UNIT -3 Problem solving techniques

http://asq.org/learn-about-quality/seven-basic-quality-tools/overview/overview.html

1. What is a problem?

Consider the following situations:

a) The rejection rate is high at intermediate product testing.
b) The complaint and warranty replacements are high on the final product.
c) Too many people are required to carry out the task.
d) Frequent breakdown of a machine production
e) There is a long queue of customers waiting to be serviced.

The list can go on and on. We would like to take some corrective actions to reduce the recurrences of such occurrences and deviations. We would like to reduce the complaints, improve the productivity, improve safety, reduce high internal rejections etc.

The gap between the current level of performance and what we would like to achieve is termed as " The Problem". The same is depicted pictorially below

…….. Target Level

GAP= PROBLEM

……. Existing level

<u>Barriers to problem solving</u>

1. Fear of admitting to the existence of a problem
2. Believing that the problem is caused by the others
3. Thinking of one' s own area only and not looking at the total picture.
4. Lack of awareness of reality
5. No awareness of company goals and policies

<u>Types of problems</u>

Problems are of two types:

a) Chronic: problems which occurs again and again
b) One of its Kind: once it is solved, it is not likely to occur again

Example : A leaking tap is a one of a kind problem. Once it is replaced, the leak stops and not likely to recur. Frequent breakdown of some machines, low productivity of some process, higher rejection at a particular operation, frequent absenting of some operators etc examples of chronic problems. Therefore the root cause of the problems have to be identified, analysed and eliminated.

Classification of problems:

a) Maintenance type
b) Improvement type

Maintenance type problems: these are those problems which go out of control and have brought back to its old level by taking suitable corrective actions.

Improvement type problems: Improvement is defined as change for the better by change of method or material.

Lack of awareness problems is the first barrier to problem solving. Many people are often unaware of or deny the real extent and magnitude of their problems. The thought that there are no problems in their area is indeed the biggest problem. Under TQM, problem solving is a disciplined systematic and structured process.

What is problem solving?

Analysis of relationship between product characteristics and causes and root causes of a problem and the execution of appropriate corrective actions.

Using a structured problem solving method- the Plan – Do- check- Act (PDCA) Cycle.

Using appropriate QC Tools, techniques and statistical Methods.

Involvement of all concerned employees.

Who should undertake problem solving?

Every person, every department, every manager, every supervisor, every worker, Why –every CEO has to undertake problem solving. There will be problems at every stage in an organization. The levels of problems may be different. The impact of problems may be different. Nevertheless all such problems have to be solved. Every department has to excel in whatever it is doing.

1.Data collection and Check sheets: “count what can be counted”. Measure what can be measured”. Galileo

> “ In God we trust……. All others must bring data”

is a structured, pre-prepared form for collecting and analysing data. Data collection is the process of collecting information systematically. It is useful in understanding the magnitude of the problem.

Types of Data:

a) Measurable data
b) Attribute Data

Measurable Data: This refers to data or facts that can be measured, that can be quantified. Examples length, breadth, height, weight etc.

Measurable data is also called variable data or continuous data. A measurable data is also called variable data which can take any value in continuous scale even in fractional form.

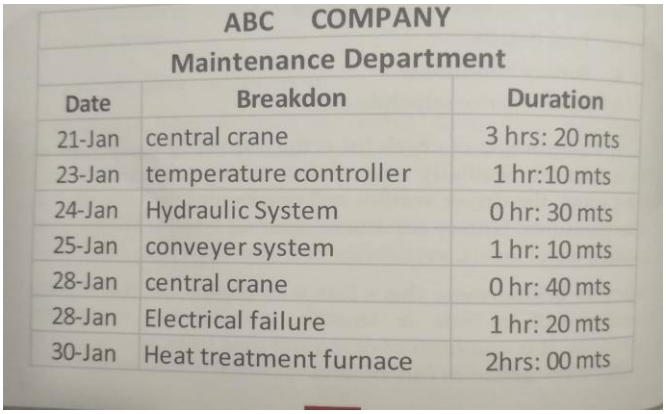
Attribute Data: Sometimes we cannot measure the data. We can only count them. Example A woman finds that 2 out of 12 oranges got spoiled Attribute data is also called discrete or discontinuous data.

Ways of data collection:

1. Check list: is a simple list of items that are relevant to a specific operation. A very simple example is the list of items that one must carry with him when he goes on tour.

Travel tickets, Money, Hotel Reservation details, Case study CD, company letter, Models, Mobile phone, Camera.

2. Data sheet: This is a simple tabular form for recording data. Given below is a partial list of the log book of the maintenance department of the company. This is a basic data sheet.



ABC COMPANY

Maintenance Department

Date	Breakdon	Duration
21-Jan	central crane	3 hrs: 20 mts
23-Jan	temperature controller	1 hr:10 mts
24-Jan	Hydraulic System	0 hr: 30 mts
25-Jan	conveyer system	1 hr: 10 mts
28-Jan	central crane	0 hr: 40 mts
28-Jan	Electrical failure	1 hr: 20 mts
30-Jan	Heat treatment furnace	2hrs: 00 mts

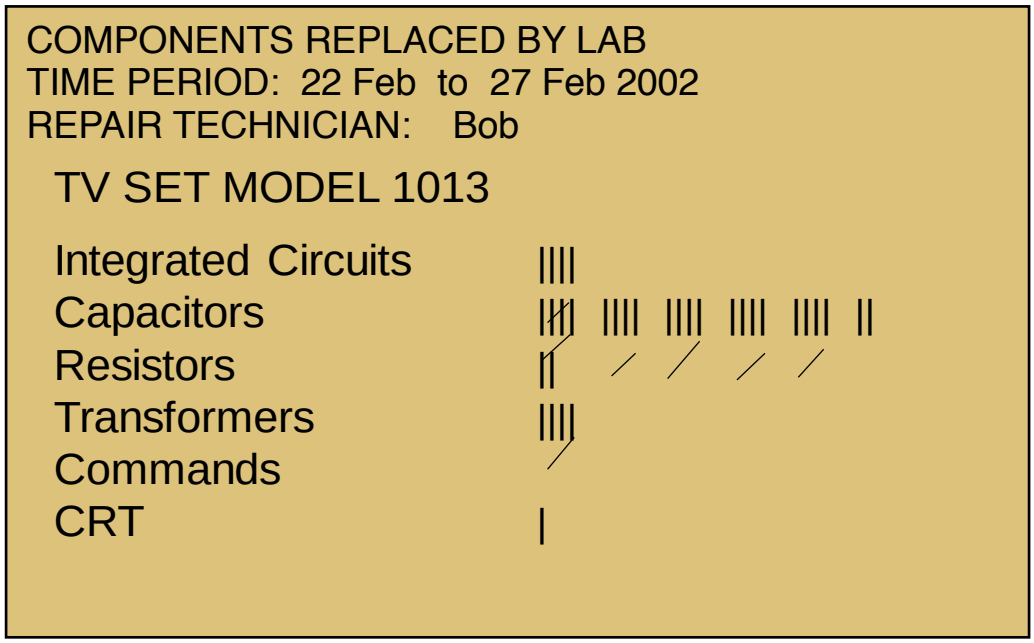
Problem solving basic seven Tools :

1**. Check sheets**:1) are simple data recording forms specially designed so that data can be collected and interpreted readily from the sheet itself. The sheet contain what to measure and when to measure. The usefulness of this method is that some conclusions can be made from the sheet itself.

2)Check sheets are nothing but forms that can be used to systematically collect data.

3)Check sheet give the user a place to start and provides the steps to be followed in

4) Collecting the data



COMPONENTS REPLACED BY LAB
TIME PERIOD: 22 Feb to 27 Feb 2002
REPAIR TECHNICIAN: Bob

TV SET MODEL 1013

Integrated Circuits	||||
Capacitors	|||| |||| |||| |||| |||| ||
Resistors	||
Transformers	||||
Commands	
CRT	|

USES

1.to gather data

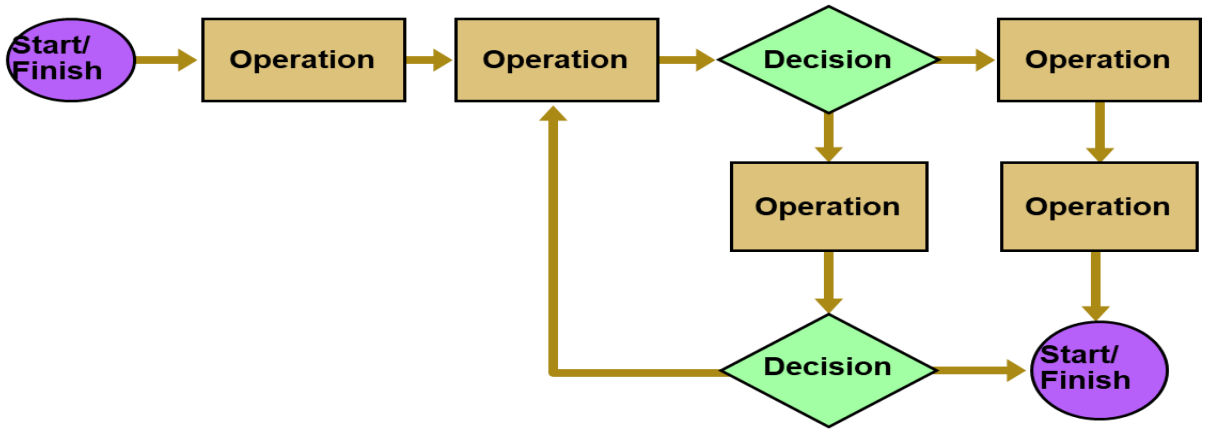
2. to test a theory

3. to evaluate alternate solutions

4.to verify that whatever improvement process you implement continues to work

2**. Flow charts**: is a graphical or pictorial representation of the sequence of steps that are performed to produce some output. Flow diagrams applies for a product, service, information etc. It is a systematic method of writing the sequences of activities with arrows indicating the direction of flow of the process sequence. In fact it is known as the armchair journey of a process without actually visiting the place.

- Flow charts are nothing but graphical representation of steps involved in a process.
- Flow charts give in detail the sequence involved in the material, machine and operation that are involved in the completion of the process.
- Thus, they are the excellent means of documenting the steps that are carried out in a process.



Detailed flow diagram/ flow charts

3. Histograms

Histograms help in understanding the variation in the process. It also helps in estimating the process capability. It is most commonly used graph to show frequency distributions. It is a specialised type of bar charts.

Histogram is a graphical representation of a frequency distribution which is a summary of variations in a product or process.

Variations are of two kinds: variations due to “Assignable” causes and variations due to “Chance” causes. The assignable causes are generally few and sporadic. There could be specific, identifiable reasons for their occurrence. On the other hand there are quite a large number of causes which are known as “Chance Causes” or Common Causes” or Random causes. Though it is difficult to identify these causes, their influence following a set pattern which is predictable by laws of laws of statistics. We can summarise the differences between chance and assignable causes as below.

Sr. No.	Chance Causes	Assignable Causes
1.	Large in Number	Few in Number
2.	Contribution to the process is small	Contribution is generally large and significant
3.	Difficult to identify and eliminate	Can be identified and corrected
4.	Exhibit a set pattern	No pattern is exhibited
5.	Governed by statistical laws	Sporadic. Do not follow statistical laws.

Histogram is a means to identify and summarise the results of such variations. It gives a graphic representation of the pattern of variations obtained by grouping the data into continuous classes or intervals.

To understand the principles, let us consider the marks obtained by the students of a class in mathematics.

61	54	55	59	55	45	57	58	53	58
51	49	60	51	51	59	54	54	55	49
55	56	54	54	57	54	50	48	57	53
54	53	58	56	52	56	54	56	54	52
53	48	54	55	60	51	52	55	61	65
52	55	47	54	53	56	55	51		

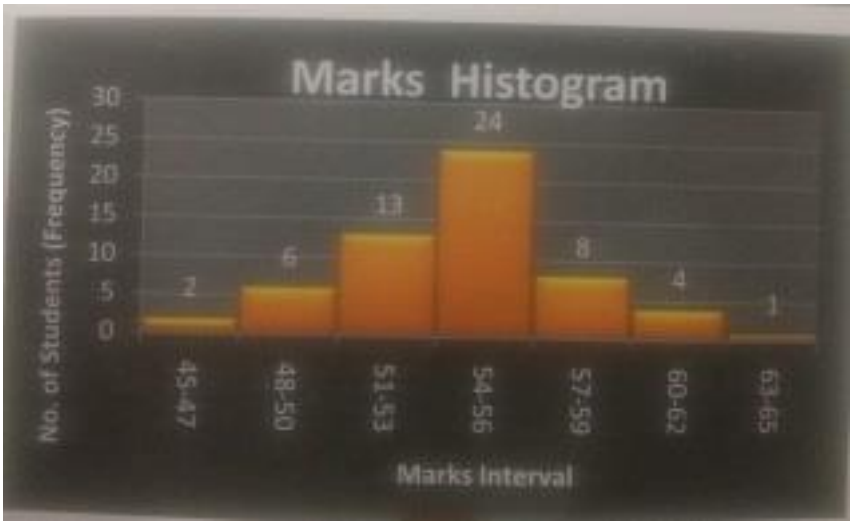
What are we able to comprehend from these readings? Practically very little.

Minimum mark is 45 and maximum is 65

Suppose we group this data as given below, then what do we see?

Here the marks obtained by 58 students of a class are grouped into groups of 3 marks starting from 45 to 47. In other words, there are 2 students who obtained marks between 45 & 47. 6 students obtained marks between the intervals of 48 to 50. 13 students obtained marks between 51 & 53 and so on. These are plotted with mark intervals on the x-axis and number if students (frequency) in each interval. The number of times an event occurs (or falls) with in an interval is known as frequency (of occurrence)

Marks	Frequency
45-47	2
48-50	6
51-53	13
54-56	24
57-59	8
60-62	4
63-65	1



The graph indicated that the marks are centered around 54 to 56. These is a tapering of students on either side of the central interval.

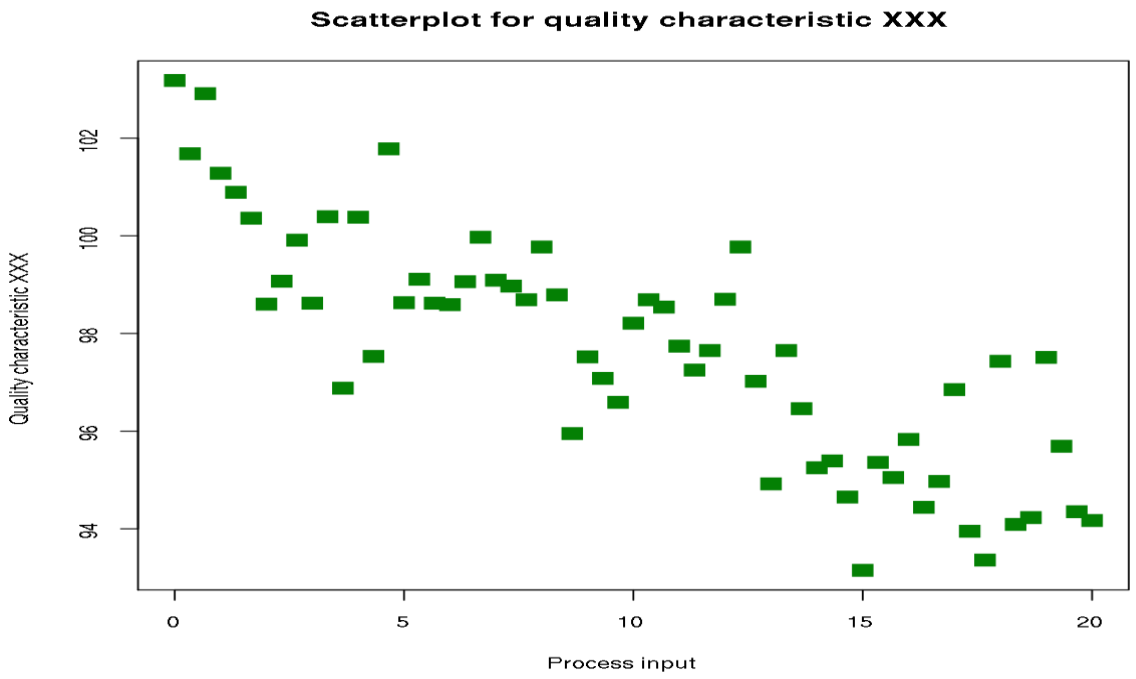
Why do we need to draw a histogram?

1. Histogram indicated the shape and extent of the frequency distribution. If it is bell shaped, it indicated a normal distribution.
2. It indicates the symmetry of distribution.
3. It indicates whether the distribution is unimodal, bimodal or multimodal.

It indicates the process capability, if specification limits are included in the histogram

4. Scatter Diagram

It is a graph of points plotted; this graph is helpful in comparing two variables. The distribution of the points helps in identifying the cause and effect relationship Between two variables. Some examples of relationship are cutting speed and tool life, breakdowns and equipment age, production speed and number of defective parts.

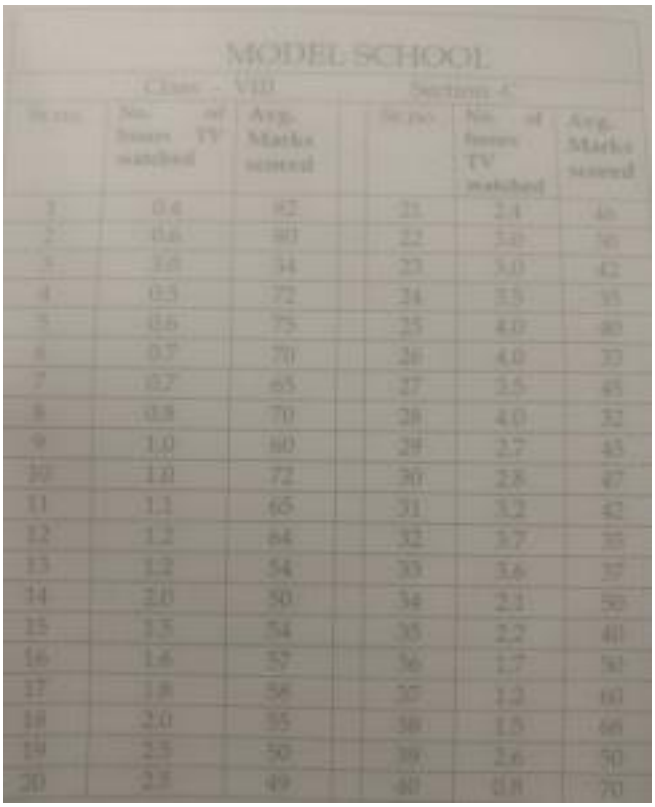


The Scatter diagram is a graphical technique to represent and analyse the relationship between two variables. One of the variables could be a cause and the other variable may be an effect, getting affected by the changes in the 'cause' variable. Here are some examples:

1) Amount of money spent in advertisement and actual increase in sales.

The teachers of Model School had formed a quality circle by name "GYAN". They had been suspecting that long hours of watching TV, could have an adverse effect on the overall performance of the students. The team members wanted to confirm this by collecting data and drawing a scatter diagram. So, on an experimental basis, they collected data from class – VIII, section -0 C. the class had 40 students. They asked each student how long he wanted TV (on an average per

day), either along or along with their parents. Against each student, the average marked scored by him in the final examination was also entered. The data table is as given below.



MODEL SCHOOL

Class - VIII Section 'A'

Sr.no.	No. of hours TV watched	Avg. Marks scored	Sr.no.	No. of hours TV watched	Avg. Marks scored
1	0.4	82	21	2.4	46
2	0.6	80	22	3.0	50
3	1.0	74	23	3.0	42
4	0.5	72	24	3.5	35
5	0.6	75	25	4.0	40
6	0.7	70	26	4.0	33
7	0.7	65	27	2.5	45
8	0.8	70	28	4.0	32
9	1.0	60	29	2.7	43
10	1.0	72	30	2.8	47
11	1.1	65	31	3.2	42
12	1.2	64	32	3.7	35
13	1.2	54	33	3.6	37
14	2.0	50	34	2.1	50
15	1.5	54	35	2.2	48
16	1.4	57	36	2.7	50
17	1.8	56	37	1.2	60
18	2.0	55	38	1.5	66
19	2.3	50	39	2.6	70
20	2.3	49	40	0.8	70

They prepared the scatter diagram in the following way

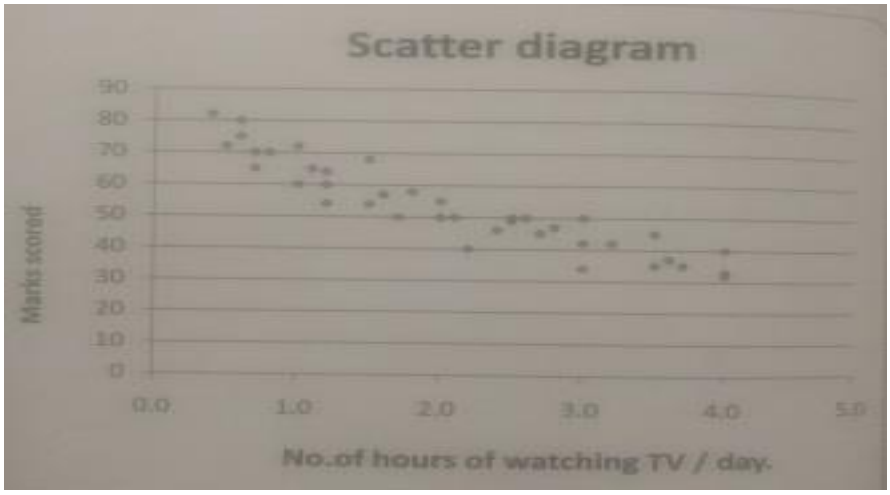
Step-1: On a graph paper, they drew the X and Y axis.

Step-2: On the X axis (horizontal axis) the independent variable, “the hours of watching TV/day” was marked. A scale of 1 to 5 was found convenient.

Step-3: On the Y axis (vertical axis) the dependant variable “Marks scored” was marked. A scale of 0 to 100 was found to be convenient.

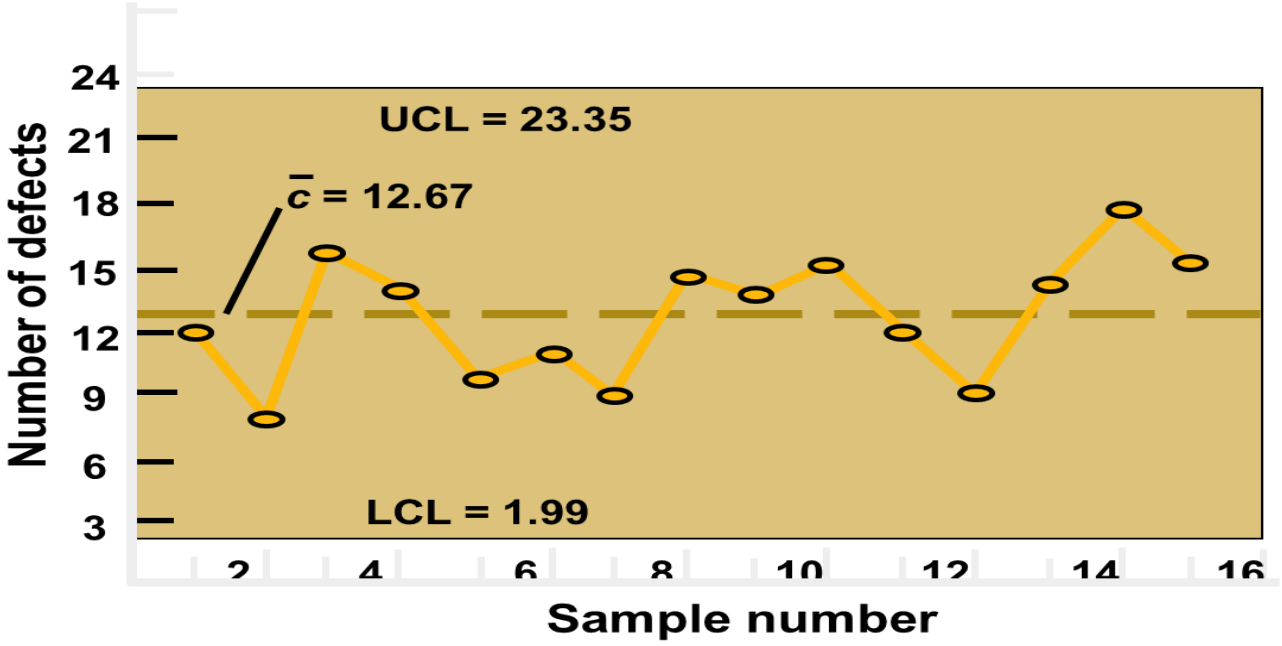
Step-4: Against each boy’s time of watching TV, his corresponding mark was plotted on the graph.

Step-5: This process was completed for all the students. If some points were repeated, a circle was made around the previous plot. The emerging picture looked as shown below:



5. Control charts:

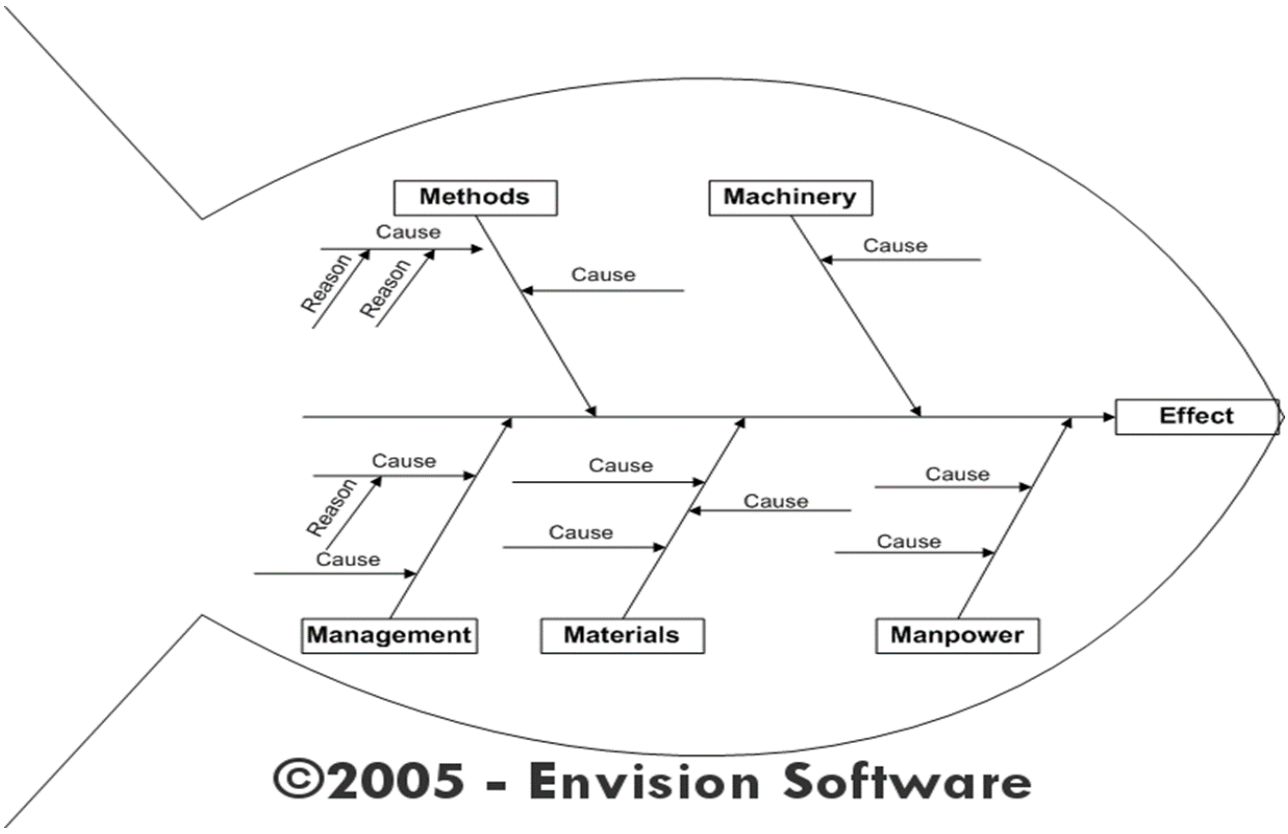
A control chart is nothing but a run chart with limits. This is helpful in finding the amount and nature of variation in a process.

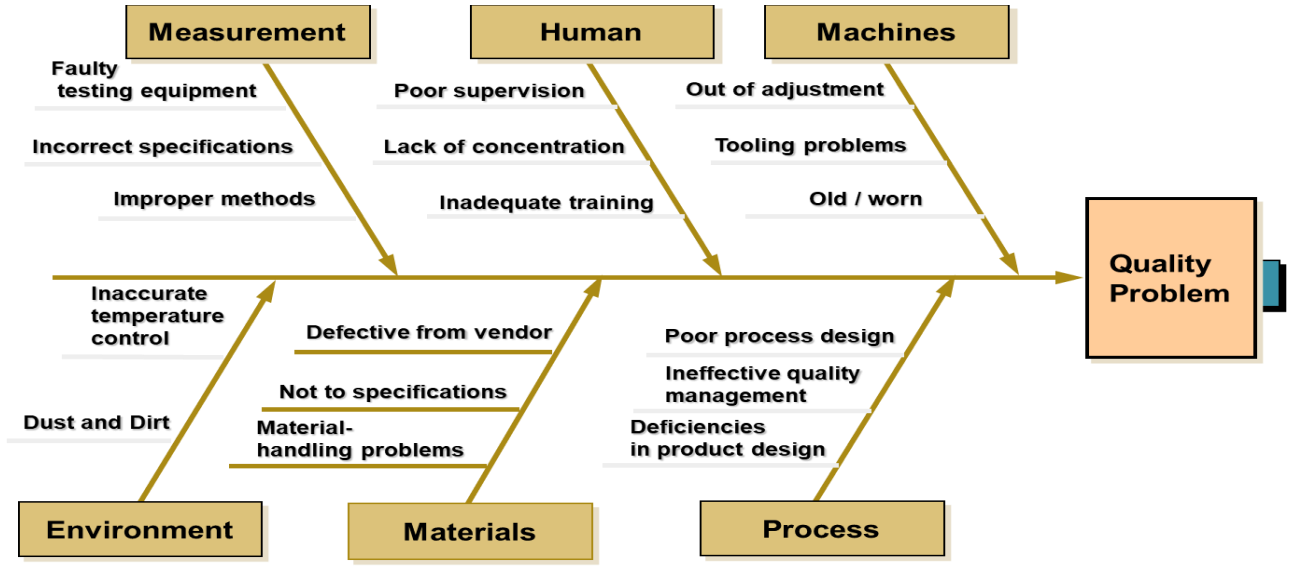


6. Cause and effect diagram

The cause and effect diagram is an investigative tool. This is also called Ishikawa Diagram. Because of its shape, the diagram is also termed as Fishbone Diagram.

There is a systematic arrangement of all possible causes which give rise to the effect in Ishikawa diagram. Before taking up problem for a detailed study, it is necessary to list down all possible causes through a brainstorming session so that no important cause is missed. The causes are then divided into major sources or variables.





GRAPHS

What is a Graph?

A Graph is a pictorial representation of data which is much easier to comprehend and understand. Graphs are capable of representing large amount of information in a compact manner.

Types of Graphs

Some graphs are most commonly used. They are:

1. Line Graph
2. Bar Graph/Chart
3. Pie Chart/Circle Graph
4. Pictorial Graph

Line Graph:-

Line Graph is one of the simplest of the graphs. It represents pairs of numeric data, indicating how one of the variables is a function of the other. For example, the production data of a company for 6 months is as given below.

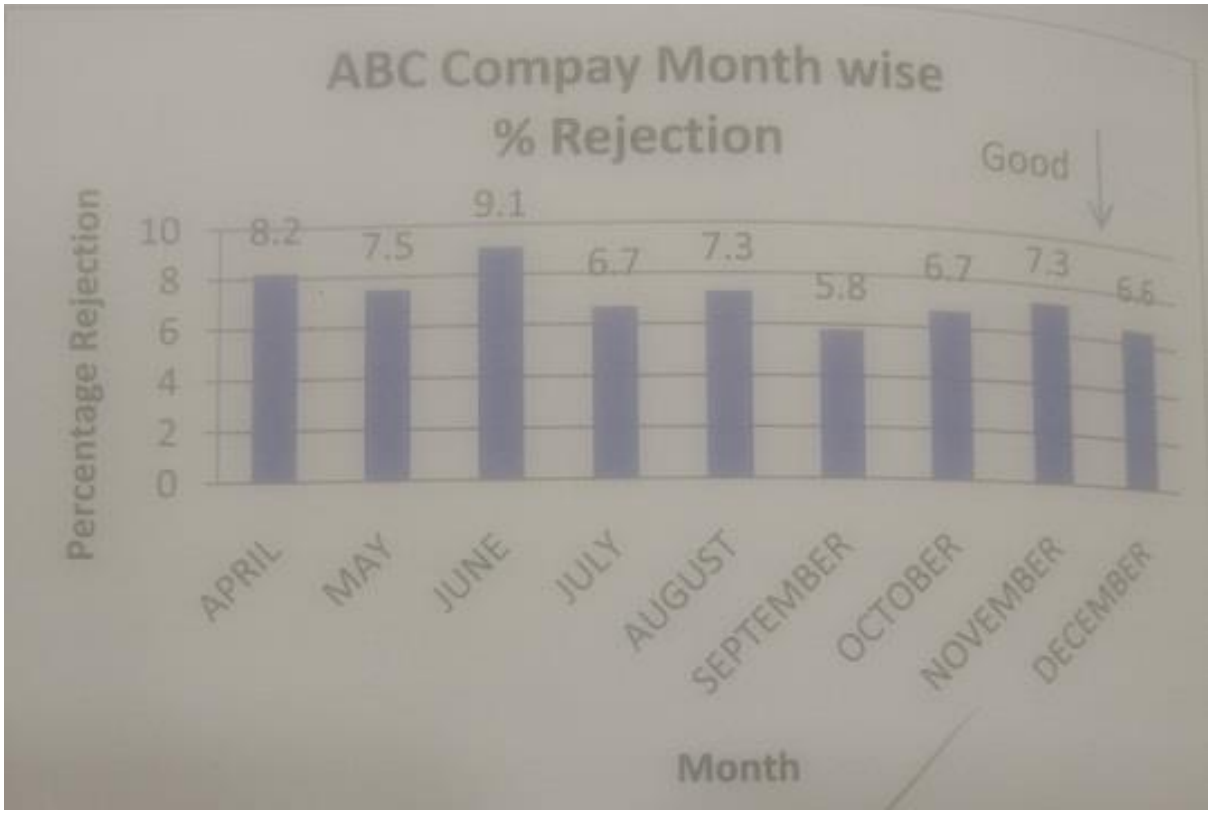
XYZ Company: Monthly Production

Month	PRODFUCTION IN TONS
JAN.	1109
FEB.	1015
MAR.	1250
APR.	1568
MAY.	1982
JUN.	2123

Bar Graph:-

A bar graph is a chart with rectangular bars with lengths proportional to the values that they represent. The bar graph is also called Bar Chart. The bars can be vertical or horizontal.

The bar chart helps us to portray the relationships between pairs of variables.



Here the horizontal axis represents the months. The height of the rectangle represents the % rejection. The arrow downwards the ''good'' written by its side indicates that lower readings are considered good. Obviously lesser rejection percentages are better.

Usually the origin of the graph is zero.

Pie Chart/Circle Graph:-

A Pie Chart is also known as Circle graph. A Pie Chart is a circular chart in which a circle is divided into sectors. Each sector (angle) represents the proportion of that data in relation to the whole total. This will be clear, if we consider the following example.

A company had made the following production during a given month.

1. Product A- 100 tons
2. Product B- 400 tons
3. Product C- 480 tons
4. Product D- 300 tons
5. Product E- 320 tons

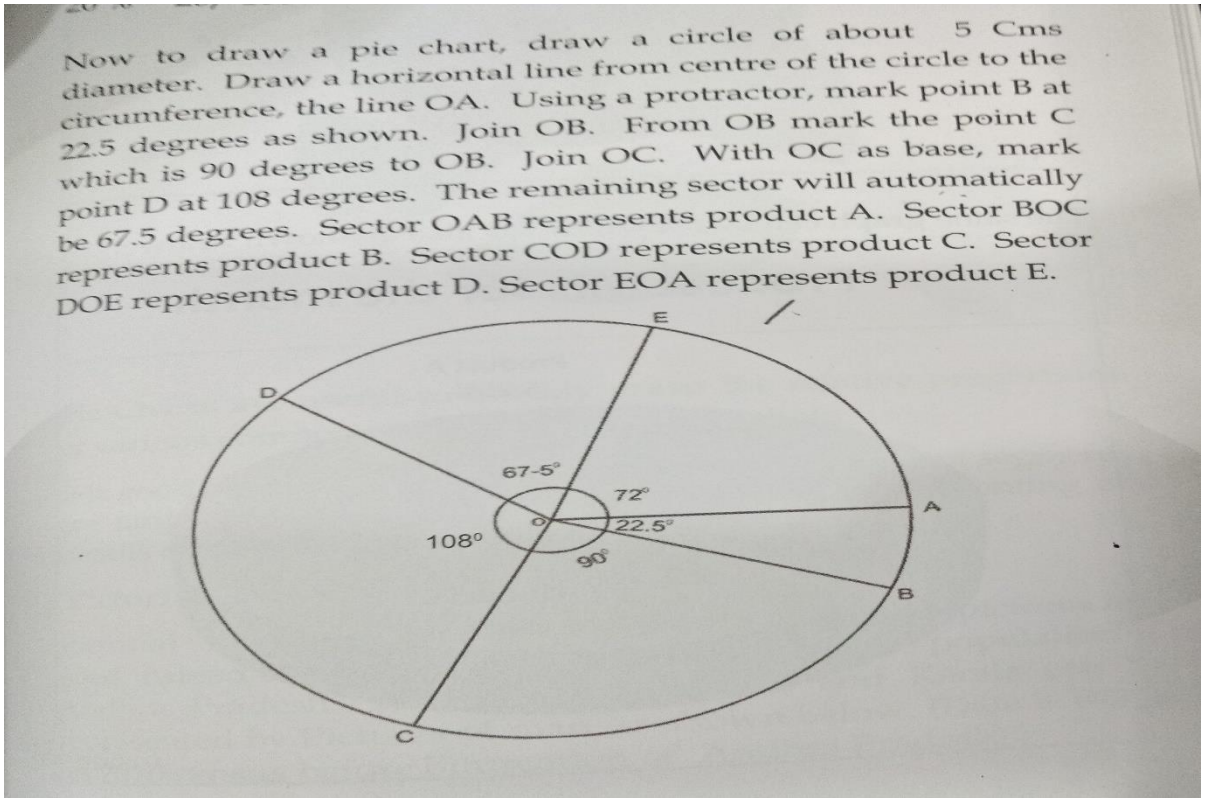
Total 1600 tons

---

1. The first step is to calculate the % of each product.

Product A = 100/1600 * 100 = 6.25%
Product B = 400/1600 * 100 = 25%
Product C = 480/1600 * 100 = 30%
Product D = 300/1600 * 100 = 18.75%
Product E = 320/1600 * 100 = 20%

A circle has 360 degrees. We have to convert percentage into proportional degrees.
6.25% = 6.25/100 *360 = 22.5 degrees
25%= 25/100 * 360 = 90 degrees
30% = 30/100 * 360 = 108 degrees
18.75%= 18.75/100 *360 = 67.5 degrees
20%= 20 /100 *360 = 72 degrees



7. PARETO DIAGRAM

Introduction:-

In 1906, an Italian economist Vilfredo Pareto while studying the distribution of wealth in Italy found that roughly 20 percent of the families were holding 80% of the wealth. Though initially it was referring to wealth distribution only, the universality of this behaviour was observed by many in the field of science and management. Here are some typical examples.

Bulk of the sales revenue is contributed by a limited number of the products of a company.

Most of the users use only a small percent of the features of a product or software.

Majority of product-complaints arise out of a small number of products.

The Vital few & useful many:-

In 1937, it was Dr. J.M. Juran, the famous quality guru, who noticed the universality of the applicability of the **Pareto principle. He found that quality defects are unequal in frequency.** This

means that few defects accounted for bulk of the rejections or defectives. Initially he termed them as the ''vital few and trivial many''. He found that it makes lot of sense to attack the vital few causes which are responsible for creating bulk of the defects. By concentrating on the ''vital few'' , lot of time, effort and money could be saved. He also suggested that solving the vital few, some other causes from the remaining trivial many would assume the status of vital few. As quality improvement is a continuous process, the second set of ''vital few'' should be taken up next. This process should be continued until all the causes resulting in defects or defectives are eliminated. Thus Dr. Juran was the first to convert this idea into a universal principle. In fact, there was a move by some of Dr. Juran's associates to name the principle as ''Juran's Principle''. However, as per the wishes of Dr. Juran himself, the principal remains to be known as **Pareto Principle.**

Pareto Principle:-

The principle that defects are unequal in frequency leading to identification of vital few & useful many is known as Pareto Principle.

Pareto Diagram:-

The diagram that prioritized the causes and helps to identify the vital few, along with Lorenz Curve is known as Pareto Diagram. It is a compound graph.

What is a Pareto Diagram:-

A Pareto Diagram is a bar chart in which the various factors that contribute to an effect are arranged in a descending order of magnitude/ frequency of occurrence. A cumulative percentage graph is added to this bar graph. Thus it is a compound graph with two vertical axis, one for the causes and another for the cumulative percentage.

Where Quality Circles use Pareto Analysis?

1) Quality Circles use Pareto Analysis during selection of problems. After identifying their work related problems, the circles usually stratify them according to safety, quality, productivity, wastage, environmental hazard related problems. From time to time, the management and organization requirements also are spelt out. So, the quality circles use Pareto Diagram to identify the problems that contribute to the company's required goals.
2) Pareto Analysis is used at the problem analysis stage.
3) Pareto Analysis is widely used to identify root causes of the problem.
4) Pareto Analysis is also widely used to check the effectiveness of the solutions they have implemented. Usually, circles draw Pareto diagram ''before'' and ''after'' the problem solution.

Note- Practice of pareto chart has been done in detailed in class.

Draw Pareto Diagram
Show the Vital few
Write the conclusion.

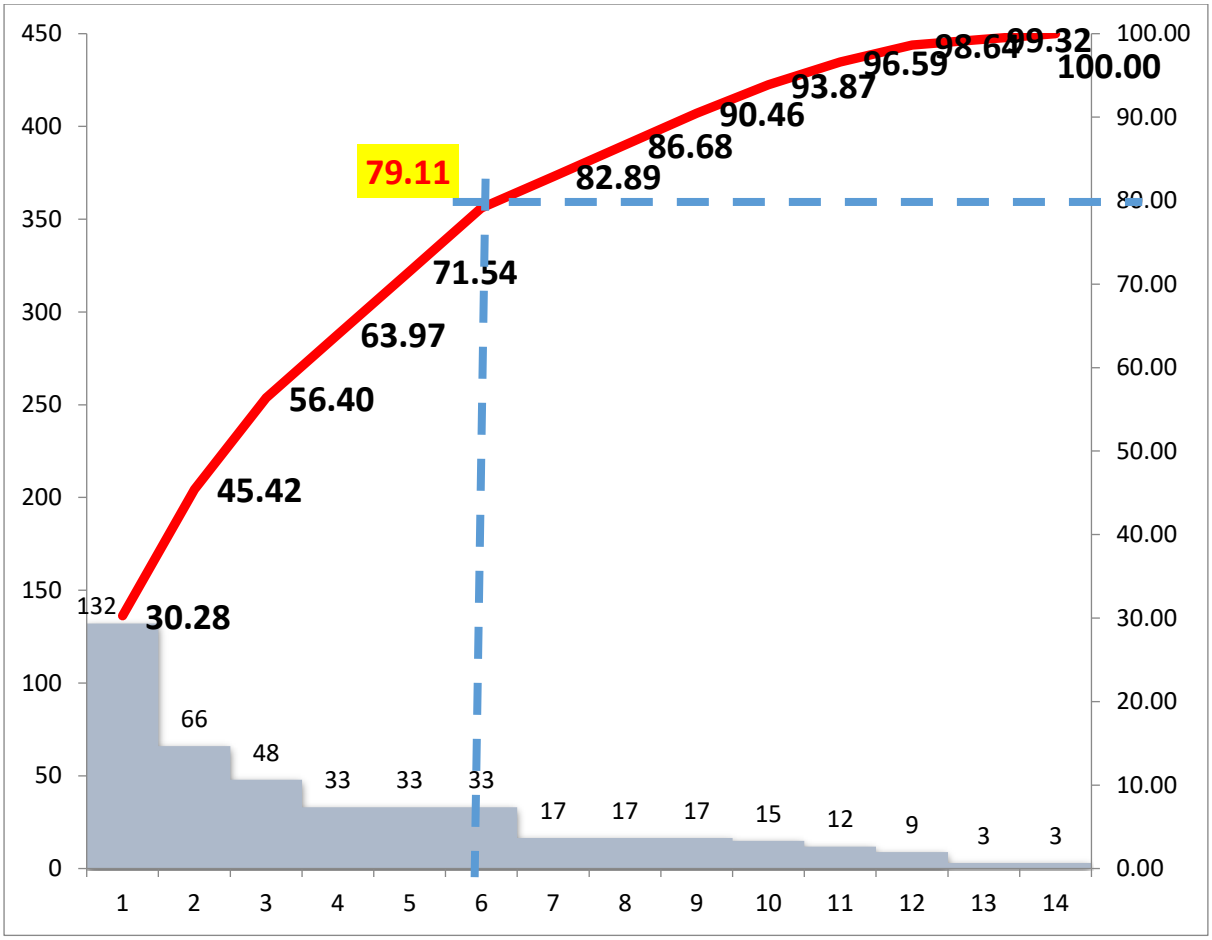
Defects	Bearing seat area crack		Dia 52 unclean	Dia 52 over size	OIL GALERY BLOCK (SUCTION)	OIL GALERY BLOCK (RETURN)	AIR PRESSURE SLOT MISSING	STUD THREAD SLIP	OIL PASSAGE BLOCKED	Others (Noise Etc.)	THREAD SLIP (G.S.RETURN PIN)	THREAD SLIP (DRUM STOP ARM BOLT)	Others (G.S.Hard)	JOINT BOLT THREAD SLIP	Drain bolt Thrd. Slip
No of Defective pieces	17		48	12	33	66	3	132	33	17	17	15	33	9	3

Defects	No of Defective pieces		cummulative
STUD THREAD SLIP	132	30.28	30.28
OIL GALERY BLOCK (RETURN)	66	15.140	45.42
Dia 52 unclean	48	10.977	56.40
OIL GALERY BLOCK (SUCTION)	33	7.570	63.97
OIL PASSAGE BLOCKED	33	7.570	71.54
Others (G.S.Hard)	33	7.570	79.11
Bearing seat area crack	17	3.785	82.89
Others (Noise Etc.)	17	3.785	86.68
THREAD SLIP (G.S.RETURN PIN)	17	3.785	90.46
THREAD SLIP (DRUM STOP ARM BOLT)	15	3.407	93.87
Dia 52 over size	12	2.725	96.59
JOINT BOLT THREAD SLIP	9	2.044	98.64
AIR PRESSURE SLOT MISSING	3	0.681	99.32
Drain bolt Thrd. Slip	3	0.681	100.00
	436	100	

In this case Vital Few is 79.11

By studding this diagram it is clearly indicated that we have to focus on following defects. After resolving these issues we are able to reduce at least 79 % Defects

Defects	No of Defective pieces
STUD THREAD SLIP	132
OIL GALERY BLOCK (RETURN)	66
Dia 52 unclean	48
OIL GALERY BLOCK (SUCTION)	33
OIL PASSAGE BLOCKED	33
Others (G.S.Hard)	33


450
400
350
300
250
200
150
100
50
0
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
79.11
132
30.28
45.42
56.40
63.97
71.54
82.89
86.68
90.46
93.87
96.59
98.64
99.32
100.00
66
48
33
33
33
17
17
17
15
12
9
3
3
1
2
3
4
5
6
7
8
9
10
11
12
13
14