Summary of a White Paper on Science and Technology, 2011
Toward a Robust and Resilient Society
~Lessons from the Great East Japan Earthquake (GEJE)~

(Provisional Translation)

Nature of this document: Annual report on government policy measures that have been implemented to promote science and technology; submitted to the National Diet as stipulated in Article 8 of the Science and Technology Basic Law
(June 19, 2010, Cabinet decision)

Part 1: Toward a Robust and Resilient Society ~Lessons from the GEJE~

This year's white paper reveals various issues and lessons gleaned from the GEJE, and it provides implications for the science, technology and innovation (STI) policy in terms of forming "a Robust and Resilient Society"

Part 2: Measures that have been implemented to promote science and technology
-On the basis of the 4th Science and Technology Basic Plan, measures taken by the government in FY 2011 are reported.

Chap. 1 Review of the Response to the GEJE

- The review revealed various problems and lessons by examining the course of countermeasures to the GEJE and Fukushima nuclear power station (NPS) accident.
- The review investigates how public awareness on science and technology (S&T) in Japan changed after the GEJE and provides an overview of the issues considered in the formulation of the S&T policy.

Section 1. Impact of the GEJE and Responses to it

Issues raised by the review on the GEJE and the responses to it

○ Issues identified (examples)

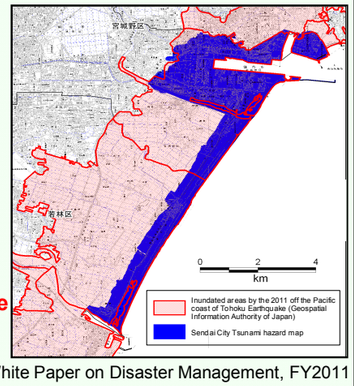
• The government failed to predict the occurrence of a mega earthquake (limitation of existing predicting methods)
× **It failed to consider** a massive earthquake that occurred in the past (**Jogan Earthquake in 869**)
× There is a lack of fundamental knowledge on the mechanism of ocean trench earthquakes.

• Method used to provide the tsunami warning
× **In the first warning, the height of the tsunami was underestimated.**

• Limitations of existing countermeasures and technologies
× Overconfidence in the embankment and technology; **some people did not evacuate**
× Gap between the hazard map and actual area that flooded.

• Insufficient preparation for risks and crises
× **Lack of risk communication**

Tsunami Hazard Map, Sendai City
Estimated and Actual Flooded Area



White Paper on Disaster Management, FY2011

○ Direction for and issues to be considered in future counter-earthquake and tsunami measures

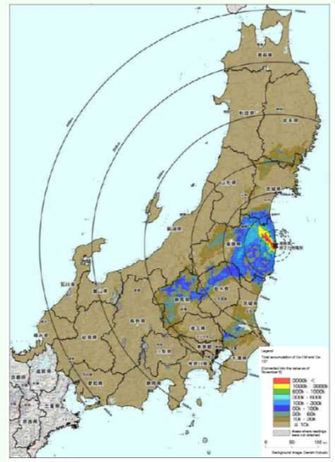
- Promotion of integrated research of different fields such as seismology, geology, archaeology and history
- Reinforcement of the observation system
- Consideration of the uncertainty in and limitation of predicting natural phenomena
- Anticipating massive earthquakes and tsunamis by taking every possibility into account
  ①Extremely low frequency, but extremely large tsunamis⇒ disaster mitigation by evacuation
  ②Highly frequent, but low height tsunamis⇒ physical countermeasures (ex. embankments)
- Social Engineering, Social Sciences, and Humanities have to be considered in implementing countermeasures
- Reinforcing efforts for effective risk communication

Issues raised by the Fukushima NPS accident

○ Report of Japanese government to the IAEA Ministerial Conference on Nuclear Safety
○ The government's Investigation Committee on the accident (Interim Report), Investigation Committee of the Diet, and non-governmental efforts
○ Interim report by MEXT
○ Issues realized after the occurrence of the accident
(issues greatly related to S&T, which have also been identified)
- Establishment and lifting of evacuation zones
- Planning and implementation of radiation monitoring
- Effect of radiation on human health
- Promotion of decontamination
- Securing food safety
- Risk communication
- Response for mitigating the effects of the nuclear power plant accident and decommissioning of the Fukushima Daiichi NPS
- Information provision for the international society

○ Reviewing the nuclear safety regulation system and the energy policy
○ About SPEEDI, various issues including the method of information provision were highlighted. Both, the government and Diet investigation committees are conducting investigations.

The total deposition of Cs-134 and Cs-137 on the ground surface as a result of the nuclear accident



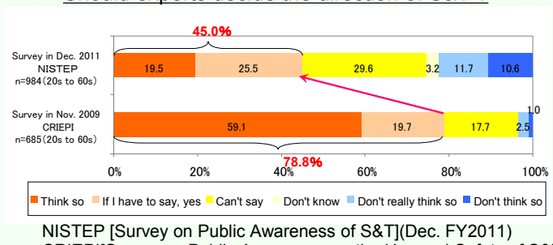
MEXT

Section 2 S&T Policy at Stake

Change in the public awareness of S&T

- After the GEJE, the public's trust in scientists declined
- The ratio of the people is reduced by half "Man can control the S&T "
- Rising concerns with regard to the development of S&T

Should experts decide the direction of S&T ?



NISTEP [Survey on Public Awareness of S&T](Dec. FY2011)
CRIEPI[Survey on Public Awareness on the Use and Safety of S&T] (Nov. FY2009)

S&T policy issues raised after the GEJE

• Risks and uncertainty involved in S&T have not been seriously considered with regard to the provision of information by the government and experts for the public. Therefore, most of the people did not have an adequate understanding of the situation.

○ **Insufficient response to risks (ex. risk evaluation)**
- Insufficient prepared measures that **considered the risk and uncertainty involved in S&T**
- Due to the difficulty in providing risk information to the public, a risk resilient society could not be formed

○ **Inappropriate provision of scientific knowledge**
- Rational **policy decisions based on scientific knowledge** and its **dissemination to the public** were both insufficient

○ **Lack of a system utilizing R&D results to cope with actual issues**
(Ex. Anticipation of the nuclear power plant accident, nuclear power plant safety technology, Earthquake and tsunami prediction skills, robot for use in search and rescue)

○ After the GEJE, **public trust in the S&T policy and experts declined** because of the lack of countermeasures for risks and actual problems.
○ However, the **expectations of the development of S&T remains high.**
○ It is now important to not only **recover the public's trust** by reviewing and reconstructing the S&T policy, but also **promote S&T in response to social needs.**

Chap. 2 Reforming the STI Policy in order to Form a Robust and Resilient Society

○ In this chapter,
- the role of S&T in achieving a robust and resilient society is outlined. This role can mitigate the impact of various problems, aid in rapid recovery, and sustain development.
- we present our stance of encouraging innovation to overcome social challenges and our effort to renew public trust in S&T (by promoting risk communication and creating guidelines on the use of scientific advice in policy making).

Section 1. Rebuilding the Society and the Role of S&T after the GEJE

[Society after the GEJE]
- Japan faces not only natural calamities but also energy crisis, cyber terrorism, and pandemics; therefore, we need a robust and resilient society to face risks and calamities

[Expectations of S&T]
- S&T solutions for the problems caused by the disaster
- Contribution by S&T in formulating solutions for various problems, including those involved in recovery and reconstruction

Section 2. Examples of STI to Overcome the Problems

Advanced efforts for achieving tasks

○Response to earthquakes and tsunamis
- •Upgrade of the Earthquake Early Warning System (JMA)
- •Upgrade of the Tsunami Warning System (JMA)
- •Development of information-collection and decision-making support systems to ensure sound operations in case of any unexpected disasters (TOKYO TECH, etc.)

○Response to the nuclear power plant accident
- •Utilize S&T for environmental monitoring (MEXT, etc.)
- •Simulation of marine pollution (JAMSTEC, etc.)
- •Decontamination using zeolites, etc. (JAEA, etc.)
- •In response to a tighter electricity supply-demand balance after the GEJE, efforts to expand the use of renewable energy (Kitakyushu City, etc.)

R&D contribution to the recovery and reconstruction of businesses in disaster-hit areas

○Implementation of existing R&D results
- •Bio-disposition spilled oil using Bark Compost (Oita Industrial Research Institute・JST)
- •Improvement of the marine environment by the micro bubble technique (Tokuyama College of Technology・JST)

○Construction of R&D bases
- •Fukushima renewable energy research base (tentative) (AIST)
- •Tohoku Medical Megabank project (Tohoku Univ., etc.)
- •R&D base for medical/welfare equipment and medicine industry (Fukushima Pref.)
- •R&D base for radiation and decontamination (Fukushima Pref.)
- •R&D base to strengthen disaster-resistance of the information and communications network (NICT)
- •Tohoku Marine Science Center (Tohoku Univ., etc.)

Section 3. Future Improvements to the STI Policy ~to Overcome the Problems Caused by the GEJE~

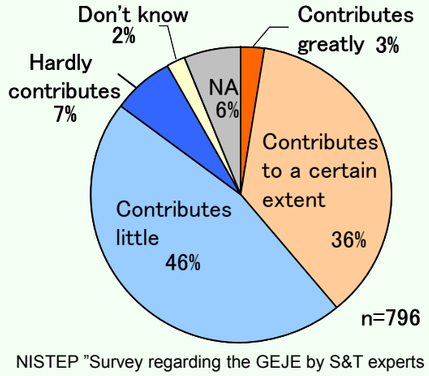
Promotion of STI in response to social needs

○Over 50% of the number of experts realize that R&D results do not contribute to solutions for social problems

[Reasons]
- Gap between the experts and society
- Inadequate understanding of and research on social needs
- S&T in Japan is not systematically organized and does not provide applicable solutions.

[Renovation Method]
- Timely discovery of urgent issues
- Overall S&T management
- Efficient and effective implementation of R&D results

Do R&D results contribute to solutions for social problems?



NISTEP "Survey regarding the GEJE by S&T experts (2nd ed.)" (Sept. FY2011)

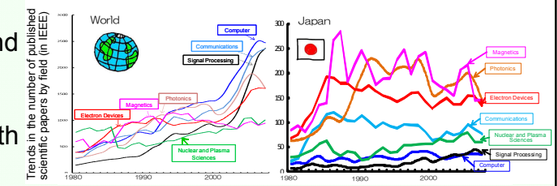
○To address the issues, integrated academic knowledge including that on social sciences and humanities is required; however…
- In Japan, there is not active coordination and integration between the fields of social sciences, humanities, and natural sciences.

- In Japan, it seems that R&D does not respond to changes in the industrial system and social needs

→In the global trend of academic paper releases, electronics was the most popular field during the 90s. Information and telecommunications was the most popular field in the 2000s. However, electronics is still the most popular field in Japan.

[Reasons]
- Highly specialized research areas deprive many scientists of opportunities to conduct interdisciplinary studies
- It is difficult to write papers on integrated studies, and therefore, evaluation and obtaining research funds also become difficult
- Insufficient number of researchers who can cope with discipline diversification
- Most researchers have little interest in disciplines other than their own, and thus, do not feel the need to conduct interdisciplinary studies

Incongruence between R&D development and the changes in the Japanese industrial system



MEXT, based on the report by NISTEP

[Efforts required]

○Research in the fields of the social sciences and humanities should be used to understand humans, society, and the economy.

(Ex.)
- Top-down projects and policy-related programs to promote cooperation
- Evaluation standards and incentives (ex. special funds) for integrated research
- Integrated education and research programs concerning the natural and social sciences and humanities at universities
- Promoting the idea of social responsibility among researchers

○In order to promote productive innovation, it is essential to construct a system that can promptly respond to rapidly changing social needs and issues

○Various policy-related efforts are required, such as the establishment of a program for integrated research, reforms in the research evaluation process and funding system, and cultivation of effective human resources to conduct the integrated research and evaluation.

Toward renewing society's trust in S&T

○ Development of science, increasing problems caused by the risks and uncertainty involved in S&T

✓ Various efforts are required to face the risks

- Risk Communication

  Process of sharing information on risks and uncertainty by stakeholders, building mutual understanding, and achieving consensus

  → It is essential to get society to agree to face the risks that can emerge in the process of employing S&T
- Regulatory Science

  Promotion of science that integrates scientific knowledge with regulations, supports rational risk management and safety policies →Use the S&T results to meet the needs of the people
- Evaluation of the impact of advanced technologies on society

  → Increase the opportunities for mutual discussions between the public and researchers, support the policy decision with social acceptance of advanced technologies

○ In attempting to deepen the relationship between society and S&T, the government faces highly complicated policy-related issues

→ A system that enables the appropriate use of experts' scientific advice is indispensable.

✓ System of providing scientific advice to the government; cases of the USA and the UK

USA: Advisors (APST, PCAST, National Academies) give advice on issues related to S&T

UK: GCSA, Royal Academy (In case of the Fukushima NPS accident, they gave appropriate advice along with relevant scientists)

→ In Japan, we also need a system through which scientific advice can be provided to the government for use in public administration

While promoting the development of S&T to overcome various disasters, including natural calamities, we should strengthen the development of a robust and resilient society that nurtures the dreams and hopes of the people.