Title: The Manufacturing Characteristics of a Successful JIT Implementation

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Abstract: Key characteristics to the successful implementation of a just-in-time installation are reviewed from the literature searches conducted, and conclusions presented.

THE MANUFACTURING CHARACTERISTICS OF A SUCCESSFUL JIT IMPLEMENTATION

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INTRODUCTION

Today's manufacturing environment is a rapidly changing and highly competitive environment which requires quick response to the new conditions. Development and introduction of new manufacturing philosophies and technologies are necessary to respond to the changing environment and to have a competitive edge. Just-in-Time (JIT) manufacturing is one of the oldest and important concepts emerged to help finding ways to solve the above problems.

The basic idea behind the JIT philosophy is to have the correct part at the desired time in the required amount through efficient production flow, inventory reduction and quality improvement[1,2]. JIT manufacturing philosophy is best utilized when it is used with other manufacturing concepts such as computer integrated manufacturing(CIM), flexible manufacturing systems(FMS), total quality management(TQM) and materials requirement planning(MRP).

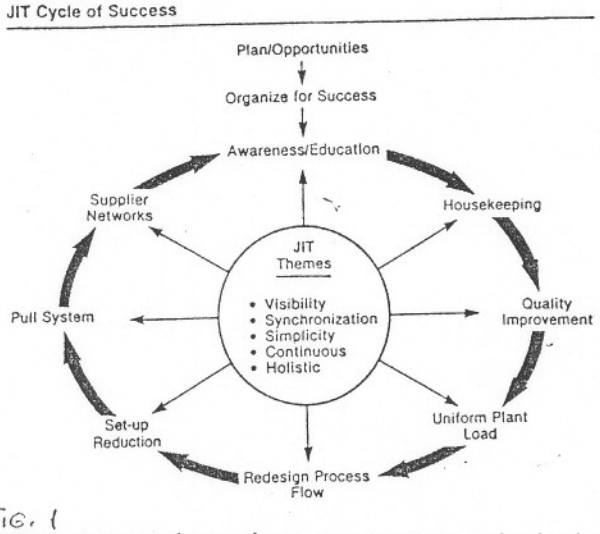

FIG. 1

JIT affects the organization through visibility, synchronization, simplicity, continuous production, and holistic manufacturing and these elements are the centre of JIT cycle of success[4,pp:25]

shown as in figure 1. The implementation of JIT requires more than new technology, a new way of thinking through out the organization from top management to the employees. To work out JIT, there should also be a total involvement and good interactive communication among management, unions, carriers, and suppliers[3]. Successful implementation of JIT, also depends on how effectively the organization coordinates the activities of management, design, supplier/carrier relations, performance measurement, human resource management, manufacturing and customer relations. In this paper, the important characteristics of manufacturing will be discussed in depth while the other activities will be considered briefly.

The major benefits of the implementation of JIT manufacturing are shorter lead times, reduced inventory, reduced waste and scrap, quick response to customers, increased productivity, profit and market share, and improved quality[5,6,12]. To achieve these goals there should be some changes in the organizational characteristics. So, the major obstacle to JIT becomes the resistance to change as most of the people dislike change[7]. To overcome this problem, the importance should be given to education, training and cooperation of suppliers, management and employees[8,9].

It will be wrong to expect short term results from JIT implementation as its benefits can be fully realized on a long term basis. The acceptance of the time and cost needed to benefit from JIT and a process-oriented behaviour with long term commitment are the key factors for the success of JIT[9,10].

BASIC CONCEPTS OF JIT

Nahmias defined JIT as a production planning philosophy aimed at reducing work-in-process(WIP) inventories to the bare minimum[11,pp:594]. As it can be understood from this definition the major aim of JIT is to reduce inventory and produce only when needed which can be achieved by small lot sizes. In the ideal case of JIT, there should be zero inventory and the lot size should be one.

But it is not realistic to view JIT only as a inventory management tool. Just-in-time manufacturing system has several effects on top management, human resource management, technology management, manufacturing strategy and quality management through continuous improvements[12].

JIT is an operating philosophy which requires the commitment and understanding of the whole organization. JIT can not be implemented quickly as it requires organizational change as well as physical plant changes. Also it is a continuous process not a one time activity. Without the understanding of these basic points it will be unrealistic to expect a successful implementation of JIT.

It is important to note that its proved credibility, the feedback it provides and total employee involvement are the three reasons why JIT can be successful where other systems may fail under same environmental conditions[13].

Using JIT with MRP is proved to have a positive effect on the expected benefits of JIT. At the beginning, they appear to be incompatible as there are major differences by definition. MRP deals with planning while JIT with process[14], MRP is a push system where JIT is a pull system[11,15] and to some extend JIT unlike MRP is a philosophy[16]. But when their expected end results are considered, it is seen that they are very much compatible and can be used together in achieving goals such as reduced WIP, reduced lead time and less waste[14,17]. They can work together as they attack the inventory problem from different aspects. They both try to obtain zero inventory balance. MRP can be used for planning purposes while JIT can be used to control the production. The only problem is how to utilize them in a coordinated manner. Bose and Rao suggested a hybrid system where MRP is used to plan production and JIT is employed to execute and control production[15]. MRP helps JIT mostly in the areas of synchronizing the production, reducing setups and producing the necessary accurate schedules that are required by JIT.

ORGANIZATIONAL CHARACTERISTICS

JIT implementation is affected by different activities of the organization and their related characteristics. These characteristics are essential for the successful implementation of JIT manufacturing and can be grouped under seven separate activities. Design, management, supplier/carrier relations, performance measurement, human resources management,customer relations and manufacturing are these activities. All of them, except the latter one, will be discussed briefly in this section. A detailed discussion of characteristics of manufacturing is going to be presented in the following section.

Design: The design process includes product design, facility design, and system design and planning. All of these designs should be made in such a way to help the successful implementation of JIT. Facility layout should be designed so that the production flow becomes smooth and easy. Also, an automated manufacturing system should be designed and implemented to aid the JIT philosophy. According to Bandyopadhyay, for product design, a holistic approach for developing, designing and redesigning products to meet customer needs is necessary[18]. Computer-aided design and engineering can be effectively utilized for the design activity. Using such computer applications will enable the designs to be updated and improved very easily.

Management: Top management must involve and support the implementation of JIT. To do so, they should understand the

underlying concepts of JIT completely. These concepts must be clearly communicated throughout the company[19]. Task forces with members from several departments should be formed to increase involvement and interaction among people and departments. Adair-Heeley stated that participation, more ideas, better ideas, willingness to take risk, power and influence and quality of work life are the six reasons of having teams[20]. Also, if management can apply TQM concepts throughout the company, the chances of a successful implementation of JIT increase considerably. Finally, manufacturing requires company coordination and integration of manufacturing with other functions which can be achieved by top management leadership[12,pp:12]

Supplier/Carrier Relations: Having a reliable transportation network which is a result of the selection of a carrier who has a dependable transit time and quick response rate is the major characteristic of a good supplier/carrier relation. Supplier selection process is another characteristic of this type. Supplier should be selected do that there will be minimum number of supplier who are reliable. The suppliers must respond to the company's needs quickly and precisely, so that the company can successfully utilize JIT manufacturing. If the company can reduce supplier lead-time, it can cut the cost and be more responsive to the changing customer requirements. Quality on the supplier side also plays an important role in determining the strength of this type of relation. Suppliers must involve and support JIT to have a perfect flow of materials and supplier arrangements must be made to assure quality

and availability of materials[23].

Customer Relations: Quality is the most important part of having a good customer relation. The perfect quality means zero defects. And this can be achieved as a combination of several processes. Using the manufacturing techniques that help to minimize defects, proper packaging by using durable containers, using a good and reliable demand forecasting technique and applying a vendor development and procurement planning. In addition to the above characteristics, direct employee participation in defect detection and providing feedback[21], and having a major control technique such as; statistical process control plan, supplier quality assurance approval and defective material tracking system[3], are the other important factors to achieve the highest quality level. Also, customer support is necessary to achieve the desired demand pattern of JIT production[23].

Performance Measurement: A properly functioning performance measurement system is one of the important success factors for the implementation of JIT. A performance measurement system helps companies to see the improvements and results of their investments. Classically, performance is measured by profitability. First of all, the old cost accounting system is not appropriate to measure the performance of such long term applications as they deal only with the short term cash flows and depend heavily on direct labour. So, some modifications should be made to overcome these difficulties. According to Cocker, developing a good accounting

system includes understanding the production and related costs, a movement toward zero inventory, targeting perfect quality and stable production rates[24]. An activity-based-cost(ABC) system can be utilized to overcome the cost problem. Also, other performance measurement criteria such as WIP inventory, lead time, quality, process tracking and feedback have to be used to cover the long term benefits of a successful JIT. To measure the system performance and receive good feedback companies should apply several quality control approaches[25].

Human Resources Management: Without managing the human resources in the organization it is hardly that a JIT implementation becomes successful. Templin stated that people should be respected and recognized as important resources whose capabilities must be fully utilized to find and eliminate the waste in the system[23]. All the personnel should be educated, trained on the JIT concepts, advantages and requirements. Employees need to be encouraged to involve in the system and to be motivated to exchange ideas. The other important characteristic is the employment of multi-functional workers[2,12,25]. Lee and Ebrahimpour stated that this will increase flexibility, productivity and teamwork[2]. Also, it is important to point out that most JIT approaches are aimed at increasing the scope of jobs and worker cross training for increased flexibility since the same labour capacity can be assigned to several different machines[25].

CHARACTERISTICS OF MANUFACTURING

Manufacturing involves the activities that are at the operational level of production. The important characteristics of manufacturing for the successful implementation of JIT are; production smoothing through setup and lot size reduction[2,11,12,23,25,26,29,30], application of pull system such as Kanban[2,11,12,23,26,28,29,30], standardization of jobs through uniform and invariable output rate[2,23,26,27,30], preventive maintenance[12,23,26,29], and WIP inventory reduction[11,12,23,26,28].

Production Smoothing: Lee and Ebrahimpour referred to setup time and lot size reduction as the production smoothing[2]. Achieving production smoothing is necessary for a company in order to be more flexible and responsive to the customer requirements. The fundamental idea of JIT is to produce in lot sizes as small as possible and minimize WIP inventory by pulling the inventory in small lot sizes[11]. With small lot sizes it is possible to meet the production requirements without worrying about the scheduling of production[23]. Setup time reduction is also essential for decreasing the total production time, decreasing WIP inventory and increasing the responsiveness to the customer needs. Setup and lot size reductions can be achieved by applying industrial engineering techniques, management techniques and organizational strategies[11,25]. Automated manufacturing and group technology can be utilized to achieve the desired levels of lot sizes and setup times.

Pull-System: One of the important elements of the JIT implementation is the demand pull-system. It is the system where material is pulled by the next process from the previous one[23]. Applying pull-system WIP inventory can be decreased considerably as the production level in one work station is determined by the requirement of the next one. So that there will be less WIP inventory. Kanban which is the word for card in Japanese, is the most common way of applying pull-system. Kanban is used to track inventory. "By using a piece of board (Kanban), the right amount of correct material can be automatically supplied at the necessary time from the preceding work process to the following work process. By introducing this system, production and delivery instructions will be made automatic"[28,pp:13]. If Kanban is supported by some computer applications the outcome of it will increase. Defect free production and continuous flow of production are the basis of the Kanban system[28].

Standardization: Standardization of jobs is necessary to obtain a more uniform, and invariable output rate[2]. When the jobs are not standardized there should be a lot of scheduling to coordinate the flow of production. In JIT manufacturing the production must continuously flow. There should be minimum disruptions to the production. Standardized products and jobs will result in a more predictable and continuous production. Also, the output rate will be uniform and less variable as the production cycle time becomes more stable and constant. Stable production is one of the key elements of success in JIT implementation. Linearity is the measure

of stability of the production process[22]. Linearity measures the average absolute deviation of the actual production to daily production. In other words, it measures how smoothly the production flows. One important way of achieving standardization is to decrease the number of parts that are in production[27]. Producing fewer parts makes the scheduling easy and the work effort required during production less. Also it will help to reduce the setup time as the need for setups will decrease. Carrying costs will decrease and parts will be produced more often as a result of the reduction in number of parts[27].

Preventive Maintenance: JIT implementations should also place a high emphasis on preventive maintenance[23]. Preventive maintenance means to take the necessary actions beforehand to prevent the coming problems and failures. By applying preventive maintenance concept machine downtimes and machine breakdowns can be minimized and the smooth flow of production can be maintained[23,31]. Automated manufacturing and usage of computers in the production will help the company to apply preventive maintenance more easily.

WIP Inventory Reduction: WIP inventory reduction is actually a result of all the above characteristics of JIT manufacturing. It is hard to separate it from the others. But as it is the major goal of JIT is necessary to indicate it as a characteristic of the manufacturing system. WIP inventory can be reduced by combining structured flow paths with a linear operation and in turn stabilizing, smoothing out and speeding up the flow of the

materials through the system[23]. In the non-JIT manufacturing systems there should be a buffer inventory (WIP inventory) to maintain low operation lead time when the company is faced up with unscheduled breakdowns in one or more parts of the production. This buffer inventory buries the problems which the company is not used to. Perfect JIT aims to reach the goal of zero inventory and a lot size of one[11]. JIT is willing to reduce the WIP inventory -seeing it as a waste- and this uncovers the problems like worker idle time, production interruption because of a machine breakdown -the company does not have enough buffer stock to compensate this. The basic solution for this problem is being proactive by employing multifunctional workers and applying preventive maintenance techniques.

CONCLUSIONS and RECOMMENDATIONS

JIT has fathomless implications in the production planning and control. To realize the benefits of JIT or to be a successful implementor, the company has to go through some changes. It will not be easy to change systems and the habits in a reasonable time frame in some companies. In those companies it is much more essential to convince people. JIT philosophy relies on people to avoid the waste associated with time, energy, material and errors such as over production, waiting time, unnecessary transportation, unnecessary processing, inventory, unnecessary motion and defective production.

JIT is an organizational philosophy in manufacturing focused on continuous material flow. It may be the system in which we experience high levels of employee, organization and manufacturing activities interaction.

However we tried to divide the characteristics of the successful implementations of JIT into activities, none of them can be easily separable from the others. They should be regarded as little squares in a mosaic. With some missing you still get the picture but not the perfection.

Once we understand the organizational principles it is easier to evaluate our production system and foresee the possible problems that may occur in implementing JIT. JIT requires continuous improvement and consistency in revealing problems and solving them.

Finally it targets an increased throughput rate. You get more out of JIT if you implement it cooperatively with other manufacturing concepts like group technology or TQM. These are highly complementary and focus on perfecting the quality and productivity of process and materials flow.

JIT is one of those incongruous things in advanced manufacturing where companies are working towards manless production facilities. But it will not be long to take man's fundamental role out of sight in factories having computer integrated technologies, artificial intelligence and expert systems.

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