Major Findings from Plant Tours to U.S. Factories and Relevant Issues for Business Schools

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1. Introduction

I was fortunately given a one-year sabbatical to stay at Harvard Business School in Boston until June 1992 as a visiting scholar. After spending the first half of my stay to achieve the main objective of learning about the case method, the second half was spent visiting factories and attending seminars in addition to regular class attendance. This paper first describes what I observed during these plant tours, mainly their problems. Then based on my own interpretation of the cause and effect relationship between these problems and business school education systems, this paper proceeds to discuss the issues concerning education and research in the area of production at business schools.

Numerous papers comparing the U.S. and Japan have been released, and the knowledge I gained from just twelve months stay may well be covered by these previous papers. General indicators of productivity have also been analyzed by a number of specialists. Nevertheless, I have decided to write this paper because the problems in U.S. factories were far more than striking than I had expected before, and also because my findings gave me a deep impression that business school education does not seem to be having a positive impact on operations at U.S. factories. Of course, there are many aspects of American society and industry which are different from the Japanese system, including racial composition, industrial relations and wage structure. However, considering my own position as a faculty member at a business school and the recent changes that have been occurring in Japanese society, the various problems that I observed in the operations of U.S. factories and the impact on them from business school education cannot be ignored as someone else's problem.

Since the theme of this paper is indeed wide-ranging, there are several premises that I have set. First, the problems faced by U.S. factories diversely include those in research and development, production technology, cost management, organizational structure, etc., but in view of my expertise and from what I could observe at the factories, I should like to focus mainly on problems at shop floor operations. Most of my factory visits were general tours and my opportunities to ask in detail about factory history and missions were limited, so this paper includes a lot of personal interpretations. Behind the observable factory operations exist behavioral norms that

are deeply rooted in history and culture, but since my knowledge about such cultural issues is limited, I shall discuss them in this paper to the minimum extent necessary. I shall make some critical comments about the curriculum at Harvard Business School, but while I appreciate the enormous contribution Harvard has made, I should like you to read these comments as my straightforward opinion limited to the area of production.

2. Impression from My Factory Tours

2.1 List of Toured Factories

The 26 factories run by 21 companies (including one in the service industry and one national research institute) that I visited during my stay in the U.S. are listed according to industry in Table 1. Of these, five factories are run by four Japanese subsidiaries (local corporations wholly owned by Japanese companies); two factories run by Honda (HAM) and one by Toyota (TMM), a precision instruments company Kao Infosystems, and a tools and machinery company Mazak. All other factories are of American companies. The factories visited towards the end of May were with a Japanese business mission group in Chicago, Cincinnati and other mid western regions. Most of the other factories were around the Boston area which were visited by myself with the cooperation of Harvard faculty in arrangement. Table 2 shows a breakdown of the factories by size. As can be seen, more than half are small or medium-sized, most of which are located around Boston.

2.2 Impressions at Visited Factories

After returning to Japan, the first thing I was asked by everyone was which factories were interesting? Apart from feeling that I had indispensable experiences, the only companies I can honestly list to this question are, unfortunately, Japanese subsidiaries. Of course, it is quite dangerous to generalize from visit to only 21 companies. In addition, many of the visited factories are assembly plants, and the industry mix is not evenly organized. But if I dare to make a general assessment, I would have to say that the four Japanese subsidiaries are the only companies with high level operations at their factories.

In comparing the level of production activity based on general plant tours, the industry types and company sizes should be balanced out, and the history and operational policies of each factory should also be analyzed as much as possible. But since I was not able to carry out such a systematic analysis in the limited time available, I have decided to assess the level of factory operations from the two viewpoints; whether the flow of products can be easily observable, and whether factory workers are vitalized and willing to make improvements.

The first point makes a direct evaluation of the processes involved in converting raw materials into finished products. The speed of these processes vary depending upon product specifications and process technology, but generally, if the overall layout is messy and non-regular processes such as rework and fixing are required, the production flow is interrupted and therefore becomes difficult to follow. Of course, the product flow of a flow-shop process is easier to observe than that of a job-shop process, but even with the flow-shop, the product flow becomes difficult to follow if there are a lot of line-stops, while for job-shop production, a flow can be created if the products are completed cyclically based on regular pitch time.

The second viewpoint, which looks at the shop flow workers, was set based on the belief that there is a considerable correlation between the vitality or morale of them and the productivity and product quality of the factory.

As a result, what I felt at almost all of the visited factories was that few had a good record both in product flow and in workers' morale. First, as for the product flow, there was a considerable amount of intermediate stocks and numerous shelves to hold them, which interrupts clear vision and smooth product flow at shop floors. What stood out in particular was that many factories had stock-rooms where raw materials were stored, so that keeping track of the inflow and outflow of these materials and the associated paperwork required enormous man-hours. I was quite surprised to see that a computer company had a stock-room actually as big as the factory production space, and that in another faculty shelves to store supplied materials rose about 20 meters to the ceiling. A precision instrument company had a huge three-story building which was solely used to hold supplied materials.

Of course, in the vast area of the United States, there might not be a strong necessity to cut down the space as in the case of Japan, but I do not believe that the

current amount of material is at a desirable level in terms of the amount of work needed to manage it and also the interruption in product flow that can result. In addition, these days an increasing number of companies are introducing the JIT (Just-In-Time) system, but because of a curious mix of the daily-based JIT system with the monthly MRP (material requirements planning) system, any delay in production schedule results in an increase in the raw material inventory at the stock-room without appropriate feedback in procurement schedule in the MRP system. This tendency was particularly obvious at several factories.

Many small factories, especially those around the Boston area, were just like normal office buildings from the outside, while inside, walls and doors divided the actual manufacturing area into a number of small rooms. This characteristic not only interrupts the smooth product flow, but also causes a great deal of inconvenience in materials handling. It also inhibits the free verbal communication among different sections.

As for the workers, generally speaking, they did not seem to have a great enthusiasm for improving their work methods, simply repeating their tasks. I saw workers at several factories smoking or listening to the radio while they were working. At one company, workers had both hands occupied with food and drink, and outside the painting booth entrance where flames of any kind were prohibited, cigarette butts were thrown away. It seems quite difficult to work efficiently with one hand holding a cigarette or food and a radio blaring.

Looking at the body motions of the workers, I found that the concept of "motion mind" was not widely spread among them. Disordered desk layout at several assembly plants is an illustration of this trend. I also noticed the slow pace of work at a couple of assembly lines. There were few factories where tools and layout were designed to enable workers to use both hands effectively. The factories well ahead of the others in this aspect were the four Japanese subsidiaries and another single U.S. factory.

In addition to these problems, I felt that the U.S. factories were not as ordered and tidy as the Japanese subsidiaries. This can be put as the lack of "5S" principles. For example, at one factory, many parts dropped from the parts feeder were left on the floor, and metal shavings were scattered all over from the lathe machine and large

amount of lathe oil had spilt onto the floor. Even a two-month-old processing plant looked almost ten years old because of the lack of cleanliness.

Behind this tendency is perhaps the often mentioned Japanese love of cleanliness, but the gap between the Japanese subsidiaries and the U.S. factories was more evident than I had imagined. I also felt at some factories that consideration to safety was not sufficient in that, for example, raw materials piled high on pallets leaned toward passageways or that forklifts were running around at high speed even next to passageways where visitors were walking.

3. Factors Causing These Weaknesses in Factory Operations

As stated in the previous section, many of the factors which cause problems in factory operations and which make those problems difficult to solve are rooted in the behavioral norms of the people involved. I shall investigate some of these factors, focusing mainly on behavioral styles at the corporate level, where these factors appear in a concrete form.

3.1 Separation of Management and the Work Force

Compared to the factory floor which is not very clean, offices in the U.S. companies are much more neatly organized than those in Japanese companies. In general, offices for management (managers or directors and above) are private rooms divided by partitions or walls, floors are carpeted, with his or her own computer terminal and secretary to manage schedules. Many members of management operate on an appointment basis, and the atmosphere is such that oil-stained shop floor workers do not feel comfortable to drop in these offices even if there occurs some problem on the factory floor. This was surprising for me, since it is natural to me that managers and directors in the production divisions have their desks close to the production line, although some American companies are recently changing their attitude. Even though management and the factory workers were working in the same building, it was as though they were working for two different companies.

It is said that American companies generally have more rank levels than Japanese companies, and an MBA degree is an important factor in promotions. It

seems to me that the rank composition in American companies is explicitly colored by academic background, more than the case of Japanese companies in general. At many companies, I felt that the management staff in their suits and ties and the general workers in their oily overalls were detached from each other in the communication aspect. I believe that this sense of detachment is dampening the management staff's interest in the production area and leading them to hold back on their efforts to solve the problems that occur at shop floors.

3.2 Vitality of the Factories

Normally when touring factories in Japan, I have a strong sense of anticipation, possibly because we are often required to change clothes for safety or cleanliness, and at the same time, there is often a sense of satisfaction when I see the shop floor workers eagerly working together with white-collar workers. However, on my series of factory tours in the U.S., the sense of anticipation or satisfaction came to me only during my visits to the four Japanese subsidiaries and a few U.S. factories.

One reason I did not feel the same way at the other factories was that they seemed to lack in vitality. It has been pointed out in many articles that since the United States is a society which attaches great importance to actions based on contracts, factory workers carry out only the work that has been assigned to them. And almost nowhere did I feel that the workers themselves were making an attempt to improve the work method. This might be a superficial observation from the outside, however, factors contributing to this general lack of enthusiasm are the primary cause of the various operational problems at the shop floor and also a big hurdle to resolving these problems.

Of course some U.S. factories are developing fine tools and eagerly making improvements that even include their suppliers. But what stands out about these efforts are that in almost all cases management takes the initiative in the form of top-down rather than bottom-up. Of course, improvements initiated from the bottom-up are not necessarily better than the top-down; essentially, shop floor workers and management must work together to realize improvements. There is a great deal of difference between a situation in which factory workers simply carry out work assigned to them, and a situation in which workers eagerly attempt to devise

ways of making their work quicker and easier. If the workers take the initiative in improvements, it will result in a synergy effect to create greater vitality in the factory.

3.3 Effects of the Excessive Division of Labor

It is generally said that in the U.S. job descriptions more clearly define the scope of each one's work than in Japan. But in many cases, this hampers a factory's efforts to identify and solve operational problems.

I shall give an example of this. At the factory of a precision instruments manufacturer, product flow was not clearly observable at all, because the final assembly line often stopped due to a need for adjustment works or reworks. When I was at the factory, the assembly line stopped and a quality manager came and stood next to the process which had caused the problem. His role was to collect data on quality-related troubles, and since the cause of the stoppage seemed not quality-related but a work error, he was just standing next to the problem process without offering any advice whatsoever. The time series data that he had collected on quality-related problems were displayed on the wall, and although the monthly trends were visually summarized in a graph, the columns for causes and measures taken were left blank. When asked about this, he said that another person should make a list of the causes, and yet another person is responsible for filling in the column of measures. Since quality problems at factories are normally caused by a complex mixture of factors, this kind of approach seems to make it impossible to take dynamic actions to improve operations.

Similar situation to such a division of labor was also observed in the indirect sections. Management level people higher than section chief, sometimes even new employees, are working in separated offices which, at least to me, do not encourage verbal communication. In this respect, in the Japanese subsidiary companies, most of the indirect sections had adopted the open-space office layout without any partitions between desks. At Honda, about 100 members of the engineering design section were working together in a big open room. I do not intend to assert that the open-space layout is superior to the conventional U.S. offices, but, as can be seen in Japanese QC circle activities, the fact that it can bring about a change in workers'

consciousness from a division of labor to cooperative work is one strong point in its favor in terms of bringing vitality back to the factories.

3.4 Overall Company Solidarity

It is broadly recognized that in the U.S. people tend to change jobs more frequently than in Japan, and that Americans have a stronger sense of individualism than Japanese. When I mentioned the circle activities carried out in Japanese companies, I was always asked about the pay arrangements in the case where there is a considerable disparity in the abilities of workers in the same group. This kind of attitude would make it difficult to enhance group activities for the betterment of operations and to foster the sense of solidarity.

In Japan, most companies or factories have veteran workers or staff who have worked their way up the ladder over many years, and I often hear that these veterans can judge whether a piece of machinery is running properly and if not what is wrong with it just by listening to the sound it makes. It is no exaggeration to say that the company or work-place atmosphere revolves around these long-serving veterans, and, under Japan's long-term employment practice, the sharing of this atmosphere by every employee facilitates group-based problem solving and contributes significantly to the success of Japanese circle activities. Although team activity is recently stressed on many occasions in the U.S., I feel that the lack of this kind of atmosphere in U.S. companies is linked to the lack of workers' desire or willingness to get together under the flag of improvement in their factory operations.

3.5 Reliance on Outside Consultants

Generally speaking, the consulting business is much more active in the U.S. than in Japan, and companies in the U.S. tend to use external human resources much more than their Japanese counterparts. In contrast, Japanese companies place greater importance on in-house training, and attempt to solve whatever problems they have with their own staff and resources.

I did not find this tendency at every American factory or company, but it is very prevalent, for example, when I received a slide presentation explaining the improvement progress of productivity and quality at one manufacturer, all major

ideas and approaches were quoted from outside consultants. One Japanese subsidiary received a special subsidy for personnel training from the state in which it was located because its opening the factory had contributed to local employment. The American personnel manager there wanted to use the subsidy to commission a university professor to devise a personnel training program, to which the Japanese staff argued that personnel training programs should be developed by company staff themselves, claiming that the company should not rely on outsiders too much.

I do not mean that companies should not seek helps from consultants at all, but I do believe that it is more effective for a company to strive for improvement using its own personnel resources, from the viewpoint of both building up know-how that will benefit in later development, and enhancing vitality within the company by raising the skill level of employees. And from the viewpoint of factory vitality, it is quite important to devise and implement even small improvements themselves rather than to adopt ideas indicated by consultants.

3.6 Dependence on Computers

It is clear even with a short stay that computer use is much more widespread among American companies than Japanese companies. Although it is an effective tool, it can hinder in some cases the human adjustment function. For example, at one factory, a staff of production management section boasted that since the parts manufacturers are all connected by an on-line network, there is no need whatsoever to make personal contact by telephone or fax to convey information about production schedule progress and parts design changes. This information will be automatically downloaded to parts makers from the host computer, he said. The actual situation, however, was quite different. The factory was overflowing with supplied parts, since there was a poor feedback on progress in production schedule to the parts manufacturers. And, as I mentioned earlier, there are many factories that rely on the computer-based MRP system for ordering parts while also applying the JIT system, thus resulting in the flood of parts inventory when production schedule is delayed against the plan. I believe that an appropriate balance of computer and manual work, using people for work which they better fit and which requires judgement, would be an effective way of raising vitality and improving efficiency in the majority of

companies.

4. Effect of Business School Education on Manufacturing Companies

Thus far this paper has discussed mainly problems of the various factories that I had the opportunity to visit during my twelve-month stay in the United States. Among a number of findings, what stood out most and was different most from my expectation before my visits was the separation of management from the factory floor, which was described in section 3.1. In particular, the American practice of placing someone who has graduated from a business school with an MBA degree into a management position without any first-hand experience at the shop floor is, I believe, a major factor contributing to the further separation of management from the workers on the factory floor. I shall now discuss in more detail the effect that business schools have on manufacturing companies.

4.1 Positive Effects

Considering the contribution that business schools have made to the development of the United States, a very long list of their positive effects can be presented, but here I shall limit the list to just three items, focusing on the impressions I gained whilst studying at Harvard Business School.

The first is the training of people with wide vision and knowledge. At business schools, subjects on the production field (called POM : Production and Operations Management) not only cover general production management issues, but also look at the characteristics of industries and market related to managerial decisions, so students will learn to examine problems within manufacturing companies not just at the production management level, but also from the perspective of overall company management as well as industrial trends. This fact indicates that the business schools are able to train students to examine various problems that can affect production from the upstream stages of product and process design through to distribution and marketing with a view of finding the best alternative for the company.

The second is the training of generalists on the basis of knowledge. It is often said that the purpose of business school education is to train generalists as opposed to

specialists. This does not mean that the business schools aim to train people to deal with any kind of work only through an accumulation of diverse experiences, but to nurture their capabilities which enable them to understand many fields while ensuring a proper balance between theory and practice. The acquisition of management skills is a good example of this. In Japan most companies have a job rotation system in which workers are regularly transferred among different sections, mostly in similar assignments but sometimes not, and as a result companies produce a number of experience-based generalists whose experience covers a wide range of issues and tasks. The important role of business school is to back up such an experience with appropriate theory and knowledge.

The third is that business schools train generalists over a relatively short period. For example, in Japan, every company has veteran people who can find out and solve production problems such as a machine trouble based on their intuition derived from their long-term experience in the company. However, in most cases, these people are middle-aged or senior employees who have taken twenty years or more to gain this sort of general knowledge. Considering the limited time that we have in contributing to the company, this period seems to be too long. In contrast, business schools can compress this period into two years. On this point, the impact of business schools is not great in Japan, where an MBA degree does not significantly alter one's position and salary. But in the United States, their impact is much greater, for business school students often go straight into management positions with high salary upon graduation.

4.2 Negative Effects

It may be relevant to the American social system, but from Japanese perspective, there are many negative effects arising from the fact that business school graduates go directly into management positions at their late 20s. In this respect, the positive effect of a condensed career development period mentioned earlier is a double-edged weapon. In manufacturing companies, I feel that there is a considerable risk in walking into a management position without having a chance to first work at shop floors.

For instance, in many cases shop floor workers know vital points in processes

which are not described or are difficult to describe in work standards sheets, such as checkpoints for inspection or assembly know-how. And behind the schedule or quality problems lie many factors which are difficult to clarify by computer, regardless of how well the information system is developed. I believe that many of the problems that occur in factories do not necessarily appear in documents or computer printouts, rather factory workers hold the most accurate and current information about these problems. So if these graduates are placed in management or supervisory positions without any experience of work on the factory floor, all they can do is to check and follow up the managerial figures, rather than take initiative role in resolving operational problems and realize day-to-day improvement programs.

The fact that business school graduates join company management without working close to the shop floor will add to the distance between management and the factory floor. Workers on the factory floor probably will not feel any particular camaraderie with people in management who have never worked side-by-side with them, while the MBA management may find it difficult to leave their clean offices to go all the way down to the factory floor which is not as orderly as it could be. This tendency has already been pointed out as one of the negative aspects of MBA training. It is not desirable for a company that these MBA graduates make decisions based on computer printouts and other written data rather than their own observations. Thus, a management team that is separated from the factory floor will have an undesirable effect on running a company. For example, the motivation towards improvement will decline, the sense of cooperation between management and workers will be loose, and this could, in turn, be detrimental to the atmosphere of the company. Even if the company sought to initiate improvements, it will be difficult to realize them by bottom-up, and since management people are not familiar with the situation at the shop floors, they cannot initiate improvements. Thus, the situation is in favor for outside consultants. As is often said, companies stress innovation, while daily improvements are left behind. It is well known that the more a company neglects to make step-by-step improvements, the greater the investment in innovation becomes and the greater its risk of failure will be.

4.3 Production Management Curriculum at Harvard

As for the negative impact of business schools mentioned in the previous section, some may argue that even without practical experience at factories, students can compensate for this deficiency with similar experiences within the business school, particularly with the case method. During my stay in the U.S., I was not able to make an intensive study on the curricula of all business schools, so I shall discuss the POM curriculum at Harvard Business School, which is where I studied and which is widely known as one of the top business schools in the United States.

The POM curriculum at Harvard comprises the compulsory Technology and Operations Management (TOM) for the first year students, and a number of elective courses for the second year students, which are listed in Table 3. Each year more than 20% of the case materials in all courses are revised, and the TOM course has been reviewed entirely including the addition of the C section from 1990 to incorporate problems at pre-production stage. In this sense, my stay in 1991 - 92 may have been during the process of revision. Although the general evaluation from the students was outstanding, I felt some concerns based on my personal perspective as follows.

First, the whole curriculum seems to place too much emphasis on strategic issues, while the basic tools and concepts regarding production management are dealt with only briefly. In particular, work measurement, work method improvement, process design, and equipment design and control (Total Productive Maintenance ; TPM included) are not touched upon, while production planning, scheduling and quality control are just briefly discussed. Since all sessions are discussions based on case studies, fundamentally important methods and concepts of production management are difficult to be covered. As a result, I felt that the students' ability to identify real problems at actual factories and devise improvements ideas was not directly fostered. In Table 3, Section D is entitled Quality and Performance Improvement, but actually it focuses more on dynamic innovation and organizational structure than on daily improvements at the shop floor level.

Second, the case study material sometimes drifts away from the actual problems at the factory, and leans towards organizational or human behavioral aspects. This is perhaps unavoidable considering the school's mission to develop students'

management capabilities to lead a company, but as I mentioned before, within the shop floor there is often living and important information. In order to educate the importance of the shop floor, case study materials should be carefully prepared with details when necessary. This requires the case writer to have sufficient ability to accurately understand things happening at the factory, and to spare the time to search for information that cannot be obtained through cursory interviews or from summarized documents.

Third, looking back after attending all sessions of the TOM course, I notice that we had no opportunity to tour a factory or touch an actual product, except for a single occasion of a circulation of printed circuit boards. Of course, considering the size that there are close to 900 students in each year and about 100 students per class, it will be a big journey to visit a factory at the same time. Instead, video tapes are extensively used and invited CEOs give lectures in the school. However, it is, I believe, essential that students be given more opportunities to touch the actual products and observe the actual manufacturing processes, in order to better understand the reality of manufacturing processes.

As for the second year elective courses, I cannot tell a great deal since I attended only a few courses, but as far as I understand from reading course outlines, technology management and formulation and implementation of strategies are stressed. In contrast, I feel daily activities at factories are made light of compared with strategic aspects. If this is a common phenomenon for POM curriculum at business schools, then it would be extremely difficult for students to develop an interest in what actually happens on the factory floor, discouraging them from carrying out an analysis to identify real causes and desirable solutions at the operational level. And if they jump into management positions at a manufacturing company, they will have difficulty in discovering effective measures to create a work-place where product flow is smooth and the vitality of the workers is beyond the desirable level.

5. Production-related Issues at Business Schools

The central theme of what I have written so far is that factories in the United

States have many problems, more than I originally imaged, and that business schools might have a negative impact on these problems. In this last chapter, I shall discuss both educational and research issues on which business schools should concentrate, in order to resolve operational problems observed in U.S. factories, and to prevent similar problems from occurring in Japanese companies.

5.1 Educational Issues

Although some business schools adopt the lecture method, given my twelve month s study at Harvard and my present status as a faculty member at Keio Business School, I shall limit my discussion to teaching by the case method.

The first point to be raised is the quality of the case material. To instil in students an interest in the shop floor and to implement education which is not divorced from what actually happens there, teaching materials must describe appropriately the status-quo and issues in factory operations. In doing so, however, there exists the dilemma that if case materials describe the manufacturing processes in detail, they will have to include technical descriptions to a certain degree, which is likely to make the teaching material more difficult for the students to understand. Moreover, in order to extract various problems at the case factory which cannot be picked up from summarized documents, the author must have vision and an analytical capability, as well as the willingness to devote the necessary man-hours to the case development. In this context, adopting research assistants in the procedure should be handled very carefully. Supervisors are requested to have sufficient guiding skills in addition to their expertise.

The second point is the balance between lectures and the case method. At Harvard all classes in the POM area are based on the case method. But in my opinion, there are limits within the case method in teaching fundamental tools and principles in production management or modelling methods to simplify real and complex problems, since the direction of the discussion largely depends on expressed opinions in a class. On the other hand, it is also true that a certain amount of repetition is necessary to raise the teaching effect of the case method. Therefore, the balance between lectures, exercises, and case method within a limited number of sessions requires serious consideration.

The next point is the breadth and depth of contents to be taught in the area of production. For example, in improving a work method, a greater number of effective alternatives can be listed if students have a good understanding of the principles of motion economy, various improvement principles, and other relevant check-lists, but acquiring such knowledge takes time, and some business schools seem to regard that these aspects belong to the engineering department but not to themselves.

The same thing can be said about quality control and equipment management. A common issue within the MBA curriculum is to what extent these methodologies should be covered and how deeply individual methods should be illustrated. Moreover, to achieve the goal that students do not simply memorize these methodologies but are able to appropriately apply them, the abilities of the instructors will indeed be put to the test. The answer to this problem is also closely connected with the definition of generalists, which is the general aim of the MBA education.

In the United States, there has been a criticism against the traditional business school education, similar to what I have mentioned in this paper, along with the decline of manufacturing competitiveness. In response to this, many business schools, including Harvard, are reviewing and revising their teaching materials, while there is another movement to introduce a new system, such as with the Leaders Program at MIT (Massachusetts Institute of Technology). With the cooperation of industry and the engineering department, MIT is aiming to train MBA students so that they can step into factories themselves and take the initiative to detect and solve problems at shop floors, by setting the requirement that one-third of the units needed for graduation must be from courses in the engineering department, and also by assigning a field study at factories for one third of the program term. This program started only several years ago, and the number of students is restricted to fifty per year, but as a new method of MBA education, I heard that it is generating a big interest throughout the country. Such an incorporation of a field study and introduction of engineering taste might be a critical solution in developing an effective POM curriculum at business schools.

5.2 Research Issues

Education in the production area at business schools must take into account its

relationship with various functional fields such as marketing, finance, accounting and personnel planning. Therefore, research at business schools covers an extremely wide range, but here I shall discuss things related to the major concerns I felt during my stay in the United States.

Business schools generally put stress on topics at the strategic level in their education programs. But in manufacturing companies, unless a factory has a fundamental capability such as low defective rate, high yield and short through put time, any strategy, regardless of how superior it may be, cannot work effectively. Of course, the policy level decisions, such as factory location and strategic alliance are also important. However, I believe that research into problems related to the capability (or strength) of the factory, which is a sort of fundamentals in manufacturing, has not been carried out sufficiently.

Analysis and improvement at the factory floor has been dealt with mainly in the field of industrial engineering (IE). There are, however, two major problems: The method of analysis is complex and difficult to master; The quality of alternative ideas is generally not correspondent to the amount of effort required in the analysis. For example, if there is a problem with workers' motions, numerous analytical symbols must be learned to carry out a proper analysis. The guide to tie the result of analysis with problem detection and improvement ideas is not sufficient. Therefore, people at the factory (factory workers and staff people) naturally feel difficulty in their method improvement effort. In reality, these people often rely on brainstorming or on the ideas of a few people with a good sense to improve factory operations. Developing analytical methods which can be readily used by staff and factory workers, such as the use of cartoons or illustrations instead of difficult symbols, and which can easily lead to problem detection or improvement ideas, is one of the basic issues in the production field.

Just as important as the research mentioned above that focuses on the factory is to expand the scope of research in response to the expanding spheres of production activities. For example, corresponding to recent trends in consumers needs, many industries try to reduce the lead time from design to mass production, or to establish a prompt and inexpensive supply structure. These activities are generally referred to as concurrent engineering or quick response program. But as far as I understand, each

company is using its own know-how to implement these activities, and development of general framework seems to be still insufficient.

In the POM area at Harvard, several case studies on these activities have been prepared, and field studies of each company's actions are intensively carried out, however purely theoretical analysis of these activities seems to me not yet adequate. Since, fortunately, business schools are not confined by a disciplinary framework, faculty there have a mission of fulfilling a pioneering role in response to such an expansion of the production activity sphere. And at the same time, the business schools themselves will become activated through these theoretical and interdisciplinary research which presents new ideas or frameworks, not by simply carrying out surveys which follow up already existing cases or facts.

What I want to point out at the end in relation to what I have described so far is the key strength of the Japanese manufacturing firms, particularly its shop floor operations, and their future issues. From my visit to U.S. factories, I have an impression that Japanese factories are better in their operations in terms of product flow and vitalization of factory workers. But a systematic explanation is difficult except for fragmentary listing of relevant factors.

During my stay in the United States, I found Japanese cars and electrical appliances everywhere, but I felt that few Americans had a reasonable understanding of why and in what aspects Japanese factories are superior. I am also concerned that there are many companies and consultants that stubbornly believe the secret in Japanese manufacturers lies in circle activities or the JIT system, and try to copy these practices without sufficient investigations. At the same time, it was unfortunate that various corporate endeavors by Japanese manufacturers were not properly recognized, partially because of the lack of information from the Japanese side. As globalization continues to gain momentum, I believe that one of the most vital tasks for Japanese business schools is to properly summarize the strength and its causes of Japanese manufacturers, and to make every effort to properly explain to overseas people the various factors contributing to this strength.

6. Conclusion

This paper has discussed the various problems and their possible causes that I felt at U.S. factories, based on my plant tours in the U.S. and studies at Harvard Business School. The motive underlying the paper is my concern that traditional business school education might have a negative impact on manufacturing companies. The various problems facing the American manufacturing industry have already been raised by many scholars, so I have intentionally based this report on my own experiences and ideas, although the visited factories might not be properly balanced in terms of size and industry.

When I look around at the environment in Japan after my stay in the United States, I notice many changes taking place, such as the move towards shorter working hours, the growing number of foreign workers, the introduction of the annual salary system, and also a change in people's sense of values, particularly among the younger generation. I feel that many of these changes are gradually pushing Japan's traditional social structure towards that of American society. I am concerned that with these social change, the problems that I have raised in this paper may also eventually be applied in Japan. What drove me to write this paper is my desire to convey my concerns at this occasion, in order to prevent these concerns from becoming reality. Although here my discussions were focused mainly on the production area, I will be pleased if parts of this paper can be useful in other areas as well.

Table 1 American Factories and Companies Visited

	Date of visit	Major products
1. Automobiles (3 companies, 4 factories)		
Honda of America Mfg., Inc. (Marysville)	92/4/ 6	Passenger vehicle
(New Liberty)	4/ 6	Passenger vehicle
Ford Motor Co. (Chicago Assembly Plant)	5/20	Passenger vehicle
Toyota Motor Manufacturing	5/20	Passenger vehicle
2. Computers (2 companies, 3 factories)		
DEC (Maryland Plant)	91/10/31	(Head office, R&D)
DEC (Hudson Plant)	92/ 3/25	CAD/CAM system
Stratus, Inc. (Hudson Plant)	3/31	Minicomputer
3. Precision instruments (3 companies, 3 factories)		
Polaroid (Norwood Plant)	92/ 1/ 7	Camera
Kao Infosystems Co.	2/20, 6/18	Floppy diskette
Xerox Corp.	6/16	Photocopier, toner
4. Measuring instruments (4 companies, 6 factories)		
General Scanning Inc. (ATE Div.)	92/2/13, 3/16	Electric automatic measuring instrument
(Recorder Div)	4/10	Analog recorder
United Electric Control	2/18	Measuring instrument
Teradyne, Inc. (Lincoln Bldg.)	3/3, 4/16, 5/26	Printed circuit board
(Harrison Bldg.)	3/3, 5/26	Semiconductor tester
Thermo Electron Corp.	5/27	Measuring instrument
5. Communications equipment (2 companies, 2 factories)		
Lifeline, Inc.	92/ 1/ 5	Communications tool for medical care
Loral Infrared & Imaging Systems	5/15	Infrared communication equipment
6. Machine tools (2 companies, 2 factories)		
General Scanning Inc. (TLSI Div.)	92/ 4/24	Laser processor
Mazak Corp.	5/21	Large machine tool
7. Food (2 companies, 2 factories)		
Ocean Spray Cranberries, Inc.	91/11/20	Fruit juice
Kraft General Foods, Inc.	92/ 5/18	Cheese, Processed food
8. Others		
Reebock (Distribution Center)	92/1/ 6	(Footwear distribution)
Tiflex, Inc.	1/ 8	Special hose
Butler Aviation	1/30	(Airport oil supply)
Argonne National Laboratory	5/20	(Research institute)

Table 2 Summary of American Factories Visited

(1) Employees (company level)

Fewer than 300 : 2 companies

300 - 1,000 : 6 companies

1,000 - 10,000 : 7 companies

10,000 or more : 5 companies

Note: Does not include capital affiliated companies such as sales companies. Some classifications are based on estimates. The national research institute is excluded.

(2) Employees (factory level)

Fewer than 50 : 3 factories

50 - 200 : 7 factories

200 - 500 : 6 factories

500 - 1,000 : 5 factories

1,000 or more : 4 factories

Note: Some classifications are based on estimates. The national research institute is excluded.

Table 3 POM Curriculum at Harvard Business School

(1) Technology and Operations Management (Compulsory for first year)

42 sessions, two examinations

Sections

A. Process Fundamentals (11 sessions)

B. Coordination and Integration of Operating Systems (8 sessions)

C. Engineering Process and New Product Development (7 sessions)

D. Quality and Performance Improvement (8 sessions)

E. Technology and Operations Strategy (7 sessions)

Note: Examinations are at the end of Section B (mid-term) and at the end of Section E (final). There are 3－4 sessions each week.

(2) Second Year Elective Courses

Management of Operations (1 section)

Operations Strategy (3 sections)

Developing and Managing Technology (1 section)

Strategic Management of Technology (1 section)

International Sourcing (1 section)

Service Management (5 sections)

Advanced Manufacturing Technologies (1 section)

Note: Three sections means that each student is enrolled into one of these three sections. Each course meets 2－3 times a week.