Implementation of Lean Manufacturing in Casting Unit

Archit Soni[1], Rituraj Chandraker[2], Vikas Kumar Sinha[3]

[1, 3] Student, Department of Mechanical Engineering at CSIT, DURG.
[2] Working as Asst. Professor in the Department of Mechanical Engineering at CSIT, DURG.
Email: riturajchandrakar@csitdurg.in

Abstract - Lean manufacturing is a technique employed to increase the value of a product by eliminating wastes and lead time. Most of the wastes generating in the small scale manufacturing industries is in the form of excessive inventory which lean considers it as its wastes. In this paper authors tried to identify the wastes generating in the manufacturing process, and then they have analyzed the problem occurring with using Break-even analysis and the suitable suggestion are given.

Keywords: Casting Industry, Lean Manufacturing, Break-even analysis

I. INTRODUCTION

Lean Manufacturing is technique which used primarily to improve the product value by abolishing the activities which does not add any values to the product. Now-a-days all companies want to produce more and more by expending less and lean is a tool which provides it. Lean system's focus is to minimize sources of loss, variability, wastes, inefficiencies, and process inflexibility. Lean provides a way to do more and more with less and less with coming closer and closer to providing customers with exactly what they want.

Lean Manufacturing tries to implement the following principles:

A. Increasing value of the product

B. Streamlining process

C. Elimination of MUDA (waste)

D. Cost reduction

There are various tools available by which lean principles can be implemented in various sectors, such as JIT (Just-In-Time), Kaizen, Kanban, 5S, Current State Mapping, ABC analysis etc. Lean basically pay attention to improve value by eliminating wastes, the wastes considered by lean are:

Wastes	Description
Waiting	Waiting for job to be done.
Unnecessary Motion	Movement of any resources without any cause.
Over Processing	Processing beyond customer segment under utility.
Excess Inventory	Raw material, finished product that has tied capital to it.
Unnecessary Transport	Any unnecessary transportation of resources during any process.
Over Production	Produce more than the requirement.
Rework	Repeating the manufacturing procedure due to some defects.

The strategy opted for improvement in the process of casting industry by eradicating waste or non-value activity in form of inventory.

II. LITERATURE REVIEW

Lean principles can be implemented by using different tools. There are some tools which can be used in both the industrial and service sectors such as JIT, TQM (Total Quality Management), human resource but all the tools are not common in both type of firm. The tools like TQM, TPM (Total Productive Maintenance), Kaizen are more widely used. Human resource tools have more

importance in the service sector while tools like TPM are used in manufacturing and casting firm widely. [1]

ABC Analysis

ABC analysis is a method to categorize the items produced by the companies which are stored as inventory into three categories i.e. A, B, C. A being the most valuable item, while C being the least and B is the item whose value lies between the values of item A and B.

A-items are those whose consumption value is high but accounts for very less inventory.

B-items are those whose consumption value are medium and also accounts for around 30% of the inventory.

C-items are those which have very low consumption value but are responsible for maximum inventory.

5S

This tool is used in most of the firm because with the help of this tool most of the wastes considered under lean principles get eliminated. Sort, Set in order, Shine, Standardize, and Sustain are 5S which comes under this principles. [2]

Quality Management

For getting the company's success one of the most important thing that should possess by a company is quality management. To be successful in today's world each and every one of the company should focus to work with a common goal. The different Quality tools are: 5 S, Kaizen, Six Sigma, Quality Function Deployment, Just-in-time etc. Quality Management tools are the crucial foundations for any manufacturing firm and are essential to study for providing a better quality management in Industries.

Break-even Analysis

Break-even analysis is a mathematical tool which tells about the level of sales at which any organization is not at any loss or at any profit. It also provide a Break-even point (BEP) at which the net sales is equal to the investment made by the firm. Break-even analysis is an important tool for establishing a relationship between investment, revenue and profit of the firm. Break-even chart is the graph which is prepared from Break-even analysis which shows total cost occurred to the firm, revenue and profit in the graph plotted between sales and unit sold. [5]
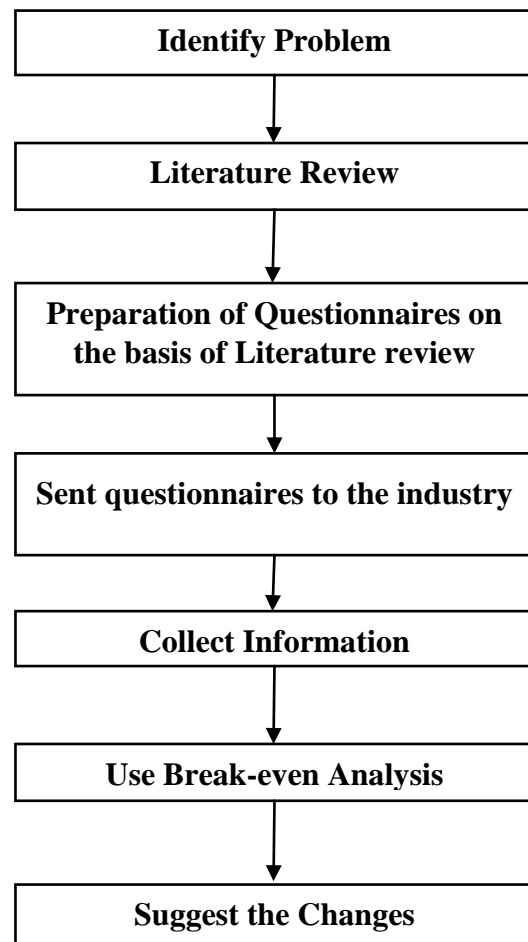
III. METHODOLOGY

Figure 1 -Methodology

A small scale casting industry is selected, named Techno-Engineering Pvt. Ltd. Which produces Insulating Sleeve, Spring Chill, Straight Bar Chill, and Triangular Chaplet but the major product is Insulating Sleeve. The authors have selected this product and find the problem arising to the industry related to this product with the help of questionnaires sent to the industry and asking from the experts. Then the most prone zone where waste is occurring most is found out. Then the authors have used different techniques in order to eliminate the wastes. The authors have also found the barrier which interrupts the continuous production in a small scale casting plant.

IV. RESULTS AND DISCUSSIONS

The flow chart of the firm selected is drawn below which tells about the process which is used for the production of Insulating Sleeve in the plant
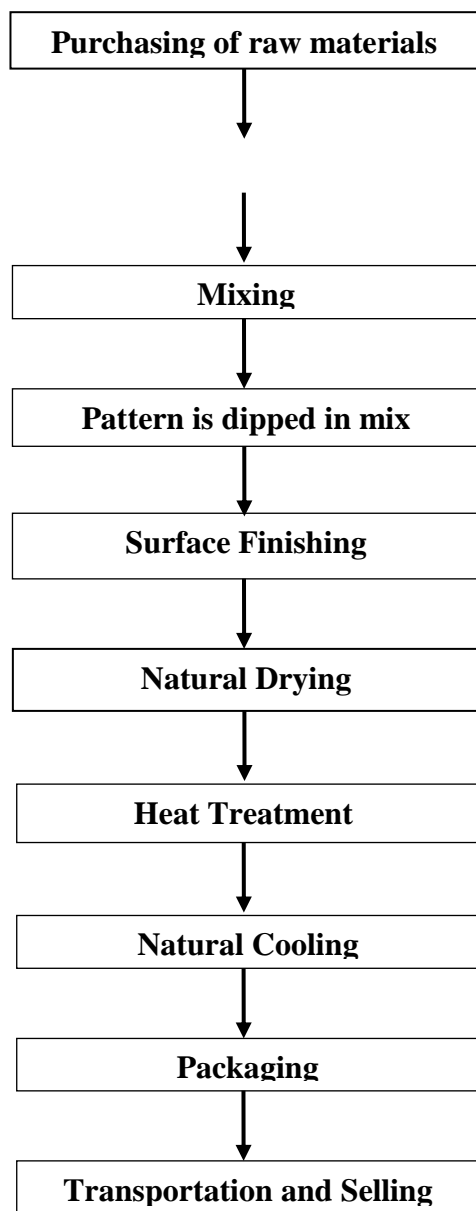
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Purchasing of raw materials

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Mixing

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Pattern is dipped in mix

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Surface Finishing

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Natural Drying

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Heat Treatment

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Natural Cooling

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Packaging

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Transportation and Selling

Figure 2- Flow Chart of Production Process

Different data's are collected from the firm which is shown in table given below:

Processes	No. of Items	Time Taken	Valuable Time
Proper Composition is done	50	15 Min	15 Min
Mixing	50	80 Min	80 Min
Pattern is dipped in mix	50	5 Min	4 Hours 10 Min
Surface finishing	50	3 Min	2 Hours 30 Min
Natural Drying	50	2 Hours	2 Hours
Heat Treatment	15	8 Hours	16 Hours
Natural Cooling	15	2 Hours	2 Hours
Packaging	15	5 Min	1 Hour 15 Min

Table -1 : Information collected from the firm

From the above table it can be clearly seen that there are 50 products which are manufactured till the process of natural drying but after that the requirement of the product is heat treatment. As there is only one furnace in the firm in which heat treatment operation can be done, and in which only 15 products can be heat treated in a day. It is clear that the major problem coming is that of inventory. In order to reduce the inventory and increase the production of the industry the authors have used more than one furnace and checked the break-even point for different numbers of furnaces and then they have find the number of furnaces which is most suitable for this firm.

Using Break-Even Analysis

Fixed Costs are that which don't vary with the number of units produced and sold. Fixed costs include the investment done on manufacturing the furnaces while manufacturing costs consists of the costs which are spend on the raw materials which are required for manufacturing of the product and the wages given to the workers employed in the production process.

Using only 1 Furnace

Cost Incurred:

Fixed Cost (F): Rs 20000, Manufacturing Cost (V): Rs 300/ unit product

No. of Products produced: 15, Selling Price (P): Rs 400/ unit product

BEQ = F / (P − V).

BEQ = 20000/ (400-300), BEQ = 200

In order to overcome the investment done the production need to be continued for 19 days and after that the authors can earn profit. But there are 35 quantities left out from heat treatment, so the authors turn towardskeeping 2 furnaces.

Break-Even Chart

Figure 3 : Break even chart for 1 furnace

Using 2 Furnaces

Cost Incurred:

Fixed Cost (F): Rs 35000, Manufacturing Cost (V): Rs 300/ unit product

No. of Products produced: 30/ day, Selling Price (P): Rs 400/ unit product

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BEQ = F / (P − V).

BEQ = 35000/ (400-300), BEQ = 350

In order to overcome the investment done the production need to be continued for 12 days and after that the authors can earn profit. But there are 20 products left out from heat treatment, so the authors turn towards keeping 3 furnaces.
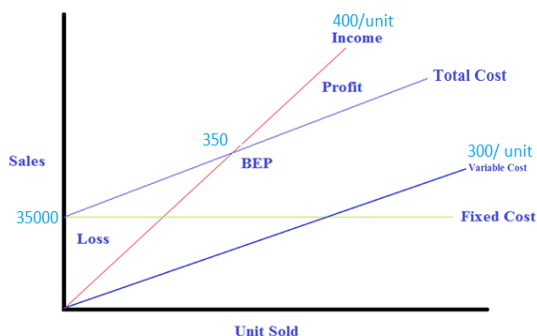
Break-Even Chart

Figure -4 : Break even chart for 2 furnaces

Using 3 Furnaces

Cost Incurred:

Fixed Cost (F): Rs 50000, Manufacturing Cost (V): Rs 300/ unit product

No. of Products produced: 45, Selling Price (P): Rs 400/ unit product

BEQ = F / (P − V).

BEQ = 50000/ (400-300), BEQ = 500

In order to overcome the investment done the production need to be continued for 11 days and after that the authors can earn profit. But there are 5 quantities left out from heat treatment, so the authors turn towards keeping 4 furnaces.
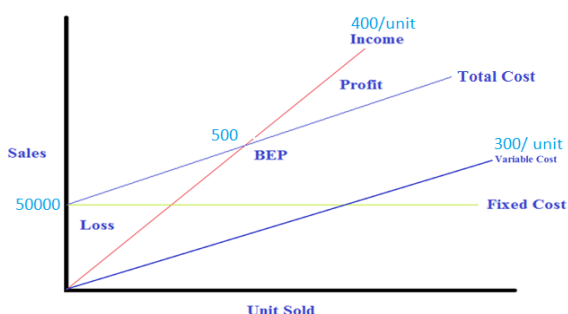
Break-Even Chart

Figure -5 : Break even chart for 3 furnaces

Using 4 Furnaces

Cost Incurred:

Fixed Cost (F): Rs 65000, Manufacturing Cost (V): Rs 300/ unit product

No. of Products produced: 50 (As the production is limited to 50),

Selling Price (P): Rs 400/ unit product

BEQ = F / (P − V).

BEQ = 65000/ (400-300), BEQ = 650

In order to overcome the investment done the production need to be continued for 13 days and after that the authors can earn profit. But for going with 4 furnaces, the authors noticed that the fourth burner remains non-working for most of the times.
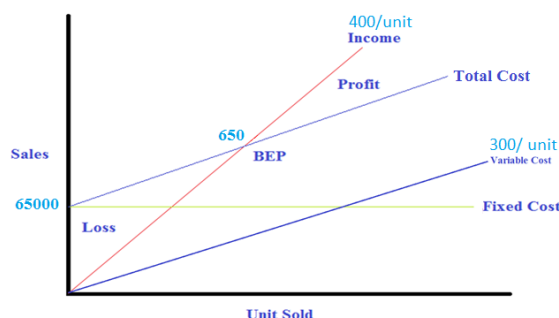
Break-Even Chart

Figure -4 : Break even chart for 4 furnaces

After observing the above information using Break-Even Analysis, the authors have find the certain observations which is shown in the table below:

No. of Furnace	No. of Product	Profit
1	15	Rs. 1500
2	30	Rs. 3000
3	45	Rs. 4500
4	50	Rs. 5000

Table-2 : Observation drawn from Break -even analysis

The production can be increased by increasing the number of furnaces in the firm selected, but to a certain extent. The production can earn maximum profit by employing 3 furnaces in the industry selected. If the authors use 4 furnaces in the firm then the authors find that the profit is not so more and the fourth furnaces remain empty most of the times in a day. So the authors suggest using 3 furnaces in the industry in order to maximize the production. Also while using 3 furnaces; it is possible to overcome the investment in 11 days which is very less as compared to other cases where the numbers of furnaces are other than 3.

For further improvement in the continuous flow production different barriers are found which interrupts the continuous flow production of the plant:

A.   **Inefficient Management**

Management is the ability to manage everything from top to bottom in any organized way; the way remains same for managing a small and medium enterprise. Efficient management is one of the prior most assets that

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an entrepreneur can have. If at a certain point of instance he/she fails to manage, he will have to pay the cost in terms of money, quality, material loss etc. So we can imply that inefficient management here is a barrier for the growth of this firm.

B.   Finance Problem

For proper functioning of a firm, financial strength is a very important factor, because this will help the firm for doing some investment or for purchasing anything which plays an important role in the firm.

C.   Absence of Organized Marketing

Marketing is a part of management where active work is needed. Without proper marketing, the dream of development can't be imagined. So unorganized marketing is also a barrier for the upliftment and smooth running of the firm.

D.   Irregular supply of Raw Materials

For doing continuous production in the plant raw materials should be made available prior to the process of production. So it can be implied that irregular supply of raw materials can interrupt the continuous production in a firm.

E.   Lack of Skilled Manpower

Skilled manpower is one of the important requirements of a firm. In order to survive in the competitive market technologies are widely used and for that skilled workers are required. So it can be implied that shortage of skilled workers can be counted as a barrier in the production in firm.

F.   Inadequate Infrastructure

Infrastructure is the basic physical and organized structure which is required for smooth governing of the work. In small scale industries, the workers are not using any safety tools like helmets, gloves, shoes etc. If the workers will not get good working place they will not be enthusiastic towards their work which is a sign of degradation of the firm.

G.   Large Scale Competition

In the market there are various types of shops, we can identify that there are many shops present in the market for the same type of product. Some are big shops which sell the products in lot and the others are small shops. In the same way in front of giant firms there are number of options to select small firms as their vendor, due to the presence of large number of small factories indulged in making parts which are useful for giant firms. So there is a tough competition for small industries. Hence we are considering this as a barrier.

H.   Burden of Taxes

From purchasing of raw materials to distribution, and from distribution to selling at every step there are some additional amounts given by the owner in terms of taxes or transportation charges. Adding to this government interference of income tax, industrial taxes, EMIs of the loans taken from banks. These are the factors which reduce the pure gain amount and are undesirable for the growth of an industry. Hence we are considering this as a barrier.

I.   Lack of Flexibility

Flexibility is a characteristic by which anything can be put into work with some comfortable movements. Flexible working operations are considered better than those of static one as it provides flexible movement of the machines by providing ease during tasks. So we are considering lack of flexibility as a barrier for the firm.

J.   Inappropriate Location

Location of a firm is also one of the important factors which decide its future. Remote locations can be a burden for the firm owner as most of the times it remains away from the market and the integrated cost of transportation from firm to market makes the budget higher. So it is desirable to be nearer to market so that transportation can be minimized. So inappropriate location is also a degrading factor for the firm and can be considered a barrier.

K.   Environmental Factors

Environment has always been a deciding factor for a firm or any industry because it makes no mercy, it is beyond all. If it would be favorable it can help in running the firm but can also destroy everything if it will be in its ugly form. There are certain environmental regulations under which the firm is bound to perform its work. This makes a change in the policies and even the budgeting of the firm. According to the environment in some cases to run a firms there are certain permit requirements that the firm owner has to fulfill. If it is not favorable it is a barrier for the firm.

CONCLUSION

With this study the authors find out the waste generating in casting industry they have selected and found that the main problem with this small scale casting industry's of inventory. Therefore their work is based on reducing the need of inventory in the plant and for that they have used more furnaces which can solve the problem of inventory up to a larger extent and also 11 barriers are found which interrupts the production system from producing continuously. This work shows that how lean principles can be implemented in small scale casting industries.

FUTURE WORKS

Now the authors have implemented Lean Manufacturing principle of eliminating waste in the form of inventory and also found the barriers interrupting the continuous flow production of the plant. In future these barriers can be eliminated by using ISM (Interpretive Structural Modelling) method which focuses on prioritizing the barriers which disrupt the production.

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