FUNDAMENTAL OF INDUSTRIAL MANAGEMENT

Unit -3 **Problem solving tools and techniques**	• Definition of a problem • Type of problems, classification of problems • What is problem solving, barriers to problem solving • Problem solving tools: Cause and effect diagram, Histogram, flow charts, Check sheets, Pareto charts, Control charts, Scatter Diagram • Problem solving techniques: Brain storming, PDCA Cycle etc

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".**

Types of problems

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 problems. 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.

Barriers to problem solving

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

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".
W. Edwards Deming "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, company letter, Models, Mobile phone, Camera etc.

.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.

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 Tools:

1. Check sheet:
A check sheet is a structured, prepared form for collecting and analysing data. This is a generic data collection and analysis tool that can be adapted for a wide variety of purposes and is considered one of the seven basic quality tools.

When to use a check sheet:
- When data can be observed and collected repeatedly by the same person or at the same location
- When collecting data on the frequency or patterns of events, problems, defects, defect location, defect causes, or similar issues
- When collecting data from a production process

Check sheet example:
The figure below shows a check sheet used to collect data on telephone interruptions. The tick marks were added as data was collected over several weeks.

No. of Telephone Interruptions in the Radiology Department

Reason	Day					
	Mon	Tues	Wed	Thurs	Fri	Total
Wrong telephone number	𝍸	𝍪	𝍪	𝍸	𝍸 𝍪	20
Information request	𝍪	𝍪	𝍪	𝍪	𝍪	10
Call from boss	𝍸	𝍪	𝍸 𝍪	𝍪	𝍪𝍪	19
Total	12	6	10	8	13	49

Procedures:

- ➢ Decide what problem will be observed
- ➢ Decide when data will be collected and for how long
- ➢ Decide the form
- ➢ Label all spaces on the form
- ➢ Test the check sheet for a short trial period to be sure it collects the appropriate data and is easy to use.
- ➢ Each time the targeted problem occurs, record data on the check sheet.

2. Cause and effect diagram:

A cause and effect diagram examine why something happened or might happen by organizing potential causes into smaller categories. It can also be useful for showing relationships between contributing factors. One of the Seven Basic Tools of Quality, it is often referred to as a fishbone diagram or Ishikawa diagram.

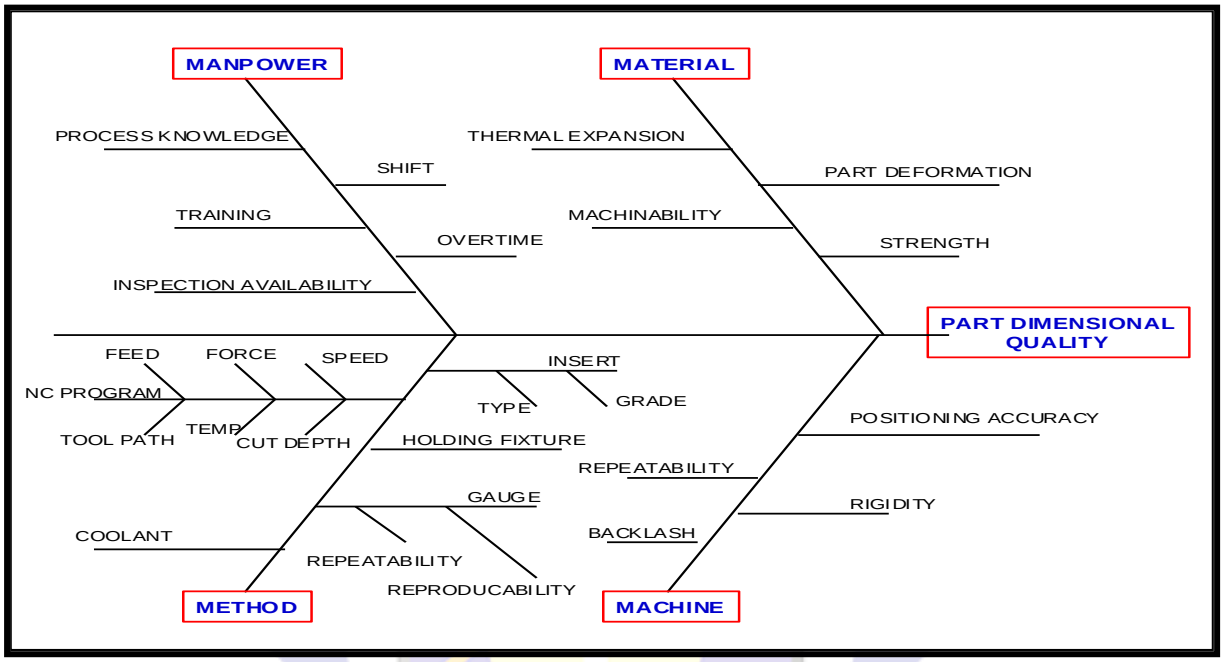
One of the reasons cause & effect diagrams are also called fishbone diagrams is because the completed diagram ends up looking like a fish's skeleton with the fish head to the right of the diagram and the bones branching off behind it to the left.

Method of drawing cause and effect diagram

These are the best and most common practices when creating cause and effect diagrams.

- **Identify the problem.** Define the process or issue to be examined.
- **Brainstorm.** Discuss all possible causes and group them into categories.
- **Draw the backbone.** Once the topic is identified, draw a straight, horizontal line (this is called the spine or backbone) on the page, and on the right side, draw a rectangle at the end. Write a brief description of the problem in the rectangle.
- **Add causes and effects.** Causes are added with lines branching off from the main backbone at an angle. Write the description of the cause at the end of the branch. These are usually one of the main categories discussed above. Details related to the cause or effect may be added as sub-categories branching off further from the main branch. Continue to add branches and a cause or effect until all factors have been documented. The end result should resemble a fish skeleton.
- **Analyze.** Once the diagram has been completed, analyze the information as it has been organized in order to come to a solution and create action items.

In the manufacturing industry, these are referred to as the 6Ms. Example of cause and effect diagram is as follows:



3. Histogram

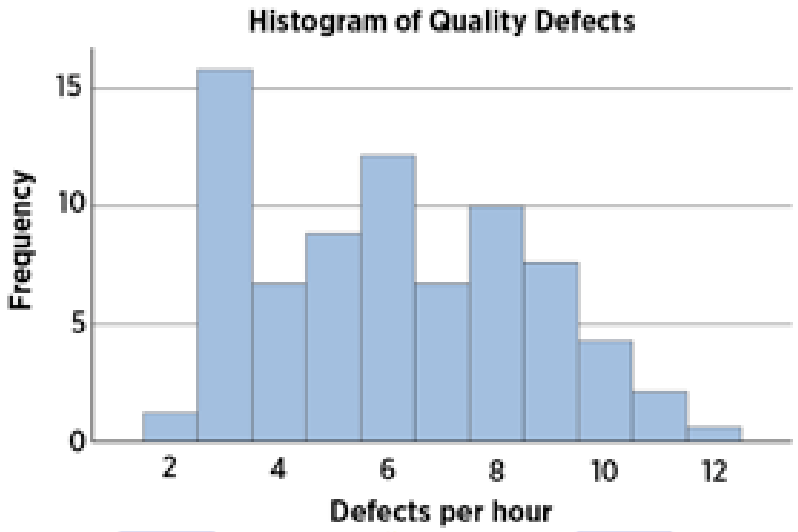
A frequency distribution shows how often each different value in a set of data occurs. A histogram is the most commonly used graph to show frequency distributions. It looks very much like a bar chart, but there are important differences between them. This helpful data collection and analysis tool is considered one of the seven basic quality tools.

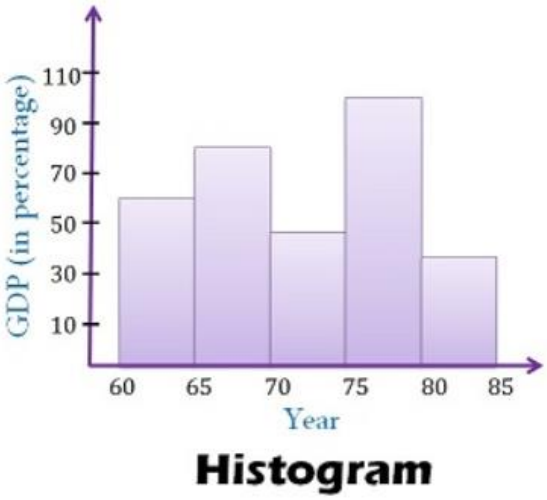
WHEN TO USE A HISTOGRAM

Use a histogram when:

- The data are numerical
- You want to see the shape of the data's distribution, especially when determining whether the output of a process is distributed approximately normally
- Analyzing whether a process can meet the customer's requirements
- Analyzing what the output from a supplier's process looks like
- Seeing whether a process change has occurred from one time period to another

- Determining whether the outputs of two or more processes are different
- You wish to communicate the distribution of data quickly and easily to others





4. Flow Chart:

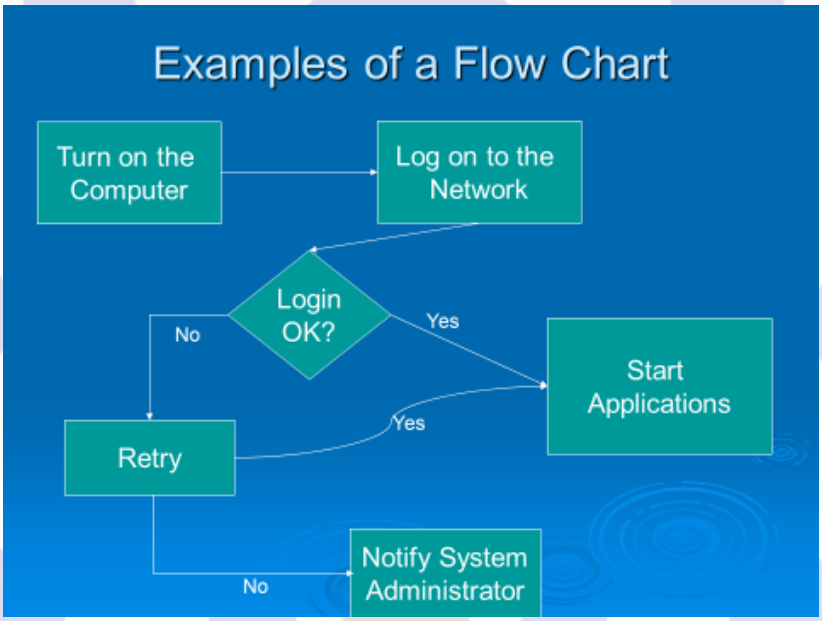
A flowchart is a picture of the separate steps of a process in sequential order. Elements that may be included are: sequence of actions, materials or services entering or leaving the process (inputs and outputs), decisions that must be made, people who become involved, time involved at each step and/or process measurements. An organized combination of shapes, lines, and text that graphically illustrates a process or structure.

The process described can be anything: a manufacturing process, an administrative or service process, a project plan. This is a generic tool that can be adapted for a wide variety of purposes.

Purpose of a flow chart: visual illustration of sequence of operations required to complete the task.

When to Use a Flowchart

- To develop understanding of how a process is done.
- To study a process for improvement.
- To communicate to others how a process is done.
- When better communication is needed between people involved with the same process.
- To document a process.
- When planning a project.

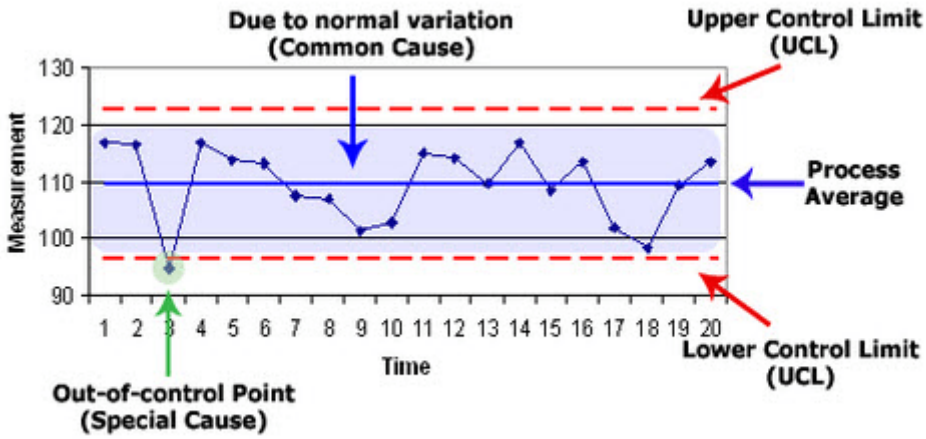


5. Control chart

The control chart is a graph used to study how a process changes over time. Data are plotted in time order. A control chart always has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit. These lines are determined from historical data. By comparing current data to these lines, you can draw conclusions about whether the process variation is consistent (in control) or is unpredictable (out of control, affected by special causes of variation). This versatile data collection and analysis tool can be used by a variety of industries and is considered one of the seven basic quality tools.

Control charts for variable data are used in pairs. The top chart monitors the average, or the centering of the distribution of data from the process. The bottom chart monitors the range, or the width of the distribution. If your data were shots in target practice, the average is where the shots are clustering, and the range is how tightly they are clustered. Control charts for attribute data are used singly.

The control chart serves to "sound the alarm" when a process shifts (for instance, a machine suddenly breaking on a factory floor) or if someone has a breakthrough that needs to be documented and standardized across the larger organization. Simply put (without taking anomalies into consideration), you'll know something needs to be fixed if you're below your lower control limit or above your upper control limit. See the control chart example below:



6. Pareto Chart

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

Use of Pareto Chart

1) Pareto Diagram to identify the problems that contribute to the company's required goals.
2) Pareto Analysis is widely used to identify root causes of the problem

Exercise

Draw Pareto Diagram
Show the Vital few
Write the conclusion.

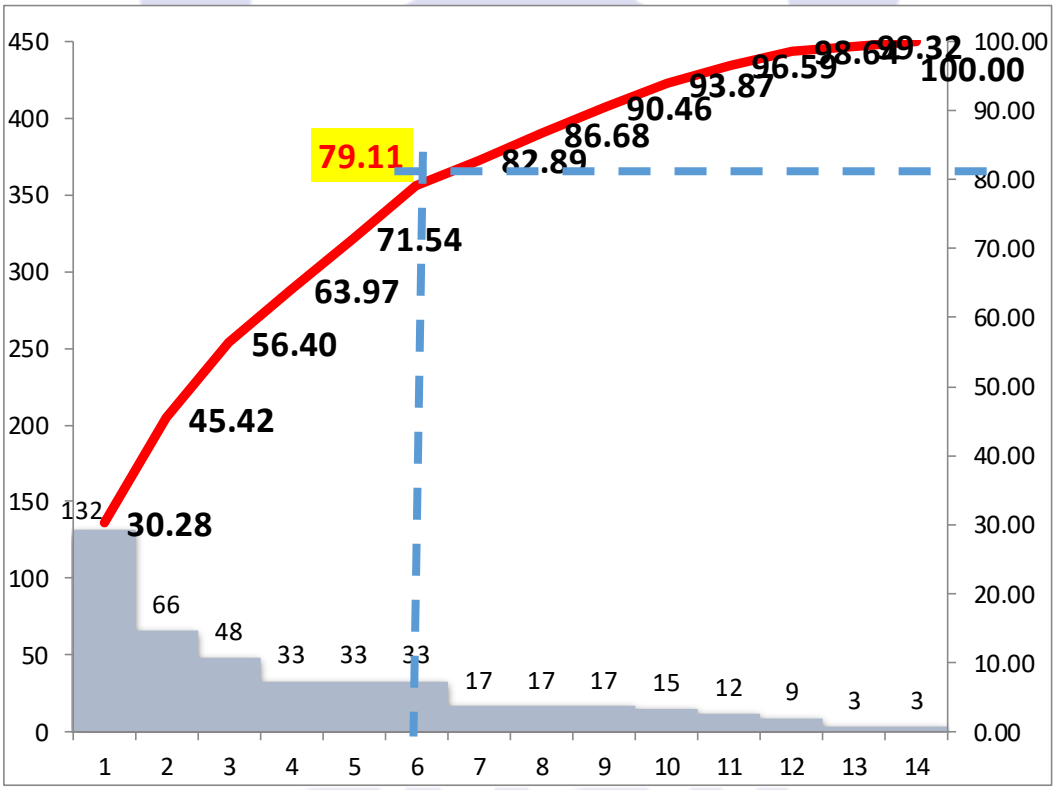
Defects	Bearing seat area crack		Dia 52 unclean	Dia 52 over size	OIL GALERY BLOCK (SUCTION)	OIL GALERY BLOCK (RETURN)	AIR PRESSURE SLOT MISSING	STUD THREAD SLIP	OIL PASSAGE BLOCKED	Others (Noise Etc.)	THREAD SLIP (G.S.RETURN PIN)	THREAD SLIP (DRUM STOP ARM BOLT)	Others (G.S.Hard)	JOINT BOLT THREAD SLIP	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	Percentage	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
Total	436	100	

In this case Vital Few is 79.11

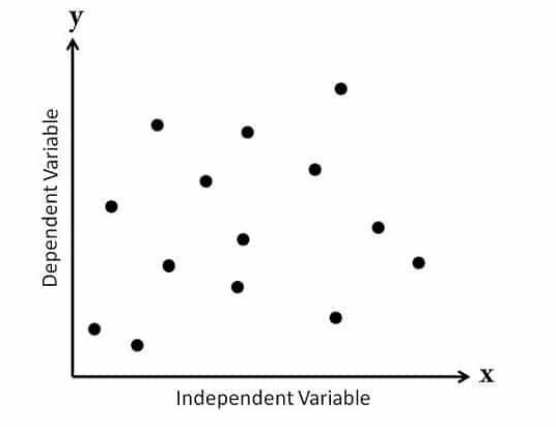
By studding this diagram it is clearly indicated that we have to focus on following defects. After resolving these issues we are able to reduce at least 79 % Defects

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



7. Scatter Diagram

The scatter diagram is known by many names, such as scatter plot, scatter graph, and correlation chart. This diagram is drawn with two variables, usually the first variable is independent and the second variable is dependent on the first variable.



The scatter diagram is used to find the correlation between these two variables. This diagram helps you determine how closely the two variables are related. After determining the correlation between the variables, you can then predict the behavior of the dependent variable based on the measure of the independent variable. This chart is very useful when one variable is easy to measure and the other is not.

Example

You are analyzing the pattern of accidents on a highway. You select the two variables: motor speed and number of accidents, and draw the diagram.

Once the diagram is completed, you notice that as the speed of vehicle increases, the number of accidents also goes up. This shows that there is a relationship between the speed of vehicles and accidents happening on the highway.

Since this diagram shows you the correlation between the variables, it is also known as a correlation chart.

Type of Scatter Diagram

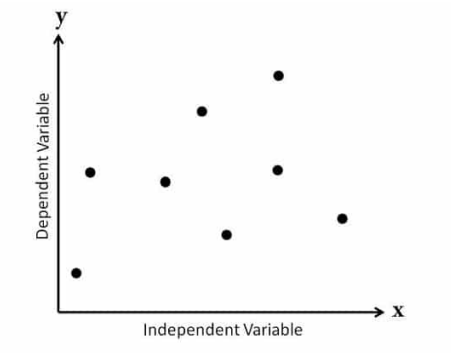
The scatter diagram can be categorized into several types; however, there are two types that will cover most scatter diagrams used in project management. The first type is based on the type of correlation, and the second type is based on the slope of trend.

According to the type of correlation, scatter diagrams can be divided into following categories:

- Scatter Diagram with No Correlation
- Scatter Diagram with Moderate Correlation
- Scatter Diagram with Strong Correlation

Scatter Diagram with No Correlation

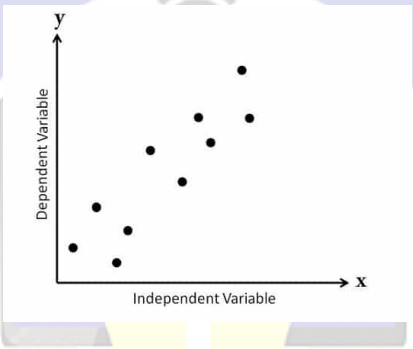
This type of diagram is also known as "Scatter Diagram with Zero Degree of Correlation".



In this type of scatter diagram, data points are spread so randomly that you cannot draw any line through them. In this case you can say that there is no relation between these two variables.

Scatter Diagram with Moderate Correlation

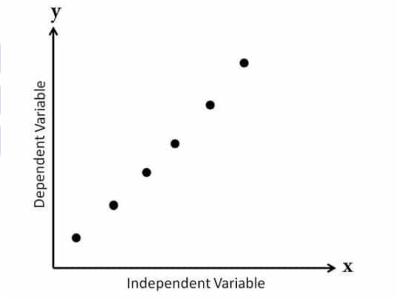
This type of diagram is also known as "Scatter Diagram with Low Degree of Correlation".



Here, the data points are little closer together and you can feel that some kind of relation exists between these two variables.

Scatter Diagram with Strong Correlation

This type of diagram is also known as "Scatter Diagram with High Degree of Correlation".In this diagram, data points are grouped very close to each other such that you can draw a line by following their pattern.



In this case you will say that the variables are closely related to each other.

Brainstorming

Brainstorming is a technique by which a group attempts to find a solution(s) to a specific problem by amassing ideas spontaneously. It is a highly effective technique for maximising group creative potential, not only to generate ideas but also to determine which ideas are most likely to succeed in a specific area of interest

PDCA cycle

The phases of this cycle are:

- Plan
- Do
- Check
- Act

These above steps are repeated to ensure that processes followed in the organization are evaluated and improved on a periodic basis. Let's look into the above steps in detail -

- **Plan** - Organization should plan and establish the process related objectives and determine the processes that are required to deliver a high-Quality end product.

- **Do** - Development and testing of Processes and also "do" changes in the processes
- **Check** - Monitoring of processes, modify the processes, and check whether it meets the predetermined objectives
- **Act** - Implement actions that are necessary to achieve improvements in the processesAn organization must use Quality Assurance to ensure that the product is designed and implemented with correct procedures. This helps reduce problems and errors, in the final product.