

History and development of jit manufacturing



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Just-in-Time (JIT) manufacturing is a Japanese management philosophy applied in manufacturing which involves having the right items of the right quality and quantity in the right place and at the right time. It has been widely reported that the proper use of JIT manufacturing has resulted in increases in quality, productivity and efficiency, improved communication and decreases in costs and wastes. The potential of gaining these benefits has made many organizations question and consider this approach to manufacturing. For these reasons, JIT has become a very popular subject currently being investigated by many worldwide organizations.

History and development of JIT manufacturing

JIT is a Japanese management philosophy which has been applied in practice since the early 1970s in many Japanese manufacturing organizations. It was first developed and perfected within the Toyota manufacturing plants by Taiichi Ohno as a means of meeting consumer demands with minimum delays (Goddard, 1986). For this reason, Taiichi Ohno is frequently referred to

The Toyota production plants were the first to introduce JIT, It gained extended support during the 1973 oil embargo and was later adopted by many other organizations. The oil embargo and the increasing shortage of other natural resources were seen as a major impetus for the widespread adoption of JIT* Toyota was able to meet the increasing challenges for survival through an approach to management different from what was characteristic of the time. This approach focused on people, plants and systems (Goddard, 1986), Toyota realized that JIT would only be successful if

every individual within the organization was involved and committed to it, if the plant and processes were arranged for maximum output and efficiency, and if quality and production programmes were scheduled to meet demands exactly.

JIT had its beginnings as a method of reducing inventory levels within Japanese shipyards (Goddard, 1986), Today, JIT has evolved into a management philosophy containing a body of knowledge and encompassing a comprehensive set of manufacturing principles and techniques, JIT manufacturing has the capacity, when properly adapted to the organization, to strengthen the organization's competitiveness in the marketplace substantially by reducing wastes and improving product quality and efficiency of production. The evolution of J IT as observed in the literature is discussed in some detail (Keller and Kazazi, 1993), Despite the plethora of literature, Zipkin (1991) asserts that a great deal of confusion exists about the subject. This, it is suggested, has led to a fundamentally different approach to JIT programmes in the west, which has the potential to be more damaging than beneficial

There are strong cultural aspects associated with the emergence of JIT in Japan. The development of JIT within the Toyota production plants did not occur independently of these strong cultural influences. The Japanese work ethic is one of these factors. The work ethic emerged shortly after World War II and was seen as an integral part of the Japanese economic success. It is the prime motivating factor behind the development of superior management techniques that are becoming the best in the world- The Japanese work ethic involves the following concepts.

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Workers are highly motivated to seek constant improvement upon that which already exists. Although high standards are currently being met, there exist even higher standards to achieve*

Companies focus on group effort which involves the combining of talents and sharing knowledge, problem-solving skills, ideas and the achievement of a common goal.

Work itself takes precedence over leisure. It is not unusual for a Japanese employee to work 14-hour days. This contrasts greatly when compared to the Western emphasis on time available for leisure activities.

Employees tend to remain with one company throughout the course of their career span. This allows the opportunity for them to hone their skills and abilities at a constant rate while offering numerous benefits to the company. These benefits manifest themselves in employee loyalty, low turnover costs and fulfilment of company goals.

There exists a high degree of group consciousness and sense of equality among the Japanese (Cheng, 1990b). The Japanese are a homogeneous race where individual differences are not exploited or celebrated.

In addition, JIT also emerged as a means of obtaining the highest levels of usage out of limited resources available. This involves reducing waste and using materials and resources in the most efficient manner possible- The input of sustained effort over a long period of time within the framework of continuous improvement is key. This is achieved by a focus on a continuous stream of small improvements known in Japan as ' kaizen* (Imai. 1986) and

has been recognized as one of the most significant elements of the JIT philosophy (Tanner and Roncarti, 1994). JIT management has a high degree of cultural aspects embedded in its development. Heiko (1989) has suggested several relevant Japanese cultural characteristics which may be related to JIT as follows.

JIT management allows an organization to meet consumer demand regardless of the level of demand. This is made possible through the use of a pull system of production. The Japanese cultural characteristic which relates to the demand pull concept involves a great deal of emphasis on 'customer orientation'. Satisfying consumer needs quickly and efficiently is a priority for most Japanese business organizations.

The degree of time lapse between material arrivals, processing and assembly of the final product for consumers is minimized by the JIT production technique. Production lead time minimization is possibly the result of the Japanese cultural emphasis on speed and efficiency. This may be due to the overcrowded living conditions which exist in Japanese cities.

JIT allows a reduction in raw material, work-in-process and finished goods inventories. This frees up a greater amount of space and time between operations within plants. The corresponding cultural characteristic is concern for space due to a very dense population.

The JIT production technique uses containers for holding parts, This allows easy identification and monitoring of inventory levels. The use of designated containers within the production process may be due to the emphasis placed

upon the types of packaging which exist when goods are purchased by consumers,

An element of JIT production requires that the plant be clean, i. e. there should be no wastes present which may hinder production. Japanese are concerned with the cleanliness of their environment which may be due to limited space. A clean and uncluttered environment may give the illusion of greater area.

JIT production involves the use of ' visible signals' to display the status of machinery. The corresponding cultural characteristic involves the use of many signs displaying various products. Another contributing factor to the use of visible signals is the high literacy rate among Japanese people as compared to other countries.

The differences which exist between Japanese and other cultures have led to the belief that JIT cannot work effectively in manufacturing organizations elsewhere in the world. The cultural differences which contribute most to this belief include the Japanese work ethic and the role of unions within many Western work environments. Unions typically play a large role in manufacturing or ' blue collar' organizations which would be more apt to adopt a JIT approach to manufacturing. In addition, unions tend to exert influence upon management in developing policies which are more favourable to labour. Therefore, issues such as increasing leisure time for labour would be contradictory to the Japanese work ethic. This may explain some of the beliefs that JIT and Western manufacturing firms are incompatible.

The claim that JIT cannot be effective in firms outside Japan has not been substantiated as several organizations have successfully implemented JIT. Many organizations realize some of the benefits of J IT in the early stages of implementation (Lubben, 1988). It should be noted that in organizations where a union plays an active role in bargaining for employee concerns, it is beneficial to consider union involvement in the beginning stages of implementation. Experience in Australia for example (Shadurand Bamber. 1994) has shown successful implementation of JIT is possible, although it is acknowledged that cultural differences may make the process more difficult.

Obtaining support and agreement will require involving, and informing, all groups who have an interest in the company. This can greatly reduce the amount of time and effort involved in implementing JIT and can minimize the likelihood of creating implementation problems. Support and agreement should be obtained from the following groups,

Stockholders and owners of the company Emphasis should be placed on the long-term realization of profit, and so short-term earnings should be plowed back into the company to finance the various changes and investment commitments necessary for JIT success. It should be made clear that most of the benefits associated with JIT will only be realized over the long run.

Labour organizations All employees and labour unions should be informed about the goals of JIT and made aware of how the new system will affect working practices. This is important in winning the union and workers' support to assist with the implementation and to remove potential problems and difficulties

Management support This involves the support of management from all levels- It also requires that management be prepared to set examples for the workers and initiate the process to change attitudes. Striving for continuous improvement is not only required of the employees on the shop floor, but must also be inherent in management's attitudes.

Government support Government can lend support to companies wishing to implement JIT by extending tax and other financial incentives. This can provide motivation for companies to become innovative as it bears some of the financial burden associated with the costs of implementing JIT (Lee and Ebrahimpour, 1987).

Plants

Numerous changes occur about the plant which encompass plant layout, multi-function workers, demand pull, kanbans, self-inspection. MRP and MRP II and continuous improvement. Each of these will be explained separately with relation (o how they tic into JIT production.

Plant layout Under JIT production, the plant layout is arranged for maximum worker flexibility and is arranged according (o product rather than process- This type of layout requires the use of ' multi-function workers.

Demand pull production The concept of demand pull involves the use of demand for a given product to signal when production should occur.

Kanbans This is a Japanese word meaning signal and is usually a card or tag accompanying products throughout (he plant. Indicated on the kanbans is

(he name or serial number for product identification, the quantity, the required operation and (he destination of where (he part will travel to).

Self inspection The use of self-inspection by each employee is done to ensure that (heir production input adds value to (he product and is of high quality. Self-inspection allows mistakes and low quality work to be caught and corrected efficiently and at the place where the mistakes initially occur.

Continuous improvement The concept of continuous improvement involves a change in attitudes toward (he overall effectiveness of an organization.

Continuous improvement is an iniegral part of the JIT concept and. to be effective, must be adopted by each member of the organization, not only by those directly involved with the production processes

The goals of JIT

There are three main manufacturing objectives for JIT (Suzaki, 1987), These objectives are universal or homogeneous in nature, i. e. they can be applied and adapted to a diversity of organizations within industries that differ greatly from one another.

Increasing the organizations ability to compete with rival firms and remain competitive over the long run Organizational competitiveness is enhanced through the use of JIT as it allows organizations to develop an optimal process for manufacturing their products.

Increasing the degree of efficiency within the production process Efficiency will concern itself with achieving greater levels of productivity while minimizing the associated costs of production.

Reducing the level of wasted materials, time and effort involved in the production process Elimination of unnecessary wastes can significantly reduce the costs of production.

In order for JIT management to work and be profitable, it must be fully adapted to the organization. Every organization is unique in its production processes and the goals it aims to achieve. In addition, every organization will be at a different stage in its development. The goals for each organization are unique in their priority and importance. The goals of JIT are useful in assisting the organization to define, direct and prepare for.

There exist short- and long-term goals, which include the following.

Identifying and responding to consumer needs.

Aiming for the optimal quality/cost relationship

Eliminating unnecessary wastes

Aiming for the development of trusting relationships between the suppliers.

Designing the plant for maximum efficiency and ease of manufacturing.

Adopting the Japanese work ethic of aiming for continuous improvement even though high standards are already being achieved

JIT can offer organizations a competitive advantage which can take the form of offering consumers higher quality products than those offered by the rival firms, or providing a superior service or developing a superior means of production which allows the organization to become increasingly efficient or

productive. Lubbcn (1988) suggests three ways JIT can assist management in obtaining a competitive advantage.

Integrating and optimizing

Improving continuously .

Understanding the customer.

Advantages and limitations of JIT

Considerable attention has been focused on the benefits associated with the use of JIT. However, in order to properly implement JIT within an organization, managers should be aware of the limitations and shortcomings of JIT which may be applicable to their organizations. An overview of the

potential advantages and limitations follows.

Advantages of JIT

The advantages of using JIT are numerous. Several advantages mentioned already are those of waste reduction and increased ability to remain competitive. Other advantages include improved working relations between employees, stronger and more reliable working relations with suppliers, higher profits and improved customer satisfaction. Numerous benefits associated with JIT, both tangible and intangible, have been observed in European manufacturing organizations (Kazazi and Keller, 1994) and perhaps more significantly direct financial benefits have been demonstrated (Inman and Mehra, 1993),

Limitations of JIT

Although the benefits of using JIT are numerous and cited more frequently than any potential limitations, several shortcomings have been identified as follows;

Cultural differences have been cited as a possible limitation of JIT. There exist many cultural differences which may be intrinsically tied to JIT success (Hall, 1989).

The traditional approach to manufacturing involves the use of large inventories with safety stocks. Safety stocks can act as a buffer for companies to fall back on to offset inaccurate demand forecasts. This has the potential to cause problems for the organization which relies heavily on safety stocks to absorb any increases in demand (Hall, 1989).

The benefits associated with increased employee involvement and participation resulting from the use of quality circles may be evident in Japanese organizations. However, the benefits associated with JIT may be culturally bound and somewhat limited to the Japanese environment (Klein, 1989),

Loss of individual autonomy has been suggested as another possible shortcoming of JIT. Loss of autonomy has largely been attributed to limited cycle times or the time between recurring activities'. In addition, reduced cycle times force workers to adjust immediately to changes in demand without taking their needs into consideration (Klein, 1989).

Loss of team autonomy is a possible result of reducing or eliminating buffer inventories. This serves to reduce the flexibility of workers to discuss

possible solutions to problems. This is a function of quality circles, which are an important part of JIT. Reduced buffer inventories and worker flexibility contradict the other aspects of JIT concerning quality circles (Klein, 1989).

Loss of autonomy over methods involves the idea that, under JIT, employees must adhere to strict methods of production in order to maintain the system. This idea diminishes the 'entrepreneurial spirit' which many workers may have previously enjoyed prior to JIT implementation (Klein, 1989).

JIT success may be "industry specific", i. e. craft-oriented businesses are considered to be better candidates for a JIT programme than organizations producing commodity-type products (Hall, 1989).

Resistance to change (Gray and Starke, 1988) may be experienced since JIT involves an organizational level of change which will affect almost every member of the organization. Employees may resist the change based on two different levels: emotional and rational resistance.

Other reasons for adopting JIT are the potential cost savings associated with its use. Consider the profit formula: $\text{profit} = \text{selling price} \times \text{sales volume} - \text{cost}$. This formula represents the components of profit. Most organizations are unable single-handedly to influence the selling price of their products as the selling price is determined by market forces of supply and demand and industry standards.

The fundamental concept underlying waste reduction requires that machinery and people do not need to be fully used at all times. They should

be used only when necessary to meet demand- These seven categories are discussed below.

Waste from over-production JIT manufacturing allows a company to produce only what is needed, operating on the demand pull concept. Therefore, in many plants that do not use the demand pull concept, overproduction will occur..

The waste of motion Motion study involves beliefs and practices developed through scientific management. The application of scientific management to JIT involves the idea that excess handling of materials and equipment to meet over-production demands requires inefficient levels of motion and involvement on behalf of employees. The motions required to move this excess of material around the plant represent waste.

Transportation wastes These are the wastes associated with the movement of materials from inventory to different workstations.

Processing wastes These include the processing of parts that affect the final or finished product. These parts may or may not be a necessary step in the completion of the product. They also may not contribute to the value of the product.

The waste of waiting or queuing time This involves the length of time inventory in transit is idle and waiting to enter the next operation. Queuing time is largely the result of inefficient work flow and can cause uneven lot sizing.