www.irmbrjournal.com
International Review of Management and Business Research
March 2013
Vol. 2 Issue.1

Just-in-Time manufacturing system, Revolution in Management Accounting From concept to implement

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Abstract

JIT production system identifies the hidden problems in the value chain and reduces the production waste of the system while increasing the throughout (Sales-Raw Material Cost). Even though the JIT system seems to be interesting and less complicated it requires lot of coordination with supply chain to avoid delays in the production schedule. This article discusses in depth the implementation of JIT manufacturing. The objectives are twofold. The first objective is to acquaint the reader with the overall JIT concept and the factors necessary for its implementation; the concepts presented here represent the ideal principles and methods of implementation.

Keywords: *Just-in-Time, Cost management, JIT implementation and Traditional manufacturing.*

Introduction

JIT in time concept was initiated in Japan making the Toyota as its mater piece. JIT is system whether company starts manufacturing/purchasing once the customer orders the good effectively making zero inventories. In other words, in a JIT environment materials are purchased and produced as and when it is needed. The whole idea is based on the phrase provide the goods just in time as promised when the order is placed by the customer. The opposite of the JIT production is known as JIC (Just in case) system where it produces goods for inventory with the intention of having goods just in case a customer places an immediate order.

JIT production system identifies the hidden problems in the value chain and reduces the production waste of the system while increasing the throughout (Sales-Raw Material Cost). Even though the JIT system seems to be interesting and less complicated it requires lot of coordination with supply chain to avoid delays in the production schedule.

The whole concept of the JIT is differentiated from traditional productions systems using push vs. pull systems of production. The push system of production pushes materials to the next stage of the production irrespective of whether time and resources are needed at the next level of production creating lot of inventories at each level of the production flow. The traditional manufacturing organizations adopt push system where they produce for inventory and work in progress. The pull system of production is where the

materials are pulled by next level of the production only when is signaled or required by the next stage of production. This drastically reduces the inventory held as it does not keep any work in progress. JIT concept is built based on the concept of pull production which eliminates the total inventory.

This article discusses in depth the implementation of JIT manufacturing. The objectives are twofold. The first objective is to acquaint the reader with the overall JIT concept and the factors necessary for its implementation; the concepts presented here represent the ideal principles and methods of implementation.

What is Just-In-Time (JIT)?

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 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.

Just-In-Time management involves the application of old management ideas; however, their adaptation to the modern manufacturing firm is a relatively new practice. Presently, many firms are studying and applying the JIT approach in response to an ever more competitive environment. North American organizations are aware of the pressure placed upon them by the success of their Japanese competitors at obtaining phenomenal levels of productivity. In order to remain competitive and experience economic success, these companies have focused on increasing productivity, improving the quality their products and raising the standards of efficiency within their products and raising the standards of efficiency within their firms. The ability to achieve higher standards of productivity without sacrificing quality is also an important goal of a manufacturing firm. Over the long run, application of JIT manufacturing may assist these companies in achieving these goals of manufacturing excellence. 10

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 (Goddadrd, 1986). For this reason, Taiichi Ohno is frequently referred to as the father of JIT.

The Toyota production plants were the first to introduction 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 system. 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. 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 the organization's competitiveness in the marketplace substantially by reducing wastes and improving product quality and efficiency of production.

The evolution of JIT as observed in the literature is discussed in some detail. 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 culture 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:

- 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 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 fulfillment of company goals.
- There exists a high degree of group consciousness and sense of quality among the Japanese. 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. Faced with constraints, the Japanese worked toward attainment of the optimal cost/quality relationship in their manufacturing processes. 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' and has been recognized as one of the most significant elements of the JIT philosophy.

Furthermore, Japanese firms tend to focus on enhancing the long-run competitiveness rather than emphasizing the realization of short-term profits. They are willing to experience opportunity costs by introducing and implementing innovative ideas within their firms. Stockholders and owners of Japanese companies also encourage the maximization of-term benefits. This enables them to experience the rewarding long-term profits as a result of their efforts.

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 minimized is possibly the result of the Japanese cultural emphasis on speed and efficiency. This may be due to the overcrowded living conditions which 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 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 sings 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 favorable 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 JIT in the early stages of implementations. 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 has shown successful implementation of JIT is possible, although it is acknowledged that cultural differences may make the process more difficult.

Although focus has been directed toward inadequacies within the Western environment, the Japanese are subject to change as well. Western culture has to some extent been adopted by many Japanese people. For this reason, many of the Japanese youth have rejected their elder's work ethic and replaced it with one that apes that of Western culture. Despite this abandonment and change in attitudes, Japan is still able to attain productivity and quality standards which far exceed those of many manufactures in the West. However, there is other evidence to suggest that there are weaknesses in the Japanese approach and opportunities to gain greater competitive advantage by the adoption of a more balanced approach.

Theory of JIT production

JIT Based Quality management is combination of inventory control, quality control and production management functions that makes sincere efforts for quality improvement by two ways. First, it concentrates on philosophical aspect of quality improvement by making the quality everyone's responsibility, and then focused on effective implementation of quality control techniques. It recognized that most valuable resources of an organization are its workers, and workers work best when they are motivated, valued, encouraged to contribute, and allowed to make their own decisions. Under this approach, Workers inspect the product quality after each successive operation. They are trained along with managers in preparation and interpretation of process control charts.

Managers motivate the workers to think quality first and production rate second. The workers have authority to halt the production line or cell, if quality problems are uncovered. Thus, this concept not only gives the quality responsibility to workers but also match that responsibility with authority to share the quality control functions so that quality problems can be uncovered and solved quickly. Also, JIT production system demands to buy parts in small lots. Small lots require less space and time. Less space and time require less peoples and facilities to complete the same job.

Besides, small lots easy to inspect, and defects can be immediately detected. Thus, the parts that are purchased steadily in small lot sizes with frequent deliveries contribute to higher quality and productivity through lower levels of inventory and scrap, lower inspection costs for incoming parts, and early detection of defects. In short, JIT based approaches has potential to improve the product quality and productivity to significant level but organizations must adopt its principles in way that meet their own organizational structure, design and processes.

Elements of JIT manufacturing

JIT manufacturing consist of several components or elements which must be integrated together to function in harmony to achieve the JIT goals. These elements essentially include the human resources and the production, purchasing, manufacturing, planning and organizing function of an organization. In short, these elements can be grouped together into the above-mentioned Toyota production system of people, plants and system.

1. People involvement

Obtaining support and agreement from all individuals involved in the achievement of organizational goals is a fundamental sine qua non for JIT success. 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 organization* 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 worker's support to assist with the implementation and to remove potential problems and difficulties. Failure to involve labour organizations will result in lack of understanding of management motives and causing fears of job loss on the part of the labour. This can lead to impediments such as non-cooperation and resistance to change. Union support is also vital in achieving elimination of job classifications to allow for multi-skilled workers and company-wide focus. Recent research indicates that one possible weakness of JIT is that it may increase the stress placed on workers; this makes the existence of good labour relations essential.
- *Management support* This involves the support to 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.

Organization theory suggests the hypothesis that people will be more compelled to work toward goals when they are included in the development of the goals. Onto this hypothesis JIT builds the idea of involving employees at different levels in the organization. The introduction of **quality circles** and the concept of **total people involvement** are examples of the avenues available for attempting to maximize people involvement through the use of JIT.

The introduction of changes in an organization has the potential to elicit reactive behaviours from the individuals who may be subjects to these modifications. JIT represents one of these changes and cause substantial organization in very positive ways, reactive behaviours such as resisting the change by working against organizational goals may develop. Involving people becomes increasingly important at this point.

Communication, training and increasing the values of the worker's jobs can help alleviate reactive behaviours.

2. Plants

Numerous changes occur about the plant which encompass plant layout, multi-function workers, demand pull, kanbans, self-inspection, MPR (material requirements planning) and MRP II (manufacturing resource planning) and continuous improvement. Each of these will be explained separately with relation to how they tie into JIT production.

- *Plant layout* Under JIT production, the plant layout is arranged for maximum worker flexibility and is arranged according to product rather than process. This type of layout requires the use of 'multi-function workers' , i.e. the focus shifts towards training workers and providing them with the skills necessary to perform many tasks rather one or two highly specialized tasks.
- *Demand pull production* The concept of demand pull involves the use of demand for a given product to signal when production should occur. Use of demand pull always a company to produce only what is required in the appropriate quantity and at the right time.
- *Kanban* This is a Japanese word meaning signal and is usually a card or tag accompanying products throughout the plant. Indicated on the kanbans is the name or serial number for product identification, the quantity, the required operation and the destination of where the part will travel to. The use of kanbans assists in trying or linking the different production processes together.
- *Self-inspection* The use of self-inspection by each employee is done to ensure that their production input adds value to the 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 the overall effectiveness of an organization. Continuous improvement is an integral part of the JIT concept and, to be effective, must be adopted by each member of the organization, not only be those directly with the production processes. Continuous improvement requires that with every goals and standard successfully met, these goals and standards should be increased but always in a range that is reasonable and achievable. This will allow a company to constantly improve upon its operations, product and, ultimately, its customer satisfaction.

3. Systems

Systems within an organization refer to the technology and process used to link, plan and co-ordinate the activities and materials used in production. Two such system are MPR and MRP II.
MRP is "a computer-based method for managing the materials required to carry out a schedule". It is a 'bottom0up' or 'consolidation' approach to planning, i.e. it involves the planning of lower level products within the product family such as component parts. Planning for MRP can be broken down essentially into two parts. These include a production plan, which is a broad plan indicating the available capacity and the manner in which it is to be allocated about the plant, and a master production schedule which is a detailed plan of what products to prodyce in specified time frames.

MRP II is a computer-based programme which can be used to provide information on financial resources available to carry out the plans of MRP. An example of the information MRP II provides is inventory investment. Other systems within an organization include those that provide linkages with suppliers and assist with the co-ordination of the overall functioning of the organization.

Given the nature of JIT, quality will assume an increasing importance. The use of total quality control is an additional element of JIT and is important in ensuring that the quality standards set production are achieved. JIT quality involves 'quality at the source'. Quality at the source means there is an emphasis on producing products correctly the first time. Quality at the source contrasts greatly with the traditional 'after the fact' approach to quality or producing the product then inspecting it. This approach does not allow for minimizing inventory levels and rework costs. Thus, it does not tie into the goals of JIT to eliminate wastes.

Benefits and limitations of JIT

1. Benefits

The potential benefits of JIT are numerous. First, JIT practice reduces inventory levels, which means lower investments in inventories. Since the system requires only the smallest quantity of materials needed immediately, it substantially reduces the overall inventory level. In many Japanese companies that use the JIT concept, inventory levels have been reduced to a point at which the annual working-capital turnover ratio is much higher than experienced by U.S. counterparts. For instance, Toyota reported inventory-turnover ratios of 41 to 63, while comparable U.S. companies reported inventory-turnover ratios of 5 to 8.

Since purchasing under JIT requires a significantly shorter delivery lead time, lead-time reliability is greatly improved. reduced lead time and increased reliability also contribute to a significant reduction in the safety-stock requirements. Safety stock extra units of inventory carried as production against possible stock outs.

Reduced lead times and setup times increase scheduling flexibility. The cumulative lead time, which includes both purchasing and production lead times, is reduced. Thus, the firm schedule within the production planning horizon is reduced. This results in a longer "look-ahead" time that can be used to meet shifts in market demand. The smaller lot-size production made possible by reduced setup time also adds flexibility.

Improved quality levels have been reported by many companies. When the order quantity is small, sources of quality problems are quickly identifiable, and can be corrected immediately. In many cases, employee quality consciousness also tends to improve, producing an improvement in quality at the production source.

The costs of purchased materials may be reduced through more extensive value analysis and cooperative supplier-development activities.

Other financial benefits of JIT include:

1. Lower investments in factory space for inventories and production;
2. Less obsolescence risk in inventories;
3. Reduction in scarp and rework;
4. Decline in paperwork;
5. Reduction in direct material costs through quantity purchases. 6

2. Limitation 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. These will be problems that may be difficult to overcome or work around without changes in attitudes and worker philosophy. The magnitude of their impact may be difficult to measure because of their nature.
- 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.
- The benefits associated with increased employee involvement and participation resulting from the use of quality circles may be evident in Japanese organizations. However, Western ideas of participation involve largely 'empowering' the workforce with respect to decision making. This suggests that the level of involvement established within Japanese organizations using JIT is not compatible with the degree of employee participation required to satisfy Western workers. The benefits associated with JIT may be culturally bound and somewhat limited to the Japanese environment.

- Loss of individual autonomy has been suggested as another possible short-coming of JIT. Loss of autonomy has largely been attributed to limited cycle times or the 'time between recurring activities'. Buffers such as slack or idle time are significantly reduced resulting in greater amounts of stress and pressure placed upon the worker to perform. The time which would otherwise be present would allow the worker more freedom to perform 'vertical tasks' which constitute administrative tasks or team meeting. In addition, reduced cycle times force workers to adjust immediately to changes in demand without taking their needs into consideration.
- 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 workers flexibility contradict the other aspects of JIT concerning quality circles.
- 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.
- 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.
- Resistance to change 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. Rational resistance occurs when an individual is deficient of the necessary information and facts pertaining to the degree to which the change will affect them. Emotional resistance refers to the psychological processes of fear, anxiety and suspicion which arise which arise from inducing change and cause resistance.

Goals of JIT

JIT management can be applied to the manufacturing processes within any company. It is also being adapted to organizations within the service industry. JIT, when successfully implemented, can reduce the fluctuations which many manufacturing firms experience contingent upon changing economic condition. Goddard (1986) suggest that differea company can achieve the "competitive edge" by competing on the basis of cost, service and quality . these three elements are the distinguishing characteristics that set products apart from one another. JIT allows companies to filter out the wastes in the production process, improve upon quality and satisfy consumer demands in an efficient and reliable manner. 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.

1. *Increasing the organization's ability to compete with rival firms and remain competitive over the long run* Organization competitiveness is enhanced through the use of JIT as allows organization to develop an optimal process for manufacturing their product. There are nces between the production processes for conventional and for progressive organization.

The conventional organization is one which adheres to the well-practiced forms of production. The progressive organization is one that can respond to changes within the environment and adapt its manufacturing processes to these changes. Frequently, these types of organization are the first to develop or implement innovative methods of production. Thus, the progressive organization is one that would be more apt to adopt JIT management. The progressive organization is one that is able to remain competitive through adaptation to environmental changes.

The progressive organization will have a well-integrated system of manufacturing which involves shared organizational values co-ordinate flow of manufacturing techniques, people involvement and the opportunity to use potential skills. The differences which exist between the conventional and progressive companies involves operational and organizational characteristics.

The operational characteristics include set-up time, lot size, inventory, floor space, transportation, lead time, defect rates and machine trouble. It is typical for conventional companies to experience long set-up times transportation and lead times. Inventory, floor space and lot sizes are likely to be larges. In addition, defect rates and machine trouble will be high for the conventional firm as well.

The progressive company will have short set-up transportation and lead times. Inventory, floor space and lot sizes will be small and defects and machine trouble low for these organization. The overall functioning of production will be smoother and more efficient than for the conventional firm.
The organizational characteristics include the structure, orientation toward goals, communications, agreement, union focus, skill base, sup-pliers and education and training. The structure of the progressive organization allows greater flexibility. Oriented is toward total optimization of the whole company while avoiding departmental focus which tends to work against the achievement of organization–wide goals. Communication within the progressive firm is open and there is not a long chain of command to follow. Also, agreement among members is trust based as compared to control based. Union focus is company based rather than skill based. The skill base tends to be broad or flexible in contract is narrow down to include a selected few and the education and training aspects constitute a significant role. These types of organizations are more likely to invest more resources in training employees.
2. *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.
3. *Reducing the level of wasted materials, time and effort involved in the production process* Elimination unnecessary wastes can significantly reduce the costs of production.
The above three universal objectives are applicable to any firm; however, there exist several other goals which may be specific to organizations. 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 implementation. There exist short-and long-term goals, which include the following.

- *Identifying and responding to consumer needs* This goal will assist the organization in focusing on what is demanded from customers and required of production. the fundamental purpose of the organization is to produce products which its customers want, therefore, developing a manufacturing process which produces quality products will ensure the organization's viability.
- *Aiming for the optimal quality/cost relationship* Achieving quality should not be done to the point where it does not pay off for the organization. Therefore, emphasis should be placed on developing a manufacturing process that aims for zero defects. this may seem like an unrealistic goal; however, it is much less costly to the firm in the long run as it eliminates redundant functions such as inspection, rework and the production of defective products.
- *Elimination unnecessary wastes* There are wastes that do not add value to the product. different categories of waste are identified (goddard,1993), some of which are of more concern in the waste elimination processes than others.
- *Aiming for the development of trusting relationships between the suppliers* Also, relationships with just a few or even one supplier, if possible, should be focused upon. this will assist in the creation of a more efficient company in terms of inventory and materials, timeliness of deliveries and reassurance that the materials will be available when required.
- *Design the plant for maximum efficiency and ease of manufacturing* This involves the use of machinery and labour that are absolutely essential to the manufacturing process.
- Adopting the Japanese work ethic of aiming for continuous improvement even though high standards are already being achieved this will ensure that the organization remains competitive by continually striving for means of fulfilling consumer demand.

Although many north American plants adopted JIT management techniques some years ago, many of these firms still have not yet realized the full potential of benefits ,although significant improvements have been made. It has taken Toyota ten years t perfect the JIT technique within its plants. Therefore, JIT is a long-term process which cannot be implemented in a short period of time, nor can its rewards be realized overnight.

JIT can offer organization 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. lubben (1988) suggests three ways JIT can assist management in obtaining a competitive advantage.

1. *Integrating and optimizing* This involves reducing the operation and resources which do not facilitate production.
2. *Improving continuously* This involves continually trying to improve processes and systems.
3. Understanding the customer this entails reducing the cost of products and satisfying consumer needs.

Hall (1989) suggests four areas that contribute to efficiency gains: 30–60% reductions in quality rejects, decreased production time of 50-90%, reduction of capital expenditures of 25–30%; and significant decreases in inventory costs. Another possible benefit which may be realized is the discovery of problems inherent in the production process that may surface due to streamlining or to reduction of slack within the process.

JIT compared with traditional manufacturing

JIT manufacturing is a demand-pull, rather than the traditional "push" approach. The philosophy underlying JIT manufacturing is to produce a product when it is needed and only in the quantities demanded by customers. Demand pulls products through the manufacturing process. Each operation produces only what is necessary to satisfy the demand of the succeeding operation. No production takes place until a signal from a succeeding process indicates a need to produce. Parts and materials arrive just in time to be used in production. To illustrate the differences between pull and push systems of material control, the example of a fast food restaurant is used:

"At McDonald`s, the customer orders a hamburger, the server gets one from the rack, the hamburger maker keeps an eye on the rack and makes new burgers when the number gets too low. The manager orders more ground beef when the maker`s inventory gets too low. In effect, the customer` purchase triggers the pull of materials through the system... In a push system, the caterer estimates how many hamburgers are likely to be ordered in any given week. He/she can then figure out roughly how many ground beef need to be ordered in a certain week in advance..."

Reduced Inventories.

The primary goal of JIT is to reduce inventories to insignificant or zero levels. In traditional manufacturing, inventories result whenever production exceeds demand. Inventories are needed as a buffer when production does not meet expected demand.

Manufacturing Cells and Multifunction Labor.

In traditional manufacturing, products are moved from one group of identical machines to another. Typically, machines with identical functions are located together in an area referred to as a department or process. Workers who specialize in the operation of a specific machine are located in each department. JIT replaces this traditional pattern with a pattern of manufacturing cells or work centers. Robots supplement people to do many routine operations.

Manufacturing cells contain machines that are grouped in families, usually in a semicircle. The machines are arranged so that they can be used to perform a variety of operations in sequence. Each cell is set up to produce a particular product or product family. Products move from one machine to another from start to finish. Workers are assigned to cells and are trained to operate all machines within the cell. Thus, labor in a JIT environment is multifunction labor, not specialized labor. Each manufacturing cell is basically a minifactory or a factory within a factory. A comparison of the physical layout of JIT with the traditional system is shown in Figure 1.

Figure 1	comparison of the physical layout of JIT with the traditional system

Traditional Manufacturing

Department A	Department B	Department C
<P1> X X <P2>	<P1> Y Y <P2>	<P1> Z Z <P2>

Each product passes through departments which specialize in one process. Departments process multiple products.

JIT Manufacturing

Product 1 (P1) Manufacturing Cell 1	Product 1 (P1) Manufacturing Cell 2
Y <P1> X Z	Y <P2> X Z

Notice that each product passes through its own cell. All machines necessary to process each product are placed within the cell. Each cell is dedicated to the production of one product or one subassembly.

Symbols:

X = Machine A P1 = Product 1
Y = Machine B P2 = Product 2
Z = Machine C

Total Quality Control. JIT goes with it a stronger emphasis on quality control. A defective part brings production to a grinding halt. Poor quality simply cannot be tolerated in a stockless manufacturing environment. In other words, JIT cannot be implemented without a commitment to *total quality control (TQC).* TQC is essentially an endless quest for perfect quality. This approach to quality is opposed to the traditional belief, called *acceptable quality level (AQL).* AQL allows defects to occur provided they are within a predetermined level.

Decentralization of Services. JIT requires easy and quick access to support services, which means that centralized service departments must be scaled down and their personnel assigned to work directly to support production. For example, with respect to raw materials, JIT calls for multiple stock points, each one near where the material will be used. There is no need for a central warehouse location.

Suppliers as Outside Partners. The most important aspects of the JIT purchasing concept focus on new ways of dealing with suppliers, and a clear cut recognition of the appropriate purchasing role in developing corporate strategy. Suppliers should be viewed as "outside partners" who can contribute to the long run welfare of the buying firm rather than as outside adversaries.

Better Cost Management. Cost management differs from cost accounting in that it refers to the management of cost, whether or not the cost has direct impact on inventory or the financial statements. The JIT philosophy simplifies the cost accounting procedure and helps managers manage and control their costs, which will be discussed in detail later in the chapter.

JIT recognizes that with simplification comes better management, better quality, better service, and better cost. Traditional cost accounting systems have a tendency to be very complex, with many transactions and reporting of data. Simplification of this process will transform a cost "accounting" system into a cost "management" system that can be used to support management`s needs for better decisions about product design, pricing, marketing, and mix, and to encourage continual operating improvements.

The major differences between JIT manufacturing and traditional manufacturing are summarized in Figure 2.

Figure 2	JIT compared with traditional manufacturing
JIT	**Traditional**
1. Pull system	1. Push system
2. Insignificant or zero inventories	2. Significant inventories
3.Manufactoring cells	3. "Process" structure
4. Multifunction labor	4. Specialized structure
5.Total quality control (TQC)	5. Acceptable quality level (AQL)
6.Decentralized services	6. Centralized services
7. Complex cost accounting	7. Simple cost accounting

Prerequisite of JIT

Prerequisites to a JIT programme economic all the action and preparation that are required of the organization prior to embarking upon a JIT programm. These typically involve plant evaluation management influence, housekeeping activities and organizational flexibility. Each of these will be discussed separately below.

1. Plant evaluation

This is required of the organization to determine exactly where the organization stands in term of production and workforce capability. The success of JIT management requires the organization to be able to assess its present condition and to be instrumental in making changes in the following areas.

- A flexible workforce will be a requirement, this entails workforce capability to respond to skills and knowledge required to perform a number of various tasks of production.
- There must be commitment from all involved in the organization in and willingness to adapt to change.
- The idea of continuous improvement must be adopted into the philosophy and goals of the company.
- The use of teamwork becomes critically important to the development of a co-ordinate system.

In addition, evaluation becomes crucial in determining the degree of change and difficulty required for JIT implementation. The type of products through the manufacturing process is one which can determine the level of difficulty.

There are three ways in which products flow through the manufacturing process: continuous production, repetitive manufacturing and job-shop manufacturing. Generally, the smoother the products flow through the production process, the easier it will be to adopt JIT to the existing flow system. Irregular or unpredictable flow will present a greater level of difficulty.

Adaptation of JIT is easiest with continuous production as it is typical in involving the production of a single product with only a minimal amount of interruption in the process flow. Companies which operate in a continuous production environment possess a streamlined flow process with little or no fluctuations, set-up change and product variability. Change which will present greater levels of difficulty will be those involving relationships with suppliers and employees and those monitoring inventory levels.

Repetitive manufacturing involves continuous manufacturing but with short production runs. Generally, the production process is not continuous as there is no demand requirement to maintain continuous production. The production process is called into action by consumer demand. Two means of adapting this process to JIT exist. The first involves converting the short runs into a continuous production process.

This is accomplished by increasing volume or decreasing the rate of production to match that of the consumer requirements. The second method of adaptation involves reducing set-up times. This method allows for a reduction in excess inventories and an increase in available machine time.

Job–shop manufacturing involves production to meet variable demand, with small lot sizes and frequent set-up. This method allows for a reduction in excess inventories and an increase in available machine time.

Job-shop manufacturing involves production to meet variable demand, with small lot sizes and frequent set-ups. This method of manufacturing cannot easily be converted into a continuous flow from due to the random nature of customer orders. Furthermore, customer orders usually very low in volume. Adaptation of this method to JIT will require the use of work cells arranged by product, quick and easy set-up and procedures which minimize production costs. Establishing close can more accurately be assessed in a timely fashion. Accurate assessment will allow for superior scheduling leveling of production.

This will be instrument in persuading and motivating the employees to ward a JIT orientation. This is an important aspect as JIT success depends upon the degree to which employees are motivated and committed to making the process work as a co-ordinate system. To a certain extent, organizational attitudes and culture will have to be modified to mirror the beliefs that are integral to JIT success.

2. Housekeeping activities

These include management and employee efforts to reduce and eliminate the visible waste, cutter and obstacles from the production area. Unnecessary materials may present an obstacle to efficiency, safety and quality of production. The removal of unnecessary materials can also aid in the detection of other problems which may impede performance.

Housekeeping activities are closely linked to improvement activities (suzaki, 1987). Improvement activities are those actions carried out by management and employees which, both directly and indirectly, lead to an increase in productivity and enhancement of the value of the firm's products. Housekeeping activities are associated closely with the number of defective products, level of employee morale, frequency of machine breakdowns, flow of materials, employee suggestions and inventory levels. Understanding this relationship may contribute to higher levels of production and assist improvement activities.

3. Organization flexibility

Flexibility on the part of the organization planning to adopt JIT will also be a prerequisite. The organization may be required to respond to situations which are very different from those it is accustomed to, as JIT may inflict very new and foreign experiences on the organization. Ability to accommodate these experiences will be measured by the organization's capacity to respond quickly to these experiences and demands. The organization should consider flexibility on four levels: adjustment to changes in volume, modification of the product mix, choice of equipment and people flexibility (HALL, 1987). These are explained below.

1. Flexibility to adjust to changes in volume pertains to the organization's willingness to plan carefully and to analyze future capital expenditures. Capital expenditures should be engaged when such purchases will assist meeting the purposes of operations and complement the overall manufacturing processes. Flexibility of this nature also implies that organizations should strive to maintain low levels of overhead, process costs and equipment in order to achieve a low break-even point.

2. Flexibility to modify the product mix will require an organization to employ multi-skilled workers, low inventory levels with a wide variety of parts and reduced set-up times for operations.

3. Flexibility in choice of equipment for operations will be a consideration of the organization when it is faced with specific tasks. The first approach to meeting the demands of specific asks is to adapt the existing general purpose equipment to those tasks. in the event that this approach proves to be inappropriate,

equipment designed to perform the specific tasks should then be purchased or built, but at the lowest cost possible to the organization.

4. Development of employees to acquire multiple skills, or of specialists willing and able to accommodate the needs of production, should be focused on as a means of creating an organization with greater flexibility. Employing such people will allow the organization to meet variations in demand and ensure that production can continue in a smooth and steady manner. An organization which fails to cultivate flexible employees may be characterized by such occurrences as production line stoppages. Line stoppages result from employees who are hesitant to perform a necessary task because it is not directly related to their job function. 10

JIT implementation strategies

JIT comprises a fairly large set of techniques that cannot all be implemented at once. Due to its complexity, it is impossible to specify a sequence of well-defined steps for its implementation in any particular case. However, some general guidelines for its implementation have been suggested and these form a basis for finding the appropriate way for implementing JIT. Inman (5) suggested that key obstacles such as long change over time; unleveled production schedules; highly variable production processes; large container sizes; severe bottlenecks, and long lead times should be removed before implementing the JIT. Long changeover times must be addressed first. Because of the complex nature of JIT implementation, it is important to focus the system on a well-defined area by delimiting the domain of application appropriately. Broadly speaking, one can think about JIT implementation from different angles, the most common being people and the engineering angles. The former comprises aspects of attitude and motivation as well as education in the philosophy of JIT and training in the detailed procedures. 'Engineering', on the other hand, comprises aspects of JIT such as layout, product design for manufacture, and setup reduction. Many companies have sought to implement JIT from the engineering side. However, JIT experts such as Schonberger (8) and Hall (4) maintain that it is essential to begin JIT implementation with a good deal of attention first being paid to the people aspects. In order to build up a knowledge base of JIT implementation steps, Fiedler et al. (3) has proposed the following two stages process:

1. Prepare the plant and its people for flexibility, low costs, short lead-times and high quality by concentrating on design; maintenance; quality; layout; set-up time; and people.
2. Strive to produce zero lead-time with no waste by focusing on: total people involvement; visibility; process data collection; enforced improvement; flow scheduling; inventory control; buffer and lot size reduction, and supplier and customer relationship.

These two stages, however, don't specify a general sequence of steps for the implementation of JIT.
Moreover, the ability of the different techniques in both stages depends highly on a specific manufacturing environment. Therefore all techniques of stage1 do not necessarily have to be implemented before starting first stage. Rather, the implementation of JIT is an ongoing cyclic process of improvements--actions in one area make actions possible in another area. Likewise, Padukone and Subba (7) have grouped the JIT techniques into two stages. The first stage of JIT implementation is composed of areas that are necessary for full JIT to work. They focus on four main elements of JIT that can be achieved in the short term. These are simplicity, flow, quality, and fast set-up and lay the foundation for moving on to the more difficult techniques like kanban and JIT purchasing, which are a part of stage two. 7

Example of JIT implementation in the U.S

The following are examples of the many implementations in of JIT in the U.S.

- The Oldsmobile division of general motors (GM) has implemented JIT project that permits immediate electronic communication between Oldsmobile and 70 of its principal suppliers, who provide 700 to 800 parts representing around %85 of the parts needed for the new GM -20 CARE.

- PTC components, a supplier to GM ,has assisted GM in its use of stockless production by sending one truck a week to deliver timing chains to several of GM's engine plants rather than accumulate a truckload to ship to each plant.
- Ford introduced JIT production at its heavy-duty truck plant in Kentucky, which forced firestone to switch its tire searching point from Mansfield to Dayton, Ohio. By combining computerized ordering and halving inventory, firestone has been able to reduce its own finished–goods inventory. In addition, its production planning is no longer guesswork.
- Each day a truck from Harley-Davidson motor co. transports 160 motorcycle seats and assorted accessories 800 miles to Harley's assembly plant in York. Pennsylvania, as a part of their advanced "materials as needed" (MAN) programs-its version of JIT.
- The Hoover Company has used JIT techniques in its two plants at North Canton, Ohio, for a number of years for production scheduling and material flow control of 360 different models and 29000 part numbers.
- Some plants of Du Pont used JIT and had an inventory savings of 30 cents on the dollar for their first year.
- The Vancouver division of Hewlett-Packard reported the following benefits two years after the adoption of the JIT method:

Work-in-process inventory dollars	down 82 %
Space used	down 40 %
Scrap/rework	
Production time:	down 30 %
Impact printers	down 7 days to 2 days
Thermal printers	down 7 days to 3 hours
Labor efficiency	up 50 %
Shipments	up 20 %

JIT techniques have also been implemented by the following companies: 2

Wal-Mart	Chrysler	Intel	Borg-Warner
Toys "R" Us	Westinghouse	Motorola	John Deere
General Electric	AT&T Mercury Marine	Black & Decker	Xerox

JIT and management accounting

Management accountants in many organizations have been strongly criticized because of their failure to alter the management accounting system to reflect the move from a traditional manufacturing to a just-in-time manufacturing system. Conventional management accounting system can encourage behavior that is inconsistent with a just-in-time manufacturing philosophy. Management accounting must support just–in–time manufacturing by monitoring, identifying and communicating to decision to-makers any delay, error and waste in the system. modern management accounting system are now placing greater emphasis on providing information on supplier reliability, set-up times throughput cycle times, percentage of deliveries that are time and defect rates.

JIT manufacturing systems result in the establishment of production cells that are dedicated to the manufacturing of a single product or a family of similar products many of the support activities can be directly traced dedicated cells. Thus, a high proportion of costs can be directly assigned to products. Therefore the benefits from implementing ABC product will be lower in JIT organization. 1

References

Colin Drury, 2001, "Management Accounting for Business Decisions, 2nd Edition", pp: 473

Don R. Hansen and Maryanne M. Mowen, 2006 "Cost Management, Accounting and Control, 5th Edition", pp: 510

Fiedler K., Galletly J.E. and Bicheno J., 1993, "Expert Advice for JIT Implementation." International Journal of Operations and Production Management, Vol.13, pp. 23-30.

Hall R.W., 1983, "Zero Inventories." (Homewood, IL: Dow Jones-Irwin)

Inman R & Bulfin R.L., 1991, "Sequencing of JIT Mixed Model Assembly Lines". Management Science, Vol.37, pp. 901-904.

Jae K. Shim and G. Siegel, 2000, "Modern Cost Management & Analysis", pp: 118-121

Vikas kumar, 2010, "JIT Based Quality Management: Concepts and Implications in Indian Context" International Journal of Engineering Science and Technology Vol.2(1), pp 40-50

Padukone H. and Subba R.H., 1993, "Global status of JIT- Implication for developing countries", Vol. 34. No.3, pp: 419-429.

Schonberger R. J. and Ebrahimpour, M., 1984, "The Japanese Just-in-Time/Total Quality control production system: potential for developing countries", International Journal of Production Research, Vol.22, pp: 421-430.

T.C.E. Cheng and S. Podolsky, 1996, "Just-in-Time manufacturing, An introduction 2nd Edition", pp: 2-18