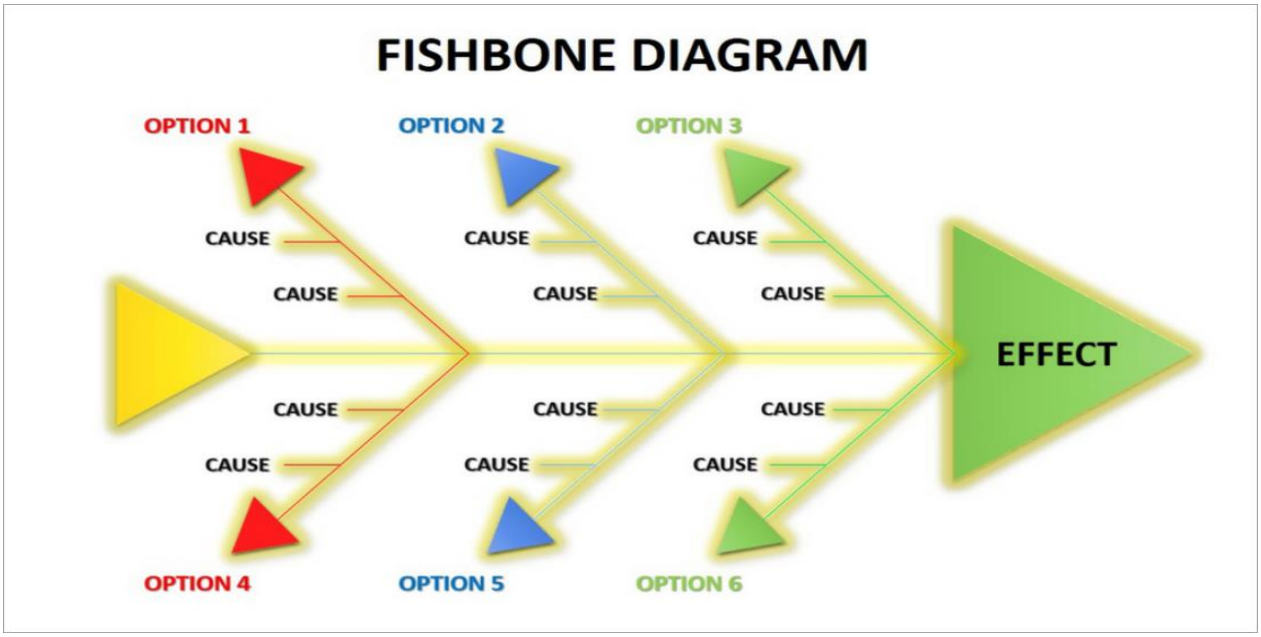
CHAPTER IV

QUALITY TOOLS(FISHBONE DIAGRAM)



- ***Chapter IV Objectives***
- ***Generality***
- ***The Deming Chain***
- ***Fishbone Diagram***
- ***Other Tools***
- ***Activities***

IV-1 Chapter IV objectives

At the end of the Chapter IV , in relation to the subjects covered, the student must be able to:

- **Learn** the different types of quality tools ;
- **Learn** the basic concepts of Fishbone Diagram ;

IV-2 Generality

Quality is fitness for use. Quality is a subjective, conditional, and perceptual quality that can mean different things to different people. "Quality is about meeting the needs and expectations of customers," says Jim Relay.

Simple statistical techniques for problem solving are the seven quality control tools. Either of these tools was created in Japan. According to Kaoru Ishikawa, 95% of problems can be resolved with these 7 instruments. A series of graphical techniques that have been found to be particularly useful in diagnosing quality-related difficulties are referred to as the "7 Tools of Quality."

They are employed in the analysis of the production process, the identification of the main issues, the management of product quality fluctuations, and the provision of solutions to prevent more flaws.

Fig 29. 7 Quality Tools

IV-3 Seven Quality Control Tools (The Deming Chain)

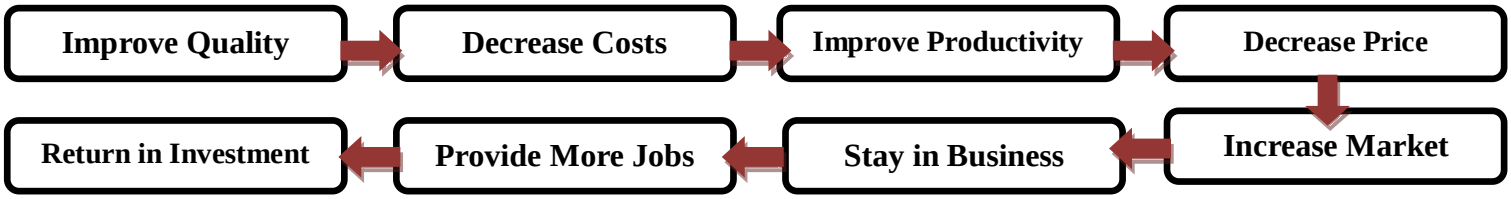


Fig 30. The Deming Chain

IV-4 FISHBONE DIAGRAM (Ishikawa's fishbone)

The diagram analysis, sometimes referred to as the "Fishbone Diagram," the "Ishikawa Diagram," or the "Cause-and-Effect Diagram," was created for the first time in the 1940s by Professor Kaoru Ishikawa of the University of Tokyo.

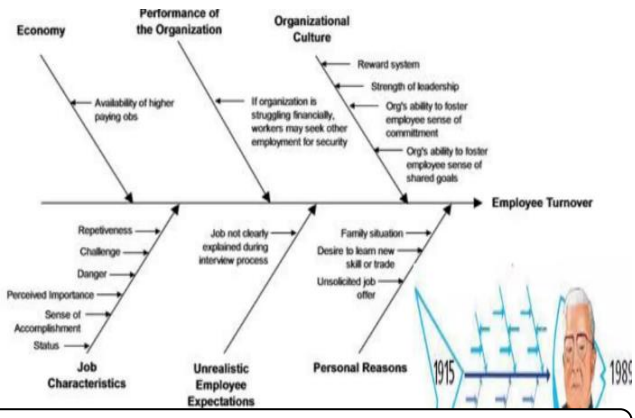


Fig 31. Ishikawa's fishbone

IV-4 -1 Description

- A multitude of possible sources for a problem or effect are displayed in the fishbone diagram. It helps with brainstorming session organization. Concepts are immediately grouped into useful categories.

We use this diagram when determining a problem's potential causes. particularly when a group's thought has a propensity to stagnate.

IV-4 -2 Fishbone Diagram Procedure

Method for Drawing a Fishbone Diagram: List the main categories of causes for the issue. It can be recognized using "6M" methods.

1) **Methods**
2) **Machines (Equipment)**
3) **Manpower (People)**
4) **Materials**
5) **Measurement**
6) **Management, Environment… etc**

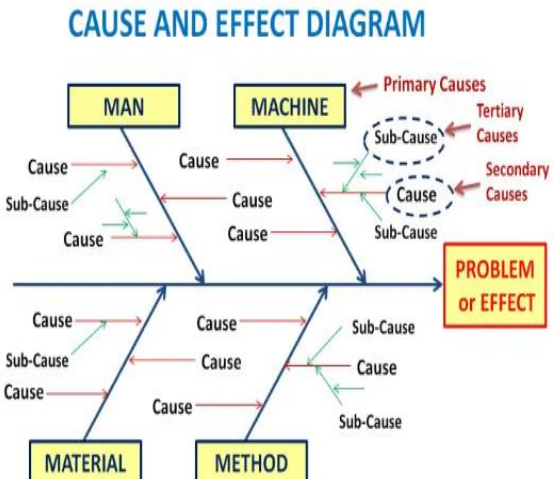


Fig 32. The M Techniques

IV-4 -2-1 M1- Materials (Raw Materials)

Thus, receiving raw materials is a crucial role in the food sector, requiring you to:

- Verify that the product matches the "specifications" using documentation and physical inspections (e.g. checking

Fig 33. Raw Materials

the temperature, etc.).

- Reject non-compliant products or damaged packaging.

➢ **Activity 12 (Chap IV) What Are The Three Major Contaminants In Raw Materials?**

The three major contaminants in raw materials are :

- Rotten and mouldy
- Soil and mud
- Fecal matter
- Store immediately under the right conditions (cold enough).
- Separate the different deliveries (e.g. separate tanks for different qualities of milk). Separate the washing and peeling of vegetables (=soil) from the "animal products" circuit.....): each product has its own "fridge".

IV-4 -2-2 M2- Machines

Fig 34. Machines Disinfection

Many machines are susceptible to Cleaning In Place (CIP), and equipment will require regular cleaning and disinfection.

- The tools need to be easy to disassemble, have a straightforward design, no sharp edges or cracks, and be appropriate for the task at hand.
- . Materials that come into touch with food (i.e., food surfaces) need to be rot-proof, smooth, leak-proof, and compatible with the food. The ideal materials are glass and stainless steel (CrNi), as they are easier to clean. While wood is prohibited, there are several exceptions.

IV-4 -2-3 M3- MANAGEMENT (MOTHER NATURE)

- As a result, the factory or workshop needs to be far away from any potential sources of contamination (minimum separations from a road are 5 meters, a dwelling is 50 meters, and a livestock farm is 100 meters);
- To keep dust and vermin away, within the factory's perimeter and surrounding the property: The plant needs a loading dock and a tarmac road.

- Classified installations laws may cause annoyances for the surrounding community, even within the facility itself. Thus, a pre-construction survey will be conducted, and prefectoral authorization will be granted.

IV-4 -2-4 M4- METHIODS

- Avoids microbial input
- Prevents microbial multiplication
- Eliminates bacteria
- Prevents Recontamination

The ideal method is AMER C. Rosset for germs!

A- Apport

- An automated operation is less risky than "manual" handling.

- Mechanical activities (such as slicing, chopping, grinding, and mixing) expose the entire product to contamination. For this reason, we have to be very mindful of how clean the equipment are.

M- Multiplication

- Bacteria can only grow if they have enough time, and the risk goes down as the temperature and time go down: cold chain, organized and refrigerated workshop.

E- Elimination

- Heat treatment (cooking at 70°C, pasteurisation or sterilisation).
- Cleaning and disinfection (equipment and premises)

R- Recontamination

- Packaging (Protected Packaged Food).

IV-4 -2-5 M5- MANPOWER

The most important hygiene control

Fig 35. Manpower

- It manages the other "M": it maintains cleanliness of the equipment, regulates raw materials, protects the environment, and follows procedures;
- They are a significant source of harmful and common microorganisms. Therefore, employees in the food business need to be hygienic, well-groomed, and job-trained.

IV-4 -2-6 M6- MEASUREMENT

This section of the FISHBONE DIAGRAM contains all techniques for figuring out if a part or process meets the necessary quality standards. Here, in addition to sub-causes like: you might also include information on scales, vision systems, or human inspectors.

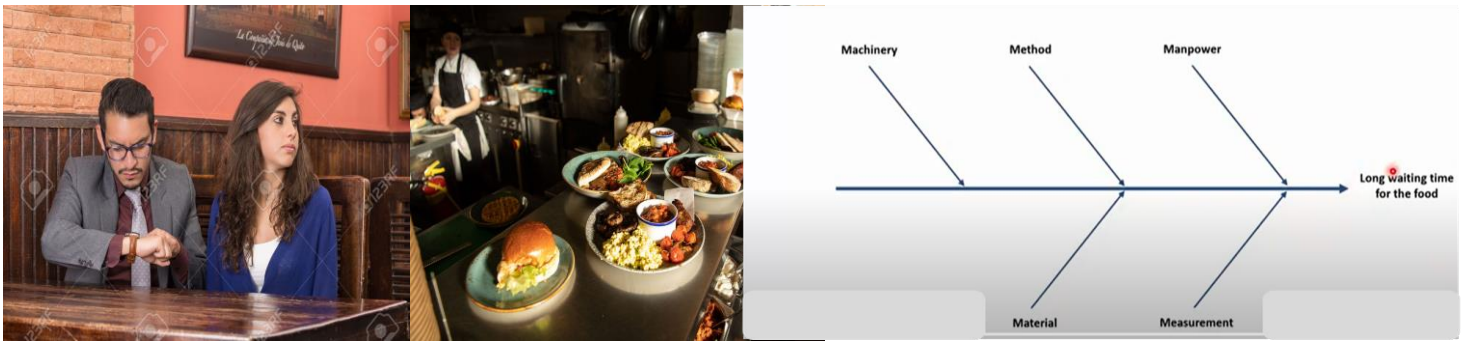
- Scale doesn't function properly
- Measuring tool broke off or is missing

➢ **Activity 13 (Chap IV) In our company, we have received fruits which is used as raw material to make jam. What measures must my company take when receiving this raw material ?**

- Check that the product complies with the "specifications" on the basis of documents and by means of checks (e.g. checking the temperature). –
- Reject non-compliant products or damaged packaging (rotten, mouldy, ...).
- Store immediately in the correct conditions (cold enough).

- **Activity 14 (Chap IV) Dairy X wants to recruit employees, what are the characteristics that must be present in these new employees**
  - Body cleanliness and good health
  - Knowledge of hygiene principles
  - Knowledge of manufacturing techniques and procedures

- **Activity 15 (Chap IV) Draw the fishbone Diagram (Restaurant Chain Example) Try to guess the reasons for the long service time in the Restaurant X**



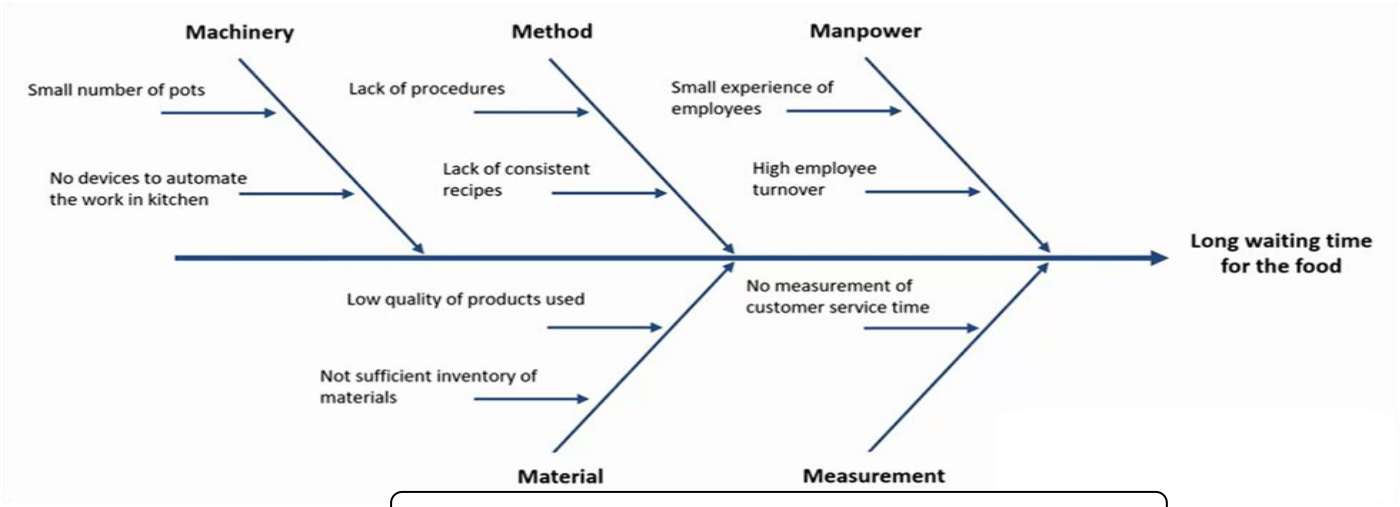


Fig 36. fishbone Diagram (Restaurant Chain)

IV-5 QUALITY TOOLS(6 OTHER)

IV-5-1 Histogram

Graphs of a data distribution called histograms are used to show the shape (relative frequency), dispersion (spread), and centering of the data. They aid in addressing the query, "Is the process capable of meeting customer requirements?," "by showing how a process's output relates to the expectations of the client (targets and specifications).

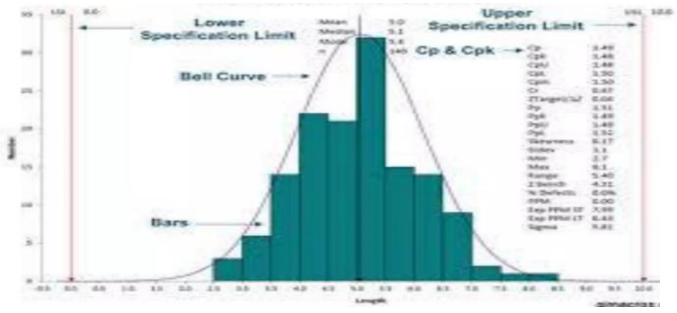


Fig 37. Anatomy of a Histogram

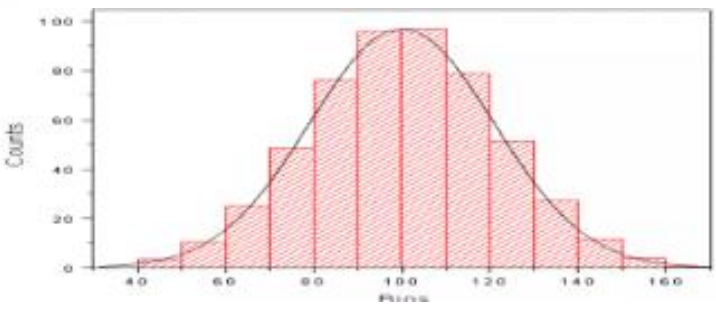


Fig 38. Histogram with normal distribution

IV-5-1-1 Construction of A Histogram

1) Count the number of data points in step one.
2) Complete a tally sheet summation.
3) Figure out the range
4) Determine how many intervals there are.
5) Use to compute the interval
6) Determine the interval's starting positions
7) Determine how many points are in each interval
8) Make a data plot
9) Include a legend and title

- **Activity 16 (Chap IV) Applies The Steps On the Example of table 02 & 03 And Create The Histogram**

Table 02. Metal Black thickness (m mm)

3.56	3.46	3.48	3.50	3.42	3.43	3.52	3.49	3.44	3.50
3.48	3.56	3.50	3.52	3.47	.348	3.46	3.50	3.56	3.38
3.41	3.37	3.47	3.49	3.45	3.44	3.50	3.49	3.46	3.46
3.55	3.52	3.44	3.50	3.45	3.44	3.48	3.46	3.52	3.46
3.48	3.48	3.32	3.40	3.52	3.34	3.46	3.43	3.31	3.46
3.59	3.63	3.59	3.47	3.38	3.52	3.45	3.48	3.32	3.46
3.40	3.54	3.46	3.51	3.48	3.50	3.68	3.60	3.46	3.52
3.48	3.50	3.56	3.50	3.52	3.46	3.48	3.46	3.52	3.56
3.52	3.48	3.46	3.45	3.46	3.54	3.54	3.48	3.49	3.41
3.41	3.45	3.34	3.44	3.47	3.47	3.41	3.48	3.54	3.47

Table 03 . Class size

Number of Data	Number of Classes
Under 50	5 - 7
50 - 100	6 - 10
100 - 250	7 - 12
Over 250	10 - 20

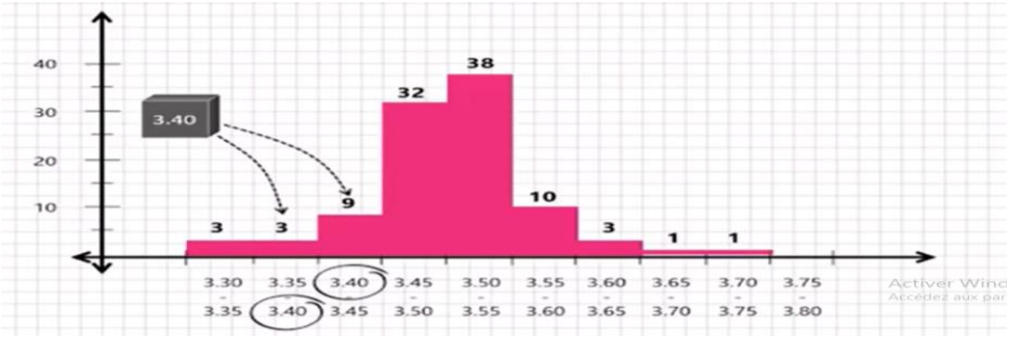


Fig 39 . Histogram

IV-5-2 CHECK SHEET

- A tool to gather and arrange data that has been measured or counted.

- The information gathered can be utilized as input for additional high-quality tools.

- The process of gathering data involves providing ar questions.

Type of Defect	Count	Score
Dirty	𝍸 𝍸 ||	12
Broken stitching	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 ||	42
Inconsistent margin	𝍸 𝍸 𝍸	15
Wrinkle	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	30
Long thread	𝍸 𝍸	10
Padding shape	𝍸 |||	8
Off center	𝍸 𝍸 𝍸 |||	18
Stitch per inch	𝍸 𝍸 𝍸 𝍸 ||||	24
Others	𝍸 𝍸 𝍸 𝍸 ||	22
	Total Defects:	181

Fig 40 . Check Sheet

When to Use a Check Sheet?

- To continuously gather data from the same source or at the same place;
- Gathering information from a production process; this can include information on the frequency or patterns of events, issues, defects, locations of faults, causes of defects, etc.

IV-5-2-1 Check Sheet Procedure

- ❑ Choose the issue or occurrence that will be watched.
- ❑ Choose the period of time and date for data collection
- ❑ Produce the form.
- ❑ Configure it such that information can be recorded using simply a check mark, X, or comparable symbol and that further data doesn't need to be collected for analysis.
- ❑ Indicate each section of the form.
- ❑ Make sure the check sheet is easy to use and collects the required data for a short trial period. Record information on the check sheet for every instance of the designated problem or event.

IV-5-2-2 Check Sheet Benefits

- To identify the cause of the issue;
- to gather information in a methodical and organized manner;
- To make data classification (stratification) easier.

- The check sheet offers a uniform method of data gathering and is a straightforward and efficient means of displaying data.
- **Activity 17 (Chap IV) Describe the figure below**

Preparation

	Inspected	Status	Comments
Employees wear clean and proper clothing	☐	⌄	
Hands are washed properly and frequently	☐	⌄	
Equipments and food contact surfaces are rinsed, sanitized, washed before every use	☐	⌄	
Food is handled with suitable utensils (gloves and tongs)	☐	⌄	
Reusable towels are not used for drying hands or the floor but used only for sanitizing equipments	☐	⌄	

Contamination

	Inspected	Status	Comments
Food is covered	☐	⌄	
Separate chopping boards, knives and other equipment used for different food	☐	⌄	
Cooked/ ready to eat foods are stored in separate fridges	☐	⌄	
All open food are covered properly in fridges and dry store	☐	⌄	

Chilled/Frozen Food

	Inspected	Status	Comments
Food is restored to its critical temperature and within 2 hours of receipt	☐	⌄	
Frozen food is kept at -18°C	☐	⌄	
Cooked/ ready to eat foods are stored in separate fridges	☐	⌄	
Out of date chilled goods are removed	☐	⌄	

This is FOOD SAFETY CHECK SHEET

A food safety checklist is a set of guidelines and procedures that can be followed to guarantee that food is handled, prepared, and served in a way that makes it safe for consumption. Health and safety inspectors and restaurant managers can utilize this list of safety standards to keep an eye on food safety in a variety of establishments, such as restaurants, schools, and other food providers.

IV-5-3 Stratification

A system of creating layers, classes, or groups is called stratification.

- Check sheet data collection requires meaningful classification. This kind of classification aids in obtaining an initial grasp of the relevance and distribution of data, allowing for the planning of additional analysis to get a relevant result. Stratification is the meaningful classification of data.

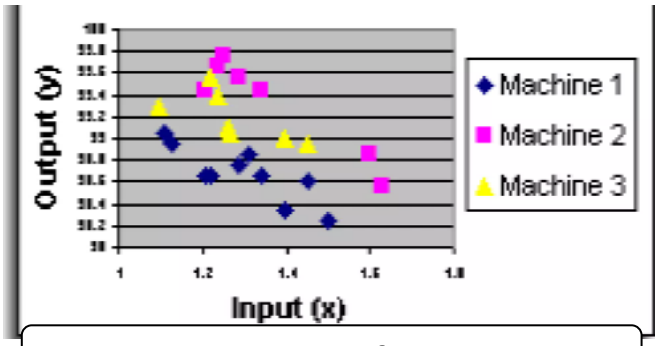


Fig 41 . Stratification

- We employ stratification in the following situations: (1) when data analysis requires separating multiple sources or circumstances; for example, shifts, days of the week, suppliers, or demographic groups.

IV-5-4 Pareto chart

Vilfredo Pareto (1848-1923) Italian economist developed this tool .

Eighty percent of the population is poor.

To discern between a problem's vital and inconsequential components, utilize a Pareto diagram.

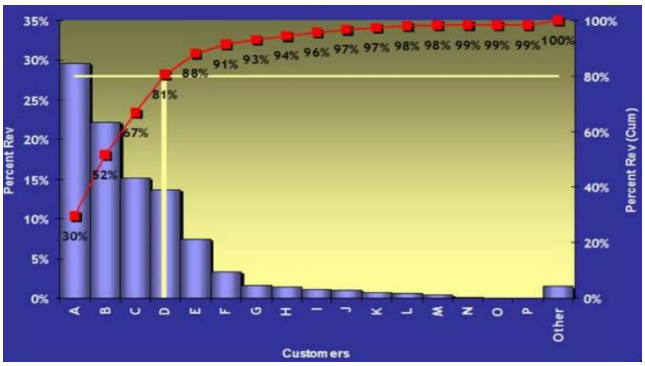


Fig 42 . Revenue by Costumer

IV-4-4-1 Pareto Chart Procedure

- **Develop a list** of issues, objects, or reasons that need to be contrasted;
- **Gather the information** at the designated time interval;
- **Calculate the frequency** of each item. Determine the sum of all the things in total;
- **Determine** each item's percentage;
- **Arrange** the objects under comparison in descending order of comparison measure;
- **Arrange** the items on a graph's horizontal axis, highest to lowest. First, write the values on the left vertical axis, and then the cumulative percentage on the right vertical axis.
- **Create** a line graph showing the total percentage. The initial point on the line graph and the top of the first bar should line up.
    - Examine the diagram and note which elements are most important.

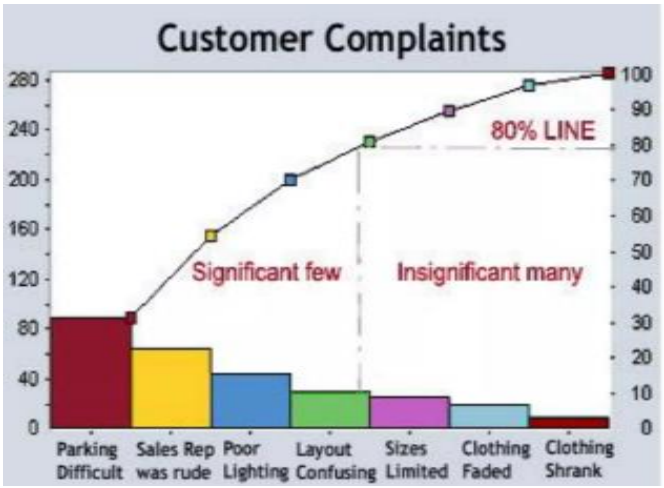


Fig 43 . Costumer Complaints

IV-5-5 CONTROL CHART

A control chart is a graph that is used to analyze how a process evolves over time.

A control chart has three lines: an average line in the middle, a lower line for the lower control limit, and an upper line for the higher control limit. These lines are constructed based on historical data. By comparing the current data to these lines, you can ascertain whether process variation is unexpected (out of control, impacted by specific causes of variation) or consistent (under control).

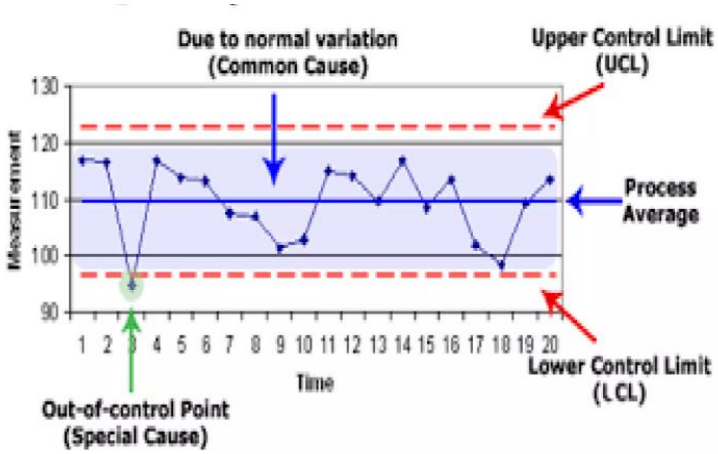


Fig44 . Control Chart

IV-5-6 SCATTER DIAGRAM

Purpose: To determine any potential correlations between a quality characteristic and a potential contributing component The correlation between two process variables is displayed in a scatter diagram. These elements may be a Critical To Quality (CTQ) feature. -: Scatter Diagram :- Dots representing data points are scattered on the diagram.

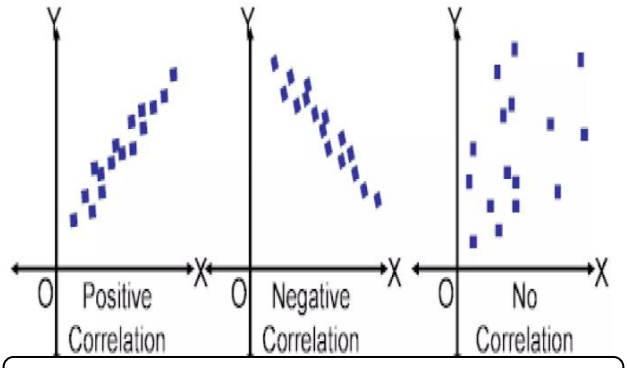


Fig45 . Scatter Diagram

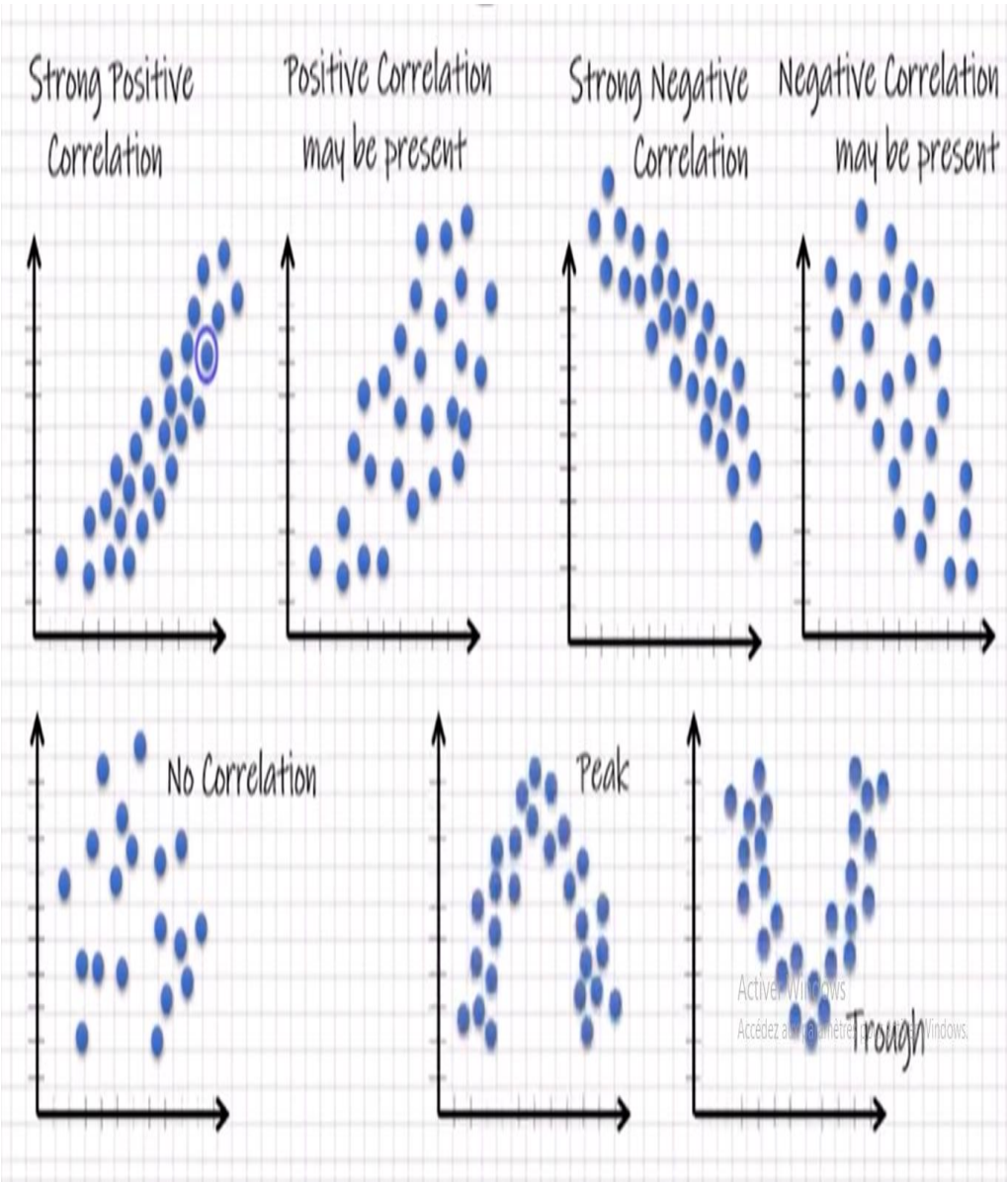


Fig 46 . Types of Scatter Diagram