Investigation, Analysis of Casting Defect By Using Statistical Quality Control Tools

Introduction concept of lean six sigma and feedback system

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***Abstract* - Organization now a days need to improve their product/process/services continuously and progressively for that lean six sigma is the holistic approach that address multiple aspect of organization competitiveness it is only tool to achieve overall operational excellence. Casting production involves various processes which include pattern making, moulding, core making, metal melting, pouring, shell breaking, shot blasting etc. It is very difficult to produce defect free castings. Occurrence of the defect may involve single or multiple causes. These causes can be minimized through systematic procedure of applying various tools and technique ·This paper represents analyses and investigation of casting defects and identification of remedial measures carried out at specific industry. Diagnostic study carried out on overall process of casting. Castings products revealed that the contribution of the five prominent defects in casting rejections were found and they are sand drop, blow hole, fin, and rough surface and cold shut. It was noticed that these defects were frequently occurring at different locations. Systematic analyses were carried out to understand the reasons for defects occurrence and suitable remedial measures were identified and implementation of lean six sigma up to some extend and generating feedback system between two industry.**

***Keywords* - casting defect, feedback, lean six sigma and statistical quality control tools.**

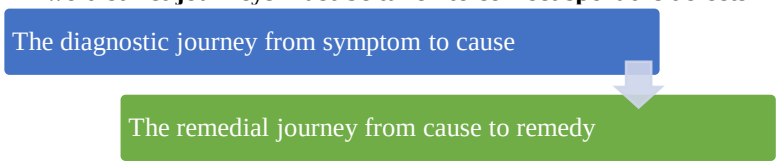
I.INTRODUCTION

For global competitiveness, Indian industry need over operation excellence and improvement in both productivity and profitability. For achieving this we are trying many improvement measures from the domain of quality engineering and management, such as, statistical quality control tools, total quality management, ISO certification etc. A boom of experimentation on lean manufacturing and a tool to change prospective of quality 'six sigma' are also on same page playing an accelerating and encouraging results too. Statistical quality control tools are capable of producing desire result. Then question? Is why this all (six sigma and lean manufacturing). The problem is with its implementation and time span it will sustain to get its benefits. Six sigma and lean manufacturing are one of the most modern and effective tools having direct impact on bottom line. Now a days it is often seen feedback system between customer and vendor but feedback system between two industries is very less seen due to communication chain internally and externally of industry is very long. If there is any problem other department is easily blamed due to feedback system root cause can be identify and each and every department can know the thought process of customer industry and it also help in brain storming process.

II.CASTING DEFECT

Casting is a very versatile process and capable of being used in mass production. The size of components is varied from very large to very small, with intricate designs. Out of the several steps involved in the casting process, moulding and melting processes are the most important stages. Improper control at these stages results in defective castings, which reduces the productivity of a foundry industry. Any irregularity in the moulding process or carelessness by employ causes defects in castings which may sometime be tolerated, sometime eliminated with proper moulding practice or repaired using method such as welding and metallization. The following are the defects which are likely to occur in sand castings in industry

Two distinct journeys must be taken to correct sporadic defects



- Blow hole
- Fin
- Cold shut
- Sand drop and
- Rough surface.

1. BLOW HOLES

Clean, smooth walled rounded holes of varying size from pin heads to full section thickness, often exposed during machining.

- ***Causes:***
  - Low pouring temperature.
  - Excessive turbulence during pouring.
- ***Remedies:***
  - Use correct pouring temperature and check with pyrometer.
  - Modify gating to reduce turbulence, use sivex filter.
  - A thin projection of metal – not a part of cast

Fig: 1 Blow holes

2. FIN

Usually occur at the parting of mould or core sections.

- ***Causes:***
  - Incorrect assembly of cores and moulds,
  - Improper clamping.
  - Improper sealing.
- **Remedies***:*
  - Reduces by proper clamping of cores and mould.

Fig: 2 Fin

3. COLD SHUT

Castings not fully form heaving lines or seam of discontinuity or holes with rounded edges through casting walls.

- ***Causes:***
  - Incomplete fusion where two streams of metal meat.
  - Metal freezes before mould is filled.
  - Die too cold.
- ***Remedies:***
  - Increase pouring temperature.
  - Increase die temperature or improve venting.
  - Increase permeability of sand.

Fig: 3 Cold shut

4. SAND DROP

Sand drop is also called as sand crush. The sand mould drops part of sand blocks, so they will cause the similar shaped sand holes or incomplete

- ***Causes*:**
  - Low green strength
  - Low mould harness
- ***Remedies:***
  - Increase mould hardness

Fig: 4 Sand drop

5. ROUGH SURFACE

Roughness must be assessed relative to the grain size of the casting selected. Un es a work piece cast in coarse sand with fully uniform surface must be assessed as being smooth, although it is rougher than a "rough area" on a work piece cast in fine grained sand.

- **Causes*:***
  - Sand mixture not proper
  - High water content
  - Abrupt mould
  - Very High pouring temperature
- **Remedies:**
  - Use finer sand
  - Reduce water content
  - Increase compaction pressure
  - Reduce casting temperature

Fig: 5 Rough surface

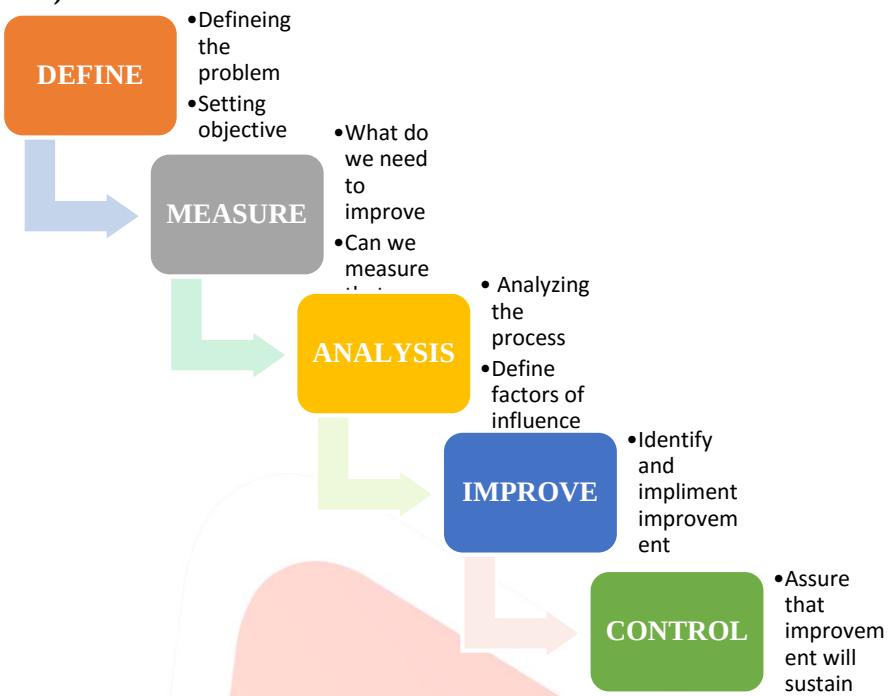
III.METHODOLOGY

The statistical quality control tools is a designation given to a fixed set of graphical techniques identified as being most helpful in reading and troubleshooting its issues related to quality. They are also called Seven Basic Tools of Quality because they are suitable for people with little formal training in statistics or to semi-skilled employ and because they can be used to it and solve the majority of quality-related issues. The statistical quality control tools used are:

- Flowchart
- Check sheet
- Histogram
- Pareto chart
- Ishikawa diagram (cause and effect diagram)

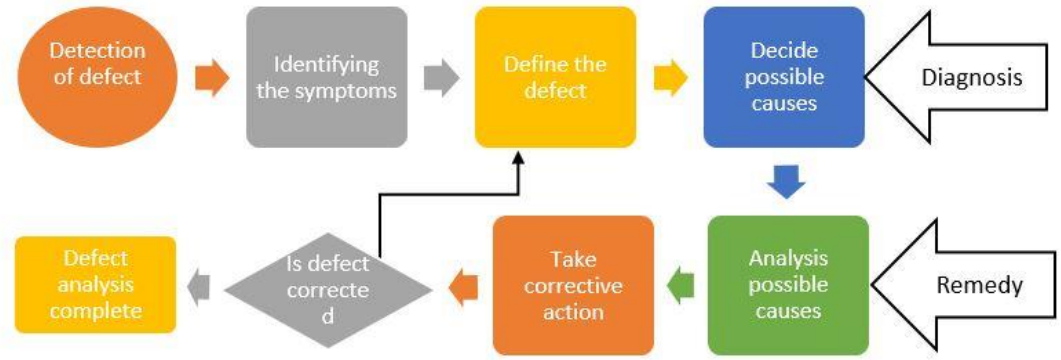
Introducing lean manufacturing and six sigma

IV.WORK PLAN (DMAIC) SIX SIGMA



FLOW CHART

It is a graphical representation of a computer program in relation to its sequence of functions (as distinct from the data it processes). In this flow chart we have shown the process how we execute the investigation, analysis of casting defect and defect reduction.



CHECK SHEET

Check sheets are the paper forms for collecting data in real time easily and concisely. The rejection data is obtained from the foundry and placed in a tabulated form for the convenience to use and understand. Rejection check sheets are generally large data sheets showing the total information about rejected items. Furthermore, collected data on check sheets can be used as input to understand the real situation, analyze occurring problem, control the process, make the decision, and develop planning.

Check Sheet

Simplified data from the total rejection sheet is represented in the following table. Data shows the different parts per month and the data is of seven months

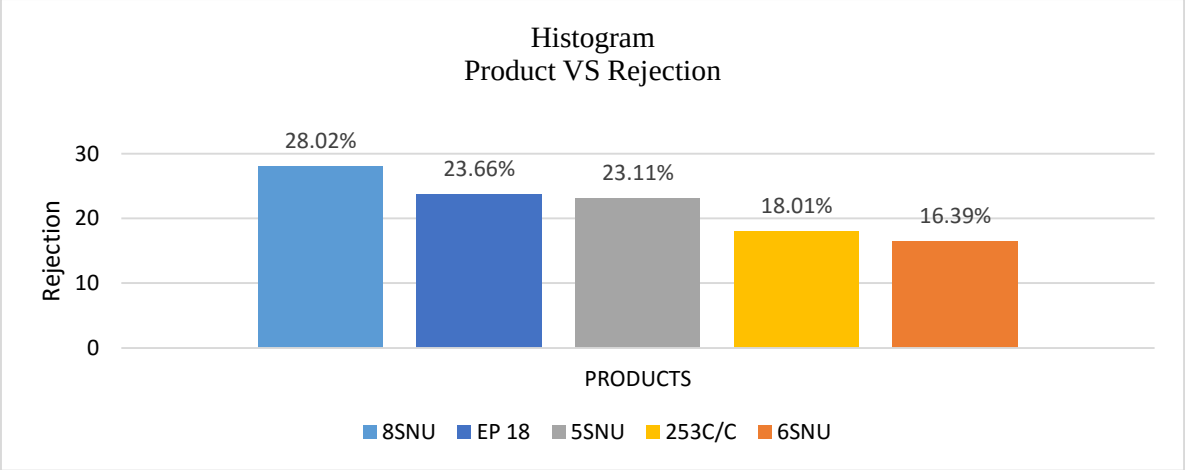
Rejection data sheet according to product

	8SNU	6SNU	5SNU	253C/C	EP 18
Jan-15	22.1%	12.92%	30.67%	15.08%	100%
Feb-15	25.5%	22.66%	23.55%	21.47%	11.84%
Mar-15	50%	22.05%	20.76%	17.06%	6.45%
Apr-15	8.69%	14.28%	8.37%	24.08%	3%
May-15	17.72%	16.8%	50%	25.51%	3.27%
Jun-15	31.15%	12.3%	16.17%	12.5%	20.58%
Jul-15	41.02%	13.74%	12.3%	10.38%	20.51%
Avg. rejection	**28.02%**	**16.39%**	**23.11%**	**18.01%**	**23.66%**

Rejection data sheet according to defect

	REJECTION	TOTAL	Blow hole	Cold shut	Sand drop	Rough surface	Other
Jan-15	207	1014	36	67	58	38	8
Feb-15	352	1623	98	77	83	65	29
Mar-15	196	1006	59	36	39	50	12
Apr-15	169	1075	59	44	35	28	3
May-15	68	339	18	24	14	12	0
Jun-15	111	619	31	23	22	21	14
Jul-15	131	915	26	29	31	31	14
Total	**1234**	**6591**	**327**	**300**	**282**	**245**	**80**

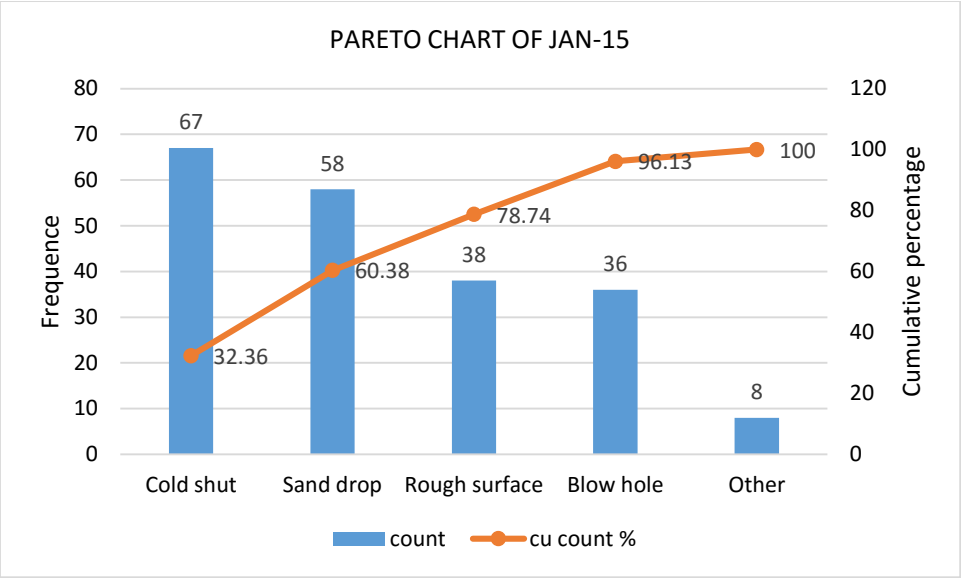
HISTOGRAM



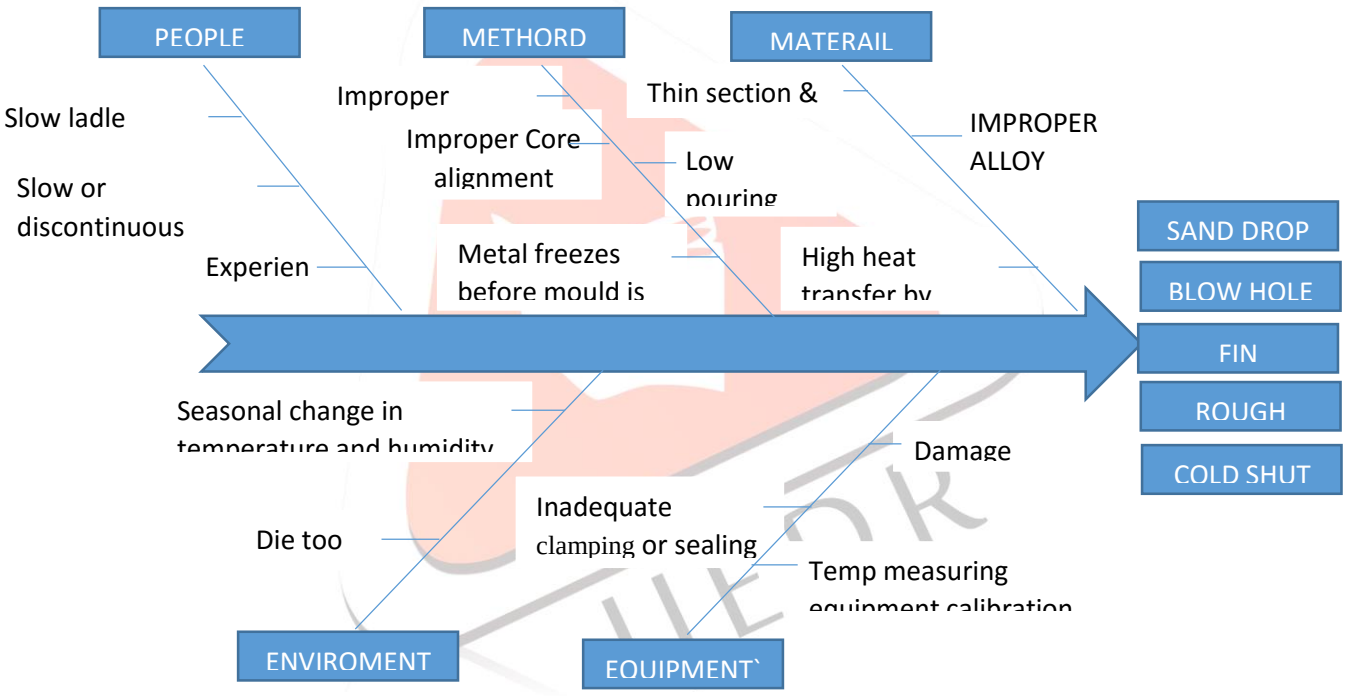
Histograms are bar graphs that present the frequency distribution of data. Not only for displaying data, histogram can also be used as a tool for summarizing and analyzing data. Following is the histograms showing the defect according to different product in seven months together.

PARETO CHART

Following is the pareto analysis made to identify the major defects those are contributing in major percentage. Pareto analysis '8SNU' identified as one of the five Major defects. It was necessary to find out the actual reasons behind the 8SNU defect, to find the reasons behind the defect use of Ishikawa diagram was made which is also called as root- cause analysis.



CAUSE AND EFFECT DIAGRAM



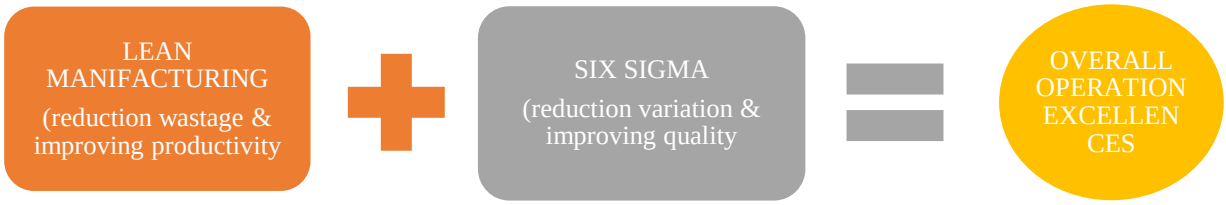
LEAN SIX SIGMA

From a sigma process we came to know that at what distance, in terms of the standard deviation, the specification limits are placed from the target value.

At analyzed industry on an average 2000 product are casted in a month and 25,000 product a year. There are 52 different Patten. From data it is analyze and observed data from 2010 to 2014 and found that currently industry lie between 3 to 4 sigma level. Data analysis of year 2014 are 26,286 were casted, 2549 were rejected and Opportunities per unit was 5 the five main defect which are describe above in this paper so from that DPMO was 19,294 and sigma level was 3.57.

Defects:	2549
Units:	26286
Opportunities per unit:	5

DPMO	**19,394**
Sigma level:	**3.57**



Lean is a systematic method for the elimination of waste within a manufacturing system. Lean also takes into account waste created through overburden and waste created through unevenness in workloads. The goal of Lean is to banish waste. Lean is about more than just cutting costs in the factory. Although the elimination of waste may seem like a simple and clear subject it is noticeable that waste is often very conservatively identified. This is hugely reduces the potential of such an aim. The elimination of waste is the goal of lean.

Some wastage founded in industry at basic level are:

- Casting defects (Sand drop, blow hole, Fin rough, surface and cold shut etc.)
- Over production (production ahead of demand of fix customer.)
- Inventory (different material casting is done when there is change of product & material older becomes inventory.)
- Motion (people or equipment moving or walking more than is required to perform the processing.)
- Human capability (Due to pollution in casting industry human capability decreases and make them uncomfortable to work.)

FEEDBACK SYSTEM

A specific industrial product related feedback online and offline form is generated. It is send to the supply industry at different department. To know what does the different employ thinks about the product and if they want to convey any message to industry about that product. By doing this the quality and relation both can be improved easily. The generated feedback form is shown in appendix.

V.FUTURE IMPLIMENTATION

After analysis and investigation of various data we found that the need of reduction casting defect is very important to accelerate the industry progress so it is planned to have a brain storming session after showing them the results of various data analyzed and the feedback from the industry and taking a step ahead to implementing lean six sigma concept at a deeper level and bringing up sigma level from three to four.

VI.CONCLUSION

The correct identification of the casting defect at the initial stage is essential for taking remedial actions .This paper presents the systematic approach to find the root cause of major defect faced at industry. The origin of the defect was identified by means of STATISTICAL quality control tools & Investigation and analysis was done through it.

Both six sigma and lean manufacturing have evolved into comprehensive management system effective merge and implementation of both these approach needs of following:

- Cultural changes in organization.
- New approaches of production.
- High degree of training and education of employees.

But can applied through some extend easily by knowing six sigma and lean manufacturing at basic level and feedback system can also applied between two industry which play an important role in quality improvement.

VII.ACKNOWLEDGEMENT

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APPENDIX
INDUSTRY FEEDBACK FORM

Industry name: - _____.
Product Ref No: - _____.
Product name: - _____.
Quantity: - _____.

Please tick mark appropriate level of RATING where 1 being lowest and 5 being highest.

Assessment point	***1***	***2***	***3***	***4***	***5***
Quality					
Communication ease					
Services					
Later support					
Over all experience					
Quality assurance/documentation system					
Product preformation					

What aspect of the product / service were you **most satisfied** by? (Can select multiple)
1. Quality 2. Price 3. Purchase Experience 4. Installation or First Use Experience 5. Usage Experience
6. Repeat Purchase Experience 7. Service
8. Any other.....:

What aspect of the product / service were you **most disappointed** by?
(Can select multiple)
1, Quality 2. Price 3. Purchase Experience 4. Installation or First Use Experience 5. Usage Experience
6. Repeat Purchase Experience 7. Service 8. Tech support
9. Any other.....:

Overall, how would you rate the process for getting your problem resolved?
1. Very good 2. Good 3. Average 4. Poor 5. Very Poor

Any (from big to smallest) problem you want to report to us?
How can we improve our product / service?

Any recommendation to us to serve you in a better way
(Adopting any tool or technology).

Any message or comment by your employ with concern to our product/ services….

Filed by: -
Post: -
Date: -

Stamp/sign.