

The Japanese Production System and Its International Transferability

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ABSTRACT

The Japanese production system has an ethnic or national basis. There are considered to be three production components of the system—shop-floor-centred work organization, waste-free production control, and participative management in the context of cooperative labour relations. For each of these, it is possible to set up a 'Japanese-type'.

The author is conducting research into the overseas operations of Japanese subsidiaries in automobile assembly. Japanese multinational enterprises presumably try to apply the system to their overseas operations to take advantage of its strengths; however, given that they have moved into a foreign country, presumably Japanese enterprises have to adapt to the management environment of the local area. This research investigates the following questions: (i) Does this 'application' and 'adaptation' result in a dilemma? (ii) What is actually being applied and what has not been possible to apply? (iii) How well is the balance between 'application' and 'adaptation' being achieved? According to surveys of Japanese manufacturing plants in North America, Asia, and Europe, the application of the system is possible. Of course this does not mean that it can be applied 100%. The pattern of application varies according to the management strategy of the Japanese enterprises.

Key words : Japanese production system, shop-floor-centred work organization, waste-free production control, participative management, application and adaptation, hybridization, application pattern.

INTRODUCTION

The main purpose of this paper is to identify specific features of the Japanese production system and its international transferability. Japanese manufacturing industries, especially the automobile and electronics industries attract the attention of researchers because of their strong competitive position. The first stage in the internationalization of these industries was the export of finished products, which was then followed by the building of manufacturing plants abroad. I have focused on these industries, especially the automobile industry, which because of its efficiency and good quality, gained a competitive edge in the international market.

In the first part of this paper, I would like to present specific features of the

Japanese production system, in comparison with mass production or Fordism. Three pivotal elements are discussed, namely, shop-floor-centred work organization, waste-free production control, and participative management in the context of cooperative labour relations.

Part two of this paper explains international transferability and application patterns of the system based on field research in automotive plants abroad. I have visited many Japanese-affiliated automotive plants, located in North America, Europe and Asia, to do research on the application of the Japanese production system in different managerial environments. In this section, I will define the research model and clarify the international transferability of the system as well as the patterns of application abroad.

Part three explains the actual patterns of application in three countries: America, Britain, and Taiwan. The final part gives a summary of this paper and also some implications.

THE JAPANESE PRODUCTION SYSTEM

The Japanese production system consists of three pivotal elements: shop-floor-centred work organization, waste-free production control and participative management in the context of cooperative labour relations. Both shop-floor-centred work organization and waste-free production control constitute core parts of the system and are necessary to achieve high efficiency and good quality production. Successful plant operation depends on these core parts of the system. Participative management in the context of cooperative labour relations provides a framework for the system which ensures steady functioning of the core parts.

(1) Shop-floor-centred work organization is characterized by flexibility in work assignments, multi-skilled workers, workers' participation in improvement, and a merit system determining both wages and promotion. A flexible work allocation system is a precondition for shop-floor-centred work organization.

Job tasks are assigned to a team managed by a supervisor. Though the task for each worker is specified clearly, it is not assigned rigidly to him/her. It can be redistributed flexibly within the team. This system differs from the American model in the following three ways: First, the smallest unit of work assignment is not the individual worker who is assigned a fixed job but the work team. Second, the main regular supervisory function is carried out by first-line supervisors. Third, the determination of standard work procedures is carried out by the first-line supervisor. Much of the decision-making regarding job content and job assignment centres around the shop-floor. In contrast, the principles of work assignment in the traditional mass production system can be described as follows: A group of engineers or Industrial Engineering (IE) specialists

design a "job" by breaking down the work into job elements. These job elements are then assembled into job tasks. In accordance with a finely demarcated job classification system designed by the IE specialists, supervisors assign workers to jobs. A worker is then assigned to a rigidly determined set of job tasks, which constitutes a single job. The entire production process is organized around this rigid job system.

Under the flexible work assignment system, a worker is expected to be versatile or multi-skilled, which means that the individual worker gains experience of a broad variety of tasks through on-the-job-training and education. Together with regular job rotation, this practice facilitates multiple skill formation. By means of this system, workers develop into core personnel who have experienced a wide variety of job assignments within and among their teams. Workers carry out various kinds of manufacturing tasks as well as some quality control and maintenance tasks. Although there is a functional separation between ordinary manufacturing work, quality inspection and maintenance, production workers carry out some quality checks and maintenance work. This system promotes the accumulation of a wide variety of knowledge and skills required by the total production process and provides ample opportunities for *kaizen* activities (improvement activities). Small group activities and systematic education promote a sense of involvement and encourage workers to contribute to ongoing job improvement and problem solving.

Wages and promotion are related to the person not to the "job". Wages are determined on the basis of length of service as well as performance evaluation primarily carried out by the worker's immediate supervisor. The promotion system is also based upon length of service and personal performance assessment. Since the formation of a wide variety of internal plant skills depends upon job rotation, On-the-Job-Training (OJT) and length of service, which supposedly corresponds to the accumulation of these skills, the skills become an important determining factor. This is in fact a rationale for the seniority and personal evaluation

system. So supervisors play a decisive role through personal performance evaluation in the determination of wages and promotion.

(2) The characteristics of a production control system which is devoid of waste are small-batch manufacturing, Just-in-Time (JIT) parts delivery, and quality-centred manufacturing methods. The Japanese production/manufacturing control system concentrates on eliminating waste and achieving the smooth flow of manufacturing operations. The traditional American system consists of a large-batch manufacturing system with voluminous parts inventory. The efficiency of the manufacturing process was pursued through volume production using large stocks of parts in order to avoid production stoppage due to a lack of parts. As a result, factories have to keep excess stocks of parts, so much so that one gets the impression that production lines are set up in the parts warehouse. This system of mass production based on large-batch manufacturing resulted in the pursuit of production volume alone. The result of this approach, combined with repetitive, monotonous work, was that the mass production system brought about poor product quality and even decreased efficiency. The Japanese production control system adopts a different approach to this problem. It adopts small-batch manufacturing using small stocks of parts. Parts are produced according to orders received from the final manufacturing process. Parts makers are required to manufacture products in accordance with the orders from the final assembly process. This so called Just-in-Time system is an indispensable part of the system. Quality-centred manufacturing methods constitute another essential element of the system. Regular workers are responsible for the quality of products. They are given the authority to stop the line if they detect product defects. "To build-in quality within the manufacturing process" is the slogan of the manufacturing system. Small-batch manufacturing, JIT, and quality-centred methods together make up the Japanese production system. Small-batch manufacturing enables both mass production and small

volume production. Also it makes it possible to produce different types of products on the same line. Small-batch manufacturing requires frequent changing of equipment and tools and both production workers and maintenance workers must be able to handle these changes. Such techniques as quick die changes have been a feature of the system since its early stages. Again, multi-skilled workers are crucially important to the operation of small-batch manufacturing.

(3) Participative management in the context of cooperative labour relations is the third element and constitutes a framework for the smooth operation of the system. Managers have the prime responsibility for plant operation and management in general. Japanese managers are expected to understand and grasp the actual situation at the shop floor. They keep in close touch with the work place so that they are fully aware of the actual situation in the plant. They keep in close communication with the workers under them, officially and personally. Also management organizes the participative arrangements at all levels of the plant: small group activities, the joint labour-management consultative committees at the shop floor as well as middle and upper levels. Whether there is a labour union or not, management organizes such committees. Participative management aims to reach a consensus with employees regarding plant operation. From the top management to the first line supervisor, the management stance is directed towards achieving a consensus with the employees. This stance requires cooperative and harmonious management-labour relations. In traditional mass production plants, the management stance was different from that of Japanese management. Management took an authoritarian attitude towards workers, so management-worker relations were correspondingly adversarial.

INTERNATIONAL TRANSFERABILITY AND APPLICATION PATTERNS OF THE SYSTEM

The Internationalization Model of the System

(1) The Internationalization Model

Because the Japanese production system stems from Japanese culture and society, and has emerged from the actual practice of management over time, it is very interesting to see whether or not the system can be applied in foreign countries where the culture, social structure and management practices are different from Japan; and, if applied in these different managerial environments, which elements are applied and which are not. The Japanese Multinational Enterprises Study Group (JMESG), to which I belong, created a theoretical model for the study of Japanese multinationals which is named the "Application-Adaptation Dilemma Model". Japanese multinationals try to apply the Japanese production system in order to retain their competitive advantage abroad. As Japanese firms, they can demonstrate the advantage of applying the system easily enough. However, they need to adapt themselves to the local managerial environment. They employ local workers and so they need to adapt to local customs and institutions. But if they adapt to the local environments completely, they will lose their advantage, because they will not be different from indigenous firms. So we thought that Japanese multinationals fall into a dilemma between the application of the Japanese production system, on one hand, and its adaptation to the local environment, on the other. In so far as local plants become a kind of hybrid which mixes application with adaptation in some way, the hybridization will be determined by such factors as corporate strategy and the compatibility of the local environment with the Japanese System (Abo, 1994).

(2) The Hybridization Analysis: "23-Factors", "6-Group Analysis", and "4-Dimensional Analysis"

In accordance with the Application-Adaptation Model, we created an internationalization model of the Japanese production system as the analytical framework. The model consists of 23 factors. Each factor is evaluated according to a five point scale to give an

application rating. If the practice of a factor at an overseas plant is the same as at the plant in Japan, we give 5 points. Conversely, if a practice at an overseas plant is the same as other indigenous firms, we give it 1 point (Abo, 1994). Though it is not strictly precise, this evaluation system allows us to quantify the rate of application at an overseas plant both in total and for each individual factor. The quantitative analysis also makes it possible to understand the application situation of each factor in quantity, as well as making it possible to identify the type of application pattern by grouping related factors. We have two different kinds of groupings, called the "6-Group Analysis" and the "4-Dimensional Analysis". With respect to the first one, we classified the 23 factors into 6 groups:

- I. Work Organization;
- II. Production Control;
- III. Parts Procurement;
- IV. Group Consciousness;
- V. Labour Relations; and
- VI. Parent-Subsidiary Relations (see Table 4).

The purpose of the groupings is to allow us to place each factor from the point of view of plant operations. "Work Organization" (I) and "Production Control" (II) are regarded as core groups in the operation of the plant. "Parts Procurement" (III) is regarded as an associate core group. "Group Consciousness" (IV), "Labour Relations" (V) and "Parent-Subsidiary Relations" (VI) are regarded as providing the supporting framework for plant operation.

The "4-Dimensional Analysis" distinguishes those factors that make a substantial and vital contribution to the transfer of the Japanese system to the local environment from those which are merely beneficial to the operational performance of the local plant. It rearranges the 23 categories into 4 categories. The "four dimensions" are derived by classifying each factor of the model as either "human" or "material", on the one hand, and as either "result" or "method", on the other. Those factors that are introduced directly from Japan as a "result" of the Japanese system are distinguished from those that are applied as

"method" regarding how to establish and operate the system. In other words, "method" refers to system-related factors, such as wage system, job rotation etc., which are difficult to apply, and "result" refers to ready-made factors, such as production equipment and ratio of Japanese expatriates, which are easy to introduce. This classification allows us to assess the content of the technology transfer by analyzing the application patterns of the system.

Transferability and Application Patterns of the System

(1) Profile of Japanese-affiliated Auto plants in three countries

Here, I would like to examine the plants in three countries with respect to plant scale, production model, and entry form. The description will show that there are some similarities between America and Britain, but Taiwanese plants are different (see Tables 1, 2 and 3). Even though plants in ASEAN have not been included, they are very similar to those in Taiwan.

First, regarding plant scale, in America and Britain, the plants are set up for high volume production and equipped with state-of-the-art facilities. Located on huge sites, they look very nice from the outside. Taiwan, on the other hand, has low volume type plants built using much lower levels of capital. Numerically speaking, American plants have an annual capacity of more than 200,000 units, which, in general, is regarded as a mass production plant. The plants in Britain are also designed to produce over 200,000 units. The target for the two newer plants in Britain is 100,000 units in the first phase. Taiwanese plants are a low volume type producing a variety of models. They are so-called knock-down plants, and have an annual capacity of less than 100,000 units.

As for entry form, America and Britain are similar, but again, Taiwan is different. In the two developed countries, the major type is sole entry and the minor type is a joint venture. But, in Taiwan, the only entry form is a joint venture with a local partner. As a rule, in the developed countries, Japanese

have management authority over plant operation even in the case of joint venture, but the situation is different in Taiwan. There are two contrasting types in terms of operational authority: operational power can be delegated to the local partner or retained by the Japanese manager. Local partners have a tendency to prefer to control plants themselves. In 1985, the Taiwanese government changed the automobile industry policy from one of protection to one of increasing imports by reducing import tariffs. After that, even local managers began to adopt the Japanese production system to cope with international competition. Local partners did not like to rely upon Japanese managers. They prefer to take management control themselves. It seems that the situation in other Asian countries is more or less the same.

(2) Hybridization Analysis and Regional Application Patterns

Now let us look at the patterns of application in these countries. To state the conclusion at the outset, the Japanese-affiliated auto plants have applied the system successfully in all these countries albeit with some modifications. But there are interesting differences in application patterns among them. There is a discrepancy between the expected application pattern based on existing managerial environments and the actual application pattern. Both America and Britain have similar managerial environments, but Taiwan is different. But the actual application pattern is not consistent with these similarities and differences. That is, American plants and British plants do not show similar patterns with respect to some important factors and British plants show close similarity to Taiwan in some other important factors.

According to Table 4, the average overall rate of application is as follows: 3.5 points for both America and Taiwan, and 3.4 points for Britain. These ratings mean that the level of application of the system at Japanese plants in these countries is high. According to a JMESG study in North America in 1989, the average rate of application

TABLE 1. Japanese Automakers' U.S.A. Manufacturing Operations

Plant	Location	Operation Start-up	Entry Form	Annual Capacity	Product Model	Number of Employees	Number of Japanese Expatriates (%)
ACp1	Ohio	Nov. 1982	Sole Entry	360,000	Pass. Car 1	10,200	500(4.9)
ACp2	Ohio	Dec. 1989		150,000	Pass. Car 2		
AB	Tennessee	June 1983	Sole Entry	450,000	Pass. Car 2 Truck 1	5,870	20(0.3)
AA1	California	Dec. 1984	Joint Venture (GM)	260,000	Pass. Car 2 Truck 1	3,883	38(1.0)
AE	Michigan	Sept. 1987	Joint Venture (Ford)	240,000	Pass. Car 3	3,600	160(4.4)
AA2	Kentucky	May 1988	Sole Entry	240,000	Pass. Car 1	4,089	73(1.8)
AD	Illinois	Sept. 1988	Sole Entry	240,000	Pass. Car 3	3,139	57(1.8)
AF	Indiana	Sept. 1989	Joint Venture	160,000	Pass. Car 1 Truck 2	1,893	108(5.7)

Sources : Japan Automobile Manufacturers Association, Inc. 1993, *The Motor Industry of Japan* and others.

TABLE 2. Japanese Automakers' UK Manufacturing Operations

Plant	Location	Operation Start-up	Entry Form	Annual Capacity	Product Model	Number of Employees	Number of Japanese Expatriates (%)
BB	Sunderland	Apr. 1984	Sole Entry	300,000	Pass. Car 2	4,600	49(1.1)
BC	Swindon	Oct. 1992	Joint Venture (Rover)	100,000	Pass. Car 1	2,000	100(5.0)
BG	Luton	Sept. 1987	Joint Venture (GM)	60,000	Truck 2 R.V. 1	2,100	3(0.1)
BA	Burnaston	Dec. 1992	Sole Entry	100,000	Pass. Car 1	1,900	50(2.6)

Sources : Japan Automobile Manufacturers Association, Inc. 1993, *The Motor Industry of Japan* and others.

TABLE 3. Japanese Automakers' Taiwan Manufacturing Operations

Plant	Operation Start-up	Entry Form	Start of Joint Venture	Annual Capacity	Product Model	Number of Employees	Number of Japanese Expatriates (%)
TB	1956	Joint Ventures (Local)	1985	70,000	Pass. Car 5 Truck 5	3,549	14(0.4)
TC	1969	Joint Venture (Local)	1974	40,000	Pass. Car 2	4,380	2(0.001)
TD	Dec. 1973	Joint Venture (Local)	1986	87,000	Pass. Car 1 Truck 5	2,009	2(0.001)
TA	May 1984	Joint Venture (Local)	1986	45,000	Pass. Car 1 Truck 4	1,867	34(1.8)
TF	May 1989	Joint Venture (Local)	1986	42,000	Pass. Car 2 Truck 1	538	11(2.0)

Sources : Interviews and others

for four industries, auto assembly, auto parts, home electronics, and semiconductors was 3.3. The average for each industry was: auto assembly 3.5, auto parts 3.6, semiconductors 3.2, and home electronics 2.7 (Abo, 1994). In North America, both auto assembly and auto parts were application-oriented type industries, and home electronics was adaptation-oriented. Thus, as far as viewing the application situation on the basis of the average rating is concerned, we can say that Japanese auto firms have successfully applied the system to the management of their overseas plants.

With respect to the local managerial environment, whereas there are a lot of similarities between America and Britain, Taiwan is different from these two countries. That is to say, there is an Anglo-American similarity in work organization, production control, and labour relations. In work organization, similarities are observed in the job classification system, job-based wages,

inflexible work assignment and clear job demarcation between skilled workers and unskilled workers. As for production control, Fordism was firmly established in America but only loosely applied in Britain. But the traditional managerial environment in Taiwan is totally different. There were no established production methods and a lack of domestic suppliers of key parts. So, as far as the managerial environment is concerned, the same features exist in America and Britain, but not in Taiwan. However, there is an interesting discrepancy between these patterns and the actual pattern of application.

The average rating for work organization is 3.3 points for America, while for Britain and Taiwan, it is 3.9 points, which indicates an extremely high rate of application (see Table 4). The high rate for British plants is because they are receptive to the Japanese-style work organization while the high rate for Taiwanese plants is because their institutional similarity with Japan makes it

TABLE 4. Hybridization Ratio for Three Countries

	America	Britain	Taiwan
I. Work Organization	3.3	3.9	3.9
1. Job Classification	4.8	5.0	5.0
2. Job Rotation	3.2	3.5	3.8
3. Education and Training	3.4	3.8	3.6
4. Role of Supervisor	3.1	3.5	3.4
5. Wage System	2.1	4.0	4.4
6. Promotion	3.2	3.5	3.4
II. Production Control	3.4	3.7	3.6
7. Production Equipment	3.9	3.3	3.6
8. Quality Control	4.0	4.3	3.8
9. Maintenance	2.9	3.3	3.2
10. Operation Control	2.9	3.8	3.8
III. Parts Procurements	3.0	1.8	3.0
11. Local Content	2.3	1.5	2.4
12. Suppliers	3.8	1.0	3.0
13. Procurement System	3.0	2.8	3.6
IV. Group Consciousness	3.9	3.4	3.9
14. Small Group Activities	2.7	2.5	4.0
15. Information Sharing	4.4	4.0	3.8
16. Unity	4.6	3.8	4.0
V. Labour Relations	4.2	4.0	3.6
17. Employment Policy	4.3	4.0	3.0
18. Employment Security	4.9	3.8	3.6
19. Union	4.2	4.3	4.2
20. Grievance	3.2	4.0	3.4
VI. Parent-Subsidiary Relations	3.5	2.7	2.2
21. Ratio of Japanese Expatriates	3.8	2.8	1.6
22. Delegation of Power	3.3	2.3	2.4
23. Status of Local Manager	3.3	3.0	2.6
Total Average	3.5	3.4	3.5

Note : The figures for America include 9 plants of which 2 plants are in Canada. The figures for Britain include 4 plants and for Taiwan 5 plants.

easy to adopt the system. In addition, Britain and Taiwan are very similar with respect to production control; Britain rates 3.7 points and Taiwan 3.6 points.

The rates for the parts procurement group show a different pattern among the three countries, with America and Taiwan having 3.0 points each and Britain having 1.8 points. Japanese parts makers have made inroads in large numbers into America and Taiwan, so some of them have close trading relations with the Japanese assemblers. In contrast, Japanese assemblers must follow the strict local content rules of the EU and, in addition, not many parts makers have set up operations in Britain or Europe. Consequently, the localization of procurement is higher in Britain.

Group consciousness shows a similar trend to parts procurement. Both America and Taiwan score 3.9 points and Britain 3.4 points.

The results for the labour relations group are interesting in that America scores 4.2 and Britain 4.0, whereas Taiwan scores lower than both of them with 3.6 points. Japanese firms take a very cautious and considered approach to labour relations in America and Britain due to adversarial practices in the past and choose a prudent response to them, though sometimes this amounts to over action. Japanese firms give careful consideration to site location, employee selection, etc.. However, they do not emphasize Japanese practices for this group in Taiwan. The trend for the parent-subsidiary relations group is rather similar to those for core groups. That is, America is high at 3.5 points, but the other two countries are low at 2.7 points for Britain and 2.2 points for Taiwan.

Next, let us look at application from another perspective, that is, focusing on the "4-Dimensional Analysis" (see Table 5). Regarding the application of methods which are difficult to bring in, all three countries, America, Britain, and Taiwan register high rates: Britain and Taiwan 3.7, and America 3.6. ASEAN and Mexico-Spain are lower at 3.2 for ASEAN and 2.3 for Mexico-Spain. Here again, Britain and Taiwan show a similar application pattern while America is different. Comparing

methods with results, America is different from Britain and Taiwan. Namely, America has 3.6 points for methods and 3.4 points for results, meaning that a high rate of application with respect to methods accompanies a high rate of application with respect to results. Conversely, there is a gap in the application rates between methods and results in the case of Britain and Taiwan. Britain records 3.7 points for methods and 2.3 points for results, and Taiwan has the same points for the methods as Britain and 2.6 points for results. These two countries apply methods at a high level without relying on the same high rate of application of results. In other words, a high application level of methods is possible with a low application level of results in these two countries.

Breaking down the four dimensions, America records high rates for human methods and human results as well as material methods and material results. However, both Britain and Taiwan record the same points for human methods but lower points than America for the human results. Also in the case of the latter two countries, the points for material methods are higher than material results (see Table 5).

Figure 1 shows interesting application patterns. If the rate exceeds 3 points, it indicates an application orientation and if the rate is less than 3 points, it indicates an adaptation orientation. Thus it is possible to identify four different types of hybridization. Namely, the first quadrant represents the "methods, results application type", which means that the application orientation applies with respect to both methods and results. The second quadrant represents the "methods application, results adaptation type", the third quadrant represents the "methods, results adaptation type" and the fourth quadrant represents the "methods adaptation, results application type". According to this typology, Britain is located in the second quadrant, that is, the "methods application, results adaptation type". Taiwan is also located in quadrant II, but its application rate for results is the reverse of Britain's. In Britain, material results rate lower than in Taiwan and human results rate higher than in Taiwan. American plants, meanwhile, fit

TABLE 5. 4-Dimensional Analysis for Five Regions

	Human		Material		Methods	Results
	Methods	Results	Methods	Results		
America	3.7	3.6	3.2	3.3	3.6	3.4
Britain	3.7	2.9	3.6	1.9	3.7	2.3
Taiwan	3.7	2.1	3.6	3.0	3.7	2.6
ASEAN	3.2	2.3	2.8	3.3	3.2	2.9
Mexico-Spain	2.2	2.5	2.5	3.3	2.3	3.0

- Note: (1) ASEAN includes 6 plants in Thailand and 2 plants in Malaysia. Mexico-Spain includes 2 plants in Mexico and 1 plant in Spain.
- (2) Human Methods include Job Classification, Wage System, Job Rotation, Education and Training, Promotion, Role of Supervisor, Small Group Activities, Information Sharing, Unity, Employment Policy, Employment Security, Union, Grievance Procedure, Delegation of Power.
- (3) Human Results include Ratio of Japanese Expatriates, Status of Local Manager.
- (4) Material methods include Quality Control Procurement System.
- (5) Material Results include Production Equipment, Local Content, Suppliers.

into the “methods, results application type”, located in the first quadrant, which means both methods and results indicate an application orientation.

ASEAN and Mexico-Spain stretch over two quadrants. In the case of ASEAN, the human aspect indicates the “methods application, results adaptation type”, but the material aspect is consistent with the “methods adaptation, results application type”. The application type for the ASEAN countries follows the Taiwanese pattern closely, but is lower in methods and higher in results than Taiwan. Mexico-Spain indicates an adaptation orientation, because the methods points for both human and material are low.

APPLICATION OF THE SYSTEM

Japanese-affiliated auto plants in the three countries studied have applied the system successfully, but they have different types of application patterns. The following is an explanation of an actual pattern of application.

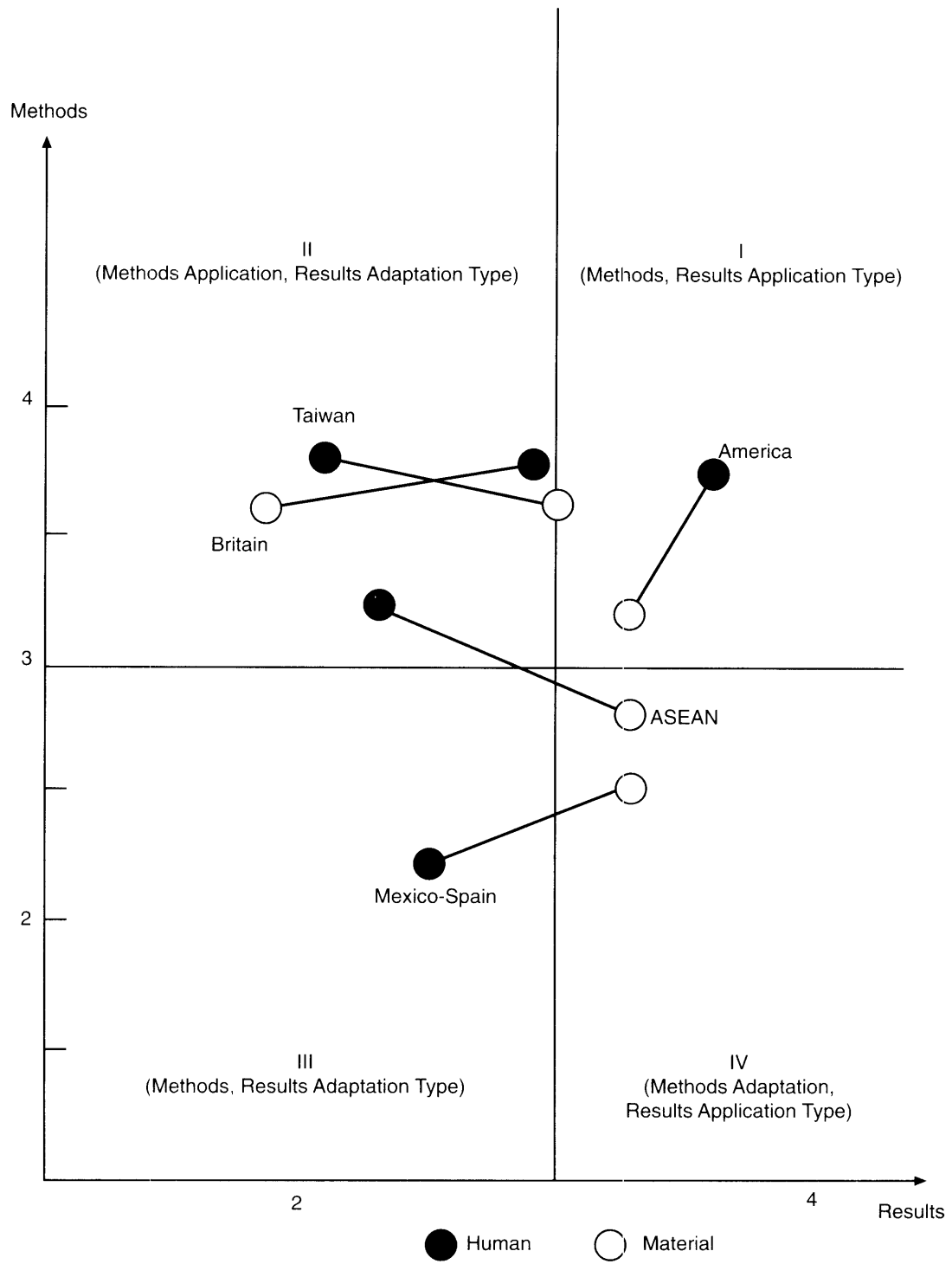
Work Organization

Both America and Britain have much in common with respect to traditional work

organization, whereas Taiwan has similarities with Japan. Thus we presumed that Japanese firms would have difficulty in applying their system in America and Britain and no difficulty in Taiwan. In fact, the system has been applied successfully in all three countries. So the rating for work organization is high in all three countries. However, America is different from the other two countries. The average for work organization is 3.3 for America, and 3.9 for Britain and Taiwan. In other words, America has a lower rating than the other two. America scores lower points than the other two countries with respect to such factors as the wage system, job rotation, role of the supervisor and promotion.

Let us examine job classification which shows almost the same points for the three countries. Simplification of the job classification system is a precondition for implementing Japanese-style work organization in America and Britain. Simplification of the system has, in fact, been achieved. Traditional American auto plants use nearly 100 different job classifications including both skilled and unskilled, but Japanese plants have reduced this to just 2 categories—production and maintenance. In Britain, Japanese plants also have only two

FIGURE 1. Application Patterns



categories for workers. In Taiwan, on the other hand, the need to change the job classification system does not arise; such a system has never existed. In this way, Japanese firms have succeeded in setting up the preconditions necessary to establish their own flexible work organization in all three countries, even though the process was different. In America and Britain, this involved reforming the traditional job classifications and in Taiwan, adapting themselves to traditional customs. As a result, job classification has a high rating of 4.8 points in America, and 5.0 in the other two countries.

Other factors also have high ratings of over 3 points. However, in general, the American plants register lower points than the other two. In particular, the wage system is a very low 2.1 for America, whereas Britain scores 4.0 points and Taiwan 4.4 points, which means they are very similar to Japan. The most important difference between America and the others is whether or not performance evaluation is used as a determinant of wages. In America, wages are determined on the basis of a simplified job classification system with an hourly rate. They do not use individual performance evaluation as a determinant of wages. On the other hand, in the case of British and Taiwanese plants, performance evaluation has been adopted as a determinant of wage levels.

The Japanese system requires production workers to be multiskilled, to be responsible for quality control and also maintenance to some extent, and to participate in *kaizen* activities. Because they are required not only to do assigned tasks but also to perform a wide range of other tasks, and because they are expected to have high morale, such workers deserve to be treated equally with white-collar workers with respect to their wage system.

Production Control and Parts Procurement

The average rating for the production control group is 3.4 for America, 3.7 for Britain, and 3.6 for Taiwan. They show a basic application orientation and there are no significant differences among them. In

contrast to this, the parts procurement group does not rate as high as other groups, and the rating for Britain is quite low. Both America and Taiwan are 3.0 points and Britain is especially low at 1.8 points. The parts procurement group tends toward adaptation, especially in Britain.

With respect to local environmental conditions for production control, America and Britain are similar. Taiwan is different, because there is a difference in the basic manufacturing capability of developed countries and newly industrialized countries such as Taiwan. In America and Britain, there is an established manufacturing system and technology. Quality control and maintenance have constituted specialized jobs and are clearly demarcated from production jobs. But, in Taiwan, the manufacturing foundation is weak because of late industrialization. Not all of the necessary parts can be provided. Also, maintenance workers have not been promoted sufficiently and production workers do not have the necessary quality consciousness to compete in the world market.

As for production equipment, America scores 3.9 points and Taiwan 3.6 points. But Britain is lower at 3.3 points, because one of the subsidiaries has restructured an old plant and is able to take advantage of the old equipment. With respect to quality control, maintenance and operation control, Britain ranks highest, because foremen and workers have been flexible in adopting the Japanese system. With respect to quality control, British plants implement the Japanese system of "building in quality within the manufacturing process", and accordingly production workers have responsibility for quality. Surprisingly, whereas the brother plant in America takes after the American system that allocates special workers to check quality, the British plant, even though it has the same parent company, has implemented the Japanese system in its entirety. Also, concerning operation control, under the Japanese system, foremen set the work standard and take part in line balancing. British plants are notable for being flexible in adopting the Japanese system. With respect to parts procurement, the developed countries have a

similar environment but Taiwan, a newly industrialized country, is different. It is possible to procure parts in developed countries, but Taiwanese parts makers are still not able to provide key parts. The rating for this group depends on local government policy and the overseas activities of the Japanese parts makers. In Britain, where the score indicates an adaptive stance, the local government requires a higher rate of local content than in the U.S.A.. In addition, although many Japanese parts makers have moved into America and Taiwan, they have not advanced into Europe in large numbers. The low rating for Britain reflects the passive attitude of the parts makers, whereas in America and Taiwan, the assembly plants procure parts from Japanese-affiliated makers.

Group Consciousness and Labour Relations

Regarding the group consciousness and labour relations group of factors, the local environment is similar in America and Britain, but different in Taiwan. Due to the tradition of a class society in Britain and the tradition of an immigrant society and an inheritor of British institutions in America, labour relations in these countries are adversarial. Blue-collar workers are discriminated against in terms of the wage system and working conditions. Because a relationship of opposition continues, a consciousness of "them and us" is prominent and there is no room for participative consciousness among workers. By contrast, in Japan, managers have placed great importance on having harmonious relations with workers since the end of World War II.

There are no noteworthy differences among the three countries with respect to the group consciousness factor: 3.9 points for America and Taiwan and 3.4 points for Britain, indicating an application orientation in all cases. It seems that Japanese managers have taken a more active attitude towards stimulating participation in America and Britain than in Taiwan. It is possible to assume that the reason for this is that Japanese managers are afraid that the workers' traditional adversarial attitude towards management may reappear. In spite of such efforts, small group activities in the two developed countries score only low points at 2.7 in America and 2.5 in Britain. A small

number of American and British workers show interest in these activities but it seems to be difficult to obtain widespread participation.

As for the labour relations factors, the average ratings are very high at 4.2 for America, 4.0 for Britain and 3.6 for Taiwan. Let us see how labour relations are taken care of factor by factor. The ratings for employment policy are 4.3 points for America, 4.0 for Britain and 3.0 for Taiwan. The two developed countries score higher points, because Japanese companies deliberately chose rural areas as site locations, considering the work ethic and the low turnover rate, and they were very prudent in hiring workers using various selection steps. In contrast, Japanese plants did not thoroughly implement such practices in Taiwan.

Regarding job security, Japanese plants in America and Britain attach great importance to long term employment. If production decreases due to poor sales performance, they do not resort to lay-offs, although recently one plant in Britain resorted to voluntary retirement because of decreased production. So the rating for job security for America is quite high at 4.9 points, but only 3.8 points for Britain. Taiwan scored 3.6 points, because one plant in which the local partner has management control does not show much concern for job security.

Japanese plants take a prudent stance towards labour unions, of course. In developed countries, labour unions are organized by industry or occupation, but in Japan and Taiwan, they are organized within the company. Japanese firms are very sensitive about unionization and its stance against management. In the U.S.A., the main trend is for Japanese plants to reject unionization. Whether or not a union exists depends on the entry form. In the case of sole entry, the companies have rejected unionization, but in the case of joint ventures with one of the Big Three auto makers, it is allowed. In the U.K., only one plant has no union. In Taiwan, though unions were organized after the lifting of martial law, there is very little trouble between management and labour. Japanese plants generally set up

a management-labour consultative system. As a result, the rating for union related factors is very high at over 4 points for all three countries.

Parent-Subsidiary Relations

Generally speaking, parent-subsidiary relations are influenced by the overseas expansion of the parent company and the local managerial environment. Japanese parent companies have a firm policy of maintaining close relations with their subsidiaries so that they can control them. They dispatch many Japanese staff to the plants in developed countries, because the local systems are different from Japan. By contrast, plant management is possible with fewer Japanese expatriates in Taiwan, because of its environmental similarity with Japan. Almost the same outcome could be expected with respect to the overseas expansion strategy and the rate of share holdings. In America and Britain, Japanese companies invested a large amount of money to build large scale plants with the state-of-the-art technology and Japanese managers took control of management whether the entry form was sole entry or joint venture. On the other hand, in Taiwan, all local plants are joint ventures. So one might assume that American and British plants would have the same high ratings, whereas Taiwanese plants would have a low rating.

In fact, however, only American plants receive a high rating. As expected, Taiwanese plants get the lowest rating, but British plants stand somewhere in between America and Taiwan, indicating an adaptation orientation. The ratings for this group are as follows: America 3.5 points, Taiwan 2.2 points and Britain 2.7 points. In other words, only American plants show a positive application orientation.

American plants score over 3 points for each of the three factors in this group: 3.8 points for the ratio of Japanese expatriates and 3.3 points for both the delegation of power and the status of the local manager. By contrast, Taiwanese plants score 1.6 points for the ratio of Japanese expatriates, 2.4 points for the delegation of power and 2.6 points for the status of the

local manager. The ratings for the British plants range from 3.0 points to 2.3 points. It is to be expected that the American plants will have high scores and the Taiwanese plants low scores, given their respective managerial environments. Here again, British plants show a somewhat different trend from the application pattern which would be expected given the similarity of its managerial environment to that of America. This means that the British are flexible in taking on the Japanese system on their own initiative.

CONCLUDING REMARKS

The Japanese production system has three pivotal elements: shop-floor-centred work organization, waste-free production control, and participative management in the context of cooperative labour relations. Compared with American mass production or Fordism/Taylorism, each element has distinctive features.

Because the system stems from the unique Japanese culture and has developed out of the actual practice of management, its international transfer would appear to be difficult. Trade friction with developed countries and the increasing yen rate compelled Japanese manufacturers to move into foreign countries. Japanese firms decided, somewhat reluctantly, to build manufacturing plants overseas. Because of this situation, we started to do field research on Japanese multinationals, with a strong interest in the transferability of this unique system into different managerial environments. This paper aimed to explain the actual situation in Japanese auto plants abroad, especially in America, Britain and Taiwan.

In conclusion, first, it has proved possible to transfer the Japanese production system into these three countries. International transferability is identified by the high rate of application points. It seems to be easier to transfer the Japanese production system into the developed countries and newly developed Asian countries than into others.

Second, different types of application patterns can be identified. On the one hand,

American plants are of the "methods, results application type", which means a high rate of application with respect to methods accompanies a high rate of application with respect to results. On the other, British and Taiwanese plants are of the "methods application, results adaptation type", which means a high rate of methods application becomes possible with a low rate of application of results. There is a gap between the expected application pattern and the actual application pattern. It is to be expected that Taiwanese plants will show a high rate of application because of their institutional similarity to Japan. Likewise it is to be expected that the American plants will have a different application pattern from Taiwanese plants, because the managerial environments are extremely different. British plants, which had the same managerial environment as the American originally, show flexibility in adopting the Japanese system and have the same application type as Taiwanese plants. The particular application type depends on both the strategy of the parent company and the local environments.

Third, in the case of ASEAN and Mexico-Spain. Japanese plants have a lower rate of application than the former two groups. The ASEAN plants display quite a similar application pattern to that of Taiwan even though they have lower ratings. Asian countries seem to have the capability to assimilate the Japanese system.

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