THE POSSIBILITY OF ZERO INDUSTRY BY ADOPTING JAPANESE PRODUCTION LINE METHODS

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ABSTRACT

The paper comments on the possible mistakes that an executive can make in applying Japanese production line methods in USA. The differences in the two cultures, the geographic proximity of Japanese firms to each other versus our own geographic dimensions and industrial heritage are discussed. Just-in-time production philosophy and the Kanban system are analyzed from the perspective of what it will require in USA to implement them successfully. Performance of MRP and order point inventory control systems are also discussed. Paper ends with a summary of what would happen if MRP is implemented when conditions required for a successful implementation of a just-in-time system are satisfied.

Introduction

Recently there have been numerous publications (e.g., Hall [2], Lee and Schwendiman [4], and Monden [5], Schonberger [8]), on Japanese production line methods, stressing some of the results achieved by them. As Nellemann [6] reported in 1982, some of these achievements were staggering. Reportedly [6],150 percent improvement in labor productivity, 200 percent improvement in material handling, 990 percent improvement in work-in-progress inventories were not uncommon.

The most popular of these Japanese production line methods discussed in the literature is "just-in-time" production or "zero inventories" (i.e.,producing an item as it is needed). I have no disagreements with this philosophy and some of the results achieved by the Japanese. However, I will disagree when Japanese production line methods and Kanban are perceived as the only means of achieving some of these goals. Precisely: 1. How well can these systems which were developed in a different culture work in our own? 2. How much are the real savings? It is true that in-process inventory is reduced. But then a just-in-time system requires heavy investment in flexible machinery and in new marketing efforts to level demand. 3. Proper motivation of the work force by management is essential to the success of any production system. 4. How well will Materials Requirement Planning (MRP or MRP II) or a two-level order point system such as (s, S) work if all the prerequisites of a just-in-time system are satisfied?

Just-in-Time

The simplest type of a just-in-time system consists of two types of Kanban cards: a withdrawal Kanban and a production Kanban (See Monden [5]). Each box of in-process inventory material on the plant floor will carry one of these Kanban cards. For sake of simplicity, define assembly operations as subsequent processes (i.e., processes consuming the units) and production

processes as preceding processes, (i.e., processes producing the parts used in the assemblies). Assume that all the processes in the plant are chained to each other in this manner. (Figure 1).

When an assembly process starts running low in parts, a worker from the assembly process will go to the production process with the required number of withdrawal Kanbans and the corresponding number of empty boxes. He will make this trip either when a predetermined number of the withdrawal Kanbans have accumulated at his Kanban withdrawal post (which is next to the assembly process) or at predetermined regular intervals. At the preceding production process, he will exchange his empty boxes for full ones. During this exchange, he will remove the production Kanban from each full box, put a withdrawal Kanban in its place, and put the detached production Kanban on the Kanban receiving post. Then he will bring the boxes, now with withdrawal Kanbans on them, to the assembly process. As the parts in these boxes are used, the withdrawal Kanbans will be detached and placed on a withdrawal Kanban post. (Figure 2).

In the production process, production will start either after a predetermined number of production Kanbans have accumulated or at predetermined time intervals. The parts will be produced in exactly the same order as the production Kanbans were received. A worker will pick up a production Kanban and an empty box, attach the card onto the box and produce the number of units of the part stated on the card. When the order is completed, it is carried back and stacked with other full boxes.

It is easy to see why just-in-time production has been closely associated with this system. Since the whole plant is chained together by a series of Kanbans, starting with the final product, it is possible to withdraw and produce one (or few) at a time. In such a system, the production will be initiated by a customer order and stopped by lack of it. Then the system will carry minimum and sometimes zero in-process inventories.

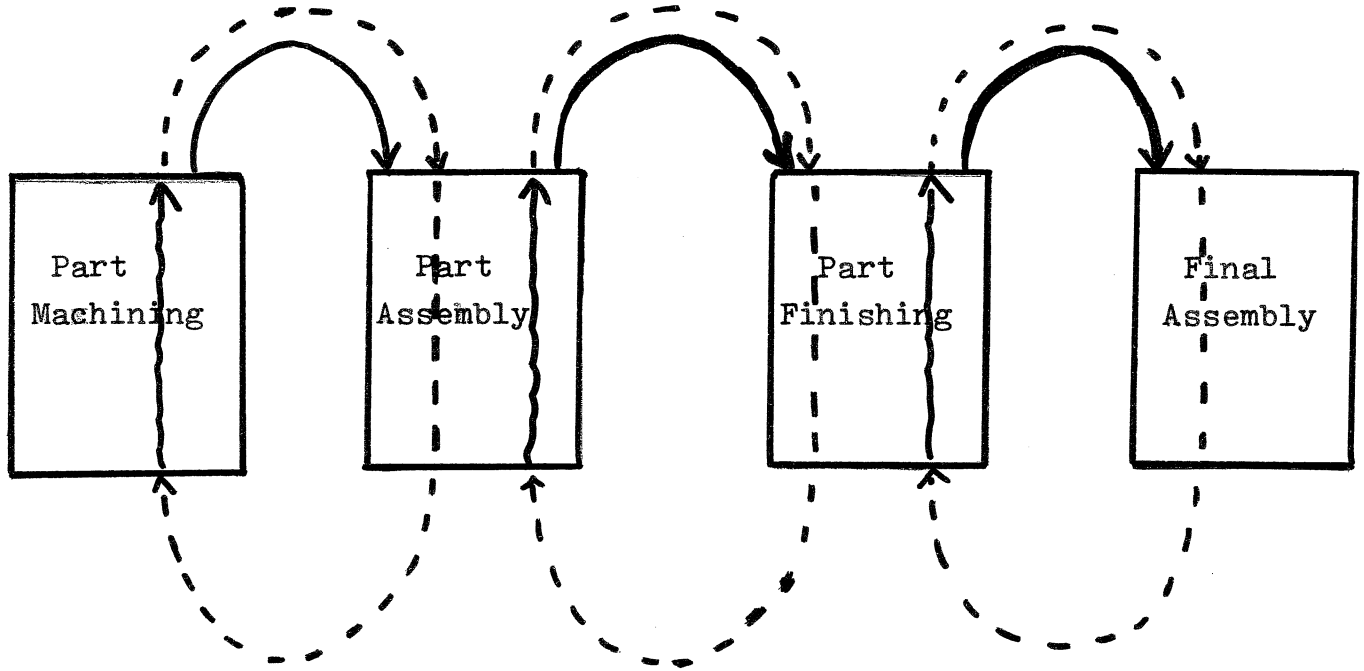
Some Considerations

It is easy to see that maintaining a very high quality level throughout the production process is essential to the success of a just-in-time system. There is no buffer inventory to pick from and defective units are easy to detect because of small lot sizes. However, if there are quality problems, as is the case with most U. S. manufacturers, or if the cost of increasing the quality level is prohibitive in the short run,switching to just-in-time will hardly be the right mode of operation.

Producing in small lots, or in the extreme case,producing one unit at a time, requires a very level (uniform) customer demand. If the customer demand is not uniform,then the system will produce just-in-time for the warehouse. In this case, it will take additional marketing effort to level the customer demand which will require additional capital that may wipe out the savings realized in reduced inventories.

In most American companies, production is made by costly specialized equipment which requires large lot sizes to economically justify the long setup time and costs. In just-in-time, since there is no buffer inventory,the setup time must be reduced. This requires investment in general purpose machinery with low setup times. The size of this investment may also be substantial enough to wipe out any savings realized from reduced in-process inventories.

There seems to be some agreement (Nakane in Lee [4, p. 128]) among practitioners and the academicians that MRP is the best system for a job-shop and just-in-time is the best system for a repetitive production system. In the extreme case of continuous flow of



Flow of withdrawal Kanban

Flow of production ordering Kanban

Flow of physical units of the product

Figure 1: Flow of Kanbans and Physical Units

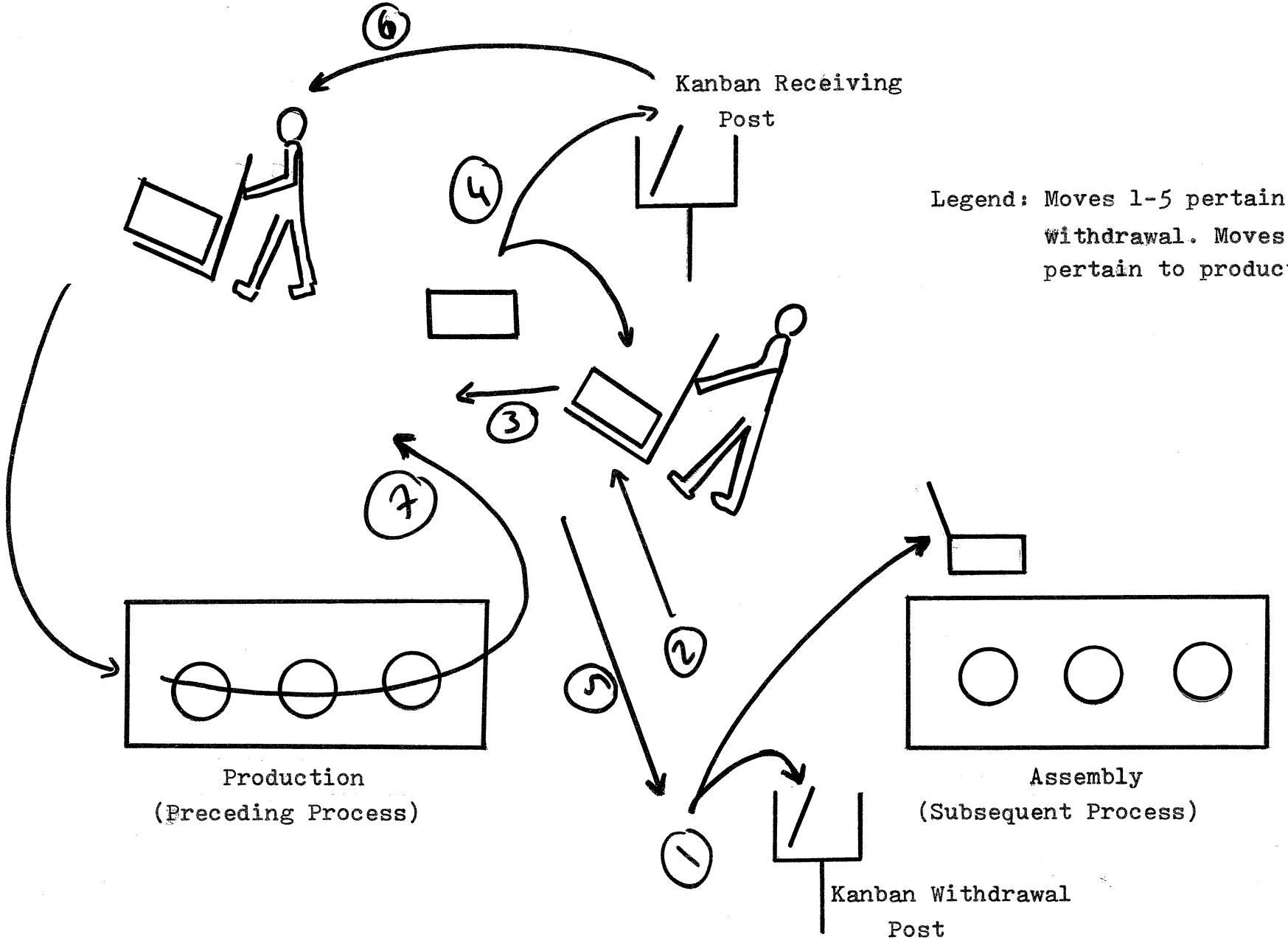


Figure 2: Just-in-time Production with Three Boxes, Two Material Handlers, and Two Kanbans.

output, just-in-time and the assembly line become the same thing. Though some still argue that just-in-time is better because it is more flexible. The main disagreement comes along when the production process is a mixture of an assembly line and a job shop. In this case,Japanese suggest group technology with assembly line mode of production for some family of products (i.e., where volume warrants it). Hence for a shop that uses just-in-time, a couple of dedicated lines co-exist with machine centers.

When volume subsides and some of the lines have to be broken, the workers must be employed elsewhere. Usually, some are assigned to other lines, some are given the task of maintaining the machines, and some form a quality circle. The idea is to keep them busy. If there is a union on the floor,which is the case with most U.S. companies, switching jobs may not be so easy. The key to successful implementation of just-in-time in a situation like this depends on the history of union-management relations on the shop floor. Trust between management and labor is essential if union's cooperation is to be secured.

Suppliers must also be in a just-in-time mode to support the production process of the parent. Educating the suppliers and forcing them to move nearby to provide frequent deliveries in small amounts may not always be possible. If the supplier is forced to carry the inventory this may cause him to raise his price or look for business elsewhere. Another solution to this problem is to force the parent company to diversify towards its sources of supply. But additional capital will be required to accomplish this goal and whatever savings that may be realized from reduced inventories may not justify this expenditure.

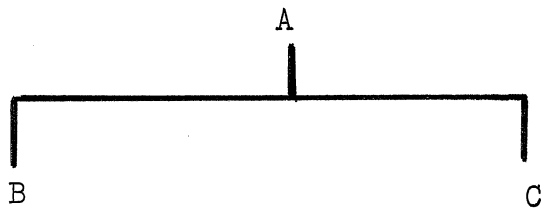
In Japan, implementation of just-in-time is preceded by a couple of years of training, developing a company attitude and a team spirit. The workers consider the company as a part of their extended family and expect lifetime employment. Our society is much more mobile than Japan's. Hardly anybody plans to spend the rest of his life in a single company. Furthermore, it is common practice among most American companies to lay off workers frequently in downturns and rehire them when the demand picks up. The lack of long term commitment either on the part of management or workers makes implementation of just-in-time harder in most American companies. How U.S. firms approach the issue of job security in union contract in the near future will, to an extent,indicate how well just-in-time may be adopted in United States.

MRP

MRP can simply be described as a planning tool (Figure 3) which provides for all the parts (components) needed by the final assembly (see Orlicky [7]). On the other hand, (s, S) is an order point system which triggers a replenishment order for the item when its stock level falls below s units and the system places an order to replenish it up to S units. It does not provide a plan like MRP. It does not look into the future as MRP. In order to gain more insight into MRP, observe the plan in Figure 3. Parts C and B are used in making the final product A. There are 50 units of A on hand, but we need 100 units in periods 3 and 5. After netting and offsetting by one week for the assembly process, these requirements generate further requirements of 50 and 100 units in periods 2 and 4 for the components B and C.

Why MRP Failed

According to recent reports (See Krajewski et al.[3]), only 9.5 percent of all the MRP users have been classified as class A users (i.e., firms implementing a closed-loop MRP). Also pointed out is the fact that MRP has not been



Item A

Lead Time 1	1	2	3	4	5	
Gross Requirements			100		100	
Scheduled Receipts						
On Hand	50	50	-50	-50	-150	
Planned Order Releases		50		100		

Items B and C

Lead Time 1	1	2	3	4	5	
Gross Requirements		50		100		
Scheduled Receipts						
On Hand		-50		-100		
Planned Order Releases	50		100			

Figure 3: MRP Plan for Items A,B, and C.

successful in bringing about the once-expected savings in in-process inventories. Some of the variables which generally contributed to failure of MRP have been demand variability, bill of material complexity, input data inaccuracy, and lack of top management support (i.e.,coordination of the efforts of different functional areas, Etienne [9]).

Let us think for a moment what we require fora successful implementation of just-in-time and consider how our MRP system would perform if all these requirements were satisfied. To begin with, smoothed (uniform) production will be passed down the line by MRP as effectively as Kanban if small lot, or preferably lot-for-lot production is assumed (which is, by the way, a requirement of Kanban). It is the lot sizing algorithms used (see Orlicky [7], Chapter 6) which inflate the amount of middle level components planned by MRP. Safety stock is another factor contributing to in process inventories under MRP. But if zero-defective from one stage of production to another can be adopted on the shop floor, then the need to plan for safety stock will also be eliminated.

Supplier dependability is as important for MRP as it is for just-in-time. Improvement in this category will help both systems equally well. If the supplier is also using a MRP system, then there is nothing to prevent the supplier and the producer form connecting their MRP systems. This has been observed and encouraged (See Orlicky [7], p. 96). Probably, it is also a lot easier to hook up two MRP systems,than to force the supplier to switch to just-in-time.

Bill of material complexity is another feature which contributed to the failure of some MRP systems. But, if the firm has flexible work force, multi-purpose machinery and short lead times (all of which are prerequisites of just-in-time),then bill of material complexity can be eliminated. Bill of material reflects the production process. If the production process is simplified, then so will the bill of material. Today's computers are flexible and fast enough to permit the restructuring of the bill of material to reflect any changes in the production process.

Input data inaccuracy occurs because of lack of motivation, or lack of education of the work force, both of which are related to the commitment of the firm to MRP. Hence the accuracy of the input to an MRP system can be improved by the degree of commitment of management. The amount of effort involved in the commitment to an MRP system is by no means more than the amount of effort involved in the commitment to a just-in-time system.

Top management support is essential to successful implementation of a just-in-time system as well as a MRP system. The redesign of the production process investment in flexible machinery, education and training of the workers and suppliers cannot be accomplished without top management support. If top management support was lacking in an MRP implementation, why is it expected to be present when a firm switches to a just-in-time system? Hopefully, in the 1990's, we won't see these same reasons, which were pointed as the culprits for the failure of MRP repeated for the failure of just-in-time.

The Re-Order Point System

The similarity of the (s,S)system to Kanban was first pointed out by Melnyk and Carter(p. 165-179 in Lee and Schwendiman [4]). We can visualize an (s, S) system as a Kanban system with variable withdrawals(i.e., the size of the withdrawal being equal to S-s). But then, if the production rate is uniform, the rate of withdrawal of an (s, S) system will be very similar to that of a Kanban system. Of course (s, S) is kept on paper whereas the Kanban boxes are on the floor. But this makes no difference and neither does the fact

whether (S-s) is represented in boxes or in number of units. None of the criticism directed to MRP applies for an (s, S) system, i.e,data inaccuracy, lack of top management support. However, a (s, S) system does not plan for components. In fact,neither Kanban nor (s, S) systems are planning systems. If uniform production rate, flexible machinery, small setups and near-to-perfect quality are maintained for a (s, S) system, there is no reason to believe that its performance will be any inferior to Kanban. It probably will provide the desired results without requiring any acculturization.

Summary and Conclusion

So, will just-in-time fail like MRP? Or, will MRP bounce back? It all depends upon how well the management perceives the issues on hand and how much top management support will go into successful implementation of either system. Unfortunately, when we look back into history of production management, the omens are not encouraging. We find that top management has consistently delegated the production function to middle and lower level management. In order for the U. S. manufacturing industry to bounce back and achieve staggering results in quality and reduction of waste this attitude of delegation must change first.

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partners. With determination and good will this goal can be achieved.

The president of a California computer company with ties to Korea's Hyundai Corporation recently summed up the perception of most American business leaders in his statement that "In South Korea, you feel like you're looking at the future." The future looks bright indeed as Koreans and Americans build a partnership that will be satisfying and highly successful for both countries.