



7 QC Tools

What are 7 QC Tools ?

QC tools are the **means** for Collecting data , analyzing data , identifying root causes and measuring the results.

THESE TOOLS ARE RELATED TO
Numerical DATA processing

***USER HAS TO DEVELOP THE
SOLUTION & IMPLEMENT***

7 QC TOOLS

- Pareto Diagram
- Stratification
- Scatter Diagram
- Cause and Effect Diagram
- Histogram
- Check Sheet
- Control Chart/Graph

Application of QC tools in Problem Solving

	Graphs	Check sheet	Stratification	Pareto Diagram	Cause & Effect Diagram	Histogram	Scatter Diagram	Control Chart
Identification of problem	◎			◎				
Defining the problem	○	◎	◎	◎		○		
Record of facts		◎	◎			◎		◎
Detecting causes of problem			○		◎	◎	◎	
Develop Improvement method (Solution)								
Implementation								
Evaluation of result	○		○		◎	◎	◎	
Process control (Standardization)								◎

Pareto Diagram

1. What is Pareto diagram ?

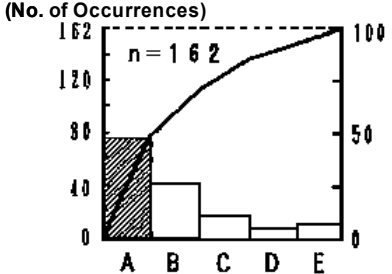
A Pareto diagram is a combination of bar and line graphs of accumulated data, where data associated with a problem (e.g., a defect found, mechanical failure, or a complaint from a customer) are divided into smaller groups by cause or by phenomenon and sorted, for example, by the number of occurrences or the amount of money involved. (The name “Pareto” came from an Italian mathematician who created the diagram.)

Pareto Diagram

2. When is it used and what results will be obtained?

Please refer to the table on next slide for the usage and benefits of a Pareto diagram. It is mainly used to prioritize matters, and because of its easiness of use, the diagram is used in a wide variety of fields.

Pareto Diagram

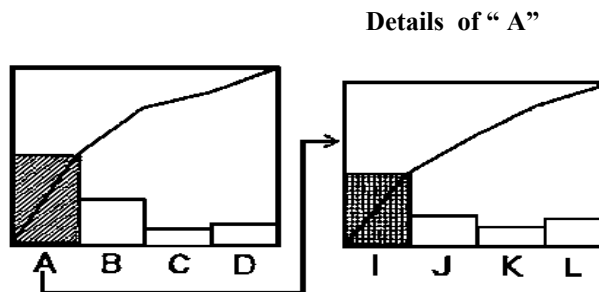
Method	Usage	Result
<p data-bbox="285 472 587 511">Pareto Diagram</p>  <p data-bbox="202 525 595 796"> (No. of Occurrences) n = 162 162 120 80 40 0 100 50 0 A B C D E </p>	<ul style="list-style-type: none"> ▪ Used to identify a problem. ▪ Used to identify the cause of a problem. ▪ Used to review the effects of an action to be taken. <p data-bbox="643 749 1228 1053"> Used to prioritize actions. (Used during phases to monitor the situation, analyze causes, and review effectiveness of an action.) </p>	<ul style="list-style-type: none"> ▪ Allows clarification of important tasks. ▪ Allows identification of a starting point (which task to start with). ▪ Allows projection of the effects of a measure to be taken

Pareto Diagram

Example

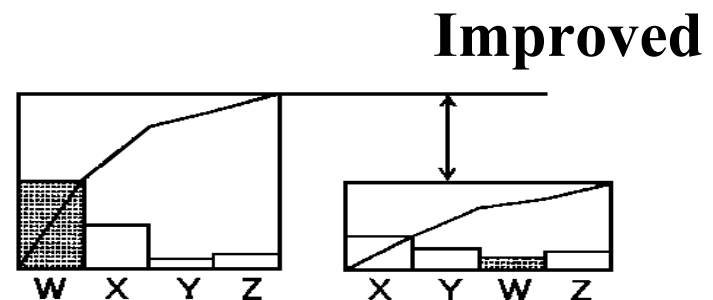
Assessment using Pareto diagram (prioritization)

To identify a course of action to be emphasized using a variety of data.



Confirmation of Effect (Comparison)

Frequently used to check the effect of an improvement.



Stratification

1. What is Stratification ?

Stratification means to “divide the whole into smaller portions according to certain criteria.” In case of quality control, stratification generally means to divide data into several groups according to common factors or tendencies (e.g., type of defect and cause of defect).

Dividing into groups “fosters understanding of a situation.” This represents the basic principle of quality control.

Stratification

2. When is it used and what results will be obtained?

The “common and basic principle” of quality control is stratification, i.e., to think a matter out by breaking it into smaller portions. Stratification has a number of useful purposes. The table below shows only a few examples of these purposes.

Stratification

Method	Usage	Result								
<p>Grouping by day, time, place, worker, or process</p> <table border="1" data-bbox="193 601 579 872"> <thead> <tr> <th></th> <th>Number of Units</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>★★★★★★</td> </tr> <tr> <td>Y</td> <td>△△△△</td> </tr> <tr> <td>Z</td> <td>○○○</td> </tr> </tbody> </table>		Number of Units	X	★★★★★★	Y	△△△△	Z	○○○	<ul style="list-style-type: none"> •Used to observe variations among strata. •Used to identify the relationship between cause and effect. •Used to identify a purpose and means to serve the purpose <p>[Used during phases to monitor the situation, analyze causes, review effectiveness of an action, perform standardization, and implement a selected control measure.]</p>	<ul style="list-style-type: none"> •Allows observation of variations among strata. •By performing a cause analysis using the stratified data, the following can be accomplished. <ol style="list-style-type: none"> 1. Identification and control of a problem 2. “Division of data (obtained by using each QC tool) into several groups”
	Number of Units									
X	★★★★★★									
Y	△△△△									
Z	○○○									

Stratification

Item	Method of Stratification
Elapse of time	Hour, a.m., p.m., immediately after start of work, shift, daytime, nighttime, day, week, month
Variations among workers	Worker, age, male, female, years of experience, shift, team, newly employed, experienced worker
Variations among work methods	Processing method, work method, working conditions (temperature, pressure, and speed), temperature
Variations among measurement/inspection methods	Measurement tool, person performing measurement, method of measurement, inspector, sampling, place of inspection

Scatter Diagram

1. What is Scatter Diagram ?

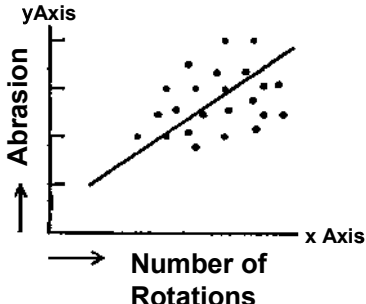
A scatter diagram is used to “examine the relationship between the two, paired, interrelated data types,” such as “height and weight of a person.” A scatter diagram provides a means to find whether or not these two data types are interrelated. It is also utilized to determine how closely they are related to identify a problem point that should be controlled or improved.

Scatter Diagram

2. When is it used and what results will be obtained?

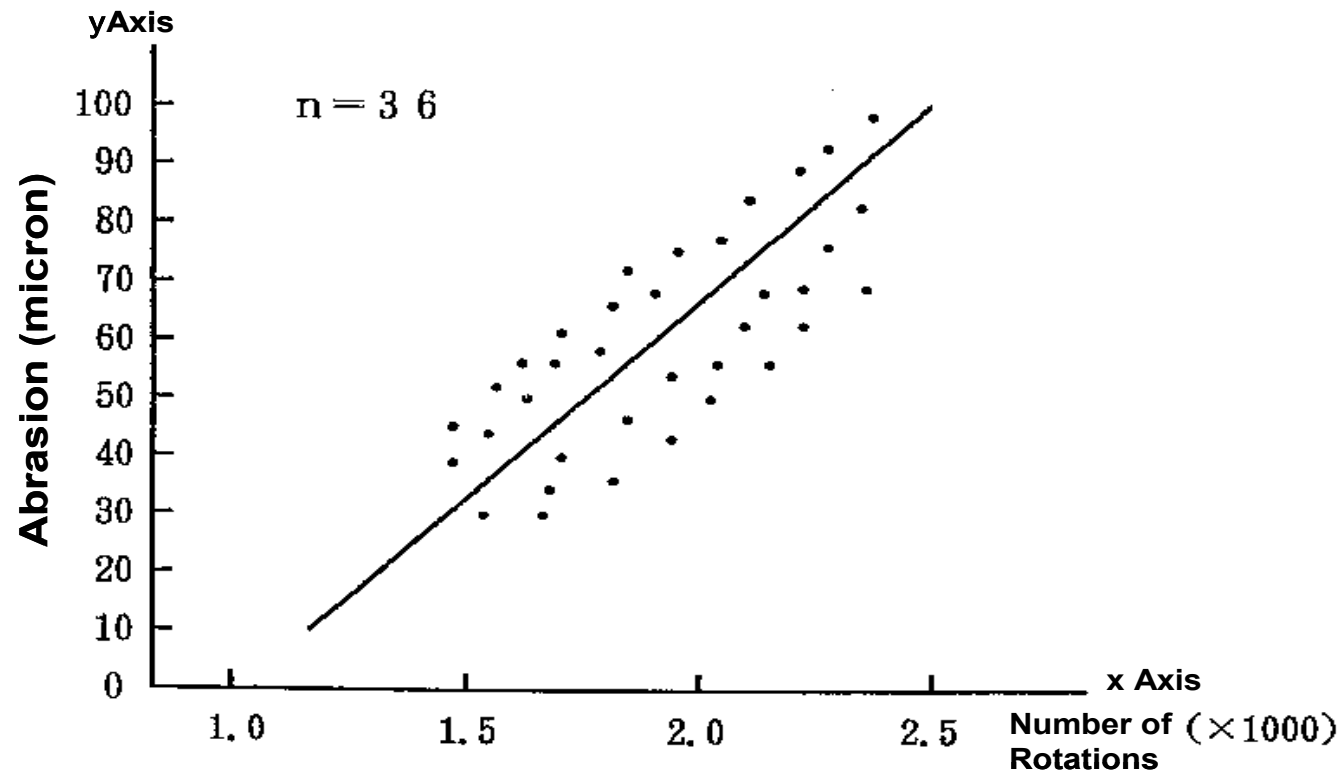
The table on next slide shows some examples of scatter diagram's usage. If, for example, there is a relationship where "an increase in the number of rotations (x) causes an increase in abrasion (y)," there exists "positive correlation." If, on the other hand, the existence of a relationship where "an increase in the number of rotations (x) causes a decline in abrasion (y)" indicates that there is "negative correlation."

Scatter Diagram

Method	Usage	Result
<p style="text-align: center;">Scatter Diagram</p>  <p>The diagram is a scatter plot with 'Number of Rotations' on the horizontal x-axis and 'Abrasion' on the vertical y-axis. A diagonal line is drawn through the data points, indicating a positive linear relationship. The points are scattered around this line, showing some variability but a clear overall upward trend.</p>	<ul style="list-style-type: none"> •Used to identify a relationship between two matters. •Used to identify a relationship between two matters and establish countermeasures based on their cause and effect relation. <p>Example Usage</p> <ol style="list-style-type: none"> 1.Relationship between thermal treatment temperature of a steel material and its tensile strengths 2.Relationship between visit made by a salesman and volume of sales 3.Relationship between the number of persons visiting a department store and volume of sales 4 Others 	<ul style="list-style-type: none"> •Can identify cause and effect relation. •Can understand the relationship between two results.

[Used during phases to monitor the situation, analyze causes, and review effectiveness of an action.]

Scatter Diagram



Cause & Effect Diagram

1. What is Cause & effect Diagram ?

A cause and effect diagram is “a fish-bone diagram that presents a systematic representation of the relationship between the effect (result) and affecting factors (causes).”

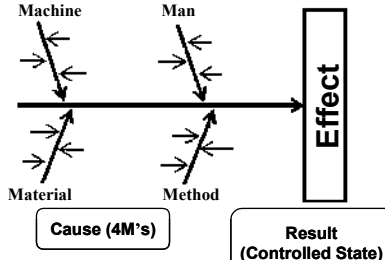
Solving a problem in a scientific manner requires clarification of a cause and effect relationship, where the effect (e.g., the result of work) varies according to factors (e.g., facilities and machines used, method of work, workers, and materials and parts used). To obtain a good work result, we must identify the effects of various factors and develop measures to improve the result accordingly.

Cause & Effect Diagram

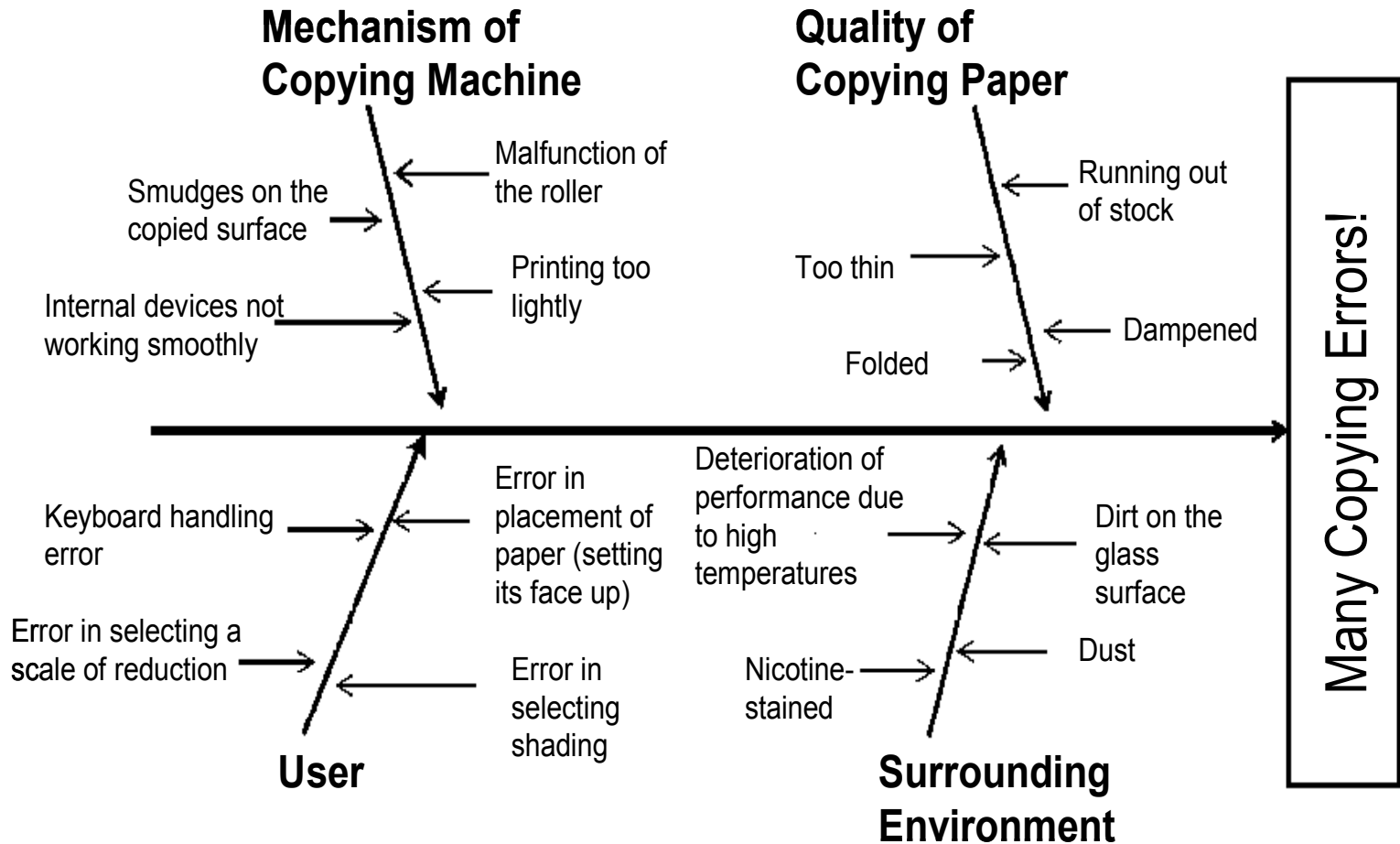
2. When is it used and what results will be obtained?

A cause and effect diagram is mainly used to study the cause of a certain matter. As mentioned above, the use of a cause and effect diagram allows clarification of causal relation for efficient problem solving. It is also effective in assessing measures developed and can be applied to other fields according to your needs.

Cause & Effect Diagram

Method	Usage	Result
<p>Cause and Effect Diagram</p>  <p>The diagram illustrates the 4M's (Machine, Man, Material, Method) as causes leading to an effect. A central horizontal line represents the main cause, with four arrows pointing to it from the left, each labeled with one of the 4M's. A vertical bar on the right represents the effect. Below the main line is a box labeled 'Cause (4M's)' and below the effect bar is a box labeled 'Result (Controlled State)'.</p>	<ul style="list-style-type: none"> ▪ Used when clarifying a cause and effect relationship. [Used during a phase to analyze causes.] ▪ Used to develop countermeasures. <p>[Used during a phase to plan countermeasures.]</p>	<ul style="list-style-type: none"> ▪ Can obtain a clear overall picture of causal relation. (A change in the cause triggers a variation in the result.) ○ Can clarify the cause and effect relationship. ▪ Can list up all causes to identify important causes. ▪ Can determine the direction of action (countermeasure).

Cause & Effect Diagram



Histogram

1. What is Histogram ?

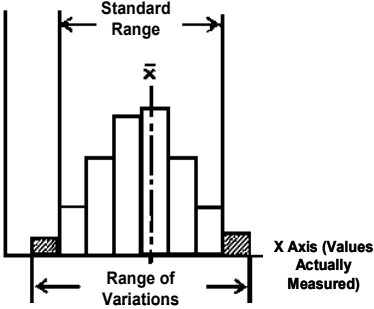
When creating a histogram, “a range of data is divided into smaller sections having a uniform span, and the number of data contained in each section (the number of occurrences) is counted to develop a frequency distribution table.” Then, “a graph is formed from this table by using vertical bars, each having the height proportional to the number of occurrences in each section.”

Histogram

2. When is it used and what results will be obtained?

A histogram is mainly used to analyze a process by examining the location of the mean value in the graph or degree of variations, to find a problem point that needs to be improved. Its other applications are listed in the table below.

Histogram

Method	Usage	Result
<p data-bbox="233 458 413 496">Histogram</p> 	<ul style="list-style-type: none"> •Used to assess the actual conditions. •Used to analyze a process to identify a problem point that needs to be improved by finding the location of the mean value or degree of variations in the graph. •Used to examine that the target quality is maintained throughout the process. •Others <p>[Used during phases to monitor the situation, analyze causes, and review effectiveness of an action.]</p>	<ul style="list-style-type: none"> •Can identify the location of the mean (central) value or degree of variations. •Can find out the scope of a defect by inserting standard values. •Can identify the condition of distribution (e.g., whether there is an isolated, extreme value).

Histogram

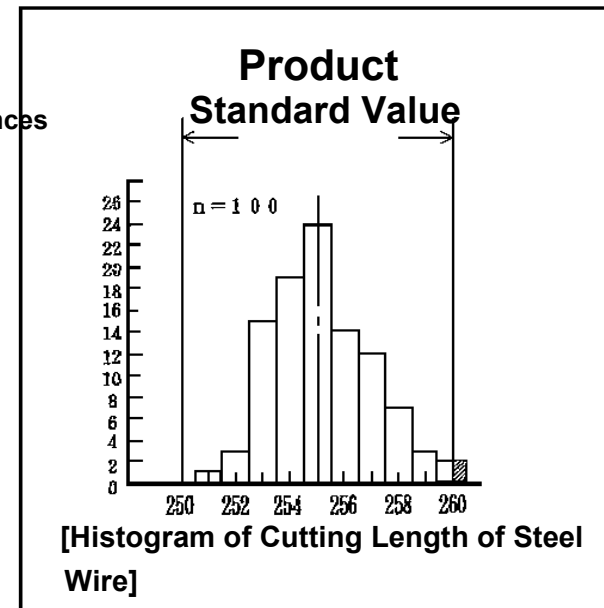
Frequency Distribution Table
Cutting Length of Steel Wire]

Standard
Lower Limit

Standard
Upper Limit

(Standard: 255 ± 5 mm)

No	Section	Mean	Frequency Marking	Occurrences
1	250.5~251.5	251	—	1
2	251.5~252.5	252	┐	3
3	252.5~253.5	253	正 正 正	15
4	253.5~254.5	254	正 正 正 正 正	19
5	254.5~255.5	255	正 正 正 正 正 正 正	24
6	255.5~256.5	256	正 正 正 正	14
7	256.5~257.5	257	正 正 正	12
8	257.5~258.5	258	正 正	7
9	258.5~259.5	259	┐	3
10	259.5~260.5	260	┐	2
				100



Check Sheet

1. What is Check sheet ?

A check sheet is “a sheet designed in advance to allow easy collection and aggregation of data.” By just entering check marks on a check sheet, data can be collected to extract necessary information, or a thorough inspection can be performed in an efficient manner, eliminating a possibility of skipping any of the required inspection items.

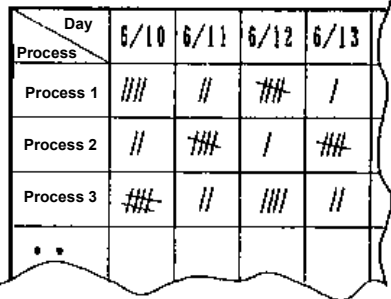
A check sheet is also effective in performing stratification (categorization).

Check Sheet

2. When is it used and what results will be obtained?

Please refer to the table on next slide for the usage and benefits of a check sheet. It is frequently used in daily business operations, often not specifically for QC purposes.

Check Sheet

Method	Usage	Result																									
<p style="text-align: center;">Check Sheet</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Day</th> <th>6/10</th> <th>6/11</th> <th>6/12</th> <th>6/13</th> </tr> </thead> <tbody> <tr> <td>Process 1</td> <td>IIII</td> <td>II</td> <td>III</td> <td>I</td> </tr> <tr> <td>Process 2</td> <td>II</td> <td>III</td> <td>I</td> <td>III</td> </tr> <tr> <td>Process 3</td> <td>III</td> <td>II</td> <td>IIII</td> <td>II</td> </tr> <tr> <td>••</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Day	6/10	6/11	6/12	6/13	Process 1	IIII	II	III	I	Process 2	II	III	I	III	Process 3	III	II	IIII	II	••					<ul style="list-style-type: none"> ▪ Used to collect data. ▪ Used when performing a thorough inspection <p>Used during inspections to monitor the situation, analyze causes, review effectiveness of an action, perform standardization, and implement a selected control measure</p>	<ul style="list-style-type: none"> ▪ Ensures collection of required data. ▪ Allows a thorough inspection of all check items. ▪ Can understand tendencies and variations. ▪ Can record required data.
Day	6/10	6/11	6/12	6/13																							
Process 1	IIII	II	III	I																							
Process 2	II	III	I	III																							
Process 3	III	II	IIII	II																							
••																											

Check Sheet

A check sheet used to identify defects

Date	/ 1	/ 2	/ 3	/ 4	/ 5	/ 8	/ 9	Total
Vertical Scratch	≡≡	≡	≡≡	≡	≡≡	≡	≡	4 5
Scratch	≡	≡	≡		≡	≡	≡	2 4
Dent		≡≡		≡	≡≡	≡	≡	3 2

Control Chart (Control Chart / Graph 1)

1. What is Control Chart ?

A control chart is used to examine a process to see if it is stable or to maintain the stability of a process.

This method is often used to analyze a process. To do so, a chart is created from data collected for a certain period of time, and dots plotted on the chart are examined to see how they are distributed or if they are within the established control limit. After some actions are taken to control and standardize various factors, this method is also used to examine if a process is stabilized by these actions, and if so, to keep the process in a stable state.

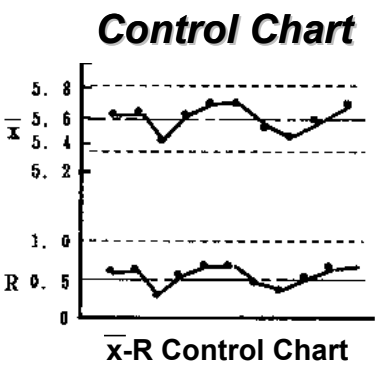
Control Chart

2. When is it used and what results will be obtained?

There are two types of control charts: one used for managerial purposes and the other for analytical purposes. A control chart is used to identify dots that are outside the control limit, which indicate some anomalies in a process. In addition, seven consecutive dots showing values that are below or above the mean (central) value, or an increment or a decline represented by seven consecutive dots also indicate “a problem in a process.”

We need to examine what has caused such a tendency or an increment/decline.

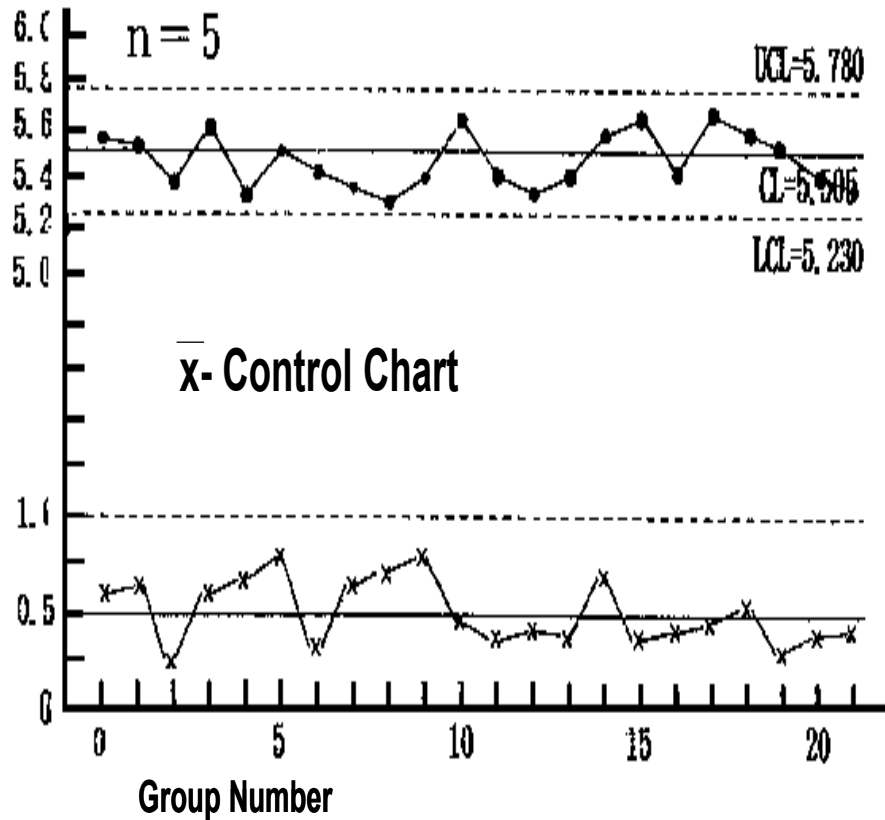
Control Chart

Method	Usage	Result
 <p>Control Chart</p> <p>\bar{x}</p> <p>R</p> <p>\bar{x}-R Control Chart</p>	<p>Used to observe a change caused by elapse of time.</p> <p>[Used during phases to monitor the situation, analyze causes, review effectiveness of an action, perform standardization, and implement a selected control measure</p>	<p>Can identify a change caused by elapse of time.</p> <p>Can judge the process if it is in its normal state or there are some anomalies by examining the dots plotted on the chart.</p> <p>In the example “x bar ” -R control chart, “X bar” represents the central value, while “R” indicates the range.</p>

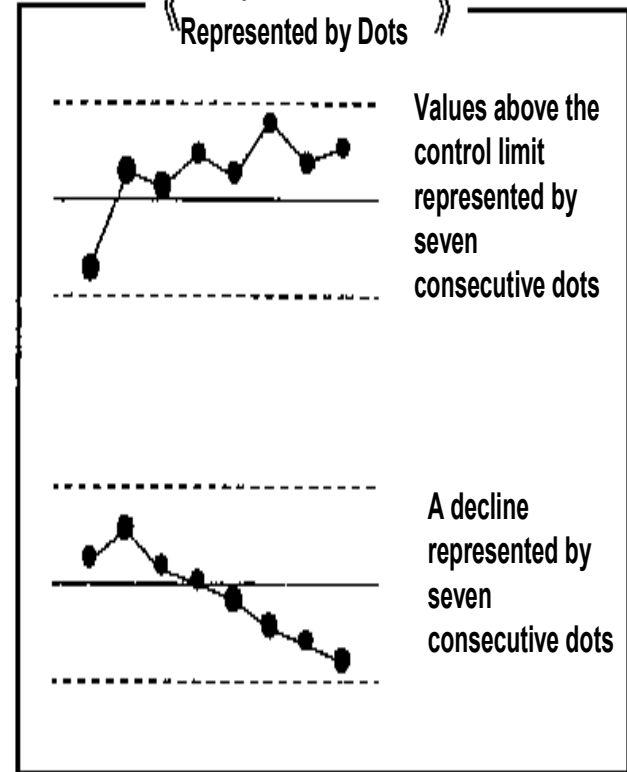
Control Chart for Managerial Purposes: Extends the line indicating the control limit used for analytical purposes to plot data obtained daily to keep a process in a good state.

Control Chart for Analytical Purposes: Examines a process if it is in a controlled state by collecting data for a certain period of time. If the process is not controlled, a survey is performed to identify its cause and develop countermeasures.

Control Chart



« Examples of Values Represented by Dots »



Graph

1. What is Graph ?

A graph is “a graphical representation of data, which allows a person to understand the meaning of these data at a glance.” Unprocessed data simply represent a list of numbers, and finding certain tendencies or magnitude of situation from these numbers is difficult, sometimes resulting in an interpretational error. A graph is an effective means to monitor or judge the situation, allowing quick and precise understanding of the current or actual situation.

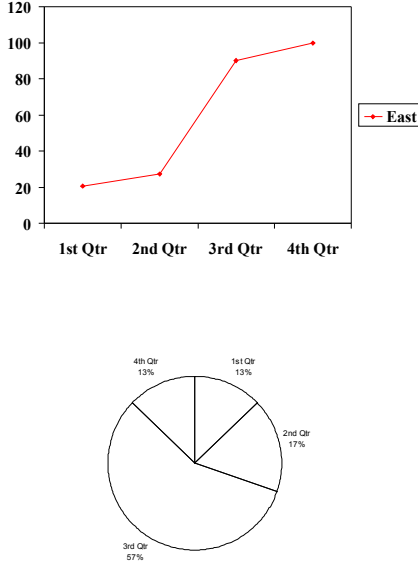
A graph is a visual and summarized representation of data that need to be quickly and precisely conveyed to others.

Graph

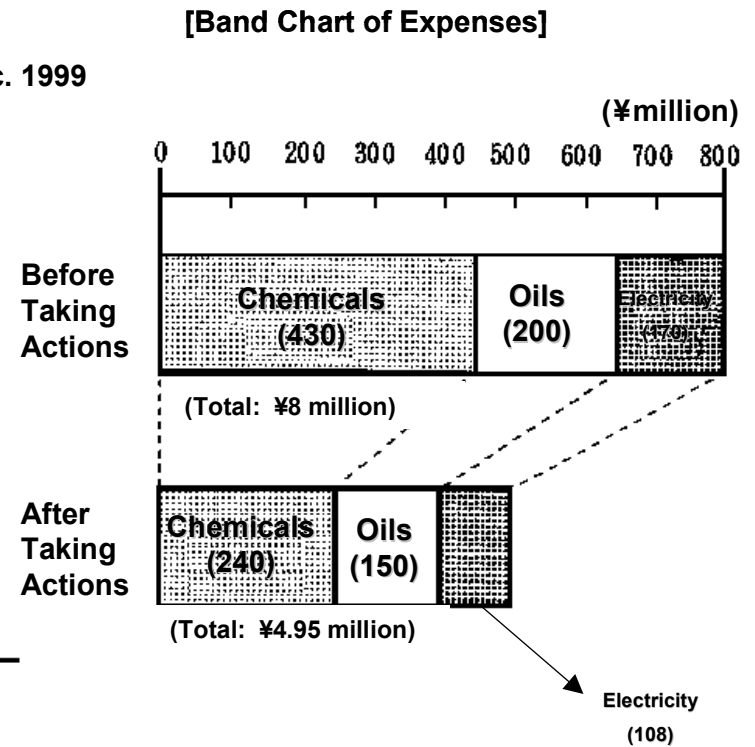
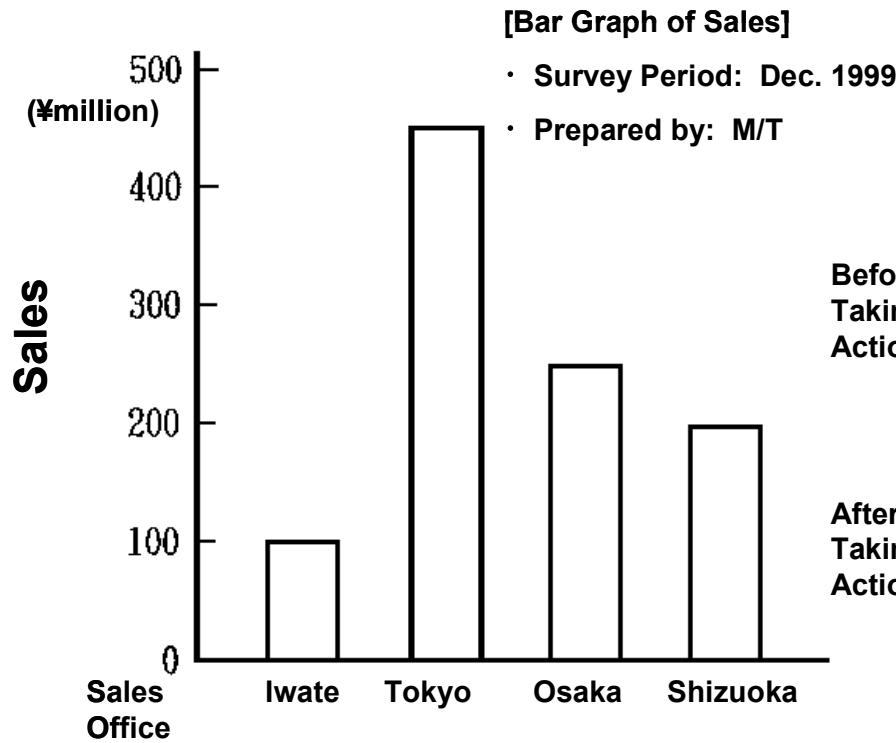
2. When is it used and what results will be obtained?

A graph, although it is listed as one of the QC tools, is commonly used in our daily life and is the most familiar means of assessing a situation.

Graph

Method	Usage	Result
 <p>The line graph shows a red line with markers for four quarters. The y-axis ranges from 0 to 120. The data points are approximately: 1st Qtr (20), 2nd Qtr (30), 3rd Qtr (90), and 4th Qtr (100). A legend indicates the line represents 'East'. The pie chart is divided into three segments: 3rd Qtr (57%), 2nd Qtr (17%), and 4th Qtr (13%).</p>	<p>Changes in a time-sequential order – line graph</p> <p>Amounts – bar graph, etc.</p> <p>Ratios – pie graph, band chart, etc.</p> <p>(The items listed above are representative examples.)</p>	<p>Can observe changes in a time-sequential order, ratios, and amounts.</p> <p>A graphs is the most frequently used tool to examine the various matters such as those listed on the left.</p>

Graph



To sum up 7 QC tools (Numerical data) are used as follow:

- **Pareto Diagram** To identify the current status and issues
- **Stratification** Basic processing performed when collecting data
- **Scatter Diagram** To identify the relationship between two things
- **Cause and Effect Diagram** To identify the cause and effect relationship
- **Histogram** To see the distribution of data
- **Check Sheet** To record data collection
- **Control Chart/Graph** To find out abnormalities and identify the current status

Thank you