# SCIENCE AND TECHNOLOGY POLICY IN JAPAN

**Yukiko Fukasaku**
*Organization for Economic Co-operation and Development (OECD), Paris, France*

**Sachiko Ishizaka**
*International Council for Science (ICSU), France*

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## Contents





## Summary

Japan was the first country in the non-European cultural sphere that succeeded in industrial development based on modern science and technology. This was done through the process of catching up to the advanced industrial countries of the world, by building up a research and innovation system particularly suited to the goal of catching up, stressing learning processes such as reverse engineering and improvement engineering. Because resources were concentrated on catching up, R&D investments have been heavily concentrated in and by the industrial sector, in terms of both funds and human resources. Because of the need to learn quickly, researchers trained in the engineering disciplines predominate in the industrial sector.

## 1. Introduction

The development of science and technology in Japan is distinct in that it was the first country in the non-European cultural sphere to attempt to absorb the western scientific and technological tradition, and along with it, launch the process of modern socioeconomic development. The process started in the mid-nineteenth century, and as

witnessed in the 1970s and 80s, after the devastation of the country during the Second World War, the nation achieved industrial success based upon superior technological advances, unprecedented for a country of non-European origin. Public policies toward science and technology played a key role in this industrial development.

## 2. Features of the Early Development of Science and Technology Policy

The modernization in the mid-nineteenth century, started with the sociopolitical developments that opened the country from the isolationist policy under the Tokugawa feudal regime in the 1850s to its overthrow and the launching of the full modernization process by the new Meiji government starting in 1868. The isolationist policy under the feudal *ancien regime*, meant that for more than two hundred years up to the mid-nineteenth century, the country was shut out from foreign trade as well as foreign intellectual influences, save for the very limited trade with China and Holland, by which some knowledge of scientific and industrial developments in Europe trickled through to the few Japanese scholars dedicated to western learning.

This line of inquiry, *rangaku*, provided the intellectual basis and resources once Japan launched the modernization process and the absorption of European science and technology. Beside this line of intellectual inquiry, the *ancien regime* had left the legacy of well-educated population and the continued aspiration for more education and training in the new Meiji era, which provided a fertile soil on which western science and technology could be transplanted.

The transplantation process even on a fertile soil was not easy. Here, public policies toward science and technology played a key role from the early days of the Meiji era. The modernization process in general was highly centralized, and the government took leadership in replacing traditional intellectual scholarship that was mainly based on schools of learning in the Chinese tradition by western scientific disciplines. The adopted policy was to import western science and technology in the restructured and/or newly founded universities and other educational institutions, government research institutions and to encourage industrial development using western technology in the private sector, as well as in the public enterprises. European and American scientists and engineers were employed in the universities and other educational/research institutions as well as in many industrial enterprises, both public and private. The government took initiatives in sending students abroad, and returning students rose up in the academia eventually to replace the foreign scientists and engineers. In this westernization process, the traditional sciences and professions, notably Chinese medicine was side-tracked as para-medicine, and the certified medical profession fell exclusively to those educated in the western medical sciences.

Thus, as a ‘late-comer’ to industrialization and modern scientific and technological development, the strategy adopted in the second half of the nineteenth century was catching up to the advanced countries of the west through transplantation of western scientific inquiry and technology transfer. Although a latecomer, the Japanese catching-up process in modern science and technology started not much later than in the United States or in Germany, and was facilitated by the institutionalization of science and technology which had started in Europe and America in the nineteenth century.

Therefore, compared to the developing countries of the twentieth century, especially in the post second world war era, Japanese catch-up had started in a privileged epoch in the development of modern science and technology.

In the research sector, the universities were structured according to European universities, professional societies were founded in analogous disciplines, and the knowledge frontier was surveyed and brought back by researchers who normally spent a part of their research career in a foreign university or research institution. Up to the Second World War, Japan may not have produced world famous scientists, but some researchers did achieve first class research, in the physical sciences as well as biomedical sciences.

On the industrial technology side, public policies supported intense efforts to import technology and improve upon them to build up indigenous capacity to innovate. These efforts were facilitated by training of appropriate scientific and engineering human resources, in the universities and technical schools in the formal education sector, and on-the-job training of technicians and workers. Also, in some large manufacturing enterprises, as exemplified in the case of Mitsubishi Nagasaki Shipyard, in-house research became an institutionalized activity in the early years of the twentieth century, which facilitated the technological learning and adaptation of imported technologies. Therefore, training and research were identified as important elements of the technology transfer process, and the institutions that underpinned the technological learning process were laid in the decades since early Meiji and were in place well before the Second World War. The basic scientific and technological policy as well as the scientific and technological infrastructure was revived after the second war and facilitated the catch-up process after the Second World War.



### 3. Post-war Catch up and S&T Policy

In the post-war phase, intense efforts to catch up to the USA and the advanced European countries in the level of economic development and investments in science and technology were pursued. These efforts, as in the pre-war phase, were underpinned by a close co-operation between the government and the large enterprises sector. In public policy, this co-operation was the result of the articulation of S&T-centered policies adopted by the Ministry of International Trade and Industry. Rather than basing long-term development strategy on traditional theory of comparative advantage, but policy makers rather sought solution for Japan's post-war difficulties in enhanced technical efficiency and innovations in production and the promotion of the most advanced technologies through new investments. For this a mode of working which depended upon a continuing dialogue on questions of technological development with university and industry, in effect, a mode of continuous consultation with S&T community was systematized.

In practice, the catching up process, as in the pre-war phase, was based on even more intensified technology importing and improving. Technological learning and adapting was pursued through such processes as 'reverse engineering' and 'improvement engineering' that have been used to characterize the Japanese mode of building domestic technological capability through technology imports. These processes, in turn,

enhanced the integration of production and innovation within large firms, which had already started before the war.

Increase in investments in science and technology was more rapid than in other advanced countries, and the increasing supply of university-trained graduates in scientific and especially, the engineering disciplines supported these developments in the industrial sector. The post-war catching up in Japan reveals a distinct institutional and social framework for innovation, a 'national system of innovation', characterized by long-term public industrial development policy, the integrated approach to production and innovation in large firms, and the public and private investments in education and training and R&D to support industrial development, which were different from other industrialized countries.

## 4. Japanese Science and Technology in the Recent Decades

The oil crises of the 1970s posed a real threat to the overwhelmingly petroleum-dependent Japanese economy. It did put an end to the so-called 'high growth' era, but compared to other advanced countries, it became clear by the 1980s, that Japan was able to absorb the adverse effects of the oil crisis and her industrial sector was showing strong competitive performance. This was often attributed to the innovative capacity of the industrial sector, which was enabling Japan to advance ahead of the other advanced countries by rapidly adopting information technologies in the industrial sector. However, the spectacular performance of the 1980s gave way to a serious downturn in the 1990s. Weakness of the public research base is pointed out to be a serious issue to be addressed in order to preserve innovativeness of the economy. This section reviews the trends in indicators of science and technology as well as new policy initiatives that Japan is launching to activate its research base. (Unless indicated otherwise, the data source in the section is *White Paper on Science and Technology, 2001*, compiled by Science and Technology Agency of Japan.)

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**Biographical Sketches**

**Yukiko Fukasaku** received her first university education in chemistry and biology and worked in the Mitsubishi Kasei Institute of Life Sciences in Tokyo for a few years before turning to studies in the history and social studies of science and international relations. She received her Doctor of Philosophy degree from the University of Sussex in UK in science and technology policy studies. She has worked for international organizations and research institutes including UNESCO, ILO, JETRO, and Centre de Sociologie de l'Innovation of the École Nationale Supérieure des Mines either as staff or independent researcher. She currently works in the Science and Technology Policy Division, Directorate for Science, Technology and Industry of the OECD.

**Sachiko Ishizaka** graduated in biology from University of Tokyo in 1984, and further studied International Relations at Yale University obtaining an MA in 1991. From 1985, she has been working in the Science and Technology Agency of the government of Japan, engaged in policy-making in earth, nuclear and biological sciences; also, involved in establishing new initiatives for international S&T collaboration such as Human Frontier Science Program. Between 1996 and 2000, she was a project Coordinator of the OECD Global Science Forum. Currently she is the Science Program Officer with the International Council for Science (ICSU) in Paris, engaged in planning, coordinating and implementation of international scientific programs.