

Scientific Advice

Science, Technology, and Policy Making in the Twenty-First Century

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with

a special contribution by **Hiroyuki Yoshikawa**

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< About this book >

Scientific advice has become essential in many policy areas today. While the process and institutions of scientific advice are discussed globally, interest in this topic has grown in Japan, too, after the Great East Japan Earthquake of 2011.

This book gives an overall picture of scientific advice and key issues relevant to it. Part I analyzes the structure and processes of scientific advice in conceptual and actual settings, and introduces global trends of scientific advice. Part II examines mechanisms of scientific advice in such policy areas as food safety, drug approval, earthquake prediction, and global warming, and compares their virtues as well as problems. Finally, this book explores future directions for scientific advice as the foundation for the twenty-first century society, which is characterized by ever more complexities and uncertainties.

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Scientists (including engineers, doctors, social scientists, etc.) and their organizations provide policy makers with scientific advice based on their expertise, so that the policy makers can make appropriate policies and decisions.

Scientific advice has steadily grown in importance in contemporary society, as the task of policy makers has become increasingly more complex. They have had to meet increasing social demands for better management of health and environmental risks, more cost-effective and rational policy making, and more accountability.

Discussions on scientific advice from various perspectives have accumulated since the 1960s. In that process, concepts such as risk assessment and regulatory science has also emerged. Establishing communication between the community engaged with such concepts and the one which has recently taken renewed interest in scientific advice can be considered as an urgent task now.

Scientific advice is an inclusive concept. It encompasses “Policy for Science” and “Science for Policy” (see table below). There are scientific advices by diverse advisors in diverse policy areas. The concept of scientific advice has lately gained worldwide attention for its capacity to offer general perspectives in examining and explaining science-policy relationships in transdisciplinary, sometimes transnational manner and taking into the picture real dynamics of politics and public administration.

In Japan, too, scientific advice has come under attention after the Great East Japan Earthquake of 2011. Scientific advice will be a critical infrastructure to support the twenty-first century society fraught with ever more complexities and uncertainties.

Table Subject and contents of scientific advice

	Policy for Science	Science for Policy
Subject for advice	Science and technology policy or STI policy	Diverse range of policy fields (medicine, environment, ...)
Main foundations of the contents of advice	Scientific evidence and broader knowledge of scientists*	Scientific evidence

* “Broader knowledge of scientists” here means, for example, scientists’ views concerning future potential of particular scientific fields and associated social and economic impacts, based on their expertise and experience. Since not much portion of “Policy for Science” is amenable to evidence-based policy making as of now, subjective judgments and discussions backed up by scientists’ past achievements and experience are still needed. Meanwhile, “Science for Policy” in such areas as food safety and drug approval should be mainly based on scientific evidence, at least ideally. Of course, however, policy making in these areas is ultimately based on overall consideration of various factors including subjective judgments, public opinion, and social and economic situations.

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Institutional and procedural design of scientific advice has recently been discussed extensively. How can scientific advice leading to proper policy making be achieved?

In general terms, the essence of scientific advice is to bridge science and politics. While the two embrace distinct values and behavioral patterns, they need to trust each other and maintain communication, so that they can solve a range of complex problems that today's society faces. In mediating the two sides, scientific advisors, scientific advisory organizations, and think-tanks play indispensable roles.

In real settings, it is important to note the diversity of policy areas that are subject to scientific advice. In many policy areas, risk assessment is expected of scientific advice. Risk assessment is always accompanied by benefit assessment; in some policy areas, the latter is more important than the former. Thus one can see two aspects of scientific advice: One for regulatory actions based on risk assessment and the other for strategy making based on benefit assessment (see figure below).

Social science plays a particularly large role in advice for strategy making, where assessment of the effects of public expenditure is critical. In reality, however, social science as of now has not matured yet to the extent where it can properly conduct such assessment. In other words, policy areas subject to advice for strategy making can be considered latecomers in the ongoing macro trend for evidence-based policy making. However, the utility of evidence in such policy areas might dramatically expand in the near future because of rapid progress of data science and other technologies.

In any policy area, a central challenge for the design of scientific advisory system is how to ensure the independence of scientific advisors from the government while also maintaining interaction and trust between them. That is the topic of Chapter 1, while Chapter 2 covers other important issues. Chapter 3 discusses the diversity of national scientific advisory systems and the trend for globalization of scientific advice.

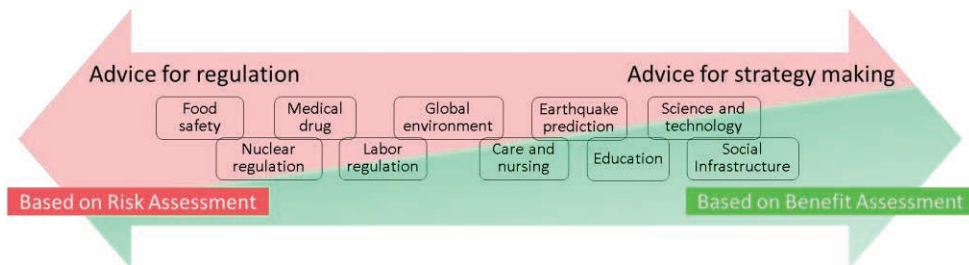


Figure Conception of the structure of advice for regulation and advice for strategy

The independence of scientific advisors from the government is the most critical requirement for effective scientific advice. At the same time, however, there must be proper communication and interaction between them. Setting an appropriate distance between them or finding the best division of labor is not a simple issue.

In policy areas where risk assessment plays a large role, such as food safety and drug approval, separating risk assessment, conducted from scientific viewpoints, from risk management, conducted from overall viewpoints, is considered important, even though communication between the two sides is also required. Their relationships are actually complex, and the realm of responsibility of scientific advisors who take charge of risk assessment is variable, as shown in Part II.

Meanwhile, the concept of “honest broker,” proposed by political scientist Roger A. Pielke, Jr., presents a general model of the role of scientific advisors (see table below). An “honest broker” offers policy options as well as relevant scientific knowledge in regard to policy issues. In risk-related policy areas, that means scientific advisors take charge of not only risk assessment but also preparing policy options (see figure below). Actually, either scientific advisors or the government, or both of them jointly, can make policy options. In other words, their realms of responsibility can overlap there.

Table Four models of scientific advisors

		View of science	
		Linear model	Stakeholder model
View of democracy	Madison	Pure Scientist	Issue Advocate
	Schattschneider	Science Arbiter	Honest Broker of Policy Alternative

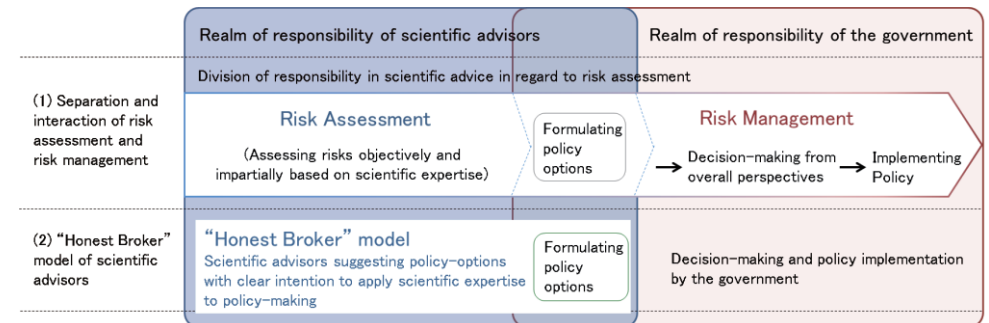


Figure Realms of Responsibility of scientific advisors and the government

The process of scientific advice needs to be carefully managed to keep it sound and effective (see figure below). In the first place, policy makers need to properly frame the question and select advisors. Then, the independence of scientific advisors must be secured to ensure the quality of advice. Finally, the advice should be communicated to policy makers in a timely and pertinent manner, and used appropriately.

The whole process must be transparent, and some schemes need to be established to handle legal liabilities that could result from administrative actions based on scientific advices. Proper mechanisms for scientific advice in emergency situations should also be installed.

In some countries, principles, guidelines, or codes of conduct have been developed recently to ensure the integrity of scientific advice. In particular, the U.K. and the U.S. have systematically set up their codes of conducts, following the BSE controversy in the 1990s and the intervention of politics in science in the 2000s, respectively. These codes of conduct address such issues as balanced selection of scientific advisors, fair handling of conflicts of interest, proper assessment, communication, and management of uncertainties associated with scientific advice, and securing the transparency and openness of the process. In addition, it is also remarkable that a U.K. code of conduct characterizes the general relationships between scientific advisors and the government this way: “Scientific advisers should respect the democratic mandate of the government to take decisions based on a wide range of factors and recognize that science is only part of the evidence that government must consider in developing policy.”

In Japan, too, after the Great East Japan Earthquake evoked widespread attention on scientific advice in 2011, the Science Council of Japan revised “the Code of Conduct for Scientists” in January 2013 to provide some basic principles for scientific advice.

Meanwhile, OECD’s Global Science Forum in 2013 started an international study on scientific advice, in which the authors participated as co-chairs. Its report, published in 2015, proposed general requirements for effective scientific advice. Such international endeavors will continue to expand in the years to come.



Figure The process of scientific advice and related issues

Each nation has its own national scientific advisory system, which comprises varied scientific advisory bodies. National scientific advisory systems are highly diverse, as they have historically evolved reflecting the unique political, administrative, scientific, and cultural traditions and institutions of nations. Nonetheless, a taxonomy of scientific bodies can be proposed as follows:

- (a) High-level councils for science and technology policy
- (b) Government advisory committees
- (c) Academies, professional societies, and research organizations
- (d) Individual scientific advisors and counsellors

While national scientific advisory systems are diverse, the trend for globalization of scientific advice has been accelerating lately. International bodies supplying scientific advice have consistently increased since the end of World War II, but many nations as well as international bodies including the United Nations have remarkably strengthened their efforts in this area in the 2010s. In order to fully exploit the potential of diverse international bodies related to scientific advice in the future, it would be desirable to form an effective “system of systems” (see figure below).

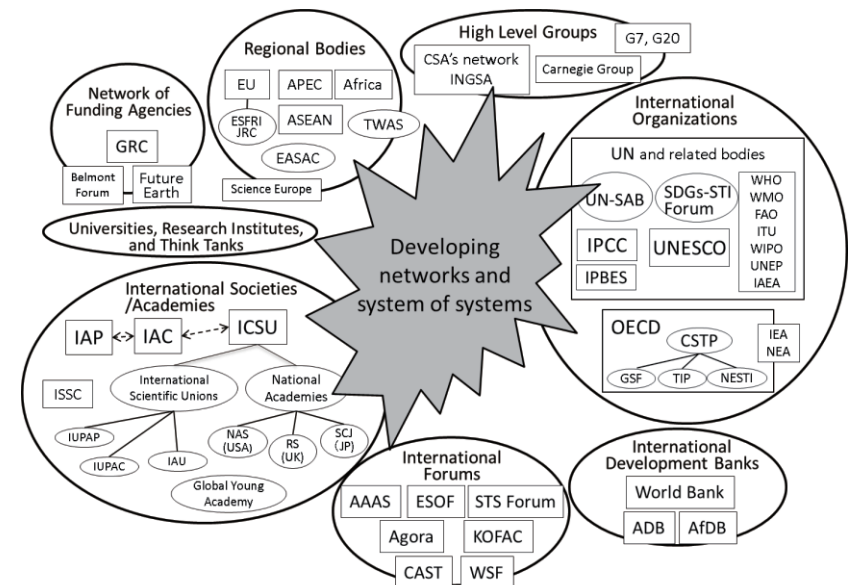


Figure Expanding international bodies and networks related to scientific advice and STI policy

While scientific advice has now become indispensable in a broad range of policy areas, scientific advisory mechanisms in each of those policy areas have been shaped historically and thus embrace unique characteristics as well as problems.

For example, realms of responsibility of scientific advisory bodies differ from one policy area to another in Japan (see figure below). In such areas as food safety and earthquake prediction, which are examined in Chapters 4 and 6 of this book, scientific advisory bodies strictly limit their roles to scientific risk assessment, refraining from preparing policy options. In drug approval, which is covered in Chapter 5, the role of scientific advisory body extends from risk assessment to preparing policy options and then actually to decision-making from overall viewpoints. In climate change, discussed in Chapter 7, IPCC's role is from risk assessment to preparing policy options.

Each policy area has unique circumstances, such as frequent conflicts of interest in drug approval and extremely high uncertainties of the science of earthquake prediction. In the STI policy area, taken up in Chapter 8, scientific advice for "Policy for Science" is also still fraught with problems, such as high uncertainties inherent in social science. Examining current schemes and practices of scientific advice in different policy areas comparatively might enable conception and design of more effective scientific advisory institutions and processes.

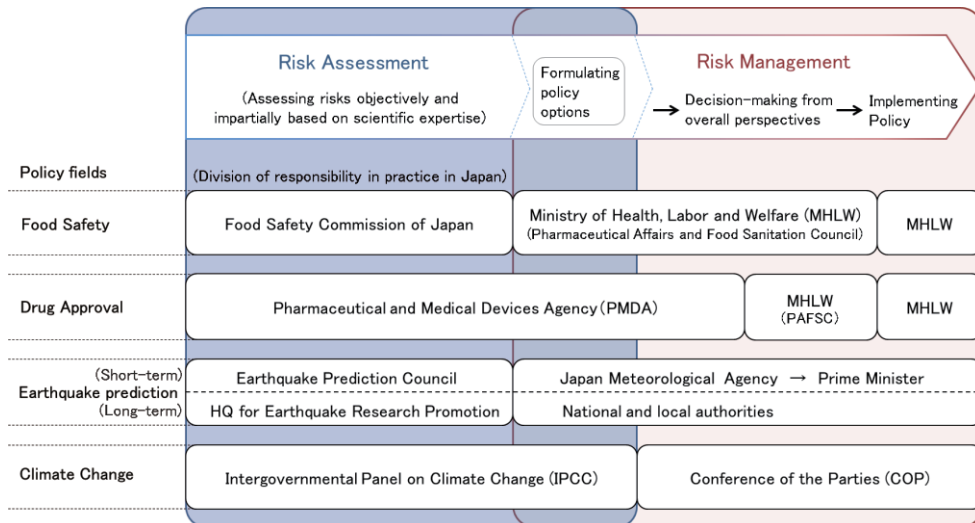
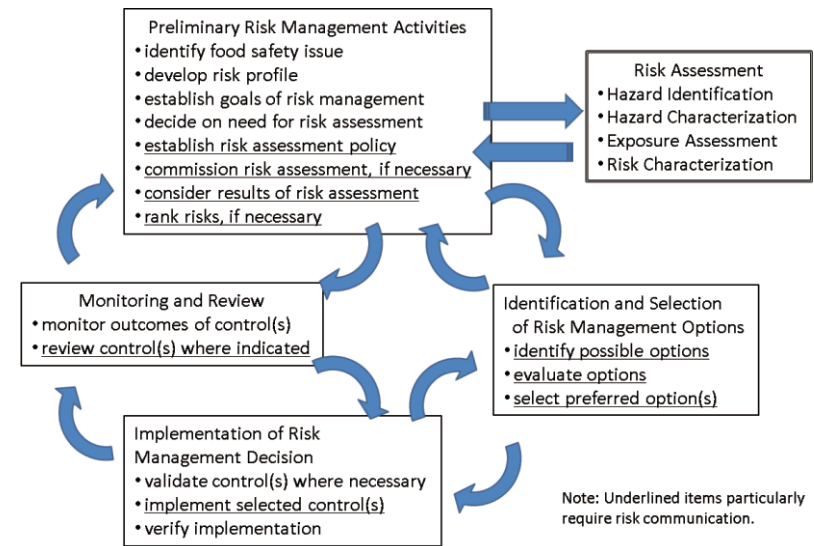


Figure Realms of responsibility of scientific advisors and the government in different policy areas in Japan

In Japan, the health effects of food poisoning and food additives, pesticide residue, and genetically-modified foods have long attracted public attention. While dealing with those matters, the government has made efforts to improve food safety. However, with the first domestic BSE (the Bovine Spongiform Encephalopathy) case reported in 2001, Japan's food safety system was fundamentally reformed. The Food Safety Basic Act and the Food Safety Commission of Japan (FSC) was established, and based on the act, the commission was mandated to undertake risk assessment from scientific viewpoints, independently from risk management institutions.

However, problems related to Japan's food safety system has recently been observed. In such cases as BSE inspection and the regulation of foods containing radioactive materials, FSC tended to persist in the independence of risk assessment and fail to maintain enough communication with risk management institutions, inviting criticisms that the commission lacked broader considerations. To establish an effective system for food safety, making best use of scientific advice, it might be of great importance to promote careful discussions on the relationship between risk assessment institutions and risk management institutions.



Reference: FAO/WHO, *Food Safety Risk Analysis: A Guide for National Food Safety Authorities*, Rome, 2006.

Figure Three Elements and Structure of Risk Analysis

For many decades Japan’s system for drug approval and control has been improved, often based on bitter experience of serious drug-induced incidents. The system seems not mature enough, however, to effectively link science/technology with society/policy. The current system for drug approval came into being in 2004, with the creation of the Pharmaceutical and Medical Devices Agency (PMDA). But around that time, serious cases of conflicts of interest started to draw public attention. Scientists involved in the approval of drugs with critical side-effects had received large donations and research funds from related pharmaceutical firms. Although the government has developed a set of clear rules to handle conflicts of interest by now, more efforts will be necessary to construct a reliable base for scientific advice in this particular policy area.

The organizational setup for drug approval in Japan needs to be reexamined as well. Currently, PMDA, the primary scientific advisory body in this policy area, is basically expected to conduct independent risk assessment from scientific viewpoints, while the Ministry of Health, Labor and Welfare (MHLW) takes charge of risk management from overall viewpoints. In practice, however, it is pointed out that MHLW’s viewpoints are deeply taken into PMDA’s review process (see figure below). Such a subtle division of labor between PMDA and MHLW should have merits and demerits, which deserve careful examination in envisioning a better overall organizational arrangement.

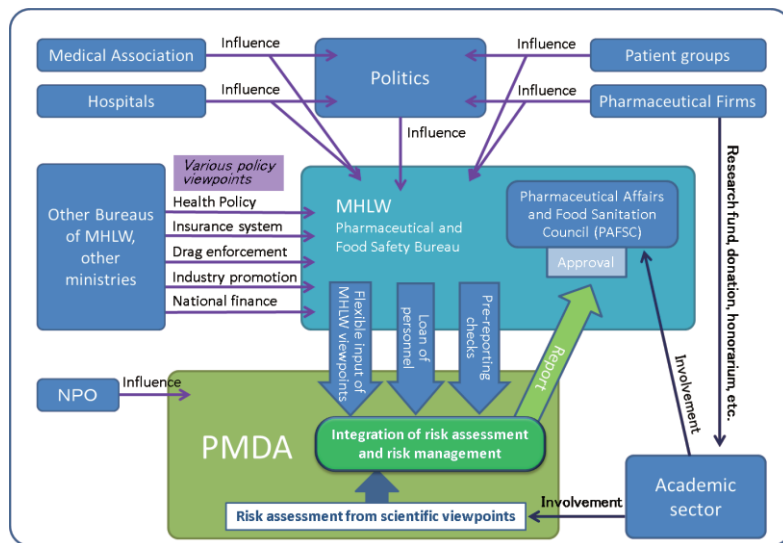


Figure Drug approval by PMDA and MHLW in practice

The Japanese government has always put high priority on taking countermeasures against earthquake, and sought to establish an effective mechanism of scientific advice in this field, in light of strong social and political demands for earthquake prediction. During the 1970s, earthquake prediction was promoted as a national project, amidst a heightened public fear for a great earthquake. In 1978, when the outlook for earthquake prediction was still uncertain, the Large-Scale Earthquake Countermeasures Law was established, and the government started to take measures against the Tokai earthquake in accordance with the law. However, the Great Hanshin/Awaji Earthquake in 1995 and the Great East Japan Earthquake in 2011 made the government acknowledge the difficulty of earthquake prediction, urging a gradual shift of emphasis from earthquake prediction to long-term probabilistic assessment of earthquake occurrence.

In retrospect, one could observe that the Japanese government, in devising policies regarding earthquake, has given much consideration to social demands but not enough attention to uncertainties of the science of earthquake prediction. Scientists, for their part, has not properly communicated its limitations, either. Scientists and policy makers should now design together proper mechanisms for reducing the damage of earthquake disaster, giving fair consideration to both social demands and scientific uncertainties.

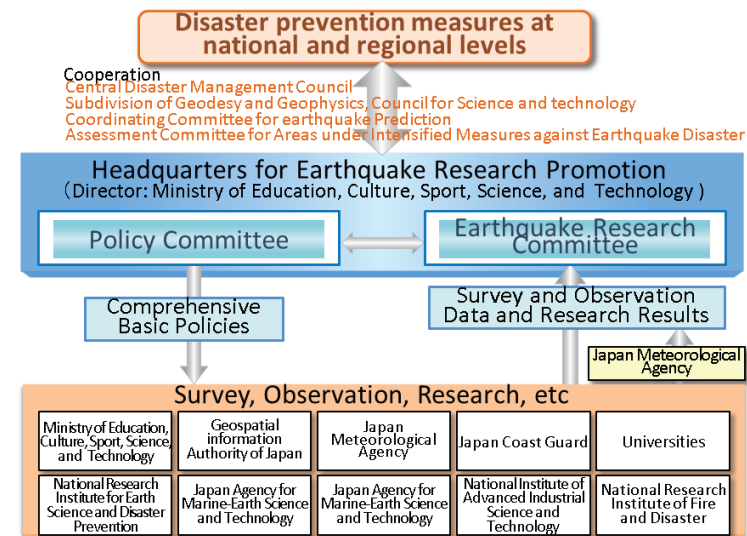


Figure Overview of organizations related to earthquake research and disaster prevention in Japan (Reference: Headquarters for Earthquake Research Promotion)

Global warming is a major policy area requiring international scientific advice. In this area, collaboration between science and politics in the international arena quickly developed. In response to clear caution by the scientific community in 1985, the risk assessment body in this area, the Intergovernmental Panel on Climate Change (IPCC), was established in 1988. IPCC published its First Assessment Report as early as 1990, and gave impetus to international efforts which would result in the adoption of the U.N. Framework Convention on Climate Change (1992) and the Kyoto Protocol (1997).

IPCC consists of three working groups, which prepares reports and “summary for policymakers” (see figure below). As government officials as well as scientists from all over the world participate in the process, the reports and summaries tend to be readily accepted by member nations. In short, IPCC is a unique organization where scientific advisors and policy makers jointly conduct risk assessment and prepare policy options.

IPCC’s scientific advice has increasingly shown its limitations, however. The Kyoto protocol was not based on risk assessment by IPCC but on political compromises, and its real effectiveness turned out to be very small. In 2009, the “Climategate scandal” temporarily destroyed the authenticity of climate science and put questions to IPCC’s transparency and accountability. While the Paris Agreement, which is based on a totally new approach to the climate change problem, was adopted in late 2015, whether it will work effectively remains to be seen.

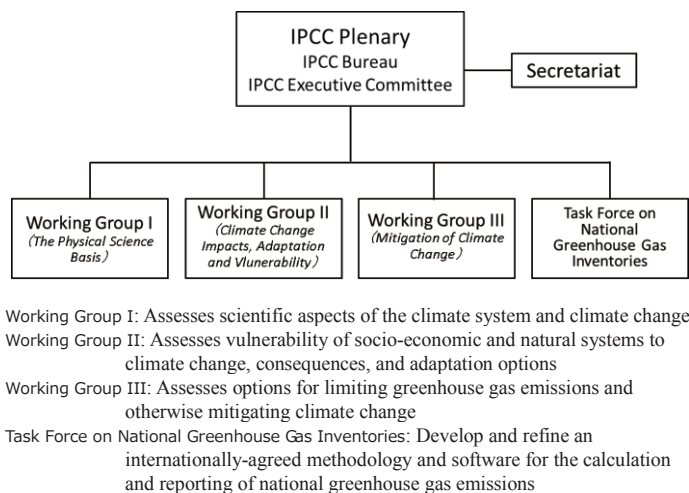


Figure IPCC organization

Scientific advice for STI policy is called “policy for science,” as opposed to “science for policy.” There are diverse organizations related to STI policy in Japan (see figure below); at the pinnacle is the Council for Science, Technology and Innovation (CSTI), which has an aspect as a scientific advisory body and another as the highest decision making body, determining policies in cooperation with other relevant organizations. On the other hand, the Science Council of Japan is a purely scientific advisory body.

Recently, evidence has been given greater weight in STI policy. A vast amount of evidence prepared by the National Institute of Science & Technology Policy (NISTEP) and other think-tank organizations such as CRDS began to offer significant foundations for policy making in the 2000s. On the other hand, STI policy also became sensitive to political agendas since around 2010.

Emphasis on evidence is steadily permeating within STI policy. However, there still are many challenges, including a high level of uncertainties associated with knowledge needed for policy making. To improve such a situation, the Japanese government has been promoting the Science for RE-designing STI Policy (SciREX) program.

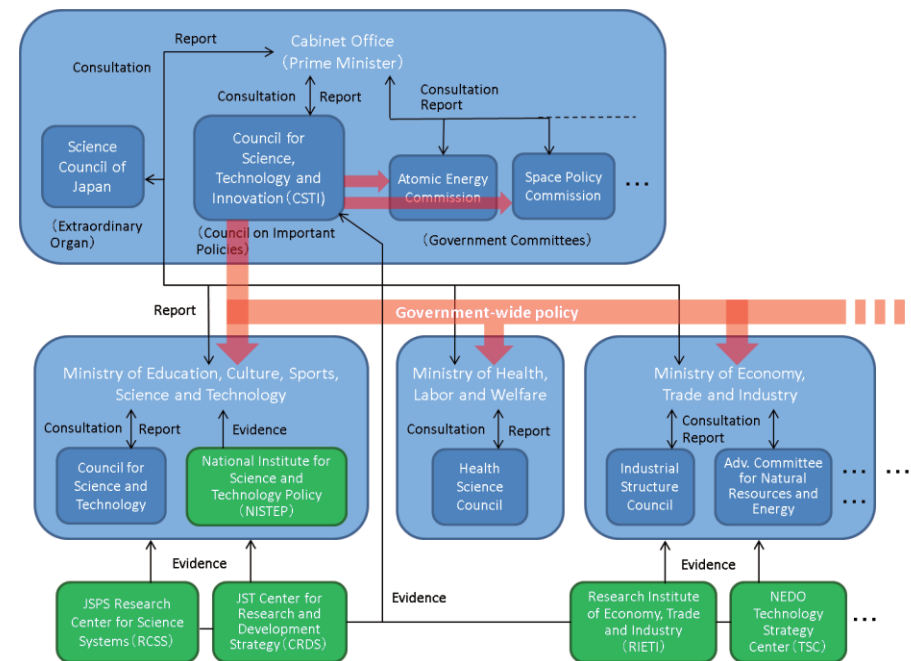


Figure Public organizations related to STI policy in Japan (2016)

The current trends of globalization, rise of developing countries, progress of ICT, and increasingly complex global challenges are impelling an enormous transformation of science and technology. In such a time of political, economic, social, scientific, and technological transition, scientific advice is getting ever more important.

Scientific advice is based on the bridging of science and politics (see figure below). Science and politics, while keeping their different values and behavioral patterns, have to collaborate to tackle challenges of today's society. Both sides must understand such a subtle structure and establish mutual trust in fulfilling their roles and responsibilities, in order for scientific advice to work well.

Scientific advisors should possess not only scientific expertise but also capabilities to understand historical viewpoints, social and economic needs, and national and global visions, and address them. It is hard, however, for a small number of individuals and organizations to make proper scientific advices for all contemporary policy issues. It is essential to strengthen durable supporting structures, including institutional networks, policy databases, and think-tank functions as well as human resources to staff them.

In September 2015, the U.N. adopted the "Sustainable Development Goals (SDGs)," a common goal for the international community for the next 15 years. Today's global challenges sorely need as much contribution from STI and scientific advice as possible.

As the importance of scientific advice has come to be recognized in Japan, the role of scientists should be reexamined. Japan has a unique tradition of social engagement by the scientific community, but the relationship between science and politics has not undergone a process of explication and social agreement. A national scientific advisory system based on the articulation of such a relationship is needed.

There are two types of scientific advice, although they are not clearly distinguished. One is "Policy for Science," which is advice needed to make STI policy. This type of scientific advice is further divided into two; one regards issues related to the essentials of science, such issues as how to protect scientific freedom and how to fulfill scientists' responsibilities associated with such freedom. The other regards policy makers' role to promote research; scientists advocate the importance of their research to policy makers, who then turn such information into STI policy.

The second type of scientific advice is "Science for Policy." In today's world, where the power of science has become so large, scientific advice is needed in a wide range of policy areas. The scientific community should have interest in making contributions to policy making in relevant policy areas with their expertise, although that is not easy in practice. A particularly important challenge in Japan is to strengthen organizations and institutions of scientific advice for "Science for Policy," which must be independent, balanced, and neutral.

The lack of a mutually shared understanding on the roles of scientific advisors and policy makers brought about confusion in policy making at the time of the Fukushima nuclear disaster in 2011. Reflecting upon this experience, necessary discussion should be accumulated on the responsibilities of scientists and policy makers as well as the organization for scientific advice, with the aim of achieving public understanding on such issues .

Two prime concerns of scientists should operate simultaneously within the scientific community. One is their concern as researchers, who devote themselves to their own research themes; the other is their concern as advisors, who do not persist in their own research themes but reflect on the relationship between science and society. Although these two concerns can coexist within a scientist, they could also be properly borne within the scientific community. It is necessary to envision how to expand ways for scientists to enter the dialogue between science and society, including scientific advice, and make such visions into reality.

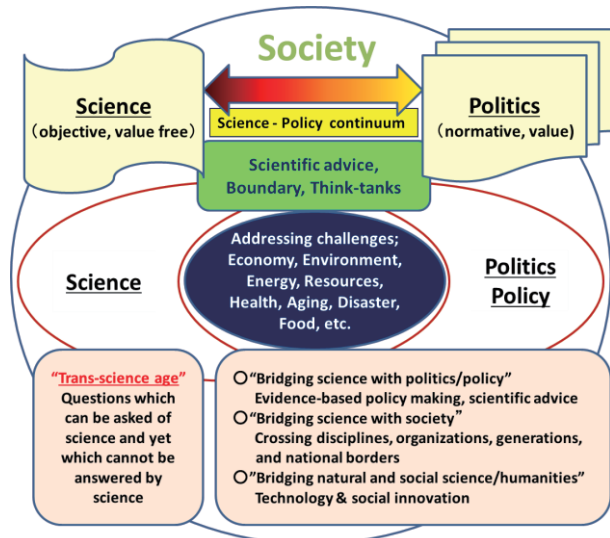
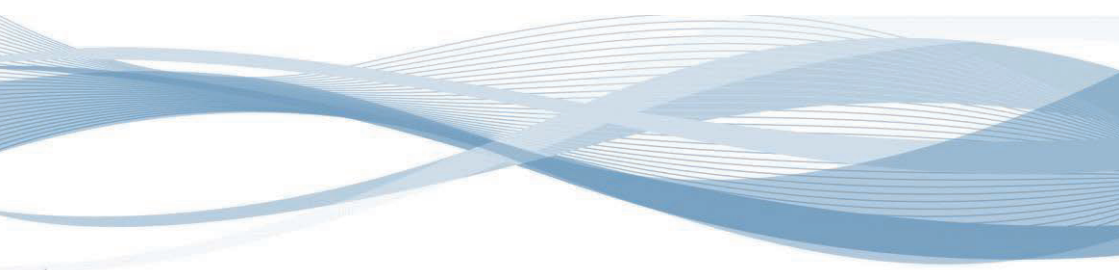


Figure The structure of scientific advice



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