Achievements of the Science and Technology Basic Plans in Japan: Impressions of a Sympathetic Foreigner[1]

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Overview

Not only the structure but also the modes of activity associated with Japan's science and technology (S&T) system (particularly though not exclusively its government- supported aspects) have changed dramatically since the fall of 1997 when I first began to become seriously interested in Japanese science policy.

The stage was set with passage by the Diet of the Science and Technology Basic Law in November 1995, which resulted in the formulation of the first and second five-year Science and Technology Basic Plans (Japanese fiscal years 1996-2001 and 2001-2006, respectively). It is worth recalling briefly the unusual circumstances through which the November 1995 Basic Law came into existence[2]. Most legislation considered by Japan's Diet is drafted not by Diet Members themselves, but by bureaucrats within the Government of Japan's relevant ministries and agencies working in cooperation with key members of the Diet. However, the initiative for the 1995 Basic Law came from a small group of members of the Diet itself, led by Mr. Koji Omi, who was to become the country's first Minister of State for Science and Technology in the spring of 2001. By 1995, Mr. Omi had become convinced that strong measures were required if Japan's science and

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1. Presented at the September 13-14, 2004, NISTEP International Workshop on the Comprehensive Review of the S&T Basic Plans in Japan

2. An unofficial English language translation of the Basic Law can be accessed at http://www8.cao.go.jp/cstp/english/s&tmain-e.html.

technology system was to meet the economic and social requirements of the country and remain internationally competitive in the 21st Century. In formulating the provisions of the Basic Law Mr. Omi and his colleagues worked closely with leading members of Japan's scientific community with whom they shared this concern for the future of their country's science and technology system.

The purpose of this workshop convened by the National Center for Science and Technology Policy (NISTEP) is to review the principal achievements of the first and second Basic Plans. NISTEP and its contractors have carried out several detailed, statistically-based evaluations to this end. Many of their conclusions have been distributed in advance to workshop participants, and others will no doubt be presented during this two-day meeting. I do not propose to try to duplicate or assess the value of these evaluations. Rather, I want to review what are, to me, some of the principal, positive changes which I have observed in the Japanese science and technology system since I first began to observe it seriously almost exactly seven years ago. These changes have come about in part because of the two Basic Plans, and those are quite properly the primary focus of this workshop. But it is also essential to establish a context for assessing the achievements of the plans by considering other measures during the past seven years have complemented and reinforced the key provisions of the two plans.

Reorganization of the Government of Japan: 2001

Merger of *Monbusho* and *STA*. No doubt the most important of these measures was the reorganization and restructuring of the entire Government of Japan which, symbolically, took place during the first days of the new century on January 6, 2001. Although this restructuring has had impacts that go well beyond the country's science and technology system. Principal impacts relevant to that system were: (1) the merger of the former Ministry of Education (*Monbusho*) and Science and Technology Agency of Japan (*STA*) to form *Monbukagausho* or, in English, the Ministry of Education, Culture, Sports, Science and Technology, *MEXT*; (2) transformation of the former Ministry of International Trade and Industry (*MITI*) into the Ministry of Economy, Trade and Industry (*METI*), which assumed responsibility for most of the nuclear-related programs of the former STA; and (3) creation of a Cabinet Office and the *National Council of Science and Technology Policy* (*CSTP*) within that office.

To a foreign observer, the impacts of the merger of *Monbusho* and *STA* have indeed been impressive. Prior to 2001 there was virtually no official communication between these organizations. When I was a staff member of the National Science Foundation (NSF) in

Arlington, VA, I received numerous foreign visitors. If any such visitors requested my assistance in obtaining a meeting at another agency such as the National Institutes of Health or the Department of Energy I was most often able to oblige. But if on my first visit to Japan in 1997 I had asked someone at *Monbusho* to help arrange an appointment at *STA*, for example, he or she would have been surprised and, perhaps, even more than a little outraged at my request.

In contrast, today staff members of *MEXT* who were formerly from *Monbusho* and *STA* work closely together, and *MEXT* itself communicates and cooperates with other Ministries, most notably *METI*[3]. As an example, *MEXT* and *METI* are the two principal ministries supporting Japan's Nanotechnology Initiative. Relevant staff members from one agency are pleased to brief foreign visitors about the highlights of the activities of the other agency, and vice-versa. The merger has also facilitated working relations between scientists working non-government institutions supported by the formerly separate Monbusho and MEXT: for example, between scientists working in Tokyo University's Ocean Research Institute (*ORI*) and the Japan Marine Science and Technology Institute (*JAMSTEC*).

One of the positive impacts of the creation of *MEXT* has been to expand the scope of *NISTEP* and bring it under the same roof as *MEXT*, its parent ministry. Prior to January 2001, *NISTEP* was a part of *STA* and therefore had ready access to data and information only from that agency and organizations associated with it. In particular, it had no ready access to data from national universities who were in the *Monbusho* sphere. Furthermore, NISTEP was located several blocks away from both *STA* and *Monbusho*. Now, NISTEP has access to data and information from all organizations associated with *MEXT*, and from other government and private organizations as well. Of course it is also located in the same building as the rest of *MEXT*.

Creation of the Cabinet Office. Even more significant than the merger of *Monbusho* and *MEXT* or the conversion of *MITI* to *METI* was the creation, on January 6, 2001, of a Cabinet Office whose objective is to provide the Prime Minister and his Cabinet with the tools required to manage effectively their government. (This was also the principal objective of the creation in the United States of the Executive Office of the President in 1939, during the second administration of President Franklin D. Roosevelt.) At the same time, the Council of Science and Technology

3. *MEXT* and *METI* account for approximately 85 percent of the Japanese government's science and technology-related expenditures.

Policy within STA[4] was elevated to the status of the *National Council of Science and Technology Policy* (*CSTP*) within the Cabinet Office. One of the first, most visible actions of the *CSTP* was to approve the Second Science and Technology Basic Plan and recommend its adoption to the Cabinet to go into effect on April 1, 2001[5]. Also, the Diet created the new position of Minister of State for Science and Technology was created who, by law, outranks all ministers in charge of the Government of Japan's operating line ministries.

Prior to 2001, it was literally impossible for the Japanese Government to implement effectively or even to formulate a coherent, long-term science policy. Rather, each individual ministry or agency pursued its own science policy consistent with its budget, as approved by the Ministry of Finance. Overall science policy was characterized by a senior NISTEP official as "policy-by-stapler". That is, one simply took the annual budgets of the various ministries and agencies and stapled them together. And of course there was little or no coherence among the stapled items.

But with the creation of a Cabinet office and of the *CSTP* within that office, a means existed to take a broad view of the programs of the science- and technology-related ministries of the government and to formulate a cross-cutting government wide science and technology policy. Not only that, but the means existed to enforce discipline on the various ministries to implement that plan[6]. I first became aware of the impacts of *CSTP* on the government's science and technology system early in September 2001 when I was serving as Director of NSF's Tokyo Regional Office. Prior to that time we were able to obtain approximate data on the science-and technology-related budgets of the ministries and agencies for the next fiscal year from STA soon after August 31 when those budget requests were submitted to the Ministry of Finance. But we were not able to obtain budget figures for Japan fiscal year 2002 until after December 31, 2001, when the entire government budget was submitted for consideration to the Diet. From September

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4. The Council for Science and Technology, ostensibly chaired by the Prime Minister, was established in 1959 to respond to his requests for advice and assistance on critical science and technology policy issues. However, because the Council was located organizationally and physically within the headquarters of the Science and Technology Agency of Japan (STA) and relied on STA for staff support, it usually confined its attention to issues pertinent to that agency.

5. An unofficial English language translation of the 2nd Science and Technology Basic Plan can be accessed at: http://www8.cao.go.jp/cstp/english/s&tmain-e.html.

6. Although the CSTP has the mandate to formulate and implement Japanese science policy, the effectiveness with which it actually does so depends on a number of factors, largely political in nature. By way of comparison, the effective of the US Presidential Advisory system has varied considerably among administrations. One important determinant is the extent that the president himself supports and makes use of that system.

through December of that year the newly created Cabinet Office, in consultation with the *CSTP*, reviewed the budgets of the various ministries for consistency, and may have obliged them to make several changes. Thus starting in 2001, the Japanese Government began to move forcefully to develop and implement a coherent budget as a foundation of a national science and technology policy, which became effective at the start of fiscal year 2002 ─that is, on April 1, 2002.

Changed Status of Government Laboratories. Another significant event that occurred within three months of the overall government reorganization was the conversion, on April 1, 2001, of the large majority of government laboratories and related research facilities to the status of Independent Administrative Agencies. This change also affected other institutions such as government-managed hospitals and museums, for example. Their new status provided the government laboratories and related facilities with substantial operating autonomy from their parent ministries, with the provision that after three years their respective budgets would be determined largely on the basis of evaluations of how well they were performing their relevant activities.

As the principal example, on April 1, 2001, the former Agency for Industrial Science and Technology (*AIST*) within *MITI*, which formerly operated 15 large research facilities directly (eight in Tsukuba and the remaining seven scattered around the country) became the *National Institute for Advanced Industrial Science and Technology* (the "new" *AIST*) funded by, but with its operations largely independent of the new *METI*. *AIST* itself was promptly reorganized into more than 50 research units: approximately 25 of these units (the great majority in Tsukuba) are known as institutes. These institutes set their own research agendas determined primarily in a bottom up manner under guidelines established by the *AIST* leadership. Also, approximately 25 new research centers were created on April 1, 2001[7]. Unlike the research institutes, these centers can exist for no more than seven years and pursue more narrowly defined objectives determined in a top-down manner. Budgets for the various institutes and centers are now determined in part on the basis of annual evaluations conducted both by *AIST* and by *METI* itself. From my rather limited perspective, this reorganization has enhanced the overall ability of *AIST* to conduct industrially-relevant research, often in cooperation with industrial researchers on temporary detail to its institutes and centers. That the annual evaluations are taken seriously is evidenced from the fact that two or three or the original centers were terminated within two or three years, presumably on the grounds that they were not living up to prior expectations.

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7. The "new" *AIST* also encompasses a handful of pilot initiatives which are in essence test beds for possible future centers.

Changed Status of National Universities. On April 1, 2004, Japan's national universities attained a status somewhat analogous to the independent administrative agency status that was granted to national laboratories three years earlier. The enabling National University Corporation Law of July 16, 2003, gave them the status of Corporations with substantial "management autonomy and independence". While it is still too early to assess the impacts of the new status of national universities, these could be substantial. For example, national universities are now free to make decisions regarding personnel and compensation, as well as curricula. Many are likely to seek their own competitive niches, with the result that the academic scene in Japan is likely to become considerably more lively and interesting during the next few years.

Additional Measures

Technology Licensing Organizations. Two additional actions by the Diet which have facilitated some of the changes in the ways that Japanese universities operate are worth noting. In 1998, the Diet passed a law authorizing the creation of Technology Licensing Organizations, or TLOs. Since that time almost 40 university-associated TLOs have been created with the objective of licensing intellectual property of faculty members to industrial organizations. *AIST* has also created its own TLO which has succeeded in licensing several discoveries of the discoveries of its researchers. As in the United States, only a relatively small minority of these organizations are making money. A more important question is the extent to which they are succeeding in moving potentially commercializable research results into the marketplace. I'll return to this question later in this presentation.

Japanese Bayh-Dole Act. Finally, in 2000 the Diet passed a law which unambiguously granted researchers rights to any intellectual property resulting from their research so that university professors, as well as researchers in government laboratories, are now able to seek patents (either through associated TLOs or independently) and to license those patent rights. The 2000 legislation is sometimes referred to as the Japanese Bayh-Dole Act, a 1980 law granting intellectual property to discoveries made by university faculty supported by US government grants and contracts to the universities themselves. Significantly, whereas the US Bayh-Dole Act grants intellectual property to universities, the comparable Japanese Law appeared to grant it to researchers rather than to their organizations. It is my understanding that that seeming ambiguity has now been clarified so that universities rather than individual researchers own the relevant intellectual property.

Highlights of the Basic Plans

Let me now present briefly the highlights of the First and Second Science and Technology Basic Plans. Both plans call of specific government expenditure targets for research and development during their respective five-year terms. The first called for total expenditures of 17 trillion yen, an objective which was not only met but slightly exceeded. The second calls for total expenditures of 24 trillion yen, but includes a caveat which ties annual government expenditures on science and technology to the growth of the country's Gross Domestic Product. Indications are that attainment of the 24 trillion yen objective is on track. In any event, it will be useful to have definitive expenditure data after the termination of the second plan period on March 31, 2006.

First Basic Plan. In addition to the above-noted expenditure goal, the First Science and Technology Basic Plan included several key provisions, namely:

1. Introduction of system of limited-term appointments for researchers in national research institutes;
2. Creation of 10,000 post-doctoral research positions by the year 2000;
3. Measures to facilitate university-industry research cooperation, including changes intellectual property provisions and a relaxation of regulations governing the external activities of national university faculty;
4. An increase in the proportion of research support awarded on a competitive basis as opposed to more traditional formula-based funding;
5. Promotion of public understanding of science and the "establishment of a national consensus on science and technology."

Second Basic Plan. Likewise, the Second Science and Technology Basic Plan includes what are referred to as several principal objectives:

1. Adopting a strategic approach to government research investments;
2. Building a competitive research environment;
3. Enhancing the independence and mobility of young researchers;
4. Improving the research evaluation system;
5. Utilizing research outcomes by promoting cooperation among the academic, industrial and government research sectors;
6. Promoting regional innovation; and
7. Enhancing communications with society.

Similarities and Distinctions. Of course, a good deal of the agenda of this workshop is devoted to evaluations of the two plans in terms of these key provisions and principal objectives, and I do not intend to discuss them in any detail. However, it is useful to consider similarities and distinctions between the two plans on the basis of these two lists. Both plans emphasized:

- Limited term appointments and mobility for young researchers;
- Competitive research; and
- University-industry cooperation.

But whereas the emphasis of the first plan primarily on expanding the Japanese academic research system, the second aims to reorient that system. This is most evident in its emphasis on a strategic approach to research investments and on a rigorous system of evaluation.

However, the most significant distinctions between the two plans has to do less with the substance of the plans themselves, but with their timing. As already noted, one of the first visible actions of the *National Council for Science and Technology Policy* after it was created on January 6, 2001, was to recommend adoption of the Second Plan to the Cabinet, effective on April 1, 2001. I have already suggested why development and implementation of a coherent national science policy was virtually impossible in Japan prior to creation of a Cabinet Office and the *CSTP*. From this perspective, it is perhaps remarkable that many of the key provisions of the first plan seem to have been realized. Perhaps the relevant ministries and agencies were convinced that the Ministry of Finance and the Diet would look more favorably at their aggregated requests for annual funding consistent with the five-year, 17 trillion yen goal if they appeared to be moving purposefully towards implementing the non-fiscal key provisions of the first plan.

The Second Plan and the *CSTP*. Be that as it may, the Second Science and Technology Basic Plan provided the *CSTP* with a template for a national science and technology policy. More broadly, the second plan has been used by that organization to set much of its agenda. The *CSTP* held 26 monthly conferences chaired by the Prime Minister between January 2001 and March 2003. Starting with the 10th monthly conference on September 21, 2001, one or another of the principal objectives of the 2nd Basic Plan were on the agenda for all but five of these conferences. At its first monthly conference on January 18, 2001, more than two months prior to its formal adoption of the second plan at its fourth, March 27, 2001, meeting, the *CSTP* established five expert panels. Three of these (S&T Promotion Strategy, Evaluation, and R&D System Reform) corresponded to the principal objectives of the second plan. Thus, it may not be unfair to suggest

that a good deal of the success (or lack of success) of the *CSTP* since its inception can be gauged in terms of the success of the second plan itself.

Ministry Initiatives. It is also useful to note that both *MEXT* and *METI* have adopted several initiatives since 2001 designed to help implement the second plan. Two key initiatives aim to facilitate technology transfer from universities to the commercial sector. In particular, *METI* (and formerly *MITI*) began to provide grants to universities to establish and maintain TLOs soon after the Diet legitimized their creation in 1998. More recently, *MEXT* has been providing grants to universities to establish intellectual property centers. Other initiatives include *MEXT*'s Intellectual Cluster program and *METI*'s Industrial Cluster program, both of which aim to enhance regional science and technology capabilities.

Significant Issues and Achievements

Issues. What are the most significant issues associated with the two plans? My own biased selection are these:

1. Increasing the independence and mobility of young researchers;
2. Utilizing research results through better links among academic, industrial, and government research facilities;
3. Establishing an effective and fair research evaluation system; and
4. Increasing the competitiveness of the research system.

How well have these issues been addressed? The record, I think, is mixed. It is still too early to assess the effectiveness and fairness of the research evaluation systems created since 2001, in part because such systems have only now begun to be implemented in the newly autonomous national universities.

Apparently the increase in the fraction of competitive funding envisioned by the second plan has yet to be achieved, although there are indications that *CSTP* will ask the Ministry of Finance for a considerably higher level of funding for competitive research for fiscal year 2005.

Technology Transfer. Perhaps the most significant change to have taken place in the Japanese science and technology system during the past few years has to do with technology transfer from universities, consistent with the second of my admittedly biased selections. In addition to enhanced university-industry research cooperation, universities now employ TLOs as a means for

technology transfer. Additionally, there has been a great deal of activity associated with the creation of entrepreneurial start-up firms by both university and AIST researchers.

For example[8]:

1. Between 1998 and May 2004, 37 Technology Licensing Offices were established to facilitate the commercialization of university research results. The number of patent applications filed by TLOs in Japan and abroad increased from 310 in 1999 to 1,619 in 2002.
2. The number of joint research projects among universities and private firms almost doubled in five years, from 2,362 in 1997 to 5,264 in 2001.
3. The number of start-up companies created to commercialize university research results increased from 315 in 2000 to 800 in 2003.

Several new university-based centers have been established with the objective of conducting basic research of relevance to industry. Two with which I have some familiarity are the Tohoku University New Industry Creation Hatchery Center and the Kyoto University International Innovation Center. But there are others as well.

Status of Young Researchers. To me, the least impressive achievement of the two plans involves the status of young Japanese researchers. It is true that there are now many attractive short term (normally five-year) research appointments for researchers which did not exist at the inception of the First Science and Technology Basic Plan in 1996. But *NISTEP*'s data indicate that although intersectoral mobility has increased somewhat, that increase is anything but substantial.

A critical question, of course, is what are the career options for talented young Japanese researchers after they complete a five-year post-doctoral research appointment? If they elect to pursue academic careers, they have little choice but to become associated with a *koza* and thus tie their careers to those of full professors until the latter are obliged to retire. To be completely brazen, let me suggest that the dead weight of the Japanese university seniority system may be the most

8. I am grateful to Ms. Miwako Waga, Japanese Manager of the Global Emerging Technologies Institute (GETI) for providing me with these data.

important element of the country's science system that still requires serious attention. Several years ago, an eminent senior Japanese researcher asked, rhetorically, "How can I release the energies of my young bears and tigers?" To me, the answer is painfully obvious: grant them a greater degree of autonomy! If I may continue to play the role of a brazen but sympathetic *gaijin*, let me suggest that reformation of the university seniority system should be assigned the very highest priority in any Third Science and Technology Basic Plan which the CSTP chooses to adopt[9]. Of course one or more of the newly independent national universities could decide to undertake reform of that system on their own initiative. However, government attention will be essential to reformation of the university seniority system as a whole.

Acknowledgements and Closing Thoughts

I am pleased to acknowledge the support that NISTEP has provided during the past 18 months as I have studied, intermittently, the two Science and Technology Basic Plans. I am also grateful to NISTEP for inviting me to participate in this workshop and for giving me this opportunity to speak.

Let me conclude by suggesting several areas of particular interest to me which would merit further research.

- As previously noted, the creation of the Cabinet Office and the *CSTP* within that organization provide, for the first time, necessary mechanisms for formulating and implementing a coherent national science policy. It would be useful to have in depth studies of how well the *CSTP* is actually performing those functions, particularly the latter, as well as the major factors contributing to its level of achievement.

- I have referred to three related modes of technology transfer current in Japan: (a) university-industry research cooperation, (b) Technology Licensing Organizations, and (c) entrepreneurial or start up firms. These and other possible modes of technology transfer might be monitored and studied in greater depth, in part to determine factors underlying the relative long-term success (or failure) of each.

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9. The November 1995 Science and Technology Basic Law required the government to develop a plan to address the concerns itemized by that law. However, it did not specify how many sequential plans the government should devise, or the period of time during which they should be effective.

- I have referred briefly to some of the positive aspects of the change in the status of government laboratories to Independent Administrative Agencies on April 1, 2001, with particular reference to the *National Institute for Advanced Industrial Science and Technology* (*AIST*). It would be useful to have in depth studies of the positive and negative impacts of the government laboratories. For example, one senior official in *AIST*'s international division admitted quite candidly that *AIST* has literally been flying by the seat of its pants during the past three years as it tries to determine how best to deal with its newly-granted autonomy. How well has it been handling that situation?

- Finally, national universities were granted considerable independence and management autonomy on April 1, 2004. It would be useful to track the national university system over the next three to five years to determine positive and negative impacts of their new status. Are national universities also flying by the seat of their aggregate pants, or have they planned systematically for their new status? What distinctions between various universities are emerging? Has the experience of AIST provided any guidance? Or has it been largely irrelevant?

In several important respects the Japanese science and technology system is almost unrecognizably different from what it was at the inception of the First Science and Technology Basic Plan in June 1996. But some aspects of that system, such as the university seniority system, seem little changed. *NISTEP* has provided those of us who have been invited to participate in this workshop with a unique opportunity to study changes in the Japanese science and technology system in greater detail, based on its own extensive analysis and those of its contractors. I hope that there will be additional, future opportunities to monitor these substantial and exciting changes.