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Declining Bush Rejection in Automobile Industry Using Six Sigma

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Abstract- The Six Sigma Methodology is a customer-focused continuous improvement strategy that minimizes defects and variation towards the achievement of 3.4 defects per million opportunities in product design, production, and administrative process. state that Six Sigma is a strategy of continuous improvement of the organization to find and eliminate the causes of the errors, defects, and delays in business organization processes. The entire study is on the rejection rate of Rejection rate was 46000ppm, which was quite high, this is losa s to the organization in the form of money and time. As varitypestype of costst were associated with the manufacturing parts. Six sigma (6σ) is the latest addition to this diagnostic–cum-treatment kit and is treated as pilot tool for this problem. Brainstorming was adopted and followed by a Cause and effect diagram, pareto analysis, run charts, bar charts and measurement system analysis wherever applicable. Data has been collected for problem solving and needful solutions were provided with the addition of Burnishing in the whole machining process. After this practice, it was observed that rejection rate has reduced from 46000ppm to 16000ppm, loss to the organization was reduced to 1.6%, and reduction in manufacturing cost was 3 %. Quality of product also improved. Rejection rate can further be brought down to almost zero percent if all the suggestions are strictly implemented by company.

1. INTRODUCTION

Bush 20*9 is a component used in transmission and provide friction free surface to the moving shaft in two wheelers. The environment of most of the manufacturing companies is very challenging these days under the massive global market competition there is a pressure of surviving the market with maximum generation of profits by bringing the manufacturing processes to the most optimum one, therefore companies are looking for systematic ways to cut production cost[1], improving production rate, and increasing production quality. Managers expect that they could improve their current production rate without increasing the existing resources. Moreover, managers noticed that their production processes are not running efficiently. After passing different quality standards and inspection[2], it was found that rejection of 46000 parts per million was being generated in Bush 20*9. Cost of each bush is Rs. 4 per part and machining cost is 74 paisa per part.

METHODOLOGY: Due to certain quality problems, regarding process variability, which produces non-conforming or defective products, in the existing manufacturing system[3] .CNC machining is chosen as a pilot-project for “Six Sigma” application, where this quality program is perfect solution to reduce process variability, thereby reducing quantity of defected product and maximize overall system efficiency / yield [4-8].

Following are the objectives for the present study:-

To become resilient by following the concept of customer centricity.

To define and study nature of non-conformity in the existing system with the organisation.

To standardize the process for the specific parameter of the organisation.

To increase the efficiency and effectiveness of the process taking place with the process.

To reduce the rejections of Bush in the organisation

Define improvement problem: Following are the parameters responsible for rejection of Bush 20*9

i) Internal diameter
ii) Outer diameter
iii) Tapering
iv)Ovality
v) Surface Finish
vi) Length
vii) Miscellaneous (raw material provided not in dimensions) [5]

Measure current status: Average rejection of Bush 20*9 is 46000ppm, which is on higher side, due to different causes and parameters and adds up to the cost to the company with the rate of Rs 4/- per piece. That ends up to a giant amount of Rs 184000/-

Decide on desired level: As we apply six sigma our aim is to achieve the rejection of 3.4 ppm. If we fail to achieve the six sigma level and control rejection still it is acceptable to the organization.

Find gap in the performance: Ideal situation for six sigma is 3.4ppm, whereas current rejection rate is46000ppm, which is in between 3σ and 4σ.

Set target: With the help of brainstorming a fishbone is prepared which gives the causes of various rejections of various parameters. By implementing MSA we come to know the various factors responsible for the rejection[9]. Pareto charts have

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been used for finding the major cause of rejection and set target parameters.

Prepare Action Plan: To overcome factors responsible for the rejection various preventive, corrective and alternate measures have been planned to enhance the production, decreasing rejection and cost of rejection.

Implementation of counter measure: Counter measures are taken by implementing quality control tools on the basis of results achieved from previous steps also concepts of alternative ideas like burnishing are introduced.

Analysis Achievement: Various results by implementing various six sigma tools are analyzed and measured w.r.t to previous results.

Performance: It is the verification of results. If the performance is satisfactory then the standardization is done if no corrective measures are taken.

Standardization: It is the current right way of doing the job, which is with fewer rejections as compared to the earlier method.

RESULTS AND DISCUSSION

Before implementing Six sigma

Total rejection= 46000ppm

Cost of Raw material from vendor = 80 paisa/-

Machining cost per part = 74paise

Cost of processed part= Rs3.2/-

Sale cost per part=Rs 4/-

Major Cost:-

1. Power cost(Electricity ppm)= 15paise per part

   Power cost for 46000 parts= 46000×15= 690000paise= Rs.6, 900

2. Labourcost:-

   a) Labour cost for machining:-Average salary of each worker is Rs.4, 000 per month. Output of each worker is 275 parts per hour and works for 8 hours daily and 200 hours in a month (25 days).Each worker manufactures 55,000 parts in a month.

   Labour cost for one part= 4000/55000= 7.2 paisa.

   Labour cost for 46000 parts= 46000× 7.2=331200= Rs.3312

   b) Labour cost for measurement: - Every worker measure average of 275 parts per hour. Again monthly measurement is 55,000 parts in a month and labor cost is Rs.3312 for every 46000 rejected part ppm.

   Total labour cost = Labour cost for machining + Labour cost for measurement
   = 3312+3312
   = Rs.6624

3. Tooling cost: Tool used for machining of bush 20*9 are as per the specifications given in Table no 1

Table 1 Tool used for machining of bush 20*9

Name of Process	Insert used	No of pieces/Insert	Cost/Insert	Tooling cost for one part
Parting(3 feet)	MC 10-1.5	360000	Rs 300	0.083 Paisa
Turning	DNMG0.8	12000	Rs 300	2.5 Paisa
Boring	TCMT 0.8	1200	Rs 250	21 Paisa
Parting	MC 10-1.5	4000	Rs 300	7.5Paisa
Grinding	AA6560X 25X4X6	20000	Rs 600	3 Paisa

Tooling cost for one part= 0.083paise+2.5 Paisa+21 Paisa+7.5 Paisa+ 3 paisa =34Paisa (34.083)

Tooling cost for 46000 parts= 46000×34=1564000 paisa=Rs.15, 640

4. Material Cost: Company receives Raw material from the vendor, which cost them 80 paisa per part

   Material Cost of 46000 parts= 46000×.80=Rs. 36,800

5. Administrative Cost: It is 10% of the total cost and total cost is the sale price, which means 40 paisa for each part.

   Administrative Cost of 46000 parts=46000×40=1840000paisa=Rs.18, 400

6. Profit cost: It is 20% of total sale cost

   Profit cost=Sale cost x 20/100
   =4 x 20/100= Rs.0.8

   Profit cost of 46000 parts= 46000×0.8=Rs.36, 800

7. Depreciation Cost(Second hand)

   Equipment cost for 15 years =Rs.11, 00,000

   Equipment cost for 1 year = 1100000/15 = 73,333

   Plant Capacity per day= 2200 parts

   Plant Capacity per month = 2200×25 = 55,000 parts

   Plant Capacity per year = 55000×12=6, 60,000 parts

   Depreciation cost per part = 73333/660000 = Rs .11/pc=11 paisa/part

   Depreciation cost of 46000 parts= 46000×11 = 506000paisa = Rs.5, 060

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Total major cost before implementing Six sigma and burnishing are shown in the Table no 2

Table 2 Total major cost involved in the manufacturing of Bush 20*9

Cost	Cost per part (Rupees)	Cost of 46000 parts (Rupees)	Cost of one million parts (Rupees)
Power Cost	0.15	6, 900	1,50,000
LabourCost(Machining+ Measurement)	0.144	6,624	1,44,000
Tooling Cost	0.34	15,640	3,40,000
Material Cost	0.8	36,800	8,00,000
Administrative Cost	0.40	18,400	4,00,000
Profit cost	0.8	36,800	8,00,000
Depreciation cost of machine	0.11	5,060	1,10,000
Total	2.744	1,26,224	27,44,000

Major cost for 46000 parts= Rs.1, 26,224
Minor Cost: - It comprises of Holding Cost, Carrying Cost, Setup Cost, Light Cost, etc.
Minor Cost = Total processing cost –Total major cost
Total processing cost = 80 % of total sale cost=4x80/100=3.2
3.2-2.744= 0.45
Hence minor cost =Rs.0.45
Total processing cost = Major cost + minor cost =2.744+0.45=3.2
Total processed cost of 46000 parts=46000×3.2= Rs. 1, 47,200
Total processed cost of 1000000 parts=1000000×3.2= Rs. 32, 00,000
%age loss to company = (147200/3200000) × 100 = 4.6%

After implementing six sigma and introducing burnishing

Total rejection = 16000ppm
Cost of each part from vendor = Rs0.8/-
Machining cost per part = 70paise
Major Cost:-

1. Power cost(Electricity ppm)= 15paise per part
   Power cost for 16000 parts= 16000×15= 240000paise= Rs.2, 400

2. Labourcost:-
   Labour cost for machining: - Average salary of each worker is Rs.4, 000 per month. Output of each worker is 262 parts per hour and works for 8 hours daily and 200 hours in a month (25 days). Each worker manufactures 52,400 parts in a month.

   Labour cost for one part= 4000/52400= 7.6 paisa
   Labour cost for 46000 parts= 46000 × 7.6=349600= Rs.3496

   Labour cost for measurement: - Every worker measure average of 262 parts per hour. Again monthly measurement is 52,400 parts in a month and labor cost is Rs.3496 for every 46000 rejected part ppm.

   Total labour cost = Labour cost for machining + Labour cost for measurement
   = 3496+3496
   = Rs.6992

3. Tooling cost: Tool used for machining is given below in Table no.3
   Tooling cost for one part= 0.083 Paisa+2.5 Paisa+5 Paisa+20 Paisa+7.5 Paisa+3 Paisa=38(38.083)
   Tooling cost for 16000 parts= 16000×38 =608000=Rs.6, 080.00

Table 3 Major tools used for machining of Bush 20*9

Sr. No	Name of Process	Insert used	No of pieces/Insert	Cost/Insert	Tooling cost for one part
1	Parting(3 feet)	MC 10-1.5	360000	Rs 300	0.083 Paisa
2	Turning	DNMG0.8	12000	Rs 300	2.5 Paisa
3	Boring	TCMT 0.8	5000	Rs 250	5 Paisa
4	Burnishing		25000	Rs5000	20 Paisa
5	Parting	MC 10-1.5	4000	Rs 300	7.5Paisa
6	Grinding	A6560X 25X4X6	20000	Rs 600	3 Paisa

4. Material Cost: Company receives Raw material from the vendor, which cost them 80 paisa per part
   Material Cost of 16000 parts= 16000×80=1280000 Paisa =Rs12, 800

5. Administrative Cost: It is 10% of the total cost and total cost is the sale price, which means 40 paisa for each part.
   Administrative Cost of 16000 parts=16000×40=640000paisa=Rs.6, 400

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6. Profit cost: It is 20% of total sale cost
   Profit cost=Sale cost x 20/100
   =4 x 20/100= Rs.0.8
   Cost of 16000 parts= 16000×0.8=Rs.12, 800
7. Depreciation Cost(Second hand)

Equipment cost for 15 years =Rs.11, 00,000

Equipment cost for 1 year = 1100000/15 = 73,333

Plant Capacity per day = 2100 parts

Plant Capacity per month = 2100×25 = 52,500 parts

Plant Capacity per year = 52500×12 = 6, 30,000 parts

Depreciation cost per part = 73333/630000 = Rs .11/pc=11paisa/part

Depreciation cost of 16000 parts = 16000×11 = 176000paisa = Rs. 1760

Total major cost after implementing Six sigma and burnishing are shown in the Table no 4

Table 4 Total major cost involved in the manufacturing of Bush 20*9

Cost	Cost per part (Rupees)	Cost of 16000 parts (Rupees)	Cost of one million parts (Rupees)
Power Cost	.15	2,400	1,50,000
LabourCost(Machining/ Measurement)	.152	6,992	1,52,000
Tooling Cost	.38	6,080	3,80,000
Material Cost	0.8	12,800	8,00,000
Administrative Cost	.40	6,400	4,00,000
Profit cost	0.8	12,800	8,00,000
Depreciation cost of machine	.11	1,760	1,10,000
Total	2.792	49,232	27,92,000

Total Major cost for 16000 parts= Rs49, 232

Cost of Processed part =total major cost + minor cost

=2.792 + .45 = Rs. 3.242

Total processed cost of 16000 parts=16000×3.242= Rs51, 872

Total processed cost of 1000000 parts=1000000×3.242 = Rs 32, 42,000

%age loss to company = (51872/3242000) × 100 = 1.60%

The rejection has been reduced from 4.6 % to 1.6 %that resulted in direct profit Rs.97968 ppm even after introduction of Burnishing.

Cost of 46000 rejections-cost of 16000 rejections=147200-49232= Rs 97968

From the above calculations it is clear that although by introducing burnishing in the machining process the overall coast of production has increased but the rejection has considerably reduced that results in overall more profitable and efficient process as compared to the process without the introduction of six sigma and burnishing . Moreover the product quality has considerably improved on the basis of which the manufacturer can negotiate to increase the price per piece within affordable limits if accepted that would further increase the profit to company and would add up to the justification of introducing burnishing in the process.

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