Differences in Technology Transfers to China Among European and Japanese Elevator Companies

Mizuno Junko
IDE

This report analyzes technology transfers and education for engineers within Japanese and European companies that have advanced into China, and examines differences between them. Based on the assumption that if the quality of locally trained engineers is different, the international division of labor is also different, I aim to clarify how they are different.

Stating my conclusion at the outset, the engineers nurtured in Japanese companies have mid-level skills similar to those of Japanese engineers. There is thus a duplication of skills between the local engineers with mid-level skills and their Japanese counterparts. When Japanese companies succeed in fostering local engineers, of course, there is a beneficial effect both in terms of the training itself and for technical development. However, these benefits may also help rivals.

In comparison, European companies foster low-level engineers, and the division of labor with engineers of a parent company is a complementary relation, without duplication.

Issues of Discussion

This investigation began from the following critical questions. In the past, people in Asian countries including Korea and China have criticized the technology transfer of Japanese companies, as follows. "Japanese companies are reluctant to offer technologies in comparison with European companies," "Japanese technology transfer is slow in comparison with that of European companies," and "the technologies offered from Japan are not new ones," "Because the unit price of Japanese technology is cheap in comparison with those from Europe."

However, in the case of the Korea, for example, the machine tool industry has developed based on imported technologies from Japan. Moreover, some Korean machine tool makers have become competitors of Japanese firms.

In addition, in the case of the automobile industry, Hyundai Motors and Kia Motors, which imported technology from Japan, had higher technology levels than Daewoo Motors, which imported technology from GM. After the economic crisis in 1997, Hyundai and Kia both survived. However, Daewoo, which had no technology of its own,

went bankrupt and a buyer did not readily appear.

In spite of this situation, however, the "knowledge" that Japan has failed to transfer technologies to Asia has become commonsense not only in Asian countries but also among social scientists in Japan.

This report analyzes how Asian countries have managed to develop with technologies imported from Japan, which is said to not give technology away. I begin by examining two items of erroneous commonsense, first, that "European companies provide technologies but Japanese ones are reluctant to do so," and second, that "European companies transfer the technologies quickly, but Japanese ones do so slowly." In fact, this report finds that Japanese companies train engineers to middle skill levels, and that they sometimes become rivals to engineers in Japan.

Type of Industry Examined

In order to examine the two elements of erroneous commonsense, it is necessary to compare the same products from the same industry among Japanese and European companies advancing abroad. It would not be proper to compare companies producing different types of products in different industries.

The data used in this paper the findings from the elevator (lift) industry. This industry was selected because its products have to be designed with very reliable technology, since they transport persons and move as do cars and trains. In this connection, when elevators are exported from Japan to a developed nation, there is generally a requirement for a certificate attesting to the technical career and skills of the design superintendent.

In addition, elevators are produced based on orders, and each product has to be customized for a specific building, creating a need for many product design engineers. Therefore, the elevator industry is an appropriate type of industry for investigating the state of technology transfer.

In addition, the elevator industry is one area of the machine sector where overseas advances took place comparatively early. This is because the demand for elevators in factories, apartments buildings and hotels emerges in the early stages of a country's industrialization. Therefore, taking the elevator industry as a case study can be useful as a precedent for other machine industries.

Another good reason for selecting the elevator industry as the object of investigation is that eight of the world's main elevator companies, including four Japanese companies and four European or American ones, have advanced into China and are competing for the Chinese domestic market. Because there are only eight main

companies, obtaining information from more than five companies makes it possible to generalize the results of the survey.

Investigation Sample

The investigation was carried out using the visiting-hearing method, and an identical questionnaire was given to the elevator companies from Japan and from Europe and the United States.

Three Japanese and two European companies agreed to cooperate with the investigation. Two of these Japanese companies were makers of completed products, while the third was a maker of major parts, with plans to become a maker of completed products. One of the two full product makers filled out the questionnaire, but did not agree to a visit.

On the other hand, two of the four European companies agreed to cooperate with the investigation. Both produce completed products.

Because the questionnaires included the many questions on details, none of the companies replied to all of the questions. Under a situation where companies are competing in the same market, they worry about leaking information to rivals, and typically are reluctant to answer all questions. As a result, there were some questions that were answered by only one company.

Periods of Advance into China of the Surveyed Companies

It was after the middle of the 1990s that the three Japanese companies advanced into China. The average year for the advance of the three companies is calculated to be 1996.

In comparison, European companies began their advances in the first half of the 1980s, more than a decade earlier than their Japanese counterparts. As a result, they had already finished the technology transfer by the time the Japanese firms moved into the market. Consequently, the persons who had been charge during that period were no longer serving in the same positions.

One person from each of the two European advance companies cooperated with the investigation. One was a manager at the local company, and the other was an engineer from the parent company in charge of technology guidance.

On the other hand, at the Japanese companies, there were engineers who had been involved in technology guidance from the beginning and who were still playing an important role. In these companies, I was able to obtain information on the initial period of the advance, demonstrating a major difference with the European

The managers and engineers dispatched from two Japanese companies answered the questionnaires at the same time, in great detail.

Investment Ratio of the Companies

The investment forms of the five companies can be divided into joint investment forms and wholly (100%) owned forms. Of the three Japanese companies, two are joint enterprises where the Japanese side holds a majority of equity, and the third is a wholly-owned investment, with the Japanese side holding 100% of equity.

One Japanese joint venture company is working with a Chinese elevator company. The other Japanese joint venture company is working with a Chinese company that is not related to the elevator industry.

On the other hand, the two European companies have both adopted fully-owned investment forms. However, they did not adopt this form at the outset. In the beginning period, they both took the form of joint ventures. During the period when they made their investments, the Chinese government required them to be joint ventures with a local company, and in one case suggested a local elevator company as a potential partner for joint management. Because the Chinese government lacked experience with joint ventures, however, there were many complex, opaque elements.

Later on, 100% investment by foreign capital was accepted by the Chinese government, and one of the European companies bought stocks from the local company in 2001 and made it a fully-owned subsidiary.

During the time of the joint management form, the European company was a joint enterprise with a minority stake.

At that time, the Chinese government did not permit foreign investors to be majority investors, because it aimed to use the right of management to acquire technology. However, the European company was not able to meet the Chinese government's request for technology transfer, because it thought that it would not be able to prevent the leakage of technology if it only had a minority stake. As a result, the plans for the Chinese partner to use its management rights in the joint venture to absorb the technology were not successful.

In response to the failure, the Chinese government changed its policy to permit Japanese companies to advance to China and to compete for the Chinese market with European companies, in an attempt to create a situation where firms had no choice but to transfer technology.

Comparison of the Product Technology Provided by the Five Companies

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Elevators can be categorized by the speed of operation and weight–carrying capacity. This analysis distinguishes products into five levels based on the speed of operation. Needless to say, the technical level required for a super-high-speed elevator is higher than for a medium-speed one.

Table 1 shows that the companies have mainly transferred technology for medium-speed elevators. Here, we confirm that it is valid to compare the technology transfers, human resources development and international division of labor about these five companies.

Categorization of Technology Level

(1) Low-speed elevator (Less than 45 meters per minute)
(2) Medium-speed elevator (60-105 meters per minute)
(3) Medium high-speed elevator (120-180 meters per minute)
(4) High-speed elevator (210-300 meters per minute)
(5) Super-high-speed elevator (More than 300 meters per minute)

(1) Low speed elevators, which travel less than 45 meters per minute, are installed in comparatively low-rise buildings such as factories or hospitals, for the purpose of ensuring stability of movement.

However, because office buildings and symbolic high-rise buildings were being constructed in China at the time when the foreign companies made their investments, the demand for elevators was mainly for high-rise buildings,

This demand later ran out. By contrast, the demand rose for elevators in factories, in apartment buildings with more than seven floors, and in middle-rise commercial buildings.

(2) Medium-speed elevators (60 meters to 105 meters per minute) are installed in commercial buildings and apartment buildings with more than seven floors.

(3) Elevators with speeds from 120 meters to 180 meters per minute are installed in a high-rise apartments and high-rise buildings.

(4) Low-high-speed elevators with speeds from 210 meters to 300 meters per minute and super-high-speed elevators with speeds greater than 300 meters per minute are typically installed in hotels and in symbolic buildings.

Table 1 shows that all five companies transferred technology for medium-speed elevators (60-105 meters per minute) to the local companies.

For the next rank, four of the companies offered technology for low-high-speed elevators (120-180 meters per minute).

Three companies offered technology for (1) low-speed elevators and of (4) high-speed elevators, whereas two offered technology for (5) super-high-speed elevators.

All five companies mainly transferred technology for medium-speed and low-high-speed elevators.

These results fail to demonstrate the unbalanced technology transfer, under which some companies concentrate on technology transfers for low-speed elevators and others concentrate on technology transfers for high-speed elevators. It is found, rather, that all five companies transfer a very similar level of technology to local companies.

From this, we conclude that there are no major disparities in the product technologies transferred by the five companies. Because all five companies transferred technology for medium-speed elevators, which have the largest domestic demand, the comparison of technology transfer in this category can serve as a comparative study.

Examination of the First Erroneous Commonsense (European Companies Provide Technologies but Japanese Ones Are Reluctant to Do So)

As seen from the cross-analysis in Table 1 using the level of technology and capital ties, there are clear differences in technology transfer between the form of joint companies and fully-owned subsidiaries.

Generally speaking, in any industry, fully-owned subsidiaries tend to transfer a wider range of technology because of the confidence that the technology will not be leaked.

We also find that J1 and J2 (the two Japanese joint ventures) seem at first glance to transfer a narrow range of product technology to the local company. By contrast, J3, E1, and E3 (fully-owned subsidiaries), despite being both Japanese and European, seem to have transferred a wide range of technology, from low-speed to super-high-speed elevators.

From Table 1, we can state that the apparent quantity of technology transferred depends not on the nationality but on the investment ratio. In other words, the technologies from joint venture companies J1 and J2 are for medium-speed and high-speed elevators, whereas the technologies from fully-owned subsidiaries J3, E1, and E2 seem cover a wide range of technology from low-speed to the super-high speed elevators.

Governments of developing countries aiming to absorb technology generally

adopt policies to regulate the investment ratio of foreign capital to less than 49%, with the aim to hold management rights.

For example, the Korean government does not allow foreign capital to take a greater than a 49% stake. Therefore, there were many cases where Japanese companies invested into joint ventures where they held a smaller than 50% stake. They were only permitted to make 100% investments in extremely limited types of industry, which were approved as pioneering industries.

Although this was not the intention of the host governments, the limitation to 49% of the investment created a situation where companies hesitated to transfer technology to developing countries.

This investigation discovered that one of the European companies, which now has a fully-owned subsidiary, was a joint venture, following the policy of the Chinese government, before becoming a fully-owned subsidiary.

They reported that the range of technologies transferred to China at the time was not as wide as at present.

With regard to the technology transfer, the interactions between the company and the host government begin from the question of whether the company will carry out an independent investment or be a joint venture. European firms seem to go as far as to enlist the support of the home government in an effort to get permission for 100% investment. Because the Japanese government offers relatively little support in this area, Japanese companies invest as joint ventures. As a result, it appears on the surface that European companies transfer a great deal more product technology than their Japanese counterparts.

Therefore, the first item of erroneous commonsense, that "European companies provide technologies but Japanese ones are reluctant to do so," should be modified as follows. "Joint enterprises seem to transfer little technology, but companies with fully-owned subsidiaries seem to offer comparatively many."

Up until now, Japanese companies making investments in Asia have adopted not 100% investment but joint venture forms, with less than 49% stakes, based on the foreign investment policies of Asian host governments.

In many Asian countries, and particularly Korea and China, joint ventures with less than 49% stakes held by the parent company were common, due to the authorization policies of the governments. As a result, the quantity of technology transfer has been relatively small in this area. This, in fact, is the source of the misunderstanding that "Japanese companies are reluctant to transfer technology."

Examination of the Second Erroneous Commonsense (European Companies Transfer the Technologies Quickly, but Japanese Ones Do So Slowly)

When making technology transfers to a developing country, the nurturing of talented personnel is a key. Many cases of technology transfers to developed nations begin with an offer of blueprints and related data, but most developing countries have few engineers who are able to read the drawings. As a result, the technology transfer has to begin from the education of engineers.

Engineers do not come in one quality alone. There are some who have deep understanding of technology, and others whose understanding is much shallower. We must, therefore, examine the skill level of engineers trained by the various companies.

In judging the level or quality of an engineer, a clear difference in the depth of technology understanding can be gauged by examining whether the engineer who can make independent judgments or has to rely on an instruction manual.

For reference, the quality level of machine tool engineers can be gauged as follows.

Division of technical level (quality) of machine tool engineers

(1) Shallowest level: only understands the components of a product and the connections between them.

(2) Shallow level: only understands information exhibited by a drawing, and understands the ease of part processing, procedures for dismantling and assembling, and the relative difficulty.

(3) Moderate: Has understanding of the need for product compactification, grassroots devices for cost reduction as exhibited in drawings, but still requires considerable experience and knowledge.

(4) Slightly deep level: is able to look at a drawing by two dimensions and imagine the three-dimensional form.

(5) Deep level: By reading the information conveyed on the cover of a drawing (the negative), can get a grasp of the new device and understand the intentions of the original designer.

(6) Deepest level: understand the intention of the design superintendent involved in the design of a product, and based on a drawing, imagine a solid object in motion. This involves imagining, from the drawing, the functions that the actual product will have, and conduct simulations and imagine dangerous parts.

Methods for Training Local Engineers for Technology Transfer

One of the questions asked in this survey was what methods companies advancing into developing countries used to educate local engineers for technology transfer.

Answers were prepared for multiple choice, as follows, for comparison.

The answers provided were as follows:

(1) Educating local engineers using drawings and other design documents

(2) Educating local engineers using drawings, other design documents and extra texts

(3) Training using OJT conducted by a local senior engineer or manager (not somebody dispatched from the parent company)

(4) Training of local engineers with OJT by an engineer from the parent company, based on a plan made in the parent company (using a manual)

(5) Training local engineers using OJT by an engineer from the parent company

(6) Sending a local engineer to be educated in the home country of the company or foreign firm with capital ties to it

(7) Having, from the beginning, a local engineer who has the experience to understand a drawing, with no need to reeducate the engineer.

The answers are shown in Table 2. In the cases of Japanese companies J1 and J2, methods (2) and (4) were used simultaneously. This shows that the companies endeavored to give the engineers both theoretical and practical education. They also implemented method (6) in cases when no machinery was available on site for training, and sent them to places where such machinery existed.

By contrast, in the case of E1, a European company, method (6) was used initially. However, normally it uses method (3). It appears to be education not based on drawings or other materials, but rather standardized education to show the engineer how to work.

I also asked what level of engineer the company was hoping to train through the education. Respondents were asked to choose between four levels to the question, "What level of local engineer are you aiming for?"

The four levels were as follows:

(1) The engineer can grasp the needs of a market and can develop products independently (product plan level)

(2) The engineer has a wide range of knowledge, and can solve most problems (experience in designing and manufacturing engineer level)

(3) The engineer can understand a drawing document and manufacturing processes, and can revise them to meet the local needs and suggest improvements. If there are

instructions, the engineer can respond to them (person of general engineer/skill level)
(4) The engineer can somehow manage to follow orders (technician level)

As shown in Table 3, the answer was clearly different between J1, J2 and E1.

J1 and J2 responded that they aimed for (2), whereas E1 replied it was aiming for level (4). Thus, though the Japanese companies are joint enterprises with the possibility of technology leaks, they are willing to invest time and money with the aim to bring up engineers of a comparatively high level. By contrast, E1, which takes the form of a 100% investment, has little worry about technical leakage, but in comparison to the Japanese companies, the engineers whom it plans to train will only be low-grade engineers.

Because it is only aiming to develop low-grade engineers, E1 can bring them up in a short term. If a problem occurs on the manufacturing floor, it will bring a senior engineer from the parent company to solve it, using local low-class engineers. This is a similar system to that in the mother country, where engineers are organized into hierarchy.

Meanwhile, I asked a question "What is the criteria for deciding when an engineer who has been dispatched by the parent company can return to the home country?" The European companies were not able to reply to this question, because it had happened in the distant past. However, I received answers from the Japanese companies.

The following choices were offered:.

(1) The time of completion of guidance on drawings about machinery was completed
(2) The time of completion of guidance on drawings and of design document including standards on machinery
(3) The time of completion of guidance on drawings and design documents about machinery and the additional text
(4) When the engineers and workers are able to manufacture the products with stable quality and a low defective article ratio, after the completion of guidance such as drawings about machinery
(5) When simple revisions or improvements of design were possible
(6) When it was possible to carry out design that grasped local needs
(7) There was no dispatch of a person from the parent company

The Japanese companies, which educate their engineers using OJT, chose answer (4). It seems, thus, that they consider the technology transfer to be completed once the real production has become stable. This answer does not contradict the answers they gave regarding engineer education, under which an engineer from the

parent company provides education in theory and practice in OJT to the local engineers, and returns to the home country after training local engineer who can "solve nearly all problems" when something happens .

Let us now summarize the differences of technology transfer between Japanese and European companies. The European system trains lower grade engineers who do not go beyond the range of interpreting a manual, but Japanese companies bring up intermediate-level local engineers who can think by themselves to solve a problem, working in parallel with Japanese engineers.

Table 1 Product Technology Provided by the Five Companies

5	Super-high speed elevator (More than 300 meters per minute)			○	○		2
4	High-speed elevator (210-300 meters per minute)			○	○	○	3
3	Medium high-speed elevator (120-180 meters per minute)		○	○	○	○	4
2	Medium -speed elevator (60-105 meters per minute)	○	○	○	○	○	5
1	Low-speed elevator (Less than 45 meters per minute)			○	○	○	3
		J1	J2	J3	E1	E2	Side total

Table 2 Methods to educate local engineers for technology transfer(multiple choice)

6	Sending a local engineer to be educated in the home country of the company or foreign firm with capital ties to it	○	○		○	○
5	Training local engineers using OJT by an engineer from the parent company	○	○			○
4	Training of local engineers with OJT by an engineer from the parent company,based on a plan made in the parent company (using a manual)				○	
3	Training using OJT conducted by a local senior engineer or manager (not somebody dispatched from the parent company)					
2	Educating local engineers using drawings, other design documents and extra texts	○	○			○
1	Educating local engineers using drawings and other design documents					
		J1	J2	J3	E1	E2

Table 3 What level of local engineer are you aiming for?”

1	The engineer can grasp the needs of a market and can develop products independently (product plan level)			○		
2	The engineer has a wide range of knowledge, and can solve most problems (experience in designing and manufacturing engineer level)	○	○			○
3	The engineer can understand a drawing document and manufacturing processes, and can revise them to meet the local needs and suggest improvements. If there are instructions, the engineer can respond to them (person of general engineer/skill level)					
4	The engineer can somehow manage to follow orders (technician level)				○	
		J1	J2	J3	E1	E2