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Reduction of scrap on honing machine through DMAIC approach

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Abstract—DMAIC is an enhancement strategy for attaining customer satisfaction by reducing variation and thus producing products and services better, faster and cheaper. This study of DMAIC approach is on project how the DMAIC methodology and statistical techniques were applied to resolve the issue of manufacturing process capability. This project has substantially benefitted the organization by reducing the scrap when piston rings are honed in honing machine, achieving zero rejection and improving the on time delivery. By using appropriate qualitative and quantitative tools in different phases of the DMAIC methodology, the critical output, key process inputs and root causes were identified, analyzed and validated. This project methodology can be used in general to reduce process variation for any other manufacturing processes as well, which will help in improving customer satisfaction.
Keywords—DMAIC (Define – Measure – Analyze – Improve – Control)

I. INTRODUCTION

A. Piston Ring

A piston ring is a split ring that fits into a groove on the outer diameter of a piston in a reciprocating engine such as an internal combustion engine or steam engine. A metallic circular spring with a high relative outward expands strain. It fits to an annular groove that fits it section. The reciprocating and/or rotating piston ring seal against pressure differential of gases or liquids between the rings and cylinder bore and one side of the ring and groove. The first piston rings used in an engine had the sole task of sealing off the combustion chamber, thus preventing the combustion gases from trailing down into the crankcase.

B. Six- Sigma

Six-Sigma is a philosophy, a measure and a metrology that provides business with the perspective and tools to achieve new loads of performance both in service and product. In Six-Sigma, the focus is on process improvement to increase capability and reduce variation. The Six-Sigma methodology aims to reduce the number of mistakes/defects in a manufacturing process and hence the manufacturing costs.

In this changing scenario of globalization the consumer expectations are increasing and changing very fast and companies must be quick to adapt them if they want to survive and thrive. In a competitive environment which progressively tightens every company claims to own the excellence and competitiveness hence, probabilities to win the competition become greater. As firms improve their processes, and move towards the exclusive Six-Sigma, they often need to redesign the products, process and services to "design-out defects and design-in quality". In its broadest sense six sigma is a methodology that firms can use to improve the output quality of a process. Six-Sigma has its roots in the repetitive processes of manufacturing; however, the same tools can be used in any business process firm hiring new people to effective product design and marketing plans. The foundation of the Six-Sigma programs is statistics; Sigma stands for standard deviations from the mean of a data set in other words a measure of variation, while six sigma stands for six standard deviations from the mean. When a process reaches the six sigma level that process will be running close to perfection, producing a mere 3.4 defects per million. By using statistical and analytical tools firms can reduce the amount of variation in a process by removing the causes of variation therefore increasing the output quality of the process.

Six-Sigma is a part of proactive business strategy that is planned, executive, monitored, steered towards success, and nurtured by the executive management of the deployment organization and also provides companies with a series of interventions and statistical tools that can lead to breakthrough profitability and quantum gains in quality, whether the products of a company are durable goods or services. There has been a tremendous amount of discussion around defining Six-Sigma in terms people within your business or organization can understand.

II. LITERATURE REVIEW

A. Hongbo Wang, presented an equation to calculate the allowable manufacturing variation in bump height and thereby to ensure

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six sigma manufacturing success in the manufacture of six sigma quality, high density interconnections.

B. Song-Kyoo Kim, have applied six sigma tools to product line business plan development to reduce variation and improve the effectiveness with which they conduct their day to day business activities. Further, they have implemented the DMAIC model for achieving the goals of manufacturing company.

C. Wang Yachao, have introduced the status of Six-Sigma implementation in service in the past and present, and then overviewed some studies of implementing Six Sigma in service, especially in banking sector. Further, they have applied DMAIC model in one short process and used control chart to identify special variations in a process.

III. MACHINE

Honing machine- Honing machine is used for honing process**.** Honing is an abrasive machining process that produces a precision surface on a metal workpiece by scrubbing an abrasive stone against it along a controlled path. Honing is primarily used to improve the geometric form of a surface, but may also improve the surface texture.

Typical applications are the finishing of cylinders for internal combustion engines, air bearing spindles and gears. There are many types of hones but all consist of one or more abrasive stones that are held under pressure against the surface they are working on.

In terms of sharpening knives, a honing steel does not actually hone knives, but simply realigns the metal along the edge

IV. MEASURE PHASE BEFORE IMPROVEMENT

This research is on a manufacturing company who produce piston rings in the company where scrap rate is very high. It contains study of scrap generated during the honing process of chrome compression piston ring while manufacturing it. Scrap generation under this process is very high which affect the production target. With the help of six sigma DMAIC approach we are able to find out the causes and remedies for scrap generation by applying it helps in reducing scrap. As the scrap on the honing machine is about 23% contributing to overall scrap so there must be a corrective measures should be taken which help in reduction of the scrap generation. Our target is to control the scrap generation in order to increase our profit and productivity. The focus of this research is on Manufacturing Cost Effective is one of the main factors for one of the company in India.

INPUT	84225			
GOOD	61104	Type	Gk110cb	
MACHINING SCRAP	19356	Size	85.0-120.0	
MACHINING SCRAP %	22.98%			
DEFECT	QTY	%age	Cumm.%	Cumm. Qty
HONING	4565	5.4%	23%	4565
VISUAL DEFECT BEFORE CHORME	1740	2.1%	32%	6305
CHR DEFECT FINAL	1717	2.0%	41%	8022
CHR PLATING	1569	1.9%	49%	9591
OTHERS	1300	1.5%	55%	10891
NON UNIFORM	1116	1.3%	61%	12007
VISUAL DEFECT AFTER CHROME	1000	1.2%	66%	13007
UNTURNED MIX	938	1.1%	71%	13945
FIRST LAPPING	901	1.1%	76%	14846
FINISH LAPPING	895	1.1%	80%	15741
AXIAL	824	1.0%	84%	16565
GAP SIZING	685	0.8%	88%	17250
ROUGH GRINDING	680	0.8%	91%	17930
DCT/GC	606	0.7%	94%	18536
FINISH GAP GRINDING	420	0.5%	96%	18956
DFS	400	0.5%	98%	19356

Table 1.Machining data before improvement.

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V. PROBLEM FORMULATION

A. *Problem statement*

High honing scraps in chrome finish section causing the wastage of resources as well as in production target to lead to the low customer satisfaction level

B. *Goal Statement*

Scrap reduction of honing machine.

VI. METHODOLOGY

A. *DMAIC*

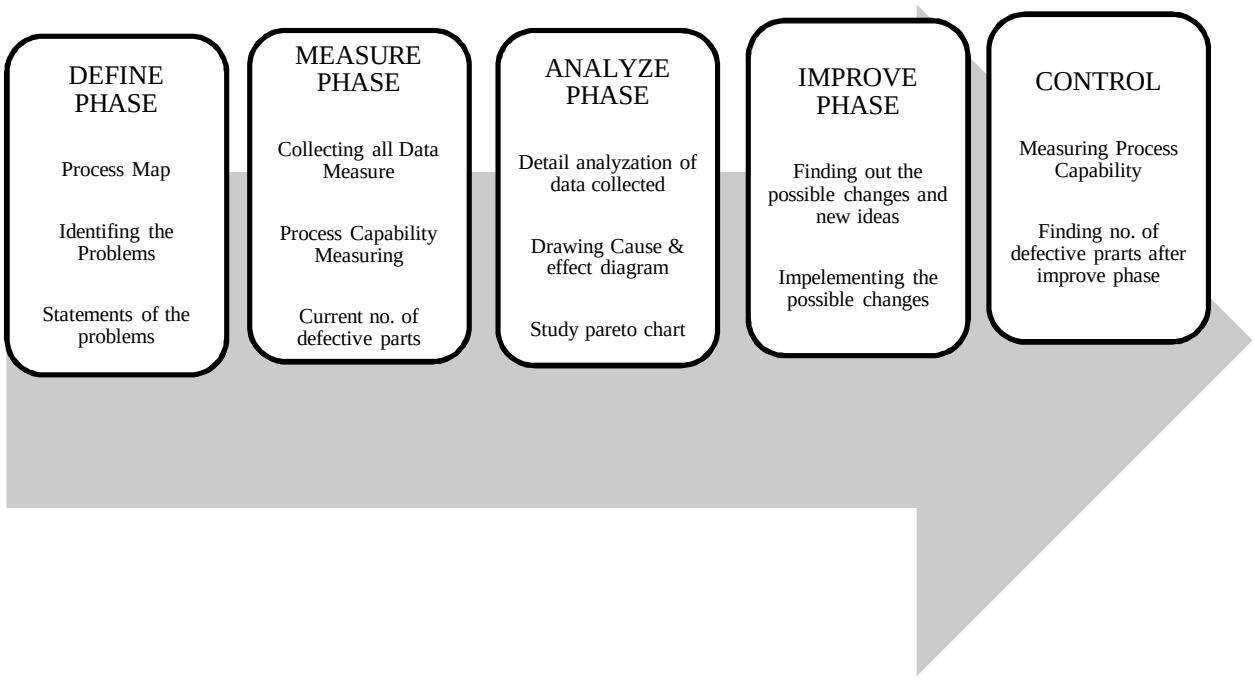


Figure 1. DMAIC

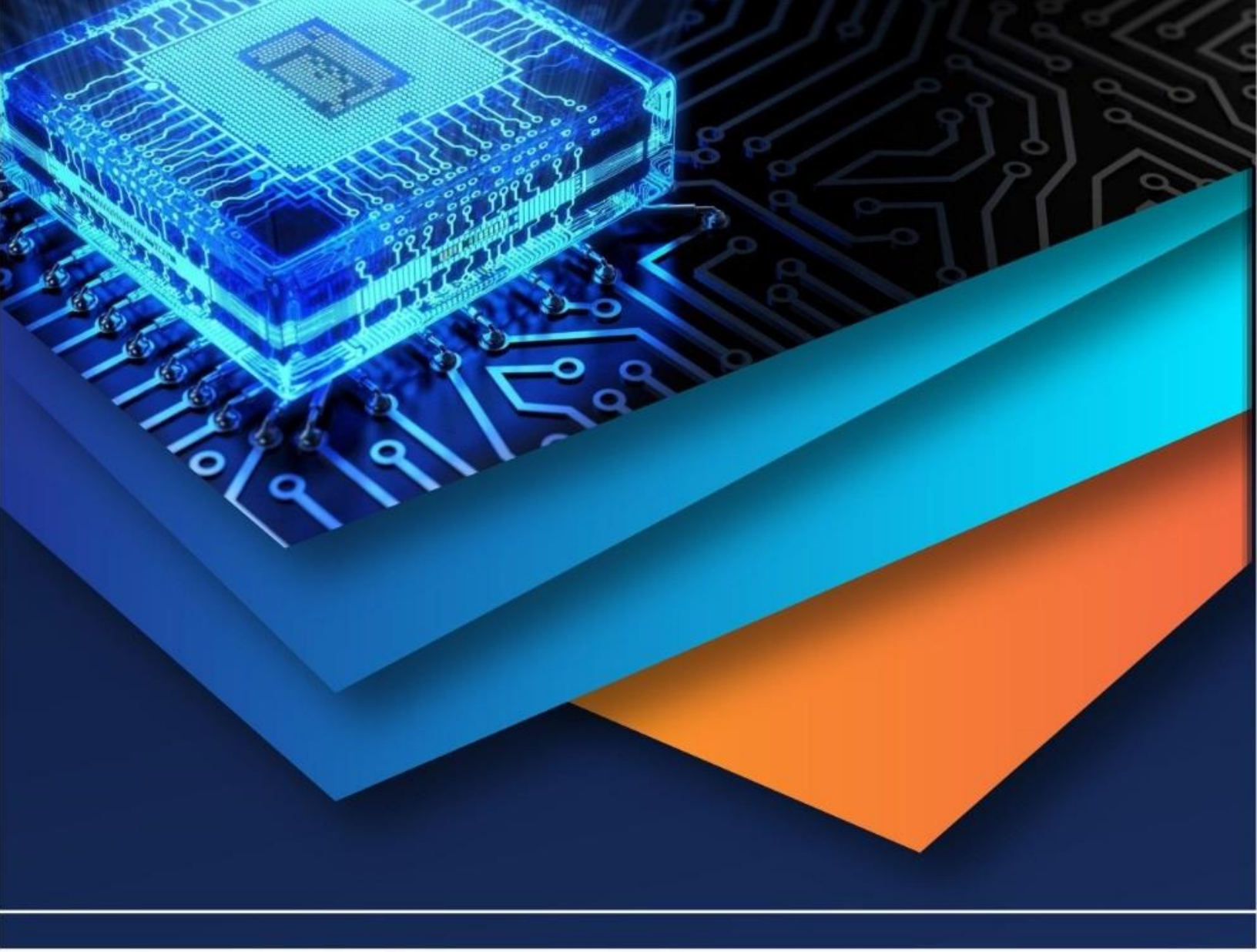
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