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A study on the Role of Japanese Engineers in Korean Industrial Innovation

Hiroshi Fukagawa*

Summary

In recent years, due to the fast pace of industrial innovation in Korea, Korean companies have been catching up with Japanese companies. Japan long commanded the largest share of the world's consumer electronics market, but in recent years Korean has come to take this position. Why did the Korean companies catch up with Japanese companies in such a short period of time?

In this study, we focus on the role and experience of Japanese engineers working in Korean companies. In other words, we considered the question, how did Japanese engineers contribute to Korean companies' catching up with Japanese companies? We conducted several interviews with Japanese engineers working at Korean companies. From these interviews, we obtained valuable insights into technology transfer and innovation.

Key words: Japanese Engineers, Industrial Technology Innovation, Technology Transfer, Catching Up

1. Previous studies and research background

(1) Background

Korean companies now have a greater market share of TV display devices than do Japanese companies. In industrial fields that were once dominated by Japanese companies, Korean companies have caught up, and with respect to industrial technology innovation, Japanese and Korean companies' former competitive positions have become reversed.

Korean companies have caught up with their competitors in Japan and the United States over a relatively short period. It is clear that Korean technological innovation has made this possible, but the specific reasons Korean companies have been able to catch up so quickly have not been clarified in past studies.

To begin to address this question, we focused on the effect Japanese engineers may have had on the process of industrial technological innovation in the Korean companies in which they are involved. One common characteristic of these Japanese engineers is that they have faced and overcome the problem of the different ways of thinking about technology in Japan and Korea. Their research activities and contributions are a part of the background of Korean industrial technological innovation.

In previous studies, the role played by Japanese engineers in the process of industrial technological innovation in Korean companies was unclear. In this study, we explored Japanese engineers' activities directly by interviewing them [1]. From their responses, we were able to glean some implications for the study of in-

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1) Interviews for this research were held in the period from 2008 to 2010.

dustrial technology innovation.

(2) Previous studies

There are several previous studies on industry technology innovation in Asian countries focusing on each country's own technology development, technology transfer, and technical guidance. The present study is different in that we focus on industrial innovation by foreign engineers. In previous research on technology transfer, the mainstream view has been that the recent catch-up has been driven by Korean companies' networks or by their innovation and management organizations. However, if we cannot disregard the role of foreign engineers in the process, a new viewpoint will be needed to study Korean industries' leaps forward in technological innovation.

If that is the case, we must examine the nature of propagation of industrial technologies. Here we will introduce research related to the present study and show how it differs.

One early study in this area of research is Mizuno (1996), a study on manufacturing techniques in the Korean automobile industry (Junko Mizuno, *Korean Automobile Industry*, the Institute of Developing Economies, 1996). According to this study, there was a greater difference then between Japan and Korea than now exists.

In the past in Korea, technology was understood to mean facilities. A higher priority was given to the introduction of new equipment from abroad than to the training of technical personnel or internal technological development. In addition, Korean companies worked to train personnel on new equipment introduced to Korea from Japan.

Japan was the largest supplier of technology for Korean companies. Because of this, Korean companies experienced the technical training of a large number of technical personnel dispatched to Japan. The agreements executed when Japanese equipment was introduced to Korean firms generally required Japanese suppliers to provide technical training for Korean companies' engineers. However, after technical training in Japan, the Korean engineers did not convey the technical information they had gained, widely within their companies, therefore, having one or a few technicians receive training was not sufficient to diffuse a technology within a Korean company.

In Korea, technology was considered to be private property or as a factor determining an individual's value, so propagating technology would be seen as reducing a trained engineer's personal value. Therefore, it was difficult for the results of training in Japan to become common property in Korean companies. In Europe and the United States, there was high turnover of technical personnel, so engineers who were moving out left their accumulated technical knowledge behind in their own manuals. In Japan, due to the high retention rate of employees, technology was handed down in other ways.

Despite high turnover, in some cases there were no manuals in Korea. Therefore, it was rather difficult to propagate technology there. In addition, technical information did not spread within individual companies because of their business organizations [2].

On the other hand, in her study on Samsung Electronics, Ha (2003) said that Samsung Electronics had solved the problem of enterprise organization and that it had achieved technological innovations ("Globalization and Technological Accumulation and Innovation of Korean Companies", *Korean Economic Studies, Vol. 3.,* edited by Hiroshi Fukagawa, Kyushu University, 2003).

According to her study, Samsung Electronics deployed a strategy for rapidly absorbing and accumulating technology. This strategy was the incorporation of human resources recruited by means of a network of people. Samsung Electronics incorporated the owners of key items of knowledge into its companies to expand its network. Adding these key people was more effective than hearing about technology through the company's private network. In this way, Samsung has increased the speed at which it can develop technology. By incorporating the people holding the major knowledge and technology into the company, with the aim of helping its people, Samsung quickly accumulated technologies and innovations. Samsung Electronics has also adopted advanced technology from the outside world, gaining knowledge and skills that diffuse into their in-house researchers and engineers. In addition to current technical expertise, their personnel hold promise in research and development.

After having attracted promising employees into a company, European and U.S. companies start the research and development that will lead to their products. Samsung Electronics' recruitment criteria are more specific than those of Western companies. Samsung incorporates the people who have the skills required at the moment and develops technologies focusing on their current human resources[3].

Although Ha described Samsung's efforts, she does not seem to distinguish between Korean or foreign technicians, or whether the technicians belong to domestic enterprises or foreign companies. In her paper, the technical personnel to be incorporated seem to be Korean engineers. Japanese engineers coming from original equipment makers do not seem to be considered to be technical personnel incorporated into the Korean firm.

This last observation further underscores the small number of research papers that focus on the role of Japanese engineers at firms such as Samsung Electronics. With respect to technology transfer, even in the limited literature, there are differing viewpoints. Mizuno views it as a matter of technical culture, whereas Ha views it as a matter of corporate culture.

Yoshioka (2005) also investigates technology transfer issues, paying attention to Japanese engineers (Hidemi Yoshioka, "A Study on the Technology of Korean Semiconductor Companies", *Renaissance Project.* 2005). Yoshioka observed the following with respect to Samsung: "Korean engineers have been able to get the opportunities to experience process development and recipe development under the guidance of experienced engineers in Japanese device companies"[4]. This suggests the role of Japanese engineers in Korea's

2) Junko Mizuno, *Korean Automobile Industry,* Institute of Developing Economies, 1996, pp.128-129.
3) HA Jee-Yeon, "Globalization of Korean Companies and Technical Accumulation and Technical Innovation", *Korean Economic Studies,* Vol. 3, edited by Hiroshi Fukagawa, Kyushu University, 2003, pp.15-34.
4) Hidemi Yoshioka, "A Study on the Technology of Korean Semiconductor Companies", *Renaissance Project,* 2005.

industrial innovation. However, the problem of technological culture that Japanese engineers faced has not yet been clarified.

Therefore, we performed interviews focusing on this point. The purpose of the present study is to reveal the contribution of Japanese engineers to Korea's industrial innovation, and the differences in technological cultural between Japan and Korea as seen by experienced Japanese engineers in Korea.

2. Management decisions and the reversal of technological superiority in Japan and Korea

(1) Bearers of Technology transfer

Kabu (2008) describes three means of technology transfer to Korea from Japan: ① Japanese companies have dispatched technicians to Korean companies, ② Korean companies have dispatched trainees to Japanese companies, and ③ Japanese engineers have joined Korean companies. (Takayoshi Kabu, "Technology Transfer to Korean Companies by Japanese Engineers", *Korean Economic Studies, Vol. 7,* edited by Hiroshi Fukagawa, Kyushu University, 2008).

Among these, Type ① is merely physically moving technology from Japan to Korea without an accompanying transfer of know-how. With Type ②, trainees from Korea can be improved. But with Korea's strong tendency for individualism, know-how is accumulated in individuals without accumulating in the organization. In Type ③, Japanese engineers can raise the technological level of the entire Korean company[5].

It has also been reported that Korean companies have focused on technologies that the management of Japan companies have abandoned and have succeeded in promoting their product development for commercialization. In such cases, Japanese technical personnel go to Korea together with their techniques.

This pattern has been observed before. In the last stage of Japan's economic growth period, Japanese companies gave up the business of making television cathode ray tubes (CRTs), and CRT-related engineers retreated from the front line of development. At that time, Korean companies had been scouting for Japanese engineers engaged in the development of CRT technology. Thus, Japanese CRT engineers became engaged in CRT manufacturing in Korean companies and Korean companies grew technically in that field.

Even recently, when a Japanese company cannot secure sufficient revenue, it may lay off many technical employees. Even though the employees have produced excellent results, they may be laid off by management if they do not produce a particular new result, and Chinese and Korean companies sometimes hire these workers. There are several benefits to hiring Japanese engineers, although Korean companies are seeking the information regarding materials and equipment used in Japan held by these engineers for the technical advantage they hope it will provide .

In the interviews conducted for the present study, we talked with Japanese engineers who were hired by Korean companies that were very interested in technologies Japanese companies had abandoned.

5) Takayoshi Kabu, "Technology Transfer to Korean Companies by Japanese Engineers", *Korean Economic Studies, Vol. 7,* edited by Hiroshi Fukagawa, Kyushu University, 2008, pp.75-76.

(2) Management decisions and technology transfer

Mr. B, a retired employee from Japanese electronics manufacturer A, joined major Korean electronics manufacturer C. Mr. B has been working in Korea since 2002 and is in his late 50s.

In Korea, Mr. B has been teaching a television display technology that his Japanese company discontinued. There are two types of TV and computer display technologies[6]. Japanese company A had promoted the commercialization of a superior technology that had been developed, but the company could not make a profit on it, so it abandoned that technology and specialized in another one. However, at present, the display technology adopted by the Japanese company has lost its comparative advantage.

On the other hand, Korean companies have adopted the display technology that the Japanese companies abandoned, increasing their share of the world display market. Thus, by a management choice, Japanese companies gave up one of the two technologies, and Korean companies who adopted the abandoned technology enjoyed great success.

Mr. B was an expert in the display technology that Japan abandoned and left Japan after its abandonment. At that time, Japanese company A narrowed its focus to a single technology, and so Mr. B lost the opportunity to apply his technical knowledge. He had hoped to continue as the expert in charge of that technology within company A, but because the company abandoned it, he had to look for other avenues to take advantage of his expertise.

Mr. B investigated transferring to a company in Taiwan or Korea. In both countries, there were opportunities for Mr. B to use his technological knowledge. However, he decided to join a Korean company, not because he was scouted by the firm, but because he wanted an opportunity to demonstrate his technical competence and this meshed well with the Korean company's policies.

Mr. B joined Korean company C in 2002. Company C's development of the display technology advanced by leaps and bounds, and the company came to hold the largest global share. Meanwhile, company A, which abandoned this technology, has been relegated to competing for a smaller segment of the display market.

As underscored by this case, there are problems in management decisions related to technology choice. Mr. B still wonders why the Japanese companies abandoned that important technology. He doubts that it was a technical issue, suspecting that it was a management-side choice. To find out the answer to that question, Mr. B explored the potential of the technology at company C. The management of company C decided to invest in developing his type of display. Through constant innovation of this display technology in Korea, it has come to dominate the world market, despite the fact that in the mid-1990s, Japan was leading the world in this display technology. Historically, Korean success was based on technology learned from Japan, but the current power relationship in the business world is reversed.

Technology transfer is not always smooth. When technology crosses borders, it causes various prob-

6) The name of the technology is not specified here in order to maintain the interviewee's identity. This unavoidably makes the explanation rather vague. Display technologies for PCs and televisions are roughly divided into two types. With more detail about the technical field, the two technologies are easily inferred.

lems. This has been the case experienced by Japanese engineers in Korea. Japanese engineers noticed that the Japanese way of thinking about technology could not be understood in Korea. Therefore, they tried to promote technology transfer to Korea differently than they would have done in Japan. The Japanese engineers said, however, that the differences between Japanese and Korean ways of thinking about technology were unexpectedly large.

3. Differences between Japanese and Korean ways of thinking about technology: Practical skills and application skills

Mr. D who was a researcher for a Japanese automaker, was recruited into Korean company E by a headhunter. He has now been working in Korea for a few years. Mr. D is in his late 50s and has a PhD. He supervises a department for technological research at company E and is in a considerably higher position in the company than he had been at his old firm.

Mr. D said that Japanese engineers have made large contributions to the development of Korean technology. He estimates that contribution to be 10–20% of the total. So how do Korean companies and engineers obtain Japanese technology, and what happens in the technology transfer process?

In the course of technology acceptance in Korea, scouting is more important than the training of technical personnel. In addition, when performing in-house technical education, practicality is emphasized, whereas basic skills and applications are relatively neglected.

Mr. F, who works in the same company as Mr. D, is in his late 30s. He pointed out the problem of differences in technology culture between Japan and Korea as follows:

"I've worked for a year and a half so far. Unlike in Japan, Korean companies focus on technical expertise. As a result, Korean engineers in an area of expertise work diligently, but when they are given work in other disciplines, they tend to give up. When there is a new, previously unseen janitorial technical matter, Japanese engineers will try to accommodate it somehow, by applying their technical capabilities and making full use of them. And quite often, this is successful. This is possible because a high priority is placed on basic education and basic research in the Japanese education system. This produces people capable of handling unusual challenges, even if a situation arises suddenly.

In general, if an engineer is versed in a basic technology, he can cope somehow, even when assigned work in another area. This can be seen as having supported Japan's technical capabilities. However, in Korea, even if an engineer has technical expertise, in many cases he has not mastered the basic technology. As a result, he lacks the ability to apply his expertise broadly. This is due to different ways of educating workers about technology, or is due to the different ways of thinking about the spread of basic technology in Japan and Korea. It might also reflect specific differences in technical education.

The differences are large, but in recent years we are seeing some Korean engineers master the basic

technology so that they can apply their capabilities more broadly. In future, we expect them to become the core that changes the Korean technology culture"[7].

Takayoshi Kabu, a researcher in the Kyushu Economic Research Association, described this in brief as "results-oriented Korea and process-oriented Japan" and said the following:

"In this respect, we also see a problem with Korean companies that receive technology from Japan. Korean companies often tend to seek just the answer to the problem at hand, but they can't logically find the clues and means for solving the problem. They do not know how to approach a solution when they develop a new product or are faced with a problem. Among Korean engineers, there are some who understand the concept of being process oriented, but they are few"[8].

According to Mr. D, the role of a Japanese engineer in a Korean company is to teach by example and cooperation. When a problem occurs, he shares his experiences with Korean engineers and solves the problem together with them, helping them understand the process of problem solving. This is also related with the careers of the next generation. According to Mr. D, at first Korean employees do not have faith in the Japanese engineers who have been recruited. However, through the process of experimenting together, many Korean engineers come to trust the Japanese engineers.

Mr. D expresses the differences between the two countries' technological cultures as "narrow scope Korea and all-direction support Japan". Korean engineers think within the scope of their research. If the contents of an assigned research project is out of his realm, he is dissatisfied with his situation, easily quits his laboratory, and moves to another company or university. In particular, among the engineers at Mr. D's company, of whom half hold PhDs, individual pride is very high. In contrast to a Korean engineer, if his company's research is important to the organization, a Japanese engineer will convince himself to cooperate, even though the research is outside of his area of specialty. In summary, although engineers in Korean companies have high-level expertise and capabilities, their scope and field of view is narrow, whereas engineers in Japanese companies will accept wider assignments.

Thus, when considering the differences, we see that these differences are due to inherent cultural factors, technical education factors, or both. Next, we examine technical education factors in Korea.

4. Differences between Japanese and Korean technical education

Mr. G is an engineer at company H, a leading Korean construction firm. He is in his mid-50s, has a PhD, and is an expert in construction-related technology. As with Mr. B, he has been working in Korea since 2002. Because he is in the construction field, he often conducts technical guidance outdoors. He guides ex-

7) Takayoshi Kabu, "The Role of Japanese Engineers at Korean Companies", *Korean Economic Studies, Vol. 8,* edited by Hiroshi Fukagawa, Kyushu University, 2009, pp.56-57.

8) ibid.

cellent young Korean engineers, but is often surprised at the technical culture of Korea.

(1) Accident prevention technology

In Korea, there was a time when accidents occurred frequently on construction sites. Thus, there was a need to reduce losses from accidents by taking preventative measures. Since joining the company, Mr. G has given advice and implemented a variety of measures, and he has been able to minimize significant losses, thus contributing to company H. According to Mr. G, when an accident occurs, engineers must have an ability that can be explained theoretically along the lines of "Because it is like this, it will become like that". Engineers in this case will need to know both the theory and the realities in the field.

"There are two Korean engineers who assist me. I have taken on the role of their teacher. Including another Korean engineer, I have three "disciples". In the future, these three disciples will be engineers who will lead company H.

At first, they were the same as other Korean engineers. I took them to a vast construction site where the company was reclaiming land from the ocean. I walked around the site for 3 to 4 hours a day. In the meantime, at the center of the construction site, my engineers just stood there looking at the site without trying to do anything. Of course, they would never learn anything that way. Also, when writing reports, they could only rehash old ideas. We must take construction materials in hand to understand them. Therefore, it is important to take action. My disciples in the field became aware that they would not learn if they did not walk. I instructed them to visit the site throughout the week. Eventually, over time, they came to understand the importance of the site.

For them to understand the importance of construction sites, they must also experience an accident. Sometimes I deliberately caused a small accident, but nothing that could lead to a serious accident. I also instructed them about design after accidents happened. In addition, I ordered blueprints of construction sites where an accident had occurred and had my engineers compare his blueprint with the accident site blueprint.

My educational policy is not to teach knowledge, but to teach a way of thinking. My educational intent is that engineers acquire the ability to solve problems by themselves without just imitating technology. Young engineers who hold PhDs have more knowledge than me, but do not know how to use that knowledge. By writing emergency scenarios on flowcharts for resolving problems, the young engineers learn to stay composed, even if something happens in the middle of a process" [9].

(2) Observed differences between Japanese and Korean technical education

One of Mr. G's current disciples is an engineer who obtained a doctoral degree at Korea's top university.

9) ibid.

Although he has been welcomed within the company, when he encounters an unexpected matter on site, he lacks applied skills. Mr. G is an expert in the technical area of suppressing accidents and his ability to apply knowledge is vital when faced with unexpected situations. His ability to acquire knowledge and theories of basic technology and apply them is indispensable. However, Korean engineers tend to focus more on very specialized technologies than on than basic ones, and on results rather than processes. Focusing on these differences, Mr. G said the following as an evaluation of doctoral degree holders in both countries.

"When a water flooding accident occurs at the construction site, Japanese people pursue the cause of the accident, but the Korean people think about waterproofing measures. For example, when water has come out at an excavation site, Japanese people think about what the cause is and where to stop the water. But Korean people think just about stopping the water.

The differences between these ideas are partly due to the education systems of the countries. For example, Korean evaluation of doctoral degrees is different than that done in Japan. In Japan, generally the undergraduate program is the stage to cram for knowledge, the master's course is the stage to acquire the ability to solve an assigned theme, and the PhD course is the stage to acquire the ability to pursue one's own theme on one's own. On the other hand, many Korean people can neatly handle the work of an assigned theme, but do not do anything on their own initiative. Even doctoral degree holders fit this mold. I feel that this is comparable to a Master's level in Japan. An engineer should proceed by trial and error, and work even if not instructed"[10].

With regard to this style of evaluating doctoral degree holders, Mr. D has focused on the company employment side. According to Mr. D, after joining a Korean company, PhD holders start at the manager level. Korean companies treat them commensurate with their doctoral degrees. In Korean companies, their expertise and specialized abilities are highly appreciated. However, in spite of how highly expertise is valued, applied skills are not taken very seriously. In contrast, in Japan, there is no significant reward for earning a PhD in that Japanese companies do not give any special treatment to PhD holders. And in Japan, PhD holders are required to apply their expertise. This is a major difference between Korean and Japanese companies.

The differences between Japan and Korea, however, do not seem to apply to engineers of all generations. According to Mr. G, the younger generation in Korea is theory oriented. However, the older generation does not put such a high priority on theory (they put less emphasis on expertise). Mr. G said that the older generation is site oriented and the younger generation takes a theory-oriented approach. He said that there are few who understand both the theory and the on-site realities[11].

10) ibid.
11) ibid.

"People over 40 are familiar with construction sites, but the structures of new buildings have become extremely complicated. This requires both theoretical knowledge and field experience at, for example, the construction site of a tower 500 to 700 meters tall. To build a tall, complicated structure, the effects of temperature and wind factors have to be incorporated into the design. Therefore, theory becomes necessary.

Many young engineers have doctorate degrees and excellent abilities. If they are given a task, they can immediately make a blueprint. In that respect, they are very smart. However, construction based only on blueprints may lead to accidents. This is because practical aspects of the site must be taken into account.

An increasing number of people who overemphasize theory over experience is now a problem in Korea" [12].

If the generations are balanced well in a company, they complement each other, and this does not become a big problem. However, over time as older workers retire and the younger generation becomes the core, the concerns that Mr. G expressed could grow. Korea's younger generation is responsible for the technology of the future. In the future, a system that can educate them in applied skills will be required.

As we saw above, Japan is application oriented and Korea is expertise oriented. This is largely due to differences in the social education systems rather than specific characteristics of either country. The Japanese engineers we interviewed pointed to problems such as an excessive emphasis on theory in the graduate education system in Korea. In the future, if graduate schools incorporate training in practical applications into their curricula, it may be possible to educate engineers with very strong problem-solving skills. If the Korean educational system seeks such an orientation, we believe that the culture of Korean technology will continue to change gradually.

Conclusion

This paper clarifies several points. First, Korea is always paying attention to Japan. Korean companies have skillfully captured leading-edge technologies that Japanese companies abandoned. While absorbing the experience and knowledge of foreign engineers, they have been working to catch up in technical aspects. Korean companies have succeeded spectacularly in the field of displays, surpassing Japanese companies. This reversal of technological superiority between Japan and Korea is largely due to management decisions by large Japanese companies. Next, the Japanese engineers who have contributed to innovation in Korean companies initially encountered problems having to do with Korea's technical culture and have improved the level of technology by overcoming them. Korean technology cultural emphasizes specialization. Korean engineers are extremely competent and have rich expertise. They work hard in the areas in which they are experts, but when faced with broader, non-specialized problems, they tend to struggle.

When a janitorial technical matter that has never been encountered before arises, Japanese engineers

12) ibid.

will try to accommodate it somehow, applying their technical capabilities to the fullest. In this context, we see a difference in the technical educational systems of Japan and Korea. Basic education and basic research is prioritized in the Japanese educational system, along with the ability to handle unexpected situations even if they arise suddenly. In general, Japanese engineers have a grasp of basic technology and can cope somehow when challenges arise outside their specific fields. However, in Korea, even engineers who are gaining a high level of expertise in many cases have not mastered basic technologies, which makes them unable to translate their expertise into applications. Differences in basic education and technological training stem from differences between the ways Japanese and Korean people think about the spread of basic technology. This seems to have been reflected in the countries' technical education.

These differences between the countries are evident, but even among Korean engineers, we have seen few engineers in recent years who have mastered basic technologies and can use their expertise in applied situations. In the future, we expect that they will become a core who will change Korea's technological culture so that it will catch up to Japan in a variety of technologies.

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