Comparative Study of Japanese Maquiladoras with Plants in the United States and Asian Countries

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Japanese companies started maquiladora operations in Mexico in the early 1980s. With the rapid appreciation of the yen in the late 1980s, a number of Japanese companies producing in the U. S. began maquiladora operations. The fundamental reason for establishing these maquiladoras was to supplement the operations of U. S. plants, however in several cases, the Japanese firms discontinued U. S. operations and shifted all of their production to their maquiladoras.

This paper examines the characteristics of these Japanese maquiladoras and compares them with Japanese transplants in the U. S. and Asia. The first section compares the maquiladoras with transplants in the U. S. The second section compares the maquiladoras with transplants in Korea and Taiwan. The third section verifies these by examining the characteristics of two companies' transplants in Mexico and Asian countries. Through an examination of these two companies, it is possible to discern a dramatic change in the Japanese maquiladoras between the date of the first field survey in 1989 and the second one in 1991. The conclusion argues that Japanese firms continuing to produce in Mexico will likely have improved results regardless of the elimination of maquiladora privileges due to NAFTA.

The Japanese Maquiladoras and the Transplants in the U. S.

The comparisons made in this paper are based on a model we have developed to compare the adoption of the Japanese model of production in the overseas manufacturing operations of Japanese firms(1). There are 23 items upon which each plant was evaluated. These 23 items are aggregated into 6 groups. Each plant is graded by a 5-point evaluation system. For each criteria a plant was awarded a 5 if it was an exact replica of the Japanese model and 1 if it was closest to the local system. With each of the criteria there was an explicit set of criteria for scoring the plant. In this model we term the exact replication of the Japanese model "application" and the replication of the local system "adaptation". Table 1 presents a summary of our findings from two separate trips to Mexico, one to the U. S. and study trips to Korea and Taiwan(2).

Table 1 Hybrid (Degree of Application) Evaluation of "23-Item, 6 Group" of the Plants in Mexico (Maquiladoras) and Other Countries

Country	Mexico (Maquiladoras)	Mexico (Maquiladoras)	USA(including 3 Canadian plants)	Korea and Taiwan
Number of Plants	7	5	34	25
Date of Investigation	Aug 1991	Aug -Sep 1989	Aug -Sep 1989	Aug -Sep 1992
I Work Organization & Its Administration	29	23	29	37
(1) Job Clasification	31	22	37	49
(2) Wage System	30	28	24	39
(3) Job Rotation	21	14	26	29
(4) Education & Training	30	26	29	34
(5) Promotion	29	28	31	37
(6) Supervisors	30	22	29	34
II Production Control	31	34	33	35
(7) Production Equipment	46	48	43	35
(8) Quality Control	23	28	34	36
(9) Maintenance	24	30	26	33
(10) Operation Management	33	32	30	35
III Procurement	29	31	30	32
(11) Local Content	30	35	27	29
(12) Suppliers	34	33	39	35
(13) Procurement Method	23	25	25	32
IV Group Consciousness	30	29	32	34
(14) Small Group Activities	23	18	25	32
(15) Information Sharing	29	28	36	35
(16) Sence of Unity	39	42	35	36
V Labour Relations	39	37	36	34
(17) Hiring Policy	37	30	34	30
(18) Job Security	29	28	34	33
(19) Labor Unions	50	48	44	40
(20) Grivance Procedures	40	40	33	32
VI Parent-Subsidiary Relations	30	29	36	23
(21) Ratio of Japanese Expatriates	19	16	37	15
(22) Delegation of Authority	30	38	36	27
(23) Managerial Position of Local Management	41	34	36	27
Average	32	30	33	33

To further clarify the conditions in the factories studied we also developed an evaluation which focuses upon the "results" and "method" of application of "human" and "material" elements. Table 2 lists the items which are included to provide the four-perspective analysis. Table 3 shows the degree of application for four-perspective aspects of maquiladoras, the U. S. and Korean and Taiwanese plants. In this case, the "material-results" and "human-results" aspects refer to the direct importation of production equipment, as well as production know-how accumulated in Japan, or directly dispatching trained employees from Japan to the local factories in each country. In contrast, "material-method" and "human-method" refer to the application of the material and human management methods which are themselves characteristic of the Japanese-style management and

Table 2 Items of Four-Perspective Evaluation

	METHODS	RESULTS
HUMAN	Human-Methods All items in I "Work Organization and Administration" and VI "Group Consciousness (18) Job SecurityManagement (20) Grievance Procedures	Human-Results (21) Ratio of Japanese Expatriates (22) Managerial Position of Local Management
MATERIAL	Material-Methods (8) Quality Control (9) Maintenance (13) Procurement Method	Material-Results (7) Equipment (11) Local Content (12) Suppliers

Table 3 Four-Perspective Evaluation of Maquiladoras and the Plants in Other Countries

Country Time of Investigation	Human-Results	Material-Results	Human-Methods	Material-Methods
Mexico (Maquiladoras) Aug 1991	3. 0	3. 7	3. 0	2. 3
Mexico (Maquiladoras) Aug. -Sep. 1989	2. 5	3. 8	2. 7	2. 8
USA (including 2 plants in Canada) Aug. -Sep. 1989	3. 6	3. 6	3. 1	2. 8
Korea and Taiwan Aug. -Sep. 1991	2. 1	3. 3	3. 5	3. 4

production system.

The average ratio for the seven maquiladoras shown in Table 1 (1991 research) is 3.2. This degree of application (i.e., the use of the Japanese model) is unexpectedly high. Although the aggregate average hybrid evaluation ratio for all of the 34 target plants located in the United States and Canada (1989 research) is 3.3, this high degree of application was in large measure due to the high score of the automobile industry (the average for auto assembly is 3.5, auto parts is 3.6, consumer electronics is 2.7 and semiconductor is 3.2). Considering that all of these seven maquiladoras produce consumer electronics (see Table 4), this degree of application, 3.2, is a relatively high score. This justifies the conclusion that the transfer of the Japanese production system to maquiladoras has had some measure of success.

Concerning the hybrid ratio of maquiladoras, it is noteworthy that the scores between 1989 and 1991 have a 0.2 points gap. This is partly due to the difference of both target plants. The target plants in 1989 were composed of four consumer electronics plants and one auto parts plant. Of the four consumer electronics plants, two factories which make CTV and chassis for CTV are the same target plants as 1991 research. The other three

Table 4 Surveyed Maquiladoras Visited in August 1991

Plants	Start of Operation	Number of Employees (Japanese Expatriates)	Main Products
A	Jan. 1980	1,212 (24)	CTV, Chassis for CTV
B	Dec. 1986	570 (5)	Projection TV, CTV, Cabinet for CTV
C	May 1987	800 (5)	CTV, Chassis for CTV
D	July 1986	300 (5)	Wire harness for consumer electronics
E	Feb. 1987	70 (3)	Wire condenser, Shelf and other components for refrigirator
F	Mar. 1987	258 (9)	Audio rack, Stand for CTV, Other parts for CTV
G	July 1987	330 (4)	Wire harness for consumer electronics

plants whose main products are chassis for CTV, transformers for microwave ovens and wire harnesses for motor vehicles, respectively, are not included in target plants of 1991 research. Despite the change in sample this rise in the average score also reflects recent changes of operational conditions of Japanese maquiladoras.

The characteristics of Japanese maquiladoras detected from the comparison with the Japanese transplants in the United States can be summarized as follows:

① These maquiladoras have a strong inclination towards the importation of production equipment from Japan

Japanese companies generally tend to rely upon importation of production equipment that is exactly the same as that used in Japan, in order to transfer their competitive advantage to the local plants as expediently as possible. This is especially true because maquiladoras are plants predicated upon foreign companies importing equipment and raw materials without paying duties, utilizing cheaper Mexican labor force, and exporting the resulting products. This explains why the degree of application for Production Equipment was 4.6. This is significantly above the score of the plants in the United States (4.3).

Thus, "direct" importation of production equipment is one of the salient characteristics of the Japanese maquiladoras, although there are some which endeavor to procure equipment locally (mostly from the United States). This high application score of Production Equipment contributed to the high degree of "Material-Results" (3.7) in the 4-Perspective Evaluation, but the score for this aspect is only 0.1 point higher than the plants in the United States. This means the degree of "direct" importation of parts and components which also constitutes an element of "results" aspect of Japanese production system is not so high. The application score of Local Content is 3.0 and its Suppliers is 3.4.

② There is a lower degree of "Human-Results" application than in the U. S. transplants

The degree of application for "Human-Results" scored 3.0 is much lower than the score in the United States. The items which constitute the "Human-Results" aspect are Ratio of

Japanese Expatriates and Managerial Position of Local Management. The degree of application for managerial position of locals is high (4.1) and exceeds the average for U. S. plants by 0.5 points. But, due to the extremely low degree of application for the ratio of expatriates, the total degree of application for "Human-Results" application was lower than the U.S. plants by 0.6 points. This is because Japanese companies dispatch relatively few expatriates to maquiladoras, however the roles of these Japanese in management and operation of the local plants are very important.

③ There is a trend to strengthen the application of the "Human-Methods" aspect of the Japanese production system

On the basis of the 1991 research trip, the author was impressed by the efforts toward strengthening the degree of application for the "Human-Methods" aspect in maquiladolas, even though the score of 3.0 is somehow lower than that one of the plants in the United States (3.1). This is reflected in the degree of application for "Human-Methods" which increased from 2.7 in 1989 to 3.0 in 1991. Of the eleven items which are included in this "Human-Methods" aspects, nine items increased the degree of application, including all of the items belonging to Group I, Work Organization & Its Administration. As pointed earlier, this increase could be the result of the different sample of plants. However, there is an important movement to strengthen the application of Japanese-style system at new maquiladoras.

The following are concrete examples of the above conclusions. The average score for the item, Job Rotation, is conspicuously low and is 0.5 points below the score of the U. S. plants. This means that job assignment at the shop floor level in maquiladora plants is extremely fixed. Production lines are organized on the presupposition of the job fixity and job assignment alters only when the production models change. This accelerated the ability of the Japanese maquiladoras to aquire a competitive advantage. This appears to be changing as some companies are making efforts to increase job rotation so that they can enhance the flexibility of the work organization. For example, Plant C had begun a cross-training program for key persons at the shop floor level using the "matrix method." Plant C initiated job rotation within team in order to reduce monotony. These anecdotes indicate the increase of the degree of application for the Group I, Work Organization & Its Administration, from 1989 to 1991.

In addition to the trend toward strengthening application efforts for the Group I, the change of the degree of application for the item, Small Group Activities, which is one of the item in the Group IV, is also noteworthy. The score of this item is rather low at 2.3, which signifies the transfer of the Japanese-style element to maquiladoras in this aspect has been limited. However, the rise of score from 1898 (1.8) to 1991 (2.3) provides some evidence for the recent changes of maquiladoras. For example, Plant A had just started the QC circle activity two months before our visit in 1989. At that time, they intended to phase in model circles. Upon revisiting the plant in 1991, 50 circles were already operating. At Plant B, ZD

circle activities had been initiated with worker participation mandatory. In this case the firm was unable to encourage the voluntary participation common in Japan. Although stimulating interest and voluntary participation in small group activities from the bottom up is desirable, the firm had to bring about improved quality and productivity through organized group activities imposed from the top down.

Thus, the recent trend to strengthen the degree of application is striking especially for the "Human-Methods" aspect. As a consequence, the degree of application for the "Human-Methods" aspect of maquiladoras in 1991 was similar to that of the plants in the United States in 1989.

④ The use of cooperative labor relations in the maquiladoras

The average score for Labor Relations (group V) was the highest, 3.9 points, of the six groups. It is the only group where the magnitude outscored the U. S. plants. For the four items of this group, the average was highest for the item, labor unions. Japanese companies operating overseas are not accustomed to foreign labor unions. Because our criteria for scoring a plant like Japan was the lack of unions, Tijuana-based plants with its lack of strong labor unions received a high score. Therefore, although some plants are organized by the unions formally, unions did not function substantially in any of the seven target plants in 1991.

The degree of application for the item, Grievance Procedures, also scored high (4.0). This was because grievance procedures are not a separate and formally established procedure in Mexico, as they are in the United States. In that sense, the Mexican system may be similar to Japan, where grievances are settled informally and through the existing channels of the workplace. In addition to that, because many of Japanese maquiladoras are U. S. subsidiaries, companies adopt the same measures used in the United States such as, open door policies. For this reason the average score for the item exceeded plants in the United States.

With regard to the previous two items, they are rather influenced by the external circumstances which Japanese companies cannot overcome only by internal efforts, although the latter plays a role in cultivating an atmosphere of cooperation and harmony between labor and management. The internal efforts are more related to other two items of this group. The average score for Job Security (2.9) is lower than the aggregate average and scored 0.5 points lower than the U. S. plants. This particular measure of Japanese-style management is not applied to maquiladoras as much as to the plants in the United States. On the contrary, the degree of application for Hiring Policy scored rather highly at 3.7, and it is noteworthy that the score in the 1991 research is 0.7 points higher than the score in the 1989 one. Such a rapid change in hiring policy in only two years is one of the most interesting findings. For example, in 1989 the number of firms using employment examinations was limited, but by 1991 five of the seven companies were using them.

⑤ Difficulties in the "Material-Methods" section

The degree of application for "Material-Methods" scored 2.3 at the 1991 research, 0.5 points below the 1989 research. Such a decrease of the degree of application is caused partly by the difference of target plants, but partly by the changes of the operational methods. The latter is true for the two items, Quality Control and Maintenance. In 1989, when the Japanese maquiladoras didn't have long operational experience in Mexico, there were some plants in which Japanese expatriates participated in quality control or maintenance at the shop floor level, but in the 1991 study these practices had been discontinued. This is due to both an improvement in systems and the increased skills of Mexican personnel. As a result this contributed to the decrease of degree of application for these aspects.

The low degree of application for both items signifies one aspect of the difficulties which maquiladora operations are facing. For example, some Japanese maquiladoras use a "double" inspection system which is not used in Japanese plants. Another solution for quality control problems has been to use more automatic machines. This is also the case at the plants in Asian countries. In the case of maquiladoras, this increasing automation is a recent tendency. The purpose of the automation is to make maquiladoras more rational and competitive as well as to solve the quality problem. Plant A raised the automation ratio of the chassis assembly process from 50 percent to 80 percent in 1990 and Plant C also raised its ratio from 70 percent to 85 percent about the same time. Moreover, in addition to such automation, the introduction of computers to parts and components order, inventory control, outgoing products as well as to the whole process control was confirmed in maquiladoras through research in 1991. In order to deal with the recent tendency toward automation, it is necessary for maquiladoras to improve their maintenance ability rapidly.

The Maquiladoras and Transplants in Korea and Taiwan

In this section the maquiladoras are compared with plants in Korea and Taiwan. The comparison sample are eight Korean plants and seventeen Taiwanese plants. Their aggregate average score was 3.3. This means that the extent of the transfer of the Japanese-style management and production system into the plants in Korea and Taiwan is almost the same level as maquiladoras, although there is a slight (only 0.1 point) gap among them. This paper does not intend to analyze the plants in Korea and Taiwan themselves, but only to compare and verify the characteristics of maquiladoras obtained through the comparison with the plants in the United States. However, a minimal explanation of these plants is necessary. Of the twenty-five plants in Korea and Taiwan, five belong to the auto assembly industry, seven to auto parts, six to consumer electronics assembly and seven to consumer electronics parts. Wholly-owned subsidiaries of Japanese companies are only seven, whereas joint ventures with local companies are eighteen. Such a high ratio of joint ventures is one of the largest features of Japanese companies in Asian countries. One more feature to notice is that Japanese transplants in Korea and Taiwan have a relatively long

history compared with the United States or Mexico. These features have a great effect on the operational conditions, as will be explained later.

A strong inclination towards the importation of production equipment obtained from the comparison with the Japanese plants in the United States was one of the most important characteristics of maquiladoras. This is true when Japanese plants in Korea and Taiwan are taken into account. The average for Production Equipment of the plants in Korea and Taiwan scored 3.5, 1.1 points below that of maquiladoras. This is due to the fact that in Korea and Taiwan there exist some local equipment makers including Japanese makers. More crucially, there is a large price difference between imports from Japan and those from local vendors. It should be noticed that there is a variety of Japanese transplants in Asian countries. For the plants established recently and producing goods for foreign markets, nearly all of the production equipment is imported from Japan. However, companies with a long history of operation and which produce goods for the domestic market as a whole do not install as much Japanese production equipment. It is noteworthy that recently some of the latter companies are seeking to automatize or rationalize their production facilities as in maquiladora plants. This is to survive the severe competition caused by recent rapid wage increase in NIEs countries.

The degree of application for the human-results aspect of maquiladoras was lower than the plants in the United States, but it exceeded considerably (0.9 points) the plants in Korea and Taiwan. The items constituting this human-results aspect are the Ratio of Japanese Expatriate and Managerial Position of Local Management. The degree of application for the maquiladoras was low, but the plants in Korea and Taiwan were even lower. There are two reasons for this. The first is the relatively long operational experiences in both countries. The second is the high ratio of joint ventures of the target plants in both countries. Of course, there are some companies which send relatively many Japanese expatriates to local subsidiaries where they fill important managerial positions. This is especially true when the Japanese parent companies desire to strengthen the transfer of Japanese-style system to their local subsidiaries. For example, the subsidiary of the largest Japanese automobile company in Taiwan (the Japanese company owns 49 percent) sent 34 Japanese expatriates to the local subsidiary, however this is far less than the firm has sent to its U.S. plant. Our data confirmes the fact that maquiladora production is supported by stronger "Human-Results" application than the plants in Korea and Taiwan although it is much lower than the U. S. plants.

On the other hand, the average for the human-methods aspect was much lower for the maquiladoras than for the Korean and Taiwanese plants. Of the eleven items in human-methods aspect, the Korean and Taiwanese plants scored higher than maquiladoras in the degree of application for all of the six items in Group I. This Group I constitutes the core elements of our hybrid model which evaluates the extent of the transfer of the Japanese production system into foreign countries. The fact that plants in Korea and Taiwan got a high score in this application aspect can be explained as follows. The first reason is that

there are not so many institutional obstacles for the Japanese companies to transfer the Japanese system into Asian countries as a whole. Far more obstacles exist in the United States. This especially corresponds to the item, Job Classification. In the United States where job control unionism used to be dominant and the practices between labor and management has been influenced even the practices of non-union companies. These job classifications contributed to very inflexible staffing practices. In the case of maquiladoras, too, these American practices are affecting and reflected in the work organization and its administration of Japanese maquiladoras. This is the reason the degree of application for these maquiladoras was lower than for the plants in Korea and Taiwan.

In addition to the above, long operational experiences might cause the higher degree of application for the Korean and Taiwanese plants. Moreover, the close distance between Japan and Korea and Taiwan might contribute to the higher score of the two countries. For example, the degree of application for Education & Training of the plants in Korea and Taiwan exceeded by 0.4 points that of maquiladoras, reflecting the number of dispatches of employees for education and training to Japan. Although there are some maquiladorass which send a number of employees to Japan or the United States, the number is limited. One of the important obstacles is the high turnover ratio. This turnover problem has the most influence on the application score for Material-Methods. The average for the maquiladoras is much lower than that of the plants in Korea and Taiwan.

However, it should be possible for maquiladoras to transfer Japanese-style production systems more effectively as they increase the operational experiences in Mexico. In addition to their relatively short history of operation, maquiladoras have good external conditions to facilitate the core system of the Japanese-style system. With the exception of measures taken by local plants, external conditions play an important role in successful transfers. The degree of application for Group V, Labor Relations, which reflects mostly such externl conditions scored higher for maquiladoras than the Korean and Taiwanese plants.

In short, the transfer of the Japanese-style production system into maquiladoras has been sucessful to a certain extent, especially considering the short operational experience. However, under the existing circumstances, the degree of application for the core system is considerably lower than the Korean and Taiwanese plants. In order to attain higher application for the core system, the determinant factor would be the strong intention to introduce Japanese-style system into local plants. That is the conclusion obtained from the comparison between maquiladoras and the plants in Korea and Taiwan.

Case Studies of Company M and Company Y

This section verifies the characteristics of maquiladoras obtained by the comparisons between maquiladoras and the transplants in the United States and Korea and Taiwan through examination of the individual plants of two companies. The important character-

Table 5 Surveyed Plants of Company M and Y

Company	M		Y		
Plant Name	M−ME	M−MA	Y−ME	Y−TA	Y−TH
Location	Tijuana, Mexico	Shah Alam, Malaysia	Ciudad Juarez, Mexico	Ping Tung, Taiwan	Phitsanulok, Thailand
Date of Investigation	Aug. 1991	Sep. 1993	Sep. 1989	Sep. 1992	Sep 1993
Start of Operation	Jan. 1980	Apr. 1989	June 1983	Feb 1971	July 1992
Number of Employees (Japanese Expatriates)	1212 (24)	1289 (32)	1700 (14)	1750 (10)	3338 (6)
Main Products	CTV, Chassis for CTV	CTV, Chassis for CTV	Wire harness for motor vehicle	Wire harness for motor vehicle	Wire harness for motor vehicle
Turnover Ratio	3%/month	2~3%/month	13%/month	7%/month	2%/month

istics of the five plants examined are shown in Table 5. Company M is the largest consumer electronics firm in Japan. Company Y is one of the world's largest wire harness maker for motor vehicles. They are excellent examples of the Japanese firms operating maquiladoras.

Plant M-ME (=Plant A in Table 4) was one of the first Japanese companies to establish a maquiladora. It started assembling the chassis for CTV in 1980 and began final assembly of CTVs in 1986. M-ME supplies all of the chassis of CTV parts assembled at a "twin" plant in the United States. The final assembly process of CTVs over 20 inches is in the U. S., while all smaller CTVs are assembled in Tijuana. Plant M-MA in Malaysia is the company's main plant in Asia and was established in order to compete with Asian NIEs CTV producers which became increasingly competitive in the late 1980s due to the rapid appreciation of the yen. In Malaysia, the company M group has 16 subsidiaries including M-MA and approximately 21,200 employees. All of the products of this plant are exported to the Near and Middle East, Asia (including Japan) and Oceania. Company M started a horizontal division of labor between M-MA and plants in Japan since April 1989, and M-MA began exporting CTVs under 14 inches in October 1990.

Plant Y-ME was the first maquiladora plant for company Y. From its establishment, Y-ME has continued to expand operations in the vicinity of Ciudad Juarez. In 1989 they had four plants in the Ciudad Juarez area and 5,000 employees. In El Paso, just across the border to the United States, they have a twin plant founded in 1988 which produces connectors, wire and other inputs for the wire harnesses assembled in the four maquiladoras. Plant Y-TA is located in the southern part of Taiwan near Kaohsiung. This plant was established in 1971 and has played an important role as one of the chief bases for exporting mainly to big American auto makers. However, since late 1980's it has been losing competitiveness due to the rapid appreciation of new Taiwan dollar and wage increases. In 1992 Y-TA had 1,750 employees down from about five thousand at the peak period around 1988. This decrease symbolizes one aspect of Japanese labor-intensive transplants in Asian NIEs. In

Table 6 Four-Perspective Evaluation of Surveyed Plants in Mexico and Other Countries

Plant Name	Human-Results	Material-Results	Human-Methods	Material-Methods
M−ME	3.5	3.7	2.8	2.3
M−MA	3.5	3.7	3.5	3.7
Y−ME	2.0	3.7	2.8	3.0
Y−TA	2.5	4.0	3.1	2.7
Y−TH	2.0	4.0	3.7	3.3

order to survive in difficult circumstances they have had to decrease the number of employees and adopt measures to rationalize manufacturing, increase the domestic sales and utilize the Taiwanese staff to operate in China. Plant Y-TH started operation very recently as a third wire harness production base of company Y in Thailand. That company has a long history of operation in Thailand, although production of wire harness began only in 1984. Supported by such abundant experience, the plant start-up was very satisfactory as 150 employees were relocated from the two other plants to set up that plant.

The following description verifies the conclusions obtained by the analysis in previous sections. Table 6 exhibits the four-perspective evaluation of these five plants. The strong inclination towards "direct" importation of production equipment of maquiladoras is reflected in the degree of application for Material-Results. But the averages for this aspect of maquiladoras, M-ME and Y-ME, is rather lower than the plants in Asian countries, M-MA, Y-TA and Y-TH, even though these three Asian plants are not located in bonded areas. The production equipment of M-MA and Y-TH is the same as in plants in Japan. In the case of M-MA, fully automatized adjustment machines which are not installed at the mother plant are equipped during the chassis process in order to homogenize the quality of the products. The automation of the maquiladoras is a little bit lower than that of the Asian plants.

The degree of application for "Human-Methods" of maquiladoras is also lower than that of the Asian plants. In the case of plant Y-TH, about 240 employees are sent to Japan every year for six months and trained through OJT (on-the-job training). They are entrusted with all of the administration of each line which is run only by Thai employees who are reported to have almost the same level of skills as Japanese workers after this study and training in Japan. Upon return to Thailand they use the same equipment as in the Japanese plant. This is the main reason that the average for production equipment for this plant scored so high (3.7). On the other hand, perhaps as a result of not having sent so many employees to Japan so often, the degree of application for that aspect of plant Y-TA is only 3.1. Sending and training employees in Japan is an effective method of applying the Japanese-style production system related to human factors. On the contrary, the degree of application for this aspect of M-MA scored 3.5, without sending so many employees to Japan (about 30 a year). Instead, they are training their employees within the factory using a systematic training program supported by relatively many Japanese expatriates. The degree of application for this aspect of M-ME and Y-ME was relatively low, although they

have long operational experiences.

As mentioned above, the number or the ratio of Japanese expatriates is not the determinant factor for the transfer of Japanese-style production system. Y-TH which dispatches the least Japanese expatriates of the five plants seems to realize a relatively high degree of application. However, as is seen about M-MA, the relatively many Japanese expatriates as well as their strong initiative to manage local subsidiaries leads to a high degree of application.

The low average for "Material-Methods" was one of the difficulties which Japanese maquiladoras were facing. This is seen in the application degrees between M-ME (2.3) and M-MA (3.7). For example, in Japan maintenance workers are usually acquired by way of in-house training of experienced production workers who have been working for a particular company since graduation from a high school (or technical high school). Japanese-style quality control exerts the greatest possible effort "to build quality into the process." In a word, the participation of ordinary workers in maintenance or quality control is one of the main characteristics of Japanese-style system. However, training ordinary workers in such a way is not an easy task for maquiladoras because of the high turnover rate. In the case of Y-ME, the degree of application for that aspect is relatively high, reflecting the company's effort to foster maintenance workers by way of in-house training as well as the existence of the twin plant in Texas for procuring parts and components that contributes to higher score for the Procurement Method.

Conclusion

Japanese maquiladoras have played important roles in supplementing and reducing the cost of the U. S. operation. Formerly the advantage of maquiladoras consisted of cheap labor cost, but the rapid wage increases and severe competition with Asian NIEs after the late 1980's have forced the Japanese maquiladoras to try to make their operations more efficient through reduction of personnel with the introduction of automatized equipment, and strengthening the transfer of Japanese-style production system. In addition to that, the formation of NAFTA forces Japanese maquiladoras to procure parts and components in North America. Therefore, the Japanese maquiladoras have been rapidly changing their attitudes toward operation. However, there remain considerable differences between the Japanese plants and the maquiladoras. On the other hand, some of the Japanese transplants in Asian countries which were started up from the late 1980's onwards in order to build export bases are intended to become like "plants located in Japan." However, there are possibilities for Japanese maquiladoras to strengthen the Japanese-style production system in order to survive in Mexico, contribute to the local economy and merge with Mexican society. This should be possible because the external conditions of the Mexican society for the Japanese system is very suitable, as is shown in the application scores for Sense of Unity (3.9) or Labour Relations (3.9) in Table 1.

NOTES

(1) For a fuller discussion of the model see Tetsuo Abo (ed.) *Hybrid Factory* (New York: Oxford University Press, 1994).

(2) The research in 1989 and 1992 was conducted by the Japanese Multinational Enterprise Study Group (Headed by Tetsuo Abo, University of Tokyo). The 1991 research was conducted only by the author. Regarding the 1989 research in Mexico, see Kunio Kamiyama, *"Genchi Nihon Kojo no Shien Kojo* (Supporting Factories to the Local Production in the United States)", in Tetso Abo (ed.) *Nihon-teki Keiei•Seisan Shisutemu to Amerika* (Japanese Management and Production System and the United States) (kyoto: Minerva Shobo, 1994). About the 1991 research, see Kunio Kamiyama, *"Makiradora ni okeru Nikkei Kojo* (Japanese Electronics Plants under the Maquiladora System)", Annual Reports of Josai Graduate School of Economics, No. 8 (March 1992). About 1992 research, see the Japanese Multinational Enterprise Study Group, *"Kankoku • Taiwan ni okeru Nihon-gata Seisan Shisutemu* (The Japanese Production System in Korea and Taiwan) (1)～(4)", The Journal of Social Science, University of Tokyo, Vol. 45, No. 3-6 (December 1993～March 1994).

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《Summary》

Comparative Study of Japanese Maquiladoras with Plants in the United States and Asian Countries

By Kunio KAMIYAMA

Japanese companies started maquiladora operations in Mexico in the early 1980s. With the rapid appreciation of the yen in the late 1980s, a number of Japanese companies producing in the U. S. began maquiladora operations. The fundamental reason for establishing these maquiladoras was to supplement the operations of U. S. plants, however in several cases, the Japanese firms discontinued U. S. operations and shifted all of their production to their maquiladoras.

This paper examines the characteristics of these Japanese maquiladoras and compares them with Japanese transplants in the U. S. and Asia. The first section compares the maquiladoras with transplants in the U. S. The second section compares the maquiladoras with transplants in Korea and Taiwan. The third section verifies these by examining the

characteristics of two companies' transplants in Mexico and Asian countries. Through an examination of these two companies, it is possible to discern a dramatic change in the Japanese maquiladoras between the date of the first field survey in 1989 and the second one in 1991. The conclusion argues that Japanese firms continuing to produce in Mexico will likely have improved results regardless of the elimination of maquiladora privileges due to NAFTA.