INDUSTRIAL RELATIONS AND "HUMANWARE":
A Study of Japanese Investment in
Automobile Manufacturing in the U.S.

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This is a preliminary paper. Please do not quote without the permission of the author. The research on which this paper is based has been conducted with the collaboration of John Paul MacDuffie, MIT. The researchers owe much to the warm cooperation of managers, employees, and union officials of Japanese auto companies and joint venture companies in the U.S. as well as American auto companies and the UAW. We would like to express our sincere appreciation for their assistance. The author would like also to thank Ann Rowbotham for her efficient typing.
I. INTRODUCTION

In the last few years, Japanese investment in automobile manufacturing in the U.S. has increased dramatically. Following the pioneering investment of Honda in motorcycle production in 1979 and passenger cars in 1981, Nissan started building small trucks in 1982 and passenger cars in 1985. Toyota started a joint-venture operation with GM in California, where they started to produce cars in 1984. Toyota then launched a large-scale independent investment in Georgetown, Kentucky in 1986. Mazda is building a large and highly sophisticated plant in the midst of the Detroit metropolitan area. Mitsubishi also has started construction of a large plant in Bloomington, Illinois this year working jointly with Chrysler. Fuji Heavy Industry (Subaru) and Isuzu are, reportedly, considering a major investment project.

By the time all these investment projects are completed, around the end of 1988, the number of cars produced by Japanese auto makers is estimated to reach the level of about 2 million a year. So far, their operations seem to have been successful. Production performance has been good, and industrial relations have been cooperative and peaceful. Will this successful performance continue? Will Japanese auto makers take over a major portion of automobile production in the United States? Or will they face obstacles or serious challenges in the long-run? If so, what will the problems be?

In the face of the large and growing presence of Japanese operations in the United States, has the interest of American automakers in Japanese production methods intensified? What can American producers learn from the Japanese which could improve their own competitive position? Efforts are being made to learn from Japanese experience both directly and indirectly through joint-ventures, exchange of information and other means. Will
American corporations learn something from these efforts? And if they do, which lessons will be most useful for their purposes?

These are some of the intriguing questions which motivated this study. In what follows, I will first present in Section II a model of what I perceive to be the key elements of the Japanese production system. There, special attention will be paid to a critical dimension of technology -- the linkage between the technological linkage between the production system and human resources, which I call "humanware." Then, in Section III, the experience of Japanese plants in the U.S. will be reviewed, being summarized in four major aspects: hardware technology and the production system, recruitment and training, work organization and its functions, and industrial relations. Finally, in Section IV, I will discuss some of the implication for the future development of Japanese investments and mutual learning possibilities.
II. JAPANESE MODEL OF PRODUCTION SYSTEM: HUMANWARE TECHNOLOGY

When you walk into Japanese plants operating in the United States, you may get several impressions. They look somewhat compact relative to American assembly plants producing a comparable quantity of cars. They have a stamping section combined with the assembly facility. However, other than that, they have essentially the same appearance as typical American auto plants. They employ basically the same production structure, the same kind of machines, and the same kind of work arrangements. American employees of Japanese plants work comparable hours at comparable wages with their counterparts in American plants.

However, the performance of Japanese plants has been so far much higher than many of their American counterparts. The quality of their cars has been graded among the highest of those being sold in this country. Cost of production is considerably lower, and productivity is higher than comparable American plants. They have so far enjoyed peaceful and productive labor-management relations.

What makes this difference? What are the gimmicks? Their hardware technology for car manufacturing is basically similar to American auto plants. Indeed, the degree of sophistication in terms of, say, automation is even lower than some of the newly equipped American plants. Outside observers are therefore often tempted to conclude that the gimmick lies in "social organization." Japanese managers' emphasis on team spirit, mutual trust, and participation, in public remarks seems to be supportive of this thesis. Not surprisingly, the social organizational side receives much attention in recent innovative efforts to improve the performance of American plants. Managements and union officials in some plants are eager to foster teams in work organization and develop participatory or involvement programs.
"Humanware"

In the author's judgment, however, the matter of central importance lies neither in hardware or social organization alone. The essence exists in the combination or in the intersection of the two. Let us name this "humanware." By "humanware," we mean a self-generating innovative interplay between human resources and hardware technology. In fact, the hardware cannot work by itself without human actions. If we may define technology as a way to produce outputs, hardware technology is in effect only a subset of technology. Technology becomes a meaningful concept only after the role of human resources, interlocking and interacting with hardware, is clarified. What we mean by "humanware" is this broader and more meaningful sense of technology. And it is our view that the answer to the questions we ponder lies in the domain of "humanware," rather than in hardware technology or social organization alone.

Let us now explain this point more in detail in the case of the automobile industry, resorting to a simple diagrammatic exposition of logical relationships (Figure 1) in the Japanese production system.

In the diagram, we can read the logical sequence from left to right. Located at the extreme left are the goals of corporations, which are followed sequentially by necessary steps to be taken to achieve the goals. The diagram identifies five stages in this logical sequence. They are: corporate goals, system outcomes, key features of production system, and major requirements for human resource effectiveness.
"JAPANESE MODEL OF PRODUCTION SYSTEM AND "HUMANWARE"

FIGURE I.
(1) Corporate Goals

Long-term corporate goals for Japanese automobile manufacturing corporations may reasonably be said to be corporate growth and profits. In order to achieve these goals, it is imperative for them to win market competition. The two major requirements for winning competition are to provide cars with high quality and at low prices. These define the targets for the next logical step.

(2) System Outcomes

The production system must produce outcomes that directly realize these targets. The Japanese production system accomplishes this by yielding through its operation three important outcomes: low inventory cost, low labor cost, and low defects. It is self-explanatory that once the system produces these outcomes, the targets of low price and high quality are satisfied. Note that low labor cost is not in terms of wage rate per worker but rather fewer head counts to produce a given output.

(3) Key Features of the Production System

There are three outstanding features in the Japanese production system, which are notable when the system is viewed as "humanware." They are: just-in-time production system (JIT), continuous adjustment of labor input, and human control of production processes and defects. As seen in Figure 1, these elements operate together to achieve low inventory cost, low labor cost, and low defects or high quality.
JIT Production System

The first element, JIT (just-in-time) production system, needs some explanation. We mean a well-organized production system made up of a combination of some unique sub-systems of production management, which altogether operate to provide just-in-time flows of goods. Let us underline here three critical sub-systems: small lot production, even flow production, and low buffer stock.

Small Lot, Even Flow and Low Buffer

Small lot production is instrumental in avoiding large in-process inventories, and is highly useful in minimizing defects in the process because quick and effective feedback can prevent defects or problems from proliferating. Once the level of defects is minimized and consequently a high level of certainty in production is attained, then production with even-flow and low buffer stock can be effectively realized. Even flow of production helps tremendously in minimizing in-process inventories. The low buffer stock system can work only when defects of materials are negligibly low, and precisely because of this, efforts to reduce defects in the process are strengthened.

These subsystems are, thus, mutually interdependent and also mutually reinforcing. They work jointly to yield low defects and low inventory, or in other terms, high quality and low cost. If this interdependence is broken at any point, the entire system will cease to operate effectively and will lose its efficiency. In other words, the system is potentially quite vulnerable because it is critically dependent upon human efforts for realizing and maintaining its effectiveness.
Continuous Adjustment of Labor

The second element, continuous adjustment of labor, refers to the continuous effort on the part of workers to reorganize labor input as needed to keep it proportional to changing production requirements. This effort naturally leads to, among other things, low labor cost.

Human Control

The third element, human control of production means that human control is utilized effectively to attain low defect or high quality production. Line workers are given the discretion to stop the line, if necessary, to remedy quality problems. Also, quality is carefully and constantly monitored and inspected by all the workers in the production process. Prevention of defects is accomplished not only with human eyes and hands. Machines and production systems are equipped with automatic defect prevention functions, wherever possible, by modifying or renovating them for the purpose of automatically avoiding problems and defects. However, here again, improvements through the experience of workers are the major input in this process. Human control of production, in this way, contributes importantly to attaining not only low defects, but also low inventory and low labor cost.

(4) Key Areas of Human Resource Involvement

As mentioned earlier, the unique features of the Japanese production system depend sensitively and critically on the role of human resources. Let us describe here three notable examples of ways human resources are integrated into the production system and play critical roles. They are: reduction of set-up time, self-management of work standards, and self-inspection.
Reduced Set-Up Time

Reduced set-up time for machine operation is an integral requirement for small lot production. Japanese auto companies have spent 10 to 20 years reducing set-up time, for example, of press machines in stamping operation from several hours to a few minutes. This process of improvement, which provides enormous cost savings and quality improvements, has not involved major hardware technological innovations. What was involved was a major breakthrough in the concept of production management and incremental improvements in operation promoted largely by daily efforts of line workers and engineers through their learning by experience.

Self-Management of Work Methods

Self-management of work methods contributes significantly, as shown in the diagram, to improving the operation of the JIT system, carrying out continuous adjustment of labor input, and realizing effective human control of defects. Toyota's practice of Hyojunka is a well-known example of this practice, where line workers are encouraged to study and write up the standardized work steps or procedures. This is a powerful device that involves workers actively and deeply not only in operational but also planning or managerial aspects of production. Although specific methods of worker involvement in production management utilized by companies vary, this participatory nature of production management is emphasized by all the Japanese companies.
Self-Inspection

Self-inspection is an integral element of human control for the purpose of minimizing defects in the process. Instead of leaving the job of inspecting quality to the specialized inspectors at the end of the production line, all the workers on the line are required to check for defects in the outputs they are producing. This active and constant participation of line workers, side by side with engineers, in inspecting outputs at all stages of production is the key to achieving the high quality cars for which Japanese auto makers are known.

(5) Human Resource Effectiveness

A review of key features of production systems and human resource involvement so far would reveal that the effective functioning of the whole system depends critically on effectiveness of human resources in the production process. If human resources fail to play effective roles in the system, the entire system will not operate properly and will lose its efficiency.

For human resources to occupy such a critical role in the production process, they must have certain desired attributes. Those attributes may be classified into three essential dimensions; skill, motivation, and adaptability. These are critically interdependent; the absence of any one of them will jeopardize human resource effectiveness.
Skill, Motivation and Adaptability

Skill is critical, but if skilled workers lack motivation they are not useful. And, even if skilled workers are motivated, if they are not adaptable to changes in technology or production structure they are not effective.

To equip human resources with these desired traits in the desired balance, the Japanese system of production is supported closely by well-organized human resource management and industrial relations policies. Figure 2 describes schematically the network of these supportive systems.

The human resource management and industrial relations policies that develop these three essential traits of human resource effectiveness may be classified into four areas: training, job structure, reward systems, and participatory policies.

Training

In the area of training, Japanese companies conduct intensive in-house training both in the areas of on-the-job and off-the-job training and promote constantly the development of a multi-skilled workforce through the use of scheduled rotation and transfer policies, among other measures.

Job Structure

In the area of job structure, broad job classifications are emphasized to create more versatility in job assignment and flexibility in work organization. Each job is expanded to include multiple tasks, the promotion ladder extends for a long span to reach higher supervisory positions, and transfers are utilized extensively in order to facilitate adjustment to product changes and demand shifts and to foster a skilled workforce.
FIGURE 2. JAPANESE MODEL OF HUMAN RESOURCE MANAGEMENT AND INDUSTRIAL RELATIONS
Reward System

The reward system is rather complex. Monthly wages are determined both by personal traits such as educational attainment and length of service, and by the skill level associated with the assigned job. In some cases, production performance is reflected also into monthly pay. Bonuses, however, reflect more sensitively corporate, group and individual performance. Side by side with these short-term pecuniary gains is promotion, a no less important element of reward for both workers and managers. Promotion decisions are made on the basis of careful monitoring and evaluation of individual performance. As a result, the mode of promotional decisions for manual workers at the workshop is not essentially different from that for managerial workers.

Participation and Communication

Participatory practices are viewed, both by management and union, as integral elements of the Japanese model of industrial relations. Among other things, communication, information sharing, and active participation of the union on managerial matters of production are strongly emphasized. Side by side with formal collective bargaining, a number of policies and organizational devices are mobilized to pursue these goals. They include: a joint consultation system; various functional committees where the union is represented together with management; meetings, both formal and informal, regular and irregular; small group activities; and various forms of joint problem-solving practices. The union plays an integral role in promoting and sometimes administering these policies and practices.
Indispensable Role of the Union

All the major Japanese auto companies are unionized. In fact, the union is an indispensable cornerstone that supports and promotes the Japanese production system. This is particularly true because the motivational aspect of human resource effectiveness, which determines the performance of the entire system, hinges critically upon the attitude of the union. Motivation is not something that the management can impose on workers unilaterally. It comes from the worker's own initiative and his own perception and understanding of the circumstances. How the union acts and reacts to different situations, therefore, can affect critically the formation of the workers' recognition of the given circumstances and also the determination of their own attitudes. Given the sensitive dependence on human resource effectiveness of the Japanese production system, the union may be said to hold a critical key in determining the success or failure of the Japanese production system.

Fragility of the Humanware System

The heavy reliance of the Japanese production system on human resource effectiveness is and has been its strength, but at the same time it could be its vulnerability as well. The system, which is so sensitively and critically dependent on human resources, could be jeopardized and lose its efficiency if human resource effectiveness were to be reduced or disrupted for some reason. This is because the technological interdependence between the production system and human resources is so essential to the system that it cannot operate properly without effective linkage between the two.
Japanese managers often stress the importance of the human side in management. They preach the importance of mutual trust, mutual help, respect to human dignity, team work, participation, etc. They do so not because they are more humanistic than others; not because their cultural values oblige them. Rather, they do so because the entire production system is so completely dependent upon the effective working and involvement of human resources. To put it differently, they do so because their very survival depends upon the human resource effectiveness for this technological reason of "humanware" linkage.

Robustness of the American Production System

In contrast, the conventional American production system is designed to be robust with regard to problems in human resources. Pursuit of economy of scale with sufficient amount of buffer stocks has been the dominant mode of management for the major American automobile corporations. While the American system is certainly also dependent on human resource effectiveness, it would not be jeopardized as seriously as the Japanese system by deficiencies associated with human resources, or by defects in intermediate inputs. This is because the system can always resort to buffer stocks to draw a sufficient supply of acceptable inputs. Inventory may be costly. However, this costliness may well be offset by the low unit cost made possible by the economies of scale of large volume production.

Historical Development

The question before us then is why did Japanese auto makers develop such a fragile and potentially vulnerable system, which depends so much on the
volatile effectiveness of human resources? What needs were they trying to meet? To understand these questions, there are several historical background factors to which we must pay attention.

Productivity Inferiority

A large productivity gap existed between Japanese auto companies and the American "Big Three" in the early stages of development of the Japanese industry. This gap was so large that it could not possibly have been narrowed by Japanese refinement of American production methods. Moreover, the American industry had a definite advantage over the Japanese industry because it could exploit economies of scale while supplying its large domestic market, in addition to its already much higher level of technology. While Japanese auto makers relied greatly on the American pattern of technology up to the early postwar period, some companies gradually diverted from it and developed their own unique production systems, concentrating on saving costs by eliminating redundancies.³ The leading and most notable example of this innovation took place at Toyota Motor Company, led chiefly by an ingenious engineer, Mr. Tai-ichi Ohno. Ohno focused on developing a production system which allowed inventories to be reduced to an uncomparably low level relative to its American counterparts, thereby gaining a competitive cost advantage. The model of the Japanese production system, as described earlier, emerged gradually through the accumulation of painstaking efforts by Toyota and other companies that followed its lead. The system, which exploits the virtues of small lot and low buffer stock production to achieve low costs and defects, necessarily had to rely heavily on human resource effectiveness, as discussed earlier.
Quality Control Problems

Another disadvantage from which the Japanese auto industry, as well as other Japanese manufacturing industries, suffered in the early stages of postwar development was the low and unreliable state of quality control. Since that time, Japanese industries have made strenuous efforts to improve quality control relying heavily on the guidance and advice of American experts. However, the methodology that they developed differed considerably from the typical American approach. The most notable difference is that Japanese companies involve line workers in the systematic program of quality control, whereas American companies tend to resort to experts. This difference may have emerged because of the relative absence of a necessary stock of expertise in the Japanese industrial sector.

Total Quality Control

Whatever the reason, this unique development of quality control methods has provided some significant advantages to Japanese production systems. One is that quality control has been built-in more deeply and thoroughly in the production process itself, and integrated into the jobs of workers, instead of being left to experts. The other is that the concept of quality control grew and expanded beyond the realm of the manufacturing process to entire fields of corporate activities, encompassing product design to sales. The significant implication of this development is that the Japanese system of quality control has evolved, here again, relying heavily upon active participation and involvement of the majority of workers.
Historical Transformation of Industrial Relations

The development of the Japanese production system, which evolved and grew out of a set of certain economic and technological restraints, has thus come to rely critically upon human resource effectiveness. This process of development had significant implications for Japanese industrial relations. To assure the survival and continuous improvement of their production systems, Japanese corporations have had to secure full support and cooperation from their unions. In fact, when the Japanese production system was in the early stage of development, many companies encountered and suffered from difficult conflicts in industrial relations. Some of the labor disputes threatened the survival of the companies. This labor turmoil was not only limited to the automobile industry. Many basic industries, such as iron and steel, ship-building, electric appliances, etc. met similar problems. However, after the mid-1960s, industrial relations in Japanese basic industries began to be transformed from a confrontational mode to a cooperative mode. In this mode of cooperative industrial relations, Japanese unions have played an integral role in running the Japanese production system as an indispensable partner to management, up to the present day.

Unique Social Infrastructure

The "humanware" of the Japanese production system has also taken advantage of some other infrastructural factors of Japanese society and economy. For instance, the well-structured public education system and the well-disciplined and relatively homogeneous labor force fostered through the education system may have helped Japanese companies develop a production system which relies heavily on the effective contribution of workers. The existence of a highly
group-oriented network of multi-tier suppliers, which grew out of the traditional Japanese industrial community of small firms, has certainly been helpful for Japanese auto companies in developing their extended just-in-time production management system which encompasses supplier relations.

"Humanware" technology in the Japanese auto industry has developed into a total entity of multi-dimensional complexity.

It is extremely interesting to ask whether or not this "humanware" system of production can be transferred into full-scale industrial operations on American soil, and how such a transfer will take place. The next section will introduce some of the recent experiences of Japanese investments in the United States in order to get some insights to this question.

III. JAPANESE INVESTMENT -- ACTUAL EXPERIENCE

Let us now summarize the actual experience of investments by Japanese companies in the United States for the following four major aspects: hardware technology and production system, recruitment and training, organization, and industrial relations.  

(1) Hardware technology and production system

Quick Feedback for Quality Assurance

Japanese plants in the United States appear to have several conspicuous technological features.

All of the four plants constructed so far contain a stamping section connected with the assembly facilities, unlike American plants. The basic
reasoning for keeping stamping together with assembly is to allow quick and effective feedback from the assembly to stamping in order to minimize defects.

Minimum Inventory

Another visible feature is the compactness of the plant. One Japanese company, which took over an existing but unused American plant, partially redesigned the production lines and uses only a small percentage of the total plant space, yet produces a quantity of cars comparable with the old plant. Within this reduced space, they even included a stamping operation which had not existed in the old plant. Another company produces 300,000 cars a year using a space of 1.7 million square feet, which is extremely narrow for its productive capacity. Still another company built a plant almost identical to its mother plant in Japan, which was designed very compactly to use the space efficiently. Although the spacial design of the plant is not the sole determining factor, the compactness of Japanese plants reflects the extraordinary commitment of Japanese management to minimizing in-process inventory costs.

Pull System

The "pull" system as opposed to "push" system is a feature of Japanese plants not so visible to the outside observer. Toyota's "kanban" system is a well-known example of this system. While different companies use different names to identify this system, Japanese companies share more or less the identical concept and apply similar procedures to realize the pull system of information flow. Combined with the "just-in-time" flows of goods, the pull system can operate effectively in minimizing inventories and therefore save
the costs of production. The extent to which Japanese plants operating in the
U.S. utilize this system varies, however. The major reason for this variance
is the suitability of supplier network available for each OEM. Some companies
still import a large proportion of parts from Japan. Many other parts come
from remote domestic American suppliers. Under these circumstances, the pull
and JIT systems may not necessarily operate effectively. Although the degree
to which the pull system is utilized, and the specific methods used to realize
it, differs among different plants, it is nevertheless clear that all the
Japanese companies in the U.S. stress strongly minimization of inventory costs
by using these systems as much as possible.

**Human Control**

Reliance on human control is another highly important, "invisible"
element. Although much of the physical production equipment installed in
Japanese plants is not state-of-the-art technology, it is utilized in very
efficient and innovative ways. One such example is the short set-up time for
machines. For instance, die change time for press machines for the Japanese
plants in the U.S. currently ranges between 9 to 15 minutes. The short die
change time enables, as discussed earlier, small lot production, low inventory
and low defects. Shortening of die change time has been promoted largely by
workers' learning and improvement efforts on the job. The effort of improving
the performance or capability of machines is often referred to in Japanese
plants as "giving wisdom to machines," which represents innovative interaction
between hardware and human control, the key feature of the Japanese production
system.
Production and work systems are designed in such a way that intermediate products are inspected carefully at each production station by line workers. Consequently, a workforce specialized in inspections occupies much less a proportion of the total employees in Japanese plants than comparable American assembly plants. Line workers in Japanese plants are given the discretion to stop the line when they feel it is necessary. They are entitled to do so in order to solve production problems as quickly as possible, working with engineers and other support staff, and to minimize the accumulation of defective products.

In summary, Japanese plants operating in the U.S. have been attempting to replicate almost exactly the hardware technology and production systems of their home country. In fact, most major production equipment and machines have been so far brought into the U.S. from Japan and installed and adjusted under the careful guidance and supervision of Japanese engineers. Plant layout and design have been also conducted mostly by Japanese engineers. Similar attempts have also been made in introducing production and work systems, which are an integral aspect of technology in a broad sense. However, the task here is much more complex and persistent. This is because the Japanese production system is designed to promote constantly innovative interactions between human resources and hardware. As such, a complete transfer or reproduction of the system is not an easy task. Although the system has reached the point where routine production operations are performed quite satisfactorily by American workers and managers, Japanese plant managers, even after several years of successful performance, are still not confident about the transfer of autonomous innovative capacity of the system.
(2) Recruitment and Training

Recruitment

Japanese plants in the U.S. place a strong emphasis on recruitment and make enormous efforts to select the desired type of workforce, although the specific mode of recruitment varies among different companies.

One company started operation by recruiting relatively small number of workers from the rural and largely agrarian local labor market in which it is located, and added more workers as it grew. Most of the recruited are young workers with high school education. Some of them had manufacturing experience but virtually none had experience in automobile manufacturing. Another plant selected some 2,000 workers in a rural local labor market in a southern state from the list of some 20,000 applications, through several stages of screening. One joint-venture plant recruited largely from the pool of laid-off experienced workers. Still another plant started to recruit some 3,000 workers in several stages from the local labor market which had a high concentration of automobile industry.

A crucial denominator which characterizes the nature of selection and recruitment process of all the Japanese plants operating in the U.S. is that they emphasize equally the worker's attitude toward team work as the most important criterion. Workers' perceptions and reactions toward team work or working together are examined closely during interviews at different stages of the screening process. Another remarkable feature commonly seen is the careful and intensive nature of screening. Employee selection occurs in several stages: examination of application forms, orientation sessions, group discussions, vocational training sessions, various tests at assessment centers, interviews, and often the process takes a few weeks to a few months. All this is for manual workers, and not for managers.
Training

Training is another factor which Japanese plants in the U.S. emphasize greatly. Training provided to workers is an intensive and long-lasting process. Training is given in several forms: preliminary vocational training, orientation sessions, introduction to Japanese mother plants, on-the-job and off-the-job training.

One company asks inexperienced workers to go through preliminary vocational training as a prerequisite for employment. Orientation is emphasized because the Japanese companies want all the employees to understand the basic concepts along which their production activities are organized. Initial orientation for American workers takes several days to a few weeks. A good proportion of employees including non-supervisory workers, say 10 to 15 percent, are given opportunities to visit mother plants and other facilities of Japanese corporations. The period of visit for each worker varies from a few to several weeks, and supervisory workers are given such opportunities up to several times depending upon their needs for training. During their visits, American workers learn Japanese methods of production operation by observing and working together with their counterparts in the mother plants. In the initial few years of plant operations, Japanese skilled workers and engineers are stationed in plants in the U.S. to teach and consult with American workers on the job. This is perhaps the most critical part of the entire training activities. One company still leaves a sizeable number of staff engineers for this purpose even after several years of successful operation. In addition, most companies provide off-the-job training programs at relevant stages for those who need or wish to attend such sessions.
Training and learning on the job sometimes relates to promotion. One company, which started from a relatively small size operation, has been able to promote young inexperienced workers even as high as managers of production departments within several years. This kind of promotional opportunity tied with learning experience on the job seems to stimulate the motivation of the employees. However, plants which start with large-scale production from the very beginning and have a relatively experienced workforce normally cannot provide as many promotion opportunities to all the workers. In those plants, while training is provided intensively and workers are deeply involved, there appears to be less concern with promotion.

Extraordinary Emphasis on Human Resources

The extraordinary emphasis placed by the Japanese plants in the U.S. on the selection and training of workers appears to be inevitable and imperative. The most obvious reason is that Japanese plants in the U.S. are carrying out a major technological transfer process. This requires that Japanese companies spend voluminous resources in educating and training American workers and middle managers to mold them to the Japanese system of production. However, the more substantial reason is the criticality of human resources in the Japanese production system discussed above. Since their entire production system depends so critically on human resource effectiveness, unlike the conventional production systems of American companies, Japanese companies need to be almost abnormally sensitive to personality, preparedness, attitude, and participation by workers. To put it strongly, the selection and training of workers are questions of survival for Japanese companies, for essentially technological reasons. Finally, the
perceived heterogeneity of the American workforce appears to intensify Japanese companies' education and training activity. The Japanese production system has operated successfully in Japan with a relatively homogeneous labor force in terms of preparedness and motivation. To attain a comparable result working with a heterogeneous workforce may oblige Japanese companies to devote even greater resources to training and education than they do in their home country.

(3) Work Organization and Its Functions

There are some notable features in the area of work organization which are found commonly among Japanese plants in the United States.

**Broad Job Class**

First is the job structure. All the companies which have started operation here in the U.S. emphasize a single broad job classification for production workers. While they do establish a few special skilled job classes as well, the overwhelming majority of workers are classified in the same single job class. In a unionized plant, the scheme of job classification and accompanying working conditions are prescribed clearly in the collective agreement.

There are at least two major reasons why Japanese companies have insisted on a single broad job class. One is somewhat cultural and the other is essentially technological. The cultural reason is that Japanese companies have been emphasizing consistently in the postwar period a classless corporate community, where every employee is treated presumably on an equal basis and no class-related status differentiation is tolerated. In sharp contrast to their
labor practices in the prewar period, Japanese corporation after the war abolished, due largely to union pressures for "democratization," intra-organizational status discrimination between managerial, supervisory and production employees in such aspects as the pay system, fringe benefits, uniforms, dining rooms and access to other corporate facilities. Japanese companies now regard this classless organization as a highly important factor in promoting a feeling of loyalty, belonging, togetherness, commitment, and other motivational aspects in employees. For this reason, Japanese companies did not want to accept conventional American practices of distinguishing formally between salary and wage earners, exempt and non-exempt employees, and different skill classes. In fact, all Japanese companies try to emphasize the uniformity or equality of most employees by calling them by the same title, such as "associates," "technicians," or "team members."

However, the more important and substantial reason is technological. One broad job class was proposed in order to make all the workers in this broad category prepared to accept whichever job assignments were needed to respond to and meet the technological needs of production management. In other words, the underlying intention is to take full advantage of versatility of job assignments that the broad job classification could provide. In fact, some American plants are also attempting to promote a shift to fewer job classifications for the same reason. This versatility and flexibility of workforce allocation to variable job structures is regarded as a key element in achieving the high productivity of Japanese work organizations.
Reward System

The reward system is closely related to the scheme of job classification. The single job classification basically means that the same single wage rate is given to all the workers in the same category. One non-unionized company applies this rule of remuneration, and the other non-unionized company provides a fairly elaborate scheme of pay increments up to a certain stage of worker maturity, and then reverts to the single wage rate for all full-fledged workers within the job class.

This pay scheme of single wage rate differs fundamentally from the widely prevalent wage system of Japanese auto companies in Japan. There, a worker's take-home pay consists of two or three major components: one based on the worker's personal traits such as education and length of service, and others on specific jobs. The system is designed so that individual workers receive different wage rates following this pay scheme, and enjoy regular wage increments as they accumulate length of service. Also their performance is sensitively reflected in the broad array of rewards, including not only monthly wages but also bonuses and promotions.

These facts appear to imply that Japanese companies, when they were planning to start operations in the United States, were obliged to follow the more-or-less prevalent labor practices in the American labor market. Perhaps, the most important of them is the practice of pay. The Japanese companies' stronghold was the single broad job class, and in return they had to adopt an accompanying single common wage rate, which is quite alien to conventional Japanese practice.
Team

All the Japanese companies in the U.S. emphasize the team concept. Each team has several to a dozen members who work closely together under team leaders. Several teams are bundled together into a group which is led by a group leader or coordinator, whose status is comparable to that of a foreman in a conventional American plant.

The concept of team is not unique to Japanese plants. In fact, the team concept has perhaps existed longer in the U.S. than in Japan. In the last decade, there have been several notable attempts in American auto plants to introduce operating teams into the workshop. In contrast, Japanese companies have never really referred to their work organizations in Japan specifically as "teams," although they constantly emphasized working together and helping within work groups. They began to use the term "team" explicitly after they started major operations in the U.S.

The Japanese concept of team seems to differ from the American use of the term in some respects. The American concept of team appears to connote an autonomous, self-managing work unit, while the Japanese team has much less of this kind of implication. Instead, the Japanese concept of team emphasizes togetherness, mutual help, and information sharing within the team, and this team concept sometimes is extended to include outside suppliers.

In fact, the emphasis of mutual help and support extends much beyond the realm of individual teams to include the entire plant and corporate organization. The work organization and its functions are designed in such a way that team members, team leaders, and group leaders are supposed to receive full support from relevant functionaries or sub-organizations of the plant. They receive assistance on production and other administrative matters not
only from immediate supervisors but also from managers and assistant managers of their respective departments, on personnel issues from personnel officers, on technical issues from line and staff engineers. Constant and intensive support from engineers to workers is particularly emphasized by Japanese managements. Team leaders play an integral, pivotal function in this process. The role of the first-line supervisor, which is normally assumed by a group leader or coordinator, differs somewhat from that of foreman in a conventional American plant. With the multiplicative support network around them, they have less prerogative over personnel matters than American foremen, while on the other hand they are involved more closely in the production operation with their team members.

Transfer

The transfer and rotation of workers is viewed by management as an important vehicle to facilitate both structural adjustment of the organization and on-the-job training of employees. Taking advantage of broad job classifications, as discussed earlier, Japanese companies can use transfer policies effectively. One non-union company has transferred workers rather extensively to meet changes in their production structure in the course of their rapid growth, but scheduled transfers for the purpose of career development have been limited only to some supervisory workers. Another non-union company has a well-organized system of job rotation for training purposes. However, rotation seems to have been confined so far within a relatively limited scope such as within a team. All companies have the system for voluntary transfer requests by workers. While flexible transfer and rotation systems are viewed as useful instruments both for the purposes of
enhancing organization flexibility and of multi-skilling of the workforce, Japanese plants in the U.S. so far do not seem to have taken full advantage of this approach.

(4) Industrial Relations

Patterns of industrial relations differ widely among different Japanese plants in the United States. The variance is particularly impressive in the question of unionization. One joint venture company has been fully unionized since its initiation. Another joint venture company, which started construction of their plant recently, seems to anticipate unionization although their official attitude toward this question is neutral. One Japanese company, which is now almost completing construction of their plant in Detroit, appears to anticipate that their plant will be unionized. On the other hand, two other Japanese companies which have been operating in the U.S. for some years have stayed away from unions.

Unionization

The joint venture company, which is fully unionized, started its operation by recruiting workers largely from the pool of laid-off UAW members from the old shutdown plant it was taking over. Soon after the initiation of the operation, an election was called to recognize the union. Indeed, the ex-union officers of the old local worked closely together with the management from the formative stage of the new company, particularly in the process of recruiting workers. The Japanese mother company, following this experience of the unionized joint venture, has recently launched construction of a major plant in a Southern rural community, and maintains an official position of
neutrality toward unionization. The other joint venture company, which has started construction of its plant in Detroit, has expressed its clear interest in fostering cooperative and productive industrial relations with UAW. The regional office of UAW is providing advice and assistance in their recruitment and training activities. In contrast, one company, which has been operating successfully for the past several years, has remained ununionized in spite of recent UAW organizing drives. The other non-unionized company has chosen a location in a rural community in a Southern right-to-work state, where anti-union sentiment allegedly prevails.

**Corporate Attitude Toward Unions**

Varied as they are, attitudes of Japanese companies toward unionization is hardly generalizable. Their official and formal attitude is unquestionably neutral. Whether their plants will be unionized, however, seems to depend on the mixture of several factors, such as their relationship with the partner American corporations, the philosophy or attitude of those local managers who have been delegated decision making authority, the location of the plant, the degree of unionization of the local labor market, the attitude of the community toward unions, the values and interest of incumbent workers, and the actual or potential relationship of the companies with regional and national union leaders.

In the Japanese production system, as discussed earlier, unions are supposed to, and actually do, play an integral role as a cooperative partner in production operations, if not in the distributive aspect of industrial relations. Apparently, the minimum common interest of Japanese companies is to build cooperative and productive industrial relations with unions by which
they can recoup the benefits of the Japanese production system. Whether unionization will become a common mode or not in Japanese plants in the U.S. in the long run would seem to depend critically on how much both management and union leaders will learn from and understand the meaning of their recent and future experiences.

Communication and Information Sharing

An outstanding feature of industrial relations, which all the Japanese managements equally stress, regardless of whether or not their plants are unionized, is communication and information sharing. In a unionized plant, this goal is pursued officially by joint consultations between management and union representatives at various organizational levels. However, more important are unofficial or informal consultations at the workshops. Problem solving is emphasized strongly through informal communications, consultations, and discussions at workshops. Grievances are rarely filed, because both workers and supervisors try to solve problems before they are formalized as grievances, unlike the conventional grievance handling procedure in American plants in which problems are first filed as grievances in order to register them formally. While a collective bargaining agreement contains a formal procedure for the joint consultation process, it is seldom resorted to, for the same reason.

Communications and information sharing through formal and informal means are also strongly stressed in non-unionized plants. Various forms of meetings and small group activities are utilized as relatively formalized devices of communication. However, here also, informal discussions and consultations at the workshop for the purpose of problem solving seem to play a more
substantial role in day-to-day operations. What is emphasized commonly and strongly in all the Japanese plants is "listening" by supervisors to opinions, complaints, suggestions or any other forms of appeals by workers in the shop. The degree to which a relatively formalized form of small group activities such QC circles prevails varies among plants, and it largely remains at the early stage of development.

Attitudes of U.S. workers appears to be quite receptive, at this stage, to Japanese management policies for human resource management and industrial relations, and in some instances they are noticeably enthusiastic about them.

IV. CONCLUDING REMARKS

In lieu of conclusion, let us probe and discuss further some of the implications derived from our foregoing observations. We select the following three points: nature of technology transfer, long-run issues and the prospects for the Japanese auto industry in the U.S., and lessons for the U.S. auto industry.

(1) The nature of technological transfer

Our review of the experiences of Japanese plants in the U.S. suggests some interesting tendencies associated with the nature of technological transfer. Needless to say, we mean by technological transfer a broad and more meaningful concept of technology (which includes the role of human resources) than the conventional usage of the term.

To express in brief, the transfer of hardware technology involves transplanting it completely as it is, while, in the sphere of humanware technology, much more diversification and adaptation to local conditions are necessary.
The fact that direct and exact transfer can be made in the area of hardware technology, however, does not mean much in terms of substantial achievement of the transfer because machines will not operate by themselves. At this stage, it is hard to conclude whether the self-generating innovative nature of Japanese humanware technology has been successfully transplanted. If this property of humanware is not successfully transplanted, the merit of the Japanese production system will not be recouped in the long run. It is interesting to note the fact here that labor unions have continuously played an integral role in supporting effective operation of this system in Japan. What lessons both Japanese management and American unions can and will learn in the sphere of industrial relations will have significant implications for the future development of this transfer.

(2) Long-run issues and prospects

Currently, some of the Japanese plants operating in the United States may be benefiting from what might be called "start-up effect," whereby American workers as well as managers are excited about their new experiments. Moreover, in some instances, workers are satisfied just by the employment opportunities provided by the Japanese plants. When this excitement evaporates as the newness and short-run start-up effect phases out, more substantial problems associated with the humanware, particularly in the aspects of human resource management and industrial relations, may emerge. For example, the Japanese approach to wage administration and promotion has not yet been implemented in the American context. Will this pose problems for the successful transfer of humanware?
Still more fundamentally, there are several basic questions which Japanese corporations must face in the long-run. For instance, how will they fare competitively with American auto makers over time? This will affect not only their future growth and profits but also employment opportunities for workers and business opportunities for parts suppliers. How will they develop a model or models which will work in the long run in social, economic and cultural contexts of American industrial society? The successful development of the Japanese auto industry in Japan has been promoted and supported by a well-integrated complex of hardware and production management technology, human resource management, industrial relations, and inter-firm organizational arrangement as well as other factors. How successfully can Japanese investors transplant critical elements of such a highly integrated production system and still acquire the necessary understanding and participation of American workers, managers, suppliers and dealers? How will they deal with American unions in the long run? These represent only some of the essential questions that Japanese investors will have to face and solve if they really wish to obtain acceptance in American industrial society in the long run.

(3) Lessons for American industry

With the growing presence in the United States of Japanese companies using the Japanese methods of production in large-scale operations and employing American workers and managers, the opportunities for learning lessons and transferring their experiences have now become real and plentiful.

The interest of American industry in Japanese systems of management and production seems to be concentrated more in the area of social organization than anything else. In fact, a number of innovative attempts pursued in
American plants, inspired partly by Japanese experience, emphasize team work, worker's responsibility and participation, and labor-management cooperation. Japanese managers do emphasize these practices and values as well. However, it is important to note that Japanese management stresses the human aspect not because they are Confucianists or humanists, but rather because the survival of their production system depends critically upon the effectiveness of human resources for technological reasons. It is for this technological reason that Japanese management spends enormous resources in its effort to educate and train human resources. It is for this same reason that Japanese managements commit themselves strongly to the workers rather than the other way around, because the human resources fostered within the company are an indispensable asset. This critical interdependence between production technology and human resources naturally create profound implications for their industrial relations as well. Whether or not American management, unions and workers will learn these lessons (and if so, what kind of lessons) from Japanese humanware technology could affect their future course of development significantly.
Notes


2. The best book to my knowledge which provides a systematic and detailed explanation of the leading model of Japanese production system, namely the Toyota production system, is: Monden, Yasuhiro, Toyota Production System: Practical Approach to Production Management, Atlanta: Industrial Engineering and Management Press, 1983. There are a number of documents which explain important properties of production systems of Japanese automobile companies including Mr. Ohno's own writing. An interesting and systematic account of the production system of another company may be found in Nihon Noritsu Kyokai, Mazda no Genba Kakushin (Mazda's Innovation at Workshop), Tokyo: Nihon Noritsu Kyokai, 1984. This section is the author's interpretation of the key factors and their relationships which support the effective operation of the production systems of Japanese auto companies.


7. Our review of experiences of Japanese automobile companies depends chiefly on the series of our interviews with both Japanese and American managers and employees as well as union officials of investment projects, including Honda, Nissan, NUMMI, Mazda, and Mitsubishi-Chrysler.

8. The fact that this new plant, NUMMI, uses only one production line in contrast to the two lines used by the old plant, GM-Fremont, makes it look extremely space-efficient to outside observers. Perhaps, a more significant aspect of efficiency is the difference in labor productivity where NUMMI's capacity is 250,000 cars a year with about 2,000 employees, in contrast to 325,000 cars a year for the old GM-Fremont with about 6,000 employees. See: Krafick, John, "Learning from NUMMI," Internal Working Paper, International Motor Vehicle Program, MIT, 1986.