

# Implementation of Lean Manufacturing in Aluminium Die Casting Industry

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**Abstract:** - This paper work aims to understand the role of lean manufacturing in aluminium die casting optimum utilization of product. Today market demands for more efficient product at low cost. To fulfil the market demands it is necessary to improve design of product constantly and to decrease its manufacturing cost. Lean thinking is a process which emphasizes on elimination of non-value added services and it augurs maximum efficiency of product research and development. Existing process and flow has been study for the improvement purpose. Defects occurring in the casting has been studied and removed. Kaizen, 5’S, TPM has been implemented in improving the process and plant layout. A modified process and flow has been proposed with total reduction of 5% cost. An alternate flow chart has been proposed for equivalent performance. Values stream mapping is also applied so to make changes in plant layout. A different type of wastes is being studied and implement in increasing the production quality.

**Index Terms-** Lean Manufacturing, Kaizen, TPM, 5’S & Value Stream Mapping.

## I. INTRODUCTION

Lean Manufacturing Definition:-"A systematic approach to identifying and eliminating waste (non-value-added activities) through continuous improvement by owing the product at the pull of the customer in pursuit of perfection." [1].

### A. TOTAL PRODUCTIVE MAINTENANCE (TPM)

The concept of Total Productive Maintenance (TPM) has been introduced and developed by Japanese in 1971. This came in response to the maintenance and support problems in commercial factory. It is team-based preventive and productive maintenance and involves every level, from top executive to the floor operator. TPM has been proven to be successful for helping to increase the productivity and overall equipment effectiveness. TPM can be defined as a program for fundamental improvement of the maintenance functions in an organization, which involves its entire human resources. [1]

## II. THEORETICAL OVERVIEW

In this topic, the overall structure of TPM is discussed with its practical approach. All the techniques which are responsible for the efficient and effective operation of machines are discussed below.

## B. PILLARS OF TPM

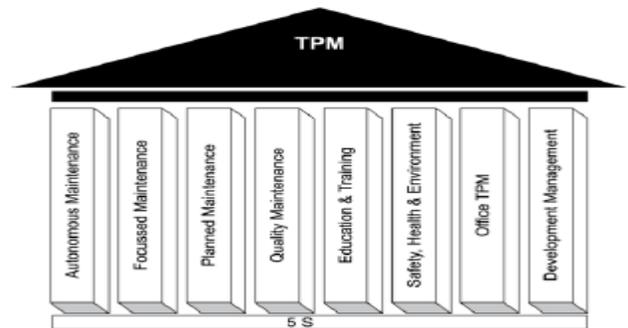


Fig 1: - Pillars of Total Productive Maintenance (TPM) [4]

### 1. PILLAR 1- 5’S

TPM starts with 5’S. Problems cannot be clearly seen when the work place is unorganized. Cleaning and organizing the workplace helps the team to uncover problems. Making problems visible is the first step of improvement.

Japanese Term	English Translation	Equivalent ‘S’ Term
Seiri	Organization	Sort
Seiton	Tidiness	Systematize
Seiso	Cleaning	Sweep
Seiketsu	Standardization	Standardize
Shitsuke	Discipline	Self-discipline

TABLE 1: - 5’S

## III. REAL LIFE IMPLEMENTATION OF TPM

The actual implementation of TPM in aluminium die casting industry is discussed in this topic. Where the various difficulties are solved by using different techniques like see through, one point lessons, CLITA, KK, PM, Poke yoke etc. In this paper only first three pillar i.e. JISHU HOZEN (Autonomous maintenance), KAIZEN, and Planned Maintenance are highlighted for the implementation practice.



Fig 2: - Shadow board for Tools



Fig 5: - CNC Tools holder.

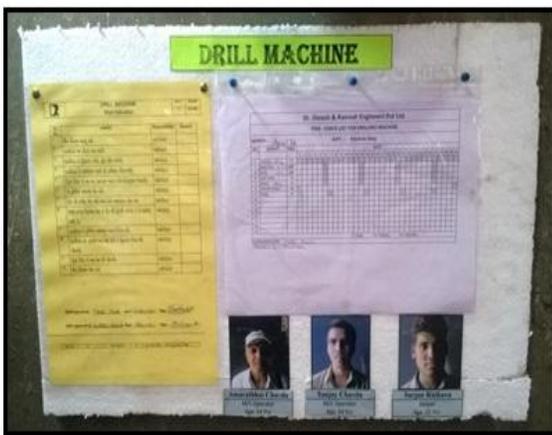


Fig 3: - Works Instruction, Worker details & Safety Instruction for drill machine.



Fig 4: - Shadow board for the tools.

Production per Tonnes in Months by Implementation of lean

Sr. No	Month	“Before” Implementation of Lean Manufacturing in Production Department Dispatch in tonnes/ month	“After” Implementation of Lean Manufacturing in Production Department Dispatch in tonnes/ month
1	August	8	8
2	September	9	8.2
3	October	11	11
4	November	8	8.5
5	December	10	11
6	January	12	14
7	February	11.5	13
8	March	11.7	12
9	April	12	14

Table 2: -Production per Tonnes in Months by Implementation of lean

After implementation of lean manufacturing average production is increased 1.36 Tonnes/month which is shown in Table:-2

**Overall Equipment Effectiveness (OEE) [7]**

OEE is a result could be communicated as the apportion of the genuine yield of the equipment isolated by the greatest yield of the supplies under the best execution condition. The Overall Equipment Effectiveness was begun from the Total Productive Maintenance practices, created by S.nakajima at the Japan Institute of Plant Maintenance, the points of TPM is to accomplish the

perfect execution and attain the Zero misfortune which implies no handling scrap or deformity, no breakdown, no accident, no waste the whole time running or changeover.

**OEE Calculation**

OEE is equivalent to the augmentation of the three principle bases for the primary six major misfortunes:

1. Availability demonstrates the issue which brought on by downtime misfortunes.
2. Performance demonstrates the misfortunes brought on by velocity misfortunes and
3. Quality demonstrates the scrap and revamps misfortunes.

**OEE = Availability \* Performance rate \* Quality rate**

**Availability:** - It is calculated as the required availability minus the downtime and then divided by the required availability. This can be written in the form of formula as

$$Availability = \left[ \frac{Required\ Availability * Downtime}{Required\ Availability} \right] * 100$$

**Performance**

The execution rate might be defined as the perfect or outline process duration to prepare the thing increased by the yield of the supplies and after that partitioned by the working time. This will give the execution rate of the equipment. The recipe to ascertain the execution rate could be communicated as

$$Performance\ Rate = \left[ \frac{design\ cycle\ time * output}{Operating\ time} \right] * 100$$

**Quality**

This could be communicated as the preparation info into the procedure or equipment short the volume or number of value absconds then separated by the preparation info. The quality rate can be expressed in a formula as

$$Quality\ Rate = \left[ \frac{production\ input * quality\ defects}{Production\ input} \right] * 100$$

Sr. No.	Product Name	Machining Process										After Implementation of Lean Total Minutes	Before Implementation of Lean Total Minutes	Difference in Time Minutes
		Riser Cutting	Grinding	Milling	Drilling	Filling	Levelling	Inspection	Finishing	Shot Blasting				
1	Easy Feed	5	15	27	8	20	5	5	3	-	88	95	7	
2	Flange	5	7	25	-	15	5	4	5	-	66	70	4	
3	Doffer	27	15	-	-	15	7	5	5	-	74	80	6	
4	Tc	10	25	-	-	25	15	15	10	5	105	112	7	

Fig 6: - OEE Value

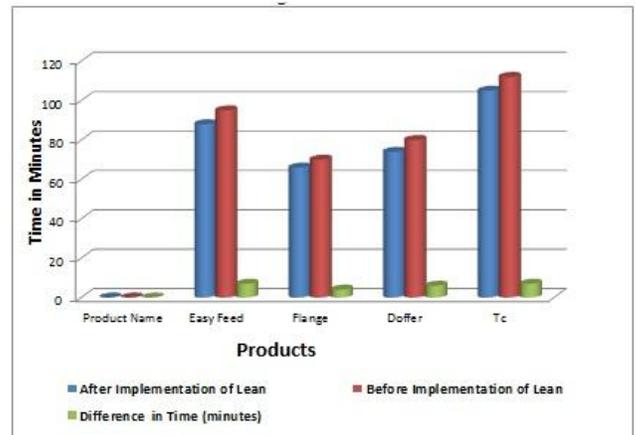


Fig 7: -Result of OEE

Product Name		OEE Company	Average %	OEE World Class
Easy Feed	Availability	88.44%	68.18%	90%
	Performance	84.03%		95%
	Quality	91.66%		99%
Flange	Availability	88.88%	80.01%	90%
	Performance	89.00%		95%
	Quality	90.00%		99%

Fig 8: -Final Result of OEE

**TIME STUDY FOR REJECTION RATE OF ALUMINIUM CASTING**

(Total nos. of parts per shift in foundry) Batch/Shift: - 30 nos.-

By implemented the lean manufacturing in the process, reduced the production time of 1 product from 95 minutes to 86 minutes, hence saved the 9 minutes per product.

**Calculations**

9 minutes consumed for 1 piece manufacturing. Total 30 pieces manufactured in a day.

Process Name	“Before” Implementation of Lean in Machining Process (Minutes)	“After” Implementation of Lean in Machining Process (Minutes)
Riser Cutting	20	18

Grinding	20	18
Filling	20	18
Levelling	15	15
Finishing	5	5
Inspection	15	12
Total Time	95	86

Table 3: Time Study for Aluminium Die Casting

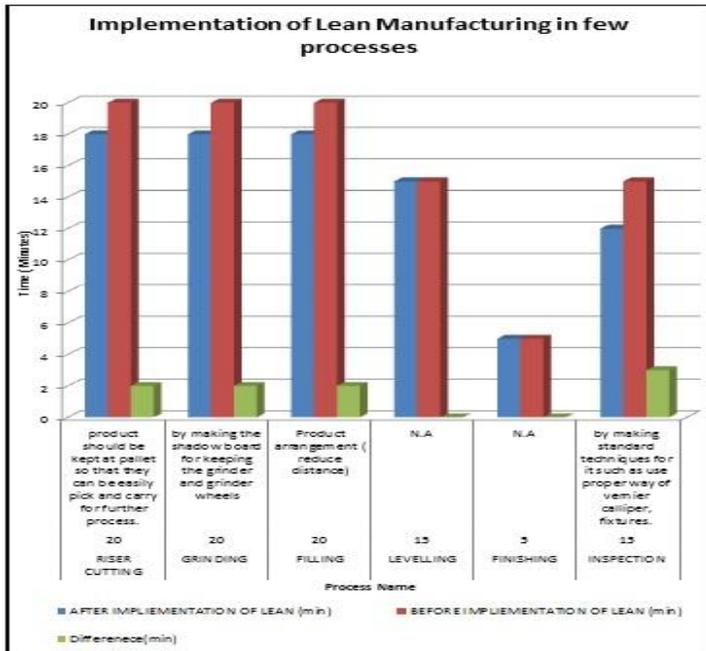


Fig 9: - Implementation of Lean Manufacturing in few processes

#### IV. CONCLUSION

Following conclusions are carried out in the Aluminium Die Casting from above study.

1. The processing time for aluminium die casting process is reduced from 95 minutes to 86 minutes, and save the 9 minutes per product.
2. By implementing VSM, 5S & Kaizen in the process flow of aluminium die casting, has increased the productivity, improved quality, reduced waste and also utilization of manpower at maximum level.
3. OEE of the industry is increased in Product name: Easy Feed is 8.18% and Product name: Flange is 7.4%.
4. After Implementation of Lean Manufacturing in Fan Department, productivity is increased 2.5 times. Also the total production in the industry is increased to 1.36 tonnes per month.
5. Awareness regarding the lean manufacturing to the industry is increased in workers & as well as staffs.

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