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The Roles of Corporations, Universities, and the Government before and after 1990

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In 1992, the economist Richard Nelson edited the book, *The National System of Innovation.*[1] It provided a comprehensive and comparative survey of the system and characteristics of innovation activities in various countries. In the chapter on the Japanese innovation system, Goto and Odagiri traced the history of technological innovation in Japan, and discussed the important actors involved in such innovation activities.[2] They specifically discussed the strength of the industrial sector and the relative insignificance of the academic governmental sectors. According to Goto, their argument was partly a counter-response to the prevalent view on the Japanese innovation system at the time, which placed greater emphasis on the strong initiatives taken by the government, especially MITI, as was discussed in Chalmers Johnson's *MITI and the Japanese Miracle.*[3] It was certainly true that corporations played a crucial role in producing much of the industrial innovation in Japan's recent past.

Since it was published in 1992, such a system of innovation like Japan portrayed via Goto and other scholars has, at least in some respects, experienced a significant change. Despite, perhaps partly due to, economic decline and financial problems in Japan, the govern-

1. Richard R. Nelson, ed., *National Innovation Systems: A Comparative Study* (Oxford and New York: Oxford University Press, 1993).
2. Hiroyuki Odagiri and Akira Goto, "The Japanese System of Innovations: Past, Present, and Future," in ibid.: 76–114
3. Chalmers Johnson, *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925–1975* (Stanford: Stanford University Press, 1982).

ment has taken new initiatives to strengthen the innovative activities in academic and industrial sectors. This chapter attempts to analyze and reconsider the views prevalent before 1990. It first introduces new historical research on cases of innovations by corporations and discusses the nature of the innovations. It will then show the new initiatives taken by the government especially through the establishment of the Science and Technology Basic Law in 1995.

1. Corporate Initiatives in Postwar Japanese Innovation

The recent popular TV program in Japan, "Project X," introduces a number of case stories for the efforts of postwar Japanese engineers to make technological accomplishment through the production of new products or solving difficult social problems. The examples are numerous—video recorders, the YS11 airplane, an endoscopic camera, the bullet train, Honda's CVCC engine, Seiko's quartz watch, and so on. The emphasis of the program director is to disclose the difficulties the engineers together with their fellow assistants or family members encountered in their struggle to achieve a goal and how they finally overcame such difficulties. In presenting the drama in that way, university engineers are occasionally depicted as armchair scholars who only criticize the unfeasibility of the proposed innovation project. The key actors in these historical stories are all engineers who acted at construction or production sites rather than university laboratories.

Whether it is real or not, this image of engineers and the evaluation of the contrastive roles of corporate and university engineers seem to be prevalent in Japanese society. In comparison to engineers at corporations, it is considered that those at universities played a relatively insignificant role with regard to the rapid technological development in postwar Japan. As traced in the previous chapters, university faculty members in engineering and science were not encouraged to have close ties with industrial corporations until around the 1980s.

While the university and industry collaboration was apparently inactive, university engineers certainly contributed to the postwar development of Japanese technology. Aside from producing young engineers, they played a role in distributing and circulating technological information from outside and inside Japan. In some cases, they introduced foreign technical knowledge in a widely intelligible form to various engineers in Japan, and circulated knowledge of cutting-edge technology through some form of research group that they organized, bringing in engineers from different corporations.

The MITI is often said to have had an important role in implementing powerful industrial policy regarding the orientation of postwar Japanese industry, and MITI successfully fulfilled its role in catching up to the more advanced industrial and technological level of other countries. However, it is also said that MITI did not play any significant role in assisting with any specific innovations and technological development of corporations.

The innovative activities in corporations in postwar Japan are well documented and analyzed in a recent historical work edited by the historian of technology Tetsuro Nakaoka.[4] The book is the outcome of a research project done by a group of historians of technology that was conducted from 1993 to 1996. The project was to trace the trajectories of technological innovations at various corporations in the 1970s and 1980s when some Japanese corporations produced innovative products that could truly compete with foreign companies on the international market. Of roughly thirty historical cases, Nakaoka selected five to characterize the nature of innovative activities of postwar Japanese corporate engineers: the development of PAN carbon fibers, liquid crystal display, a stepper for lithographic alignment of semiconductors, turbines, and the pressing of steel plates.

As the book's subtitle, *Creation or Imitation,* indicates, Nakaoka poses a question about the originality of Japanese innovation in these years. After World War II, the Japanese made every effort to introduce foreign technologies from the Untied States and Europe in order to catch up to their technological level. They succeeded in doing so in

4. Tetsuro Nakaoka, ed., *Sengo Nihon no Gijutsu Keisei: Mohō kara Sōzō e* (*The Formation of Technology in Postwar Japan: From Imitation to Creation*) (Tokyo Nihon Hyoronsha, 2002).

the 1960s, attaining a high rate of economic growth. In the 1970s, however, Japanese industry started to experience economic competition on world market, and had to produce innovative products of a less expensive but still better quality. The five cases selected here examine the nature of the creativity of the products of Japanese innovation in this period.

All these products—carbon fibers, LCD, etc.—are original technology and competitive in the world market. The reason for the accomplishment in producing such original products was the accumulation of relevant technologies in corporations. However, Nakaoka emphatically denies the once-often-quoted statement that Japan became No. 1. He aptly analyzes that the degree of originality of these products was not as high as some produced in other leading countries.

They are certainly original in comparison to those produced when Japanese corporations were competing to catch up with the technological levels of U.S. and European companies. The Fuji Film Company attempted to produce its own film qualitatively equivalent to Kodak's by 1971 when the government lifted the ban of the import of foreign film. In a way, Fuji created its own process and product, but in the sense that the goal was clearly fixed, its innovation effort was not conducted in an environment of uncertainty. Tore, Sharp, Nikon, Canon, and Mitsubishi, the companies that produced the products analyzed by Nakaoka's group, did work in an environment different from Fuji. No company around the world achieved the goal of their innovation effort. It was uncertain whether the expected products could be made by the new technologies in hand. It was so uncertain, in fact, that RCA and Rolls Royce failed to produce a television set with LCD and a turbine blade strengthened with carbon fiber. They failed because their estimation of time for successful development was too optimistic. Nakaoka's emphasis on this uncertainty in developing new technologies and products led him to conclude that part of the reason for the success of Japanese companies was their luck in retrospectively selecting the right technology to attain their goal. Sharp was lucky, Nakaoka points out, firstly because RCA was on the wrong track, and secondly because RCA declined for Sharp to develop its product and so it was forced to develop the product by itself. Thirdly, unlike RCA, it did not select the wrong technology to use to make the product.

But Nakaoka also states that the degree of uncertainty that these Japanese companies overcame was not as high as the truly original accomplishment that no other company even attempted to produce similar products. While they tried to produce new products, the original scientific idea of the production technology had been found elsewhere and other companies were trying to make similar products using similar technologies. Based on this historical and economic analysis, Nakaoka points out that Japan entered an entirely different stage of technological innovation where technological uncertainty prevailed.

2. The New Initiative by the Government

In their paper on Japanese innovation systems, Goto and Odagiri posed the idea that "the weight of government policies will further decline, particularly because the government is losing most of its control tools through deregulation and liberalization." As they suggested, the government industrial policy of the postwar MITI style certainly seems to be losing its influence for the reasons mentioned by the authors. They stated, "MITI's role in the collection and diffusion of information may have been significant, as it could obtain information on overseas markets through its Japan External Trade Organization (JETRO)," but "this role has also declined as firms themselves accumulated international experiences and technological knowledge."[5] Goto, in his recent paper, refers to the achievement of the government-initiated large-scale technological development programs, such as "Next Generation Projects," as well as "research consortia."[6] Although he acknowledges the accomplishments made through these programs in the 1980s, he casts doubt on the feasibility of this policy to promote technological innovation that is not in "catch up" phase and

5. Odagiri and Goto, "The Japanese System of Innovation," op.cit., p. 103.
6. Akira Goto, "Japan's National Innovation System: Current Status and Problems," *Oxford Review of Economic Policy*, vol. 16, no. 2 (2000): 103–113.

also of new technologies such as IT and genome engineering, in which small venture capital firms can play important roles.

In the paper, Goto re-examines the possible roles of three sectors: industries, universities, and the government. In particular, he emphasizes the prospect of Japanese universities. Although the role of the university has been low key in postwar years and it seemed to remain so due to the financial stringency of the government, he points out that the situation surrounding the university is rapidly and vastly changing and the government is increasing its role in supporting basic research. As he states:

> This trend has changed significantly in recent years. In accordance with the 1996 Basic Science and Technology Plan, which was based on the provisions of the Science Technology Act of 1995, the target budgetary funding for research was doubled to about 1 per cent of GDP, a figure on par with the allocations in Europe and the United States. Government spending on research has since grown faster than other public expenditure items, and the 1 per cent target is being achieved, as planned, this year. [7]

The Science and Technology Basic Law (Act) originated from an idea of a Liberal Democratic Party politician, Koji Omi, who worked for science and technology policy in the party.[8] The Act itself had once experienced total refusal as a law in 1967, when the proposed act was rejected because it included the promotion of human and social as well as natural sciences. Omi started to investigate the content of the act to be proposed in 1994, and the act was passed in congress the next year. Behind the establishment of the act, there prevailed a public opinion to improve the deteriorated research conditions at university laboratories, and there was also a new policy to construct a Center of Excellence.[9]

7. Ibid., p. 107.
8. This Japanese act, "Kagaku Gijutsu Kihon Hō," is now officially more often translated as "Science and Technology Basic Law."
9. Shuichi Tsukahara, "Science and Technology Policy towards Basic Research," *Journal of Science and Technology Studies*, 24 (1994): 12–36.

With the establishment of the Science and Technology Basic Law and Plan, the Council for Science and Technology Policy at the Science and Technology Agency increased the importance to implementing science and technology policy. The Council for Science and Technology Policy (CSTP) was established in 1959. Because the function of the Science and Technology Agency was decided not to cover research conducted at universities as well as human science research, the role of the CSTP was limited. In the early 1980s, a new fund was established and enhanced its power. It was the Special Coordination Fund for Science and Technology (SCFST), established in 1981, which aimed at enhancing the coordinating function of the Council for Science and Technology Policy at the Science and Technology Agency. The SCFST was to "promote cutting-edge and basic research, to promote research and development requiring more than one institution, and to enhance the cooperation between academia, government, and industry."

The numbers of SCFST steadily grew in the 1980s and its growth rate further increased in the 1990s. The establishment of the Science and Technology Basic Plan further enhanced it despite the government and Japanese society suffering from devastating financial problems.

In January 2001, the Japanese government experienced a massive reorganization, and the Ministry of Education and the Science and Technology Agency merged together into the new Ministry of Education, Culture, Sports, Science, and Technology (officially abbreviated as MEXT). As a result of this substantial reorganization, the Council of Science and Technology was transferred from the Science and Technology Agency to the Cabinet Office under the Prime Minister. Its objectives were "basic/comprehensive policy planning of science and technology and general coordination, taking the initiative among the ministries concerned, with an overall and panoramic view."[10]

At the eve of the merger of the Ministry of Education and the Sci-

10. Council for Science and Technology Policy, "Council for Science and Technology Policy," February 2002. As accessed in 2002 at the website of the Council of Science and Technology Policy. The document has been, however, subsequently deleted from the website.

ence and Technology Agency, a private group of experts in science and technology policy presented a report on the significance of the Council of Science and Technology Policy. The report was based on the investigation of a special committee at the Society of Science, Technology, and Economy, whose members included industrial leaders, journalists, and scholars in innovation policy. The investigation, which took place in 1999 and 2000, consisted of research about published materials, including the reports of the Council for Science and Technology Policy, as well as interviews with those concerned with the research and development of science and technology in some way or another. At the meeting of those interviewed, experts in science and technology policy provided an insightful and well-summarized view about the significance of the Council of Science and Technology Policy. In conclusion, the report summarized the points of both positive and negative evaluations. Of them, the positively evaluated points are:

(1) Leadership in the promotion of science and technology as an important national policy;
(2) The education of scientists and engineers;
(3) The emphasis on basic research;
(4) The presentation of goals of research investment;
(5) The promotion of life sciences;
(6) The promotion of earth and environmental sciences and engineering;
(7) Planning of the general policy on the evaluation of national research and development;
(8) The promotion of national experimental and research laboratories.

On the other hand, rather negatively evaluated points are:

(1) It could not hold enough discussion at the Council;
(2) The strong tendency to approve the plan of each ministry;
(3) The lack of the follow-ups of the execution of basic policies recommended by the Council;

(4) The partial selection of members of the Council;
(5) The lack of the function of analysis and investigation at the Council;
(6) Problems of the function and organization of the administrative office of the Council;
(7) The delay in the engagement of scientific and technological education;
(8) The lack of emphasis on the utilization of achievements through technology transfer by the cooperation of academe, industry, and government.

From these analyses, the report proposes to emphasize five points of "syntheses (sōgō)" to be attained by the new science and technology policy:

(1) The synthesis between private and public sectors;
(2) The synthesis between the center and the local;
(3) The synthesis between society and scientific and technological communities;
(4) The synthesis among separate academic and bureaucratic structures;
(5) The synthesis between Japan and the world.

The "synthesis" means here putting emphasis on the relatively neglected domains, such as S&T research activities in local regions and at private universities, as well as constructing a productive relationship between relatively separate domains. Notably, item four proposed to bridge the gap between separate academic disciplines as well as between separate bureaucratic offices under different ministries. And item three stated the need to bridge the gap between researchers who create scientific ideas and technological products and people in the public who are supposed to receive the benefits from these products. After the report was presented, the Council for Science and Technology Policy was reorganized. Whereas its English name was not changed, its original Japanese name notably added "sōgō (synthesis)" at the top of its name. Its new Japanese name "Sōgō Kagaku Gijutsu

Kaigi" initially meant "Synthetic," "Comprehensive," or "General" Science-and-Technology Council.

The renewed Council, which started in the new century, incorporated several characteristics requested by the above report. First, the new Council moved from the Science and Technology Agency to the Cabinet Office under the Prime Minister, thus greatly enhancing its power in the bureaucratic structure of the Japanese government. The newly established Cabinet Office itself has had a function to plan the basic and strategic policy and to generally coordinate separate bureaucratic branches. Strategy and coordination are the two key words of the function of the Cabinet Office and its branches. In addition, the Minister of State for Science, Technology and Innovation Policy was appointed to empower the Council.

Second, the Special Coordination Fund for Science and Technology, which has worked as an effective funding tool to implement the policies proposed by the previous and present Council, put emphasis on synthesis—the problems relating both to natural and social sciences or to more than one bureaucratic branch. Beginning in 2001, the ScoFST was allocated not only to national laboratories but also to universities to emphasize the lens of research encouraged by the basic policy proposed by the Council.

The outcome of the new science and technology policy encouraging various "synthesis" is yet to be seen. Whether this renewed emphasis on the university and industry cooperation will contribute to the Japanese economic growth of is also yet to be seen.

3. Postscript

In the last three chapters, I have discussed the postwar history of university-industry cooperative relationship in Japan. I did so to explore direct and indirect contributions of academic engineers to the creation of new industrial technologies or to the efficient importation and assimilation of new Western technologies. It should be remembered, however, that the relative autonomy of university engineers from corporations should have provided institutional merits to them.

First, the relative aloofness from urgent corporate needs permitted academic and government engineers to be engaged in basic and fundamental research on important technological subjects. Their research would not produce economically viable results within a short length of time, but would bring in the long run useful and profitable outcome to the public. There are successful cases of such long-term research whose decades-long consistent pursuit of a specific engineering subject brought about fruitful technological outcome only many years after its initiation.

Second, it should also be remembered that the role of engineers in present society is not limited to the creation of industrial technologies and technical know-how. They not only educate future engineers, but also often assume positions to control and orientate technologies to be used and created in society. Academic engineers, together with corporate and government engineers, joined committees to search for the cause of accidents and malfunctions of technological systems when they happened, to set standards to protect safety and environment, and to lay out policies and plans to allocate government financial supports among various engineering topics to attain a better society. For these increasingly important purposes, the relative autonomy of academic engineers is considered to provide indispensable merits and conditions allowing them to make sound judgments at increasingly complicated circumstances. And making such reasonable, considerate, and far-sighted judgments on complex and grave problems in the current changing world is becoming an increasingly important task for today's engineering experts.