Case Study on quality control tools for Bearing industries

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Abstract: -

In this paper a review of systematic use of 7 QC tools for improving the quality of deep groove ball bearing is presented. QC tools are the means for Collecting data, analyzing data, identifying root causes and measuring the results. Quality Control tools are related to numerical data processing techniques. All of these tools together can deliver prodigious process chasing and analysis that can be very helpful for quality developments. These tools make quality improvements easier to see, implement and track, using 7 QC in mini tab, graphs can be easily calculated with dimension.

***Keywords**: Deep groove ball bearing, Mini-Tab, optimal result, Quality Control.*

1.1 INTRODUCTION: -

The 7 QC Tools are simple statistical tools used for problem solving in different sectors. These tools were initially developed in Japan by Deming and Juran. In terms of importance, these are the most useful. Kaoru Ishikawa has specified that these 7 tools can be used to solve 95 percent of all problems. These tools have been the base of Japan's astonishing industrial renaissance.

In today's era more than a hundred different tools are available to solve problems for giving accurate results and saving time. Tools are generally a means of achieving change and in this paper we will focus on the most fundamental quality tools which are commonly used in many software's called the seven basic quality control tools 7 QC Tools: -Cause and Effect Diagram, Graphs / Flowcharts, Pareto analysis, Check sheets, Control charts, Scatter diagram, Histogram.

These tools are used to find out root causes and eradicates then, thus the manufacturing process can be enhanced. The procedures of defects on manufacture line are examined through direct remark on the production line and statistical tools.

1.2 METHODOLOGY AND APPLICATION OF 7QC TOOLS: -

These simple but effective "tools of improvement" are widely used as "graphical problem-solving methods" and as general management tools in every process between design and delivery. The challenge for the manufacturing and production industry is for: "Everyone to understand and use the improvements tools in their work". Some of the the seven tools can be used in process identification and/or process analysis.

1.2.1 CAUSE AND EFFECT DIAGRAM

It shows the relationship between a problem and its possible causes.

A systematic arrangement of all possible causes which give rise to the effect are made. The causes are first divided into major sources (4Ms) i.e., MAN, MACHINE, METHOD & MATERIAL. Then each source is divided into sub-sources and so on. It helps to find out the root cause of the problem**.**

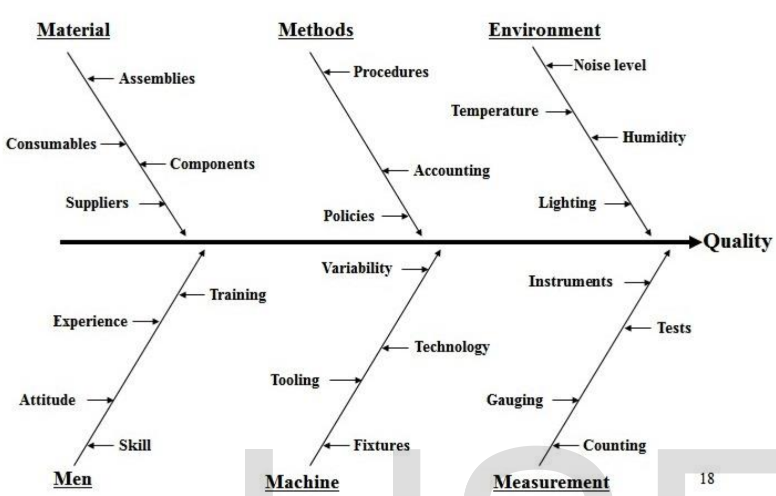
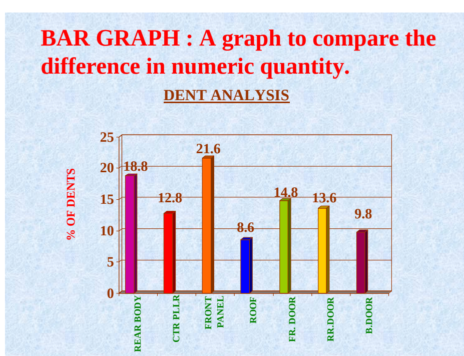


Fig. Cause and Effect Diagram

1.2.2 Flow Chart / Graphs

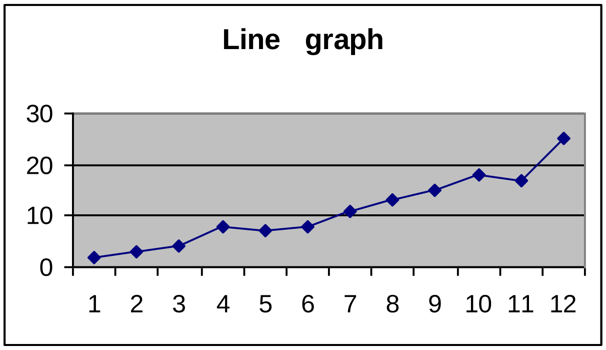
Flow Chart: A Tool that graphically represents the steps of a process. Different icons/symbols to indicate the different types of actions in the process.

(a) Bar Graph

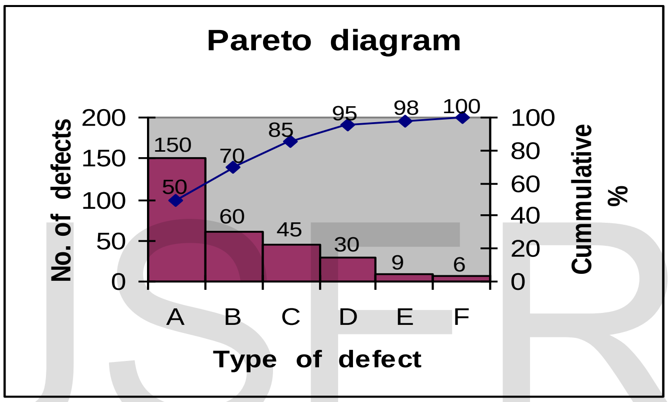


(b) Pie Chart: A graph for the proportion of the different classifications

1.2.2 **Line graph:** A graph to see the changes in condition of any numeric changes



1.2.3 PARETO DIAGRAM –



1.2.4 CHECK SHEET :

A check sheet is a paper form on which items to be checked have been printed so that data can be collected easily and concisely. Its main purpose is twofold.

•To make data gathering easy

•To arrange data automatically so that they can be used easily later on.

It is necessary to decide clearly how to record the defects. When these are found in a product. We should give proper instructions to the staff regarding the format in which the defects are to be gathered. In this case, 42 out of 1525 components were found defective. However, the total nos of defects was 62 because two or more defects were found on the same piece.

1.2.5 CONTROL CHARTS:

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Control charts serve to detect abnormal trends with the help of line graphs. It differs from standard line graphs as they have control limit lines at the center, top and bottom levels.

CONTROL CHARTS FOR VARIABLES

- **The variable control charts that are most commonly used are average or X-bar-charts, range or R-chart and sigma-standard deviation charts.**

1.5.1 X CHART

X chart shows the centering of the process, i.e. it shows the variation in the average of samples. It is the most commonly used variable chart.

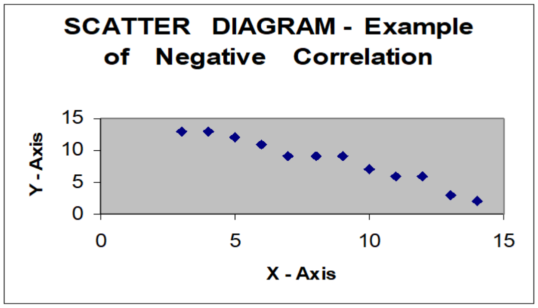
1.2.6 HISTOGRAM :

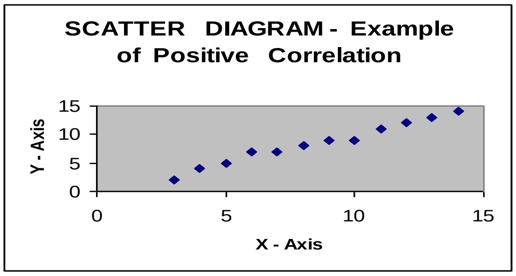
A diagram that graphically depicts the variability in a population. The frequency data obtained from measurements display a peak around a certain value. The variation of quality characteristics is called distribution. The figure that illustrates frequency in the form a pole is referred to as a Histogram.

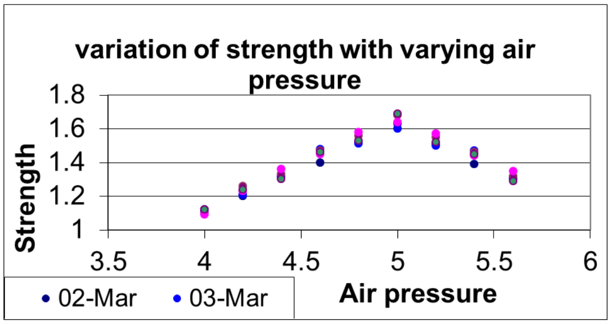
POPULATION AND SAMPLE

The entire set of items is called the Population. The small number of items taken from the population to make a judgment of the population is called a Sample. The numbers of samples taken to make this judgment is called Sample size.

1.2.7 Scatter Diagram







1.2.7 SCATTER DIAGRAM

<u>Two variables</u> :

a) Speed of the car in kms / Hr.

b) Petrol consumption in kms / Lt.

Speed of the car in kms / Hr.	**Petrol consumption in kms / Lt.**
30	**15, 15.5**
35	**16, 16.5**
40	**17, 17.5**
45	**18, 18.5**
50	**19, 19.5**
55	**20, 20.5**
60	**22, 22.5**
65	**21, 21.5**
70	**20, 20.4**
75	**19, 19.6**
80	**18, 18.6**
85	**18, 18.5**
90	**17, 17.4**
95	**16, 16.2**

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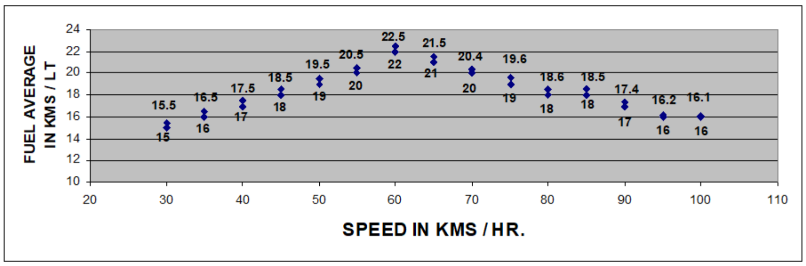
100	**16, 16.1**

Here:-
<u>Cause</u> : Speed of the car in kms / Hr.
<u>Effect</u> : Petrol consumption in kms / Lt

Positive and negative co-relation



<u>1.3.1 X CHART -</u>

X chart shows the centering of the process, i.e. it shows the variation in the average of samples. It is the most commonly used variable chart.

<u>1.3.2 R CHART –</u>

R chart shows the uniformity or consistency of the process i.e. it shows the variation in the range of samples.

Diameter of Shaft: 23.75 + 0.1 mm
No. of samples per day : 6
The diameter of shafts are as given below :

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1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day
23.77	23.80	23.77	23.79	23.75	23.78	23.76	23.76
23.80	23.78	23.78	23.76	23.78	23.76	23.78	23.79
23.78	23.76	23.77	23.79	23.78	23.73	23.75	23.77
23.73	23.70	23.77	23.74	23.77	23.76	23.76	23.72
23.76	23.81	23.80	23.82	23.76	23.74	23.81	23.78
23.75	23.77	23.74	23.76	23.79	23.78	23.80	23.78

Construct the X and R chart:

Average diameter for the first day

$$X1 = \frac{X1+X2+X3+X4+X5+X6}{6}$$

$$= \frac{23.77+23.80+23.78+23.73+23.76+23.75}{6}$$

$$= 23.765$$

Similarly, the averages for each day are calculated:

X1	X2	X3	X4	X5	X6	X7	X8
23.765	**23.77**	**23.7716**	**23.7767**	**23.7717**	**23.7583**	**23.7767**	**23.7667**

$$\text{Now } X = \frac{X}{N} = \frac{190.1567}{8} = 23.7696$$

Ranges :

R1	R2	R3	R4	R5	R6	R7	R8
.07	.11	.06	.08	.04	.05	.06	.07

$$R = \frac{R}{N} = 0.0675$$

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For X chart:

UCLX =X + A2R

=23.7696 + 0.48 x 0.0675

(A2= 0.48 for subgroup of from table)

= 23.7696 + 0.0324 = 23.802

LCLX =X - A2R

= 23.7696 – 0.0324 = 23.7322

For R chart :

UCLR = D4R

= 2 x 0.0675 = 0.1350

LCRR = D3R

= 0 (D3 = 0 for subgroup of 6 or less)

Process capability: o = R / d2 = 0.0675 / 2.534 = 0.0266

(for subgroup of 6, d2 = 2.534

X max = (USL) upper specification limit, X min. = (LSL) lower specification limit

1.4 Types of Variation in 7 Quality Tools

1) Variation due to chance causes

2) Variation due to assignable causes.

1) **Variation due to chance causes:**

Variations due to chance causes are inevitable in
any process or product. They are difficult to trace and difficult to control even under best conditions of production. Since these variations may be due to some inherent characterstic of the process or machine which functions at random. For example, a little play between nut and screw at random may lead to back-lash error and may cause a change in dimension of a machined part.

2) **Variation due to assignable causes:**

These variations possess greater magnitude as compared to those due to chance causes and can be easily traced or detected. The variations due to assignable causes may be because of the following factors:

a) Differences among machines.
b) Differences among workers
c) Differences among materials
d) Change in working conditions

Xmax – Xmin = 0.2 mm from data

Process capability Cp = (USL – LSL)/ 6 sigma

Cp= 0.2 / 6* 0.0266 = 0.2 / 0.15982 = 1.25

Cpk = (USL – X) / 3 sigma or (X – LSL) / 3 sigma

Cpk = (23.85 – 23.7696)/ 3*0.0266=1.0

Cpk = (23.7696 – 23.65)/ 3*0.0266 = 1.49

Cpk = 1.0 or 1.49 (1.0 is minimum)

1.5 Conclusion: -

Tools are simple, very powerful and help to identify the causes for work related problems and to find solutions for the same in a systematic manner. Quality Control tools are basically concerned in making sure that numerous procedures and occupied arrangements are in place to provide for effective and efficient statistical processes, to minimize the risk of errors or weaknesses in procedures or systems or in source material.

Seven QC tools are most helpful in troubleshooting issues related to quality, all processes are affected by multiple factors and therefore numerical QC tools can be practical for any procedure.

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