CHAPTER 4

JIT MANUFACTURING: ELEMENTS & PREREQUISITES

4.1 INTRODUCTION

Many factors affect JIT implementation directly or indirectly. Factors such as excess inventory, waste, product quality, lead time etc. directly affect the implementation of JIT. On the other hand, factors such as work environment, working conditions, motivation, flexibility whether manufacturing or organizational and others affect JIT implementation indirectly, although their impact is no less important than those affecting directly. Major JIT elements and their effects on its implementation along with prerequisites for JIT manufacturing are discussed below:

4.2 ELIMINATING WASTE

One of the primary and long-term goals of JIT is waste reduction. The desired outcome of waste reduction is value enhancement. Firms can thus reduce costs and add value to their products and services by eliminating waste from their production systems. Shigeo Shingo of Toyota identified seven wastes in a manufacturing system that should be eliminated. They are overproduction, waiting, unnecessary transportation, unnecessary processing, inventory, unnecessary human motions and defects. Overproduction relates to producing more items than what is needed at a particular point of time. It will require additional space to store the surplus and also may require to be disposed of at reduced prices. Waiting relates to delays or events that prevent a worker from performing his or her work on account of situations like a machine is occupied for another product or the machine or equipment has broken down. Unnecessary transportation relates to travelling of people or works through longer distances or more
materials handling, and may occur on account of poor design of the workstations. *Unnecessary processing* relates to extra steps in a process, for example, removing burrs from machined parts, reworking defective parts and entering the same information into multiple databases. *Inventory* of any kind including raw materials, work-in-process (WIP) and finished goods are treated as waste for JIT, as they require space for their storage, must be insured, handled carefully, and all these activities incur costs. Products may involve *unnecessary human motions* and effort during their processing, and it reduces the efficiency of workers and productivity of an organization. *Defects* include defective parts and scraps. Defective parts require inspection, and may be reworked or replaced, thereby incurring additional costs. It can be summarized that all these wastes are not adding any value to products but are simply increasing the costs of production.

The *Five S* method which consists of five Japanese words starting with S is extremely useful in waste reduction. These words with their equivalent English *S terms* shown in the brackets include *Seiri* (*Sort* - means simplify what is kept or stored at each workstation so as to eliminate searching for parts and tools and avoid using the wrong tools or parts), *Seiton* (*Straighten* – means keep every item in a designated place at each workstation so as to avoid unnecessary movements), *Seiso* (*Sweep* – means keep each workstation clean), *Seiketsu* (*Standardize* – means set standards to reduce processing variabilities by eliminating nonstandard activities and resources), and *Shitsuke* (*Self-discipline* – means instill the discipline in employees to form and refine work habits for better organization of workstations). Significant waste reduction results in a number of positive outcomes including lower costs, shorter lead times, better quality and greater competitiveness (Wisner et al., 2015).

### 4.3 CONTINUOUS IMPROVEMENT

Continuous improvement is derived from the Japanese word kaizen. Kaizen refers to small, incremental but continuous improvements in manufacturing.
Individually, each improvement might not appear to be of any great use, but combined, the total contribution from these incremental changes can be huge (Brown, 2000). Behind JIT is the continuous drive to improve production processes and methods. Typical goals of kaizen include one or more of the following: reducing the amount of floor space needed, increasing process flexibility, improving work flows, improving quality, enhancing the safety of the working environment, and reducing or eliminating non-value-added activities (Meredith and Shafer, 2015). Quality improvement is important part of ongoing continuous improvement. And continuous improvement is central to the philosophy of JIT, and is a key reason for its success. Toyota did not stop working on JIT after originating it and continue to improve its implementation.

4.4 REDUCING INVENTORY

Excess inventories are considered a waste, as they tend to hide a number of purchasing, production and quality problems within the organization. The reduction of inventory levels causes problems to surface in the organization and among its trading partners. Once these problems are detected, they can be solved, improving product value and allowing the system to run more effectively with lower inventory investment. For example, reducing safety stocks of purchased materials will cause stockouts and potential manufacturing disruptions when late deliveries occur. Firms must then either find a way to resolve the delivery problem with the supplier or find a more reliable supplier. In both cases, the end result is a smoother-running supply chain with less inventory investment. Similarly, properly maintained equipment breaks down less often, so less safety stock is needed to keep downstream processing areas fed with parts to be further processed.
4.5 REDUCING SETUP TIME

Setting up production equipment for the next production run takes valuable time, and tends to increase the lead time. Setup times can be reduced in a number of ways including doing setup preparation work while the previous production lot is still being processed, moving machine tools closer to the machines, improving tooling or die coupling, standardizing setup procedures, practicing various methods to reduce setup times, and purchasing machines that require less setup time. Japanese manufacturers use a tool, called single minute exchange of die (SMED), to reduce setup times. They use SMED to achieve their goals to have all set-ups take less than a minute. While SMED literally translates to a single minute, but for practical purposes, the goal is to reduce setup times to under 10 minutes, that is, a single digit, not a single minute.

4.6 PEOPLE’S INVOLVEMENT

Businesses ultimately succeed or fail because of their people, and JIT is no exception to this rule. JIT is an innovative approach and it is people-oriented. Waste reduction and continuous improvement largely depend upon dedicated workforce. The important role of human resource management practices in JIT implementation has been stressed upon by many researchers (Spencer and Guide, 1995; White et al., 1999). Managers and workers must see each other as coworkers whose common goal is success of the company. A culture of teamwork must prevail, and workers, managers, suppliers and customers must all be motivated to get involved in teamwork for JIT manufacturing to be effective. World class manufacturers put great stress on teamwork and people involvement at every stage of operation and activity. JIT manufacturing requires a strong element of training and involvement of workers in all phases of manufacturing. Employees are cross-trained in many of the various production processes to enable capacities to be adjusted at different workstations as needed, when machines break down or workers are absent. Managers should encourage workers to speak out when problems
exist and to suggest better ways of doing things from small suggestions to strategic issues. They should be empowered to take independent decisions on the matter of immediate action.

4.7 ORGANIZATIONAL SET-UP

Organizational setup refers to the organizational structure and elements of working environment prevailing in the organization. It represents the enduring characteristics of a company that is reflected in the attitudes employees show towards the policies, practices and conditions in the work environment. Organizational structure and organizational culture are two key elements that have profound effect on JIT implementation.

Organizational structure is the formal system of task and authority relationships that control how people coordinate their actions and use resources to achieve organizational goal.

Organizational culture is the values, assumptions and beliefs held in common by organization members that shape how they perceive, think and act. JIT requires not only change in the way a company handles its inventory but also changes in its culture.

4.8 SMALL BATCH SCHEDULING AND REDUCING LEAD TIME

In a dynamic market, where everything is uncertain and unpredictable, it becomes vital for an organization to acquire the ability to fulfill customer’s specific demands in very short time. For this to become reality, orders consisting of only a few items, that is, in batches are required to be transferred directly from vendors to shops within short lead times. Small batch scheduling tends to reduce in-process and
finished-goods inventories, and also makes the firm more flexible to meet varying customer demand in a shorter period. Besides using small batches, JIT manufacturing is required to exploit parallel processing of operations wherever possible to reduce the manufacturing lead time. For example, by doing product design and process design simultaneously, the time to bring new products to market is reduced. Many operations in a manufacturing system can be made parallel simply through scheduling. The shorter lead time enhances customer response. In a conventional manufacturing system, material handling equipment and setup have their own problems and require delicate handling. It takes some reasonable time to equipment or product changeover, which makes lead time longer. A flexible manufacturing system (FMS), on the other hand, eliminates or reduces majority of shortcomings of conventional system, and thus has the ability to reduce the manufacturing lead time drastically. Reduced lead time can help fulfill customer’s demand on time, and can produce goodwill for the company. In other words, it accelerates JIT implementation.

4.9 EFFECTIVE SUPPLY CHAIN MANAGEMENT (SCM)

SCM coordinates and integrates all the supply chain activities into a seamless process and links all of the partners in the chain. It enables manufacturers to actively plan and collaborate across a distributed supply chain, to ensure all parties are aware of commitments, schedules and expedites (Walker and Alber, 1999). Effective and efficient supply chains tend to offer least interruptions in the chain, thus facilitating smooth flow of materials and information among the members of the chain. It results in better customer service and less inventory and waste, which helps in speedy implementation of JIT. In these days of intense worldwide competition, supply chain management is taking on significantly more importance, as it accounts for a greater and greater proportion of the total cost of all outputs. The success of a company depends to a great extent on how well it manages its supply chain relationships. World-class companies see supply chain management as a key element in capturing increased shares of world markets.
Information is the essential link between all supply chain processes and members. The use of information technology (IT) has not only provided global markets for a company, but also has eliminated many associated problems in the supply chain. It has resulted in reduced lead time, making on-time delivery more reliable and predictable, and thus paving the way for effective implementation of JIT.

4.10 CONSOLIDATING SUPPLIER-MANUFACTURER RELATIONSHIP

The supplier’s relationship with manufacturer is important in the context of quality of raw materials being supplied. JIT emphasizes on strong supplier relationship as it makes the system more dependable and eliminates any uncertainty regarding manufacturing schedule, which strongly influences lead time. Burt (1989) stressed on supplier dependency and its selection and management in respect of a modern manufacturing plant. The manufacturer can work with suppliers to improve overall quality, and to ensure that its supply needs are met. In this way, the manufacturer can eliminate many of its own inspection and control functions. A partnership type relationship can prove to be extremely useful and can go a long way in maintaining good relationship between the two. It helps them to know each other’s requirement more precisely, and makes them answerable for everything, whether good or bad. The result is visible in terms of increased product quality, higher productivity and increased benefits.

4.11 PREFERING NEARBY SUPPLIER

Proximity of suppliers to their manufacturers has immense impact on JIT implementation. If suppliers are near to the site of manufacturing, uncertainty relating to transportation of materials can be managed without much problem, hence continuity in the production system can be ensured as usual. At the same time, transportation costs are drastically cut short. It leads to reduction in overall costs of production, and timely delivery of goods to customers with highest level of customer satisfaction. That is, it
accelerates JIT implementation. In case, when suppliers are scattered apart, the coordination activities of supply chain network are relatively complex, raising uncertainty in timely supply of raw materials. This condition forces the unit to keep surplus stock to meet the fluctuating demand level. It may increase inventory holding cost. Japan is the most suitable example for JIT implementation. Because of Japan’s geography and the long-term relationships between suppliers and manufacturers, Japanese suppliers tended to be located much closer physically to their customers, making daily delivery possible. As a result, the costs of transportation and storage got reduced significantly; and secondly it also reduced the manufacturing lead times. Wilson (1985) pointed out that one of the principal reasons why Toyota became successful in implementing JIT lies in the fact that its suppliers were located in the same area as the company itself existed. He further stated that, in the United States components often have to be shipped through hundreds of miles of distance and may be getting delayed by adverse weather conditions, particularly in winter. O’Neal (1985) found that geographical dispersal impedes JIT implementation.

4.12 PRODUCT QUALITY AND TOTAL QUALITY MANAGEMENT (TQM)

Quality refers to the ability of a product or service to consistently meet or exceed customer requirements or expectations. It is the culmination of efforts of the entire organization and its supply chain. Determinants of quality include design, conformance to design, ease of use, and service after delivery. The occurrence of quality defects during the process in a production system can disrupt the orderly flow of work, and hence affecting JIT adversely. Quality needs to be continuously improved upon to make products or services nearly defect-free. Attaining one time improvement in quality is not enough. Kaizen is useful in improving the existing features or adding features in the product. Quality perfection is represented by the term Six Sigma, a statistical method that does not allow 3.4 defects per million opportunities (DPMO), and makes the product or service almost perfect. The principle of quality at source should be used where errors
or defects in a product or service is detected and rectified at the source and not passed on to the finished products or services. Quality at source starts with the quality of raw material. It will result in saving in inspection cost and the cost associated with replacing the defective items. JIT manufacturing depends on a system of TQM.

Total quality management (TQM) is an integrated management concept that is directed at continuous improvement of product or service quality (Flynn et al., 1995; Lau and Anderson, 1998). It immensely helps in improving manufacturing environment. JIT and TQM have played key role in improving organizational effectiveness in today’s competitive and ever-changing world market. While JIT philosophy concentrates more on improving manufacturing efficiency by eliminating non-value added activities and minimizing inventory, TQM, on the other hand, thrusts upon improving the overall effectiveness of an organization through a focus on quality improvement (Lau, 2000).

4.13 MANUFACTURING ENVIRONMENT

Productivity of a manufacturing unit is linked to the optimum utilization of its resources which include materials, capital, energy, labour, equipment and technology. Manufacturing environment refers to conditions that are favourable to produce a product. It reduces wasted movements of workers, customers and/or in-process inventories, and achieves smooth product flow through the facility. Moving parts and people around the floor shop does not add value. It helps in utilizing resources effectively by allowing people and materials to move only when and where they are needed. It facilitates JIT implementation. JIT aims at rationalization of the production system through stable and level production schedules, which can be achieved through elimination of waste, reduction in defects, increase in machine’s utility, repetitive manufacturing (producing same products in same quantities), improvement in manpower efficiency and reduction in other non-productive works. JIT eliminates waste through simplification of manufacturing processes (Schonberger, 1986; Harmon and Peterson, 1990).
Good manufacturing environment ultimately helps in the production of customized products offering many advantages including total customer satisfaction.

Preventive maintenance reduces the untimely breakdown or failure of machine or its components, which may cause frequent interruptions in manufacturing operations, leading to inventory pile-up that is against the spirit of JIT. Regular maintenance measures ensure continuity in operations, helping the organization running smoothly.

Kanban production control is extremely useful in JIT manufacturing. It reduces in-process inventory drastically, and helps in producing only the desired products. At the core of JIT manufacturing at Toyota is kanban.

Flexibility in manufacturing takes care of variety of products. Companies are increasingly using cellular-based flexible manufacturing system (FMS), as a part of automation, to produce manufacturing flexibility. Cellular manufacturing uses manufacturing cells which represent manufacturing units in themselves, where cells are U-shaped to facilitate easier operator and material movements within the cell. It uses the principle of group technology (GT), where families of parts with similar manufacturing processes are grouped together, and greatly helps in inventory management. Increased global competition, demand for an increased variety of products, reduced product life-cycles and time-to-market are forcing new strategy to adopt. The mass production is being replaced by mass customization of goods and services (Pine et al., 1993).

Hence, in order to realize the fruits of JIT manufacturing, its important elements need to be thoroughly studied. Certain prerequisites must be present before JIT has a chance to succeed. Production must be of repetitive nature, products must move through production in a continuous flow without waiting at any step, and schedules must be stabilized and leveled. These changes make production planning and control simple
enough to allow JIT to work. Additionally, product defects and machine breakdowns must be eliminated. To cope with unexpected events, workers must be cross-trained so that they can do several jobs.