are developed. As one of the measures to that end, the programs lunched in FY2007 will be improved and reinforced.

**- Improvement and reinforcement of support for foreign residents living in Japan**

The following actions will be taken to improve and reinforce support for foreign residents living in Japan in view of creating an environment where they can enjoy the same public services as Japanese people, as members of society.

- Community development where foreign residents are comfortable to live, such as improvement of Japanese language education
- Strengthening education for foreign children
- Improvement of a working environment for foreign residents and promotion of participation in social insurance
- Revision of the immigration control of foreign residents

**- Revision of periods of stay contributing to the inflow of highly-skilled foreign workers**

Every country in the world is increasingly aware of science and technology as the base of national power, and the competition to attract outstanding researchers is intensifying. In order to establish the world's preeminent center, it is imperative to create an environment where outstanding foreign researchers can stay in Japan for a long period of time to continuously generate research results. Thus, in view of actively gaining highly-

skilled foreign workers in specialized and technological fields, the periods of stay of highly-skilled workers will be extended by about five years, upon taking appropriate measures, such as provision of certain requirements for the place of employment of foreign workers.

**(iii) Developing human resources who are unique and outstanding, by accepting diversity**

**- Improvement of youth exchange programs**

The exchange activities with those in the same generation with different cultures, lifestyles and practices are a cross-cultural experience that deepens international understanding and fosters international mindedness. It is thus important for developing human resources who are unique and outstanding. In view of providing opportunities for experience at a young age, the following actions will be taken.

- Provision of opportunities for discussions with excellent foreign researches; improvement of international learning opportunities through long-term dispatch to research institutions abroad
- Improvement and reinforcement of short-term study abroad programs to promote exchange between university students
- Support for study abroad of senior high school students; promotion of cross-cultural experience of senior high school students by inviting students from abroad
- Improvement of support aiming to provide about 10% of doctoral students (2000 students /year) with opportunities to study abroad through cooperation programs with overseas universities for one year
- Discussion at an early time on the programs to promote exchanges among junior and senior high school students (the “Asia Youth House” project, etc.)

**- Developing of human resources with entrepreneurship**

In view of creating an environment for experiential opportunities such as internships, and developing human resources with entrepreneurship, which is the driving force to generate new inventions, the following actions will be taken.

- Information provision for education and dissemination to entice young people and baby boomers to be engaged in agriculture, forestry and fishery and to live in dual regions; training for smooth employment and settlement; support for setting up business
- Provision of opportunities for meeting and integrating with different elements (e.g. cultivation of a sense of independence and encouragement of entrepreneurship) through the development and implementation of high level internship programs

conducted with cooperation between industries and universities

- Government-led promotion of industry-university partnership in human resources development as an arena for dialogue and cooperation to facilitate specific actions from both industries and universities through various discussions on cross-sector and inter-disciplinary issues
- Development of human resources who have basic abilities as members of society, through practical education, such as problem-solving courses and internships, in cooperation with companies
- Improvement of opportunities to demonstrate the abilities of those who have entrepreneurship or to develop those who have entrepreneurship through the promotion of efforts of industry-university-government partnerships to develop human resources focusing on local communities
- Promotion of career education and vocational training to assist people to systematically experience and understand the joy of working through manufacturing and on-the-job training or internships, by utilizing experiences and ideas of private entities, such as NPOs and private companies
- Promotion of the investment to the human resources in private sector

- Developing human resources with the ability to manage technology

Active use of both domestic and foreign researchers and post doctoral researchers in conducting joint research projects between companies and public research institutions will be strongly encouraged to develop human resources with the ability to strengthen practical management of technologies that would link science, technology, business and market.

- Improvement of support for those who have motivation and an ability to learn

- Improvement of scholarship programs, while ensuring its financial soundness, for those who are in financial difficulties although they have motivation and an ability to learn
- Target: 20% out of living costs for doctoral students will be sufficiently supported by 2010, through the improvement of fellowships for doctoral students, including strengthening the fellowship program or utilizing competitive funds.

**(iv) Developing human resources in sciences and mathematics who support science and technology innovation**

- Provision of opportunities for learning advanced sciences and mathematics

The following actions will be taken in view of providing students who are interested in sciences and mathematics with opportunities to learn advanced sciences and mathematics, and to develop international-mindedness and professionalism through interaction with "different" elements. They will also be taken in view of developing outstanding human resources who play a lead role in the arena of science and technology in the future.

- Reinforcement of support to science and technology related contests such as Science Olympics for senior and junior high school students (physics, chemistry, biology, mathematics, information, research project, etc.) (target: double the participants by 2010)
- Reinforcement of activities of senior high schools that emphasize mathematics and science education (a.k.a. Super Science High schools) and of support for international exchange programs between these schools and the similar type of schools abroad
- Support of universities that provide students with outstanding motivation and ability with advanced learning opportunities
- Promotion of development of engineers with creativity and practical skills who support innovation

- Improvement of science and mathematics education

The following activities will be taken in view of improving science and mathematics education in elementary, junior and senior high schools to become competitive internationally by strengthening the teaching capabilities of teachers and other measures.

- Encouraging utilization of the special certification and the appointment of special part-time lecturers to expand opportunities for people with science background, motivation and ability to become teachers
- Expansion of employment of science collaboration teachers for elementary schools
- Enhancement of facilities for science and mathematics education at elementary, junior high and senior high schools
- Improvement and strengthening of quality and quantity of text books based on the revisions of curriculum guidelines
- Implementation of science experiment classes organized by engineers of local companies, utilizing their experience and expertise (Experimental Science Class)
- Enhancement of teacher training programs to improve experiential teaching activities, such as experiment, observation and practical learning experience

### 3) University reform

Universities are the source of “knowledge” that leads innovation, and major universities in the world are in fierce competition to attract the best brains. They have also formed the international university consortium and established extensive industry-university partnerships with international companies, seeking stimulus from the outside without being confined to the inner circle. They have been achieving dynamic changes as a center of competition and cooperation among versatile researchers and students. It is necessary to be aware that Japanese universities cannot escape from such competition, for better or for worse.

Therefore, universities in Japan should become open to the world, should attract many excellent international students and provide them with appropriate environment they can study and learn from each other, and should be revitalized to powerful communities for developing a variety of energetic and talented people. Opportunities should be provided to the Japanese students to study abroad, where they are compelled to interact with “different” elements, to be able to gain broad views and sense and build personal international networks.

As their original roles, universities are expected to develop scholars and men of wisdom, to promote broad and deep learning, to promote unique and advanced research and to contribute to the development of society. It is important to contribute to the economic growth and the creation of innovation by achieving these expectations.

The following actions will be promoted under these concepts.

If all universities choose the same direction, it will have the opposite effect of impeding their effectiveness. Thus, it is necessary for government to promote non-stereotyped and detailed implementations, while respecting the motivations and initiatives of individual universities.

#### (i) Strengthening the research capacity and education capacity of universities

**- Improving international competitiveness both of research and education at universities**

In order to develop world-class, high-quality and talented human resources who can bring about innovations, Japanese universities need to establish internationally attractive graduate schools, as well as realize reliable undergraduate education to strengthen international competitiveness. Thus, the following actions will be promoted while allocating sufficient basic fund that supports basis of education and research at universities.

- Efforts for building internationally acclaimed centers with international

competitiveness both for education and research

- Development of well-organized and systematic educational programs at graduate schools to develop advanced human resources who can work extensively in various areas of society
- Developing creative human resource for innovations by improving the independence of young researchers, creating a work-friendly environment for female researchers, and promoting interactions of researchers with “different” backgrounds
- Efforts for the provision of unique education for undergraduate students.
- Discussions on the framework to ensure the quality of education contents and offered degrees, by improving education and research training for students, implementing strict grading systems, conducting teacher evaluations and reflecting the results in employment conditions
- Improving facilities to make universities internationally attractive.

- Filling the gap between humanities and science

In order to create innovation, it is necessary to have inter-disciplinary and broad knowledge and experience. In particular, so that society and companies can maintain the innovative edge, it is essential to develop business leaders with knowledge of science and technology and researchers and engineers with business sense who understand market needs.

Therefore, the following actions will be promoted to offer education free from the division between humanities and science, so as not to restrict the range of options of coursers or career paths after graduation.

- Revision of university application criteria to promote a wide range of learning by high school students, without confining them to the divided fields of humanities or sciences
- Efforts to introduce a multi-major system in which students can systematically take courses outside their major subject, and to improve the quality of undergraduate education emphasizing liberal arts education
- Multidisciplinary efforts for educating students with wide range of knowledge and expertise who can contribute to creation of innovation.

- Improvement of university admission process to select potential students

The following efforts will be promoted in view of improving admission process for university students, by using more detailed selection criteria to comprehensively evaluate ability/aptitude, and learning about the motivations and the purpose of

applicants.

- Promotion of efforts, including development and implementation of screening science and mathematics students who have high motivation and ability, development and implementation of curriculum to draw up potentials of those students, and admission of students to research laboratories and participation in academic society at an early stage
- Investigation and analysis of needs of applicants, parents and corporations for further utilization of the Admission-Office Entrance System (AO Entrance System) (detailed screening method to comprehensively evaluate ability/aptitude, learning motivation and sense of purpose of applicants ) by combining detailed screening of the application documents and long and careful interviews; follow-up survey and analysis of enrolled students and alumni are necessary to ensure the quality of students who have enrolled through the AO entrance system.

**(ii) Opening universities to the world**

**- Promotion of credit compatibility with partner universities/graduate schools abroad**

Credit compatibility with partner universities/graduate schools abroad will be promoted in view of drastically expanding the number of exchange students.

**- Support for forming an international consortium through university partnership, and expansion of a double-degree system**

The following efforts will be promoted to form an international partnership program in view of promoting the internationalization of Japanese universities and strengthening international partnership with prominent universities abroad.

- Expansion of a double-degree system with major universities abroad
- Institutional exchange of students and faculty members based on university exchange agreements
- Provision of well-organized educational programs in English by Japanese universities (promotion of programs in which students are able to satisfy graduation requirements by taking classes only in English)
- Support for Japanese students wishing to study abroad
- Fall (September) entrance to Japanese universities

**- Improvement of mobility of professors and associate professors**

Efforts will be made for broad introduction of fixed-term and tenure track systems in view of further improving the mobility of professors and associate professors and

building an energetic research environment.

- Support for attracting excellent human resources from abroad

The following efforts will be promoted in view of creating an environment to entice excellent human resources from abroad to Japanese universities.

- Promotion of employing the world's top notch scientists by improving the mobility of professor positions and promoting international solicitation; necessary support to facilitate smooth settling-in of foreign researchers in Japan (aiming at doubling the percentage of foreign nationals by the year 2011)
- Promotion of the "Asian Human Resource Fund" initiative and other initiatives which includes improvement of specialized educational programs through industry-university partnership, advanced Japanese language for business use, business courses to understand Japanese corporate culture, internships at Japanese companies, and support for working at Japanese companies
- Support for foreign residents living in Japan
- Extension of period of stay for foreign workers up to 5 years, upon taking appropriate measures, such as provision of certain requirements for the place of employment of foreign workers, to promote acceptance of highly-skilled foreign workers

- Granting fellowship to excellent students regardless of nationality

Implementation of internationally open selection process with no preference to alumni will be promoted by, for example, conducting selection procedures in English. This will be done with a view to promote internationalization of graduate schools in the true sense. The efforts will be promoted to gather the best brains by granting fellowships to excellent students regardless of their nationality.

### (iii) Establishment of life-long learning system that leads new challenges, utilizing local universities

As more individuals choose their own lifestyle along with the increase in life expectancy, further expansion of the possibility of challenges can be made by injecting new knowledge. Thus, the following measures will be promoted in view of establishing a life-long learning system that meets the needs of "continued education," and utilizing the power of education of local universities to develop human resources in local areas.

- Improvement of opportunities for practical re-learning in local communities by providing practical education programs in cooperation with life-long learning facilities/universities/technical colleges/vocational schools and stakeholders of

local industries

- Support for developing and hiring young engineers working at small- and medium-sized enterprises through partnership between industries and local universities/technical schools/vocational schools; support through lectures and practical training that meets the needs of local industries by utilizing existing school facilities and teachers with the help of senior engineers of companies
- Collaboration of local universities in providing university education and making local contributions and in contributing to human resource development for local needs.

Basic guidelines for the university reform will incorporate items listed above and results of discussions at the Education Rebuilding Council.

#### 4) Growth and international contribution through science and technology of Japan, such as environment and energy

Environment/energy issues such as climate change are among the urgent issues of today, and response to these environmental problems is of extreme importance in aiming to achieve not only economic growth of the world but also sustainable growth.

Particularly in Asia, where remarkable growth has been achieved and strong growth is expected to continue, it is forecasted that energy demand will dramatically rise. Subsequently, demand for measures for environment and energy will grow.

In the meantime, Japan has attained the world's top-level technologies in the high-tech area and the technologies to satisfy highly demanding consumers, represented by those utilizing use clean energy or biomass, energy-saving and resource-saving technologies for production, and IT, nanotechnology, biotechnology; and there is a business opportunity for Japan to take advantage of these competence in developing environmental businesses and realizing innovation.

Emphasizing these strengths and through our technology development and social reform, Japan must realize eco-innovation that technology development and social reform for realizing sustainable industrial systems, infrastructure and living both solve driven by economic growth of the world and of Japan. Japan can achieve this by contributing to solving problems that have global scale constraints, such as those on environment, resources and energy, and become the driving force behind economic growth of world and of Japan by realizing sustainable industrial systems, infrastructure and living.

Through these efforts, Japan should use the world-acclaimed technologies in environment and energy, experience and knowledge to overcome serious pollution issues, as well as abundant human resources with motivation and ability, as an engine for

environment-oriented economic growth and local revitalization. Such revitalization is then presented to Asia and to the world as a Japanese Model for an environment-based country contributing to the development and prosperity of the world under the concerted efforts of various stakeholders.

The following efforts will be made under these concepts.

**(i) Strengthening science and technology diplomacy**

**- Strengthening science and technology in cooperation with developing countries**

To support developing countries for life and health maintenance (water and food issues, infectious diseases), and to provide technological support for economic development and for the issues of environmental technologies closely associated with conservation of ecosystem, a commitment will be made to develop mutual local networks of higher education and research institutions as a local base for cooperation toward joint research and human resources development and support will be given to the development of higher education/research institutions and research facilities and equipment, such as system to dispatch researchers who carry out cooperation activities in developing countries to conduct joint research and human resources development in an integrated manner.

**- Transmission and demonstration of Japan's excellent technologies in science and technology to the world**

- Active provision of Japan's excellent environment-related technologies in accordance with the needs of developing countries: for example, provision of data of advanced earth observation satellites, provision of prediction data on changes in climate and water conditions in the future obtained by the Earth simulator and other computer systems, and provision of disaster prediction
- Support for the demonstration of Japan's prominent technologies to the world in the areas of environment, energy and water, such as reusable energy, water management, resource- and energy saving, capture and storage of carbon dioxide, waste management/3Rs (reduce, reuse, recycle), to be conducted in the most suitable conditions with the participation of industries, and dissemination of Japan's technologies to the world
- Support for the establishment of stable and sustainable production and supply systems tailored to each region, avoiding the competition between food production and biomass production by, for example, developing monitoring technologies of food and biomass resources of the world, developing technology for effective

energy generation from untapped resources, and cultivation of high biomass forage utilizing tropical plants

- International contribution in the form of, for example, technical cooperation utilizing Japan's knowledge and technologies concerning both mitigation and adaptation measures: including capacity development for research on impact on global warming or disaster-risk management in developing countries vulnerable to global warming, technical cooperation including development of human resources concerning adaptation measures, development and dissemination of new harsh-environment resistant varieties in Africa, etc., and stabilization of food supply/demand through greening of the desert
- Undertaking of initiatives for joint projects to promote eco innovation on an international scale, encompassing various areas ranging from technical issues to social systems, on the occasions of the OECD meetings, etc.

**- Support of establishment of environment-conscious systems in Asia, etc.**

Discussions will be undertaken within FY2007 on specific environment/energy–related systems to be introduced and disseminated in Asia as an "Asian Standard," for example, Pollution Prevention Manager system, which was the foundation of the industrial development in Japan. The goal is to support sustainable economic development in developing countries, particularly in Asia and to improve environmental measures.

**- Commitment to the initiative for addressing climate-change issues**

At the bi-lateral summit meeting with China and United States, Japan proposed an issue of climate change as first priority which should be addressed with a top level leadership and agreed to strengthen the bi-lateral cooperation to solve this issue. To foster and proceed this movement, Japan will take initiative by using the various opportunities of international conference, such as summit meeting, proposing an prime minister's initiative "Cool Earth 50," a strategy to address this issue.

**- Strengthening approaches to climate-change issues by environment/energy technologies**

By promoting the activities of the Asia-Pacific Partnership on Clean Development and Climate (APP), in which main countries in Asia and Pacific regions participate, the public-private partnership focusing on energy technology will be built up and regional collaboration to develop, disseminate and transfer clean and efficient technology will be accelerated.

- Developing the world's environmental leaders

In order to give young people of Asia and the world opportunities to learn environmental technologies and environmental policies in Japan so that they can contribute to developing an environment-conscious economy and sustainable society after returning to their home countries, programs to develop environmental leaders will be formulated. This includes the acquisition of degrees from universities and practical experiences at research institutions through cooperation among competent authorities, and it will be done in partnership with international universities and industries under the leadership of the Japanese government.

- Strengthening cooperation in the field of advanced science and technology

Cooperation in the field of science and technology will be actively promoted by making the research activities of universities and public research institutions of Japan open to the world, and by collaboration with various "different" elements, such as the world's top level brains. Particularly, mutual use of advanced research facilities will be promoted by actively making those facilities in Japan open to the world. Acceptance and dispatch of researchers and joint research will also be promoted.

- Strengthening network of science and technology cooperation

Efforts will be made to provide support for international activities and strengthen the network with partner countries by significantly strengthening the functions of science and technology diplomacy of diplomatic establishments abroad, and soliciting and actively utilizing the cooperation of overseas centers of research institutions, including universities.

- Framework for promoting international joint research project

Discussions will be carried out on international and advanced research on the environment by actively making proposals from Japan, such as establishing an international framework to support international joint research projects contributing to solving common global issues.

**(ii) Promotion of measure to nurture environmental business**

- Visualization of environmental values

- Life Cycle Assessment (LCA), which is used to make assessments by quantifying environmental values and Environmental Accounting/Environmental Management Accounting, will be introduced in industry-specific, region-specific and

project-size-specific ways, after improving their reliability and effectiveness. The goal is to promote environment-conscious business management. Examinations about the standardization of Environmental Management Accounting will start.

- In order to develop an environment where products with high environmental values are selected through market systems, assessment methods will be established to provide consumers with understandable information as to how much environmental impact is generated from general merchandise, office products ships and ship equipment at different stages of the product (i.e., production, utilization, and disposal).

**- Strength of the activities of the 3R system, considering whole lifecycle of the product**

To create a new business model useful for raising resource productivity and reducing the burden to the environment, discussions will be carried out to introduce the regulation for restricting the use of resources at each stage of supply-chain of products, such as procurement and processing of natural resources, manufacture of the component, assembly of products and for promoting high quality recycle products whose quality never wanes and to build up the physical distribution systems conducive to recycle resources.

**- Expansion of the top-runner system in accordance with the Act concerning the Rational Use of Energy**

In order to disseminate new environment-conscious products developed by environment/energy technologies, discussions will be held on the expansion of products subject to the top-runner system, and it will be done in line with the Energy-saving Act and further revision of target values.

**- Promotion of dissemination and expansion of renewables, through the comprehensive use of biomass**

In order to create and expand the market of renewables, such as biomass energy and photovoltaic generation, discussions will be undertaken on the dissemination and expansion of renewables using various policy methods. These methods include support for technology development and new business entries to reduce costs.

Particular efforts will be made to establish biomass towns, which are a comprehensive biomass-based system, in order to establish an economic circulation system by continuously utilizing biomass.

- **Expansion of green procurement**

  Aiming to achieve $CO_2$ neutrality in cooperation with public and private sectors in Japan, further effort in the green purchase by government and its further expansion to industry will be sought.

### 5) Promoting Public Awareness

Innovation is a social reform. In order to incessantly generate innovations, it is essential to deepen the understanding of the people—from children to the elderly—about innovation and pave a way to raise their awareness to promote innovation. Thus the following measures will be examined specifically and will then be implemented swiftly.

- Award system
- Educational and campaign activities for people using such occasions as events related to the National Science and Technology Week, etc.

### (2) A long- and medium-term plan for the reform of social systems

New technologies and services that create innovation are not often given a change to spread widely under the conventional systems and rules.

The following efforts will be necessary in applying the achievements of advanced research and development to society. It is also necessary to review the methods and time schedule of the measures listed here on an as-needed basis to accelerate the speed and expand efforts.

#### 1) Creating a society where all can stay healthy throughout life

**(i) Reform of social systems along with the progress of information and telecommunications technology**

Since medical provision is expanding into daily-life activities, social systems need to be developed to respond to the changes (e.g., widely approving the drugs prescribed by clinical check through monitor).

**(ii) Transformation of treatment-based medicine to a preventive and health-promoting healthcare system**

As effects of preventive medicine and health promotion have been scientifically proven, preventive technology has been further developed, and the information infrastructure to use health information has advanced. Thus, the treatment-based medicine needs to be transformed to a preventive and health-promoting healthcare system with an aim to achieve appropriate medical costs.

**(iii) Balance between bioethics/safety and measures to promote medical technologies**

Along with the rapid progress of medical technologies, as in the case of regenerative medicine, the importance of discussions as to how to balance out the issues on bioethics/safety and measures to promote medical technologies will further increase. It is therefore necessary to conduct an in-depth discussion involving the general public and to add new rules when needed.

#### 2) Creating a safe and secure society

**(i) Creating a utilization environment to develop the Intelligent Transport Systems (ITS)**

Creation of a utilization environment, including system standardization and discussions on the necessity of new regulations concerning vehicles and road traffic

**(ii) Creating an environment to promote dissemination of new vehicles**

Revision of existing legal framework and development of rules concerning traffic and land-use to realize independent outdoor activities of robots and unconventional ultra-small vehicles

**(iii) Development of rules to introduce advanced monitoring technologies**

System standardization and development of rules to introduce advanced monitoring technologies using space-based positioning, navigation, and timing technology, such as GPS (Global Positioning System), robot technology, a large sensor network system (technology to create the most appropriate movements based on autonomous information flow, by automatically recognizing various circumstances and environment, including men, objects and their surrounding environment)

**3) Creating a society that embraces diversity in life**

**(i) Revision of systems responding to the extension of a healthy life span**

**- Reform of work style and social security system**

Since elderly people will able to stay healthy and participate in society, the work style of the elderly and social security system need to be reformed in response to the extension of the healthy life span.

**- Activation of human resource exchange among industries, universities and governments**

Necessary discussions will be carried out on a system to increase opportunities for self-realization and improve free career change. The need for such a system is expected to grow due to the extension of a healthy life span. Organizational, personnel and accounting systems will be established with the assumption of constant human resource exchange with external parties in public offices and universities.

**(ii) Establishment of related systems for the full-scale implementation of telework**

The short-term goal is to raise the percentage of teleworkers to 20% by 2010. In order to further increase the percentage of teleworkers to firmly establish the telework system in society, discussions will be made as needed about developing an environment for employment-related systems, such as formulation of guidelines concerning labor management.

**(iii) Vitalization of volunteer activities, social contribution activities and social projects**

The importance of volunteer activities and social projects is expected to grow increasingly prominent from the perspective of provision of effective social services in

cooperation with the public and private sectors. In order to further promote such activities, volunteer opportunities at educational institutions, for example, will be increased and all types of social accountability activities, including those of business entities, will be supported.

### 4) Creating a society that contributes to solving the global issues

#### (i) Promotion of effective measures against global warming

Based upon an prime minister's new initiative "Cool Earth 50," to address the issue of climate change, Japan will propose to endorse a long-term target of cutting global emissions by half from the current level by 2050 as a common goal for the entire world and to achieve this goal, Japan will do the effort to get an consensus among international society about addressing the issues by developing innovative technology toward a low-carbon society. At the same time, excellent "Japanese model" such as 'Satoyama,' an initiative to address environmental issues, which is based upon Japanese traditions and excellent technology, will be transferred to the international society.

- Development of innovative technologies, toward the realization of the technology which could pursue both economic growth and reduction of greenhouse gas emissions, includes the ones such as innovative zero-emissions coal-fired power generation, advanced nuclear power generation with high temperature gas-cooled reactor or small and medium reactors, solar power generation, a fuel cell, next-generation automobiles, or ultra high energy efficiency technology such as hydrogen-reduction technology in iron and steel making process.
- A low-carbon society, which aims at the realization of both affluent life and carbohydrate emission reduction, includes the social and lifestyle reform such as a lifestyle harmonized with nature or forests, efficient public transportation system, and compact city.

#### (ii) Active efforts towards creation of low-carbon society

Discussions will be carried out on various systems to promote the use of natural energies (solar, wind power, geothermal, biomass, etc.) and to establish a low-carbon society, aiming for energy independence in regional units.

Discussions on biomass fuels will be carried out toward the mass production to introduce super-efficient transformation technology of ethanol, to promote the understanding among people, and to check the rules or regulations to hamper the promotion.

**(iii) Communicating the Japanese Perspective**

In order to induce the world to understand Japan more correctly and to gain a well-diversed reputation for the international contributions made by Japan, a full-fledged framework dedicated to communicate the Japanese perspective will be constructed. This could include the launch of a new international video broadcasting for non-Japanese in FY2008. At the same time, utilizing ICTs such as an automatic translation technology, the system will be developed on a step-by-step basis, which enables the multi-lingual information delivery (simultaneous with that in Japanese) of nationwide and local events.

**(iv) Creation of a system to support foreign residents working in Japan**

In order to help Japanese nationals work in various countries for long periods of time, including in developing countries, a support system for improving the working and social environment abroad will be expanded. Discussions will also be promoted about bilateral social security agreement with due consideration to the international mobility of the Japanese people.

**5) Creation of a society open to the world**

**(i) Further promotion of accepting world class highly-skilled foreign workers**

Discussions on a framework for smooth mobility of the best brains across national borders

**(ii) Promotion of international patent strategies/international standardization activities**

In order to realize the world's highest level of expeditious and efficient patent granting, in other words, to eliminate the first action pendency, efforts will be made to reduce the first action pendency by about half (11 months) of the current level by 2013. Also, aiming for realization of the "global patent system" so that one invention can smoothly gain patent protection in the world, international coordination of patent systems and cooperation with governments of other countries and international organizations will be promoted.

In order to promote international cooperation concerning the application of the protection of new varieties of plants, and aiming for the establishment of an integrated system at an international level, unification of examination procedures and registration operations in Asia will be promoted, and development cooperation in identification technology for forage crop cultivars at a level of gene expression will also be propelled.

In order to help the Japanese standard be accepted as an international standard,

efforts will be made to take on the role of the International Chair and the Secretary as often as other western nations and to double the number of proposals on the international standards to the ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) by 2015.

### 6) Common issues

#### (i) Establishment of related systems in response to the advance of cryptographic technologies and personal verification technologies

In response to the spread of such technologies as collection and sensor of fingerprint information, automatic recognition and automatic monitoring by RFID tags, discussions will be conducted on developing explicit rules concerning personal data management, including its necessity, from the perspective of privacy protection.

#### (ii) Discussions on related systems in response to the advance of information search technologies

Appropriate systems need to develop consistently with the issues of the protection of copyright, in order to provide advanced search services along with the progress of the information search technologies by IT.

#### (iii) Developing an environment for full-scale dissemination of ubiquitous network and robots for personal use

In view of the full-scale spread of ubiquitous network, discussions will be conducted on the development of an environment necessary for safe and secure information delivery by protecting privacy.

From the perspective of the general public, the importance of ensuring the safety of robots increases along with progress in the multi-purpose application of robots. Thus the “guidelines for next-generation robot safety” (to be compiled in FY2007) will be appropriately reviewed based on the use of robots and the increase in performance. Specifications concerning the structure and usage of robots will be formulated and the standards concerning building structures and facilities will be reviewed on an as-needed basis.

Along with the establishment of the ubiquitous network and robots as a social infrastructure, discussions will be held on the development of rules concerning future improvement of information security and the use of the ubiquitous network and robots.

**(iv) Formation of public consensus for the dissemination and promotion of new technologies**

In view of ensuring acceptability of general consumers about social application of new technologies and ideas, discussions will be held on whether it is necessary to consider safety when conducting research and development and when commercializing new technologies. Evaluation methods based on scientific evidence will be developed along with a highly transparent management system. Campaign activities will be carried out for public understanding (particularly, production of agricultural and food products using genetically modified technology, and the formation of public consensus about participation in the clinical tests of pharmaceutical products and medical equipment).

**(v) Establishing international rules in the advanced science and technology fields**

International rules will be established involving various countries in the fields of advanced science and technology, such as advanced medical technology, safe nanotechnology and the use of space.

**(vi) Roles and powers of central and local governments, including the regional system**

Under the basic principle of decentralization represented by the slogan of “From Central Government to Local Governments,” the roles of the central government and local governments will be clearly defined. Discussions will be held on the role and powers of the central and local governments, including the regional system, to create an environment that generates innovations originating in local regions in accordance with the characteristics of the region.

**(vii) Continuous revision of regulations**

In view of establishing and maintaining the most advanced environment for the creation of innovation, existing regulations will be examined and periodically reviewed, while considering international trends, including the level of technologies and social conditions in a given age.

## 2. Roadmap for technology innovation strategies

The roadmap for the technology innovation strategy has three tiers: Project for Accelerating the Transfer to Society, Promotion of Field-specific and Strategic Research and Development, and Basic Research. Project for Accelerating the Transfer to Society is meant to show outcomes of technologies by verification with a bird's eye view of the entire process, from basic research to the transfer of science and technology to society. Promotion of Field-specific and Strategic Research and Development is carried out on a selective and concentrated fashion. Basic Research is highly creative and includes challenging activities that generate seeds of innovation.

In order to steadily promote these measures, a budget will be ensured for required research and development activities in line with the 3rd Science and Technology Basic Plan, by eliminating duplication or waste and prioritization through selection and concentration.

### (1) Promotion of projects that accelerate social returns

It is necessary to go through the following processes so that each one can realize the innovation:

- Development of various technological elements and their integration;
- Verification of effectiveness as a social system through verification studies on integrated technology; and
- Establishment of a framework necessary for putting the technology firmly in place.

Thus, as a pioneering model to take initiatives in the future by integrating some technologies that are expected to reach a verification stage in the relatively near future, Japan will promote the Project for Accelerating the Transfer to Society under the leadership of the Council for Science and Technology Policy in cooperation with relevant authorities and the private sector. The goal is to ensure that the speed of transferring outcomes to society is accelerated through verifications.

#### (i) Characteristics of the Project for Accelerating the Transfer to Society

The Project for Accelerating the Transfer to Society shall have the following characteristics:

- **Integration of different fields:** a project that integrates technologies in different fields
- **Public-private cooperation, integration of ministries:** a project that enhances public-private cooperation, partnership of different industries, and integration of ministries
- **System reform:** a project that encompasses system reforms, such as regulation

reform and government procurement

- **Verification of technology as a social system:** a project to launch a verification study to examine the effectiveness as a system within five years (presentation to the general public of the image of changes in lifestyle, work style and society), in consideration of a pioneering model project

### (ii) Procedures of the Project for Accelerating the Transfer to Society

The project will be implemented through the following promotion measures:

- System to promote the project in a centralized manner;
- System to allow competition among several teams over the project adoption;
- Development of a system to carry out a check–and-review from the initial stage (establishment of external evaluation committee, etc.); and
- Implementation of verification studies by selecting a model region; discussions on the experimental use of the special zone system when necessary

### (iii) Projects for Accelerating the Transfer to Society to be launched soon

In order to tangibly make the image of the society described in Chapter 4 into a reality, the following projects will be urgently launched as cases of government-initiated pioneering projects.

We will be developing new projects that satisfy the conditions of ①Characteristics of the Project for Accelerating the Transfer to Society

- Aiming for a “society where all can stay healthy throughout life”
  Realization of medical care that replaces and restores a lost function
- Aiming for “a safe and secure society”
  - Construction of the information and communication system which gives detailed disaster information to each resident, and helps disaster countermeasures
  - Realization of a safe and effective road and traffic system using information and telecommunications technology
- Aiming for “a society with diversified lifestyles”
  Realization of advanced home medicine and home care
- Aiming for “a society contributing to solution of the global issues”
  Comprehensive use of biomass resources which is contributed to addressing the environment and energy issues
- Aiming for “a society open to the world”
  Realization of audio communication technologies that overcome language barriers

### (2) Promotion of strategic research and development in individual fields

In order to appropriately respond to policy issues with limited resources, it is necessary to implement research and development on advanced science and technology in every field in a selective and concentrated manner. Roadmaps on research and development toward the realization of the five images of society described in Chapter 4 are presented in this section. In doing so, Strategically Focused Science and Technology was mainly constructed based on the Promotion Strategies for Prioritized Areas, which was compiled by the Council for Science and Technology Policy in March 2006, toward the realization of the 5 society mentioned above.

To use these roadmaps as a guideline, research and development strategy will be steadily implemented. These roadmaps will be flexibly revised when necessary in accordance with PDCA cycle.

| 1. Long and Healthy Lives | | | | |
|---|---|---|---|---|
| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Life Sciences | Translational and clinical research | | | |
| | | Clinical research and trials for developing new medical care | ・Translational research from basic research to the practical application of treatments and diagnosis for cancer and diabetes mellitus, etc.<br>・Improving clinical research systems in major medical institutions and promoting human resource development (e.g. clinical researchers, biostatsticians) | ・Establishment of new medical system to effectively return the benefit of innovative medical technology to the people<br>・Establishment of new diagnosis and therepy methods to meet the people's needs |
| | | Research on relationship between lifestyles and heredity to elucidate the causes of disease, prevent diseases, and discover drugs | ・Accelarating the screening of drug candidates by imaging technology to discover pharmacodynamics and molecular funcion of drugs<br>・Development of new methods to identify critical disease-related genes and its application to tailor-made preventive/therapeutic treatment | ・Establishment of new medical system to effectively return the benefit of innovative medical technology to the people<br>・Realizing early-diagnitics and advanced therapeutic treatment suitable for the individual's charactaristics |
| | | R&D on the prevention, diagnosis and treatment of major critical diseases (e.g. cancers, immunity and allergic disease, lifestyle-related disease, bone and joint disease, kidney disease, and pancreas disease) | ・Clinical tests of heavy particle radiotherapy for developing new cancer treatment protocols<br>・Research on the genetic and environmental factors of lifestyle-related diseases | ・Establishment of easy and less-invasive methods of early diagnotics for malignant mesothelioma to improve patient's QOL<br>・Establishment of new therapy for super-intractable cancer by utilizing heavy particles<br>・Realization of early-diagnitics and advanced therapeutic treatment suitable for the individual's charactaristics<br>・Ralization of early-diagnosis and advanced therapeutic treatment for critical diseases (e.g. cancer, diabetes, dimentia) by acceleratinig a fusion with nanobiotechnology (by 2020s)<br>・Faster examination by upgraded clinical imaging technology and early detection by the visualization of biofunction |
| | | R&D on the cause and therapy of diseases (e.g. psyco-neurologic disease, sonsory disorder, dimentia, inttractable disease) | ・Establishment of infrastructure arrangement for providing patients with proper therapy options by integrating information on brain science<br>・Development of new suiside intervention methods to decrease the ratio of suicide and recommitment of suicide | ・Establishment of cell therapy and other compliment therapies for neurologic diseases and sensory disorders<br>・Elucidation of brain's recognition function and development process |
| | | R&D to create innovative therapeutic medicine (e.g, regenerative medicine, gene therapy) | ・Environmental arrangement to support the establishment of organ creation and cell therapy<br>・Identification of disease-related genes and elucidation of their functions<br>・Establishment of generic technologies to suport the safety and effectiveness of gene-therapeutic medicines | ・Establishment of regeneration technology for the regeneration of myocardium or blood vessel<br>・Realizing regeneration technology to revive the organ's function (by 2025s) |

| 1. Long and Healthy Lives | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Life Sciences | | Integrated research for promoting bioimaging technology | ・Developing medical devices for less-invasive diagnotics and therapy with over ten times increase in sensitivity<br>・Development of upgraded molecular imaging equipments to detect the functional change of cells with high accuracy, sensitivity, and speed for earlier discovery and diagnosis of tumors | ・Realization of faster examination by upgraded clinical imaging technology and ealy detection by the visualization of biofunction |
| | | R&D for integrated and innovative medical technology by utilizing IT and nanotechnology | ・Discovery and systemization of the principles of life sciences in bio-related informations by utilizing informaton science<br>・Development of manipulation technology by information on brain activity obtained by less-invasive measuring methods manipulation technology<br>・Realization of brain-type information processing technology<br>・Realization of the ultimate brain-machine interface (BMI) that makes objects move by thinking<br>・Technology development for new therapeutic methods by drug delivery system | ・Advancing drug discovery process by accelerating researches on disease mechanism, upgrading diagnosis devices, and improving accuracy in the screening of drug candidates<br>・Realization of less-invasive, easy and fast therapeutic treatment by infomation integration on diagnosis and therapy (by 2025s)<br>・Establishment of early-diagnitics and advanced therapeutic treatment for critical diseases (e.g. cancer, diabetes, dimentia) by acceleratinig a fusion with nanotechnology (by 2020s) |
| | | R&D of diagnostic or thrapeutic machines for enhancement of QOL | ・Upgrading molecular imaging technology for developing new methods to evaluate the reactivity against remedy and drug efficacy, predict the possibility of cancer metastasis, grasp the character of cancer, and diagnose mental diseases<br>・Development and commercialization of medical instruments with higher suitability with human-functions/tissues by utilizing devices, bio-sensors, and other nanotechnologies | ・Realization of faster examination by upgraded clinical imaging technology and ealy detection by the visualization of biofunction<br>・Realization of medical surgery with higher accuracy by pre-surgery planning and image-guided surgery<br>・Establishment of regeneration technology for the regeneration of myocardium or blood vessel<br>・Realization of less-invasive, easy and fast therapeutic treatment by infomation integration on diagnosis and therapy (by 2025s)<br>・Realization of regeneration technology to revive the organ's function |
| | | R&D for the accelaration and efficiency of drug discovery process | ・Accelarating the screening of drug candidates by imaging technology to discover pharmacodynamics and molecular funcion of drugs<br>・Starting disease prediction system by constructing the toxico-genomics database<br>・Constructing disease-related protein database for drug discovery<br>・Development of new vaccines for the diagnosis and therapy of infectious disease, intractable disease, and other crucial diseases to be tackled by government<br>・Development of new model animals for drug discovery | ・Advancing drug discovery process by accelerating researches on disease mechanism, upgrading diagnosis devices, and improving accuracy in the screening of drug candidates<br>・Realization of early-diagnitics and advanced therapeutic treatment for lifestyle-disease and intractable disease suitable for the individual's charactaristics |

| 1. Long and Healthy Lives | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Life Sciences | Targeted therapy and other innovative technologies for cancer therapy | | | |
| | | R&D on the prevention, diagnosis and treatment of cancer | ・Establishment of easy and less-invasive methods of early diagnotics for malignant mesothelioma to improve patient's QOL<br>・Establishment of new therapy for super-intractable cancer by utilizing heavy particles<br>・Realization of upgrading drug discovery system and advancing cancer prevention/early-diagnosis technology in response to the individual's characteristics<br>・Realization of faster examination by upgraded clinical imaging technology and ealy detection by the visualization of biofunction<br>・Realization of early-diagnitics and advanced therapeutic treatment for cancer by acceleratinig a fusion with nanobiotechnology (by 2020s) | |
| | Molecular recapitulation of the genome program | | | |
| | | Elucidating the structure/function/interaction of genome, RNA, proteins, sugar-chains and metabolomes | ・Development of simulation program of cells and living bodies by utlilizing genome analysis data and IT<br>・Analysis and identification of the proteins of crucial diseases for Japanese (hypertension, diabates, cancer, dementia, etc) and construction of disease-related protein database to contributes to R&D for drug discovery<br>・Structual and functional analysys of unanalyzed proteins by technology development to produce, analyze, and control proteins that are important but have ever been difficult to analyze<br>・ Molecular recapitulation of the system of life by analyzing interaction among proteins, sugar chains, metabolomes, etc. | ・Promotion of the practical use of disease/medication-related genomic and protein analysis for targeting drug discovery, and its prompt and effective clinical application to the realization of revolutionary medical care to provide with new preventive treatment and diagnosis based on scientific knowledge |
| | | Elusidating the life's and brain's hardware and softoware by a fusion with IT | ・Delopment of brain-type information processing technology | ・Development of brain-machine interface (BMI) that takes information as a system from brain, decodes in real time, and interacts with IT equipments<br>・Elucidating brain function and its development process to proceed toward the conquest of brain or mental diseases<br>・Development of brain-type computers based on brain's information processing system (by 2030's) |
| | | Elucidating higher control system of brain and immune systems, mental development and communication system, and their disorders | ・ Elucidating brain's recognition function (e.g. brain's functions of recognition, emotion, decision, comunication, behavior, the process of aging)<br>・ Elucidating development process of emotion and sociality<br>・ Establishment of new remedy and diagnosis methods with the knowledge of higher control system of immunity | ・ Elucidating brain's function of emotion, recognition and mental disease control<br>・ Establishment of new immunotherapy for inmmnological/alergic disease control |

| 1. Long and Healthy Lives | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | World's leading core robot technologies supporting life at home and in town | | | |
| | | Robots supporting life at home and in town | ・Establishment of basis for common platform technologies such as structured environmental information technology.<br>・Establishment of robot's communication technology.<br>・Realization of robots that support human activities at public space and institution. | ・Installation of multifuntional robots supporting life at home and in town (e.g., robots that can cleanse, wash, and help meals and baths) (by about 2025). |
| | Utilization technologies of ubiquitous networks to supplement human ability and to support human life | | | |
| | | Development of advanced ubiquitous devices | ・Creation of basic sensing device technologies for realizing useful services including health and medical system for the safe and secure society. | ・Creation of basic sensing device technologies for making advanced useful services including health and medical systems for the safe and secure society. |
| | | Ubiquitous security platform | ・Realization of the system that automatically, effeciently controls the medical information system, and provides informarion such as danger inherent to each person in the hospital, by the secure information system for safety and individual privacy protection. | |
| | Next-generation network technologies that can transfer the huge amount of information instantaneously, and can be used conveniently and comfortably, by every one | | | |
| | | Ubiquitous mobility by wireless networks | ・Realization of the environment where terminals and equipments are connected to networks and necessary information are obtained when necessary.<br>・Realization of technologies that enable us to distribute necessary information continuously under many kinds of situation.<br>・Realization of ubiquitous network environment by development of technologies in unused frequency bands and by upgrading technologies of effective utlization of frequencies. | |
| | | Fusion of technical challenges | ・Contirbution of networks to medical services (remote medical service/ 24-hour monitoring in medical service).<br>・Realization of the environment where terminals and equipments are connected to networks and necessary information are obtained when necessary. | ・Realization of sophisticated information processing and transmission technologies with ultra-low energy (by about 2025). |

| 1. Long and Healthy Lives | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | Security technologies that realize the safest and securest IT society in the world | | | |
| | | Sophistication of information security technologies. | ・Technology developments for preventing or minimizing damages caused by unknown threat in information systems, software or networks. | ・Minimizing ratio for people who feel fear of utilizing IT technology. |
| | | Management research that conpensates technology and creates more secure infrastructure | ・Technology developments for preventing or minimizing damages caused by unknown threat in information systems, software or networks. | ・Minimizing ratio for people who feel fear of utilizing IT technology. |
| Nanotechnology /Materials | Cutting-edge nano-bio and medical technologies that aim at the realization and integration of very early diagnosis and less invasive treatment. | | ・Development of equipment and treatment for less invasive diagnosis fully using nanotechnology and MEMS technology.<br>・Development of equipment to measure genetic information with high sensitivity and high efficiency. | ・Establishment of management systems to prevent environmental risk.<br>・Development of hazardous property evaluation chip for chemical substances, etc. |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Life Sciences | Production and supply of safe and foods with international competitiveness | | | |
| | | Increasing plant's productivity by the systematic understanding of plant's metabolism, physiology, and its environment adoptability | ・Elucidating metabolism and biochemistry of agricultural animals/plants/microorganisms and their adoptability to environment | ・Identifying useful genes and metabolomes of agricultural plants by analysing their growth, morphogenesis and response systems to environment |
| | | Genome research for foods and environment | ・Application of animal function to the creation of model animals and technology development to produce useful meterials | ・Development of genomic breeding technology for faster introduction of useful characters<br>・Establishment of technologies for producing synthetic resin, surfactant, and other chemicals by utilizing microorganism function<br>・Establishment of technologies to produce industrial/medical/chemical materials by utlilizing plant's function |
| | | Technology development for stable production and provision of high-quality foods | ・Technology dvelopment to increase the productivity of agriculture, forestry, and fishing by utilizing robotics and IT<br>・Technology development and its commercialization for the production and provision of safe and high-quality foods in high demand<br>・Establishment of technologies to produce functional foods by promoting nutrition science and nutrigenomics useful for the prevention of life-style diseases and health maintainance | ・Establishment of technologies for the stable production and provision of high-quality foods by utilizing high-techs<br>・Technology development of GM plants suitable for developing countries |
| | | R&D of functional foods based on the scientific evaluation on safety and efficiency | ・Development of highly-functional foods assured by human tests<br>・Establishment of new scientific methods to evaluate the influence of nutrient components on human body by utilizing gene information<br>・Technology development for the functionality assesment of foods based on neutrigenomics (e.g. tools, databases)<br>・Establishment of technology system for developing scientifically functional foods in high demand (e.g. tiredness, stress, alergy) | ・Establishment of technologies to procudce functional foods based on scientific evaluation in combination with medical science |
| | | R&D for food safety and consumer trust | ・Commercialization of fast and sensitive examination methods for BSE and food poisoning<br>・Technology development to increase credibility on the process of food production (e.g. food polution control technology, risk-reducing technology, traceability)<br>・Technology development to identify the cultivar of crops and inspect GM foods | ・Establishment of new risk assesment methods for food safety with high credibility and transparancy based on science<br>・Development of new methods to assess the influence of newly-developed GM crops on natural environment<br>・Establishment of new risk management system for assuring safety in the process of agricultural production |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Life Sciences | | Translational research from basic research to the commercialization of food production | ・Technology development to comercialize high-quality/productivity agricultural products<br>・Development of agricultural materials for medical use | ・Development of high-quality/productivity agricultural products/foods and agricultural materials for medical use by utilizing gene recombinant technology |
| Information and Communications | Development of the world's leading "Next Generation Super Computer" for science & technologies | | | |
| | | Development of the Super Computer at the world's top level for leading science and technology | ・Full operation of the Super Computer with the world's top-level calculation speed (by about 2011).<br>・Realization of simulation enabling innovative design of new medicine (by about 2012). | ・Continuing development program of world's leading Super Computers and promotion of applying component technologies to high performance computers and information appliances (later than about 2012). |
| | Super-minute, low-power, design and processing technologies to go through global competition of next generation semiconductor development | | | |
| | | Hyper-fine process technologies for CMOS-LSI | ・Establishment of the process and material technologies for semiconductor devices that enable the refinement below 45-nm-width level, including high dielectric materials, insulating interlayers of 2.1 dieletcric constants, thin films CVD, EUV lithography's light source and mask, and multilayer (12 layers) wiring. | ・Restructuring the semiconductor manufacturing industry through joint development of basic technologies at an industrialization stage. Optimum arrangement of management resource in each enterprise and new business model creation. |
| | | Innovative technologies for assisting design and development, that overcome present technology saturation (from simple devices to LSI and modules). | ・Realization of high speed and low power devices that enable the refinement below 45-nm-width level, including system LSI design over 44 million gates, 98% realization of introducing standard process, and low power and high-efficient semiconductor application chips. | ・Realization of energy-saving IT utilization, by high-efficient, functional device and design technologies. |
| | | Platform for intellectual property rights or efficient use/reuse of design resources | ・Realization of high speed and low power consumption devices that enable the refinement below 45-nm-width level, including DFM (design for manufacturing) that enables on-process tests, and automatically repair technologies in logic circuits. | ・Realization of design technologies, including power devices, high frequency devices, superconducting devices, and high-performance processor chips. |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | Core technologies for displays, storages and super-high-speed devices to be at the top-level of the world | | | |
| | | New storage technologies (High-performance non-volatilization memory and advanced storage technology) | ・Realization of large capacity, high speed and low power gigabit-class memory and terabit-class storage such as 32 - 64 gigabits class flash memory and super-gigabit class M-RAM. | |
| | | Future devices (advanced optical device, post-silicon device, MEMS application, superconducting devices such as the single flux quantum circuits, and sensors, etc.) | ・Realization of low power devices using superconductivity.<br>・Realization of optical switching device of the 10Tb/s communication traffic.<br>・Realization of the high-efficient inverter by the 10W/cm$^3$-grade power devices.<br>・Realization of the high frequency device of 350GHz class. | ・Realization of high-efficient, functional devices, including power devices, high frequency devices, superconducting devices, and high-performance processor chips.<br>・Creation of basic technologies for sensing devices indispensable for natural and artificial environment monitoring, intelligent traffic system, and traceability of food distribution.<br>・Realization of stable all-optical communication networks with ultra-low power consumption at the increasing communication traffic. |
| | World's leading core robot technologies supporting life at home and in town | | | |
| | | Robots for safty and security | ・Development of integrated medical information systems (robots) for diagnosis and treatment with low pain and damage to human.<br>・Development of robots collecting information at the spot of disasters such as earthquake.<br>・Development of robots keeping an eye on children at the street. | ・Development of life-rescueing-robots at the spot of disasters including earthquake or fire and terrorism by biological or chemical weapons (by about 2025). |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | Software-development supporting technologies aiming at the world standard | | | |
| | | Higher-reliable, safer, and more secured embedded software development technology | ・Establishments of embedded software development methodologies by formalizing the know-how of the design and development method and adjusting theoretical method to the real systems. | |
| | Next-generation network technologies that can transfer the huge amount of information instantaneously, and can be used conveniently and comfortably, by every one | | | |
| | | Dynamic-network that can provide best environment for user requirements | ・Development of network technologies that enable user to obtain necessary information freely with the optimum environment and quality.<br>・Development of sophisticated authentication technologies in time-location information and transmission technologies. | ・Realization of network technologies and environment where users can utilize networks freely and the networks support various kinds of activities of people.<br>・Realization of ubiquitous information society where time-location information can be utilized with high accuracy and reliability. |
| | | Cooperative control of among 10 billions terminals | ・Realization of cooperative control among over 10 billions terminals (RF ID tags, sensors, and home informative electronics), and utilization of recognition results of real world by connecting things one by one. | |
| | | Dependable secure-networks that adapt to user's requirements | ・Development of autonomous reconstruction technologies that autonomically recover communication routes broken down by accidents or disasters, address obtaining technologies in accordance with network structure, and detours reservation technologies. | ・Realization of quantum communication networks that provide high capacity and security (by about 2030). |
| | Utilization technologies of ubiquitous networks to supplement human ability and to support human life | | | |
| | | Ubiquitous network platform to asist creative life | ・Realization of high-speed and safe platform that makes the global traceability by RFID tags.<br>・Establishment of the integrated evaluation technology of the environmental loads and the function / benefit of social systems. | ・Popularization of the social infrastructure where anyone can utilize, at any time, at anywhere, necessary information for the safe and comfortable living including position, geographic information, migration pathway, means of transportation, and the destination. |
| | | Real world recognition technology | ・Realization of the cooperative control among more than 10 billion terminals including RFID tags, sensors, and home informative appliances.<br>・Realization of advanced utilization of RFID tags and sensor networks, etc. for safety ensuring of the child in the school zone and so on. | ・Development of the integrated sensing technology that rapidly and accurately detects and transmits them quickly danger and threat to the social safety and security including natural disaster, and the man-caused damage. |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | | Ubiquitous-oriented network development | ・Realization of seamless traceability systems covering production, distribution and consumption, that utilize ubiquitous network technologies such as RFID tags. | |
| | | Development of advanced ubiquitous devices | ・Strengthening industrial competitiveness and realizing the ubiquitous network society by distributing the durable RFID tags that comply with the international standard. | ・Creation of basic technologies for sensing devices indispensable for natural/artificial environment monitoring, intelligent transport system, and the traceability of food distribution. |
| | | Ubiquitous security platform | ・Realization of the environment where the home informative appliances connect to the network, communicate in and out of the home, and operate cooperatively.<br>・Realization of the system that automatically, efficiently controls the traceability of food production and distribution, and provides danger of the food, by the secure information system for safety and individual privacy protection. | |
| | Security technologies that realize the safest and securest IT society in the world | | | |
| | | Sophistication of information security-oriented technologies. | ・Technology developments for preventing or minimizing damages caused by unknown threat in information systems, software or networks. | ・Minimizing ratio for IT-related defect on infrastructure. |
| | | Management research that conpensates technology and creates more secure infrastructure | ・Technology developments for preventing or minimizing damages caused by unknown threat in information systems, software or networks. | ・Minimizing ratio for IT-related defect on infrastructure. |

| 2. A Safe and Secure Society | | | |
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| Strategically prioritized S&T areas | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Environmental Sciences | World-leading risk assessment and risk management technology; evaluation of the novel materials and international corporation. | ・Establishment of international strategies for the monitoring system and the management of toxic metals and other international initiative based on the international activities for regulation of chemical substances by UNEP, etc..<br>・New Methods for predicting a risk using toxicogenomics and QSAR (quatitative structure-activity relationship).<br>・Technology suppressing cadmium absorption and storage in rice in accordance with the CODEX standard.<br>・Practical use and generalization of technology for removing cadmium form the paddy field.<br>・Development of basic technology for risk assessment of the pesticide including the environmental transport in atmosphere.<br>・Development of transport model of POPs (persistent organic pollutants) in atmosphere and technologies for the regulation based on the POPs treaty.<br>・Characterization of nanoparticle and establishment of their risk assessment and management technology. | ・Minimization of human health risk by the chemical substance.<br>・Contribution to international regulation and cooperation for the prevention of the environmental pollution, etc., by active participitation to international cooporation for controlling toxic metal in UNEP, etc.. .<br>・Establishment of conventional technology for countermeasure to cadmium in main crops in accordance with the CODEX standard.<br>・Development and practical use of effective management technology based on risk assessment of the pesticide in the atmosphere and presentation of remedy to multiple chemical sensitivity, etc.. |
| | Science and technology for proper popularization of the risk management of chemical substance by humanity socioscientific approach. | ・Development of socioeconomical analysis nethod for the risk trade-off.<br>・Proposal of risk communication based on analysis of its current state. | ・Presentation of materials for scientific judgment based on the comparison of different kind of risks, through cost-benefit analysis of health-improvement effect. |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Nanotechnology/Materials | Innovative nanotechnology and materials technology that support safety and security of life. | | ・Development of environmental purification materials with small environmental burden, recyclable materials and innovative structural materials that can survive big earthquakes, and improvement of the technologies to inspect, evaluate, and utilize those materials.<br>・Elucidation of physicochemical property and intestinal absorption properties of nanoparticles of foods., etc. | ・Development of environmental purification materials with small environmental burden, recyclable materials, innovative structural materials and incombustible or refractory materials that can survive the disaster such as the earthquake and the fire, and improvement of the technologies to inspect, evaluate, and utilize those materials.<br>・Development of technology to stably include functional ingredients in food without affecting flavor, and the development of the technology of design, manufacturing and application of micro- and nano-particle for the purpose of the efficient absorption of functional ingredient, etc. |
| | R & D for the social acceptance of the nanotechnology. | | ・Establishment of evaluation method and management method for properties and risks of nanoparticles. | ・Establishment of evaluation method and management method for properties and risks of nanoparticles. |
| Social Infrastructure | Land monitoring and management for disaster mitigation | | | |
| | | Advanced earthquake observation technology | ・Construction of the network system to observe the Tonankai Earthquake and tsunami<br>・Improvement in accuracy on prediction of earquakes caused by plate subduction dynamics, etc.<br>・Improvement in accuracy on prediction of earthquakes caused by fault activity, etc.<br>・Improvement of the network and data center to observe earthquakes<br>・Development of non-contact type displacement measurement systems and detection technology for the earth crust change with time, etc. in order to improve the observation and analysis of earthquakes<br>・Reconstruction of the centralized data processing system for supersensitive seismograph data<br>・Upgrading of the GPS continuous observation network (GEONET), and investigation on mechanisms of earthquake and volcanic activities to improve their predictions<br>・Execution of large-scale simulations to investige the earthquake occurrence mechanism in which rock fractures grow to plate destruction, etc.<br>・Construction of the earthquake hazard station which integrates strong-motion earthquake observation, underground structure modeling, and advanced simulations<br>・Development of numerical models of earthquake crust acitivity, and simulation model for its prediction<br>・Improvement of the GIS database on active faults, etc.<br>・Accurate observation of seismic activity in sea area<br>・Inprovement of the Multi-disciplinary Ocean Bottom Observation System to observe marine earthquake in real-time, etc. | ・Construction of the network system to observe the Nankai earthquake and tsunami<br>・Construction of the Asia-Pacific seismographic network<br>・Improvement in accuracy of prediction on near-field earthquakes under the capital area, etc. |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | | Technology to use disaster monitoring satellites | ・Verification of the high accuracy positioning experiment system using the Quasi-Zenith satellite system, Advanced Land Observing Satellite (ALOS), etc.<br>・Developement of a concept and elemental technology for an unmanned aircraft system to collect and provide disaster information<br>・Development of land monitoring and advanced image processing technologies for disaster mitigation | ・Construction of a satellite monitoring and observating system<br>・Collection and provision of on-site accident information by the unmanned aircraft system |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | | Technology to quickly promote disaster mitigation | ・Execution of full scale vibration experiements for various structures to improve understanding the relationship between load applied by earthquakes and deformation in the structures<br>・Development of economical and effective repairs and reinforcement for highway bridges, river structures, etc.<br>・Development of erosion-free and earthquake-proof farm pond structure using geomembrane,etc.<br>・Development of river flow forecasting and flood prediction in nearly real-time<br>・Development of water management such as timely refuge, flexible dam management, etc.<br>・Development of a structural simulation to track ulimate states with high accuracy<br>・Evaluation of damping devices in a tall building, etc.<br>・Evaluation of long-period vibration effect on harbor and airport facilities<br>・Development of practicable and reasonable seismic retrofits for residential houses and a<br>・Development of construction systems with automatic drilling equipment<br>・Upgrading automated and measuring function of construction equipments to improve safety and productivity in construction site<br>・Practical use of nondestructive examinations of frequency and damping in order to investigate structures<br>・Establishment of structural analysis with 10s centi-meter accuracy for railway structures with variable ground conditions<br>・Development of a three-dimensional tsunami numerical model and development of a three-dimensional tsunami simulator to estimate tsunami damage<br>・Development of a evacuation simulator for tsunami and evaluation of disaster mitigation for coastal zone facilities.<br>・Development of a retrofit standard on floating tanks, based on experiments of floating roofs in real scale<br>・For landslide disaster, improvement of prediction, and real-time damage estimation, data accumulation of large-scale experiments, and verification of numerical models | ・Proposal of design and construction methods of highily earthquake-resistant structures<br>・Improvement of earthquake-resistant designs to cope with uncertainty in seismic load estimation<br>・Development of design and construction methods on durability-enhanced water facilities<br>・Development of earthquake response simulation in virtual space with a super computer<br>・Development of upgrading technology for high-rise buildings, etc.<br>・Advancement of measurement and automation in cnstrution, structuralization of environmental information, and realization of construction with information technology such as automatic construction robots<br>・Promotion of disaster prevention countermeasures by facilitating mutual understanding between local residents and authorities using simulations<br>・Improvement of outdoor tank safety against long-period seismic vibration using the retrofit to be developed based on the vibration experiments for floating roofs |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | | Integrated management for land preservation | ・Dynamic prediction for the whole quicksand system<br>・Use of the soil generated in construction for construction materials<br>・Development of measuring technology for microorganism, etc. in environmental water and sewage, and understanding of water pollution<br>・Development of indicators for land maintenance function by developing effect evaluating models for water-retentive of soil, etc. in a watershed category from forests to farmland and cities<br>・Construction of water supply and quality models to evaluate soundness of the hydrologic cycle<br>・Development of resource utilization method for maintenance, recovery and improvement of the circulatory system<br>・Evaluation of the runoff load of nutritive salts from upstreams, and the dynamic phase in lower current areas<br>・Investigation, analysis, and evaluation for river ecosystem and biodiversity<br>・Development of environmental evaluating technology for the integrated effect of natural regeneration from river basin to coastal zone<br>・Monitoring of water interception sheets for solid waste disposal sites of sea-based type, etc.<br>・Understanding of the mechanism and development of extension and diffusion in the synoptic-scale<br>・Grasp of the effect of climatic variations, etc. on transition of land utilization, etc. and proposal of load use alternatives when its condition changes | ・Establishment of quantitative prediction of soil and sand transfer for the whole watershed system.<br>・Development of soil and sand management to preserve land from erosion, etc., and also to decrease unnecessary deposite of silt<br>・Development of an information collecting system for nutritive salt in the watershed and a watershed database system<br>・Quantitative determination of farmland and forest management goals in the watershed considering geology, soil and weather conditions.<br>・Development of hydrologic cycle system management which includes resource use, aqueous environment maintenance, cooperation of upper and down stream facilities in water use, etc.<br>・Determination of watershed management scenarios for nutritive salt drain considering regional economy.<br>・Development of a management system to maintain and create natural environment for urban areas including human activity, unit water system areas, and coastal zones |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | | Disaster mitigation technology featuring social science | ・Establishment of snow and ice disaster prediction in a few days advance with space resolution of about one square kilo meter<br>・Development of advanced numerical models for regional precipitation prediction<br>・Establishment of more accurate prediction of typhoon and local heavy rain in 72 hours advance by completing the simulation code integrating non-static force, whole globe, region, atmosphere, ocean and land plane elements<br>・Mechanism elucidation and prediction of local and remarkable phenomena such as urban local heavy rains<br>・Development of a real-time wave observating information system<br>・Estimation of landslide disaster occurrence probability caused by heavy rain, earthquake, etc.<br>・Development of predicting models, laser geomorphic analysis, and the labor saving type three-dimensional electrical search method for gravel flows caused by mountain decay, landslide etc.<br>・Improvement of weak point detection of embankment with the advanced integrated geophysical exploration<br>・Proposal of effective and economical flood countermeasures<br>・Development of integrated evaluation for a safety standard of various dangerous facilities<br>・Development of fundamental technology on safety m | ・Development of prediction for snow and ice disaster with 1 kilo meter space resolution to create a snowstorm and avalanche hazard map<br>・Establishment of more accurate prediction for urban local heavy rain and its damage<br>・Development of time and place prediction for landslide disaster<br>・Development of a selecting and site planning method of disaster management facilities using underground structure monitoring<br>・Safety evaluation of steel work facilities and establishment and practical application of their safety evaluation technology |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | New technology to support on-site activities for rescue and damage control | | | |
| | | Technology for reinforcement of on-site rescue efforts | ・Evaluation of effect of natural disasters and terrorisms, etc. on international traffic, and construction of a risk management system for international traffic infrastructure<br>・Development of an emergency and alternative transportation support system<br>・Development of the advanced saving equipment to accelerate rescue operations in fires<br>・Development of quick exploration for survivors hidden in debris<br>・Establishment of evaluation of fire-fighting-protective clothing with nanotechnology for heat resistance, comfortability, kinematical performance, etc.<br>・Development of a support and communication network system for national and local authority to support effective disaster prevention in a large-scale earthquake, etc.<br>・Understanding the fires in special facilities, environment and causes, and establishment of measures to extinguish them<br>・Development of evaluating technology of new hazardous materials and chemical substances to elucidate their risk of fire and explosion<br>・Development of a route optimizating and volume estimating system for the land and sea transportation considering support goods estimation for disaster situation<br>・Construction of a standard crisis management system to manage organizations facing disasters<br>・Rapid improvement of disaster prevention by the cooperation of local authorities, universities, research institutes, etc.<br>・Development of a disaster risk evaluating system by integrating hazard and risk infromation provided by research institutes and municipalities<br>・Execution of full scale vibration experiments to establish a stratergy for an earthquake-proof medical system, composed of man-machine interface, including building, lifeline, medical instrument, and human beings<br>・Development of an economical tunnel structure design for shield method considering ground property of deep underground | ・Construction of a risk management system of the international traffic infrastracture to drastically reduce various risk. and to ensure the international reliability<br>・Practical application of extinguishing methods for special fires, etc.<br>・Practical application of fire fighter support equipments to enhance safety and/or to reduce load |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | | On-site detechtion technology of hazardous materials | ・Development of detection technology of new explosives<br>・Development of on-site detection technology of chemical warfare agents and biological toxins<br>・Development of detection technology of a pathogenic organism of CDC category AB<br>・Development of real-time detection equipment of concealed hazardous materials in containers | ・Development of quick detection technology in public facilities and/or border contols<br>・Development of on-site detection sysytems of chemical warfare agents and biological toxins in survice<br>・Development of information security systems to gather, fuse and analyze about chemical terrorism |
| | | Crime prevention technology | ・Improvement of investigation support technology to use the criminal profiling and/or GIS<br>・Development of a facial indetification model of criminals and/or suspects by physiognomic comparison featuring a 3-D face database<br>・Development of DNA profiling systems<br>・Identification of concealed drug and explosives by means of the THz wave technology<br>・Development of security technology for children in school and/or school zones | ・Development of new crime prevention technology sytems<br>・Development of non-destructive detection equipment for concealed drug and/or explosives<br>・Development of new technology for child position conformation, suspicious character recognition, and hazardous material detection |
| Social Infrastructure | | Renewal technology of social capital and city coping with large-scale renewal needs, population decline, and aging society | | |
| | | Innovative technology of social capital management | ・Development of new technology for inspection, diagnosis and the prediction of deterioration<br>・Development of technology and management for building perfomance using objective indicators<br>・Development of new materials to reduce life cycle cost (LCC) , and development of tools to determine the optimum repair time and methods<br>・Development of construction system which increases earthquake resistance and high variability, and the development of evaluation and confirmation method which enables the improvement in the function of existing buildings etc.<br>・Survey on actual situation of sewerage management, factorial analysis of maintenance, and development of evaluation indicator and non-destructive method to estimate damage and deterioration | ・Sophistication of inspectng method with sensors etc., and development of preventive maintenance and management method to improve facility safety<br>・Development of technology which ensures structural performance and optimizes life cycle cost<br>・Establishment of efficient maintenance and management method for sewage pipe facilities based on objective business indicators |

| 2. A Safe and Secure Society | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastructure | | Renewal technology of urban environment | ・Development of evaluating method of region planning and building design with respect to crime prevention<br>・Development of safety and security database including accident information<br>・Development of planning and design guideline of buildings and regions with comprehensive safety and security functions, using the Universal Design approach | |
| | New traffic and transport system technology which fits for future society | | | |
| | | Advanced, preventive safety technology for traffic and transportation | ・Technological demonstration of low-cost, domestic aeronautical electronic equipment realizing high-density, all-weather flight operation system<br>・Development of conflict detection method with downlinked aircraft parameter, and the technology which effectively offers various information to pilots and flight operators<br>・Demonstrative experiment of driving safety support systems (DSSS) in the public road of specified areas in co-operation with government and private organization, and quantitative evaluation of DSSS on effect of reduction of traffic accidents<br>・Development of system which detects driver's physical and mental condition during driving and judges the deviation from the normal operation, and development of an appropriate driving support system<br>・Experimental examination of relation between the mechanism of traffic accidents and human error with the environment of road and roadside, and proposal of effective countermeasures for the prevention of accidents etc.<br>・Development of evaluation system for road traffic environment based on knowledge and jud | ・Completion of safe flight system which enables solitary-island commuter and emergency flights, etc. even at bad weather<br>・Development of technology which properly maintains separation between aircrafts<br>・Nationwide development of driving safety support system, especially in the area where traffic accidents frequently happen |
| Frontier | Enhancement of satellite technology for high reliability and sophiscated function | | | |
| | | Fundamental satellite technology for disaster countermeasure and crisis management | ・Execution of demonstrative experiments of the disaster countermeasure technology using satellite communication network, and the development of satellite communication technology for mobile phones | |

| 3. Society with Diverse Work Styles | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | Development of the world's leading "Next Generation Super Computer" for science & technologies | | | |
| | | Technologies for obtaining required information at proper cost by accessing networks | ・Preparation and utilization of the intellectual infrastructure at the world's top level to consider user's convenience. | |
| | Development of the highly-talented human resources who play key roles in the next generation information and communications technology | | | |
| | | Development of creative highly-talented human resources | ・Distribution of assisting creative technologies for visual contents.<br>・Realizing automatic accumulation and storing technologies for know-hows and knowledges in contents creation, and technologies for analysis and making rules of them. | |
| | | Establishment of the next generation open-architechture and its development basis that enables problem-solving, internationally competitive international services | ・Establishing human resource development systems for leading business leaders who have professional skills required for world's leading software engineers and can quickly response to social and changes. | |
| | Core technologies for displays, storages and super-high-speed devices to be at the top-level of the world | | | |
| | | Communication and network devices | ・Realization of optical switching device for the 10Tb/s class communication traffic. | ・Realization of energy-saving IT utilization, by high-efficient network equipments, devices, and functional devices utilizing electrical and optical technologies.<br>・Realization of stable all-optical communication networks with ultra-low power consumption when communication traffic increases more and more. |
| | World's leading core robot technologies supporting life at home and in town | | | |
| | | Robots supporting life at home and in town | ・Establishment of basis for common platform technologies such as structured environmental information technology.<br>・Establishment of robot's communication technology.<br>・Realization of robots that support human activities at public space and institution. | ・Installation of multifuntional robots supporting life at home and in town (e.g., robots that can cleanse, wash, and help meals and baths) (by about 2025). |
| | | Robots for safe and comfortable | ・Development of transfer systems enabling to move on the road and in the park easily. | ・Realization of transfer systems moving on the road and in the park easily. |

| 3. Society with Diverse Work Styles | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | | Communication robots that provide smooth and intuitional coversation | ・Establishment of basics of robot technology as human interface at the operation of various instruments. | ・Realization of robots as friendly human interface at the operation of various equipments. |
| | | RT system cooperated integration technology | ・Realization of robots supporting human motion and work by their own control of cleaning, guarding, guiding, checking or conveying at public space and institution.<br>・Establishing of basics of common platform technologies. | ・Establishment of common platform technology and distributing it toward the world.<br>・Realization of robots alternative to all sorts of service workers. |
| | | Sophisticated technologies of RT module | ・Establishment of basis of common platform technologies including high performance viewing systems and manipulators.<br>・Development of basic element technologies and system including sophisticated recognition and control of voice and image. | ・Accelaration of robots' development by establishment and distribution of common platform technologies including highly reliable viewing systems and manipulators with high performance. |
| | | Interaction technologies between human and robot (science and technology at human-robot interface) | ・Establishment of safe contact technologies between robots and humans. | ・Realization of human-friendly communication technologies by robots. |
| | Software-development supporting technologies aiming at the world standard | | | |
| | | Higher-reliable, safer, and more secure embedded software development technology | ・Establishments of embedded software development methodologies by formalizing the know-how of the design and development method and adjusting theoretical method to the real systems. | |
| | Content creation technologies and information utilizing technologies that enable us to share emotion with people all over the world | | | |
| | | Realization of multi-international super communication | ・Establishment of non-verval communication recognition technology.<br>・Establishment of multi-language speech recognition-synthesis technology, and natural language semantics analysis technology. | ・Development of user friendly human interface for multi-language speech and so on.<br>・Realization of standard-conversation-level multi-language imterpretation. |

| 3. Society with Diverse Work Styles | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | | Realization of brain-based "enhanced" human interface | ・Establishment of basic technology of brain data decoding analysys for brain information and communication. | ・ Development of primitive communication system using brain information. |
| | Next-generation network technologies that can transfer the huge amount of information instantaneously, and can be used conveniently and comfortably, by every one | | | |
| | | High-speed, capacity, and low-power network that can transmit super high-quality visual contents flexibly | ・Establishment of technologies toward realization of photo-electronic routers with 100 Tb/s class.<br>・Establishment of control/management technologies of photonic paths.<br>・Establishment of assurance technologies of links. | ・Realization of stable all-optical communication networks with the ultra-low power even in communication traffic that increases more and more. |
| | | Information communication networks that enable wide users to utilize them easily | ・Construction of service infrastructure for selecting/coordinating several services freely among millions of services including one-time application of automatically coordinating number of administrative procedures. | |
| | Utilization technologies of ubiquitous networks to supplement human ability and to support human life | | | |
| | | Real world recognition technology | ・Establishment of elemental technologies including control and management techniques for sensor networks, and management of real-time huge amount of data. | |
| Social Infrastracture | Renewal technology of social capital and city coping with large-scale renewal needs, population decline, and aging society | | | |
| | | Renewal technology of urban environment | ・Development of prediction and evaluation of depopulation impact on city activities<br>・Development of building renovation methods etc.<br>・Development of quantification methods of the efficiency and effect of regional planning | ・Development of basic information system for urban restructuring design<br>・Development of effective and efficient manegement methods of public facilities from the viewponit of regional management |

| 3. Society with Diverse Work Styles | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Social Infrastracture | New traffic and transport system technology which fits for future society | | | |
| | | Domestic production technology of aircraft satisfying new demand | ・Development of technology for fuel consumption reduction by 20%, direct operating cost reduction by 10 to 20%, etc. compared with those of the existing airplanes, and demonstration of the technology with experimental models<br>・Development of engines to reduce fuel consumption and CO2 exhaust by 10% to those of exsting models, and to reduce noise by 20 dB against the current ICAO regulation, and NOx reduction by 50% to those of existing engines<br>・Development of advanced technology of low-cost composite materials and aerodynamic optimization, etc., and application to the practical design<br>・Development of an airframe design to reduce the sonic boom of supersonic transport by half<br>・Establishment of basic structural technology at the level of laboratory material test considering economical and environmental aspects, etc.<br>・Development of noise reduction and all-weather-flight technology etc. for rotatorcrafts<br>・Development of elemental technology of V/STOL aircraft<br>・Establishment of basic technology on carbon fiber composite materials at the level of laboratory material test<br>・Establishment of aircraft equipment technology such as flight control system and electronic-control actuator system | ・Development and deployment of the first civilian jet plane and engine to which domestic companies mainly contribute<br>・Acquisition of advanced technology for Japan to independently participate in the international joint development of the supersonic transport<br>・Development of Japan-originated advanced technology on the local use type aircraft<br>・Application of elemental technologies such as the developed composite materials and systems to the machinery and material of next principal aircrafts |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
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| Strategically prioritized S&T areas | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Life Sciences | Emerging and re-emerging infectious diseases | | |
| | R&D for the prevention, diagnosis, and remedy of infectious disease | ・Realization of revolutionary medical care by R&D on new dianosis/remedy methods for infectious diease, intracable disease, and other critical diseases<br>・Building domestic and international networks for rapid information-gathering/shareing on infectious disease | ・Development of new methods for the prevention, diagnosis and therapy of emerging and re-emerging infectious diseases to prepare proper health cares for the nation<br>・Technology development for the prevention or easy and quick diagnosis of BSE, bird flu, and other major livestock infectious diseases |
| | Application of bio-function to new material production and environmental protection | | |
| | Applying bio-function to the production of useful materials | ・Development of gene recombinant or culturing technology for the production of useful materials by utilizing microorganism, animals, and plants | ・Establishment of technologies for producing synthetic resin, surfactant, and other chemicals by utilizing microorganism function<br>・Establishment of technologies to produce industrial/medical/chemical materials by utlilizing plant's function (by 2020) |
| | Applying bio-function to the development of eco-friendly technology | ・Development of 'super trees' for environment protection<br>・Technology development of soil fertilization and crop protection by utilizing bio-function<br>・Technology development for bio-mediation and the control of plant's chemical-absorption of harmful chemicals in environment<br>・Technology development to produce evvironmentally-tolerant crops by utilizing genomic breeding<br>・Development of new methods to analyze the diversity of soil organisms | ・Development of higher degradative/disposal technology of waste and contaminant by microorganism functions (by 2020)<br>・Developing basic technologies to promote organic agriculture |
| | National Life Science Database | | |
| | ・Discovery and collection of useful genes by meta- and individual-genome analysis of organisms in various environments | ・Discovery and collection of useful genes by meta- and individual- genome analysis of organisms in oceanic invertebrates<br>・Constructing library collections useful for useful material production | ・Establishment of technologies for producing synthetic resin, surfactant, and other chemicals by utilizing microorganism function<br>・Establishment of technologies to produce industrial/medical/chemical materials by searching and collecting useful genes of organic groups in environment |
| | Preservation and maintainance of bio-resource | ・Establishment of sysrems to collect and provide approximately 70,000 strains of microorganisms useful for industry<br>・Maintaining Japan's bio-resources (incl. samples from living organisms) as the world's best | |
| | R&D to establish an integrated life science database | ・Development of standarzation technology, search technology, and other information technologies to integrate databases of life sciences | ・Construction of integrated database of genome information, genetic resource data, medical information, and other data to be integrated |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Life Sciences | | R&D on standardization in life sciences | ・R&D to standardize measuring technology and the discovery of standard materials for biomolecules | |
| Information and Communications | Development of the world's leading "Next Generation Super Computer" for science & technologies | | | |
| | | Development of the Super Computer at the world's top level for leading science and technology | ・Full operation of the Super Computer with the world's top-level calculation speed (by about 2011).<br>・Realization of simulation enabling innovative design of new medicine (by about 2012). | ・Continuing development program of world's leading Super Computers and promotion of applying component technologies to high performance computers and information appliances (later than about 2012). |
| | | Processor systems with high performance and low power consumption toward sustainable generation of highly value-added products | ・Development of internationally competitive processor system technologies with low power, high performance and high application productivity at the world's top level. | ・Realization of the products utilizations of developped processor-style technologies by applying these technologies in the highly value-added parts like home information applications in the major business sector. |
| | Super-minute, low-power, and design and processing technologies to go through global competition of next generation semiconductor development | | | |
| | | Low power technology (from devices to the system) | ・Realization of high-speed and low power devices as the bases of the most advanced energy-saving society utilizing information and communications technology, by the establishment of the semiconductor process and material technologies that enable the refinement below 45-nm-width level. | ・Realization of energy-saving IT utilization, by high-efficient, functional device and design technologies including power devices, high frequency devices, superconducting devices, and high-performance processor chips.<br>・Realization of high performance and highly functional home informative appliances like portable informative appliances by developing ultra-low power technologies. |
| | World's leading core robot technologies for supporting life at home and in town | | | |
| | | Robot for advanced manufacturing | ・Robot-based cell production system with higher performance and lower cost.<br>・Development of robot's skill technology inheritated Japan's manufacturing technique of measurement and creation with meister's precision. | ・Trasferring robot-based cell fabrication systems into small companies.<br>・Transferring Japan's manufactiring technique in measurement and creation with meister's precision to people and digital tools. |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
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| Strategically prioritized S&T areas | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Environmental Sciences | Science and technology for comprehensive observation system of greenhouse gases, carbon dioxide and others, by space satellite | ・ Development of dual-frenquency precipitation radar for the main satellite for the global precipitation measurement plan (GPM) and ground and aircraft demonstrating ryder system for the high-precise observation of the greenhouse effect gas.<br>・ Demonstration of cloud radar technology for the observation of three-dimensional structure and life time of cloud board on EarthCARE satelite.<br>・ Clarification of carbon balance and distribution in one to several hundred km scale by improving the accuracy of greenhouse effect gas observation satellite. | ・Improvement of accuracy of the greenhouse effect gas observation from satellites, by establishing comparative approach of observation data between spaceborne sensors and ground sensors such as GOSAT<br>・Contribution to effert of making climate model more accurate by observation data of the EarthCARE satellite.<br>・ Contribution to knowledge integration by the IPCC ( Intergovernmental Panel on Climate Change ) and international promotion of the global warming countermeasure by quantitative evaluation and validation of carbon dioxide discharge inventory of each country. |
| | Science and technology for accurate prediction of climate change in the 21st century by using supercomputer to be prepared for the post-Kyoto protocol. | ・ Providing reliable prediction result on local climate change and change of extreme phenomena such as heavy rain, by analysizing experimental result by high resolution climate model.<br>・ Detection of changes in extreme event caused by global warming, and validation of their reproducibility in climate modeling..<br>・Development of earth system model for global warming prediction adopted mass transport process of carbon cycle, etc. and the precise regional model of 4 km-horizontal resolution. | ・Offer of result by prediction research as the stochastic expression considering the uncertainty of the natural variation by the analysis of the result of ensemble experiment for about 30 years in come by high resolution climate model. |
| | Science and technology for prospective estimation of risk of global warming and design of the de-warming society. | ・Development of simulation model for the design of de-warming society vision, and proposing of qualitatively and quantitatively desirable future vision.<br>・Development of model to study possible road-map to de-warming society, and reserch policy and technological option using the model. | ・ Construction of vision scenario by policy evaluation model enabling integrated evaluation of the warming countermeasures.<br>・ Defining reduction options and their action plan for post-first commitment period of Kyoto protocol and long-term. |
| | Biomass utilization technology that maches the region for efficient energy exploitation. | ・ Developement of bio-ethanol production technology from wood with over 70% yield, resulting in cost reduction and competitiveness with the fossil fuel.<br>・ Development of optimum resources circulation and biomass energy utilization system in the region | ・ Development of highly efficient bio-ethanol production technology by the introduction of novel crops with the high biomass quantity, utilizing the results such as genome research and using whole crop including ligno-cellulosics material such as wood and rice straw.<br>・ Reduction in the manufacturing cost of the bio-plastic.<br>・ Establishment of technical basis in the energy or material production from waste and biomass and contribution for promotion of the utilization.<br>・ Development of efficient collection, transportation and storage system suitable to the biomass resource and utilization area. |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
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| Strategically prioritized S&T areas | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Environmental Sciences | Material utilization and toxic substance management technology coping to international trade of the waste materials. | ・For international competitiveness; Developement of technology for eliminating the recycling inhibitor in design and production process of the product; Developement of technology for recovery of rare metals dispersed in the product in low-concentration; and Developement of reuse and recycling technology for fuel cell with expectation of increase in future demand and alternative technology of precious metal in the catalyst.<br>・Studying actual condition of the resources circulation and proposing suitable technology system in developing country. | ・Construction of advanced product 3R system utilizing environmently conscious product information.<br>・Construction of technology system and proper management network for proper resources circulation in the Asia region. |
| | Science and technology for establishing sound water-cycle and human and natural symbiosis society | ・Development of DDR(Dual-frequency Precipitation Rader) for GPM (Global Precipitation Measurement) core satellite, remote censing technology for high density 3D monitoring in near ground and atomosphere, and monitoring data process and distribution system at near real time<br>・Development of scenario and criteria for policy evaluation to preserve river basin environment, and integrated coastal environmental management plan on the assumption of the changing ecosystem<br>・Development of urban planning techniques such as simulation of preservation and/or networking of green fields and water areas, regional air conditioning, water - absorptive pavement etc for anti-heat island in urban area and its contribution to reduction of CO2 emission. | ・Contribution for accuracy improvement of prediction model of urban weather, and development of monitoring technology for speed and direction of window in the sky over city, precisely and three-dimensionally<br>・Dissemination of environmental information to support decision making by governments and to improve the quality of the life of people through accuracy improvement of monitoring data and prediction technique.<br>・Provision of policy evaluation tool for implementation of effective anti heat-island measures by central government, municipal government and private companies, development of urban planning techniques for implementation of comprehensive anti heat- island measure and the contribution to the reduction of CO2 emission.<br>・Development of monitoring technology for water and material cycle, and data sharing system<br>・Development of comprehensive coastal environmental management |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
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| Strategically prioritized S&T areas | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Environmental Sciences | Science and technology for accurate monitoring, preservation and mitigation of ecosystem | ・Construction of database system for integrating data obtained by monitoring of ecosystem and material-cycle, and offer of global distribution of plants on land in the scale of 10 m.<br>・Clarification of spread and individual groups activities of alien species and development of technology for anti-spread measure for alien species | ・Construction and development of information infrastructure for making senario of sustainable development while considering changes in population and land use pattern and their environmental impacts through construction of database system for managing ecosytem.<br>・Development of environment preservation-reproduction-creation-management system in urban area toward creating ecological network at national level.<br>・Development of resource management model for sustainable use of aquatic living resources<br>・Development of technology for preservation, reproduction, creation and management of green field in urban area, including creation of water and green networks and measurement for alien species |
| | Science and technology for accurate evaluation of total life cycle of the product and design of production and consumption system suitable for 3R. | ・Development of technique for indicating the effect and the cost comprehensibly for various recycling such as material recycling, chemical recycling and thermal recovery, etc. in LCA or simple index. | ・Establishment of technique for planning various resources circulation systems: topographical type; collaborative type of wide region; core base type; and international type by MFA,LCA, etc.. |
| Nanotechnology/Materials | Innovative materials technology that enables significant cost reduction of clean energy. | ・Development of materials technology to enable energy use including high efficiency fuel cell, equipment utilizing superconductivity technology, and thermoelectric generation technology to use waste heat, etc. | ・Improvement of the performance of fuel-cell vehicle.<br>・Practical application of equipment utilizing superconductivity technology in the fields of energy and power, etc. |
| | Innovative technology of alternative materials for scarce resources and insufficient resources that will contribute significantly to the solution of resource problems. | ・Development of alternative technology to substitute the functions concerning rare metals. | ・Development of alternative technology to substitute the functions concerning rare metals. |
| | Cutting-edge metrological and processing technologies in the nano area. | ・Establishment of elemental technology that enables the measurement in all kinds of environments including the solution, and that also enables measurement of actual time and rapid measurement, in the metrology of properties and functions.<br>・Establishment of elemental technology that enable the measurement, analysis, and operation on the surface and inside cells and the measurement of nano structures and components within materials and devices. | ・Establishment of elemental technology that enables the measurement in all kinds of environments including the solution, and that also enables measurement of actual time and rapid measurement, in the metrology of properties and functions.<br>・Establishment of elemental technology that enable the measurement, analysis, and operation on the surface and inside cells and the measurement of nano structures and components within materials and devices. |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
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| Strategically prioritized S&T areas | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Energy | System technology that realizes high energy-efficient city by the surficial utilization of the energy | ･Development of simulation technique that evaluates optimum thermal energy utilization system, and technology development of the direct dumping of building waste heat in the sewerage, and development of the prototype of small-scale and expandable thermal energy utilization system | ･Introduction and practical application of developed thermal energy system in a part of city |
| | Advanced housing- and building-related technology that realize energy-efficient life | ･Development of the environment performance evaluation technique applicable to city block and individual house and development of the technology for non-distructive evaluation of the thermal insulation performance of existing housing stock | ･Technology development for energy saving of housing and building, including the natural energy utilization performance enhancement of heat insulating material, and energy management system for housing and building |
| | Advanced high-performance multi-purpose device technology that realizes the convenient and rich energy saving society. | ･Realization of the high-efficient inverter that realizes considerable energy saving, etc, and development of semiconductor application chip technology and high-speed low power consumption device contributing to the upgrading and higher energy-efficient of home information device (multifunctionalization, etc ) | ･Technology development of efficiency upgrading, function enhancement, high integration, systematization, capacity enlargement of devices such as the semiconductor, etc |
| | Innovative material manufacturing process technology that realizes the ultimate energy saving factory | ･Achievement of elemental technology of the environmental harmony type chemical process technology using high-efficient oxidation catalyst, etc. and achievement of the combination material technology<br>･Development of materials and roll-to-roll fabrication technology for flexible display<br>･Development of the generic technology of energy-saving-type steel production technology such as reformative iron manufacture process technology | ･Practical application of high-speed and low-cost technology for the production of the flexible device by novel, roll-to-roll fabrication process |
| | Innovative core technology of the new generation vehicle that does not require the petroleum. | ･Technology development for miniaturization and performance enhancement of the lithium ion battery and advanced orientation technique of the single walled carbon nanotube and achievement of the mass production technology.<br>･Development of the electric double layer capacitor with high energy density and durability. | ･Performance improvement and development of the technology that contributes to cost reduction of the lithium ion battery |
| | Most advanced manufacturing technology of Gas to liquid(GTL) for the automobile that replaces the petroleum | ･Achievement of GTL (naphtha, kerosene, diesel oil, and other synthetic oil made of natural gas, etc as substitute for petroleum ) manufacturing technology at commercial scale | ･Reduction of the manufacturing cost of the GTL and development of the utilization equipment that contribute to introduction of gaseous energy source |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
|---|---|---|---|
| Strategically prioritized S&T areas | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Energy | Advanced fuel cell system and safe, innovative hydrogen storage and transport technology | ・Establishment of safety measures of hydrogen supply facilities, etc<br>・Technology development for reduced cost, high durablity and enhanced function of fuel-cell vehicle, stationary fuel-cell and hydrogen supply system | ・Technology development for further reduced cost, high durablity and enhanced function of fuel-cell vehicle, stationary fuel-cell and hydrogen supply system<br>・Demonstration of sophisticated hydrogen utilization technology that utilized the region of resources. |
| | Innovative technology for high-efficiency and reduced cost of solar photovoltaic generation to penetrate global market | ・Improvement in the economical efficiency of solar photovoltaic generation by technology development and demonstration for higher efficiency, and reduced cost | |
| | High-performance electric power storage technology that overcomes the constraint of utility form and power supply | ・Achievement of SMES (Superconducting Magnetic Energy Storage) system that achieves cost reduction and higher reliability enhancement.Development of generic technologies such as capacity enlargement by yttrium system wire rod, etc. and high-performance coil.<br>・Development of the electric double layer capacitor of high energy density and high durability | ・Realization of further performance enhancement of SMES that utilized yttrium system wire rod with the aim of commercial introduction of 10's to 100's kWh scale, etc. |
| | World-leading clean, high-efficient coal gasification technology | ・Establishing high-efficiency coal-gasification generation technology through demonstrating integrated coal gasification combined cycle(IGCC) | ・Achievement of coal gasification technology that contributes to the promotion of the clean and high-efficient utilization of the coal |
| | Practical application technology of the next generation light water reactor that is excellent in safety and economically efficient and spreads through the world | ・Selection of next-generation reactor technology with high economic efficiency and safety, and competitiveness in world market<br>・Development of mid-to long-term RD strategy of the reactor type | ・Establishing next-generation light water reactor technology with high economic efficiency and safety, and competitiveness in world market |
| | Geological disposal technology indispensable to disposal of high-level radioactive wastes | ・Scientific research to the middle depth in two underground research laboratories (Horonobe, Mizunami) with different geology. Systematization as a knowledge base that supports disposal business and safety regulation.<br>・Presentation of feasibility of engineering technology including quality and performance og production and construction of the artificial barrier. | ・Consolidation of technology base necessary for disposal business and safety regulation through start of disposal operation |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | |
|---|---|---|---|
| Strategically prioritized S&T areas | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Energy | Fast breeder reactor (FBR) cycle technology that ensures long-term stable supply of energy | ・Defining innovative technology to be applied to commercial FBR cycle facilities ( reactor, and fuel cycle )<br>・Conceptual design of whole plant of commercial FBR cycle<br>・Small-scale demonstration of MOX fuel fabrication technology of high economic efficiency, and demonstration of extended fuel burnup and fuel cycle technology | ・Verificating of FBR system technology by achieving expected purposes such as demonstration of the reliability as power plant and achievement of the sodium handling technology on Monju<br>・Presentation of vision and research and development program for commercialization of FBR cycle that is competitive in safety and economy with future LWR, highly efficient in resource utilization, reduced environmental burden high nonproliferation |
| | Fusion energy developed in international cooperation : The ITER project | Development and manufacturing of equipment that our country shares, and promotion of the prototype reactor design by the wide approach carried out by cooperating with ITER, based on the schedule that internationally agreed with the aim of ITER completion and starting operation | ・Demonstration of the burning plasma through construction and operation of ITER and the incorporated wide approach<br>・Consolidation of core plasma technology and nuclear fusion engineering necessary for the prototype reactor construction. |
| MONODZUKURI (Manufacturing) Technology | Science-based technology to "visualize" the manufacturing process, leading to further evolution in Japan's manufacturing | | |
| | Innovative equipment for measurement and analysis and processing technology that will meet the needs in manufacturing fields. | ・Development of Japan's original measurement and analysis technologies and equipment based on the technologies such as 3-D visualization of nano-level materials structure, high-resolution active analysis, and high-precision quantitative analysis in order to build the foundation of next-generation manufacturing technology.<br>・Improvement of the added-value of strong industrial technology such as automobile and information appliances by using MEMS technology, and strengthen the international competitiveness of Japan's manufacturing. | ・Strengthening Japan's international competitiveness of manufacturing, and by contributing greatly to the progress of S&T, while improving the domestic share of advanced measurement analysis equipment by using world's leading next-generation measurement analysis technology.<br>・Achievement of the "visualization" of phenomena or problems, secure the reliability of products and the safety of products and workers by means of the advancement of the measurement and analysis technologies that contribute to the development of sensing technology, etc. |
| | Process innovation for manufacturing in order to overcome constraints relating to resources, the environment, and population, to be tackled as Japan's flagship project | | |
| | Innovative manufacturing processes using robots, suitable for a society with a declining birthrate. | ・Realization of robots that can work in collaboration with human beings in manufacturing sites, release the specifications of the construction machines improve the safety and labor productivity of construction sites, and can reduce the supplementary work by humans. | ・Development of a work environment where women and elderly people can participate in manufacturing, achieve the safety and comfortable work sites by utilizing world's highest measurement technology, information technology, and robotics technology. |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | | |
|---|---|---|---|---|
| Strategically prioritized S&T areas | | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| MONODZUKURI (Manufacturing) Technology | | Innovative manufacturing processes using biotechnology. | ・Establishment of production technology such as industrial material from recyclable material such as biomass by the utilization of micro-organism functions<br>・Establishment of efficient dissolution and treatment technology of waste and pollutants. | ・Establishment of the production process technology of useful material that utilizes biotechnology, and aim to form a recycling-based society harmonious with the environment by establishing the basis for super-efficient production technology of dissolution. |
| | | Energy saving in the manufacturing process. | ・Development of a design support system that takes into account the lifecycle of products related to the manufacturing industry, reduce energy loss in the production process through such system, and achieve energy-saving. | ・Development of iron making processes that utilize the waste heat of ironworks, chemical engineering processes that help energy and resource savings, and efficient energy use technologies such as thermoelectric conversion in order to contribute to measures against global warming such as CO2 emission from the production process. |
| | | Manufacturing technology designed for the effective use of resources and that is environmentally-friendly. | ・Development and standardization of 3R design/ production/maintenance technology, elimination technology of recycling inhibitory in design/production phase, management technology of useful or hazardous substances. | ・Realization of functional materials that can sufficiently cope with uncertain risks by going a step ahead of the international environmental regulations.<br>・Achievement of green processing of material production. |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | | |
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| Strategically prioritized S&T areas | | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Frontier | Highily reliable space transportation system | | | |
| | | Development , production and launch of the H-II A launch vehicle | ・Continuous launches of the H2A launch vehicles and achievement of succes rate over 90% (in more than 20 launches ). | |
| | | The H-II B launch vehicle (upgrade version of the H-IIA launch capacity) | ・Development and operation of the H2B launch vehicle that is capable to transport the satellites to geostationary transfer orbit （8 tons ) and HTV.<br>・Establishing the H2B launch vehicle as the world highest level by continuous transport to the international space station | |
| | | The H-Ⅱ Transfer Vehicle (HTV) | ・Development of the H-Ⅱ Transfer Vehicle (HTV) as Japan's original supplier to the international space station<br>・Steady operation as an autaonomic transportation | |
| | | Flight demonstration of LNG propulsion system | ・Development of the LNG propulsion system which can be an alternative future transportation system and execution of flight demonstration, leading to appropriate technology transfer to private sector | |
| | | Development of basic design technology on the next generation transportation system ( the GX launch vehicle ) | ・Shortening of delivery period, improvement of reliability and cost reduction by shortening the time from order to launch | |
| | | Improvement of reliability program ( transportation system ) | ・Improvement of reliability of launch vehicle technology such as the engine performance by means of accumulation of experiences and research on highily reliable design for the puorpose of the achievement of more than 90% success in H2A launches | |
| | Enhancement of satellite technology for high reliability and sophiscated function | | | |
| | | Remote sensing technology ( Hyperspectral sencing technology ) | ・Development and partial operation of the earth observation sensors ( ASTER,PALSAR,DPR, cloud radar, etc. ).<br>・Development of a system to analyze and provide the acquired data<br>・Establishment and ground demonstration of more accurate observation of carbon dioxyde density | ・Demonstration of the following technologies; precipitation distribution observation by GPM,EarthCARE, etc., observation of vertical distribution of aerosol and cloud, and more accurate carbon dioxide density by the lider<br>・Contribution to the global environmental problems with the technologies stated above by improving their accuracy |
| | | Reliability improvement program ( satellite-related) | ・Improvement of reliability of satellite bus technology, electronic technology for the space devices, and fundamental technology of mechanical elements by means of advanced examinations and additional back-up equipments, etc.. | |

| 4. Society that Contributes Significantly to Resolving Global Environmental Issues | | | | |
|---|---|---|---|---|
| Strategically prioritized S&T areas | | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Frontier | | Space Environment Reliability Verification Integrated System (SERVIS) | ・Cost reduction ( by about 1/2～1/3 ) in satellite parts with SERVIS to increase the market share in the space equipment industry | |
| | Next generation offshore exploration technology | | | |
| | | Development of the most advanced deep sea drilling technology in the world ( Chikyu ) | ・Establishment of 7000 meter-deep drilling technology by the deep sea drilling vessel (Chikyu)<br>・Utilization of Chikyu for seismic obsevation, reserch on microbes in the earth crust, and material exploration | ・Search and collection of microbes in the earth crust in order to know the past global environment and its change, the origin of the life, and the evolutions of the life |
| | | Development of the next generation deep sea exploration technology | ・Development of elemental and integrating technologies necessary to extend the navigation of the unmanned deep sea servey ship, to improve the precise deep-sea survey, and to explore in the most deepest sea in the world | |
| | Ocean platform technology | | | |
| | | Research and development on the ocean platform. | ・Development of elemental technologies; stable floating structure ,reliability improvement, mooring, etc. to realize the ocean platform on which facilities such as windmills can work | |

| 5. Society that is Open to the World | | | |
|---|---|---|---|
| Strategically prioritized S&T areas | | S&T goals by 2010 (During the 3rd S&T Basic Plan) | S&T goals after 2011 (After 4th S&T Basic Plan) |
| Information and Communications | Development of the world's leading "Next Generation Super Computer" for science & technologies | | |
| | Technologies to obtain required information at proper cost by accessing networks | ・Preparation and utilization of intellectual infrastructure at the world's top level to consider users' convenience. | |
| | Super-minute, low-power, design and processing technologies to go through global competition of next generation semiconductor development | | |
| | System-on-a chip technology and embedded software technology | ・Realization of commonality and standardization of technology specification (28 items) for equipment certification and copyright management, to ensure interconnection and operability of the home information appliances. | ・Development of home informative appliances middleware technologies that realize the user-friendly human interface including multi-lingual speech recognition, and use intention and environment understanding. |
| | Core technologies for displays, storages and super-high-speed devices to be at the top-level of the world | | |
| | Non-silicon devices | ・Realization of the high-efficient inverter by the 10W/cm$^3$-grade power devices.<br>・Realization of the high frequency device of 350GHz class. | ・Realization of energy-saving IT utilization, by high-efficient, functional device and design technologies including power devices and high frequency devices. |
| | Next-generation display technology including organic display | ・Realization of low power display.<br>・Construction of the stereoscopic image systems where the image changes without glasses same as watching real things by the observation position and the focus adjustment of the eye is possible.<br>・Establishment of modeling and interface technology of recognition with five senses that exceed visual and auditory sense. | ・Realization of the energy-saving and rich society where the contents watching and listening in the high-resolution large-screen are provided by the next generation display system using high-efficient display & light emitting device by innovative materials, etc.<br>・Realization of the stereoscopic image communications by the development of super reality system that cannot easily identify the real or the virtual. |
| | Software-development supporting technologies aiming at the world standard | | |
| | Establishment of the next generation open-architecture and its development basis that enables problem-solving and competitive international services | ・Enhancing information search and analysis technologies for text, image, speech, and video media on web and on non-web. | |

| 5. Society that is Open to the World | | | |
|---|---|---|---|
| Strategically prioritized S&T areas | | S&T goals by 2010<br>(During the 3rd S&T Basic Plan) | S&T goals after 2011<br>(After 4th S&T Basic Plan) |
| Information and Communications | Next-generation network technologies that can transfer the huge amount of information instantaneously, and can be used conveniently and comfortably, by every one | | |
| | High-speed, high-capacity, and low-power networks that can flexibly transmit super high-quality visual contents | ・Upgrading of the processing ability to about 10,000 times.<br>・Establishment of automatic network reconstruction technology that can autonomously realize adequate network with less than 1/100 time from now regardless of types of information in obstruction. | ・Realization of stable all-optical communication networks with the ultra-low power even in communication traffic that increases more and more. |
| | Content creation technologies and information analysis technologies that enable us to share emotion with people all over the world | | |
| | Establishment of infrastructure to share emotion with people included | ・Construction of a super hi-precision image system and a glassless three-dimensional image presentation system.<br>・Establishment of SD-level three-dimensional image capture, presentation, and communication technologies, or establishment of these for "natural vision." | ・Establishment of super hi-precision image communication by seamless super-realistic technologies between the virtual and the real world. |
| | Realization of multi-international super communication | ・Establishment of non-verval communication recognition technology.<br>・Establishment of multi-language speech recognition-systhesis technology, and natural language semantics analysis technology. | ・Development of user friendly human interface for multi-language speech recongnition technology and so on.<br>・Realization of standard-conversation-level multi-language imterpretation. |
| | Realization of brain-based "enhanced" human interface | ・Establishment of basic technology of brain information communication for brain data decoding analysys. | ・Development of primitive communication system using brain information. |
| | Huge accumulation of information and its utilization | ・Enhancing information search and analysis technologies for text, image, speech, and video media on web and on non-web. | |
| Nanotechnology /Materials | Cutting-edge electronics that exceeds the limitations of the performance of devices. | ・Development of high-speed and multifunctional devices with low power consumption. | ・Development of new device which outperforms the conventional operation principle of the semiconductor. |

Meanwhile, when promoting field-specific and strategic research and development, it is necessary to take required measures particularly for the following items.

<Life science>

- Development of a system to promote translational research to clinical research and clinical medicine
  - Securing and developing clinical researchers and clinical research supporters
  - Developing a support system for clinical research and translational research
  - Developing infrastructure to realize accelerated review of new drug / medical device applications and improvement in its quality
  - Bioethics, genetic diagnosis, genetically modified crops
- Use of IT in medicine
- Promotion of life science to ensure safety
  - Promotion of research and development contributing to risk analysis on the entire food chain

<Information and Telecommunications>

- Establishment of the most advanced and safe/secure information and telecommunications infrastructure (development of high security environment, etc.)
- Realization of an advanced computer science infrastructure and development of human resources for software development
- Strengthening efforts for international standardization activities
- Verification experiments by active use of test bed, technology transfer for practical application, and acceleration of human resource exchange
- Promotion of strategic efforts in view of a wide range of research and development covering from basic studies, such as mathematics and physics, to practical application

<Environment>

- Proactive efforts as an international leader and contribution to the world
- Developing researchers in the integrated areas between natural science and the humanities
- Cooperation between local governments and regional efforts
  - ㅡ Global observation, comprehensive use of biomass, collaboration with regional government and measures

<Nanotechnology/Materials>

- Human resources development and establishment of a center, such as education in inter-disciplinary/multi-disciplinary areas
- Proactive efforts to promote social acceptance
- Strategic efforts to ensure intellectual property

<Energy>

- Promotion of the transfer to society by strengthening the partnership between research and development and dissemination measures, and international dissemination of outcomes
- Strict project management in large-scale projects
- Appropriate partnership between private and public sectors

<Manufacturing technology>

- Handing down of practical technologies and skills, such as knowledge and know-how of baby boomers
- Strengthening of intellectual infrastructure for manufacture, such as common utilities, facilities and various databases
- Government procurement of the products made from the results of research and development, creation of initial demand and promotion of deregulation

<Social infrastructure>

- Strengthening of partnership among relevant authorities in disaster-prevention measures
- Promotion of verification for the steady transfer of outcomes to society/people

<Frontier>

- Enhancement of industry-university-government, inter-ministry, and inter-institution cooperation
- Expansion of the base of human resources who lead science and technology in the next generation
- Appropriate project management in large-scale projects
- Steady promotion of projects for industrialization

### (3) Promotion of diverse basic science that can be an incubator of innovation

Many seeds of innovation generate unexpected results from unexpected places. It is therefore necessary to support aggressive and challenging research with high objectives without being swayed by short-term performance.

Active promotion of such aggressive and challenging research will create many seeds of innovation, which will lead to the creation of innovation in the future.

Starting in FY2008, Japan will make efforts to further improve evaluation for adoption of research activities to various competitive funding systems in accordance with their characteristics. At the same time, Japan will increase the percentage of aggressive and challenging research activities adopted to the system and will utilize the results of research for the above-mentioned (2) Promotion of Field-specific and Strategic Research and Development and (1) Promotion of projects that accelerate the transfer to society, upon accurately evaluating them.

### (4) Reinforcement of research and development system that propels innovation

#### (i) Research and development activities of independent administrative institutions for research and development

- **Reform of independent administrative institutions for research and development to accelerate innovation**

The following efforts will be made in view of strengthening the research and development power of independent administrative institutions for research and development, and ensuring incentives for management efforts for the acquisition of external funds.

- Under the policy of uniform reduction of personnel cost, it is virtually difficult to estimate, in advance, the personnel cost related to the competitive research funds when employing fixed-term staff using said funds. Therefore, this has been treated as an exception in consideration of political significance. Based on the same principle, fixed-term staff employed from private institutions by external funds to be engaged in commissioned or joint research activities shall be exempt from the personnel-reduction target. At the same time, treatment of fixed-term staff employed by external funds to conduct major national-level policies will be discussed based on the principle that funds should also be flexibly used in the same way.
- Revenues from intellectual property are deemed to be business efforts and all of such revenues will be used as appropriated surplus. At the same time, with respect to the balance of the appropriated surplus that are carried forward beyond

the medium-term target period, efforts will be made to improve the predictability while managing the funds under the existing rules.

- The above points will be put into practice at an early time as items to be addressed in the immediate future. At the same time, discussions will continue on the ideal vision and the roles to be played by independent administrative institutions for research and development for the promotion of innovation so that the research and development power can be utilized in the future.

### (ii) Research and development activities in the private sector

**- Support for commercialization of new technologies using the SBIR system[1] as a model**

The following efforts will be made to comprehensively support small- and medium-sized enterprises and venture firms that challenge technology revolution, ranging from financial support at the stage of research and development and commercialization of results of research and development.

- In order to increase the opportunities of financial support for small- and medium-sized enterprises and venture firms, the target expenditures of each ministry of specific subsidy for small- and medium-sized enterprises and venture firms will be disclosed from FY2007.
- Systems of high-quality selections for venture firms at each stage will be introduced from FY2008 in a step-by-step manner.
- With respect to the appropriateness of fund-allocation and the relevance of selections conducted by each ministry, discussions will be held on the intergovernmental ex-post evaluation, including that of the Council for Science and Technology Policy.

**- Building a framework to realize risk money supply**

The following efforts will be taken to support the supplier of funds and development of a market environment so that funds are appropriately supplied in accordance with the development stage of a company.

- Discussions on the promotion of the environment for personal investors in order to promote fund supply to newly established venture firms
- Discussions on the measures to promote the evaluations on the information discloser system in newly emerged markets and the disclosure of information pertaining to intellectual property management.

**- Further development of environment to promote research and development of private companies**

The following efforts will be made to develop an environment to further promote research and development of private companies.

- Discussions on the system to further accelerate investments of private companies in research and development

[1] Refers to the R&D support system for venture firms, which is similar to the Small Business Innovation Research of the United States

- Technology based management including intellectual property strategy in private sector will be promoted and the methods of the technology governance, in which the fruits of R&D is sure to combine to the profit, will be advanced, introduced and disseminated.

- **Forward-looking development of infrastructure to support research and development and commercialization**

In order to improve the efficiency and reliability of commercialization of new technologies, discussions will be conducted to build a system to make incessant innovations in terms of management and financial aspects from a long-term point of view in collaboration with businesses, venture capitals, financial institutions, independent administrative institutions for research and development, universities and administrative offices.

## Chapter 6　Promoting system towards “the world’s leading nation of innovation”

In view of realizing “the world’s leading nation of innovation,” it is essential to make long-term efforts for a social system reform and technology renovations targeting 2025, in line with the long-term strategic guidelines “Innovation 25.” It is thus necessary to develop a comprehensive promotion system beyond the boundary of ministries and to establish a PDCA cycle.

To that end, it is necessary to set up the innovation promotion headquarters comprising relevant ministers and experts and chaired by the Prime Minister in an attempt to establish a PDCA cycle of the long-term strategic guidelines “Innovation 25.”

Furthermore, the roadmap of strategies for technology revolutions is closely related to the Promotion Strategies for Prioritized Areas, which was compiled based on the 3rd Science and Technology Basic Policy by the Council for Science and Technology Policy. Thus, the Council for Science and Technology Policy will take an initiative to implement the PDCA cycle as part of implementation of policies based on the Science and Technology Based Plan, with cooperation among the relevant ministries.