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A Case Study on Application of JIT in Lean Manufacturing Industry

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Abstract: In today's business world, Just in Time (JIT) has been a very popular operation strategy. JIT or lean manufacturing provides a systematic way for minimising the wastage from the manufacturing processes. This system follows certain principles like elimination of waste, delivering products on the right time etc. JIT implementation can lead to various benefits such as better product quality, inventory reduction. Though implementation of JIT requires a series of incremental steps to get the essential outcome. As nowadays customers are mostly focused on product quality, delivery time and price of product, successful implementation of JIT is important for many organisations. By surveying some information and examining the role of a company's resources, this paper presents a case study on a local manufacturing industry that implements the JIT system as their new resources configuration and remove buffer system. The result and observations of this case study will display that the removal of the buffer system led to many advantages which indicates that implementation of the JIT system is successful.

Keywords*:* Just In Time (JIT), Waste Management, Lean Manufacturing, Kanban

I. INTRODUCTION

Globalisation phenomena had created the business without limitation. Nowadays the main focuses of global organisations are Customer satisfaction and the product and service quality. These are the two main portions that can influence the global market. To survive in today's competitive business environment, all organisations across the world need to take initiative to increase the product quality to satisfy the needs and customer demands that always change besides minimising the production cost [1]. The Just in Time (JIT) concept is one of the most effective solutions for this initiative. The concept of JIT was first theorised and implemented by Japan. Triggered by the economic climate of the post-World War II, Japanese manufacturers began adopting the JIT manufacturing practices era. Following the war, Japan faced many challenges in the economic field and lacked enough resources for big-batch finance and also faced high unemployment issues. The system that they used to overcome their economic decline is known as just in time manufacturing, popularised in Western media as the Toyota Production System.

JIT is an inventory management system used to manage the stock that is kept in the storage. It involves receiving goods from the suppliers as and when they are required rather carrying a large inventory at once. Gaither and Frazier state that Just-in-Time is a weapon of choice in speeding market responsiveness. Companies use this inventory strategy to increase the efficiency and decrease waste by goods only as they need for the production process which reduces the inventory cost. Proper inventory system depends upon the production schedule as per market demand. Excess of inventory can lead to increase in costs, however less inventory can lead to a loss in sales, both are less profitable for an organisation. Therefore, a balanced inventory management is important for the organisation to increase productivity. For this inventory management JIT is required. Heizer and Render [2] described the goal of Just in time is to have the minimum amount of inventory on hand to meet demand. This strategy will make the company more efficient, reducing the wastage level which leads to a reduction in inventory cost and increases the quantity of the company [3].

Lean manufacturing provides a systematic method for minimising waste within a manufacturing system, while staying within certain margins of control such as productivity and quality. Principles of the lean manufacturing are: Eliminate waste, delivering fast by managing flow, practice iterative development, built quality in, defer commitment, create knowledge & respect for people. JIT system would give a lot of benefits such as to the producer to increase the quality to fulfil the customer demands and reduce the inventories and build a good relationship with the supplier. Some of the quantitative benefits experienced by manufacturers worldwide are increase the quality and technical support, increase productivity, Reduction in inventory, reduction in labour costs, reduction in space needed to operate, reduction in WIP (work in process), reduction of throughput time, reduction of standard hours.

The main objective of this paper is to increase the productivity and quality of work by implementing the JIT system which is one of the Lean Manufacturing introduced by Toyota Motor Corporation [4]. JIT system identifies non-value-added activities in the value chain and by removing these it reduces the production waste [5]. The fundamental focus of JIT is the systematic elimination of nonvalue added activity and waste for the production process [6]. The main focuses of JIT concept are on Buffer stock removal, cellular manufacturing, group technology, layout improvement, set up time reduction, worker motivation, W.I.P. reduction.

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After taking some semi structured interviews and analysing some relevant data, the researchers can conclude that the JIT principles are implemented successfully across many parts of an organisation, a significant competitive advantage can be enjoyed [7]. In this recent era there are research papers written which show the successful JIT implementation [8]. Enhanced efficiency from waste reduction in order taking, purchasing, operation, distribution, sales and accounting [9]. Waste management is required in JIT production, wastes are identified and eliminated in some areas like waste from overproduction, waste of motion, transportation waste, processing waste and waste from product defects [10].

In this paper we have discussed the Just in Time (JIT) concept and how its implementation could be more successful for a company in this current society. We presented a case study of a local company that removed the buffer system and implemented a JIT system. In section 2 we showed a flowchart of the model. In section 3 we discussed different types of waste or non-value-added activities and waste removal procedures along with the buffer system and its removal techniques. Further using some tools and concepts like 5's, Takt time, Kanban, we can implement JIT as discussed in section 4. In section 5 we presented the case study and some related graphs and data and came to the conclusion that JIT implementation is indeed a success. Lastly in section 6 we have concluded the model and discussed the application with managerial insight.

II. FLOWCHART OF THE MODEL

We have illustrated the model in the way given in the flowchart.

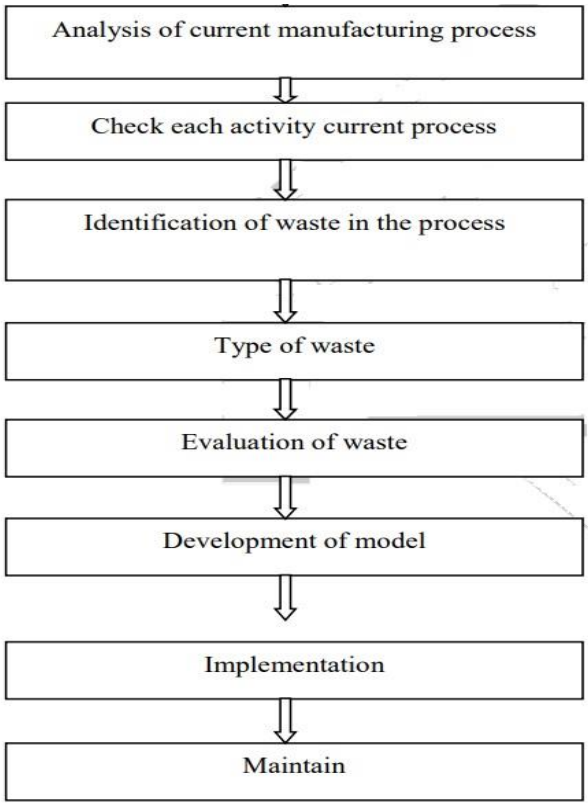

Fig. 1 Flowchart of the model

This is a step-by-step representation of the processes that need to be done in order to remove the buffer system and implementation of JIT.

III. NON-VALUE-ADDED ACTIVITIES AND WASTE MANAGEMENT

After identifying the activities, the next step is to detect value added and nonvalue added activities. Activities for which the customer is willing to pay for are known as Value-added activity. Non-value-added activity is an action taken that does not increase the worth of the product that is delivered to a customer. These activities are also called "waste". Non value activities are categorised as: transportation waste, excess inventory waste, Motion wastage, waste for defects, waste for overproduction, waste at the time of processing, waste for waiting.

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A. Types of waste & removal technique

Transportation waste

Transportation waste indicates the material movement that is not directly associated with a value addition. Processing stations should be closer to each other and material should flow without any significant delays between the alternate processes. Poor layouts of consecutive operating stations, complex material handling systems are mostly the reason for excessive transportation waste.

Remedies: By using an effective material handling system and designing an effective plan layout based on lean principles, transportation waste can be managed.

Excess Inventory waste

Inventory waste in stocks and work in process inventory are the unnecessary inventories accumulated before or after a process and are the indications that continuous flow of work-piece cannot be achieved. Lack of balance in workflow, incapability of process, large batch size are the reasons for excess inventory waste.

Remedies: By using Kanban system, push and pull type demand system, by sorting the inventory using automatic storage and retrieval system, making necessary calculations for deciding optimum Economic Order Quantity this situation can be avoided.

Motion wastage

Motion wastage is the increased motion of machinery or a person due to an inefficient manufacturing process. The main causes of the waste of motion are with regards to cell layout, poorly organised place, poor methods of transferring parts from one to another, disorganised tools.

Remedies: To reduce the motion wastage rearrangement of workplaces is needed to have more efficient layouts. Moving equipment and materials are needed for the manufacturing process.

Waste for overproduction

Overproduction creates more excessive wastage but because it can easily lead to the other wastes of Lean including waiting, inventory, extra processing, and defects. Overproduction waste can happen when extra parts are produced which are not needed.

Remedies: To reduce overproduction waste use piecewise production and Kanban process, Improve the overall order of delivery cycle, adopt most suitable method of aggregate planning

Processing Wastage

Over processing or under processing causes extension in processing time which thereby results in delays. The major causes of processing waste are unclear standards and specifications, unawareness of the operators, non-standardized working practices.

Remedies: By developing a better processing method where standardisation is maintained and Automation techniques can be adopted. Also, by monitoring the existing production system this type of waste can be removed.

Waste of Waiting

When two interdependent processes are not fully synchronised, some idle time is produced that is known as a waste of waiting. Poor machine coordination, long changeovers, unreliable process and excess time required for reworking cause waiting wastage.

Remedies: Synchronisation of various processes, use of SMED concept for quick changeover tools and set ups are some remedies of this type of waste.

Waste of Defects

Improper operating processes cause some defects in manufacturing or processing the required service or product and correction of those defects include extra work so this type of waste is called waste of defects. The causes of generated defects are: Inadequate training and lack of skills, Process instability and operator errors.

Remedies*:* By checking process capability index and process reliability and providing training to the employees can solve this problem.

B. Buffer system & its removal technique

Buffer Inventory is an excess inventory. It is the extra stock of either raw material or final product a company maintains as a conservation against unexpected conditions. A company stores for an undetermined future. If the products spoil easily or for some

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reason the market is going down then keeping the inventory could result in losses. Creating and maintaining a buffer inventory can result in extra elevated costs. Extra inventory also takes up additional space.

Just-in-time (JIT) is a stock control method where the organisation doesn't have to store any raw materials. It has regular deliveries that are only needed before existing raw materials are finished. So using JIT we can control the buffer system therefore much wastage (like wastage for waiting, wastage for over processing, wastage for inventory etc) can be reduced.

IV. IMPLEMENTATION OF JIT

For every organisation Improvement in quality, flexibility and productivity are commonly required focusing on the elimination of buffer stocks to highlight production problems scheduled by high inventory level. Implementation of JIT in any organisation starts with the improvement in level of education and training to the employees by encouraging them with various suitable incentive schemes and promotions.

A. JIT Tool

- **"5's"**

  The basis of implementation of JIT lies in the "5s" concept (Vikas Panchal et al., 2013). 5s" is an abbreviation of five Japanese words beginning with the letter "s".
  'Seiri' focuses on sorting out all the tools, equipment, materials, etc. in the workplace and maintaining only necessary items which thereby minimises work interference. ***'Seiton'*** focuses on arranging the tools and equipment in its proper location so that extra motion can be eliminated. ***'Seiso'*** focuses on systematic cleanliness and regular restoration of equipment at appropriate places. ***'Seiketsu'*** focuses on standardisation of operating practices in a consistent manner. ***'Shitsuke'*** focuses on nourishment of standards that were present during the initial 4s establishment process.

- **Takt Time**

  The rate at which suppliers need to finish a product or service to meet customer demand is known as takt time. For example, if one receives a new product order every 2 hours, their team needs to finish that product within 2 hours or less to meet the demand of their customer. Takt Time allows one to optimise their capacity in the most efficient way to meet demand without keeping too much inventory in reserve.
  Mathematical Formulation:
  Takt time = Available operating time per shift /Customer order per shift

- **Kanban**

  Kanban is a scheduling system for lean manufacturing(Tung-Hsu (Tony) Hou).Taiichi Ohno, an industrial engineer at Toyota, developed kanban to improve manufacturing efficiency.Kanban became an effective tool for supporting an organisation to run a production system as a whole, and an excellent way to promote enhancement. Problem areas are identified by measuring standard time and cycle time of the full process and process steps.One of the main advantages of the kanban concept is to initiate an upper limit to work in process (commonly referred as "WIP") inventory to avoid overproduction.

V. CASE STUDY

In this study the author will discuss the result of the survey taken from a local stamp processing company. Here, JIT implementation is implemented by following the concept of '*Kanban*'. By observing the graphs and other information, authors can conclude why the JIT system is much more beneficial than the previous buffer system.

B. Flowchart of stamping production:

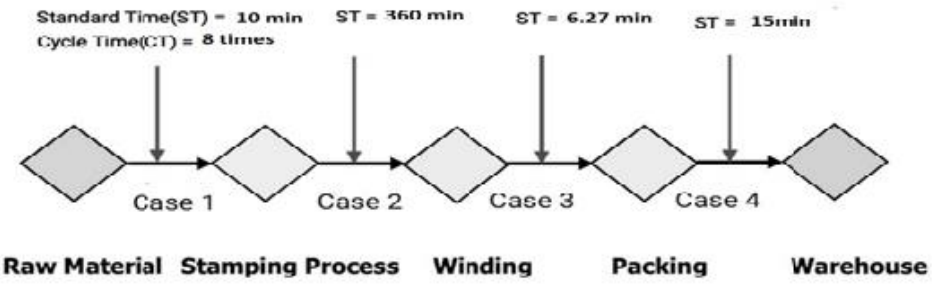

Fig. 2 Schematic diagram of stamping production.

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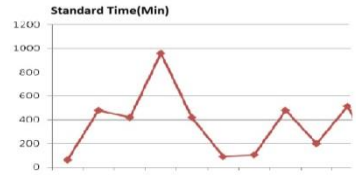
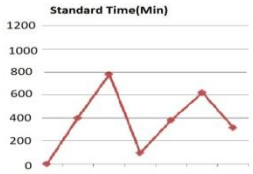
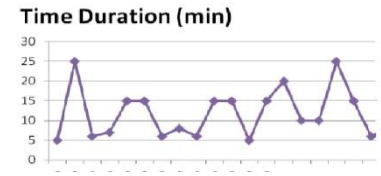
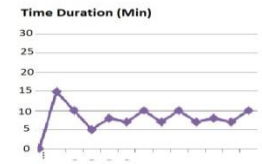
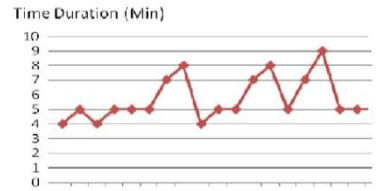
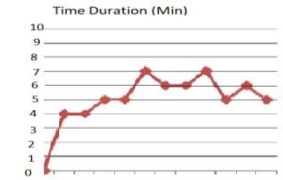
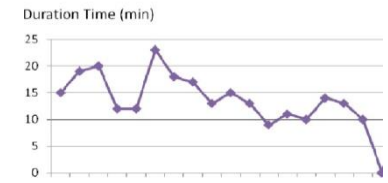
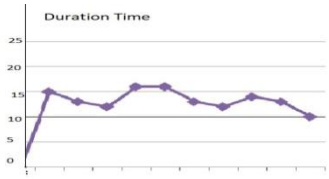
So, a table is presented which will show the time duration graph of before and after JIT implementation.

TABLE 1: Effect of JIT in different processing manufacturing process

Case No.	Before JIT implementation	After JIT implementation
Case 1: Raw material to stamping process		
Case 2: Stamping process to winding		
Case 3: Winding to packing		
Case 4: Packing to delivery		

By observing the graphs and analysing some data taken from the survey, we can conclude that after JIT implementation raw material are always in enough quantities, work in processes are at the minimum quantities, delivering raw materials depends on demands of the customers and more often in small sizes, buffer stocks are at least quantity and finished goods will directly deliver to the buyers on right time. This observation indicates the fact that implementation of the JIT system in this local company is a huge success.

VI. CONCLUSION

From this paper we can identify that in the purpose of waste management JIT implementation is very much successful. By using various tools wastages are identified as well as removed. Just in Time manufacturing makes outstanding improvement in area of cost and productivity by focusing on waste elimination and time reduction. This paper has examined the role of an organisation's resources by surveying related information.The outcome of this paper shows that implementation of the JIT system is successful and leads to many advantages in managerial point of view.

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