Chapter 2
The Role of Private Organizations in the Introduction, Development and Diffusion of Production Management Technology in Japan

Tsuyoshi Kikuchi[1]

2-1. The role of Japanese private organizations in the introduction, development and diffusion of production management technology

In Japan, private organizations played a significant role in the introduction and adaptation of production management technology, as well as its transfer and diffusion in Japanese industry.[2] The three major organizations that assumed such roles are: the Union of Japanese Scientists and Engineers (JUSE), an incorporated foundation that contributed to quality improvement in Japan; the Japan Productivity Center (JPC), a public interest incorporated foundation that developed the productivity improvement movement; and the Japan Management Association (JMA), an incorporated association that contributed to the development of Japanese industry through the "*noritsu* (efficiency)" improvement towards scientific management or management innovation.[3]

In this chapter, the term "production management technology" is used as a general concept that refers to the skills, techniques and approaches that are used to improve productivity and quality (including the elimination of defective products), reduce costs, and shorten delivery time or lead time in the manufacturing industry.[4]

2-1-1. Overview of the Union of Japanese Scientists and Engineers (JUSE)

The JUSE significantly contributed to the quality improvement in Japanese industry. JUSE originated

[1] Senior Industrial Consultant, Japan Development Service Co., Ltd. This paper, originally written in Japanese, is published in "The Bulletin of the Graduate School of International Cooperation Studies," No.4, Takushoku University, 2011.

[2] As Tadao Miyagawa and Takashi Ishiguro point out in their article (Miyagawa et al., 1989, p. 146), Japanese companies took an active part in introducing business management technology along with manufacturing facilities and technology from Western countries in the postwar period. Apart from it, JMA (established before the WW2) and JPC (established in 1955) also played a pivotal role in the introduction of business and production management technology. Akira Suehiro points out the important role played by intermediary organizations that mediate between government and private companies (Suehiro, 2002, p.65). The term "intermediary organizations" includes business associations in the private sector, private local economic organizations, and the Industrial Structure Council. The private organizations analyzed in this paper also can be categorized as "intermediary organizations" that acted as intermediaries between Western countries with advanced technology (technology source) and Japanese private companies.

[3] The following organizations also played an important role: the Japan Institute of Industrial Engineering (established in 1959), which was an offshoot of JPC and contributed to the promotion of industrial engineering (IE); JMA Consultants Inc. (established in 1980), the former consulting division of JMA; and the Japan Institute of Plant Maintenance (established in 1981), which was an offshoot of JMA, and contributed to the promotion of Total Productive Maintenance (TPM; maintenance of production facilities based on the company-wide participation).

[4] The term "production management technology" in this chapter has the same meaning as the term "kaizen (improvement)" in a broad sense. It is roughly the same as the concept that Masaaki Imai presents in his book Kaizen (Imai, 2010).

from the following three organizations: the *Koseikai* Association (established in 1918), *Nihon Kojin Kurabu* or the Japanese Engineers' Club (established in 1920; renamed *Nihon Gijutsu Kyokai* or the Japan Technology Association in 1935) and *Zennihon Kagaku Gijutsu Toudoukai*, or the National Science and Technology Association of Japan (established in 1940). These three organizations were merged on November 3, 1944 into *Dainihon Gijutsu Kai* or the Japan Technology Association, which was subsequently dissolved on April 30, 1946. JUSE was established on May 1946 to take over the business, assets and staff of the Japan Technology Association. In 1962, JUSE was officially approved as a foundation under the jurisdiction of the Science and Technology Agency.

JUSE's current articles of endowment states that their objectives are to "promote systematic studies needed for the advancement of science and technology, that contribute to the development of culture and industry" (Article 3). Although this article defines the JUSE's objectives broadly as promoting science and technology and improving the status of scientists and engineers, the foundation has, since its establishment, focused its efforts on promoting the quality improvement movement.[5]

2-1-2. Overview of the Japan Productivity Center (JPC)

On September 24, 1954, the Cabinet adopted a policy to improve productivity. The resolution was based on the recognition that the productivity improvement in Japanese industry was an urgent priority in order to achieve cost reductions, improve quality, promote exports and increase the national income. Based on this Cabinet resolution, the JPC was established on March 1, 1955 as a leading organization to improve the productivity of Japanese industry (Foundation Prospectus) (JPC-SED, 2005a, pp.4-5).

JPC established in 1973 the Social and Economic Congress of Japan (SECJ) as a sister organization with the objective of realizing a welfare society. JPC succeeded the function of the SECJ in 1994 in order to pursue the productivity movement from a more social perspective than ever before, and the name of organization was changed into Japan Productivity Center for Socio and Economic Development (JPC-SED), which was renamed as JPC in 2009.[6]

---

[5] Article 4 of JUSE's current rules defines that JUSE engages in the following operations in order to achieve their goals.
1) Research and public relations services on policies for the science and technology promotion
2) Exchange of information on science and technology in Japan and overseas
3) Promotion of support and collaboration with science and technology related organizations, scientists and engineers
4) Research and studies related to science and technology
5) Lectures and training sessions to improve the capability of scientists and engineers
6) Publication of materials related to science and technology
7) Technological consultation on business management
8) Other operations required to achieve the organizational goals
As shown in the above articles, it is clear that their operational goals are not limited to quality improvement but are aimed at achieving the promotion of science and technology in general.

[6] www.jpc-net.jp (April 21, 2011).

The JPC's Foundation Prospectus defines the purpose of productivity improvement as reducing production costs through the effective and scientific use of resources, manpower and facilities in order to expand the market, increase employment and raise the level of real wages and living standards, thereby promoting the common interests of labor, management and general consumers (JPC-SED, 2005a, p.4). It should be noted that productivity improvement is defined as a concept designed for the promotion of companies' interests, as well as those of workers and the general public.

2-1-3. Overview of the Japan Management Association (JMA)

The JMA was established on March 30, 1942 as the sole nationwide private organization for the promotion of technology, after the dissolution and integration of the Japan Management Federation (established in 1927) and the Japan Industry Association (established in 1931). These two were regarded as the leading organizations for the promotion of "*noritsu*" through scientific management approach in Japan at the time.

JMA's current organizational goals are to "conduct investigations and research relating to management, to collect and provide this information to others, and to enhance the overall development of human resources, thereby encouraging business management innovation of enterprises and organizations and contributing to the national economy, the national standard of living, and the international community" (Article 3 of JMA's Articles of Incorporation). In short, JMA is an organization established to provide support for companies and organizations in achieving management innovation and in solving related problems.

The term "*noritsu*" is said to have come into use around the end of the Meiji period in Japan. Japan was lagging far behind Western countries in industrial development at the time and scientific management technology was adopted to catch up with the West. Eminent scholars and business leaders coined the phrase "*noritsu zoshin* movement" or "efficiency improvement movement" with the aim of promoting scientific management or management innovation. The term "efficiency" is referred to as the production management technology required to make maximum use of human resources, physical facilities, and materials.[7]

Both JUSE and JPC provide support to solve the problems that companies face (regarding quality and productivity). However, JPC focuses more on the productivity improvement movement from a macro-socioeconomic perspective, while JUSE places greater emphasis on the transfer and diffusion of production management technology for improving quality and solving problems from an industry-wide perspective. Unlike these two organizations, JMA focuses on activities to help

[7] Based on a document from JMA Consultants Inc., *JMAC: Introduction Note*.

individual companies solve respective problems from the view point of scientific management or management innovation while also taking into consideration the overall trends of industry. The JMA has promoted the transfer and diffusion of production management technology (including techniques and approaches) through this process.

2-2. Introduction, development and diffusion of production management technology by Japanese private organizations

2-2-1. The three stages of technology transfer

The process of introduction and diffusion of production management technology by JUSE, JPC and JMA includes three stages: learning new technology from advanced Western countries (first stage); examining the adaptability and validity of the introduced technology in Japan (second stage); and the full-scale diffusion of the technology (third stage). In this paper, these are referred to as the "three stages of technology transfer." The term "technology transfer" here includes technology introduction from technologically advanced countries, as well as its diffusion to companies and industries in Japan.

In the following paragraphs, we will summarize the activities of the three organizations at each stage of technology transfer.

(1) Learning new technologies from advanced Western countries

There are many ways to learn about the technologies of advanced Western countries, such as sending missions, inviting foreign consultants and experts, obtaining literature for translation and publication, sending students and long-term trainees abroad and attending international conferences and academic conventions.

The three organizations analyzed in this paper have respectively sent study missions almost every year in order to learn the advanced business and production management technologies of Western countries. These organizations have provided all their member companies with the knowledge of new business and production management through various means, such as holding briefing sessions after the missions returned to Japan or distributing mission reports to their members.

They have also invited prominent experts and consultants from advanced Western countries and held lectures and training seminars in Japan in order to provide companies with opportunities to learn advanced management methods and production management technologies directly from these experts.

Moreover, they have obtained literature and materials from Western countries for translation and publication and distributed them to a wide range of companies and researchers.

In addition, they have encouraged their members to actively participate in international academic conventions, conferences and symposiums, in order to provide opportunities to obtain new information.

(2) Examining the adaptability and validity of technologies in Japan

There is a need to examine whether new technologies from advanced Western countries are adaptable and valid for Japanese companies. Once their validity has been confirmed, it is still necessary to examine how to adapt them to Japanese companies. The three organizations formed committees and study groups to examine these issues. Experts and researchers from industry, government agencies, universities and research institutes participate in these committees and study groups in order to conduct industry-government-academia joint discussions and research. In some cases, tests were conducted at manufacturing sites to check the adaptability and validity of new technologies.

Thus, the three organizations have not transferred and diffused Western-originated production management technology to Japanese industries and companies simply by imitating it. Technologies for facility management, quality management and production management are good example of how they have made it possible to improve the technologies originally introduced from Western countries, through examination and self-study (JMA Group Collaboration Promotion Committee, 2010).

Technology for facility management was introduced from the United States (US) around 1945. While the technology was mainly used for reducing maintenance costs in the US, it was uniquely developed in Japan by focusing on the maintenance of facility function.

Similarly, technology for quality management was originally developed in the US to improve economic performance by keeping a balance between quality and cost. In Japan, the highest priority was given to improving and stabilizing product quality itself, resulting in significant improvements to the original technology. In addition, emphasis was placed on raising awareness of quality among all factory workers rather than among experts in charge. Technology for production management was also improved from the original technology introduced from the US, resulting in a highly sophisticated management system designed to reduce the stock of in-process items and provide materials to each manufacturing process in a timely manner.

In addition, the Japanese private organizations developed the following technologies: technology for

Company-wide Quality Control (CWQC) or Total Quality Management (TQM),[8] QC Circles and New Seven Tools for Quality Control were developed by JUSE with its member companies; approaches such as Single-Minute Exchange of Die (SMED) and Total Productive Maintenance (TPM)[9] were developed by JMA.

Various meetings and seminars were held to present these achievements to member companies, and reports and publications were widely distributed. In addition, training programs were organized to disseminate newly developed technologies among companies, and develop human resources capable of utilizing these technologies.[10]

(3) Diffusing of new technologies

Means and methods for the diffusion of new technologies include advice and guidance (consulting services) for solving problems using production management technology, human resource development, public relations/education activities, qualification certification systems, and awards for the excellent companies and experts that have made outstanding contributions to the development of technology.

Consulting services using production management technology are the most practical and effective form of technology transfer and diffusion. These services enable companies to acquire new technology by solving specific problems and provide opportunities for on-the-job training (technology transfer).

Not all organizations provide consulting services. JUSE gives priority to personnel training and does not provide consulting services for companies. However, at the request of companies, it provides support for the development of in-house education and training programs and introduces lecturers for training sessions. JPC provides individual companies with consulting services on productivity improvement. However, these services are only a small part of the JPC's overall business, considering that its operational strategy takes a macro perspective (socio-economic perspective) rather than a micro perspective (company-based perspective), as mentioned earlier.

---

[8] TQM was originally developed in the US. There is a difference in its concept and way of practice between the US and Japan. In the US, TQM is practiced under the guidance of quality control experts, while company-wide participation is most required in Japan.

[9] TPM was initially an acronym for Total Productive Maintenance, but it subsequently evolved into a broader concept that covers not only facility management but also business management in general.

[10] Efforts were also made by respective companies to improve the skills, techniques and approaches introduced (learned) from abroad through the three organizations or their own routes and to develop their own technology. As a result of their improvement and development, skills and techniques became more advanced than those adopted from Western countries, and these techniques were transferred and shared within companies or company groups. The Just-in-Time (JIT) system of Toyota Motor Corporation, Cellular Manufacturing System, Small-Group Activities and the 5S are amongst the unique production management technology and methods developed by Japanese companies.

JMA was originally established as an organization for providing consulting services and has continued to give priority to these services since its establishment. However, JMA established JMA Consultants Inc. (JMAC) in 1980 by converting its consulting division into an independent company. JMAC took over JMA's experience and know-how and provides companies with its own technology, methods, and approaches through consulting services (technology transfer). JMA now focuses its efforts on education and training services. JMA has other independent affiliated organizations and works in collaboration with all JMA group organizations to provide companies and organizations with various support services for management innovation.

Technology transfer and diffusion is supported by human resources. Therefore, based on the recognition that human resource development is of crucial importance for the development of technology, all three organizations have provided companies with various training programs on technical skills and methods (training courses tailored to the level of each target group such as top executives, middle-ranking managers, workers as well as training programs for different industries). These organizations have also invited prominent experts, researchers and consultants from Western countries and actively organized training seminars and lecture sessions given by these guests in order to promote and advertise new technologies and approaches for production management. However, these lecturers from abroad have gradually been replaced by Japanese lecturers as excellent production management technologies are developed in Japan.

Qualification and certification systems play an important role in developing the abilities of personnel who are engaged in technology transfer and diffusion and in maintaining their abilities above a certain level. To this end, all three organizations have trained personnel in order to help them gain theoretical knowledge, practical skills and techniques required in their priority areas. For example, they have created qualification and certification systems, such as Quality Control Specialist (JUSE), Management Consultant (JPC) and CPE (Certified Production Engineer) Qualification (JMA). Qualification and certification also serves to increase customers' trust in the personnel who are engaged in technology transfer and diffusion.

All three organizations provide awards for companies that have achieved outstanding performance in improving quality, productivity or "*noritsu*" in industry. These awards have enabled award-winning companies to improve their corporate image and reputation, resulting in increases in their sales and exports. These results, in turn, have had the effect (known as the demonstration effect) of increasing other companies' motivation for improving their own quality, productivity and efficiency. Typical examples of these awards are: the Deming Prize and the Japan Quality Medal (JUSE), the Japan Quality Award (JPC) and the JMA Human Resources Development Excellence Award (JMA).

They also promote public relations/education activities through their bulletins. JUSE publishes a monthly magazine entitled *Quality Management*, JPC publishes the *Seisansei Shimbun* (Productivity Newspaper) three times a month, and JMA publishes *JMA Management Review*. They also undertake other activities, such as the publication of technical literatures, the provision of radio training courses and correspondence courses, and the development of audiovisual training materials (by all three organizations).

To raise the awareness of business managers, executives, production managers and employees toward the improvement of quality, productivity and efficiency, all three organizations hold conventions and symposiums to discuss specific themes. At these conventions and symposiums, successful companies often present important achievements that they have attained by applying production management technology. These events were also utilized to stimulate the other participating companies to work harder. Some of these conventions and symposiums are attended not only by company members but also by the general public.

Furthermore, JUSE, JPC and JMA all promote nationwide public relations/education activities. JUSE annually holds the Deming Prize Award Ceremony during its Quality Improvement Month and creates slogans for nationwide quality improvement campaigns. JPC has issued “declarations” whenever required, while JMA has published various “suggestions” in order to attract the interest of those working in industry and of the general public.

2-2-2. Categorizing the activities of the three organizations

The activities of the three organizations described above are developed in three stages: introducing or learning new technologies (including techniques and approaches) (first stage); examining their adaptability and validity and then making adaptation and implementing pilots (second stage); and widely diffusing the developed technologies that have been adapted and validated (third stage). Their activities in the three stages of technology transfer can be categorized (abstracted) in the following table (see Table 2-1).

JUSE, JPC and JMA have successfully managed their activities in all three stages shown in Table 2-1. These organizations did not possess management capabilities from the beginning, but acquired the capabilities required throughout all the stages by undertaking activities to achieve their respective goals. The experiences of the three organizations suggest that the most crucial factor required for developing countries to continuously introduce and diffuse production management technology is the formation of management capabilities in the “three stages of technology transfer.”[11]

[11] There are the terms used in the existing research papers and literatures on technology transfer, such as “social capability for technology absorption,” “social capability,” “society’s technological capability,” “social capability for

Table 2-1. Categorization of the Activities of the Three Organizations

Stage	First stage	Second stage	Third stage
Main Activities	Introducing or learning new technologies, skills, and approaches	Examining the adaptability and validity of the introduced or acquired technologies, skills, and approaches, including pilot implementation	Widely diffusing technologies, skills, and approaches that have been adapted and validated.
Specific activities	- Sending study missions and presenting reports - Inviting prominent experts/researchers and holding training sessions - Obtaining literature and materials for translation - Sending students and long-term trainees abroad	- Establishing committees and study groups (industry-government-academia joint research) - Trial introduction of new technologies (modification and development)	- Provision of consulting services (advice and guidance) - Personnel training (including training for promoters/specialists and instructors) - Qualification certification systems - Award systems - Conventions and symposiums - Public relations/education activities (publication of bulletin and technical books) - Suggestions and declarations

Note: Compiled by the author based on materials from JUSE, JPC and JMA.

2-3. Conditions that supported the activities of Japanese private organizations

The year 2010 marked the 64th anniversary of the establishment of JUSE, the 55th of JPC and the 68th of JMA. All these organizations have continued to provide their services for over half a century. In general, an organization loses its *raison d'être* when it has completed its mission. The fact that they are active more than fifty years after their establishment suggests that there is still a need for their services from industry and the Japanese public.[12] We are therefore led to conclude that they still have missions and roles to play in Japanese industry.

What then are the reasons why the three organizations have continued to play an important role over

industrialization." More details on these terms will be analyzed in my upcoming doctoral dissertation. In my opinion, "management capability in the three stages of technology transfer" in this paper is a narrower concept than that of the above terms, but more specific. They are used in the following materials:
"social capability for technology absorption": Ohkawa, Kazushi and Henry Rosovsky, *Nihon no Keizai Seicho: 20 Seiki ni okeru Susei Kasoku* [Japanese Economic Growth: Trend Acceleration in the Twentieth Century], Toyo Keizai, 1973.
"social capability" : Watanabe (1986), and idem, *Seicho no Ajia, Teitai no Ajia* [Asia; its Growth and Agony], Kodansha, 2002.
"society's technological capability": Nakaoka (1991).
"social capability for industrialization": Suehiro (2002).

[12] As a result of the Lehman Crisis that occurred in 2008 in the US and subsequently spread worldwide, the number of participants in the training courses and seminars by these organizations is decreasing.

so many years in improving quality, productivity and management efficiency in Japanese industry? What special conditions were required to enable them to play their roles? Furthermore, are these conditions unique to Japan, or can they also be applied to developing countries?

In this paper, we will analyze the following six conditions, which provided considerable advantages to the three organizations in developing their activities: (i) the strong need for production management technology; (ii) collaboration among industry, government and academia; (iii) strong leadership of top management of private organizations; (iv) capacity of private companies to absorb and develop new technologies; (v) collaborative relationship between managers and workers; and (vi) the establishment of various national systems to support their activities. We will analyze these conditions in turn.

2-3-1. Strong needs for production management technology

Devastated by the Second World War (WW2) and with scarce natural resources, Japan was faced with the strong needs to promote industries that exported goods by processing resources imported from abroad in order to survive in the post-war world. At that time, Japan lagged behind Western countries in terms of its product quality and manufacturing productivity. The poor quality of Japanese products attracted the attention of GHQ (General Headquarters, the Supreme Commander for the Allied Powers), which occupied Japan shortly after the end of the WW2. Manufacturing productivity in Japan was said to be one-ninth or one-eighth of that in the US and one-third of that in Germany (Ohno, 1978/2005, p.8). The US Embassy in Japan even offered support to improve Japan's productivity level. The three organizations frequently sent missions to the US in order to study their measures for improving quality and productivity, as well as methods and approaches for production management technology. Japanese companies actively sent their employees to the education/training programs held by these organizations. These facts show that there was a strong need for production management technology among Japanese companies. During the post-war period, Japanese industries and companies had a strong motivation to absorb production management technology, which led them to actively participate in the activities promoted by the private organizations. In other words, the activities of respective organizations evolved, driven by the strong need for new production management technology among Japanese companies.

2-3-2. Collaboration among industry, government and academia

Since their establishment, the three organizations have successfully mobilized support and cooperation from government and academia for their activities.

JUSE has received the cooperation of scholars and researchers since its establishment. In particular, its association with Dr. Deming (an American statistician) provided an opportunity to strengthen the

cooperation with statisticians and stochasticians, which facilitated the introduction, research and development of new technologies and methods for quality improvement.[13] Scholars actively collaborated, as they considered it a good opportunity to apply their theories in practice. Related government agencies and local governments also provided cooperation and support through hosting or co-hosting the events annually held by JUSE during its Quality Improvement Month.

As an organization established based on a Cabinet resolution, JPC has received support from government and academia from the beginning. Despite their initial opposition, labor organizations also participated in the productivity improvement movement.[14] As mentioned above, the participation of labor organizations in this movement was of crucial importance, because the active participation of employees and factory workers in productivity/quality improvement movement was essential to the development of production management technology based on QCCs and small-group activities.

As for the relationship with academia, these organizations invited university professors as directors or members of various committees.[15] JPC also received support from abroad (the US). From its foundation in 1955 until 1961, JPC received support from the US government for its various activities, such as sending study missions, inviting experts from abroad, collecting literature and information, and making movies on technologies.

During the WW2, JMA, as a private consulting organization, promoted the rationalization and efficiency improvement of manufacturing processes, and also provided training for factory workers in the war industry. For this reason, JMA received subsidies from the Japanese government. However, these subsidies were terminated by GHQ in 1945, when the war ended, presumably because the association had been working for the war industry. This is in sharp contrast to JPC, which received financial support from the US government.

JMA was not as active as JUSE or JPC in developing relationships with academia. This is probably due to the "association's three major principles" which were formulated by its first Chairman, Takuo Godo. The three principles are: developing an efficiency improvement movement with Japanese characteristics; placing emphasis on practice over theory; and making a focused effort. Godo's views about the relationship with academia can be seen from his statement on the emphasis of "practice over theory": "Theories of manufacturing efficiency, production technology and management discuss

[13] Tetsuro Nakaoka, emphasizes the importance of JUSE's function of "promoting communication among industry, government and academia." (Nakaoka, 1980, vol. 82, No. 3, p.57).
[14] The General Council of Trade Unions of Japan made a statement in February 1955 that they would not participate in the productivity movement. However, the Japan Federation of Labor made their decision to follow the movement in June and officially joined in September (see JPC-SED, 2005b).
[15] Ichiro Nakayama, President of Hitotsubashi University, was appointed as the JPC's first Vice-Chairman. (The President was Taizo Ishizaka, Chairman of Keidanren, and another Vice President was Shigeo Nagano, President of Fuji Iron & Steel Co., Ltd).

general principles that do not address specific and individual conditions. These academic arguments do not serve companies or factories well." (JMA Group Collaboration Promotion Committee, 2010)

2-3-3. Strong leadership of top management of private organizations

JUSE, JPC and JMA were committed to and actively engaged in various activities to achieve their respective objectives. Of particular importance is the fact that the top management of each organization had a strong sense of mission and leadership.

JUSE's first Chairman Ichiro Ishikawa and first Managing Director Kenichi Koyanagi, JPC's first President Kohei Goshi, and JMA's first Chairman Takuo Godo and President Kakuzo Morikawa are legendary figures who exercised strong leadership and played important roles in their respective organizations.

Ichiro Ishikawa of JUSE, who also served as the Chairman of *Nippon Keidanren* (herein after referred to as *Keidanren*), made considerable efforts to persuade Japanese industrial and business leaders of the importance of improving product quality. JUSE's Managing Director Kenichi Koyanagi invited Dr. Deming to Japan and contributed to the establishment of "the Deming Prize."

At the time of JPC's establishment, the General Council of Trade Unions of Japan announced that they would not participate in the productivity improvement movement. In response to this announcement, JPC's first President Kohei Goshi strongly urged labor unions to join the movement by carrying his message in "*Rondan*" of the Asahi Shimbun,[16] which resulted in the participation of the Japan Confederation of Trade Unions. Goshi emphasized that the goal of productivity improvement was to increase employment and raise the level of real wages. His message was also of great historical significance in that it attracted public attention to the hitherto little known productivity improvement movement.

Takuo Godo of JMA is regarded as amongst "the three pioneers of the efficiency improvement movement." Godo, worked at the Kure Naval Arsenal before joining JMA,[17] promoted the efficiency improvement movement. Apart from him, Okiie Yamashita[18] of the Japanese National Railways and Yoichi Ueno[19] who worked in the private sector, promoted the movement from their own standpoints.

[16] Dated February 21, 1955. JPC-SED (2005b), pp. 9-13.
[17] The Kure Naval Arsenal is the shipyard where the battleship Yamato, which was the biggest battleship in the world at the time, was constructed during the WW2. Various technologies adopted for the construction contributed to the progress of production management technologies in postwar Japan.
[18] After working at the South Manchuria Railway Co., Ltd., Okiie Yamashita joined the Japanese National Railways (Today's Japan Railway Company). He achieved remarkable results in technology management and established the Japan Industry Association, forerunner of JMA. He started their consulting services by recruiting experts that could lead companies (see JMA Group Collaboration Promotion Committee, 2010).
[19] Yoichi Ueno (1883–1957) was a psychologist and later became a researcher in industrial efficiency and scientific

These three people achieved outstanding results and are known respectively as “Godo of the military,” “Yamashita of the government,” and “Ueno of the private sector.” (JMA Group Collaboration Promotion Committee, 2010)

They all had the foresight to understand the importance of improving product quality, manufacturing productivity and management efficiency in Japanese industry. They led their respective promotion movements with a strong sense of mission.

2-3-4. Capacity of private companies to absorb and develop new technologies

Establishment of the organizations that promoted production management technology, led by strong top management, is not enough for a successful transfer of technology. It is indispensable that the companies have the desire and capacity to absorb new technologies.

Japanese industries and companies, including JUSE, JPC and JMA, possessed the capacity to absorb new technologies and techniques introduced from the West. Here, the absorptive capacity of new technologies means that the companies’ top management and engineers had knowledge to understand the relevant skills and techniques and the desire to adopt them. In addition, factories must have workers capable of absorbing the new technologies.

Dr. Deming, who was invited by JUSE to teach statistical methods for quality control, is said to have been deeply impressed by the fact that many Japanese engineers understood and acquired the methods in a short period. This means that Japanese business managers and engineers already had knowledge of statistics and stochastics as well as the capability to understand the new techniques and approaches of quality management taught by Dr. Deming. Tetsuro Nakaoka analyzes this point in his paper “The Scientific Management Movement in Japan during and after the Second World War.” (Nakaoka, 1980, vol.82, No.3) The following paragraph quoted from his paper reveals the secret of the success of the quality improvement movement in Japan and has important implications for technology transfer in developing countries in the future.

“The quality management movement during this period (when JUSE was established – note by Kikuchi) was aimed exclusively at learning from the US. It was therefore a one-way flow of technology, which can be accurately described by the term “technology transfer.” However, the acquired techniques themselves were based on the mathematical theory of stochastics. These

---

management. He introduced management philosophy and technology from the US into Japanese industry and became the first management consultant in Japan. In 1925, he established the Japan Management Research Institute, forerunner of SANNO College. After the WW2, he worked as a Commissioner of the National Personnel Authority on the establishment of the Japanese civil service system. He also established SANNO College in 1950 and greatly contributed to the modernization of Japanese business management. (http://www.mi.sanno.ac.jp).

techniques were not something that could be acquired simply with the decision to learn about the advanced production management methods of other countries. I would like to emphasize that what was of crucial importance for the quality management movement during this period was the capability of the Japanese to immediately comprehend and develop the theories learned, to adapt the techniques suitable for Japanese industry, and to diffuse them far more broadly than the US did. Dr. Deming, known as the father of the quality management movement in Japan, also believes that the extensive knowledge of stochastics that had been accumulated in Japan before his teaching was the secret of the success of the quality management movement there."[20]

As Masatake Wada states in his paper "Technology Transfer and Policy Support—Today's Developing Countries as Recipients of New Policies,"[21] the process of adopting industrial technology in Japan from the Meiji Restoration through to the postwar period was supported by private companies. Japanese private companies played active roles in introducing advanced industrial technology from Western countries, absorbing and applying it into their own production activities, and even exporting their own products, with a higher quality than those of Western countries, to the global market. Wada points out that this success was due to such factors as: the high motivation of recipients for learning new technologies; their constant efforts to understand the essence of modern technologies; and their recognition, through their own experiences, that the basic culture of Japan and Western countries were different so the technology developed in the West was unsuitable for use in Japan in its original form. In other words, Japanese companies, in adopting new technologies, had the capability to understand what was required to absorb new technologies.

One of the principal management policies that the JMA has adopted since its establishment is the formulation and establishment of a management efficiency improvement method with Japanese characteristics. Based on this policy, JMA has followed a strategy to develop unique technologies and techniques. Its goal is to contribute to the development of Japanese industries and companies by adapting knowledge and technology to the Japanese cultural climate rather than simply importing it from abroad. (JMA Group Collaboration Promotion Committee, 2010)

Meanwhile, one of the JPC's three guiding principles specifies that, "labor and management must cooperate in researching and discussing specific methods to improve productivity, in consideration of the specific circumstances of companies." Based on this principle, JPC has promoted research activities through cooperation between labor and management. From this perspective, it can be said

[20] Nakaoka also points out the factors that enabled Japan in the postwar period to adopt production management technology from Western countries and develop their own technology. According to him, this was because the groundwork for the development had already been laid down during the war. In other sources, similar concepts are also stated that the Japanese technology development in the Meiji period was not just a miracle, but due to the groundwork for the development prior to that Period. (Nakaoka, 2006 and Nakaoka et al., 1995).

[21] Hashimoto (2008), pp. 123-140.

that JPC has contributed to creating an environment for improving the capacity of individual companies for technological development.

As Masatake Wada points out, it is likely that the cultural climate of Japan forms the general background e industry to develop the capacity to absorb new technologies (capacity to improve the existing technology and adapt it to specific circumstances).

2-3-5. Collaborative relation between managers and workers

Improvements in quality, productivity and efficiency all require the understanding and cooperation of employees and factory workers involved in the production processes. No matter how much improvement is made to quality or productivity, failure to distribute the benefits to employees and workers leads to dissatisfaction among them and causes difficulties in the process of adopting production management technology. In Japan, a collaborative relationship has been maintained between management and labor. Although there was opposition to joining the productivity improvement movement among labor unions when JPC was established, they soon agreed to cooperate with the movement. This was made possible partly due to strong persuasion from JPC's top management, but it was also a result of an appeal to the workers from the President of the Japan Confederation of Trade Unions that the productivity improvement movement would also bring benefits to workers. He insisted that promoting conflict between management and labor in a small country like Japan, and trying to solve all problems by class struggle, would only lead to the destruction of the nation. (JPC-SED, 2005b, p.39)

Tetsuro Nakaoka also points out, in his paper "The Scientific Management Movement in Japan during and after the Second World War" cited above, that there was no conflict between management and labor in Japan, unlike the case of the US.[22]

In Japan, new production management technologies were developed by adopting the ideas and suggestions of workers, as well as by responding to their complaints. Technologies, methods and approaches for production management were improved and developed through daily improvement activities (*kaizen*) based on collaboration between management and labor. These trends were common not only at major companies but also small and medium enterprises (SMEs), which was probably due to the JPC's three principles adopted at the time of its establishment. As mentioned above, these principles emphasize that "labor and management must cooperate in researching and discussing concrete methods to improve productivity giving consideration to the company's specific

[22] "In contrast to Taylor's scientific management movement, which often led to head-on clashes with the labor union movement in the US, the scientific management movement in Japan did not cause any outright confrontation with the labor union movement." (Osaka City University, Keizaigaku Zasshi (Journal of Economics), op. cit.)

circumstances," and that "the fruits of the productivity improvement should be distributed fairly among labor, management, and consumers in line with the state of the national economy." (JPC-SED, 2005b, p.38)

It can be said that the collaborative relationship between management and labor was one of the key factors that facilitated the adoption and diffusion amongst Japanese companies of production management technologies and methods, such as Toyota Production System (TPS), TQM, TPM and QCC activities.

Frederick W. Taylor, who proposed the scientific management method in the US, also acknowledged the importance of the relationship between management and labor. He wrote that, "This close, intimate, personal cooperation between the management and the men is of the essence of modern scientific or task management."[23] These words, written exactly a century ago, had been followed by Japan much faithfully than the US.

2-3-6. The establishment of various national systems to support their activities

Quality management was developed with the sincere efforts of Japanese industries and companies, for example, by attending lecture sessions held by the GHQ's Civil Communication Section, and instructions and lectures by W. Edwards Deming and Joseph M. Juran, American statisticians. In addition, there were various national systems that played important roles in the development of quality management technology in Japan.

The Japanese standards system is one such crucial system. Based on the Industrial Standardization Act established in 1949, systems such as the factory labeling permission system of the Japanese Industrial Standards (JIS) and the commendation system for excellent factories with good performance (since 1953), promoted the diffusion of the standards systems in Japan. (MITI Trade and Industry Policy Editorial Board, 1990, p.352) According to Masatake Wada, "When certifying products for the JIS label, not only the products themselves but also the factory's quality management systems and facilities were examined, in order to check whether they had enough capacity to meet the standards. Around 1,500 product items were selected for the JIS label. These items were originally chosen with the aim of improving quality, rationalizing production, simplifying transaction procedures, promoting fair trade, increasing international competitiveness and promoting SME's technological improvement." (Wada, 2009, p.67)

This standards system enabled SMEs in Japan to make positive efforts to improve their quality and

[23] Taylor, 2009/2010, p.30 (English original: Frederick W. Taylor, The Principles of Scientific Management, New York: W. W. Norton & Company, 1911, p.26).

technological skills. Some people even argue that this system has made a major contribution to the creation of high-quality industrial products in Japan today.

The export inspection system in Japan also contributed to improving the product quality of Japanese companies.

Products exported from Japan shortly after the WW2 were labeled as poor-quality goods by importing countries, where movements to restrict imports from Japan gathered strength. The Japanese government, forced to take measures to prevent the export of poor-quality products, enacted the Export Inspection Act in 1957 in order to enhance the inspection system and improve the quality of export products. The following gives an outline of the Act. (MITI Trade and Industry Policy Editorial Board, 1994, pp.334-335)

- Goods designated by government ordinances must be inspected by a government organization or government-designated inspection organization before they are exported.
- Export inspections include inspections of product quality, packaging conditions, materials, and manufacturing.
- Inspection organizations with the capability to conduct fair inspections and perform public functions are designated based on application and are placed under the supervision of the government.
- Provisions regarding orders to suspend illegal exports and crimes related to attempts to export illegal goods are specified.[24]

Based on this Act, on-site inspections were conducted annually by government organizations. As a result, the percentage of rejected products decreased from 2.1% in 1960 to 0.8% in 1965 and to less than 0.5% in 1969. These results show how this system contributed to the improvement of product quality. (MITI Trade and Industry Policy Editorial Board, 1989, p.142)

In his paper "Japanese SME Policies in the Postwar Period" (*The Teikyo University Economic Review*, vol. 42, no. 2, March 2009), Masatake Wada evaluates the government's policies that contributed to the improvement of the technological skills of SMEs in Japan. He mentions that apart from the export inspection system and the standards system mentioned above, the *Shindan* system (management consultant system) and *Kosetsushi* (public research organizations) played important roles.

The *Shindan* system is a "SME management consultant system" in which public organizations

[24] While there was progress in the development of the inspection system for quality improvement, problems regarding design duplication became more serious. In order to prevent these problems, the Export Product Design Act was enacted in April 1959 (MITI Trade and Industry Policy Editorial Board, 1994, p.335).

evaluate SME's business performance and provide them with advice and consultation for improving their management systems and facilities. In 1948, the Small and Medium Enterprise Agency was established under the Ministry of International Trade and Industry (MITI) based on the Outline of SME Measures adopted by the Cabinet. Then the *Shindan* system was adopted by the MITI's regional office, prefectures and five principal metropolitan areas of Japan. According to Wada, more than 10,000 consultations were provided to companies in 1950 upon the adoption of the scientific management method. This result shows not only the keen interest of individual companies in the new management technology, but also the deep and nation-wide influence of the *Shindan* system. A visiting consulting system was also established in 1952. (Wada, 2009, p.65)

Unlike national research institutes, *Kosetsushi* are the public research organizations which conduct public testing and research that meet the industrial needs of local communities. These institutions conduct tests and inspections and provide technological information to local SMEs. Through these services, they have greatly contributed to improving the technological skills of local SMEs, their quality and productivity. Data as of 1997 shows that more than 600 public research organizations have been established by municipalities, including 32 organizations created by prefectures. (Wada, 2009, p.65)

2-4. Conditions required of public organizations in charge of the introduction and diffusion of production management technology in developing countries

In this section, we will examine the conditions that enable public organizations in developing countries to successfully introduce and diffuse production management technology, based on the experience of private organizations in Japan.

As mentioned above, the following conditions were needed for Japanese private organizations to play their important role in the introduction, development and diffusion of production management technology: (i) the strong needs for production management technology; (ii) collaboration among industry, government and academia; (iii) strong leadership of top management of public organizations; (iv) capacity of private companies to absorb and develop new technology; (v) collaborative relationship between managers and workers; and (vi) the establishment of various national systems to support their activities. All of these conditions are required not only for Japanese private organizations, but also for those in developing countries. In this section, we analyze these conditions in turn in order to examine whether they can be replicated in developing countries.

The first condition that enabled Japanese private organizations to develop their activities was the strong need of Japanese private companies for production management technology. Where did those needs come from? The Japanese economy was completely devastated by the WW2. To restore the

national economy, Japan as a country with scarce natural resources needed to promote the processing trade (exports) and improve product quality and productivity through collaboration between the public and private sectors. Such historical needs existed at the time.

Whether or not production management technology can be successfully adopted depends on the needs of companies for the technology. Needless to say, the circumstances of today's developing countries can not be the same with those of postwar Japan. However, the current progress of economic globalization makes it imperative for all companies—in both advanced and developing countries and regardless of whether or not they are exporting their products—to improve their competitiveness. Therefore, companies in all industries are faced with the need to enhance their competitiveness. Industrial technologies in the manufacturing industry include business management technologies, research & development and design technologies, manufacturing technologies, and production management technologies. In order to improve overall competitiveness, it is necessary to enhance all of these technologies. Although the adoption of technologies other than production management is also required, there is likely to be a potential need amongst the companies of all developing countries for production management technology in order to enhance competitiveness.

Secondly, in Japan, industry, government and academia worked together to assist private organizations in their efforts to improve quality and productivity. They cooperated with each other to actively adopt related technologies and techniques from advanced Western countries, examining their adaptability and validity for Japan and promoting them accordingly. Are these conditions replicable to today's developing countries? Although the possibilities for such collaboration vary from one country to another, private organizations are generally not fully developed in developing countries. Nevertheless, collaboration among industry, government and academia is essential for the development of technology in any country in the long run. Government organizations in charge of the introduction and diffusion of production management technology need to build collaborative relationships with private sectors and academia, through promoting private organizations and keeping close contact with universities. I was engaged in several technical cooperation projects, such as Japan International Cooperation Agency (JICA) technical assistance for Tunisia (The Study on Formulation of a Master Plan for Quality/Productivity Improvement in Tunisia, from August 2006 to July 2008) and for Argentina (The Study on the Diffusion Plan for the Business and Production Management Technology for SMEs in the Argentine Republic, from April 2009 to March 2010). My experience in these projects confirms that the introduction development and diffusion of production management technology cannot be carried out by government organizations alone and that collaboration among industry, government and academia is indispensable for achieving successful results.

Thirdly, the top management of the three Japanese organizations all had a strong sense of mission and were committed to developing companies and industries in order to advance the postwar economic

recovery. They demonstrated strong leadership in introducing and diffusing the production management technology. Their commitment and leadership promoted the activities of the respective organizations and stimulated the interests of business managers and engineers in production management technology. In developing countries where private organizations are not yet fully developed, the top management of public organizations will be required to assume such roles. In this respect, the top management of the counterparts (public organizations) in both the Tunisian and Argentine projects fully recognized the importance of production management technology and were firmly committed to its promotion. The existence of such institutions is essential for the development of technology. The prime minister of an African country, who was informed of the JICA cooperation project in Tunisia, requested that Japan provide similar support to his country. As a result, a cooperation project is currently underway and preparations are being made to establish a core organization responsible for the introduction and diffusion of production management technology in his country. There is no doubt that government initiatives like this will make it easier to introduce and diffuse production management technology. However, government leaders do not always have a proper understanding of production management technology, nor do they always exercise strong leadership in promoting it.

Fourthly, Japanese private organizations had the capacity to absorb new technologies, improve the original technologies and methods introduced from the West, and develop them further on their own. This effectively means that Japanese companies had personnel with the necessary educational background, technical knowledge and experience. Countries like Tunisia and Argentina still lack such personnel. This is due to the small number of production management technology courses available in universities and technical colleges, as well as the lack of practical experience in factories. Therefore, with a view to developing human resources for the future, core government organizations will be required to collaborate with academia and industry and improve the capacity of companies and industries to absorb and develop technology.

Fifthly, the collaborative relationship between management and labor, involving factory workers and employees, promoted the improvement of quality and productivity in Japan. Most developing countries are unlikely to follow the example of Japan from its beginning. However, in our pilot projects in Tunisia and Argentina, we introduced new technology on an experimental basis in order to check its adaptability and validity. Considering the local counterparts' performance, we acknowledged the following points: even if there is not much communication between managers and workers, workers became more cooperative, once they had understood that the introduction of the 5S (the 5S stands for *Seiri* (Sort), *Seiton* (Straighten), *Seiso* (Shine), *Seiketsu* (Systematize) and *Shitsuke* (Standardize/Self-discipline), which are the five basic principles for effective management in the workplace) improved their working environments; and if the management placed suggestion boxes to ask for workers' ideas and gave incentives to the workers whose ideas were adopted, their motivation

for participation increased. These findings suggest that developing a collaborative relationship between management and labor may not be easy, but is nevertheless possible.

Finally, various national systems, such as the export inspection system, designated factory system based on JIS and *Kosetushi*, supported the activities of Japanese private organizations. In particular, the following incentives contributed to improving the product quality of the companies in Japan: there was a period when all export products had to be inspected, therefore exporting companies had no other choice but to improve their product quality; JIS labels guaranteed the product quality and helped to earn customers' trust and increase sales; and technical consultation services were always available at public research organizations nearby. The establishment of such favorable conditions may not be expected immediately in developing countries. Therefore, the core government organizations in developing countries will be required to examine how to establish systems and frameworks appropriate for their respective countries, in the process of introducing and diffusing product management technology.

It can be concluded that although developing countries may not satisfy the same conditions that supported the activities of the three Japanese organizations in Japan, similar conditions are required for any organization—whether public or private—in order to introduce and diffuse new technologies.

2-5. Conclusion

In this paper, we analyzed and generalized the activities of three Japanese organizations (JUSE, JPC and JMA) in the introduction, development and diffusion of production management technology after the postwar period. This paper aims at drawing implications for the public organizations of developing countries that will be in charge of the introduction and diffusion of production management technology in the future.

Apart from these three organizations, many other private organizations (e.g. industry associations[25]) have worked towards the introduction and diffusion of production management technology in Japan. Although the scope of their activities is more limited, they have also been engaged in activities similar to those of these three organizations (sending study missions, conducting research, providing education and training seminars, developing public relations activities, etc.).

Will developing countries need as many organizations as in Japan to introduce and diffuse production management technology? Although conditions may vary from one country to another, it is not always necessary to have as many organizations. If only one organization were to perform all the functions

[25] In addition to JUSE, JPC and JMA, there are many other associations and organizations specializing in specific business fields. They have also sent overseas missions to Western countries in order to acquire new technological information.

required for improving quality, productivity and efficiency, conflicts or difficulties are unlikely to occur. The top priority in developing countries is to establish organizations that can play a pivotal role in the introduction and diffusion of production management technology. It would be preferable to leave the role to the private sector as much as possible. But in many developing countries, where private organizations are not yet fully developed, public organizations are expected to play a central role.

Our analysis in this paper was limited to three Japanese private organizations and we did not analyze the activities of private companies as recipients of transfer of production management technology. A further study is required of how the activities of JUSE, JPC and JMA have affected private companies in the introduction, development and diffusion of technology. Such a study may reveal more about the roles of these three organizations.

Many of the existing research papers on technology transfer analyze the capacity and initiatives of recipients to absorb new technologies rather than those of providers. Although technology transfer itself is a one-way flow of technological knowledge, the communication process flows two ways. (Rogers, 2007) It is therefore necessary to study the conditions and capacity[26] required for the providers of technology.

In the three stages of transferring production management technology, all three Japanese organizations possessed the necessary capabilities to develop the activities required at each stage and to manage these activities through all three stages. Of course, these organizations did not have such capabilities from the beginning, but developed them step by step by undertaking various activities to achieve their respective goals. It is recommended that when Official Development Assistance (ODA) projects support public organizations in charge of the introduction and diffusion of production management technology, a final goal should be set in developing their capability to manage the three stages of transferring production management technology.

[26] The capabilities required of the donors will be analyzed in detail in my upcoming doctoral dissertation, by referencing "Study on Human Resources Development Policy in the International Cooperation Field (Human Resources Assignment Department, JICA, 2002)."

References

Japanese:

Hashimoto, Hideo, ed. (2008), *Kaihatsu Tojokoku to Nihonjin Choki Seisaku Adobaiza Ron* [Japanese Long-Term Policy Advisor's Theory on Developing Countries], International Institute for Advanced Studies.

Imai, Masaaki (2010), *Kaizen*, McGraw-Hill Education.

Japan Industrial Management Association, ed. (2005), *Seisan Kanri Yogo Jiten* [Glossary of Production and Manufacturing Management Terms] (Third Printing), Japanese Standards Association.

Japan International Cooperation Agency (JICA) and Japan Development Service Co., Ltd. (JDS) (2008), *Chunijia-koku Hinshitsu/Seisansei Kojo Masuta Puran Chosa Saishu Hokokusho* [Final Report; Study on Formulation of a Master Plan for Quality/Productivity Improvement in Tunisia], JICA, March.

JICA and JDS (2010), *Aruzenchin-koku Chusho Kigyo Keiei / Seisan Kanri Gijutsu no Fukyu Taisei Kochiku Keikaku Chosa Saishu Hokokusho* [Final Report; Study on the Diffusion Plan for the Business and Production Management Technology for Small and Medium Enterprises in the Argentine Republic], JICA, March.

JICA Human Resources Assignment Department (2002), *Kokusaiteki ni Tsuyo suru Enjo Jinzai Ikusei ni kakaru Enjo Sakutei* [Study on Human Resources Development Policy for International Cooperation Field].

JICA Institute for International Cooperation (2006), *Capacity Development*.

Japan Institute of Industrial Engineering (JIIE), *Katsudo Annai* [Guidebook].
.
JIIE (2010), *IE no Ayumi to Tembo (50 Nenshi)* [History of the IE and its Prospects for the Future (Fifty Years of History)].

JIIE (2010), *IE Rebyu 265* [IE Review 265], vol.51, no. 2.

Japan Management Association (JMA) (1986), *Morikawa Kakuzo no Sekai* [The World of Kakuzo Morikawa].

JMA, *JMA Kokai Kyoiku Sogo Gaido 2010* [Guidebook for JMA Open Training Courses 2010].

JMA Consultants Inc., *JMAC: Introduction Note*.

JMA Group Collaboration Promotion Committee, ed. (2010), *JMA Gurupu no Genten* [Guiding Principles of JMA Group].

Japan Productivity Center for Socio-Economic Development (JPC-SED) (2005a), *Seisansei Undo 50 Nenshi* [Fifty Years of the Productivity Movement].

JPC-SED (2005b), *Nenpu, Seisansei Undo 50 Nenshi* [Chronology: Fifty Years of the Productivity Movement].

Kikuchi, Tsuyoshi (2009), "*Seifu Kaihatsu Enjo ni okeru Sangyo Gijutsu Iten Moderu An to sono Tekiyo Jirei* [An ODA Industrial Technology Transfer Model and its Applications]," Takushoku University Institute for International Development, ed., *International Development Research*, vol. 8, no. 2 , Keiso Shobo, March.

Kikuchi, Tsuyoshi (2010), "*Seifu Kaihatsu Enjo ni okeru Sangyo Gijutsu Iten Moderu Kochiku no Kokoromi* [An Attempt to Establish an Industrial Technology Transfer Model in ODA]," *Development Engineering* (vol. 16, October 21, 2010), International Development Engineering Society, July.

Koike, Yoichi (2000), "*Keizai Hatten to Gijutsu Iten, Higashi Ajia no Gijutsu Hatten to Kadai* [Economic Development and Technology Transfer: Technological Development in East Asia and its Problems]," Toshio Watanabe, ed., *Kokusai Kaihatsugaku II* [International Development Studies: vol. 2], Toyo Keizai Inc.

Ministry of Trade and Industry (MITI) Trade and Industry Policy Editorial Board (1989), *Tsusho Sangyo Seisakushi IX: Daisanki Kodo Seichoki (2)* [History of Japanese Trade and Industry Policy IX: (Third Stage) Rapid Economic Growth (2)], Research Institute of Trade and Industry, April.

MITI Trade and Industry Policy Editorial Board (1990), *Tsusho Sangyo Seisakushi VI: Dainiki Jiritsu Kiban Kakuritsuki (2)* [History of Japanese Trade and Industry Policy VI: (Second Stage) Establishment of the Foundation for Self-Support (2)], Research Institute of Trade and Industry, March.

MITI Trade and Industry Policy Editorial Board (1994), *Tsusho Sangyo Seisakushi I: Soron* [History of Japanese Trade and Industry Policy I: General Introduction], Research Institute of Trade and Industry, July.

Miyagawa, Tadao, and Takashi Ishiguro (1989), "*Nihon Kigyo no Pafomansu* [Performance of Japanese Companies]," Uzawa, Hirofumi, ed., *Nihon Keizai: Chikuseki to Seicho no Kiseki* [Japanese Economy: History of Accumulation and Growth], University of Tokyo Press.

Monden, Yasuhiro (2006), *Toyota Purodakushon Shisutemu, Sono Riron to Taikei* [Toyota Production System, its theory and system], Diamond Inc.

Nakaoka, Tetsuro (1980), "Senchu Sengo no Kagakuteki Kanri Undo [The Scientific Management Movement in Japan during and after the Second World War]," *Keizaigaku Zasshi* [Journal of Economics], vol. 82, no.1 and 3, and vol. 83, no.1.

Nakaoka, Tetsuro (1991), "Sosetsu: Tojokoku ni okeru Gijutsu Keisei to Wagakuni no Gijutsu Kyoryoku [Introduction: Development of Technology in Developing Countries and Japanese Technical Cooperation]," *Kokusai Kyoryoku Kenkyu*, vol. 7, no. 2, JICA, October.

Nakaoka, Tetsuro (2006), *Nihon Kindai Gijutsu no Keisei* [Development of Modern Technology in Japan], The Asahi Shimbun Company.

Nakaoka, Tetsuro, Tadashi Ishii, and Hoshimi Uchida (1995), *Kindai Nihon no Gijutsu to Gijutsu Seisaku* [Technology and Technology Policy in Modern Japan], (Second edition), United Nations University Press, (First edition published in 1986).

Ohno, Taiichi (1978/2005), *Toyota Seisan Hoshiki* [Toyota Production System], Diamond, Inc.

Ohkawa, Kazushi and Henry Rosovsky (1973), *Nihon no Keizai Seicho: 20 seiki ni okeru Susei Kasoku* [Japanese Economic Growth: Trend Acceleration in the Twentieth Century], Tokyo Keizai.

Rogers, Everett M. (2007), (translated by Toshio Mitsufuji), *Inobeshon no Fukyu* [Diffusion of Innovations, 1995], Shoeisha.

Suehiro, Akira (2002), *Kyatchi Appu gata Kogyokaron* [Catch-up Industrialization], The University of Nagoya Press, (first edition: 2000).

Union of Japanese Scientists and Engineers (JUSE), *Soritsu 50 Nenshi* [Fifty Years of Our History].

JUSE, *Nikka Giren: Kyoiku/Semina Sogo Gaido 2010* [JUSE: Guidebook for education and Seminar 2010].

JUSE Deming Prize Committee, *Demingu-sho no Shiori 2010* [Guidebook of the Deming Prize 2010].

Taylor Frederick W. (2009/2010), (translated by Yuko Ariga), *Shinkan: Kagakuteki Kanriho, Manejimento no Genten* [The Principles of Scientific Management], Diamond, Inc.

Wada, Masatake (2008), "Gijutsu Iten to Seisaku Shien [Technology Transfer and Policy Support]," in Hashimoto, Hideo, ed. (2008).

Wada, Masatake (2009), "Sengo Nihon no Chusho Kigyo Seisaku, Nihon no Chusho Kigyo no Gijutsu Suijun no Takasa no Gensen [Japanese SME Policies in the postwar period: Origin of the Japanese SME's High-Level Technology]," *The Teikyo University Economic Review*, vol. 42, no. 2, March.

Watanabe, Toshio (1986), *Kaihatsu Keizaigaku: Keizaigaku to Gendai Ajia* [Development Economics: Economics and Contemporary Asia], Nippon Hyoronsha.

Internet materials:

Japan Institute of Industrial Engineering (JIIE): http://www.j-ie.com
Japan Institute of Plant Maintenance (JIPM): http://www.jipm.or.jp
Japan Management Association (JMA): http://www.jma.or.jp
Japan Management Association Consultants Inc.(JMAC): http://www.jmac.co.jp
Japan Productivity Center (JPC): http://www.jpc-net.or.jp
SANNO Institute of Management: http://www.sanno.ac.jp
Union of Japanese Scientists and Engineers (JUSE): http://www.juse.or.jp