Keynote Speech

Hiroo Imura

Council for Science and Technology Policy, Japan

I currently work as a member of the Council for Science and Technology Policy of the Japanese Cabinet. Today I wish to speak to you about science and technology policy and expectations for technology forecasts in Japan.

The Council for Science and Technology preceded today's Council for Science and Technology Policy. The previous council was created in 1959, and in 2000 it was reorganized as the Council for Science and Technology Policy. A major function of the former Council for Science and Technology was to determine national science and technology policy for 10-year periods. It published its first report in 1960, and basic policy was subsequently set three more times, in 1972, 1984, and 1992. The 1992 report was noteworthy as a plan that looked to a new century.

At that time, the Council for Science and Technology was located in the now-defunct Science and Technology Agency, which in 1970 began publishing technology projections that were first titled *Technology Forecast* and later *Foresight*. First carried out in 1970, the forecasts predicted technology by utilizing the so-called Delphi Method of repeated questionnaires. Since 1970, these technology forecasts have been conducted and published approximately once every five years, for a total of seven times.

Just how far such forecasts were used in formulation of national science and technology policy, however, is a matter of some doubt. As you know, Japan has been struggling with long-term economic recession since 1990. It has become increasingly clear that this recession is structural rather than a part of the ordinary business cycle. Technological innovation is considered one method of overcoming these economic difficulties, and increased promotion of science and technology has become an important policy.

In 1995, the Japanese Diet passed the Science and Technology Basic Act. Although a 1960 report by the Council for Science and Technology had called for the enactment of just such a law, it was not until 35 years later that the law actually came into being.

Under the Basic Act, national science and technology policy for the coming 10 years must be determined at 5-year intervals. In 1996, therefore, the Science and Technology Basic Plan for the next 5 years was decided. Under the plan, Japan greatly increased its investment in science and technology. While such investment had been somewhat below the level of the U.S. and Europe as a percentage of GDP, it was actually raised to approximate the same standard.

In 2001, the Council for Science and Technology was reorganized as the Council for Science and Technology Policy. Also in 2001, the second Science and Technology Basic Plan, covering the years 2001 through 2005, was determined.

The current Council for Science and Technology Policy is situated within the Cabinet Office, and the prime minister is the Council chairperson. The remainder of the Council comprises five government ministers and eight other persons of knowledge and achievement, two out of that eight from private industry. By law, the cabinet minister overseeing science and technology may also be a member, and Hiroyuki Hosoda, Minister of State for Science and Technology Policy, currently holds that post. The Council office has a staff of approximately 100.

The Council for Science and Technology Policy meets monthly, and determines basic science and technology policy for Japan. At the same time, it serves to coordinate policies among the various government ministries. Science and technology policies are actually implemented by the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Public Management, Home Affairs, Posts and Telecommunications, the Ministry of Health, Labor, and Welfare, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Economy, Trade and Industry, the Ministry of Land, Infrastructure and Transport, and the Ministry of the Environment.

The Second Science and Technology Basic Plan is made up of two core policies. First is the strategic promotion of science and technology research. Because basic research is extremely important, a certain amount of funding is set aside for research based on the free expression of scientists. Four fields, however, life science, telecommunications, environmental science, and nanotechnology and materials, have been selected for prioritized, goal-oriented research. Fields such as energy and new fields that may come into existence are also taken into consideration. Because increased funding is vital in order to prioritize science and technology, the Plan sets a goal of increasing research funds over the five years.

Merely increasing funding, however, cannot ensure the success of Japan's science and technology research. That is why the second core policy of the Basic Plan is to reform Japan's science and technology research and development systems. Japan's universities have been lacking in competition, which must be promoted. The Plan therefore sets a goal of doubling funding for competitive research grants. It also calls for increased funding for younger researchers and for the promotion of easier movement of scientists between research institutions. Furthermore, because research facilities at Japanese universities, and at national universities in particular, are aging and being outgrown, improvement of that situation is an important goal. In addition, systems for the evaluation of research are to be reformed. Finally, the Plan calls for improved science education, strengthened cooperation between universities and industry, and deepened channels between science and technology and society.

Now I will describe some of the activities of the Council for Science and Technology Policy during its two-year existence. First, it completed the Science and Technology

Basic Plan for the years 2001 through 2005. Based on the plan, in September 2001 the Council determined priority research areas in each field. The Council also devised a structure to give it input into the process of determining science and technology budgets every year. The Council achieves input into budget allocation by evaluating each ministry's science and technology budget and informing the Ministry of Finance of the results.

Processes to distribute competitive research grants are being reformed as part of the reform of science and technology systems. Implementation of policies to ease the movement of scientists between research institutions has begun. Research funding for younger scientists has been increased. Improvement of research facilities at national and other universities is underway. The fundamental principles and basic policies for evaluating research within each ministry have been determined. Policies to promote cooperation among industry, academia, and government and to promote research and development activities in various parts of Japan are being implemented. For example, research and development clusters are now forming in different parts of Japan.

There is still much to be done, however. Because there are many problems with Japan's systems for distributing competitive grants, further reform efforts are necessary. It is also vital to promote research in emerging fields such as nanotechnology. Furthermore, the development of outstanding scientists, particularly in emerging fields, is an important concern. Another important issue is how to reform universities so that they can respond to rapid changes in science and technology.

Expectations placed on technology forecasts, or science and technology forecasts, have therefore become higher. By providing knowledge of future possibilities and needs, technology forecasts can offer a vision that plays an important role in determining national science and technology policy.

However, there are obviously many difficulties involved in making science and technology forecasts. One difficulty is the appearance of unexpected breakthroughs. Such breakthroughs are often serendipitous discoveries. In other words, a scientist pursuing research with one goal in mind may serendipitously make a completely different but useful discovery. Such things are beyond the ability of human beings to predict. We forecast the future based on experience and knowledge, but natural phenomena that no one had thought of are often discovered, and science and technology make great advances thereby.

A second difficulty is that new fields are continuously and rapidly developing. For example, it is very difficult to forecast the development of new fields such as nanotechnology and bioinformatics because there are few scientists and specialists in those areas.

A third problem is rapid changes in research and development systems. The number of scientists around the world has greatly increased, as has joint research by international consortiums. The participation of venture capital in research and development is also causing great changes in R&D activity.

Research can, of course, be divided into two kinds, the breakthrough type and the incremental type. Breakthroughs advance research. Incremental research is relatively easy to forecast, but breakthroughs are extremely difficult to predict.

One example of this is research on the human genome. In 1988, a G8 meeting on bioethics and human genetics was held in Rome. The purpose of the meeting was to examine the scientific and ethical aspects of genetic research. I also attended this meeting in which a Nobel Prize laureate, Walter Gilbert, delivered the keynote lecture. During the lecture, Gilbert predicted that the human genome would not be mapped until 2015. He also stated that it would probably take until the end of the 21st century to understand the functions of genes.

As you know, however, a draft map of the human genome was announced in 2001, with a final version to be presented in April of this year. Gilbert's prediction was way off the mark.

One reason for that was rapid advances in technology. The formation of an international consortium also made a significant contribution, and the participation of the venture corporation Celera accelerated the pace of research. Human genome research thus serves to demonstrate some of the difficulties involved in forecasting technology.

Despite these difficulties, science and technology forecasts are significant to the formation of national policy. It is important not only to predict the birth of new fields, but also to foster the development of younger scientists in appropriate fields. In this sense, science and technology forecasts are extremely significant.