A Systematic Review on Just in Time (JIT)

Swapnil S. Dange[1], Prof. Prashant N. Shende[2], Chetan S. Sethia[3]
Scholar M.Tech[1], Assistant Professor[2], Scholar M.Tech[3]
Department of Mechanical Engineering
Yeshwantrao Chavan College of Engineering Nagpur[1,2,3]
(An Autonomous Institution Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

***Abstract* - How many people in the automobile industry, manufacturing industry, and electrical industry can truly say that they have not heard about JIT? Not many. Just in Time (JIT) has been a very popular operation strategy partly because of its success in Japanese industry. Various benefits for example, inventory reduction, improved in operation efficiency and faster response. JIT implementation can involve a series of incremental steps and missteps, before the desired outcome is achieved. Customer has focus on product quality, product delivery time and cost of product. Therefore, success full implementation of JIT is vital to many industries. JIT implementation improves performance through lower inventory levels, reduced quality cost and greater customer responsiveness. This paper will examine the roll of a company's resource. This paper present a literature review on a small manufacturing that altered its resources configuration from a producer- consumer relationship separated by a buffer, to a simultaneity constraint. The result of this paper shows that the removal of the buffer system increased the manufacturing system's need for mix flexibility and indicates that JIT system is success full, and operating JIT system can lead to many advantages to the case company.**

***Keywords* - Just in Time, Buffer system, Inventory reduction, Producer- Consumer relationship**

I. INTRODUCTION

The principle of Just in Time (JIT) is to eliminate sources of manufacturing waste by getting right quantity of raw material and processing the right quantity of products in the right place at the right time. Just-in-Time (JIT) theory has been operating widely in the Japanese automobile industry and the electronics industry, though more and more applications can be found in many industries over the world. In today's competitive global business environment, the goal of all manufacturing systems is long-term Survival. The ideology of JIT is '*producing the necessary item in the necessary quantity at the necessary time is an eternal diver of production and operations management*'. A manufacturing company's survival in an increasingly competitive market closely depends upon its ability to produce highest quality product at lowest possible cost and in a timely manner with shortest possible lead time.

The roots of JIT system can probably be traced to Japanese manufacturing industries. Japan has inherent limitation of lack of space and lack of natural resources. Japanese have developed an aversion towards all kinds of wastes. They view scrap and rework as waste and hence strive for perfect quality. They strongly believe that inventory storage wastes space and results in locking up of valuable material and capital. Anything that does not contribute value to the product is viewed as waste. Thus, it is quite natural for the JIT philosophy to develop in Japan. Apart from eliminating wastes JIT has another important feature utilizing the full capability of the worker. Workers in JIT system are charged with responsibility for producing quality parts Just in Time to support the next production process. The objective of JIT system is to improve profits and return on investment through cost reduction, inventory reduction and quality improvement. Involvement of workers and elimination of waste are the means of achieving these objectives [18].

Just in Time (JIT) means making only what is needed, when it is needed, and in the amount needed. For example, to efficiently produce a large number of automobile parts, which can consist of around 40,000 parts, it is necessary to create a detailed production plan that includes parts procurement. Supplying what is needed, when it is needed according to this production plan can eliminate waste, inconsistencies, and unreasonable requirements, resulting in improved productivity.

In addition, these goals should be achieved by paying utmost respect to the humanity of the employees who make the system work. Sometime, the difficulty of achieving the goals lies in the complexity of manufacturing operations. It is not difficult to build the high quality product, but is extremely difficult to do so while maintaining excellent quality, and at some time respecting the humanity of people who do the actual work of building that product.

Just in Time (JIT) is a production strategy that strives to improve a business return on investment by reducing in-process inventory and associated carrying costs. Just in Time (JIT) is a type of operations management approach which originated in Japan in the 1950s.

Just-In-Time (JIT) is a system that focuses on waste reduction and continuous improvement to achieve operational excellence. In a manufacturing context, JIT involves a manufacturing system where the parts needed to complete finished products are produced or delivered at the assembly site as required. Over the last three decades, hundreds of journal articles have been written on research carried out in the area of JIT manufacturing. The vast majority of these articles extol the benefits that can be achieved through the implementation of JIT practices, including increased performances with respect to manufacturing costs, quality levels, delivery responsiveness and flexibility. JIT manufacturing is said to be based on a number of principles. These principles, though somewhat varied depending on the research focus, almost always list two factors: elimination of waste and total employee

involvement; with researchers sometimes including other factors such as supplier participation, total quality control and workplace organization [18].

II. LITERATURE REVIEW

The main focuses on product quality, product delivery time and cost of product. The objective of this paper is to increase the productivity and quality of work by implementing the JIT [1]. This author take the semi structured interviews were organized and thus relevant data can be collected. The conclusion of this research indicates that JIT system can lead to many advantages to the company [2]. The fundamental focus of JIT is the systematic elimination of non value added activity and waste for the production process [3]. The flux used in submerged arc welding after use generates wastages of flux i.e. slag. It is generally thrown away as waste after use. So this slag collected and mixed with some additives and reused [4]. This author focus on Buffer stock removal, cellular manufacturing, group technology, layout improvement, set up time reduction, worker motivation, W.I.P. reduction [5]. The main focuses on producer consumer relationship separated by a Buffer, to a simultaneity constraint. JIT system focuses on waste reduction and continuous improvement to achieve operational excellence [7]. This is based on the application of activity based management. To check each activity and reduces the non value adding activity [8].

There is reasonable consensus among researchers that Just in Time (JIT) is a philosophy of continuous improvement in which non-value-adding activities are identified and removed in order to reduce cost, improve product quality, improve performance, improve delivery, add manufacturing flexibility and stimulate innovation in workplace [11, 12, and 13]. When the JIT principles are implemented successfully across many parts of an organisation, a significant competitive advantage can be enjoyed. Enhanced efficiency from waste reduction in order taking, purchasing, operation, distribution, sales and accounting [14, 15]. Operationally, JIT production requires that waste be identified and eliminated in the following areas: waste from overproduction, waste created by waiting or idle time, waste of motion, transportation waste, processing waste and waste from product defects [16, 17].

III. RESOURCE COORDINATION

Resource coordination considers the process of managing dependencies among activities; where dependencies are the relationships of the actions carried out by an element in a system which can affect the actions of another element in the system. In this research, a company's manufacturing resource configuration outlines the relationship and layout of resources [8].

Table 1 shows three types of dependencies commonly found in manufacturing systems: shared resources, producer – consumer relationships and simultaneity constraints, along with the coordination mechanisms used to manage these dependencies.

The workforce is main source of flexibility in JIT. With this flexible workforce, when one worker is not available or falls behind to perform his work, another worker can do this job. Therefore flexible/multifunctional workers are trained to perform a wide range of jobs at very short notice [6]. Most interviews support that proper design of information system could assist JIT system. They pointed out that information system is a technological foundation and its application to JIT is an elevated method for implementing JIT production system [2]. Each organization requires information to make decision, set priorities, allocate resource and monitor the action taken [3].

Table 1 Types of Dependency In Manufacturing System

Dependency	Features	Coordination Mechanism
Information shared	Involves organizational information sharing	Direct communication
Producer Consumer relationship	Links two activities, where the output of one activity is the input of the second activity	1.Coordination by plan 2.Inventory management
Continuous constraint	Occurs when activities must be carried simultaneously or when activities are mutually exclusive and cannot occur at the same time	1.Sheduling 2.Synchronization

IV. OBJECTIVE OF JIT

The objective of the JIT manufacturing to eliminate waste hence better inventory control, better product quality and better overall financial and operational procedure can be achieved. The main objective to achieve that the manufacturing time is less than or equal to customer requested lead time.

Just in Time is a manufacturing system whose goal is to optimise processes and procedures by continuously pursuing waste reduction.

V. JIT TOOLS

- Preventive maintenance.
- Eliminating waste.
- Set up time reduction.
- Mixed production.
- Kanban.
- Cellular work flow.
- One piece flow production.
- 5 S's.
- Poke yoke.
- Total productive maintenance.

VI. ACTIVITIES

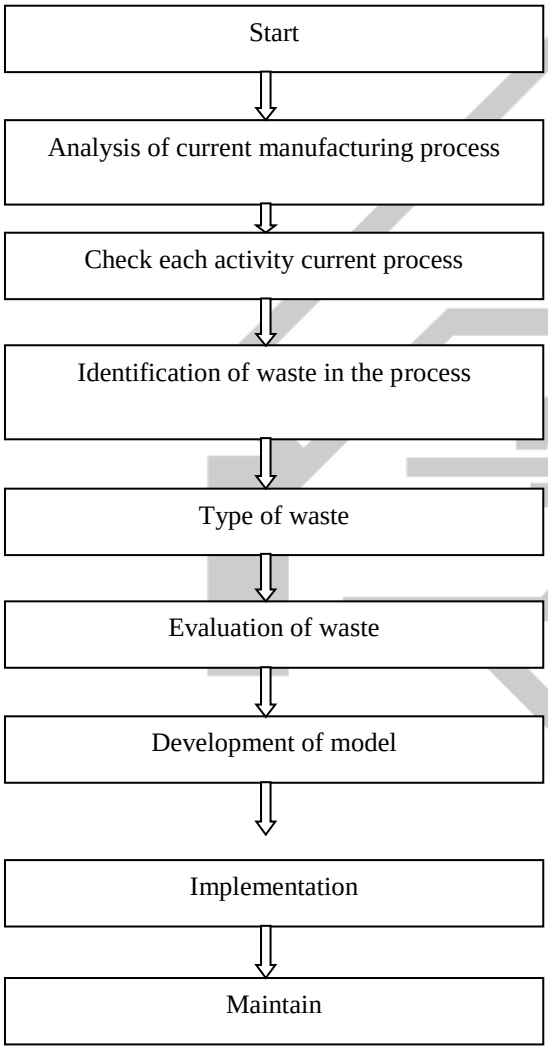
1. Finding Value-Added and Non-Value-Added Activities

Once the activities are specified the next step is to identify value-added and non-value-added activities. A non-value-added activity is often defined as 'Activity that can be eliminated with no deterioration of product attribute. Definition of a value-added and non-value-added activity is often confused and misunderstood. Some people think that non-value-added activity means waste, other it means cost of quality and to other it might mean everything other than labour. The value stream analysis was carried out by breaking down each step into a series of activities, the time taken for each activity was recorded, and each activity was given a designation to indicate whether it added value. Value-add activities were designated as operation, while non-value-add activities were categorized as delay, transport, and inspection [3].

The cost of maintaining quality in processes should be considered in eliminating the inspection activity. Material handling activities cannot be eliminated at the cost that is difficult to justify. Sometime, non-value-added activities can be clearly identified, but difficult to eliminate completely. However, it is always possible to reduce the cost of these activities [10].

All activities should be carried compared with similar activities in other manufacturing industry or within the organisation which performs the best in class. Benchmarking should be carried out for both value-added and non-value-added activities and Finding out and comparing an activity with a benchmarked of good practice help to determine the scope for further improvement. A manufacturing system operates with timing of step-by-step activities which is shown in flow chart.

FLOW CHART



2. Process Improvement (Removing Buffer)

Improvement in quality, flexibility and productivity are commonly required. Constant elimination of buffer stocks is emphasised to highlight production problems scheduled by high inventory levels. Just in Time manufacturing is a philosophy rather than a technique. By eliminating all wastes and seeking continuous improvement, it aims at creating a manufacturing system that is responsive to the market needs. The phrase Just in Time is used because the system operates with very low WIP (work in process) inventory. Products are assembled just before they are sold, subassemblies are made just before they are assembled and components are made and fabricated just before sub-assemblies are made. This leads to lower WIP and reduced lead times. To achieve this organizations have to be excellent in other areas, e.g. quality.

The following lists some of the way that process can be improved.

- Rearranging the layout to eliminate large amount of inventory between operations.
- Add additional machine in parallel to increase the capacity.
- Minimize non-value-added activities.
- Eliminating the buffer stock and moving one piece flow.
- To improve the efficiency.

VII. TAKT TIME

Assuming a product is made one unit at a constant rate during the net available work time, the takt time is the amount of time that must elapse between two consecutive unit completions in order to meet the demand. Takt time means the rate at which the customer buys the product.

Available time = Working hours - Breaks

$$Takt\ Time = \frac{Available\ working\ time\ per\ shift}{Customer\ demand\ per\ shift}$$

Net available time is the amount of time available for work to be done. This excludes break times and any expected stoppage time.

VIII. OVERALL EQUIPMENT EFFICIENCY

OEE is a key performance indicator to evaluate how effectively a manufacturing process is utilized.

Value-Added = Total process time

Total time = Total process time + non-value-added

1. *Available Operating Time (AOT)*

   Availability indicates the problem which caused by downtime losses.

   $$AOT = 1Day*1Shift\ time\ (consider\ downtime)$$

2. *Performance Factor (PF)*

   Manner or quality of functioning a machine performance takes into account speed loss, and is calculated as:

   $$PF = \frac{Design\ cycle\ time * Output}{Operating\ time}$$

3. *Quality Factor (QF)*

   Quality indicates the scrap and reworks losses, and is calculated as.

   $$QF = \frac{Production\ input - Quality\ defect}{Production\ input}$$

4. *The Overall Equipment Efficiency (OEE)*

   OEE takes into account all three OEE factors, and is calculated as:

   $$OEE = Availability * Performance * Quality$$

   It is very important to recognize that improving OEE is not the only objective. The beauty of OEE is not that it gives you one magic number; it's that it gives you three numbers, which are all useful individually as your situation changes from day to day. And it helps you visualize performance in simple terms-a very practical simplification.

IX. CONCLUSION

From these papers we are identified that value mapping activity is an ideal tool to find out wastages. Just in Time (JIT) manufacturing makes outstanding improvement in area of cost and productivity through best use of human resources by focusing on simplicity, waste elimination and time reduction. It helps the companies to reach their ultimate goal of sustainability and profitable growth in the future.

Future scope of Just in Time (JIT) to bench mark or to study more manufacturing, automobile companies so the result can be generated it helps to improving productivity as well as Overall Equipment Efficiency (OEE).

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