

Application of DMAIC Methodology in Stamping Production Process

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Abstract - This paper describes the importance of Six Sigma in manufacturing industries and examines the various articles published by eminent Researchers in the field of Six Sigma. Finally, it identifies the problem and implements DMAIC methodology by finding the factors that influence the rejection of the final product during production. It is observed that with using Six Sigma methodology, the rejection rate of product is found to be considerably reduced.

Key Words: Six Sigma, DMAIC Methodology, Rejection rate, Root Cause Analysis

1. INTRODUCTION

Six Sigma is a problem solving methodology and it is the statistical term for a process that produces fewer than 3.4 defects per million opportunities for defects and was introduced more than 25 years ago by William Smith of Motorola. It is an extension of other quality initiatives such as Deming's statistical quality control and total quality management (TQM).

A number of large organization took on the challenge of applying DMAIC methodology of six sigma in the recent years in Indian Industry. This paper is an attempt to apply DMAIC methodology in manufacturing organization producing stamping to minimize defects. Stamping is a product, which is used for making stator and rotor of motor and generator. Stamping unit consist of three types of operation namely Blanking-segmental notching-varnishing. The process required CRNGO steel sheets as an input material. The end product of varnishing line is called Stamping.

2. LITERATURE SURVEY

M.Sokovic et.al (2006) conducted a six sigma project, undertaken within company for production of automotive parts, which deals with the identification and reduction of production cost in the deburring process for gravity die-castings and improvement of level of produced parts.

Kishore Kumar Paleti (2010) focused on the quality of the major defect in cylinder liners which are manufactured by injection moulding process. In order to analyse the data, statistical quality control tools are used such as Pareto chart, histogram, cause and effect diagram and control chart.

Prabhakar Kaushik and Dinesh Khanduja (2008) applied Six Sigma DMAIC (define, measure, analysis, improve,

control) methodology to a process industry seeking energy conservation, taking a specific case of a thermal power plant.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

3. CASE STUDY

3.1 The Company

The company selected for study is an engineering firm engaged in manufacturing stamping. The unit will produce 77 lakh stampings in 2014-15. The unit will reach its full capacity of 130 lakh stampings per annum by March 2016.

3.2 The Problem

The problem selected for six sigma's DMAIC methodology was large rejection rate of stampings.

3.3 The Methodology

The DMAIC methodology applied is briefly illustrated below.

3.3.1 Define Stage

Before the process can be investigated, all circumstances have to be defined. Such circumstances are often described as SIPOC (Supplier, Input, Process, Output and Customers)

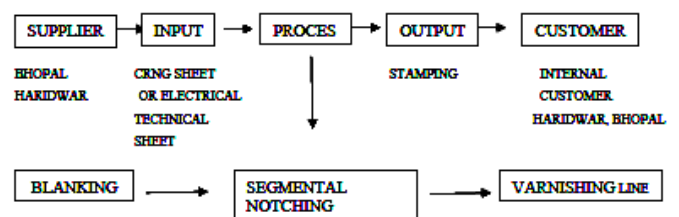


Fig.1. SIPOC Diagram

3.3.2 Measure Stage

Data was collected for six months continuously from January to June 2015 for output line reject that occurred in the blanking – Notching – Varnishing line that focused on the production of stamping to track down the problem encountered by Burr. Since there are three machines required to produce the stamping. The reject data were

collected for each machines, these data were used to calculate defect per million opportunities for each month.

Table.1. Machines Reject Quantity

MON	OUTPUT	MACHINES (REJECT QUANTITY)			TOTAL REJECT PER MONTH	DPMO	SIGMA
		BLANKING	NOTCHING	VARNISHING			
JAN	299520	1870	930	1819	4619	3084.3	4.2420
FEB	299520	37	11	14	62	205.8	5.0630
MAR	299520	33	05	07	45	152.7	5.1883
APR	299520	39	03	11	53	229.1	4.9910
MAY	299520	28	06	13	47	155.3	5.1912
JUNE	299520	21	06	09	36	118.3	5.3130
TOTAL	1797120				4862		

3.3.3. Analysis Stage

Table .2 explains that burr defect 31% of the total rejects are the major contributor for the rejection rate.

Table.2. Defects in Stamping

DEFECT	BLANKING	NOTCHING	VARNISHING	TOTAL DEFECT	PERCENTAGE	CUMULATIVE FREQUENCY
BURR	694	381	185	1260	30.82	30.82
SCRATCH	608	243	162	1013	24.77	55.59
OIL DIRT	320	0	141	461	11.27	66.86
DENT	234	202	0	436	10.66	77.52
VARNISH DEPOSIT	182	0	252	434	10.61	88.13
VARIATION IN LAYER THICKNESS	95	0	389	485	11.83	100
				4619		

3.3.3.1. Root Cause Analysis

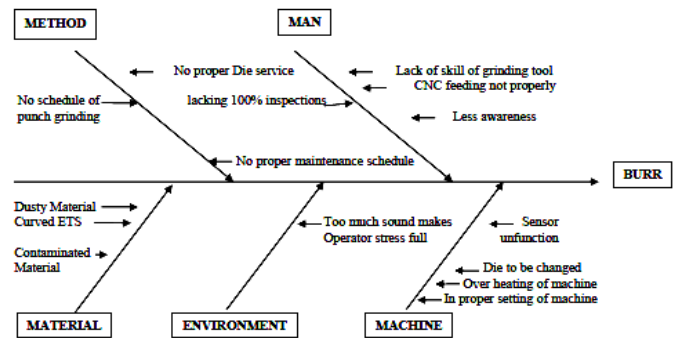


Fig.2. Root cause analysis

In order to determine the exact and most likely causes of major defects, a brainstorming session was carried out with the Quality Assurance Engineer. Through the brainstorming session, all possible causes including major and minor causes were listed in the cause and effect diagram. Figure shows the cause and effect diagram for the Burr defect.

3.3.4. Improve Stage

After collecting and analysis the data, the identified defect was the burr defect, which caused major quality problem in the production line of stamping. Cause and Effect diagram was also drawn to identify the causes of major defect. The following suggestions were recommended to reduce the defects. The suggestions are as follows:

- Die-Punch Cleaning: 500 tones blanking machine consists of several parts but Die and Punch are two important which contributes defects if it is not properly maintained time to time. The punch becomes carbonized due to operation continuously. After a request as a suggestion to the Engineering group to clean the die and punch, the result gained. Sand paper and some chemical solvents were used to clean the die-punch system. Most of the dirt was identified from the material which was carbonized because of over-heated of the die-punch system. The overheated material will stick on the punch and will indent on stamping each time a punch fall. The machine factors plays on important role and its need to maintain for time of period in order to eliminate or reduce the burr problem.
- Viscosity plays an important role in varnishing line so viscosity and density of varnish should be checked for time to time.
- Measurement should be correct as per drawing and requirement.
- Always make sure that all of the stamping such as vent hole keyways and lines of borders and fingers is good with burr height and dent.

- Detect the problem of sticking of tiny metallic particle on the die at the earliest, in the log sheet of the operation.
- Operational staff should be instructed to cross checks from time to time in their routine rounds.
- Six month periodic training cum awareness program for technician should be conducted to make them aware of the disadvantage of burr defects during production.

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3.3.5. Control Stage

Following control measures were suggested.

- Periodic review of the various solutions.
- Continuous watch on the success rate of reducing defects.

4. RESULTS

The largest issues facing in stamping production is Burr which contributes almost 31 % of the problem. The root cause for this is related to method of operation, environment, materials and operator. With the application of six sigma methodology, the sigma level was significantly rose from 4.2420 to 5.0630.

5. CONCLUSIONS

The objectives of this study to apply the Six-Sigma methodology in a manufacturing company. The suggestions for improvement were implemented on Blanking-Segmental Notching-Varnishing production line. The quality problem in this operation was analyzed using Six-Sigma methodology. The root cause for the burr defect had been successfully determined. Corrective action to overcome this quality problem has been suggested. The implementation of the proposed corrective action needs commitment from the management of the company.

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