Tentative translation

Japan's STI Policies looking beyond Mid-long Term

–Toward the 5th Science and Technology Basic Plan –

(Interim report, proposed by the Council for Science and Technology, under the jurisdiction of MEXT, January, 2015)

【Main Points】

Tomorrow is not simply an extension of the path we have walked until today. The world is constantly changing, its speed is constantly increasing, and its direction is uncertain. Naturally, Japan is required a science, technology and innovation (STI) system suited to the times. As always, in addition to producing solid scientific results as the basis for innovation steadily, it is necessary to involve ourselves in bold cooperation and interaction in order to change our society as we need with an eye to the near future and to work to implement these results in society. What should we as individuals do to help Japan proceed in the right direction? The key lies in the social design skills and the ability to act flexibly and swiftly of the young people who must take the responsibility for future societies.

Goethe has the following saying, “Knowing is not enough; we must apply. Willing is not enough; we must do.” The ideals of universities, research institutes, and communities, etc. and the policies for the advancement of such cannot be allowed to remain as simply dogma. In the case of researchers and all of the organizations to which they are affiliated, in order that they are able to respond to the expectations and requests of Japanese society, they must have an attitude of working to achieve goals and, when it comes to the implementation of their research, they must avoid falling into making easy compromises. Additionally, researchers must open their eyes widely to the world, and at the same time, while taking dignity in their own culture, take autonomous action in working toward further advancement in STI.

(Excerpt from “Introduction”)

Mid-term Summary Points

Background

✓ Twenty years have passed since the enactment of the Science and Technology Basic Law of 1995. Improvement of the research environment, the accumulation of human resources, and the realization of epoch-making achievements have been planned out under the Science and Technology Basic Plan over four stages.

✓ On the other hand, there are innumerable problems to solve. The following, in particular, are pressing issues: clarifying career paths for young human resources, assuring a diversity of basic research, and the creation of innovation systems that tie in with societal reform.

✓ Again, it is also important to accommodate changes in socio-economics. (For example, in relation to: population decline; the expansion of globalization; the intensifying of global competition; the concretization of knowledge-based societies; the arrival of "the advanced cyber society"; changes in the security environment; and, the worsening of global scale problems.

Proposing comprehensive policies – bringing together university, academic, STI policies under one umbrella with a view to the mid-long term future of Japan– from the perspective of seeking answers to promoting sustainable development in Japan and throughout the world.
Giving consideration, from the perspective of leadership in social reform through innovation, to dialogue and cooperation with all stakeholders in cooperation and unification between the humanities, the social sciences, and the natural sciences.

Point 1: Proposing the importance of strengthening "innovation creation basis" in order to deal with the diverse issues of the future with alacrity.

✓ In regard to the human resources that are responsible for carrying out STI, it is most important that there are reforms to systems from the perspectives of improving the quality of each individual and of promoting the production of innovation. Such reforms are to be implemented in many various ways.

✓ As "open innovation" proceeds in enterprises, reforms and strengthening of academic and basic research that bring new knowledge and value that will be a basis for innovation.

✓ Switching from an old "linear" model of industry-academic-government cooperation, new innovation systems will be created that give birth to "collaboration", where there is a flow of people, things, money, and information between industry, academia, and government.

Point 2: Presenting new issues with consideration to changes in socio-economic circumstances

✓ Noting the importance of: strategies for leadership of the "the advanced cyber society" that is the outcome of the dramatic progression of cyber society; and, with looking to the long term, technological developments that the government responsibly acquires, maintains, and developments.

✓ Giving importance to the idea of strengthening systems for dealing with misconduct in research, etc. and restoring the public's trust in S&T and researchers, etc.

Point 3: Proposing comprehensive plans going beyond individual organizations and policies for the integrated functioning of all aspects

✓ Clarifying the roles of universities and public research institutions, and conducting their reformation and strengthening. In particular, the National Research and Development Agency will be strengthened to act as a "hub" for driving innovation systems.

✓ Carrying out expansion of governmental R&D expenditure on the basis of securing the total amount of governmental R&D expenditure equal to 1% of GDP and monetary reforms to aid the effectiveness of these expenditure.

Overall Composition

Target picture of Japan

Building nation based on STI

A nation that realizes sustainable development for Japan and the world, with high level STI skills that, through its activities, finds solutions to problems inside and outside of its borders

Directionality (3 Ideals)

- Live together with Earth, and contribute to the advancement of mankind
- Ensure the safety of the country and its people, and realize a comfortable and happy life
- Preserve world-ranking top-class economic strength and presence

- Socio-economic conditions and changes
- Trends in foreign policies
- Achievements and issues from the 1st S&T Basic Plan

The government's role and basic stances for realization of target picture of Japan

Changes the shape of STI (changes derived from "linear" model; activities of open innovation; etc.)

2 Roles of Government

Make clear the important role of the government (the important functions in the future) for realization of above target picture, considering the socio-economic conditions and changes and the achievements and issues from the 1st Science and Technology Basic Plan.

Improve STI skills, and implement application

Strengthening innovation creation basis

(Reform human resource systems, strengthen sources (academic and basic research, etc.), and create new innovation systems, etc.)

Resolve various issues both within and outside Japan (Also consider concrete direction)

Leading society through STI

(STI through policy setting, S&T diplomacy, and strengthen the relationship with society, etc.)

6 Basic Stances

In regard to the promotion of STI policies, establish a general stance that must be very well understood, particularly by the concerned parties. (promotion of academic research; global outlook; individual sectors' roles; views on distribution of budget ; cooperation between related policies; cooperation with stakeholders.)

Concrete Initiatives

Strengthening the innovation creation basis

Reforming human resource systems; promoting academic and basic research; strengthening common basic technology and research infrastructure; reforming industry-academic-government cooperative relationship; strengthening support for venture and small and medium enterprises; and, fostering and securing innovation promoting human resources; etc.

Leading society through STI

Leading of "the advanced cyber society"; promotion of the "National Critical Technologies"; S&T diplomacy; regaining society's trust; etc.

Optimization of capabilities for new STI creation

Strengthening the functions of universities and the National Research and Development Agency; reforming distribution of budget; etc.

Strengthening the structures that promote STI policies

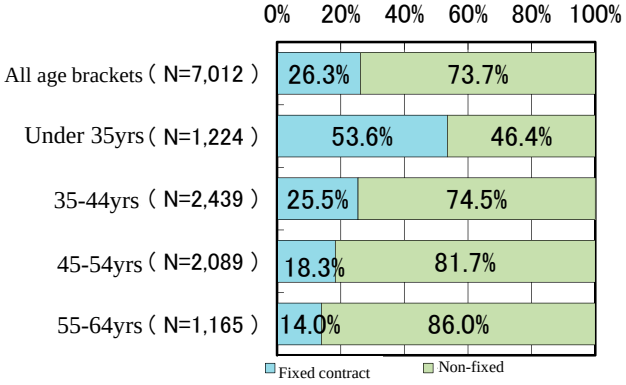
Strengthening the headquarters' functions; making PDCA cycles more efficient; expanding governmental R&D expenditure; etc.

Proposal 1: Reforming career systems for young human resources

Basic Understanding

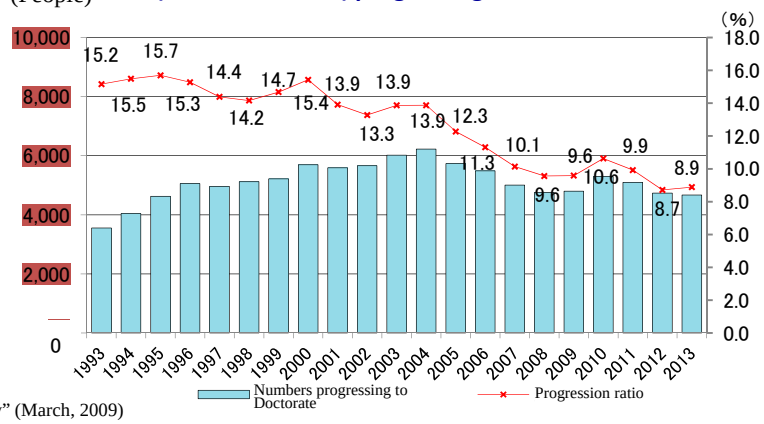
- ✓ In raising all STI activities to a high level, the key words are “securing outstanding human resources,” “fostering human resources,” and “active participation of young human resources.”
- ✓ However, in a situation where we have what might be called “a generation gap in mobility,” as positions to which youths can aspire are limited and due to a lack of diversity in career paths, the career prospects for youths are unclear and there is no guarantee of employment.
- ✓ In addition to these problems regarding career paths, because of problems with financial support and lack of independent research environment, etc., students are choosing not to proceed to doctorate course, and this is an extremely serious issue for Japan’s STI future.

Ratio of fixed-term employment contracts in universities by age bracket



Source: NISTEP’s “Survey of Human Resources in Science and Technology” (March, 2009)

Numbers and trends in ratio of students in master course (natural sciences) progressing to doctorate



Source: Compiled by MEXT based on “School Basic Survey”

Direction of Initiatives

- ○ Through **promoting the introduction of an annual salary system and changing to fixed-term employment systems for senior researchers**, plan to **expand the number of stable posts to which youths can aspire**, and ensure appropriate mobility for all generations. Create an environment where all researchers can work to their full potential.
- ○ **Clarify career paths from end of doctorate up until work as an independent researcher.**
  - ✓ **Introduce, as a rule, a tenure track system (※)** in the employment of new researchers on university.
  - ✓ **Establish “System for Distinguished Researchers(provisional name)”** that targets especially outstanding human resources, etc.

※ Employ young researchers (mainly, assistant professors) for a fixed term in an independent research education environment, and, after they pass a tenure examination, employ as independent researchers under a personnel system fair and high in transparency.

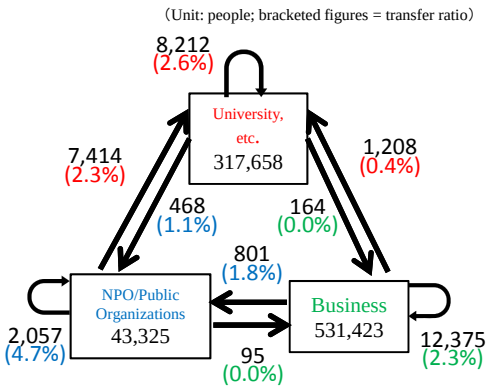
- ○ Diversify doctoral graduates’ career paths, and reform university graduate school education in conjunction with industries, etc.
- ○ Improve financial support for doctoral students
  - ✓ In addition to improving fellowships and scholarships, etc., promote the employment of research assistants in the National Research and Development Agency, etc. (which will also have the effect of diversifying career paths).
- ○ Not only directly subsidize these initiatives in each agency, **but also strongly promote initiatives related to reforms in the competitive fund system (for example, using effective requirements and evaluations in the government projects, etc.) and reforms in national universities.**

Proposal 2: Promoting active participation of a diverse range of human resources, increasing mobility of human resources.

Basic Understanding

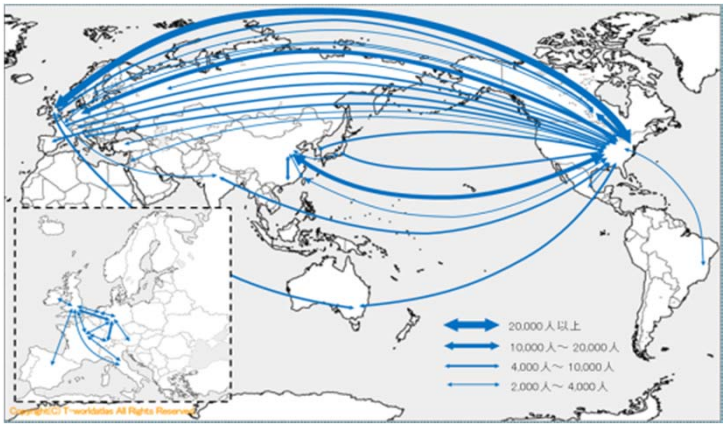
- ✓ In order to maximize Japan's potential for create innovation, it is important to: secure a diverse human resources with different views, knowledge, and ways of thinking; increase the mobility of human resources; and, advance cooperation between different fields, between industry, academia, and government, and between countries.
- ✓ While the implementation of environments where diverse human resources participates actively, i.e., women and foreigners, is certainly proceeding, such is still lacking when compared with other countries.
- ✓ Because of Japanese own peculiar employment traditions, moving across agencies, the industry-academic-governmental sector, and international borders is almost non-existent.
- ✓ This situation is a significant cause of preventing innovation in Japan.

Transfer between sectors



Source: Compiled by MEXT based MIC's "Survey of Research and Development"

Main global transfers of researchers of the world



Source: Compiled by MEXT based on OECD "Science, Technology and Industry Scoreboard 2013"

Direction of Initiatives

- ○ **Promote the appointment of women** to have initiatives in research activities **as leaders**, and promote the development of the next generation's female S&T human resources, etc.

- ○ Strategic expansions of accepting first-class foreign researchers, especially excellent foreign post-doctoral researchers, and the bold creation of environments to accommodate such, promote the acceptance and fixtation of foreign exchange students.

- ○ Build **systems that allow for mobility across the border between** the industrial, academic, and governmental **sectors.**
  - ✓ **Promote the introduction of new systems for salary and employment**, such as annual salary system and cross-appointment schemes, etc.
  - ✓ Improve research budget and workspaces for researchers after transfer.
  - ✓ Build a place for human resources and technology that goes beyond industry-academia-government sector borders at the National Research and Development Agency, etc.

- ○ **Improve Japan's presence in the international research networks** by improving support for foreign-based dispatch and support for researchers wishing to up-skill overseas.

Proposal 3: Strengthening Academic and Basic Research

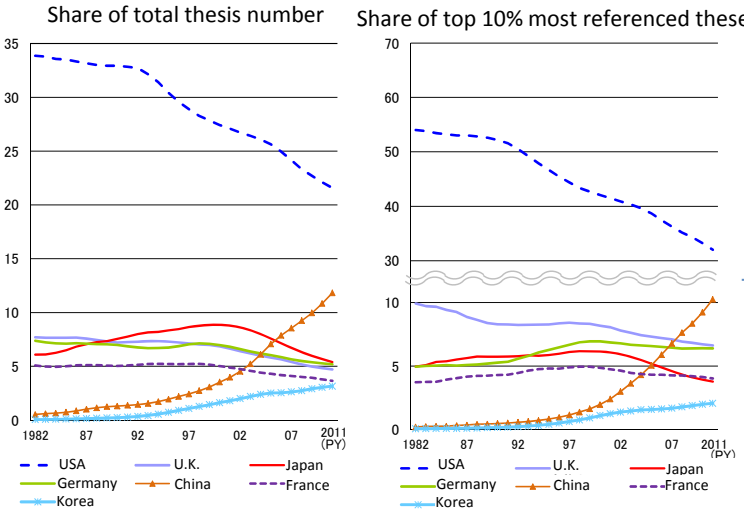
Basic Understanding

✓ It is imperative for sustainable innovation to strengthen academic and basic research that produces diverse and excellent knowledge and value as the basis for innovation. Fierce competition is developing at the forefront of research around the world.

✓ However, in recent years, growth in numbers for both total production of thesis and production of highly-referenced thesis has been sluggish in Japan, and there is a downward trend in terms of international share.

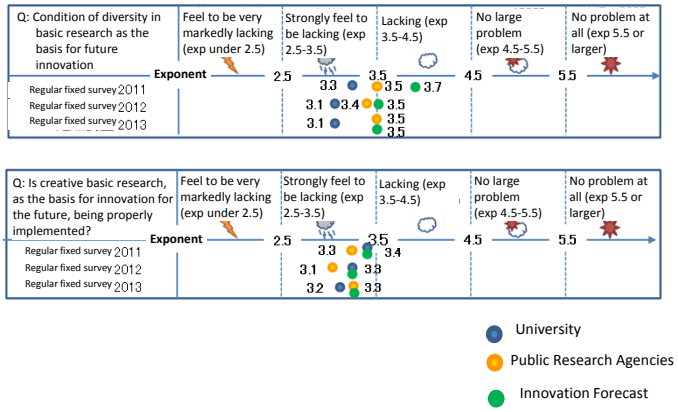
✓ Adding to this, a decline in basic funding and insufficient atmosphere of appreciation for research, etc. has meant that there has been a drop in the diversity of basic research, researchers' attention has shifted to the short-term, and researchers no longer take risks. These are significant problems.

Trends in major countries' share of total thesis numbers and share of top 10% most referenced theses



Source: NISTEP's "Japanese Science and Technology Indicators 2014" (August, 2014)

Changes in perception of affiliated persons in regard to basic research



Source: Compiled by MEXT based on NISTEP's "2013 NISTEP Expert Survey on Japanese S&T and Innovation System" (April, 2014)

Direction of Initiatives

○ The government, in its research funding, is to **place importance on funding academic and basic research that is not being implemented via the market principle.**

○ **Reform *Grants-in-Aid for Scientific Research* (KAKENHI) as the basis for innovation** (review of fundamental structure of inspection categories, methods, and system structures; review of redundancy restrictions; promotion of improvement of support with consideration to life events; and, promotion of international cooperation and network construction); promote Strategic Basic Research Programs effectively and efficiently (set evidence-based strategic goals).

○ In regard to universities' joint usage / research system, reconfirm the ideology and mission in regard to each organization and facility, and strengthen reforms centered around collaborative research bases that are open to working across fields, organizations, sectors, and international borders.

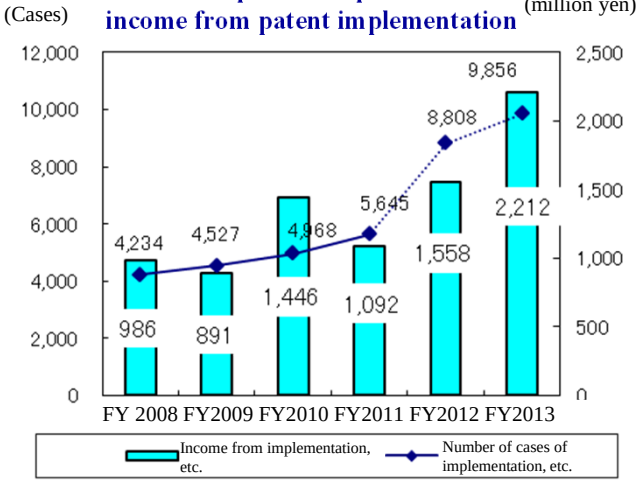
○ **Build a database** to enable greater visibility and application of research outcomes and the seamless integration of various kinds of research funds.

Proposal 4: Creating new innovation systems

Basic understanding

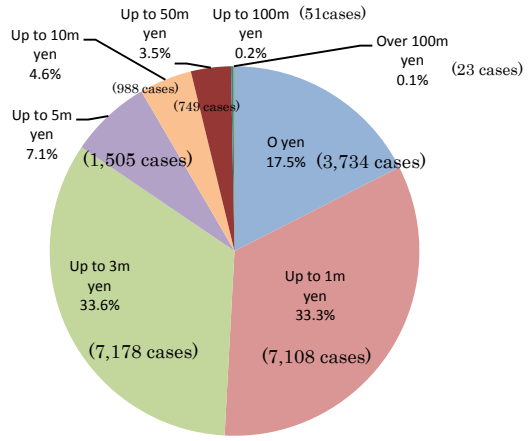
- ✓ Cooperation between industry, academia, and government is becoming more active, but earnest cooperative efforts are limited to only some cases, such as in the many small-scale initiatives.
- ✓ Compared to overseas there are few businesses making innovations a reality, and this suggests that the systems in Japan that should link new knowledge and technology coming out of universities, etc. with new innovation are weak.
- ✓ In recent years, private businesses, etc. have placed importance on open innovation initiatives (i.e., methods that make proactive use of outside knowledge and technology), and it is imperative to promote the transfer of people, things (research outcomes, etc.), money, and information between industry, academia, and government, and to build new systems that will allow for research development and implementation in society with alacrity.
- ✓ The key lies not in being caught up in the characteristics of research, i.e., basic research, applied research, and developing research, but rather in having all the different research aspects working together to allow research to advance in a spiral manner.

Trends for universities, etc. in numbers of patents implemented and income from patent implementation



Source: MEXT's "FY2013 Implementation Conditions in Universities, etc. of Industry-academia Cooperation, etc."

budget structure for universities, etc. cooperative research with businesses and independent administrative institutions, etc.



Source: NISTEP, Booklet 3 " Industry-academia Cooperation and University-lead Innovations (ver. 3)" (December, 2014)

Direction of initiatives

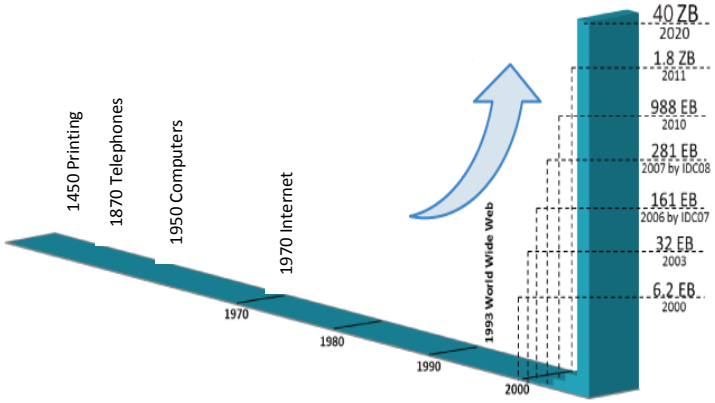
- ○ **Increase mobility of human resources** beyond sector boundaries, **clarify research outcomes and needs**, and **build a "collaboration platform"** where it is possible for the knowledge, views, and ideas, etc. of human resources from industry, academia, and government to stimulate one another, create fusions, work on strategic outcomes together, and have such link to societal implementation.
- ○ **Promote the matching** of regional needs with the technological seeds of universities, etc. nationwide, and **promote the regional creation by open innovation** through **the formation of regional R&D complexes** etc.
- ○ Strengthen support for university-originated ventures, and provide effective support for small and medium enterprises.
- ○ Define and position program managers, research administrators, technical support staff, and entrepreneurs, etc. as important **"innovation promoting human resources"** on the same level's career as researchers, foster and secure them, and promote establishment of their career paths.

Proposal 5: Realizing the desired “the advanced cyber society”

Basic Understanding

- ✓ In recent years, accompanying the fast development of cyber space, there have been major changes in the methodology of science and the shape of society due to activities that go beyond the scope of actual society having been autonomously carried out in the cyber space. (The arrival of a “the advanced cyber society.”)
- ✓ In regard to this issue, Japan, up until now, has based its cultivation of systems and human resources in the field of hardware. In comparison to other countries, Japan is lacking in systems based on the creation of software and services.
- ✓ For this reason, in addition to the 5 issues in relation to Comprehensive Strategy on STI, “reform targeted at the realization of the desired ‘the advanced cyber society’” is to be established as an urgently important issue. It is important to become quickly involved in this through cooperation between the humanities, the social sciences, and the natural sciences.

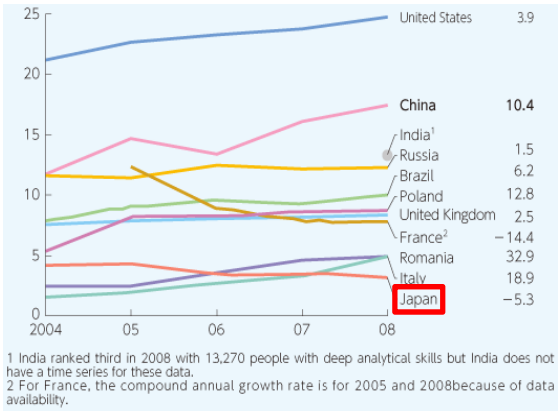
Prediction of world digital data volume increase



Human resources equipped with data analysis abilities

(Unit: 1,000 peo.)

（Yearly growth percentage （2004-08） Unit: %）



Source: MIC’s “"Information and Communications White Paper 2014” (July, 2014)

Direction of Initiatives

- ○ The role of cyber space has become indispensible in the creation of service and value so the necessary research development, such as **big data manipulation, AI, sensor application, and unified systems technologies**, are to be promoted.
- ○ Deal with the ramifications of cyber space on actual society, from the perspective also of social systems, about dealing with personal information, cyber security, and responsibility for AI robotics, etc.
- ○ **Reform STI methods** by promoting data science, strengthening academic information networks, and working with open science, etc.
- ○ **Foster and secure human resources** in the fields of data science, security, and system design, etc. In this case, it will be important to foster and secure diverse human resources that are able to not only specialize in ICT, but also plan out issue resolution and service solutions from a specialized perspective.

Proposal 6: Promoting critical technologies that nation should take leadership

Basic Understanding

✓ In deciding issues of Comprehensive Strategy on STI, in order to strongly promote economic recovery, immediate issues that require urgent resolution are central.

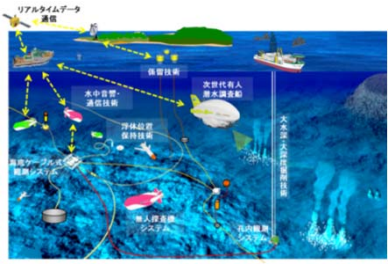
✓ Meanwhile, in order to protect the security and safety of Japan and its people or to provide a driving force for the growth of the country – with consideration to changes in security environments, the threat of natural disasters, and the intensification of international-competition, it is important to acquire, maintain, and develop technologies as the basis of the nation's existence, with an eye to the long-term.

✓ Of these technologies, it is necessary for the government, itself, to designate technologies whose R&D is not easily advanced under private company as "National Critical Technology" and promote strategically with a long-term focus.

Example of "National Critical Technologies"

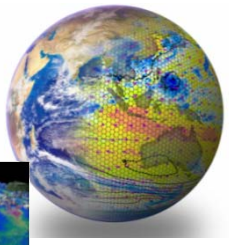
Observation, prediction, and countermeasures for natural disasters; high-performance computing; space exploration; next-generation aircraft; ocean resource surveying; data-driven material design; dynamic living systems science; AI; robotics; cyber security; and, advanced lasers; etc.

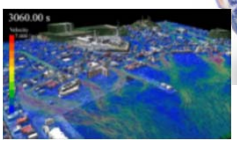
Example of "National Critical Technologies"

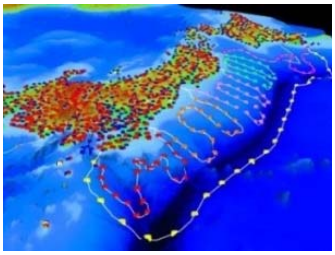


Ocean resource surveying technology (example)

High-performance computer technology (example)







Earthquake and tsunami observation technology (example)

Direction of Initiatives

○ Selection of technologies

✓ **The government must carefully select technologies** with attention to the following perspectives (/requirements):

1) Technologies indispensable in securing the independence and autonomy of Japan.
(Independence/autonomy)

2) Technologies that require long-term R&D and engender high development risks.
(Long-term/uncertainty/unpredictable)

3) Technologies with obvious international originality or with potential of high competitiveness.
(Originality/competitiveness)

4) Technologies with a high flow-on effect to a variety of fields, including social effects. **(Potentiality)**

○ Promotion of technologies

✓ With the activities and functions of the National Research and Development Agency as a base, conduct the accumulation of technologies and human resources and strengthen innovation functions targeted at the integration and systemization of technologies.

✓ Consider roles among industry, academia, and government with reference to the particulars and developmental steps of the technologies; consider open-close strategies, etc. relevant to the particulars of the technology; and, construct appropriate structures for promotion.

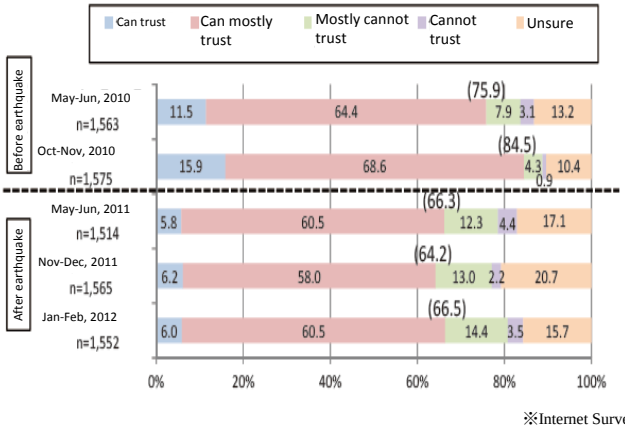
✓ **Specify plans for promoting "National Critical Technologies" through cooperation and collaboration among industry, academia, and government.**

Proposal 7: Strengthening the relationship between STI and society

Basic Understanding

- ✓ Make gaining the understanding, trust, and support of society a major priority in order to strongly advance STI policy moving forward into the future and to drive societal change.
- ✓ From the 1st S&T Basic Plan, importance on the relationship between S&T and society has been placed, and various initiatives have been implemented. However, with extreme changes in society, those initiatives were not necessarily sufficient. Also, due to the Great East Japan Earthquake and misconduct in research, etc., society has continued to lose trust in S&T and researchers, etc.
- ✓ For this reason, placing importance on the idea of regaining trust from society, it is necessary to rebuild the trust relationship between society and S&T and researchers and society, etc.

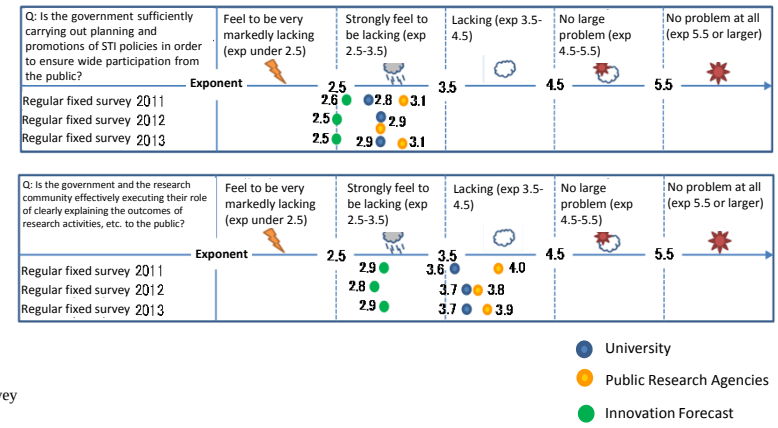
Changes in trust levels toward scientists before and after the Great East Japan Earthquake (Do you think you can trust what scientists say?)



※Internet Survey

Source: NISTEP's "The Analysis about the Change of the Public Attitudes to Science and Technology" (June, 2012)

Changes in perception of affiliated persons in regard to society and STI policies



Source: Compiled by MEXT based on NISTEP's "2013 NISTEP Expert Survey on Japanese S&T and Innovation System" (April, 2014)

Direction of Initiatives

- ○ In addition to creating and revising guidelines, seek the full **cooperation of universities and public research facilities in properly dealing with the problem** of misconduct in research and the dishonest use of research funds.
- ○ Due to the fact that in S&T that there are limits and unknowables, etc. and the fact that unexpected things can occur, promote S&T risk communication dialogue with the public.
- ○ **Promote participation in STI policies and S&T activities by a great variety of stakeholders**, for example, establishing spaces for participation and cooperation between the public, policy makers, and researchers, etc. beginning at the establishment of issues through to their resolution.
- ○ In regard to the building of social systems that make efficient use of advancements in S&T, etc. promote **research development through cooperation between the humanities, the social sciences, and the natural sciences.**

Proposal 8: Strengthening the functions of the National Research and Development Agency

Basic Understanding

✓ The National Research and Development Agency has the excellent qualities such as (1) the goal is maximizing R&D result; (2) top-down structure from facility head; (3) possibility for long-term, strategic initiatives; (4) possibility of organizational initiatives; and, (5) the possibility of the concentration of R&D resources. With new innovation systems in demand, its importance is heightened.

✓ However, the National Research and Development Agencies have not been able to make the most of the important roles that its qualities allow due to the various limitations imposed by the structure of its budgetary and evaluation systems and due to a decline in management expense grants.

✓ With the opportunity offered by the start of FY2015's new system, the drastic strengthening of the National Research and Development Agencies' functions are indispensible.

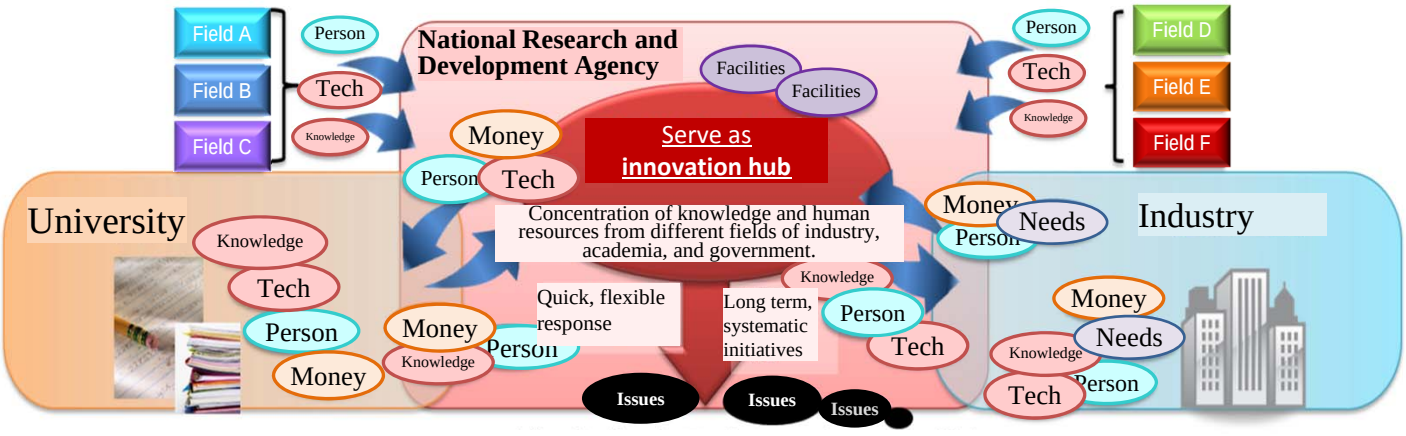
Direction of Initiatives

○ While taking note of its particular qualities, **strengthen the functions of the National Research and Development Agency as the "innovation hub"** that acts as a driving force for new innovation systems.

- ✓ Create **a researcher evaluation system unique to the agency that is not overly concerned with written theses**.
- ✓ **Lead reforms in human resources systems**. (Place importance on experience overseas when employing young researchers; improved treatment of researchers; improved employment of doctoral students; etc.).
- ✓ Form a place for people, things, money, and information from industry, academia, and government to come together. (A space for the melding of human resources and technologies).
- ✓ Research and development in rising/fusion areas through the coming together of researchers, etc. from different fields.
- ✓ Strengthen "bridge-building" research that brings emerging technologies from universities, etc. to industrial level, etc.

○ Promote these initiatives through mid-to-long term goal setting and agency evaluations and through appropriate budget allocation, etc. (repletion of management expenses grants; allocation of chair discretionary expenses; etc.).

○ **Introduce and fully utilize Specially Recognized National R&D Agencies (provisional name).**



High-speed innovation creation