Application of Lean Manufacturing - A Case Study on Jindal Steel Power Limited

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***Abstract* - The lean manufacturing has been used in an extensive manner at some industrial sectors, like automobile industry, which its assembly lines of components, presents better adaptability to the lean concepts. This paper starts with the proposition of applying lean manufacturing concepts in productive processes, and contributes a lot to turn corporations more competitive. The foundry industry, small to medium sized plant, has the difficulty of implementing improvements in its internal logistics systems, and, it has to deal with the problem of temperature processes dependency, such as the casting and the cooling processes. Focus on line balancing and lay out improvement, this work researched the lean manufacturing application, in a foundry industry.**

***Keyword*- Lean manufacturing, line balancing, Assembly line, Foundry industry**

I. INTRODUCTION

In this paper we are study about the production in a way to improve the industrial lay out and line balancing of these small to medium industries, making the valuation of lean application, contributing to the knowledge about this kind of process. Study and analysis of lean manufacturing to production process, with low level of intermediate inventories, more productivity and shortest times of supply, has been the main challenge imposed to the small to medium enterprise of industrial. Normally with unbalanced lines in their processes, the small to medium foundry industry is characterized by a higher level of inventory of raw material near its production area and a great volume of semi-elaborated products inside the production area, which turns arduous the internal movement of materials and the creation of a lay out to make flow the production. Moreover, the foundry industry has the complexity of its processes dependent of temperature, as ferrous or aluminum melting process as the product cooling processes. The application of lean manufacturing concepts, in balancing of production lines, contributes a lot to develop more economic processes, guaranteeing a better attending to the clients.

Brief Background of the Company

This study and analysis of lean manufacturing is conducted by the foundry shop of JSPL Raipur (C.G).Jindal steel and power ltd .was founded in 1930. In active home and international market of special, custom made casting, mild steel, alloy and steel. His manufacturing process is continuously upgraded to improve the quality of the products and services. To keep in touch with customers demands, it builds long standing relations by mean of transparent attitudes and actions in constant close cooperation with its employees, suppliers and clients where it emphasizes quality, commitment and, above all, social responsibility. It works actively with the preoccupation of respecting the interaction between industry and environment.
As on 21 January 2014, the company had 7,488 employees, out of which 299 were women (4%) and 5 were employees with disabilities (0.07%).During the FY 2012-13, it incurred INR 6.41 billion on employee benefit expenses.

II. STUDY AND ANALYSIS OF LEAN MANUFACTURING METHODOLOGY

The purpose of this study the application of lean manufacturing paradigm at the small to medium sized foundry (JSPL) industry. The main steps of work:

- Identification of process or problem assumptions;
- Study and analysis types of operational process.
- study operational definitions of the operational process and the decision system.
- Development of furnace to mold making process.
- Results of measurements and observations.
- Confirmation and/or rejection of the product.

Process of foundry

The main activities of this foundry are the production of metal casting products of different classes to different applications, as technical (high degree of exigency) as general utilization pieces.

Pattern making

Patterns provide the exterior (mould) or interior (core) shape of the finished casting and are produced in wood, metal or resin for use in sand mould and core making. Patterns are usually made in two halves.

Sand mould and core making

Sand casting is the most common production technique, especially for ferrous castings. Sand is mixed with clay and water or with chemical binders and then packed or rammed around the pattern to form a mould half. The two halves are joined together to make the mould - a rigid cavity that provides the required shape for the casting.Cores are produced by blowing, ramming or in heated processes, investing sand into a core box. The finished cores, which can be solid or hollow, are inserted into the mould to provide the internal cavities of the casting before the mould halves are joined. Sand cores are also widely used in die-casting, where permanent metal moulds are employed.

Metal melting

Molten metal is prepared in a variety of furnaces, the choice of which is determined by the quality, quantity and throughput required.

Electric induction furnace

This are the most common type used for batch melting of ferrous, copper and super alloys. This method involves the use of an electrical current surrounding a crucible that holds the metal charge. Furnace sizes range from 1 tone, 4 tones, 6 tones. For production of super alloys and titanium, melting may be undertaken in a vacuum chamber to prevent oxidation.

Casting and separation

Molten metal is poured into moulds using various types of ladles, or in high volume production, automated pouring furnaces. Metal is poured into the "runner" (a channel into the mould cavity) until the runner bush is full. The "riser" provides an additional reservoir of feed metal to counteract the shrinkage that occurs as the casting begins to cool. When the metal has cooled sufficiently for the casting to hold its shape, it is separated from the mould by mechanical or manual methods. Where sand moulds are used, the process is often referred to as shakeout or knockout, and large amounts of dust may be generated.

Removal of runners and risers

After casting, these extraneous pieces of metal are removed and often collected for re-melting. In ferrous castings and larger non-ferrous castings, they may be removed by knocking off, sawing or cutting using an arc air or oxy-propane torch. In die-castings, they are often snapped off manually

Finishing

A range of finishing processes is usually undertaken. These include.

1. Cleaning to remove residual sand, oxides and surface scale, often by shot or tumble blasting.
2. Heat treatment, including annealing, tempering, normalizing and quenching (in water) to
3. Enhance mechanical properties.
4. Removal of excess metal or surface blemishes, (e.g., flash resulting from incomplete mould
5. Closure or burrs left from riser cut-off), by grinding, sawing or arc air (oxy-propane cutting).
6. Rectification of defects by welding.
7. Machining.
8. Non destructive testing to check for defects.
9. Priming, painting or application of a rust preventative coating

The industry recycles a large proportion of mould and core making sand internally for re-use. This involves processing to remove tramp metal and returns the sand to a condition that enables it to be used again for mould or core production.

Calculation of power

For Heat treatment of product of mild steel for 1 kg casting – 3kg sand

Fresh scrap- 95% yield

10 kg casting = (350/1000)×10kg = 3.5 kw/h

Where 350 unit power for grinding process required power= (60/1000) ×10kg=.06 kw/h

C material = C direct +C indirect

$$\boxed{C = C \text{ unit metal} \times W\text{cost} \times f\,p \times fm \times ff}$$

Where

Cunit_metal = Unit metal cost

Wcast = Casting weight

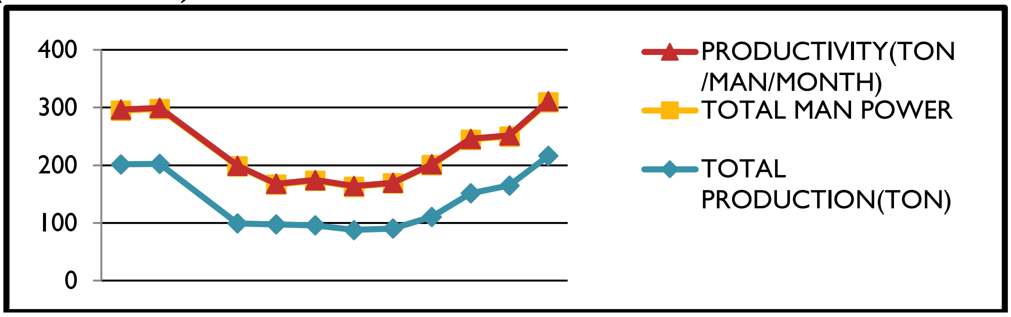
Vcast = Casting volume

fm = Factor for metal loss in melting = 1.01-1.12

fp = Factor for metal loss in pouring = 1.01-1.07

ff = Factor for metal loss in fettling =1.01-1.07

Total manpower (Ton/man/month)



PRODUCTION(TON)	TOTAL MAN POWER	PRODUCTIVITY(TON/MAN/MONTH)
99.288	99	1.00
97.727	69	1.41
96.048	77	1.24
87.878	75	1.17
90.457	78	1.15
110.579	90	1.22
151.315	93	1.62
164.871	85	1.93
216.193	93	2.32
201.526	93	2.16

CALCULATION OF PRODUCTIVITY
PRODUCTIVITY= TOTAL PRODUCTION TOTAL MAN POWER

Productivity of Pattern making shop = 87.878/75 = 1.17 (ton/man/month)
Productivity of Sand mould and core making = 90.457/78 = 1.15 (ton/man/month)
Productivity of metal melting = 110.579/90 = 1.22 (ton/man/month)
Productivity of Electric induction furnace =151.315/93 = 1.62 (ton/man/month)
Productivity of Casting and separation = 164.871/85 = 1.93 (ton/man/month)
Productivity of Removal of runners and risers = 216.193/93 = 2.32 (ton/man/month)
Productivity of Sand recovery and reclamation= 201.526/93 = 2.16 (ton/man/month)
Productivity of Finishing = 202.453/95 = 2.13 (ton/man/month)

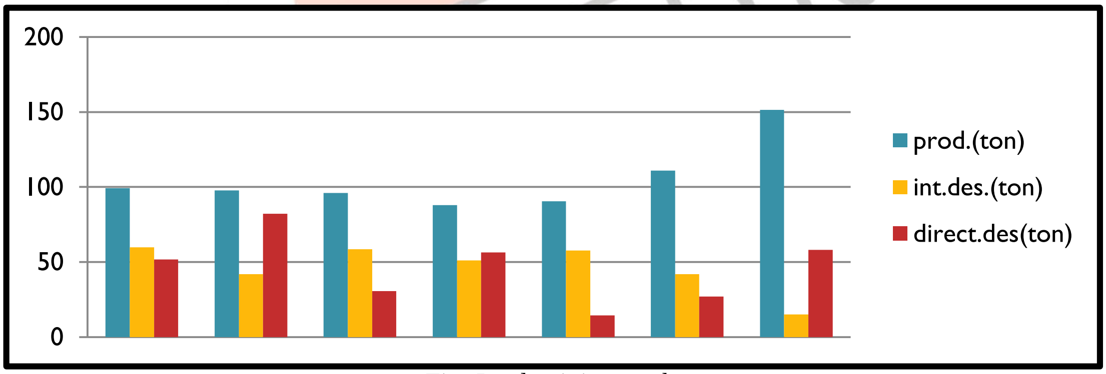


Fig- Productivity graph

PRODUCTION	INTERNAL DESPATCH	EXTERNAL DESPATCH	OVERALL DESPATCH
99.288	59.901	51.764	111.665
97.727	41.848	82.222	124.007
96.048	58.590	30.723	89.313
87.878	51.078	56.438	107.512
90.457	57.771	14.500	72.271
111.00	41.888	27.000	68.00
151.315	15.402	58.220	73.622

III. CONCLUSION

It focused on the process of pouring metal inside the mold, cooling casting, shake-out, and transport to the finishing area, cleaning and cut burr processes. It was observed and conclude it to be nothing less than an enlightening experience. This industry consisting of three induction furnace(including 6,4 and 1 tones) total capacity is 20 tones unit, centrifugal casting unit, molding, well equipped power plant and much more, provide and this article we have studied the leveling production problem at a small to medium foundry

In this 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 paradigm. The lean concepts, besides the automobile industry, can be applied in the foundry industry, bringing benefits of better productivity.\

IV. REFERENCES

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