Zero inventory management: facts or fiction? Lessons from Japan

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Abstract

If inventory is waste and product lifetimes decline at a growing speed, a firm should be very cautious about having such inventories. Since JIT practices originated in Japan, if zero inventory management is possible, one should find it in Japanese firms. In this paper, theoretical reflections are compared with Japanese experiences from eight case studies. Although these factories strive for no inventory of inputs, work in process, and output, they have not reached this goal. For each of these types, other factors are relevant: geographical and infrastructural factors for the inputs, technological reasons for work in process, and market and technological factors for output prevent firms from being successful in this respect. So zero inventory management is, at least for the time being, a fiction, but western factories can, nonetheless, learn a lot from the step-by-step improvements in Japan in this field. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

Bonney [1] states that attention in the manufacturing industry has concentrated on an ‘inventory is waste’ philosophy using JIT production, usually accomplished by visible pull or consumer-driven systems.

Slack et al. [2] quote Voss’s definition of JIT: “a disciplined approach to improving overall productivity and eliminating waste. It provides for the cost-effective production and delivery of only the necessary quantity of parts at the right quality, at the right time and place, while using a minimum amount of facilities, equipment, materials and human resources. JIT is dependent on the balance between the supplier’s flexibility and the user’s flexibility. It is accomplished through the application of elements which require total employee involvement and team-work. A key philosophy of JIT is simplification”.

In the internal supply chain for a factory, three types of stock can be distinguished: raw materials, work in process, and final products.

External stocks of raw materials may require JIT deliveries based upon contracts calling for deferred delivery to prevent running out of stock as well as outdatedness. This stockless purchasing will mitigate the necessary storage facilities and handling activities, but increase transportation and call
frequency. Depending on the contract, the firm will run the risk of having to pay for goods that it will not use.

For the stocks of work in process, the kanban system can be seen as an equivalent of the blanket orders. Blanket orders are contracts to purchase certain items from a vendor, but shipment is only made upon receipt of an agreed upon document [3] (p. 497). The various subsequent production units can be seen as internal suppliers and customers, known from the quality management field. The kanban system enables internal JIT delivery between the departments or even the workstations in a line. In this way, using detailed and centralized production planning, it coordinates the flow of goods in the lean or Japanese production organization. Thus, either markets (external) or hierarchy (internal) can govern the deferred delivery. The stocks of work in process will be mitigated, which is advantageous, but the system becomes also more vulnerable. Disturbances may occur either as a result of technical problems or the workers’ behaviour. This is why in the socio-technology, originating from Europe, stocks are introduced as buffers: technical disturbances are not so easily exported to the next department; workers can be motivated because of their discretionary room, and overhead costs for planning diminish [4].

Finally, pull production can prevent inventories of final products as production takes place only after sales orders have been received and accepted. Lowson [5] refers, with respect to no or low stocks of final products to the Quick Response Philosophy (QRP) to reach the same result in a pull system (1995).

So, if inventory is waste and JIT can be used to prevent this, this will require new organizational forms to implement supply chain management [6].

As Japan is the example, if not the cradle, of JIT, we could learn from their experiences to what extent JIT performance can be effective and what conditions facilitate or hamper this.

In this paper, we will compare the experiences of Japanese factories (Section 4) with the ‘western’ ideas found in the literature (Section 2), both with respect to each type of inventory and to the overall, internal supply chain to find out whether zero inventory management is a fact or a fiction, what lessons western factories can draw from the Japanese experiences, and how mutual understanding between east and west might be improved (Section 5). The case study approach is described in Section 3.

2. Theoretical backgrounds

The JIT system is said to have been developed at the Toyota Motor Company [7]. Though it might be traced back some 20 years before that time to the Japanese shipbuilding industry [8]. In the 1980s, it was transferred to the USA and Europe, in most cases, to subsidiaries of Japanese firms. The roots can probably be traced back to the Japanese environment: lack of space as well as of natural resources have contributed to their aversion to waste. US companies have sufficient space and vast supplies of material, so JIT would more readily develop in Japan than elsewhere, but not because of cultural circumstances as such.

Johnson and Wood [9] claim that JIT is much more an American invention, pointing to Henry Ford’s integrated production and assembly plants in Detroit in the 1920s. They quote Ford: “Waste is that stock of materials and goods in excess of requirements that turns up in high prices and low wages”.

Slack et al. [2] say that the original reluctance to adopt JIT in the West came from two mistakes. First, people did not distinguish between the ‘technical’ aspects (kanban, set-up reduction, etc.) and the ‘cultural’ factors (such as consensus decision making). The technical aspects may be adopted in one way or another in any country. Secondly, the ‘national’ culture may be different throughout the world and this will influence the way but not the fact of adoption. Harland [10] found that chains in the different territories examined, Spain and the UK, exhibit different operational requirements. De Meyer [11] concluded from the results of the 1994 European Manufacturing Futures Survey that there will be an emphasis on the improvement of dependability and speed of the delivery in the context of the internationalization of the production function. European manufacturers expect a significant increase in the internationalization of
the supplies, the production, and the sales of their business units. This will have a strong influence on the supply and delivery chains.

Regardless of whether JIT is a Japanese or an American invention, it can be used all over the world because of its technical aspects. Cultural aspects may, however, flavour the way in which it is implemented to control the supply chain.

2.1. JIT purchasing

Akintoye [12] refers to the huge proportion of the cost of construction constituted by materials: procurement, storage, insurance, guarding against theft, and becoming obsolete. JIT ensures that suppliers deliver directly to the production site to achieve next to zero inventory and, consequently, a reduction in production costs. According to Heizer and Render [13], the goals of JIT purchasing are the elimination of unnecessary activities, the elimination of in-plant inventories, the elimination of in-transit inventory and the improvement of quality and reliability.

According to Schroeder [8], the master schedule is planned for a fixed period of time to allow work centres and suppliers to plan their respective work schedules. Within that period, the schedule is levelled on a daily basis. Suppliers are asked to make frequent deliveries (as many as four times a day) directly to the production line. Suppliers are, so to speak, treated much as internal work centres. To improve reliability, local suppliers are preferred.

Johnson and Wood [9] refer to JIT II, which is characterized by close integration of the buyer and seller and its use in industrial purchasing. A vendor employee at the purchasing firm replaces both the buyer and the seller and is empowered both to place orders on himself and to practice ‘concurrent engineering’, attending any and all design engineering meetings involving his company product area. Another important aspect they mention in this respect has to do with international sourcing. This implies not only the existence of inventories in motion, but also reliance on specialists to help with export and import transactions.

De Toni and Nassimbeni [13] studied the underlying dimensions of, and relationships between, operational and organisational JIT purchasing attributes. These two aspects are closely connected; the joint development of new products, in particular, represents an important factor to trigger the organizational actions activated by the buyer firm.

Mould and King [14] mention Central Scotland (Silicon Glen) as a very suitable site for the implementation of JIT production systems with both electronics manufacturers and suppliers concentrated in the same geographical area. Reese and Geisel [15] describe experiences with JIT delivery in different industries in the Federal Republic of Germany. They found a decrease in capital tie-up costs and in inventory management costs as well as one in inventory level.

With respect to JIT purchasing, we, therefore, find that the goals are clearly defined as is the revision of the relationship with the suppliers. European authors report positive experiences with JIT purchasing.

2.2. JIT production

Heizer and Render [3] state that inventories in production often exist ‘just in case’ some deviation from the production plan occurs. Just-in-time production has come to mean elimination of waste, synchronized manufacture, and little inventory: producing batch sizes to standards.

Alawneh [16] refers to the role of logistic management in implementing the just-in-time system. He mentions 5 important elements: kanban, production smoothing, standardization of jobs, multifunction workers, and JIT purchasing.

Quality means a better, easier to employ, JIT system as it prevents scrap, rework, and damage costs. Vuppalapati et al. [17] stress that JIT principles were developed and applied in Japan as an integral part of the TQM philosophy. Firms with such an integrated strategy will outperform those who view them in isolation and implement either one. Schroeder [8] adds that one of the decisions management should take is how much safety stock to carry in relation to safety lead-time and safety capacity. In addition, he sees that the plant layout is much different with JIT since
inventory is held on the shopfloor and not put in the storeroom between the processes. This counts even more if group technology has been implemented and the parts can flow smoothly from one workstation to another.

Slack et al. [2] also refer to design for manufacture, operations focus, small simple machines, layout and flow, total productive maintenance, and set-up reduction.

Schroeder [8] mentions two pure operations strategies that can be used to meet fluctuating demand over time. The first one is levelling the workforce (the rate of regular-time output is made constant) and the other is chasing the demand with the workforce (the work force level is adjusted to meet/chase the demand).

Coleman and Vaghefi [18] point to ‘heijunka’ as the method that is most basic to the Toyota production system: distributing the production of different (body types) evenly over the course of a day, a week, and a month in the assembly process.

The kanban system can be used for the coordination of JIT logistics of work in process. This is especially true for the withdrawal cards ensuring input coming to the workcenter (cf. Ref. [8]) whereas the production cards initiate the manufacturing input and transformation at a previous workcenter.

In the symbiotic approaches, such as socio-technology, (semi)-autonomous work groups [19] or production islands [20] are created, with buffer stocks as cushions in between. The autonomy of the groups is based on being given a certain measure of technical independence in relation to the remainder of production. Before, as well as after, each group one finds a both quantitative and qualitative measurable buffer [19]. When the production islands were first implemented, work structuring was a problem created by automatization projects within several large firms. Rethinking the organization of production was indicated by interface and buffer problems on production lines: inflexibility and vulnerability had to be overcome. The solution could be completely producing a family of parts within the production island, making it the full responsibility of a group of skilled and flexible workers [20].

Thus, while the goals for JIT production do not seem to be too well articulated, the conditions JIT production can make successful are treated into some detail, especially the coordination aspects. Surprisingly, not much attention is paid to the role of production planning.

2.3. JIT distribution

A firm may face technical and/or commercial problems that force it to have inventories after all. Technical batch sizes may be required that do not match sales orders. Immediate delivery upon call may be required because of product and/or market characteristics.

Heizer and Render [3] see three functions of inventories: to decouple production and distribution, to form a hedge against price changes, and to obtain quantity discounts. Related to this is the difference between the economic order quantity (EOQ) approach and the fixed-order-interval system (Johnson and Wood, 1996). In the EOQ system, the time interval fluctuates, with the order size remaining the same. In fixed-interval systems, the opposite holds, and order sizes may vary.

Richman and Zachary [21] refer to the fact that in an ideal pull system, no inventory is created before its time, causing inventory and inventory costs to drop to zero. Reese and Geisel [15] found an increase both in service degree and in flexibility with regard to demand fluctuations.

Waters-Fuller [22] claims a win–win relationship in the case of a just-in-time supplier in distribution. Although the implementation of JIT results in a shifting of costs from the buyer to the supplier, causing a reduction of margins, there are, however, positive outcomes as well. Sales volumes increase through single sourcing and, once selected, supply arrangements are generally over an extended period, thereby providing a degree of security. Bennett and Forrester [23] refer to the problem of homogeneity of a firm’s product, as they see both a conflict and a challenge in product variety in connection with just-in-time production.

Lowson [5] as indicated, with respect to no or low stocks of final products, to QRP. QRP is a customer service strategy (a pull system) that uses
technology to make possible an industry pipeline that is so flexible and efficient that, ideally, retailers can continually replenish what is sold with accurate speed of response and have the merchandise in the stores on time and in the right quantities, colours, sizes, and styles.

Walker [24] identified several areas for potential savings through OR inventory control, order processing, distribution administration and customer service, because of the faster and more accurate transfer of information within and between partners in the logistics chain.

Bowersox and Closs [25] added demand-driven techniques: rules-based reorder (ROP), continuous replenishment (CR) and automatic replenishment (AR). Reorder point logic for managing inventories uses statistical probability to plan safety stocks to accommodate variability in demand and leadtime. It has become popular because of information technology that enabled point-of-sale information and eliminated substantial variability in the performance cycle. CR or vendor-managed inventory is a modification of QR that eliminates the need for replenishment orders: daily transmission of sales or shipments makes the supplier assume responsibility for replenishment of the retail inventory and the customer agrees to honour replenishment as a purchase commitment. Automatic or profile replenishment gives suppliers the right to anticipate future requirements according to their overall knowledge of a merchandise group in a particular type of retail outlet. All these methods improve the possibilities for supply chain management.

Thus, with respect to zero inventory distribution, JIT seems to have alternative strategies to reach the same results. Techniques exist to mitigate stocks of final products in markets where push production (still?) is dominant. It is also important to balance the costs and the benefits of zero stocks over the parties involved.

3. The case study approach

In this section, we first concentrate on the selection of the case study factories and how we executed the studies, after which we introduce the factories that were studied.

When empirical data on Japanese firms are presented in the literature, there is a strong emphasis on the automotive industry and the electronics industry. Internationally these industries attract the most attention probably because of their tremendous competitive successes in the last few decades. The Japanese economy does of course consist of more industries and not all of them produce consumer products or sell on the international market. This is why we selected factories from various industries, which use different technologies and also sell domestically. This diversity should enable us to determine how, the Japanese achieve a zero inventory firm.

We collected the data on each of the factories using different methods. First, we gathered as much publicly available information as possible. Then we visited the factories to interview key persons as well as to observe the actual situation in the factories with respect to the stocks.

The project was carried out by a group of both Japanese and Dutch researchers.

The eight factories we studied are introduced in Table 1.

From Table 1, we may conclude that our selection not only includes the popular industries, but also different ones. Some of them produce raw materials such as fibres and steel, while others produce common consumer products like shoes and beer. The other industries, power devices and water taps, in some respects resemble the car industry: transforming raw material into parts and assembly. There are also differences with respect to the technology in use: process production for fibres, steel and beer and batches in the other five. The size ranges from 220 to 3000, for the factory under study. All factories belong to larger firms; some of those are very large and known internationally.

Three of the factories produce raw materials or equipment for the industrial market; the others produce for the consumer market. Only one of the factories produces to a large extent for the international market, the others provide mainly the domestic market with their products.

Consequently, for most of the criteria, the selection includes very different factories and, as such,
Table 1
The case study factories

<table>
<thead>
<tr>
<th>Firm/item</th>
<th>Product</th>
<th>Market</th>
<th>Employees</th>
<th>Purchases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teijin Tokuyama</td>
<td>Fibres</td>
<td>Industrial</td>
<td>330</td>
<td></td>
</tr>
<tr>
<td>Shinitetsu Oita</td>
<td>Steel</td>
<td>Industrial</td>
<td>3000</td>
<td>Coal, lime, iron ore, a.o.</td>
</tr>
<tr>
<td>Sapporo Moiji</td>
<td>Beer</td>
<td>Consumer</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td>Mitsubishi Fukuoka</td>
<td>Power devices</td>
<td>Industrial</td>
<td></td>
<td>Barley, malt hop, bottles, a.o.</td>
</tr>
<tr>
<td>Mazda Hofu</td>
<td>Cars</td>
<td>Consumer</td>
<td>1500</td>
<td>Textile, rubber, strings, a.o.</td>
</tr>
<tr>
<td>Tsukiboshi Kurume</td>
<td>Shoes</td>
<td>Consumer</td>
<td>2000</td>
<td>Steel plates, parts</td>
</tr>
<tr>
<td>Toyota Kyushu</td>
<td>Cars</td>
<td>Consumer</td>
<td>1100</td>
<td>Steel plates, pipes, parts</td>
</tr>
<tr>
<td>Toto Kokura</td>
<td>Watertaps</td>
<td>Domestic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

it might reveal how the Japanese achieve a zero inventory firm.

4. The Japanese experiences

In this section, we will present the outcomes of our case studies for each of the types of inventories we introduced.

4.1. No inventory of raw materials?

Japan does not have many basic raw materials itself, thus, most of them have to be imported. This holds, for instance, for the coal and other raw materials used by Shinitetsu. These goods are brought to Japan by ships carrying large quantities. The production location is near the sea and the factory has facilities at its disposal to unload the ships. In other cases, such as Sapporo, this is also the case for semi-manufactured materials such as malt hop.

This is not uncommon in Japan: many industrial areas are near the sea and ships are frequently used as a means of transportation. This has, of course, to do with the geographical situation in Japan, and, again because of that, the quality of the road infrastructure. This is the reason why the parts for Toyota Kyushu that come from the parent company on Hokaido are also transported by ship to Kyushu. Only the last part of the transport is done by road.

These factors prevent these factories from using JIT delivery as a policy and force them to keep stocks of raw materials and/or parts. It seems, however, that the distance is of greater importance than the type of goods because this applies not only to the process technology-oriented firms but also to Toyota Kyushu which is far removed from the parent company.

But as far as possible, they try to use JIT, as can be seen from the example of Toyota Kyushu. As far as the regional related-firms are concerned, they have to deliver their products every day. Another example might be the contracting out of all kinds of work as is done by Shinitetsu. Not only is unrelated work such as planting trees on the works’ site contracted out, but also related work such as unloading the ships.

There is, however, at least one exception to this ‘rule’: Mitsubishi. This factory gets its materials and parts on a once-a-week delivery basis. Management sees JIT delivery as an ideal that creates many
planning and production problems both for the supplier and for the customer. This is particularly true of factories producing to order, where too strict a control of stock would cause virtually unsolvable problems.

For the other factories, especially Toto and Mazda, the situation is totally different. Here we find daily delivery; at Toto, one day before actual use. The suppliers receive information derived from the production plan set by the Head Office Production Planning Department, about two weeks before delivery time. The contracts, especially the product specifications, with these suppliers are negotiated by the Head Office Purchasing Department. Normally, the contract period lasts as long as the lifetime of the product concerned. For instance, in the automotive industry, new contracts are negotiated when there is a model change. Suppliers get the negotiated price, but are supposed to improve their performance over time. So they too have to continuously improve as in the Kaizen system. The benefits of these improvements lead to decreasing the prices of their products.

Most of the related firms are located a short distance from the factory. Traffic jams and other road infrastructure related problems are to be solved by the supplier.

To sum up the foregoing, two patterns can be distinguished. Firstly, there are those firms which have inventories of inputs because of ‘technical’ factors. Long distances as well as the mode of transport seem to be the most important, influenced by the geographical situation of the country. But if inventory can be avoided these firms would take advantage of such an opportunity.

Secondly, as far as nearby suppliers are concerned, the factories wish to have JIT delivery, but with a small, one-day buffer.

It can therefore be concluded that factories prefer external over internal inventories. The concomitant risk is mitigated by the shelter of the contracts negotiated by Head Office. Both the Purchase and the Production Planning Department play an important role in the relationship of the factory with its related firms. This conclusion may be influenced by the fact that the large firms dominate our sample.

4.2. No inventory of work in process?

Whether or not stocks can occur in this step depends in the first case upon technical aspects. At Teijin, for instance, the five stages of the production process are executed without any interruptions. Control is either mechanical or computerized and people are only present to solve detected problems. Consequently no stocks can occur. In Shinitetsu’s steelworks there are two processes, but they are connected by a special means of transport that prevents the steel from cooling down too much. Once again: no stored, just moving stocks. At Sapporo, the natural processes in and before the brewing take much time but these also should not be viewed as stocks.

In the case of batch production, stocks can occur and whether they do depends upon the policy of the firm. Mitsubishi deliberately takes stocks for granted. Toto can be found at the other extreme, preventing all stocks whatsoever in the manufacturing. In this factory, the provisioning of the assembly lines, for instance, has been completely computerized: AGVs deliver JIT the parts directly from the parts warehouse where they were delivered by the internal respective external supplier the day before. After assembly, the products are transported to the shipping department. Sapporo may use less advanced technology in its bottling department, but the result with respect to stock is the same. Both Toyota Kyushu and Mazda, one could say, take a position in between. Toyota Kyushu recognizes that for the time being technical disturbances necessitate establishing buffers along the line, especially in the assembly department. At the start-up of the factory, they used to have a buffer of five cars between the various sub-assembly lines they have. Now they are about halfway to the intended zero buffer. The buffers are used to prevent disturbances being exported to the subsequent sub-assembly lines. In both automotive factories, the different stages in especially assembly have been connected by an ongoing conveyer belt. The parts used at each of the workstations are delivered there with a fixed frequency related to the tact time in use by a specialist group. Under these circumstances production control or better production planning is of the utmost importance. Planning is preferred
because everything is done in Japanese firms to make sure that production is 100% according to plan. Workers and their superiors are constantly informed about how they are doing, so they can and will take corrective measures whenever needed.

Production planning and disciplined living up to it are crucial for zero buffer production. The Japanese factories have production plans that can be characterized as both very detailed and very centralized. The multi-echeloned production plans with time horizons from one year in different steps down to one day are normally prepared at the Production Planning Department at the Head Office. Mitsubishi again is the most important exception to this rule, as the production planning is done at the factory level. Other exceptions are Shinitetsu and Sapporo where the most detailed plans are made at the factory level, and Teijin where the factory is consulted. So, in contrast to the process-oriented industries, the batch-oriented industries plan in every detail.

At least three reasons can be mentioned for this difference between the two technological groups. Firstly, the mix flexibility, different combinations of parts in one product, is higher which requires more planning. Secondly, the production process has been split up into a greater number of sub-processes and each of them has to be planned on its own but also as a part of the total production process. Finally, people in the production processes may cause more problems than (computerized) machines.

Of course, detailed planning and removing buffers are reinforcing processes. If buffers are to be removed, no unforeseen events should occur, so planning should be of 100% quality. The fewer buffers required, the easier the planning process is.

To sum up, in the process-oriented industries, stocks do not occur because of technological reasons, and centralized planning requires too much attention to detail. The batch-oriented industries have to prevent all kind of problems that can come up and they seek ways to make the production process as transparent as possible. If they do so, they will look more like the process-oriented industries.

4.3. No inventory of final products?

After production, the product has to be shipped to the customer. This can, of course, only be done when the customer is known. This is the case, for instance, with the customized power devices at Mitsubishi or with the cars at Toyota Kyushu, which are only produced when they have already been sold. But the more standardized power devices at Mitsubishi show an average stock of 0.3 months. For Tsukiboshi, this figure is three months and the short-term goal is to reach two months, but the ultimate goal is zero inventory for finished products. This will hardly be possible for this factory as they produce a very wide assortment: a 10000-item collection in different sizes. Sapporo, which also produces for the consumer market, has a stock of finished products of only 5.5 days, two of which are required for quality control. This factory, however produces a rather homogeneous product, which can be sold in different packages or under different brand names. To reach this level of availability and to prevent outdatedness, the factory must sometimes accept occasionally idle capacity because of the seasonal sales pattern. Teijin has storage facilities for final products at its production site for only three days. The production process of the 100-item collection in 13 product lines requires batches of a certain minimum level. This size does not always balance with the sales orders. If the stocks of final products exceed the available storage room, it is deposited outside with non-related firms.

In summary, whether or not stocks of final products appear depends upon:

- the type of the products; customized or not and seasonal sales patterns,
- the width of the standardized products assortment and
- the technologically required minimum level of production.

But here again we see that the policy of the factory is important. Idle capacity may be taken for granted to produce at levels as close to expected (seasonal) sales levels as possible; JIT production even to the level of production after sales are some of these policies.
5. Conclusions

For the three types of inventories we distinguished in this paper, in the factories we investigated we found both no inventories and existing inventories. As these were all Japanese firms in Japan, we should, according to Saito, have expected no inventories because of the JIT practices. We should therefore take a closer look at what conditions seem to be important influences for this. The facts show that even in Japan, zero-inventory management is a fiction.

As far as the inputs are concerned, the proximity of the suppliers in relation to the mode of transport seems to be a decisive factor. Although not mentioned in the literature overview, seasonal production or better growing patterns cause stocks, but they may be held by the growers. Factories can, to a certain extent minimize this type of stocks, by buying from local suppliers. But as Japan imports many raw materials, this is not an option for some factories. If possible, factories, or rather the Purchase Departments at the Head Office, select suppliers located nearby. Here we can recognize the observations on national resources made by Schroeder [8], as well as the ones made by Mould and King [14] on the importance of distance.

The main reason to aim for as low an inventory of raw materials and components as possible stems from the costs of such inventories. This is in line with the remarks made by Akintoye [12], who mentioned all the costs related to purchasing materials.

The length of the relationship, at least the product lifetime, together with the necessary continuous improvement, refer to the intended win–win relationship Johnson and Wood [9] mention.

As far as the work in process stocks are concerned, technology seems to be an important factor. In the process-oriented industries, uninterrupted continuous production prevents such stocks. In the batch-oriented industries, production planning is an important means to reach the lowest level of stocks possible. But to achieve the most accurate planning, the process control should meet the highest demands. Especially in these industries, we see the most centralized and detailed production planning. In these procedures, the Production Planning Department at Head Office plays the crucial role and the workers and their superiors must live up to the plans. Here we see not only the influence of the kanban system (cf. Ref. [16]), but also the necessary (or better: total) quality that should be reached to ensure uninterrupted production [17]. Detailed and centralized production planning (cf. Ref. [2]) is possible not only because of the available information on cycle times, but also because of the synchronized production on the basis of the heijunka principle [18]. Despite Karlsson [10] and Latniak [20] emphasis on the autonomy of the workers in the production planning to meet the flexibility demands put forward by the market and the motivation of the workers, the detailed and centralized production planning in Japan seems to be effective. This fits into the first of the pure operations strategies put forward by Schroeder [8] as the workforce is levelled against the production demand and the rate of regular-time output has been made constant. He also mentions that the specific relationship between Japanese firms and their employees, both in terms of responsibilities and rights, facilitates the acceptance of limited discretionary room in operations.

With respect to the final products, stocks may exist for technological reasons, but, of course, the commercial ones prevail. Both the character of the product (customized) and the market (will customers accept JIT production or do they insist on immediate delivery from stock?) seem to be crucial. The more accurate the sales forecasts can be, the more producers of non-customized products which have to be delivered immediately can imitate JIT production. Here QR and related techniques, as put forward by Bowersox and Closs [25], can create the win–win relationship sought by Waters-Fuller [22]. Whether this is possible or not depends to a great extent on the existing level of homogeneity of the output (cf. Ref. [23]). Here seasonal sales patterns cause trade-offs between idle capacity and stocks of final products.

We must conclude that in Japan the zero inventory factory may be the ideal, but it has not (yet) been reached. Whether one factory or the other may reach it depends on its specific situation: suppliers, technology, product, and customers. A second observation has to be made as well: most of the factories in our sample have a policy of trying to
minimize their stocks. This holds for all three types of inventory but, of course, the measures for all three differ. So, if stocks do exist, it may in some cases be necessary to have buffer stocks [2], but hardly ever 'just-in-case' stocks [3]. Both the limited availability of space and the deep desire to prevent waste seem to be the driving forces to minimize inventories as much as possible [8].

Japanese factories do try to control their internal supply chain, not only as such, but also as an integrated part of the overall external supply chain.

We can also learn some lessons from our comparison of Japanese experiences and western ideas.

Zero inventory management is, as the Mitsubishi management said, an ideal that causes many problems. It also demands a reconsideration of a factory’s day-to-day practices to reveal weaknesses. This ideal can be ‘the’ starting-point for continuous, step-by-step improvement of logistical performance.

We discovered a number of conditions that facilitate zero inventory management, such as total quality, and others that can hinder it, such as distance, traffic, type of products and type of market. These and other conditions can be reasons why zero inventory is not reached, but the number of such excuses seems to be rather limited.

Culture is not among them. It does not matter whether or not JIT is an American invention. If it was, it seems to be watered down because of love of ease in an affluent society.

References


