Unit 2:
L-6
Statistical Quality Control

Learning Objectives

A **control chart** is a graphical tool for monitoring the activity of an ongoing process. Control charts are sometimes referred to as **Shewhart control charts,** because Walter A. Shewhart first proposed their general theory. The values of the quality characteristic are plotted along the vertical axis, and the horizontal axis represents the samples, or subgroups (in order of time), from which the quality characteristic is found.

Objectives:

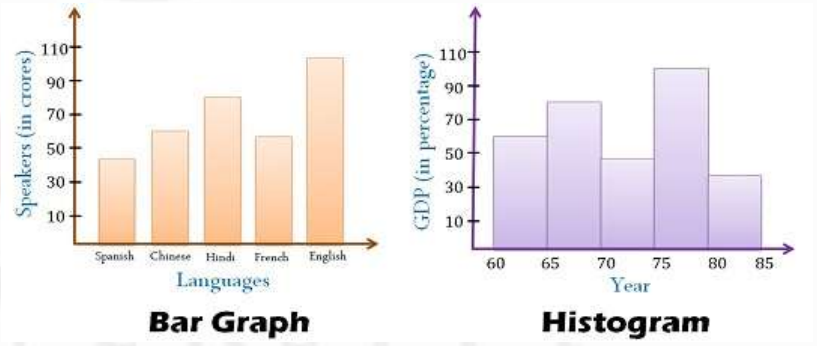
- Kaoru Ishikawa developed seven basic visual tools of quality so that the average person could analyze and interpret data.
- They are called *basic* because they are suitable for people with little formal training in statistics and because they can be used to solve the vast majority of quality-related issues.
- These tools have been used worldwide by companies, managers of all levels and employees.

Seven Quality Tools

- Histograms
- Pareto Charts,
- Cause and Effect Diagrams
- Check Sheet
- Scatter Diagrams
- Flow Charts,
- Control Charts

Histogram

- A histogram is a bar graph that shows frequency data
- Histogram is a chart with columns
- Histogram, basically represents the distribution by mean
- If the histogram is normal, the graph takes the shape of a bell curve
- Histograms provide the easiest way to evaluate the distribution of data.



Creating a Histogram

- Collect data and sort it into categories.
- Then label the data as the independent set or the dependent set.
  - The characteristic you grouped the data would be the independent variable.
  - The frequency of that set would be the dependent variable.
- Each mark on either axis should be in equal increments.
- For each category, find the related frequency and make the horizontal marks to show that frequency.

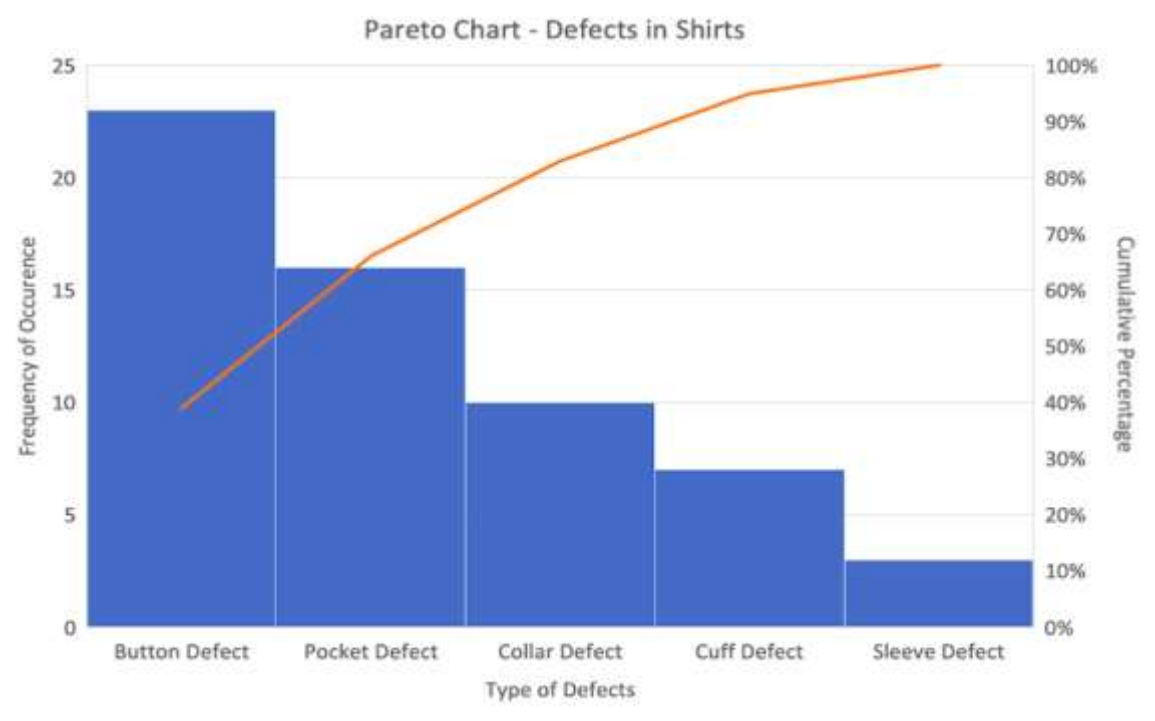
Pareto Charts

- Pareto charts are used to identify and prioritize problems to be solved.
- They are actually histograms aided by the 80/20 rule adapted by Joseph Juran.
  - Remember the 80/20 rule states that approximately 80% of the problems are created by approximately 20% of the causes.
  - It uses percentage to show the importance.

Creating a Pareto Chart

- First, information must be selected based on types or classifications of defects that occur as a result of a process
- The data must be collected and classified into categories
- Then a histogram or frequency chart is constructed showing the number of occurrences.

Pareto Chart



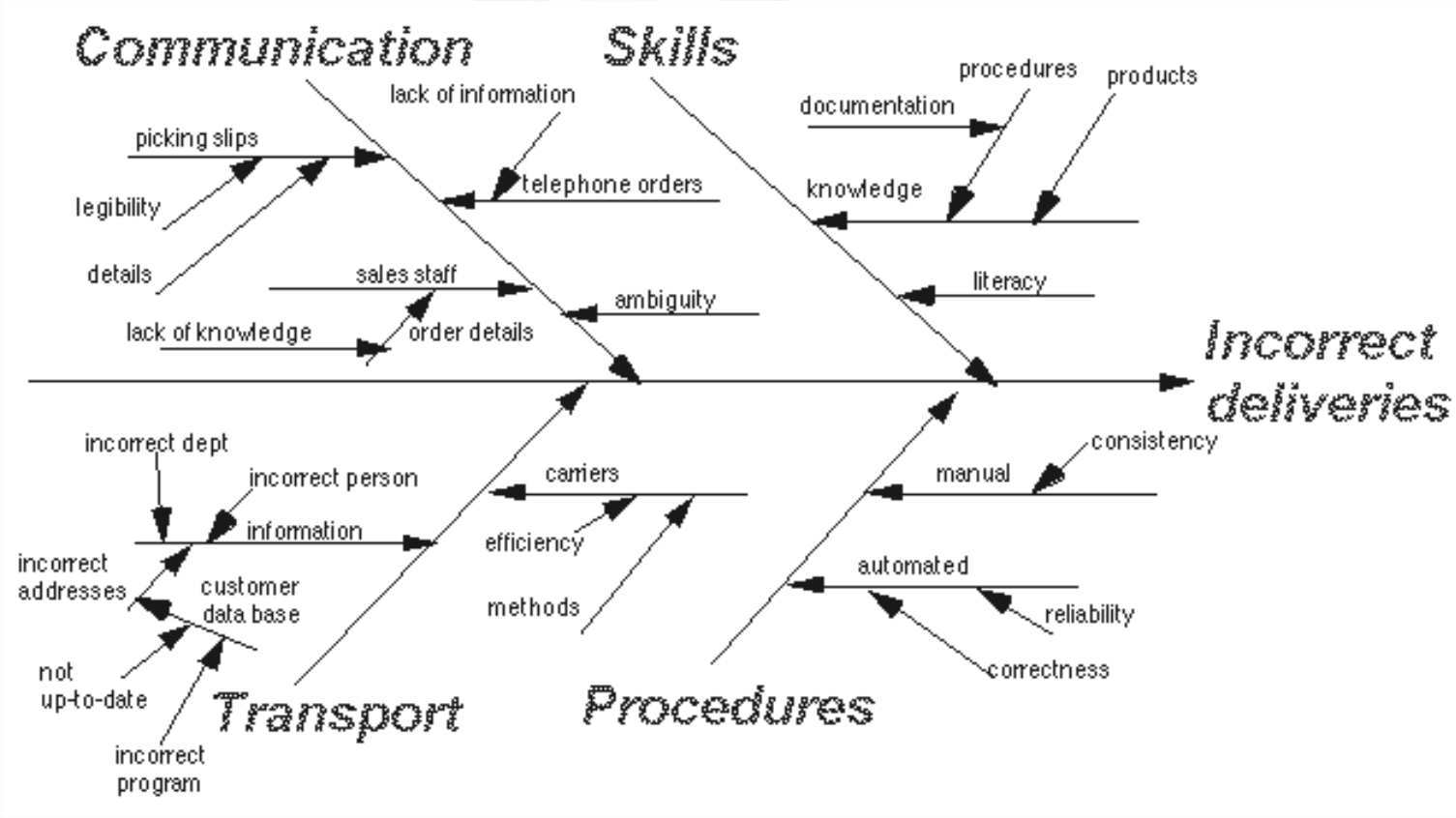
Cause and Effect Diagrams

- The cause and effect diagram is also called the Ishikawa diagram or the fishbone diagram.
- It is a tool for discovering all the possible causes for a particular effect.
- The major purpose of this diagram is to act as a first step in problem solving by creating a list of possible causes

Creating a Cause and Effect Diagram

- First, clearly identify and define the problem or effect for which the causes must be identified. Place the problem or effect at the right or the head of the diagram.
- Identify all the broad areas of the problem.
- Write in all the detailed possible causes in each of the broad areas.
- Each cause identified should be looked upon for further more specific causes.
- View the diagram and evaluate the main causes.
- Set goals and take action on the main causes.

Cause and Effect Diagrams



Scatter Diagrams

- A scatter plot (also called a scatterplot, scatter graph, scatter chart or scatter diagram) is a type of plot or mathematical diagram using Cartesian coordinate to display values for typically two variables for a set of data
- Scatter Diagrams are used to study and identify the possible relationship between the changes observed in two different sets of variables

Creating a Scatter Diagram

- First, collect two pieces of data and create a summary table of the data.
- Draw a diagram labeling the horizontal and vertical axes.
  - It is common that the “cause” variable be labeled on the X axis and the “effect” variable be labeled on the Y axis.
- Plot the data pairs on the diagram.
- Interpret the scatter diagram for direction and strength.

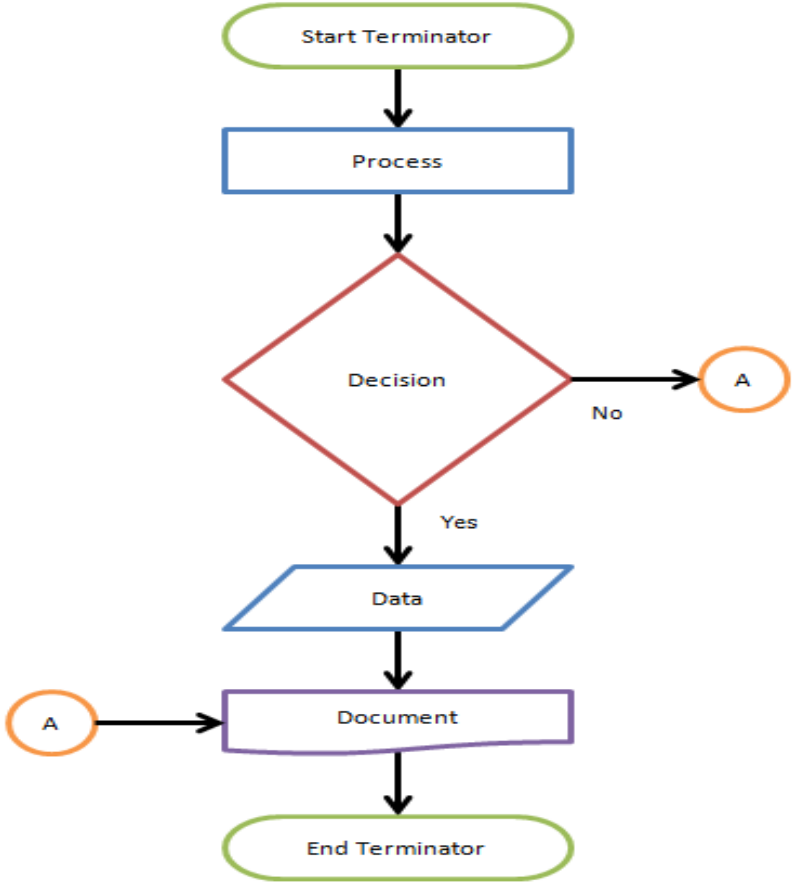
Flow Charts

- A flow chart is a pictorial representation showing all of the steps of a process
- While creating a flowchart different kinds of symbol like rectangle, ellipse, parallelogram can be used to take different decision and get the results
- Here arrow is used to show the direction of flow of the data

Creating a Flow Chart

- First, familiarize the participants with the flow chart symbols
- Draw the process flow chart and fill it out in detail about each element
- Analyze the flow chart. Determine which steps add value and which don't in the process of simplifying the work.

Flow chart:


Start Terminator
Process
Decision
No
A
Yes
Data
A
Document
End Terminator

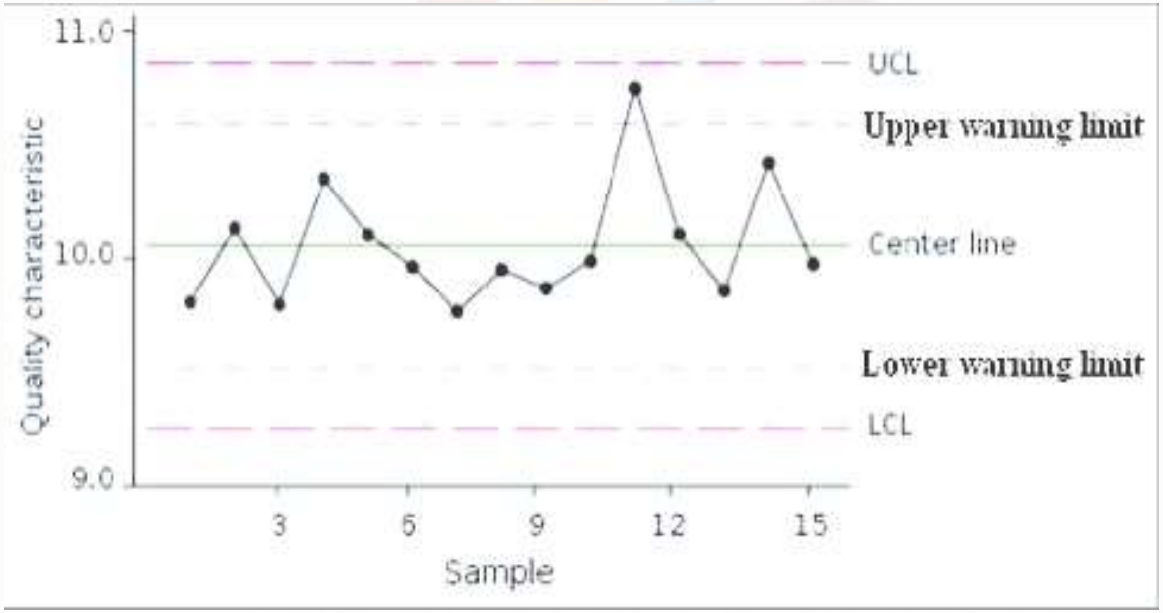
Control Charts

- Control charts are used to determine whether a process will produce a product or service with consistent measurable properties
- These charts allow you to identify the following conditions related to the process that has been monitored.
  - Stability of the process
  - Predictability of the process
  - Identification of common cause of variation
  - Special conditions where the monitoring party needs to react

Creating a control chart

- Identify critical operations in the process where inspection might be needed
- Identify critical product characteristics
- Determine whether the critical product characteristic is a variable or an attribute
- Select the appropriate process control chart
- Establish the control limits and use the chart to monitor and improve
- Update the limits.

Control Chart



Check Sheet

- A check sheet can be introduced as the most basic tool for quality and is basically used for gathering and organizing data
- This is done with the help of software packages such as Microsoft Excel
- We can always use a paper-based check sheet when the information gathered is only used for backup or storing purposes other than further processing

Check Sheet

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Wrong orders	///	𝍸	𝍸 𝍸 𝍸 𝍸 //	/	//	////	𝍸 //
Reworked orders		/	//	///		/	//
Late deliveries	𝍸 ///	/	///	//		///	//
Shipping damage						𝍸 𝍸 𝍸 𝍸	𝍸 ///
Late payments		/					
Totals	11	8	27	6	2	28	19

Conclusion

- Seven quality tools were discussed
- Procedure to draw the different quality tools were known

References:

- Fundamentals of Quality Control and Improvement: Amitava Mitra
- Montgomery, D. C. (2004). *Introduction to Statistical Quality Control.* 5th ed. Hoboken, NJ:
- ASQ(1993). ANSI/ISO/ASQ. *Statistics—Vocabulary and Symbols-Statistical Quality Control,*A3534-2. Milwaukee, Wi: American Society for Quality.
- Wadsworth, H. M., K. S., Stephens, and A. B. Godfrey, (2001). *Modern Methods for Quality Control and Improvement,* 2nd ed. New York: Wiley.