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International
Journal
Of Modern Engineering Research (IJMER)

Implementation of Lean Manufacturing Principles in Foundries

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ABSTRACT : *It is the general perception that the foundry industries are inherently more efficient and have a relatively less requirement for major improvement activities. Managers and engineers have also been hesitant to implement lean manufacturing tools and techniques to the continuous sector because of typical and identical characteristics that sector. These include costly and special purpose inflexible machines, options of modifications in machines are limited ,long setup times, and the general difficulty in producing in small batches.*

Lean manufacturing technology when applied appropriately in a process industry , can help in eliminating waste , enhance the quality of product , attain better and smooth control on operations and thereby reducing the production cost and production time .

Keywords : *casting shakeout, Lean manufacturing, Takt time, production line,*

I. Introduction

Lean manufacturing (LM) is seen as major breakthrough process and is widely used by major industries all over the world. In a continuous process industry like casting the main approach of implementing the lean manufacturing is to reduce the production cost by eliminating the non value added activities. A basic concept of LM is pull production in which the flow on the factory floor is driven by demand from downstream pulling production upstream as opposed to traditional batch-based production in which production is pushed from upstream to downstream based on a production schedule. In a recent survey, approximately 36% of US-based manufacturing companies have implemented lean or are in the process of implementing lean.

An LM facility is capable of producing product in only the sum of its value added work content time. The significance of a LM model include: production of only one unit at a time; non-value added time eliminated; production of the job within time pre decided ; relocation of required resources to the point of usage; and all processes must be completed within same Takt time ,therefore it provide the smooth production of the complete job . The rate at which work progresses through the shop floor is called Takt. The available production time divided by customer demand. The objective of takt time is to measure the production with respect to demand. It sets the rate for production so that production cycle times can be matched to customer demand rate.

II. Principle

Jerry Kilpatrick [1] stated that “Lean” operating principles began in manufacturing environments and are known by a variety of synonyms; Lean Manufacturing, Lean Production, Toyota Production System, etc. It is commonly believed that Lean started in Japan (Toyota, specifically), but Henry Ford had been using parts of Lean as early as the 1920’s, as evidenced by the following quote:

“One of the most noteworthy accomplishments in keeping the price of Ford products low is the gradual shortening of the production cycle. The longer an article is in the process of manufacture and the more it is moved about, the greater is its ultimate cost.” Henry Ford 1926

In order to set the groundwork for this paper, let’s begin with the definition of Lean, as developed by the National Institute of Standards and Technology Manufacturing Extension Partnership’s Lean Network:

“A systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection.”

Keep in mind that Lean applies to the entire organization. Although individual components or building blocks of Lean may be tactical and narrowly focused, we can only achieve maximum effectiveness by using them together and applying them cross-functionally through the system.

III. Objective

The lean manufacturing will help reducing the waste, waiting time and balancing the production line. The major benefit is high productivity which is the need of the hour. Modification automation and effective utilisation of production resources ultimately serve the purpose. Lean Manufacturing is one such area having great potential to obtain higher productivity especially in foundry practice.

IV. Methodology

Collection of data through literature survey, interviews, group discussions, questionnaires, databases, seminars, conferences etc. Data analysis by using various tools like hypothesis testing, qualitative analysis, using relevant statistical software Mat Lab ,ANSYS etc.

John S. W. Fargher [2] suggested a method in his case study as follows:-

- The first step is to group products into families of similar production processes.
- The second step is to establish the Takt time. The Takt time is the demand rate and consequently the time between completion of each product off of the production line. It is first necessary to find the available capacity of the production line:

Available Capacity = Time Available x PFS x Utilization

Where:

Time Available = Hours / Time Period x Number of Employees

Personal, Fatigue, and Safety (PFS) = Standard Hours Produced / Hours Worked

Utilization = (Hours Available - Downtime) / Hours Available

- The third step is to review the work sequence by:

  i. Observing the sequence of tasks each worker performs,
  ii. Break operations into observable elements,
  iii. Identify value added versus non value added elements and minimize or eliminate non value added operations, and Study machine capacity, cycle times and change over times
  iv. In IE words, conduct methods and standards studies.

- The fourth step is to balance the line using the calculated Takt times found in step two.
- Step five is to design and construct the cell to:

Implement a "U" shaped line to assure one way flow and maximize visibility,

Provide a flexible layout to account for all members of the production family,

Decrease distance between operations and integrating process operations wherever possible for simplicity, minimizing both transportation and production lot sizes, integrate in point of use storage next to each assembly operation.

Minimize material handling by concentrating on value added motion

Establish replenishment procedures for point of use storage using the A-B-C rule

Assure the personnel understand their role and are cross trained to use their skills at a variety of tasks and work stations.

Provide visibility to allow operator decisions on problem solving, moving to where work needs to be performed, and focus management attention on production disruptions.

The objective of this practice is to achieve economies of scale by saving costs and making better use of assets. In addition, with a smaller number of employees (30 to 1000, as Toyota has in each plant), it is also easier for managers to motivate the workforce.

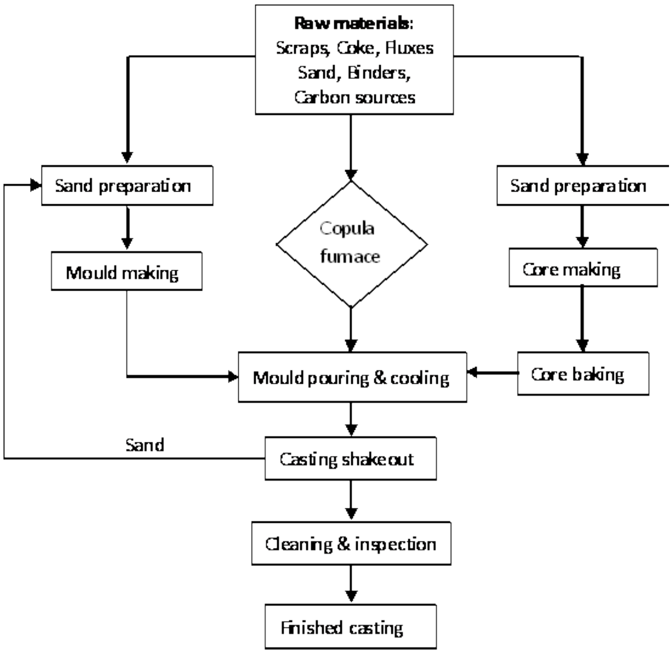

Fig. No. – 1: Flow chart of Foundary Practice

To carry out the proposed research work through data collection, small and medium sized foundries to be visited. Complexity of casting process and parameters need to be studied.

There are other lean practices to implement. If production flows perfectly, there is no inventory waiting to be worked on. Metal casters have helped minimize work-in-process by installing conveyor lines to keep castings moving right through to finished goods storage. This eliminated putting the castings in totes and the added handling. One low to medium volume gray/ductile iron jobbing foundry (casting weights under 50 pounds) we know now ships 30% of its production the same day and believes they can achieve 70% same day shipment. These standards aren't just for the high volume or dedicated metal casting companies any more.
"Autonomation" or "smart automation" is a part of lean manufacturing as well. Autonomation refers to automating the process so humans can focus o n what humans do best. The objective here is to design the machine so it knows when it is working abnormally and alerts a human. The human no longer has to monitor normal production but can focus on abnormal or fault conditions. Removing routine and repetitive activity reduces the chance for error.

V. Case Study

A Case study on Application of Lean Manufacturing to Higher Productivity in the Apparel Industry in Bangladesh has been done and following outcomes have been observed :

5.1 Introduction

Generally in an industry more focus is given on profit. Though there are different issues involved in cost reduction internally spent by an industry through finding wastages, preventing and correcting defective work would result in huge savings [3]. The apparel industry faced considerable changes as a result of the removal of Multi Fiber Agreement in 2005 [4]. Delivering high quality garments at low cost in shorter lead times are the major challenges faced by the apparel manufacturers. Most of the apparel manufacturers are trying to achieve these challenges successfully. In 2008, global recession badly affected almost all the apparel manufacturing industries in the world [4]. Due to that demand for the low cost garments are increased by the customers. Suppliers are forced to deliver low cost garments. Because of many high cost factors in Bangladesh, most of the companies faced difficulties in getting orders and some companies were closed down. The companies are seeking ways to minimize their cost in order to meet the competition by other low cost countries such as China, India, Sri Lanka, and Pakistan and to survive. Lean Manufacturing can be defined as "A systematic approach to identify and eliminate waste through continuous improvement by flowing the product at the demand of the customer" (Introduction to Lean, 2010) [6]. Lean manufacturing helps to identify productive and non- productive activities. Group[5] located at, Gazipur, Bangladesh, to identify non productive activities so as to eliminate them for saving time, cost and improve productivity. By eliminating waste in the processes, companies can achieve a shorter lead time, lower cost, highest quality and can understand a competitive advantage over the others.

5.2 Basic Research Approach

As shown in Fig. 1, a comprehensive literature review was carried out on Lean Manufacturing. After that effective suggestion and recommendations were made. The steps considered in the process are given below:-

Fig-1 Research approach- steps by steps process

5.3 Result of Case Study:

In Modern industries it is difficult to identify the key areas and practices, which can be used to eliminate waste in their processes. Based on the practical experiment conducted, it can be seen that lean manufacturing can be effectively applied to apparel industry as the key step of waste identification. Using this tool, it is possible to map the current status and subsequently analyze to achieve waste elimination. The case study presented in this paper, has shown that the wastes such as transport, inventory and defects, over processing, excess motion, over production etc can be reduced to a great extent which in turn improves the productivity of the organization. In order to accomplish this task, the managers of the case company have to implement approaches like 5S, one piece flow etc. Thus, lean manufacturing helps the organization to visualize the present level of wastes occurring in the organization and the future possibilities of reducing or eliminating them. In order to continuously reduce or eliminate waste, management of companies need to apply different Lean tools and techniques accordingly while giving adequate training to their employees. Therefore organizations of similar type can use the research outcomes as a knowledge base to identify their wastes and come up with suitable remedies. Findings of this research can be valuable to other organizations of Bangladesh, which expect to implement Lean Manufacturing in the near future.

VI. Conclusion

Expected outcome of the research to focus on the process of pouring metal inside the mould, cooling casting, shake-out, and transport to the finishing area, cleaning and cut burr processes. At the foundry industry where the research collected data, the scenarios simulated suggested to explore alternatives to reduce the time of pouring times through an improvement in industrial lay out and workload balancing including worker's multi skilling training. These procedures can lead to reduce the waste of time and reduce the queuing inside the processes, an agreement with lean manufacturing technology.

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